

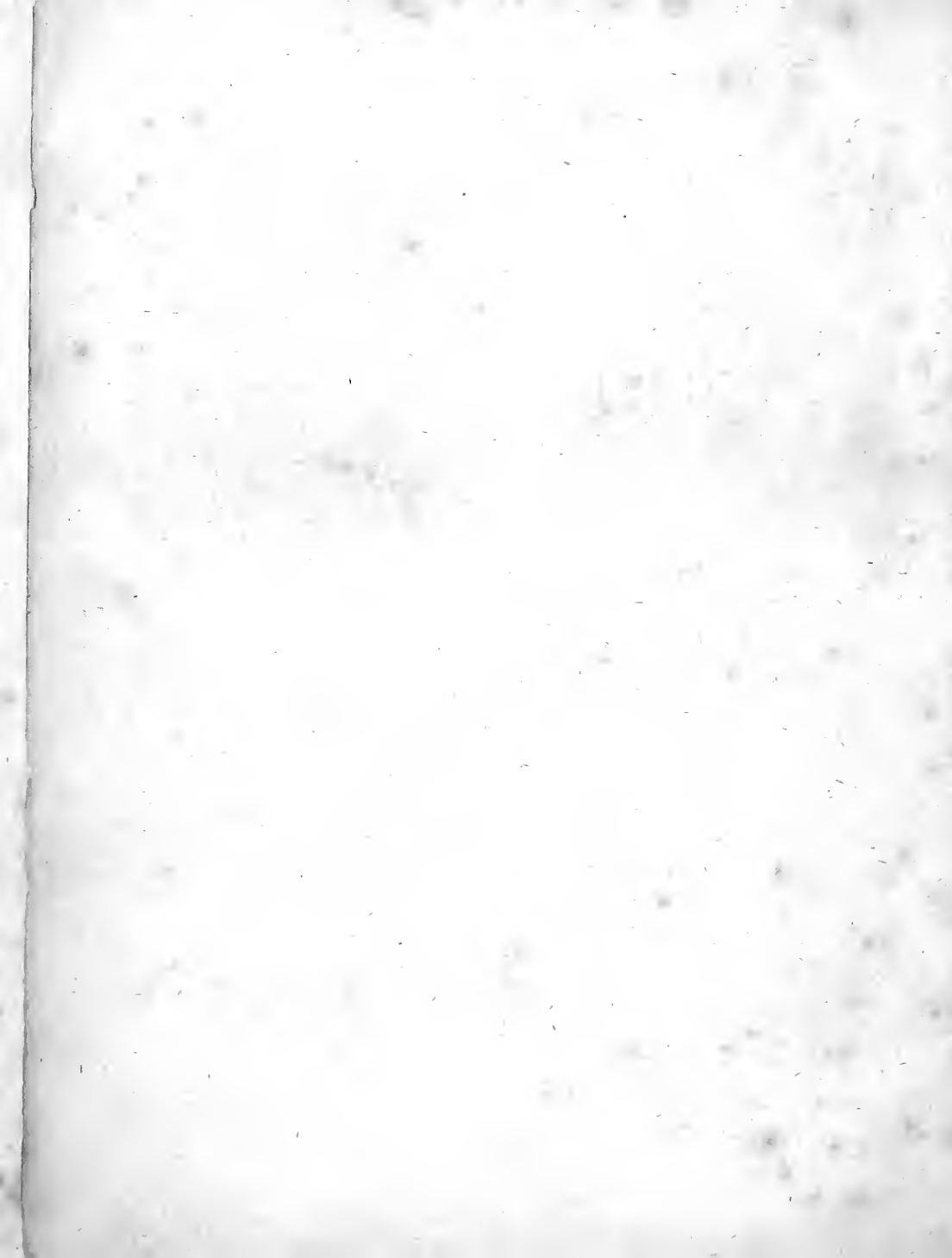
BOSTON MEDICAL LIBRARY
in the Francis A. Countway
Library of Medicine ~ *Boston*

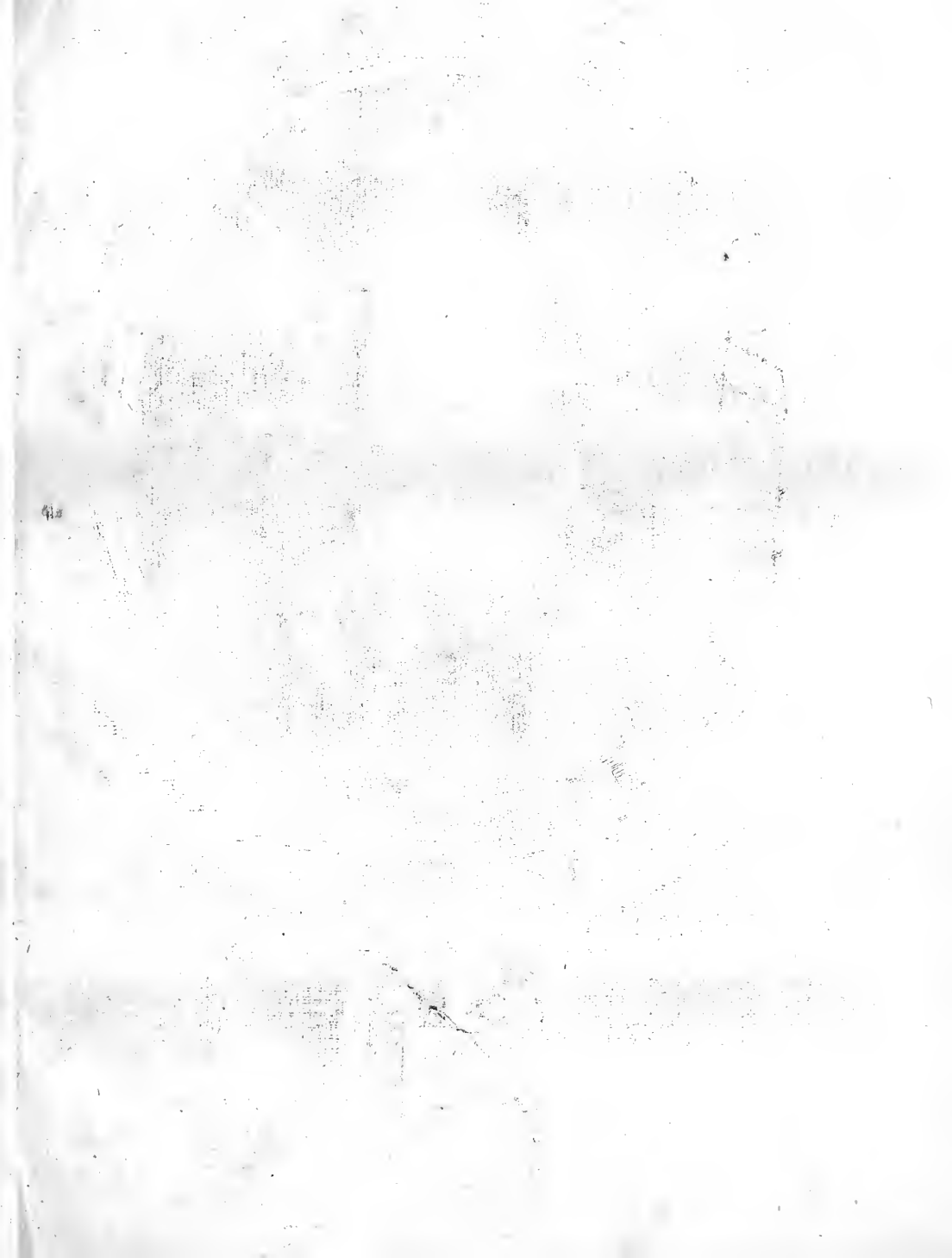
Charleston
Georgia



Digitized by the Internet Archive
in 2011 with funding from
Open Knowledge Commons and Harvard Medical School

<http://www.archive.org/details/enquiriesintohum00char>







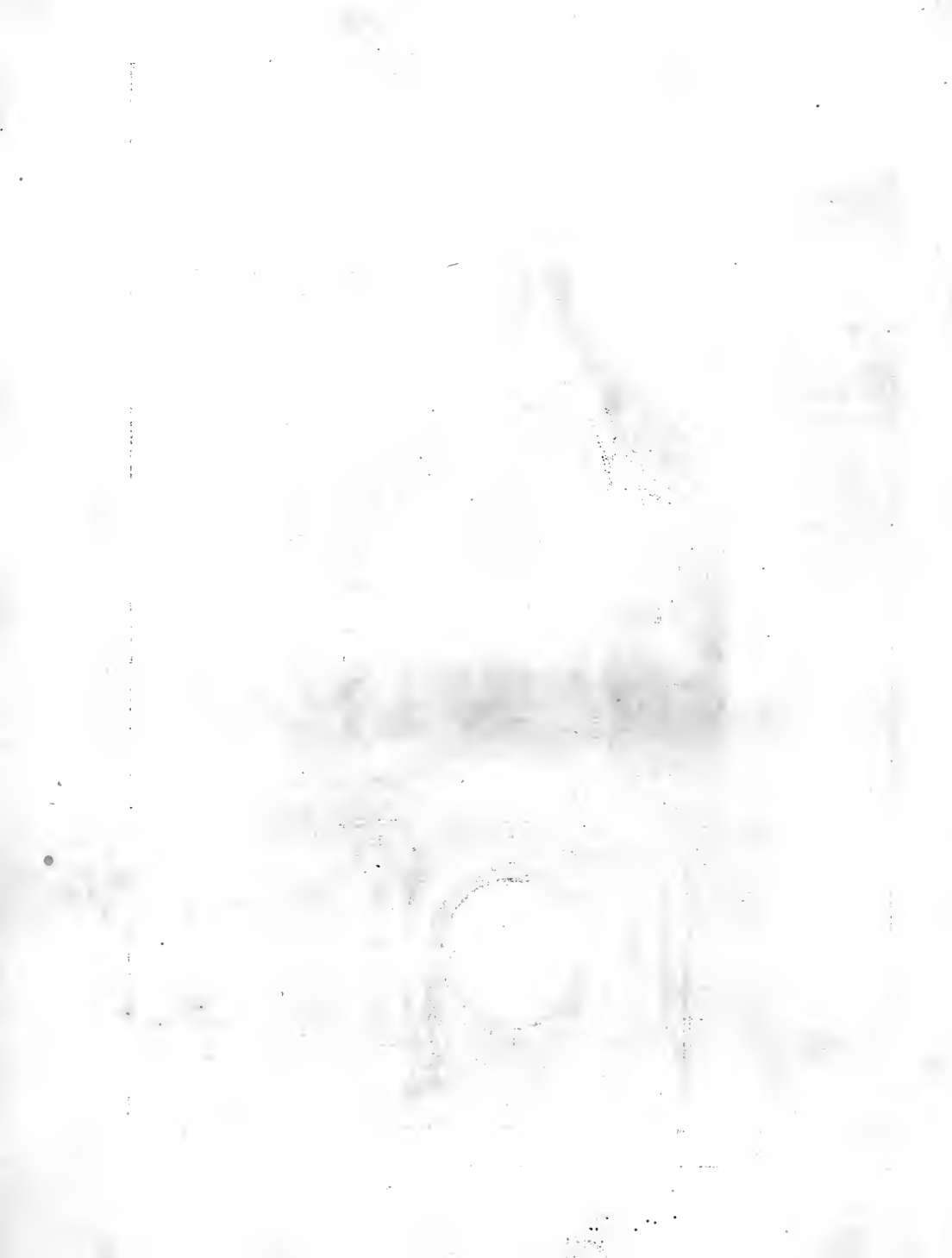
D. Loggan ad Vivum

delin. et. Sculp. 1679.



Πατριστασις κ'

ἀντιόχιστο



ENQUIRIES
INTO
Human Nature,
IN
VI. Anatomic Prælections
IN THE
New THEATRE of the Royal
Colledge of Physicians in LONDON.

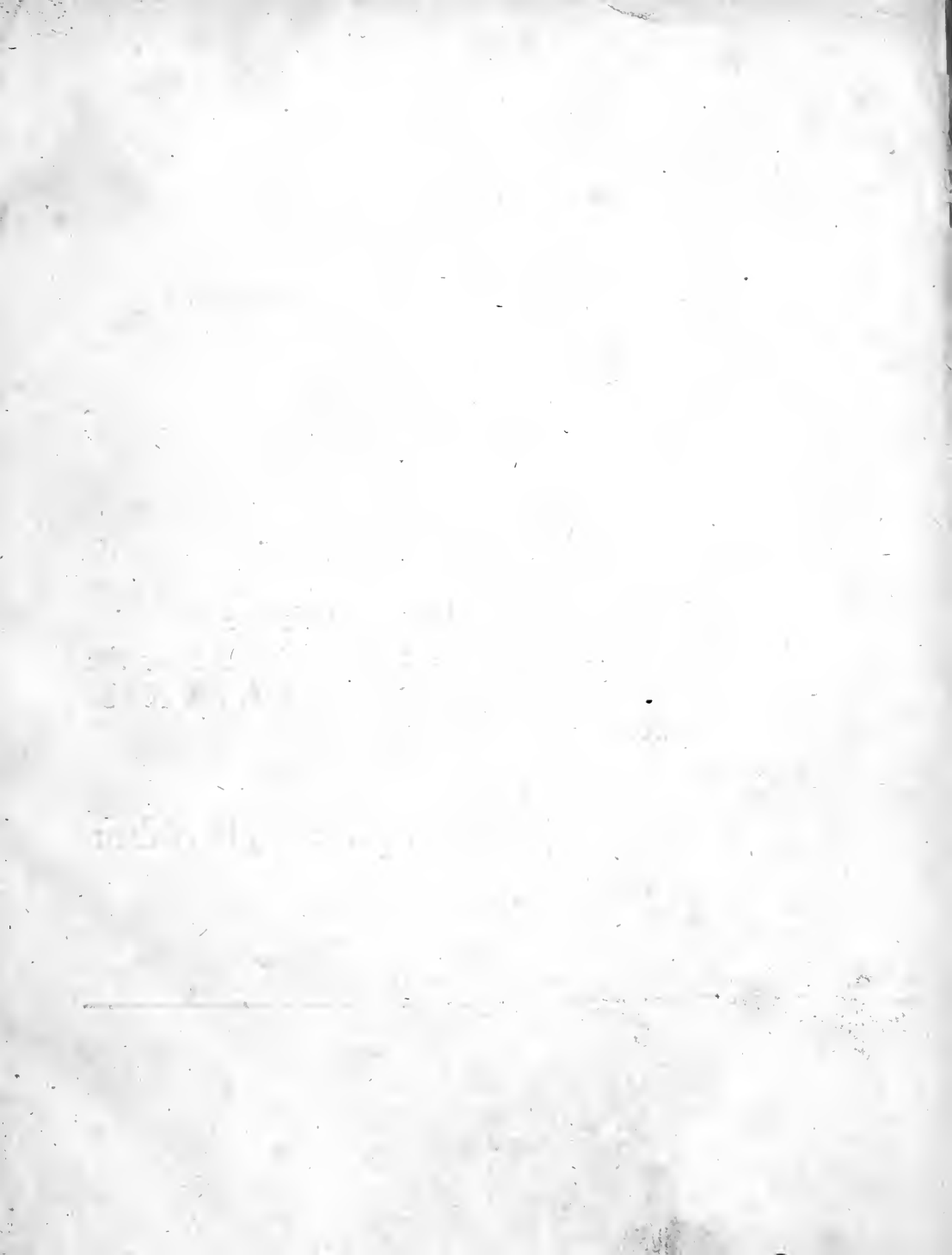
BY
WALTER CHARLETON, M. D.
and Fellow of the same Colledge.

Publish'd by Order of the Most Learned PRESIDENT.

*Furori ac dementia proximum est, suprema inquirere, & aliena
perscrutari, iis ignoratis que sunt in nobis. Socrates.*

LONDON,
Printed by M. White, for Robert Boulter, at the Turks Head in
Cornhill, over against the Royal Exchange. 1680.

28-2-130 \$25. 7/18/49



March 25. 1679.

ORdered, That Dr. Charleton's late *Anatomical
Prælections* in the THEATRE of the
Colledge of Physicians in LONDON be
Printed.

John Micklethwait, President.



TO THE
Right Worshipfull
S^r. JOHN CUTLER,
Knight and Baronett.



Whatsoever Sacrifices Men have at any time offer'd up to God, they had first receiv'd from His Bounty : nor were they therefore the less Acceptable to Him, if offer'd with humility, gratitude, and sincere devotion. I have reason then to hope (*Noble Sir*) that this *Book*, which I now bring as an Oblation of Honor to your *Name* ; and bring with grateful sentiments

(a)

EPISTLE DEDICATORY.

ments of your exemplary Munificence so happily exercis'd upon our Illustrious *Colledge of Physicians*; will not be the less acceptable to You, because it is already *Yours*, by unquestionable right.

I call it *Yours*; because, though it be an abortive Child of my weak brain, 'twas begotten by a Conjunction of my Obedience to the Command of our Most Worthy *President*, with my honest Ambition to contribute my Mite toward the advancement of the Noble *Art of Dissection*, to which You have given so ample Encouragement: because 'twas born in Your *Magnific Theatre*, at the Inauguration thereof: and because it now comes abroad into the World with no other aim, but publickly to acknowledge Your *Heroic Beneficence*.

Nor do I indeed know any other way of making that Acknowledgement, so agreeable either to the *Generosity* of Your *Mind*, or to the *Nobility* of Your *Design*, in erecting the *Anatomic Theatre*; as this I have taken, is.

For, to Your *Great Spirit*, 'tis much more delightful to accumulate Benefits, than to receive Thanks and Eulogies from Your Beneficiaries: and You are alwayes best pleas'd with those acts of Your Charity, which are
done

done in *secret*, and which are not otherwise to be known, than by the light of their own *Merit*. Whence it is, that Your *Liberality* walks in paths new and remote from the Common rode, yet direct, and leading at length into most spatiose fields of public Utility, where industrious Men may reap a more plentiful harvest of rewards, than they can at first expect: and that the streams of Your *Goodness* resemble those Rivers, which, though running under ground, diffuse fertility to whole Countreys and Provinces through which they pass. Of this, the *Mechanic Lecture* You have founded in *Gresham* Colledge, for the promotion of *Manual Trades*; and Your *Anatomic Theatre*, are illustrious *Examples*, worthy the imitation of Good Kings, and the envy of Bad: being Both so deeply founded upon *Wisdom*, that the Advantages they promise, are of Universal concernment to the present Age, and (if Men be not wanting to themselves) cannot but extend to all in Ages to come; rendering their Usefulness more and more Conspicuous, the lower they descend to Posterity.

And as for the *Nobility* of Your *Design* in the later; that can not be deny'd to be full of Piety toward God, and of Benevolence toward Men.

Of *Piety toward God*; in that it aims at the incitement of even Philosophers, to make farther researches and discoveries of the infinite Goodness, Wisdom, and Power of God, discernable in all his Creatures, but more eminently in the admirable fabric of Man's Body: and by consequence, to encrease their *Love and Veneration* of the Divine Majesty. For most certain it is, that profound Contemplation of the Works of Nature, is of it self powerful enough even to compell Human Reason to admire, love, praise, and adore the Transcendent Perfections of the *Author* of Nature; that we are all naturally disposed to form in our Minds such *Notions* of the Deity, as are proportionate to the discoveries we make of the Excellencies thereof, in the Objects we contemplate; and in fine, that our *Devotion* toward the same Deity, is alwayes proportionate to those *Notions*. Hence doubtless it was, that the most inquisitive *Naturalists* amongst the Antients, were also the greatest Celebrators of the *Supreme Being*: and that the Indian *Gymnosophists*, the Persian *Magi*, the Egyptian *Sacrificers*, the Gallic *Druids*, and the Athenian *Hierophantæ*, were to their several Nations both *Philosophers* and *Priests*; teaching at once the mysteries of *Nature*, the
duties

duties of *Religion*, and the rites of *Divine Worship*. Evident it is then, that Your *Theatre* may be properly enough call'd, a *Temple* of *Natural Theology*, where the *Perfections* of God are studied in the Works of His hands, and His *Praises* celebrated with Understanding. *Deum enim colit, qui novit.*

Of *Good-will toward Men*; in that it hath provided the fittest Means to bring the most Antient, the most universally Useful, and therefore the Noblest of all Arts, the Art of *Healing*, to Perfection. For, *Anatomy* being the Grand fundament of *Medicine*, and yet (with sorrow I write it) incomplete; it cannot be, but every new discovery thence arising to the Learned and Judicious Professors, must conduct them, not only to more certain Science, first of the true *Oeconomy* of Mans body, in the state of Nature; and then of the disorders and perversions of that *Oeconomy*, by *Diseases*, with their respective Seats and Causes: but also to the most rational and propre *Indications*, for the preservation of *that*, and the cure of *these*. Nor can You think me to speak rather from affection or partiality, than from right judgement; if I affirm, that no Men are more likely to make such Discoveries by accurate Dissections, than
some

Some of the now flourishing *Fellows* of our Colledge are : so great are the Testimonies they have already given to the World of their unwearied *Diligence*, solid *Erudition*, and admirable *Sagacity* of Spirit. So that 'tis not easie for me to determine, whether these Gentlemen be more Worthy of Your Theatre, or Your Theatre more Worthy of them. But of this I am sure, that *such* a Theatre hath been most fitly conjoyn'd to *such* a Colledge: and I dare prophesie, they will mutually add more and more Honor each to the other.

Now (*Honor'd Sir*) if You please to reflect upon what I have said, of the Generose Temper of Your *Mind*, and of the Wisdom of Your *Design* in this Magnificent Structure; You will (I presume) be soon induced to believe, what I before affirm'd, that I could give no testimony of the great Respect and Gratitude I owe You, more decent and congruous to *Both*, than the Dedication of these my late *Anatomic Praelections* to You is, in which (how imperfect soever) I have shewn my self willing at least, and Zealous to be serviceable to Your *End*, without offending Your *Modesty*.

The Reasons I have brought, seem sufficient, both to evidence the *Right* this Book hath to Your *Favor*, and to justify my *Election* of it,

EPISTLE DEDICATORY.

as the least indecent Sacrifice I could offer to Your *Glory*: and the same may serve also to incline You to receive it benignly, as a *specimen* of my *Devotion* to so Eminent a Benefactor; and to permit me to expose the same to the Censorious World, under Your Auspicious *Patronage*; which will certainly afford it *defense* from Contempt, and might also give it *long Life*, were it not of an infirm constitution, as having been form'd in haste, and in the declining age of its Author, and,

Noble Sir,

*Your most sincerely devoted, humble
servant,*

March the 27th
A. D. 1679.

Walter Charleton.

Advertisement.

Lest the Errors of the Press (which yet are neither many, nor great) be imputed to the Author, who wanted leisure to prevent them; the Reader is civilly desired to correct them thus.

In Page 19. Line 26. of the *Preface*, read, of one and the same part: p. 26. l. 30. of the *Preface*, r. *Trismegistus in Asclepio*.

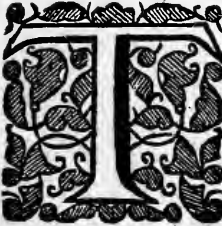
In the Book.

Pag. 23. l. 31. r. *Pelican and most other fowls*: p. 52. l. 19. r. *betwixt it and the second or middle coat*: p. 130. l. 20. r. *spontaneous*: p. 132. l. 13. r. *and is not only convenient*: p. 421. l. 19. r. *διουσιζεδς*. p. 430. l. 11. r. *ἀλλὰ ἢ ἔγω* — p. 436. l. 2. r. *ἢ κινέειν* — p. 437. l. 31. r. *purification of the blood*: p. 438. l. 1. r. *or not yet despoiled of its spirits*: p. 473. l. 26. r. *πέποινα φαρμακεύειν*: p. 478. l. 7. r. *which threatening a flux*: p. 498. l. 5. r. *a force by transmission*: and l. 16. r. *of such a power*: and l. penult. r. *framed*: p. 502. l. 25. r. *Kingdom of Fairies*: p. 505. l. 20. r. *Philosophy*: p. 513. l. 24. r. *arise*: p. 515. l. 22. r. *divine Wit*: and l. 33. r. *so like a bogg*: p. 519. l. 9. r. *Caspar Barlaus*: p. 544. l. 25. r. *coadjuvantesq; omnium operas*.

P R Æ F A C E.

P R E F A C E.

OF THE
Antiquity, Uses, Differences, &c.
OF
A N A T O M Y.

 *HIS Place is sacred to the study of God's Works, for the benefit of Mankind; the Occasion of this Assembly, rare, inaugural, and worthy of the greatest solemnity; the Assembly it self, frequent, and consisting (for the major part) of Men Noble, Wise, Learned and Curiose; and my talent, but a mite. Highly then it concerns me, before I advance one step, to stand still, a moment or two, and seriously consider, what my Subject is, and what my Province.*

My SUBJECT is, the most abstruse Oeconomy of Nature in the body of Man; a System of innumerable smaller Machines or Engines, by infinite Wisdom fram'd and compacted into one most beautiful, greater Automaton: all whose parts are among themselves different in their sensi-

P R E F A C E.

ble elements, in their magnitudes, figures, positions, textures, motions, actions and uses; yet all ordain'd and adjusted to one common End, namely, to compose a Living Ergasterium or Work-house, in which a Reasonable and Immortal Soul may, not only commodiously, but also with delight, exercise all her divine Faculties, to her own felicity, and to the praise and glory of her Omnipotent Creator. A Subject (as ye, Noble and most judicious Auditors, will all readily acknowledge) admirable even to astonishment; full of variety, and no less full of wonders: a Subject, wherein the most acute and piercing Wits have found more, much more to amuse, than to satisfy their Curiosity; and which hath forced them, after all their anxious disquisitions, to sigh forth that pious Exclamation of King David, Quam admirabili nos structurâ Deus formavit!

My PROVINCE is, the Anatomic Administration of these ruins of a Man, i. e. to take asunder some few at least of the various Organs of this Master-piece of the Creation, so that we may explore their several conduits, pipes, their springs, movements, actions, communications, offices, in fine, their whole Mechanism or Construction, upon which their respective Functions necessarily depend. For, most certain it is, that the Divine Architect hath fram'd all things, as in the Greater World, so likewise in this Microcosm, in number, weight, and measure: and we have it, as a precept, from our Oracle Hippocrates (lib. αὐτῆς Εὐχρηστοῦν) that a genuine Physician ought [πᾶν τὸ ὑποδείξθαι ἐπέχειν] to evince whatsoever he delivers as doctrine (if it be possible) by demonstration.

These things consider'd, I appeal to You, Most Prudent and Venerable President, who have been pleas'd, from Your good opinion, not of my sufficiency, but only of my diligence, this day to place me where I deserve not to sit; and to You, my most Learned Collegues of this Illustrious

ous

P R E F A C E.

ous Society, who honour me by your presence: whether it be not necessary for me to set before you, in a short Proem, some at least of the many sentiments I have conceiv'd in my mind, of the singular Dignity and Excellency of the task assign'd me. When by so doing, I shall at once pay some part of the debt I owe, both to the honour of this Temple of Philosophy, in which we now sit; and to the Solemnity of this Convention: and shew my self, however unfit worthily to administ're so noble a Province, yet duely conscions of the weight of it; which may perhaps somewhat conduce to render my faileurs the more Venial.

That I may therefore both invite your Attention, and pre-engage your Candor; I ask leave to make my self, for a few minutes, your *reminiscens* or Remembrancer, by recalling into your memory, what ye have heretofore read, in the monuments of the Antients, concerning the Antiquity of the Art of Dissection; and what ye have, from your own happy Experience and Observation, collected, touching the great and manifold Utility of the same. Which, I shall endeavour to do, with as much of Perspicuity, as the Umbrage of the Argument, and the Scantness of my Readings will permit; with as much of Conciseness, as can be brought to consist with that Perspicuity. ¶

As for the ANTIQUITY of Anatomie; that doubtless is, if not equal, yet not much inferior in age to Medicine it self, which seems to have been invented by men in the very infancy of the World. For, (1.) If Necessity be, as hitherto on all hands it hath been admitted, to have first suggested to Man all those profitable inventions, whereby Humane life has been render'd either more defensible, or more comfortable: we may with good reason infer, that the Art of Medicine, i. e. of preserving and restoring health, had its beginning as early in the morning of Time, as any of the rest: it being certain that mens bodies were

P R E F A C E.

then not only liable to, but actually infested with various distempers, pains, infirmities and other maladies; the Laws and Constitutions of Nature continuing perpetually the same: and no less certain, that men observing what things were agreeable, what disagreeable to the body, what mitigated, what exasperated their maladies, were by the very dictates of Reason taught to provide for the conservation of their Health, by abstaining from things noxious, and for the restitution of it when impair'd, by using things convenient and beneficial; as the Divine old man of Coos hath with admirable sagacity observ'd in his excellent Book *αἰανίνων*. Now if Medicine be so antient, 'tis highly probable, that Anatomy, which is the principal fundament thereof, is not much less antient, if not equal. Could Men (think ye) feel themselves tormented in any member or part of the body, or unable to use the same in the actions to which it was originally destin'd and comparated, and which it had with facility and indolency alwayes perform'd before; could they (I say) be sensible of this, and at the same time not highly solicitous to know in what part of that disaffected member the pain or defect chiefly lay, what piece of the Organ had been broken, stopp'd, displaced or otherwise vitiated, so as to discompose the whole frame, and make it unfit to execute its proper functions? Or how was it possible for them to acquire this knowledge, unless by first acquainting themselves with the natural composition of that same member, i.e. with the various similar parts whereof it is made up, with their severall constitutions, sizes, figures, textures, positions, connexions, &c. in fine, with the whole Mechanical ration of the organ, upon which its aptitude to perform its proper actions necessarily depends? But this they never could do, otherwise than by dextrous dissection of that member in the body of some one or more defunct. I guess therefore, that the Art of Dissection and that of Medicine were Twins, that had Humane Wit for their Father, and Necessity

P R E F A C E.

city for their Mother : and (2.) That they neither were born in Grece, nor are so young by a thousand years, as even most Antiquaries themselves have concluded them to be. For, tho' that great devourer of its own productions, Time, hath consumed the greatest part of the monuments of the younger world ; leaving us very few, and those too imperfect, full of chasms and decays : yet I am able to prove, from the records of an Author or two of unquestion'd credit, and venerable antiquity, that both are much elder than most Learned men have, after long raking in the rubbish of old Athens, determin'd them to be.

It is not unknown to the Learned part of this assembly, that Ptolomæus Philadelphus King of Ægypt, a Prince of a curious spirit and large heart, finding in the immense treasure of Books he had collected and stored up in his Library, the Histories of most other Nations, but none of his own the Ægyptians ; to supply that defect, employ'd one Manetho, a man of solid Erudition, a Priest and Master of the Rolls kept in the Temple of Memphis, to compose a History de rebus Ægyptiacis, from the first original of that mighty people, down to his own times : and that accordingly Manetho, consulting the antique Volumes of Mercurius Secundus, which had been many hundred of years preserved in the most sacred recesses of the Temple, and the more antique Hieroglyphic Marbles, compiled out of them a true History of Ægyptian Antiquities ; a Book, whose loss all Learned Chronologers lament, whose dispers'd fragments they religiously venerate. From this Book, Syncellus, an excellent Chronographer, who flourish'd in the year 800. after our Saviours Nativity, is said to have transcribed whatever he wrote in Græc in his so much admir'd work, concerning the Dynasties of the Kings of Ægypt, and other Antiquities of that Nation ; which our most profound Reformer of the vulgar Computation of Times, Sr. John Marsham, thus commends. Quicquid supellectilis hodie superest ad in-

staurandas Ægyptiorum origines, id fere totum debetur Syncello; neque tanti sunt momenti quæ Herodotus omnium primus, aut illum secutus Diodorus Siculus, de Regibus Ægypti tradiderunt.

Pag. 54. c.

This Syncellus, among many other memorable things recounted of the Egyptian Kings of the first Age, delivers, That after the decease of Menes, first King of the Thinites, Son of Cham, Founder of Memphis, call'd by the Hebrews Ham, by the Egyptians Jupiter Hammon; Egypt came to be divided into two Kingdoms, Thebes and Memphis: this, under Athothes or Mercury; that, under Toforthus or Æsculapius; both after honor'd with Divine titles and worship. Then commemorating the virtues and merits of these two Kings, he saith of Mercury, τὸ ἐν Μέμφει βασιλεὺς οἰκοδομήσας, ἔφραζεν ἡ βίβλος ἀνατομικῆ· ἰατρῶν δὲ ἦν:

P. 56. 6.

he built a palace in the City of Memphis, and wrote Books of Anatomy; for he was a Physician: of Æsculapius, ἔτῳ Ἀσκληπιῶς Αἰγυπτίους καὶ τὴν ἰατρικὴν νενομίσα, &c. he is held to be Æsculapius by the Egyptians for his skill in Medicine; and he found out the art of building with squar'd stones. *This Record is attested also by Clemens Alexandrinus, an Author of no less credit, and near upon six hundred years elder than Syncellus, who saith expressly; Ex 42. Mercurii Libris, 36. ad Ægyptiorum Philosophiam, 6. reliqui ad artem Medicam pertinent; quorum primus fuit Anatomicus, ἀπὸ τῆς αὐτῆς ἀνατομικῆς βίβλου, de constructione corporis.*

Stromat. lib.
I. p. 634. b.

I am not ignorant, that some great Scholars of this our Age, hold it more probable, that the Art of Anatomy here attributed to Mercury the first, was the invention rather of his equal Æsculapius, who is esteem'd πολυεργότατος Medicinæ Autor. But since these same Critics deny not Mercurius and Æsculapius Ægyptius to have been Contemporaries; it makes no difference, as to the Antiquity of Anatomy, which chiefly we are now seeking, to which of the two

the

P R E F A C E.

the glory of its first invention be ascrib'd. Let others then contend about this nicety, while we remarque, that from the Texts just now recited, three considerable things are evident.

(1.) *That the Ægyptians have a just and clear right to the honor of the invention of the noblest of all Arts, Medicine: and therefore Pliny did them no wrong in saying, non immeritò Medicinam Ægyptii apud ipsos volunt repertam fuisse; & Æsculapius Memphites inter primos hominum numeratur, qui opinione humanâ Dii facti sunt.*

Nat. Hist. l. 29.
c. 2.

(2.) *That the most useful inventions of the first of Historical Times, were Medicine and Architecture: one to furnish mankind with helps against infirmities of the body, the other to defend him from injuries of the air: both suggested by Necessity. Hinc quippe præmaturum medicandi ædificandique studium.*

(3.) *That this our Ægyptian Æsculapius was one thousand years elder than the Æsculapius of the Græcs, who was of Epidaurus, and there for many hundred years worship'd with solemn rites and religious devotion, as the God of Health. For, Clemens Alexandrinus casteth the Apotheosis or Consecration of this Æsculapius Epidaurius into the fifty third year before the sackage of Troy: telling us from Apollonius the Rhodian, that he accompanied Jason in his voyage. Which, tho' the name of Æsculapius be not found in Apollonius his list of the Argonauts, is yet probable from the consent of Times: for Machaon, son to the same Æsculapius, is by Homer numbred among the noble Græcians that bore arms at the siege of Troy. Iliad. β.*

Stromat. l. 1.
p. 322.

Τῶν αὖδ' ἡγέσθην Αἰσκληπιῶ δύο παῖδες,
Ἰππῆς ἀγαθῶ, Ποδολείου ἠδὲ Μάχαιον:

Quos duo ducebant, Medicorum principe nati,
Præstantes Medici, Podalirius atque Machaon.

P R E F A C E.

Lib. 1. cap. 10.
institutionum
divinar.

So that if we compute from the second King in the first Dynastie of the Ægyptians, down to the fifty third year precedent to the Excidium Trojæ, we shall find the inter-venient space of time to amount to about a thousand years. Of so much greater antiquity is the first Inventor of Medicine among the Ægyptians, than that Æsculapius to whom the Græcs erroneously or arrogantly ascribe it, and of whom Lactantius saith, quid fecit aliud divinis honoribus dignum, nisi quòd sanavit Hippolytum?

*This I have noted, only to shew the great Antiquity of my Profession, not to detract from the renown of the Græcian Æsculapius, who being also excellent in the Art of Medicine, augmented the honor of it in his own Nation; and therefore deserves from me the incense of a little breath in sacrifice to his memory. Give me leave then, I pray, to speak a few words concerning him, toward the satisfaction of those among my Auditors, who perhaps have been less conversant in Books. At Epidaurus a City in Argolis or Argia (at this day call'd by some, Saconia, and Romania Moreæ by others) situate near the Ægean sea; he was worship'd as a Divine Numen; having there erected to him a magnific Temple, in which the Sick, after due oblations, were lay'd to sleep, and said to be secretly taught by the God himself in their dreams, by what remedy they might certainly be heal'd. This is more fully deliver'd by Pausanias: and Strabo reports farther, that among many others in that place and manner restor'd to health, one Archias, son of Aristæchmus of Pergamus, was freed from dreadful Convulsions in all his limbs, only by following the counsel of his dream: and that returning to Pergamus, in gratitude he brought with him the religion and worship of the Epidaurian Temple, building another in imitation of it. De quo templo etiam Corn. Tacitus (Annal. 3.) in asylorum apud Græcas civitates antiquitus constitutorum origines inquirens, hæc habet: "Consules apud Pergamum
" Æsculapii*

Lib. 2.

Lib. 8.

P R E F A C E.

“Æsculapii compertum asylum retulerunt: cæteros ob-
“scuris ob vetustatem initiis niti. *From Pergamus the
same Superstition was in process of time transferr'd also to
Smyrna, and a third Temple rais'd there: in which one
C. Claudius Valerius Licinnianus was Chief Priest; as ap-
pears from a Marble not long since brought from Smyrna,
and now extant in the Sheldonian Theatre at Oxon. in
number the forty sixth Marble.*

*The testimonies I have brought, are (you see) authen-
tic; nor can you longer doubt, that among the few reliques
of the younger world that have escap'd the jaws of Oblivi-
on, some are yet extant to attest the great Age and honor of
this pair of Noble Sisters, Medicine and Anatomy. So
solid were their Principles, so durable have been their Con-
stitutions, so illustrious their Propagators, so sacred their
Records, and (if I may be permitted to speak as a Plato-
nist) so powerful a Genius has preserv'd them. ¶*

*Was Anatomy then taught by the Founder of Memphis?
Is it by a whole Age at least elder than the eldest of those
mountains of brick, or as Diodorus Siculus vainly calls
them, Ἄιδου οἶκος, Eternal Habitations, the Ægyptian Py-
ramids? And has it from that time to this day continued in
use and esteem among wise men wheresoever Letters and Ci-
vility have flourish'd? This certainly, is alone sufficient
to evince the great UTILITY of it, were all other ar-
guments wanting. “For, Human Inventions, however sub-
“til and grateful at first to the Curious, are never long-
“liv'd, unless afterward they be found useful also and
“beneficial to Mankind. But in what do's the Utility of it
consist? In so many things, I want time to enumerate them,
and must therefore content my self to touch only two or three,
such as lye most open and obvious even to vulgar observa-
tion. I say then, that the study of Anatomy is singularly
profitable to a Man, in respect of Himself, in respect to*

Lib. 4. c. 169.

C

God,

P R E F A C E.

God, in respect of the Divine Art of Healing: each of which requires to be singly consider'd.

(1.) In respect of Ones-self. That Apollo, when from his Delphic Oracle (as Plato in his Alcibiades relates) he deliver'd that most wise precept, γινῶσι σεαυτῶν, Know thy self, thereby implicitly injoin'd the study of Anatomy; is more than I shall venture to avouch; but this I dare boldly affirm, that no Mortal can attain to any profound knowledge of Himself, without long and strict scrutiny into the mysterious Oeconomy of Human nature; which can be no otherwise made, than by the helps and light of Anatomy. Of the simple essence of the Rational Soul, we seem in this umbratill life incapable to know much. For, She being, as Wise men teach, and most of us believe, a pure Spirit; we can have of her no idea or image in our Phantasie, and consequently no Notion: all our Cognition being built upon Idols or Images stamp'd in the mint of Imagination; and all our Reasonings or Discourses, nothing but connection of many of those Images into chains, sometimes of more, sometimes of fewer links. We cannot therefore deny our ignorance of the nature of that noblest part of our selves, from which we derive all our little Science: and must be content to entertain our irrequiet Curiosity with the faint glimmerings of light, that shine through the acts and operations of that Celestial Ghest in our frail and darksom Tabernacles of flesh. What then remains to be known by us of our selves? Nothing, I think, but the Divine Architecture of the Body, the fabrique of the various Organs, by which the Soul acts, while she sojourns in it: and these (ye know) are not to be understood but by dissecting and distinctly contemplating the severall parts of each Organ, so as to investigate the Mechanical reason of its aptitude to its proper motions, actions and uses.

Doth any man here conceive, that the Oracle is to be expounded only of the Passions of the Mind, and the Art of moderating

P R E F A C E.

moderating them by the dictates of Prudence, and rules of Virtue? I say, that neither is the knowledge of the Passions to be acquir'd without frequenting the Scholes of Anatomists. For, the Passions seem to be in the general, only certain Commotions of the Spirits and blood, begun in the seat of the Imagination, propagated through the Pathetic nerves to the heart, and thence transmitted up again to the brain: and therefore whosoever would duly enquire into their nature, their first sources and resorts, their most remarkable differences, tides, forces, symptoms, &c. will soon find himself under a necessity to begin at Anatomy, thence to learn the course of the blood, the structure of the brain, the origin and productions of the nerves, the fabric of the heart with its pulses, and the wayes by which a reciprocal communication or mutual commerce is so swiftly effected, so continually maintain'd betwixt the Animal and Vital machines. Otherwise, how highly soever he might think of his own speculations, he would hardly be able clearly to solve any one of the Phænomena of this or that particular Passion; for instance, whence it is, that Blushing is the proper sign of Shame, Paleness the Character of suddain Fear, Sadness the inseparable concomitant of Hate, & sic de cæteris. In a word, he would as soon be at a loss in tracing the intricate Labyrinth of Human Affections, as a blind man that should undertake to give the Chorography of a whole Countrey, meerly from a relation of some memorable action done in some part of it.

Nor should I believe such a man half so likely to temper and compose the tumults of his inordinate Passions, as a skilful Anatomist, who understands, by what impressions they are occasion'd, upon what parts of the brain those impressions are made, what sympathy and confederation Nature has instituted between those parts and the Cardiac nerves, how those nerves divided into innumerable fibres contract the ventricles of the heart, and how that Contraction, accor-

P R E F A C E.

ding to the various degrees of its force and velocity, necessarily impells the blood more or less copiously and violently through the arteries into the parts most concern'd in the Passion at that time most urgent. For, certainly, he that hath the advantage to understand all these things, is better instructed to appease the impetuous Commotions at any time rais'd within his breast, by reducing the rebellious appetites of his inferior Faculties to obedience to the contremands of his Superior or Reason; in which one thing the summ of all Moral Philosophy consists, and which advanced into a Habit, becomes Virtue it self. So that take the Counsel given by Apollo, in which of the two senses ye like best, viz. either as directing to learn the admirable frame of the Body; or as intimating that wisdom consists chiefly in the regulation of the Affections; still the study of Anatomy will be requisit to acquiring the Knowledge of Ones-self.

(2.) Requisite it is also to conduct even a Naturalist to the Knowledge of G O D. I mean the knowledge of not only the Existence of a Supreme Being in the World, but also of his Eternity, omnipotent Power, infinite Wisdom, and inexhaustible Goodness; for as to the Divine nature it self, that we must all with holy astonishment confess to be to Human Understanding incomprehensible; for, how can a finite have an adequate notion of an Infinite? Most true it is indeed, that there are in every part of the Universe certain marks or impresses of a Divine hand; and the smallest Insect that creeps upon the earth, the very grass whereon we tread, yea, even things Inanimate proclaim the Glory of their Maker, inciting us to venerate, praise and adore Him: so that St. Paul preach'd true Natural Theologie to Infidels, when he taught, that the invisible things of God are known by the visible things of his Creation; and Heraclitus gave a memorable hint of his piety toward the Summum Numen, when inviting into his poor smoaky cottage some proud strangers that disdain'd to put their heads

P R E F A C E.

heads under so vile a roof ; Enter, said he, nam etiam hinc Dii sunt, here also are Gods. And in truth, every page in the great Volume of Nature, is full of real Hieroglyphicks, where (by an inverted way of Expression) things stand for words, and their Qualities for Letters. Whence perhaps Plato (in Timæo) took a hint of that sublime thought of his, that the World is Gods Epistle written to mankind. But if we survey the Epitome of the World, the Temple of Mans Body, in which as in a Model or Exemplar, all parts of the Greater World are represented in little ; we shall there find something more august, more Majestical. Who can observe, that so magnificent a pile is rais'd only è luto, out of a little slime ; that from a few drops of the Colliquamentum or Genital humor, of a substance Homogeneous or simple, are formed more than two hundred bones, more Cartilages, very many ligaments ; membranes almost innumerable, myriads of arteries and veins, of nerves more than thirty pair with all their slender branches and continued fibres, near upon four hundred muscles, a multitude of glandules, and many other parts, all divers each from other in substance, consistence, colour, texture, fabric, &c. Who can, I say, observe this, without being forced to acknowledg the infinite Power of the Divine Architect, who makes the very Materials of his building ? Who can look into the Sanctum Sanctorum of this Temple, the Brain, and therein contemplate the pillars that support it, the arch'd roof that covers and defends it, the fret-work of the Ceiling, the double membrane that invests it, the resplendent partition that divides it, the four vaulted cells that drain away impurities, the intricate labyrinths of arteries that bring in from the heart rivulets of vital blood to heat and invigorate it, the Meanders of veins to export the same blood, the Aqueducts that preserve it from inundation, the infinite multitude of slender and scarce perceptible filaments that compose it, the delicate nerves or
chords

P R E F A C E.

chords spun from those threads, the original of that silver chord (as Ecclesiastes calls it) or Spinal marrow, upon which the strength of back and limbs chiefly depends; and many other parts of the wonderful Engine: and not discern an infinite Wisdom in the design and construction of them? And as for the infinite Goodness of God; that is no less conspicuous in the connexion of so many and various instruments into one complex Automaton, by which they are so admirably combin'd, that every one works for it self and for the public at once; that every one performs its peculiar office apart, yet all co-operate to one and the same common end, the subsistence, safety, and welfare of the whole; and that if any one happen to be put out of order or tune, all the rest sympathize with it, and the whole Harmony of Functions is compos'd. Add to this stupendous Machine an internal Principle to give it life, sense, voluntary motion, and understanding: and then ye may say with Cicero; Jam verò animum ipsum mentémque hominis, rationem, consilium, prudentiam, qui non Divinâ curâ perfecta esse perspicit; is his ipsis rebus nobis videtur carere.

If then the admirable fabric of our Body demonstrates the Power, Wisdom and Goodness of the Maker; (whom the Scripture most emphatically calls [Yotzêr Hakkôl] (the Former of all things, Jer. 10. 16.) and if it be by the help of Anatomy alone, that we come to contemplate and understand the excellency of that fabric: we may safely conclude, that to study Anatomy diligently and reverently, is to learn to know God, and consequently to venerate Him; Deum enim colit, qui novit. After this, what others, out of ignorance, may think or speak to the prejudice of this so useful Art of Dissection; I am neither concern'd, nor solicitous to know: but this I openly declare, that if I knew an Atheist (if there can be such a Beast in the world) I would do my best to bring him into this Theatre, here to be sensibly

P R E F A C E.

sensibly convinced of his madness. For, sure I am, that some of the Antient Heathens have call'd the structure of Mans Body, the Book of God: and that even Galen himself, an Ethnic too, slow of belief, and most alien from Superstition, learn'd so much of Piety from dissections, that in his whole seventeen Books de usu partium, he sings a perpetual Hymn as it were in praise of the Divine Architect that form'd them. Of which laudatory Hymns I have chosen one, which seeming to me more lofty and harmonical than any of the rest, and more proper for this place, deserves my recital and your remark. In his third Book, contemplating the skin that invests the sole of the foot (a part despicable to vulgar eyes) He breaks forth into this rapture of admiration. Cutem ipsam (says he) non laxam, aut subtilem, aut mollem; sed constrictam, & mediocriter duram, sensilémque, ut non facîle pateretur, subdidit pedi Sapientissimus Conditor noster: cui Commentarios ego hos, ceu hymnos quosdam, compono: & in eo pietatem esse existimans, non si Tauro-
εργασίας ei plurimas quispiam sacrificarit, & casias aliâque sexcenta unguenta suffumigarit: sed si noverim ipse primus, deinde exposuerim aliis, quænam sit ipsius Sapientia, quæ Virtus, quæ Providentia, quæ Bonitas; ignorantia quorum summa impietas est, non si à sacrificio abstineas. Quod enim cultu convenienti exornavit omnia, nullique bona inviderit; id perfectissimæ Bonitatis specimen esse statuo: invenisse autem quo pacto omnia adornarentur, summæ Sapientie est; ac effecisse omnia quæ voluit, Virtutis est invictæ. A Hymn not unworthy to be sung, with solemn Music, even in our Churches.

(3.) Besides these two noble uses of Anatomy, by me now explain'd, there remains here to be consider'd yet a third use, not, as the former, common to all mankind, but proper to Physicians: to whom the study of it is, not only profitable

P R E F A C E.

fitable and delightful, as to their private speculations; but also necessary, as to their well understanding the divine Art of Medicine which they profess. This Necessity is indeed so universally known and acknowledged by all wise men, that to go about to prove it, would be as supervacaneous, as to light a candle to shew the Sun at noon: yet because there are some, who either blinded with the smoak of fallacious Chymists, or corrupted by some private interest, perceive it not; give me leave, I pray, toward the disenchantment of these, briefly to set before them two or three of the plainest causes or reasons that make Anatomy the grand fundament of Medicine.

I. Epidem.

Hippocrates (I remember) doth often inculcate to his Disciples, the genuine Sons of Art, three cardinal precepts, in which the whole duty of a Physician seems to be comprehended. The first is, γινώσκειν τὰ παρόντα, to understand the present state of the sick, the nature of the malady, and the part affected: the second, προλέγειν τὰ ἐπιούσα, to prognosticate the event of the disease: the third, ὑγιᾶν ποιεῖν τὸν ἀδυνάτου, to relieve or heal the sick. But in all these three duties, he that is ignorant of Anatomy, must needs be shamefully deficient.

In the Diagnostick part, because no good judgment can be made of the nature and kind of any disease, unless it be first known, what part of the body is thereby chiefly affected; and the most certain indicia or distinctive signs of the part affected, are taken principally from the situation of the part, and from the action of it hurt. For instance, he that knows the Liver to be naturally seated in the right Hypochondrium, if in that place pain be felt, or swelling appear from a Tumor within, will easily thence collect, that the Liver is the part then affected: and he that knows, that the principal action of the Stomach is Concoction, will soon know, if Concoction be hurt, that the Stomach is misaffected. But both the places and actions of the parts are
learn'd

P R E F A C E.

learn'd only from Anatomy: and therefore whoever is ignorant of Anatomy, can have no certain knowledge of either those, or these.

In the Prognostic part he must likewise fail, because the best Ostenta or Signs of the future good or evil event of any Sickness, are all derived from these three heads, viz. the Excretions, the Action hurt, and the Habit of the body, in colour, figure and bulk: none of all which are to be known without Anatomy: and he is likely to make but an ill Predictor of events to come, who has not skill enough to observe and discern the signs that portend them.

In the Curative part also he must be equally deficient, because the true and exquisite Method of Healing is grounded upon, and design'd by rational Indications, and every Indication is desum'd not only from the nature of the Malady, but also from the part thereby affected; and therefore according to the various constitution, temper, site, connexion, sense and other qualities of the affected part, the remedies to be used, ought to be various. And with what face can a Chirurgeon pretend to recompose broken, or restore dislocated bones, who is ignorant of their site, figure, structure, and articulations? Manifest it is then, that whoever pretends to the cure of diseases, and yet remains ignorant of Anatomy; is either an impudent Impostor, or at best a Fool. What then are they, who put their life into the hands of such men?

From these nobler Uses of Anatomy in Physic, Natural Theologie, and Medicine now explicated, I might descend to many others, less noble indeed, yet not unworthy the notice and consideration even of Wise men, observable in various inferior Arts, more particularly in those two Arts so highly inservient to Magnificence, Ornament and Delight, Architecture, and Painting, both which borrow their exemplars, rules, graces, perfection and estimation from the proportions, symmetry and pulchritude of the parts of

P R E F A C E.

Mans body. But these being alien from my task, and the hours assign'd me for the performance thereof, being few; I am obliged to pretermit them. Notwithstanding, lest I should by mentioning them en passant, excite in some of my ingenious Auditors of the Tonger sort, a curiosity which I have not now leisure to satisfie: 'tis fit I should refer them to two or three Authors of good note, to be by them fully inform'd how requisite the study of the fabric of mans body is to all who desire to excell in either of these Arts. For Architecture then, I would direct them, first to Vitruvius, (who in lib. 3. cap. 1.) laying this down for a fundamental Maxim; non potest ædes ulla sine symmetria atque proportione rationem habere compositionis, nisi uti ad Hominis benè figurati membrorum habuerit exactam rationem; and immediately after measuring the proportions that the several parts of a well-shap'd Man hold one to another; proceeds to commensurate the parts of sacred Ædifices or Temples by the like proportions: and (in lib. 4. cap. 1.) treating of the Columns of the three Orders, expressly derives the dimensions of those of the Tuscan Order, with their bases, diminutions, pedestals, capitals, &c. all from the proportions observ'd by Nature in the feet, leggs and thighs of man; pursuing the same Analogie, upon all occasions, throughout his whole work: and after to Albert Durers excellent Book de Symmetria corporis humani. To these may be added Spigelius, who in his first Book of Anatomy, from the seventh Chapter to the end of the Book, hath with singular diligence describ'd the proportions of the exterior parts.

For Painting, I recommend to them the incomparable Lionardo Da Vinci, della Pittura: not only because he was eminently skill'd in all parts of Anatomy, as appears by the accurate Figures that illustrate and adorn Vesalius's noble Volume De Corporis humani fabrica, all which were drawn and cut by Da Vinci's own hands; and the original

Draughts

P R E F A C E.

Draughts of which are yet extant in a large Manuscript of his in Folio, in the Italian language (but written from the right hand to the left) carefully preserv'd in His Majesties Cabinet at White-Hall, where I have had the good fortune sometimes to contemplate them: but also because in his Treatise Della Pittura just now mention'd, he seems to me to have describ'd the figures, motions, forces and symmetry of the limbs, their Articulations and Muscles, in various postures, more clearly than any other Writer I have hitherto read. ¶

Having thus compendiously enquir'd into the Antiquity, and recounted some of the principal Uses of Anatomy; 'tis now opportune for us to explain, what notion we have, and what are the most remarkable DIFFERENCES of the same.

Be it known therefore, that by Anatomy, according to the strict use and proper signification of the Græc word Ανατομή or Ανατομία, I with all Learned Physicians and Chirurgeons understand, a diligent, accurate and artificial dissection of the body of any Animal, chiefly of a Man, in order to acquiring knowledge of the substance, magnitude, figure, site, structure, connexion, action and use of all and every part thereof.

In the true notion of Anatomy then, two acts are comprehended; a work of the hands, Dissection; and an exercise of the Mind or Intellect, Speculation. Of these, the first is call'd by Galen, Ανατομική ἐγχείρησις, Administratio anatomica, manual operation: the other, Ανατομική θεωρία, mental contemplation.

And hence arises the first Difference of Anatomy, viz. the discrimination of it in πρακτικὴ καὶ θεωρητικὴ, into Practic and Theoretic. The former of these is to be acquir'd by long use and experience; and natural dexterity: the later, by reason and sagacity, by hearing the Lectures, read-

P R E F A C E.

ing the Writings of Learned men concerning that Subject, and by intent Meditation. Again, the former may (for distinction sake) be named Historical; the later, $\epsilon\mu\sigma\iota\mu\epsilon\tau\iota\kappa\eta$, Scientific.

To Anatomic Administration are requir'd, not only many instruments of various kinds, too well known to be here singly named, much less described: but various manual Operations also, besides meer dissection, all subordinate thereto: viz. exact commensurations and ponderations of parts inquir'd into, injections of divers liquors by syringes, inflations, extensions, ligations, excarnation, application of Microscopes, and many others: and all to one general End, the attaining to perfect knowledge of the Subject, and every the most minute part thereof; at least as much Knowledge, as the narrow limits of Human Wit can comprehend.

To the Theoretical or Speculative part it is requisite that the Anatomist accurately observe (1.) the Universal Structure of the whole, and all its proportions, beauties, and general defects; also its general Communities and Differences with other Animals, and above all with other individuals of the same species: (2.) the Conformation and Texture of every part, with their Similar particles or visible Elements; also the Symmetrie or proportion the parts hold both among themselves, and compared with the whole; the Communities and Differences of one and the same parts in various Animals, and in other individuals of the same kind; the comparison and disparity of any one part with the rest of the same individual; and finally the various Sympathies and Antipathies of every single organical part: (3.) the various Faculties, Actions and Uses of every part.

Of both, the most proper SUBJECT is the body of Man extinct, consider'd as an Universal Organ adequately accommodate to all Faculties of the Soul, and compos'd of a great

P R E F A C E.

great multitude of less Organs, the retexture or unweaving of which, so as to find out the Mechanical reason of their motions and actions, is the grand scope of the Anatomist.

I say, the most proper Subject; not to exclude the bodies of Brute Animals, the dissection of which also, though less properly, belongs to the Art of Anatomy, as being subservient to the principal End thereof, nor a little helping to the more facil investigation of what is sought for in the most proper subject. For which reason, Zootomie or the dissection of Brutes of various kinds, hath been commended and diligently practis'd by many as well Antient as Modern Physicians, as a thing of good use toward the advancement of the History of Nature. Nor is Dendranatomia or the Anatomy of Plants and Trees, begun (as it seems) many hundred years past by Theophrastus, and very lately with happy success cultivated by Malpighius and our Dr. Grew, to be neglected: forasmuch as from thence may be learned the admirable Analogy betwixt Plants and Animals, chiefly as to their Generation, Nutrition and Augmentation; and how far that Resemblance holds.

I say also, the body of Man extinct; to intimate my just abhorrence and detestation of dissecting Men alive: a cruelty condemn'd by Celsus, forbidden even by Humanity it self, nor ever (for ought I have hitherto read) publickly permitted by any Nation how barbarous and sanguinary soever, no not in the most flagitious of Criminals. I am not ignorant, either that Herophilus hath been by some * accused of inhumanly raking in the bowels of condemn'd Malefactors, while they lay roaring under his knife: or that Fabius Quintilianus, that excellent Orator, in his eighth Declamation, intitl'd Gemini Languentes, introduces the Wife impeaching the Husband Malæ Tractationis, for that he had given leave to an Empiric (for I cannot vouchsafe him a better title, nor easily find a worse) to dissect one of her Twinns while yet alive, that he might

* Tertullianus ait, *He ophitum* pluisquam septuaginta cadavera secuisse, & saepe viva hominum corpora. & Galenus de eodem scribens, *Herophilus* (inquit) ad exquisitissimam anatomiam cognitionem pervenit, ac majori ex parte non in brutis, ut plerique solent; sed in Hominitibus ipsis periculum fecit.

find

P R E F A C E.

find out the way to preserve the other, who languish'd of the same sickness: and yet notwithstanding I think my self free to choose whether I will believe or doubt the verity of these Accusations. For, the Works of Herophilus being lost, and nothing of his Memoirs remaining, but what hath been transmitted to us by such as either impugned his doctrine, or emulated his glory: 'tis not improbable, but his frequent dissections of Living Beasts might give occasion to his Adversaries to feign him guilty of greater cruelty upon Men, by cutting up them also while alive. And as for Quintilian's Twinns; I should tell you no news perhaps, if I affirm'd, that the Roman Orators sometimes feign'd the subjects or arguments of their Declamations, supposing knotty and perplex cases, on purpose to shew the dexterity of their Wit, and power of their Rhetoric in unravelling them: and that therefore I think this case of the Twinns to be not really true, but only imagined by Quintilian, as a fit subject whereon he might make an elegant Harangue or pleading. But were it granted that these are no fictions; yet would it still remain to be prov'd, that the Dissection of Men alive, hath at any time been used with public permission or connivence among either Græcians or Romans.

The parts of a body dissected, whether it be of Man or Brute, are consider'd either Absolutè, as they appear in that body; or Relativè, as they have more or less of Analogie to the same parts in other Animals either of the same, or of a divers kind. And hence arises a second division of Anatomy into Simple and Comparative: of which the former is wholly conversant about the observation and knowledge of those parts, which pertain in general to the Body of Man, without farther scrutiny: the later, tho' inservient to the former, is yet of much greater extent. For, to Comparative Anatomy it belongs (1) to compare the whole body with all its most remarkable parts; and to note the weight, measure, proportion, symmetrie and pulchritude

P R E F A C E.

tude of both that and each of these: (2.) to compare the same parts in human bodies of different Ages, different Sexes, different Climats, Countreys, &c. for these things may cause a visible disparity, and there is no doubt but that the figure and structure of the interior parts is very little inferior, for variety and lineaments, to the exterior; and that the Hearts, Livers and Ventricles are as different in Men, as either their foreheads, or noses, or ears: (3.) to compare the parts of Brutes of various kinds, Quadrupeds, Fowls, Fishes, yea even of Insects and Worms, with the same or like parts in Man; that so the Communities and Proprieties may be observ'd and register'd. Nemo enim de partis alicujus usu sive officio rectè determinaverit, qui ejus in pluribus animalibus fabricam, situm, annexa vasa, aliâque accidentia non viderit, secumque diligenter pensitaverit. *Harv. in præf. ad lib. de Generat. Animal.*

This COMPARATIVE Anatomy, how recent soever as to the name, was yet most certainly held in great estimation, and much practis'd by the Antients, chiefly Græcians. For, well known it is, that Democritus of Abdera exercis'd himself assiduously in dissection of Brutes of various kinds, ἢ μῦθον δὲ ἔγρα (as himself expressly declared to Hippocrates come to visit him) χαλῆς δὲ δὴχουσθούου ἢ δέου, not from hatred of Gods works, but curiosity to find out the nature and seat of Choler and Melancholy. Nor is it less known, that Aristotle also spent some years in the same work, as is most evident from his elaborate Books de generatione, de partibus, and de historia Animalium: being to that end furnish'd with Living Creatures of all sorts, that whole Asia and Græcia, in Land or Seas, afforded, at the charges of his Royal Disciple, Alexander the Great, to the expense of no less than eight hundred Talents: and that this mighty Conqueror, in the heat of his Wars and pride of his Triumphs, gloried in his

In Epistola
Hippocratis
ad Damag-
tum.

Plin. lib. 2.
cap. 16.

Athenæus lib.
9. cap. 13.

P R E F A C E.

his great proficiency in the knowledge of the nature and fabric of the parts of various Animals, under so wise a Teacher; as if he had obtain'd by his Learning no less glorious victories over the secrets of Nature, than he had gotten from Nations by his sword. How much Galen was vers'd in this Comparative Anatomy, is sufficiently apparent, not only from his excellent *Volums de Administrationibus Anatomicis, & de usu partium*, and the account he gives of his many public dissections at Rome in the presence of the Noblest Romans, and among them of Boetius and Paulus Sergius Consuls; but also from this, that some of the Neoterics, and principally Vesalius, objected against him, that he had been less conversant in the dissection of Human bodies. What progress the Græc Physicians that succeeded long after Galen, made in the same part of Anatomy, is indeed difficult to be collected from their Works, now grown almost obsolete among us: but whoever hath perused the monuments of Aretæus, Theophilus, and Oribasius, needs not to be advertis'd by me, that they have not wholly neglected it. If we come down to this last Century of years, we find the dissection of Brutes, in order to the collation of their inwards with those of Man, to have been diligently persued, first by Falopius, Casserius Placentinus, and Bauhinus; and after them, by Fabricius ab Aquapendente, M. Aurelius Severinus, and our immortal Harvey, &c.

Just cause therefore I have to admire, why the Lord Chancellor Bacon, a man of almost infinite reading, strong memory, and profound judgement, and who doubtless had look'd into the Writings of many, if not of all the Eminent Authors by me now mention'd; should yet notwithstanding (in lib. de Augmento Scientiarum 4. cap. 2.) among the *Desiderata Medicinæ*, put down this Comparative Anatomy, and so positively define it to be deficient; accusing Physicians to have altogether neglected it. Nor can I easily solve this my admiration, unless by conceiving, either (that

P R E F A C E.

that this Great Man understood much more of his own Profession, the Law, than of ours, the Art of Medicine; or that by the word, Deficient, he meant Imperfect. If this later Solution be admitted; then indeed he will be the less culpable: because it is too true, that the ample field of Anatomy Comparative hath not been hitherto so fully cultivated, as to bring forth a harvest rich and abundant enough to satisfy our hopes and expectation. But that Physicians have been guilty of so much sloth and ignorance, as to suffer it to lye barren and wholly neglected, through so long a series of Ages: this, I humbly conceive, ought not to have been affirm'd, unless it could have been fully prov'd. ¶

Nevertheless I gratefully acknowledge, and applaud the Heroic Zeal this Illustrious Lord had for the improvement of our Art, among others useful to human life: yea I interpret his censure, not as a reproche, but incitement of our industry. And this I the more willingly do, because if he were somewhat too severe in his sentence of Comparative Anatomy, he hath bin (in the very same place of his Book) as much too favorable to Simple; concluding it to have been most clearly handled, and observed even to a curiosity: whereas in truth we are not so happy, as to have just cause to say so at this day. For, after all the new Discoveries made in Human bodies by Anatomists who have liv'd since his time, Simple Anatomy must be confess'd to be still in its Youth, far short of Maturity and Perfection. There are yet, alas! terræ incognitæ in the Lesser World, as well as in the Greater, the Island of the Brain, the Isthmus of the Spleen; the Streights of the Renes Succenturiati and some other Glandules, the North-east passage of the drink from the Stomach to the * Kidnies, and many other things, remain to be farther inquir'd into by us, and perhaps by Posterity also. In fine, this Simple

E

Anatomy

* Serosi humoris iter ad renes, hætenus quæsitum magis, quam repertum arbitror: frustra que fuisse omnes, qui Isthmum hunc fodere aggressi sunt, &c. Cl. Entius in Antidiatribæ pag. 63.

P R E F A C E.

Anatomy is a study so abstruse and difficult, and withal so vast and diffuse; that the last complement of it cannot with reason be expected from the diligence of any one Man how sagacious and industrious soever. 'Tis therefore seriously to be wish'd, that the work were so divided among those curious Wits, that are by secret instinct disposed to digg in this mine of knowledge, as that every one might take to his share some one single part of those that are not yet fully explain'd, and do his best devoirs to explore and demonstrate the whole Mechanic frame of it. If this were done, doubtless we should in few years find a very considerable Accession made to the late inventions in Mans body, and with more justice than now we can, approve the Lord Verulam's opinion, that Simple Anatomy is already arriv'd at Perfection.

To advance this so noble, so useful Art of Anatomy, and accelerate its progress toward Consummation; that so the Pathologic part of Medicine being by degrees rais'd from the darkness of uncertain Conjectures, to the light of even sensible Demonstrations, the infirmities of Mens bodies may at length be more certainly and easily cured, their pains and torments sooner eas'd, and their Lives prolong'd: to this Noble End, I say, this Magnificent THEATRE, wherein we now sit, hath been with so great cost and art erected by the Generose FOUNDERS; whose private Munificence, exceeding that of Kings, admits of no rival but the Wisdom that directed it; whose large hearts were at the same time fill'd, with Charity toward all Mankind of the present Age, and with Providence for the relief of all in Ages to come.

Among these, Gratitude it self exacts, that I should with singular honor mention our Principal Benefactor, Sr. JOHN CUTLER; a Person to whom God hath given that double blessing of great Riches, and as great Prudence how to use them to the noblest of Human Ends,

P R E F A C E.

Ends, the Public Good ; and who having no Augustus to favor and assist his Beneficence, is by so much a greater Patron to Learning than Mecænas was.

Doth any here think, that this stream of His Bounty might have been deriv'd upon some other ground more fruitful of benefits, than this Garden of Philosophy ? Let me, to undeceive that man, advise him seriously to consider, first that excellent sentence of Pythagoras (to whom all Philosophers ow that modest name) that there are two things which most ennoble Man, and raise him up to a resemblance of the Divine Nature, namely, to know truth, and to do good : and then, that there is no Human Science that doth either more gratifie and enrich the Understanding with variety of choice and useful truths ; or more enable a Generose Mind to exercise its Faculties to the good and benefit of others, than that of Anatomy, as it is a principal fundament of Medicine, doth. For, both these are certain and evident Verities : and after due consideration of them, no man can longer doubt, that he who placeth his Munificence upon erecting an Anatomic Theatre, for advancement of the Art of Healing the Sick ; doth a Work as conducive both to the Glory of God, and to the Common Good of Mankind ; as he that builds a Church, or as he that founds and endows an Hospital.

I say, to the Glory of God ; because I am taught, not only by Galen (3. de usu partium.) that the discerning ones self, and discovering to others the Perfections of God displaid in His Creatures, is a more acceptable act of Religion, than the burning of Sacrifices or perfumes upon His Altars ; nor only by Trismegistus (in Asclepium cap. 15.) that the thanks and praises of Men are the most grateful incense that can be offer'd up to God : but even by God Himself, in His Written Word, that he who sacrificeth Praise (for so 'tis in the Original) honors Him.

P R E F A C E.

I say also, to the common Good of Mankind; as well because the Necessity of Medicine is Universal; so that even Kings themselves are sometimes forced to obey the precepts of Physicians, when the pains they feel assure them, that a Crown cannot mitigate the Head-ake, nor an Army deliver from the horrors of a Fever, nor the Roial Garter drive away the torments of the Gout: as because to heal the sick, is by so much a nobler act of Charity, than to feed the Hungry, or cloth the Naked, by how much Intellectual Powers of the Mind are both more difficult to be attain'd; and more Excellent in their nature, than the transitory gifts of Fortune. Riches manytimes come easily, and unexpected, even to Men ignorant of the right use of them: the Art of Healing is never acquir'd but by hard, anxious; and long study, and by accurate Observations. Manifest therefore it is, that whosoever by his Munificence contributes to the advancement of this so difficult, so noble, so universally useful Art, doth thereby signalize both his Piety toward God, and his Charity toward Men, in a way most acceptable to Him, most beneficial to them.

More, much more I would say in Commemoration of this Worthy Knight's Exemplary Bounty; but that I know, that to him it is far more grateful to conferr Benefits, than to receive Acknowledgments; and that this very Fabrick hath already rais'd him, as above all Envy, so above all Praises. The same will (I prophesie) remain a perpetual Monument of his Heroic Zeal for the promotion of Natural Science, and recommend his Name to all posterity. For, Fame built upon Universal Beneficence, cannot but be immortal; because it can be no mans interest to suppress it, and all are by gratitude obliged to propagate it. Some Great Men (as the Vulgar call them) hunt after Renown, by enlarging Empires and Kingdoms; some by conducting mighty Armies, and fighting bloody Battles; others again by erecting Pyramids, massy Tombs, and other the like Pageants.

P R E F A C E.

geants of human injustice, pride, or cruelty : but these, alas ! all these pursue only flying shadows : and either the gulph of Oblivion will soon swallow them down, as ignoble and obscure ; or if any memory of them chance to survive their funerals, 'twill be conjoin'd with contempt and detestation. Quæ saxo struuntur (saith Tacitus, Annal. lib. 4.) si judicium posterorum in odium vertit, pro sepulchris spernuntur. Only those happy Men shall flourish in the esteem and veneration of all future Generations, who have acquir'd fame and honor by doing good. This therefore is true Glory, and of this our Noble Benefactor, of whom I speak, may rest secure. Multos veterum velut inglorios & ignobiles oblivio obruet : C U T L E R U S posteritati narratus & traditus, æternim superstes erit. ¶.

Would I were equally secure of Your good acceptance (I dare not say, Approbation) of the mite I am about to contribute toward the accomplishment of his so glòriose Design. But, alas ! this is a wish without hope ; so destitute I know my self to be of all the Faculties of Mind requisite to so difficult an Atchievement ; my Zeal for the promotion of Anatomy, only excepted : and much more reason there is, why I should apologize for my insufficiency, before I farther expose it. Notwithstanding this discouragement, considering with my self, that profound Erudition, and great Humanity are (like Love and Compassion) inseparable : I think it much safer to confide in Your Candor and Benignity for pardon of my Defects, than to attempt to palliate them, by Excuses, however just and evident. Not to be conscious of my faileurs and lapses in my following Lectures, would argue me of invincible ignorance ; not freely to acknowledge them, would be tacitly to defend them : to seek by speciose pretences of haste, of frequent diversions, of natural impatience of long meditation,

P R E F A C E.

ditation, of bodily indispositions intervenient, and other the like vulgarly alleged impediments, to extenuate them; were the most certain way to aggravate them: and to conceal them from your sight, is in this place and occasion impossible. Having then no other Refuge but in Your Grace and Favor, I fly to that alone, to secure me from the danger of malignant Censures, which I am more than likely to incur: nor will I fore-arm my self with any other defense, but this.

*If the Matters of my subsequent discourses shall appear to be, neither Select, nor of importance enough to compensate Your time and patience; be pleas'd to remember that saying of Aristotle, (Metaphys. lib. 2. cap. 1.) Non solum illis agenda sunt gratia, quorum opinionibus quis acquiescet; sed iis etiam, qui superficie tenus dixerunt. Conferunt enim aliquid etiam isti: habitum namque nostrum exercuerunt. Si enim *Timotheus* non fuisset, multum melodiae nequaquam habuissimus. Si tamen *Phrynis* non fuisset, ne *Timotheus* quidem extitisset, &c.*

*If my Stile shall sound somewhat harsh and ungrateful many times to Ears unaccustomed to any but their Mother tongue, as coming too near to the Latin; I intreat you to consider, this is either no indecency in this place, or such a one at worst, which I could not otherwise avoid, than by involving my sense in the obscurity of words less proper and significant; the nature and quality of the Subjects treated of, being such, as cannot be fully expressed in our yet imperfect Language. So that I have a clear right to that honest plea of *Lucretius*,*

Abstrahit invicem patrii sermonis egestas. ¶

PRÆLECTIO I.

Of Nutrition.

MAN being consider'd, *ut Animal-Rationale*, as a *living* Creature naturally endow'd with *Reason*, and compos'd of two principal parts, a *Soul* and a *Body*; each of which hath various *Faculties* or *Powers*: the summe of *Human Nature* must be comprehended in those *Powers* conjoyn'd.

Of these *Powers*, some are peculiar to the *Soul* or *Mind*, others belong to the *Body*, as Organical and animated by the *Soul*.

To the *Former* sort are referr'd the *Faculties* of *thinking*, *knowing*, *judging*, *reasoning* or *inferring*, *concluding*, *electing*, and *willing*; all commonly signified by *Understanding* and *Will*. All which being remote from the Province of *Anatomists*, I leave them to be handled by *Philosophers* inquiring into the nature of the *Soul*.

Of the *Later*, some are requisite to the complement of *Man*, as single or *individual*; *viz.* the *Faculties* of *Nutrition*, of *Life*, of *Sense*, and of *Voluntary Motion*: and there

there is one that respects the Procreation of Mankind, namely the Power *Generative*. And these are the natural Faculties, to which as principal Heads, the Learned Anatomist is to refer all his Disquisitions; that at length he may (if it be possible) attain to more certain knowledge of the Mechanic frame of the Organs in which they are founded. But being more than can be, tho' but perfunctorily, enquir'd into in so few hours as are assign'd to this publick Exercise; I have therefore chosen to treat of only some of them at this time, *viz.* *Nutrition, Life, and voluntary Motion*; not as more worthy to be explain'd than the rest, but as more comprehensive or of larger extent.

I have chose also to begin from *NUTRITION*; not only because the Stomach, Guts and other parts principally inservient thereto, being, by reason of impurities contain'd in them, more prone to putrefaction, ought therefore first to be taken out of the cavity of the *Abdomen*, to prevent noisomness: but because *Nutrition* seems to be, if not one and the same thing with, yet at least equal or contemporany to *Generation* it self; and that both $\kappa\tau\iota$ $\chi\epsilon\acute{\iota}\nu\omicron\nu$, in respect of *Time*; and $\kappa\tau\iota$ $\phi\acute{\upsilon}\sigma\iota\nu$, in respect of *Nature*.

For tho' the operation of the Power *Generative*, or *Formative* Virtue, may seem to precede that of the *Nutritive*: yet in truth the *Stamina* or first rudiments of an Embryo are scarcely delineated, when they begin to be augmented also by nutrition; so that 'tis consentaneous as well to the observions of Dr. *Harvey* and others since, as to reason, that *Formation* and *Nutrition* are but different names of one and the same act of the *Plastic* power. Again, *Generation* and *Accretion* are not perform'd without *Nutrition*: nor *Nutrition* or *Augmentation* without *Generation*. To nourish, what is it but to substitute such, and so much of matter, as
is,

is, by reason of exhaustion, wanting to the solid parts of the body, namely flesh, nerves, veins, arteries, &c. ? and what is that in reality, but to *generate* flesh, nerves, veins, arteries, &c. ? In like manner *Accretion* is not effected without Generation ; for all natural bodies capable of Nutrition, are by accession of new parts augmented, and these new parts must be such as those of which the bodies were at first composed : and this is done according to all their dimensions. So that in verity, the parts of an Animal are increas'd, distinguish'd, and organiz'd all at the same time, by the same *Formative* power. Moreover if we reflect upon the *Efficient* cause of Formation and Nutrition, and upon the *Matter* it uses ; we shall on both sides find it necessary, that those two works (if ye will have them to be distinct) be carried on together. On the part of the *Efficient* ; because *idem esse principium efficiens, nutriens, & conservans in singulis Animalibus, necesse est : nisi aliam formam in puero, aliam in adolescente, & in senē aliam constituamus ; quod absurdum est.* On the part of the *Matter ex qua* ; because all Animals (such as are produced *per Epigenesin*, of which alone is our discourse : not of such *Insects* that are generated *per Metamorphosin*) are made of one part of the Matter prepar'd by the Formative Spirit, and nourish'd and augmented out of the remainder, not out of a divers matter. For, whatsoever is superadded to the first rudiments of the parts, ought certainly to be of the very same substance with what was præexistent, and so must consist *ex congenere materia* : their renovation, as well as first corporation, being effected by Aggeneration or superstruction, *i. e. per Epigenesin.* So that from all these reasons put together it is constant, that Nutrition is nothing else but *Generation continued* ; and as necessary to the conservation of every individual Animal, yea every individual Plant

also, as Generation it self is, to the conservation of the Universe. Which our most sagacious Sr. G. Ent well understanding, recommends to the belief of his Readers in these few, but memorable words (in *Antidiatribæ* pag. 40.) *Nutritio sane videtur esse veluti continuata quedam generatio; quæ est opus ideale, ad exemplar primitivum actiones suas dirigens, &c.*

In lib. de ovo
incubato.

That I may both illustrate and confirm this Theorem, give me leave to represent to you in a few lines, the method and process of Nature in the formation of a Chick out of an Egg according to the most accurate Observations of *Malpighius*, the summe of which is this. From those Observations, containing eight several acts of the Formative power, it is highly probable,

(1.) That the *Spirit, Plastic Virtue, or Archeus* (call it by what name you please) of the Egg, lies dormant as it were and unactive for some time after the Egg hath been laied, as if it expected the incubation of the Hen, or some other warmth equivalent thereto, to help it to exert its power, and begin the great work of building for it self a house, according to the idea or modell prescrib'd by the Divine Architect, whose instrument it is: and that having obtain'd that requisite aid, it soon acts upon the *genital humor*, in which it is lodged, by way of attenuation or eliquation, that so the *Matter* may be made more fluid and obedient to its energy. Which seems to be the *first Act*.

(2.) That this *Spirit*, having drawn the first lines or threds of the solid parts of the *Embryo*, and dispos'd them into their proper seats, doth immediately after design certain wayes or passages, by which those slender and delicate *Stamina* may be commodiously supplied with *vital* and *nutritive* liquors, for their enlivening and nutrition: and to that end, mark out and appoint three Fountains as it were in the now more fluid

Colliquamentum,

Colliquamentum, and thence deduce as many *Canales* or rivulets; two of which are from their origine united, and therefore somewhat greater; one out of the first rudiments of each ventricle of the *Heart* (not yet conspicuous, because not coagulate, but pellucid) and a third consisting of many smaller rills flowing from the like rudiments of the *Brain*. So that we may thence collect, that the two former of these *Canales* are made to bring in the vital humor from the *Heart*, the third to bring in the *Succus Nutritivus* from the *Brain*, to the first rudiments of the *Chick*: and that in process of time, those are turn'd into the *Aorta* and *arteria Pulmonaris*; these into pairs of *Nerves*. And this I take to be the whole work of the *second Act*.

(3.) Lest these so necessary fountains should by exhaustion fail, the same Architect, directed by divine instinct, provides also for their perpetual supply. To irrigate the *Brain*, Rivulets are brought thither from the trunc of the grand canale of the *Heart*: and to feed the current of the *Heart*, three new streams are deriv'd to it; one from the *interior Lake* or *Colliquamentum*, a *second* from the *exterior* by the wayes of the *Navill*, and a *third* from the yolk of the *Egg* by veins, that by all these importing conduit-pipes fresh liquors may be continually deduced from the parts nourished into the *Heart*. Which pipes are soon after compacted into *veins*, either such as are design'd to bring back the *Bloud*, or such as are ordain'd to convey the *Chyle*, or the *Lympha*. And this may be call'd the *third Act*.

(4.) 'Tis evident, that the same invisible Agent advances in the next place to distribute the vessels derived from the rudiments of the *Heart*, *viz.* the *Arteria Pulmonaris* and *Aorta*, first whole, then divided and subdivided into branches still smaller and smaller, till at last they dwindle into *Capillaries*: and on the contrary,

to collect and by degrees unite all the rivulets that return from the *Stamina* of the solid parts to the Heart, till they all meet and make a confluens in the single trunc of either the *vena porta*, or *vena cava*. For even common sense teaches us to call that the original or source of a Canale, from whence the liquor which it conveys, flows: as every River is truly said to begin from its head or spring. And *Malpighius* hath, by the help of Microscopes, observ'd, and in his sixteenth and eighteenth Figures faithfully (as I believe) represented, certain varicose veins lying in the Umbilical *area* or space, not yet extended to either the Heart or Liver: and therefore also, not the Heart, but the *Stamina* of the parts circumjacent, ought to be reputed the Origin of the veins. And this *distribution* of one sort of Canales, and *collection* of another, completes the *fourth Act*.

(5.) No less evident it is, that from the beginning the *Vital Nectar* is clear and transparent, and so remains, till somewhat of the *Yolk* hath been mix'd with it. For, not only *Malpighius*, but our equally curious *Dr. Glisson* (*de ventriculo & intestinis cap. 20. num. 67.*) expressly affirms, that he had seen blood of a rusty colour in the coats involving the Embryo of a Chick, before any the least sign of blood could be discern'd in or about the Heart. But this so early beginning of blood may be ascrib'd, either to the speedy excitation of the Spirits by the incubation of the Hen, to whose heat those veins are somewhat nearer than the Heart is: or to this, that perhaps somewhat of a yolky tincture had preceded and caus'd that rusty or dark red. However, this beginning of Change in the *Vital liquor* from transparency to redness, seems to be the *fifth Act*.

(6.) All the Canales just now describ'd, being fix'd and open'd, and the vital liquor exalted some degrees nearer

nearer to perfection; the *Plastic Spirit* proceeds to finish the whole body: so regulating its operations, as to augment those parts first, which ought to be first used; and then to add to the dimensions of others, whose use may be longer wanted without detriment. And this slower work of accomplishing all parts, by way of *Nutrition* and *Augmentation*, may be accounted the *sixth Act*.

(7.) The same *Architectonic Spirit* as it spins the first *Stamina* of all the solid parts, so doth it gradually augment and complete them all out of one and the same homogeneous liquor, *viz.* the *Colliquamentum*, or spermatic humor clarified by Eliquation: and this by *transmuting* the same into as many several forms, as there are different kinds of similar Spermatic parts in the whole body; namely into *bones, cartilages, ligaments, tendons, membranes, fibres, &c.* So that all the Organs are at length compos'd of dissimilar parts by wonderful artifice context, without the least of confusion or incongruity. Which deserves to be reckon'd the *seventh Act*.

(8.) In that work of *Organization*, 'tis credible, the inimitable Artist *divides* without section, only by terminating the parts; and *unites* without glew or cement, only by continuing them to the common term or bounds, which depends more upon union of matter, than upon union of nature. By these admirable artifices of Division and Unition, the *Plastic Spirit* perforates, separates, conjoins, cements the yet fluid, at least soft *Stamina* of the parts, where, how, and as often as need requires: it deduces and runs out their Rivulets terminated in the fluid matter as by chanel; it preserves from confusion the two different *Colliquamenta*, and the *Yolk*, divided as it were by partitions: it so distinguishes and determinates even contiguous and semblable parts,

that,

that they may be diversly moved at the same time without interfering or impediment, and each yield to other when occasion requires: and thus almost all fibres, very many membranes, and (in many sorts of Animals) the Lobes of the Lungs and Liver, and the Cartilages mutually touching each other in the joints, &c. are divided among themselves. In a word, by these wayes and degrees here by me from *Malpighius* his Microscopical Observations collected and rudely described, it seems most probable, that the *Embryo* is form'd, augmented and finish'd in an Egg.

Now therefore (that we may accommodate this *Epitome* to our present Argument) if this be the method and process that Nature uses in the Generation of *Oviparous* Animals; and if she uses the like in the production of *Viviparous* also, as Dr. *Harvie's* observations, and our own assure us that she doth: we may safely conclude, that Human *Embryons* are in like manner form'd, augmented and finish'd, by one and the same Plastic Spirit, out of one and the same matter, the *Colliquamentum*. *Quod erat probandum.*

I add, that the same *Plastic Spirit* remaining and working within us through the whole course of our life, from our very first formation to our death; doth in the same manner perpetually regenerate us, out of a liquor analogous to the white of an Egg, by transmuting the same into the substance of the solid parts of our body. For, as I said before, *Nutrition* is necessary to all Animals, not only in respect of the *Augmentation* of their parts, while they are little *Embryons*; but also in respect of their *Conservation* after during life: because their bodies being in a natural consumption or exhaustion, would inevitably be soon resolv'd into their first elements, unless the providence of Nature had ordain'd a continual renovation or reparation of the parts,
by

by substitution and assimilation of fresh matter, in the room of those particles dispers'd and consum'd. Having therefore, to some degree of probability explain'd the former necessity of Nutrition, and the causes of it, my next business must be, to inquire into the *Later*. Which that I may the more effectually do, I find my self obliged to begin my scrutiny from the *Causes* of the perpetual *Decay* or *Depredation* of the substance of our bodies, *viz.* the *Efficient* or *Depr.edator*, and the *Matter* or substance thereby consum'd, and the *Manner* how.

The *Depr.edator* then, or *Efficient* cause of the perpetual consumption of our bodies, seems to be, what all Philosophers unanimously hold it to be, the *Vital Heat* of the blood, therein first kindled by the Plastic Spirit, continually renew'd by the Vital Spirit, and by the arteries diffus'd to all parts of the body, that they may thereby be warm'd, cherish'd, and enliven'd. This *Lar familiaris*, or *Vital Heat* continually glowing within us, and principally in the Ventracles of the Heart, call'd by *Hippocrates*, $\epsilon\mu\phi\omicron\tau\omicron\nu\ \pi\acute{\nu}\varsigma$, *ingenitus ignis*; by *Aristotle*, $\eta\ \epsilon\kappa\ \tau\eta\ \kappa\alpha\rho\delta\iota\alpha\ \pi\acute{\nu}\varsigma\ \psi\upsilon\chi\eta\varsigma\ \epsilon\mu\pi\acute{\nu}\epsilon\tau\omicron\upsilon\varsigma$, *accensio anima in corde*; and *flamma Biolychnii*, the flame of the Lamp of Life, by others; and by others again, *igneus pars Anima Sensitiva*: is what Physicians generally have heretofore understood by *Calidum innatum*, tho' they seem to have had but an obscure and inadæquate notion of the thing it self, as I hope to evince, when I shall come to inquire, what *life* is, and upon what it chiefly depends. Meanwhile supposing it to be an *Actual Heat* consisting in a certain motion of the various particles of the blood, and in some degree analogous to fire or flame; I cannot conceive, how 'tis possible for it to subsist or continue, for so much as one moment of time, unless it be maintain'd by convenient fuel, which is thereby incessantly fed upon, and by degrees consum'd: for it is

of the nature of all fire, how gentle or mild soever, to generate and conserve it self only by preying upon and destroying the matter in which it is generated. This *Vital Heat* therefore without intermission agitating, dissolving and consuming the minute and most easily exsoluble particles of the body ; must be the *Depradator* here sought after. So that in truth, we have one and the same cause both of our *life*, and of our *death* ; or (to speak more properly) our very life is nothing but a continual death, and we live because we die. For, we live so long, as while this internal *Vital Heat* is kept glowing in the blood : and when it ceases to glow, either from want of convenient sustenance, or by violent suffocation , life is instantly extinguish'd. So true even in this natural sense is that Distich of *Euripides* ;

Quis novit autem, an vivere hoc sit emori :
An emori, hoc sit quod vocamus vivere ?

The *Matter* consum'd, I humbly conceive to be, for the greatest part, the *fluid* parts of the body, chiefly the *blood* and *spirits*, which are most easily exsoluble ; and somewhat, tho' but little, of the substance also of the *solid* parts. For, Experience teaches, that divers Animals, Bears, Dormice, Swallows, &c. sleep the whole Winter , without receiving any supply of aliment : and yet have all the solid parts of their bodies as large and firm, when they awake again in the Spring, as when they first betook themselves to their dens or dormitories : and the *Reason* hereof seems to be this, that their *Vital Heat* being all that time calm and gentle, consumes their blood and spirits but slowly, and very little of their solid parts ; as a lamp burns long, when the oyl that feeds it, is much, and the flame
but

but little and calm. We have Examples also of *Leucophlegmatic Virgins*, who from a gradual decay of Appetite, have fall'n at length into an absolute aversion from all food, and endur'd long abstinence, without either miracle or imposture; and yet notwithstanding have not been emaciated in proportion to the time of their fasting. Whence 'tis probable, that in our bodies there is not so rapid and profuse an expense or exhaustion of the substance of the solid parts, as heretofore many learn'd Physicians have imagin'd to be made by the activity of the Vital Heat.

If it be *objected*, that in many diseases, the habit of the body is wont to be very much extenuated: we are provided of a double *answer*. *First*, That extenuation seems to proceed rather from a meer subsidence or flaccidity of the Musculous flesh, for want of blood and the nourishing juice to fill and plump it up; than from any great deperdition of the substance of the fibres, of which the Muscles are mostly made up: otherwise such decays could not be so soon repair'd, as we observe them to be in the state of convalescence. *Secondly*, Whatever be the cause of the extenuation objected, it impugns not our present supposition, which extends not beyond the natural and ordinary deperdition made by the Vital Heat in the state of *Health*.

And as for the *Manner* how the blood, spirits, and other fluids (and if ye please to have it so, also the less fixt, and more easily exsoluble particles of the solid parts) are consum'd by the Vital Heat; this may be sufficiently explain'd by the familiar example of oyl consum'd by the flame of a Lamp. Whether we take fire or flame to be a substance luminose and heating; or conceive it to be only a most violent motion of globular particles in its *focus*: most certain it is; that it consisteth in a perpetual *feri*, *i. e.* in a continual agi-

ration or accension of the particles of its *σύνεργον, pabulum* or fuel, and perishing as fast as it is propagated: so that fire is made fire, and again ceaseth to be fire, in every the shortest moment of time; and when in the combustible matter there remain no more particles, in which it may generate it self anew, it instantly perishes. Now continual *Dispersion* being the proper and visible effect of fire or flame; the matter or fuel wherein it subsisteth, cannot but be in continual flux or decay. In like manner, the *Vital Heat* of Animals subsisting by a continual accension of new spirits in the blood, as that is passing through the Heart; those vital spirits, transmitted from thence through the arteries to the habit of the body, no sooner arrive there, but having warm'd and enliven'd the solid parts, they immediately fly away, and disperse themselves by insensible transpiration, carrying along with them many watery vapors, and (perhaps) some sulphureous exhalations. Moreover, there being in all the solid parts of the body, certain mild, sweet and balsamic spirits, as it were affixt unto and concorporated with them; 'tis very probable, that the Vital Spirits acting upon them also by way of exagitation, by little and little dislodge them, render them Volatil, and at length wholly disperse them: whereupon the minute particles in which they did reside, become mortified, and as excrements, are excluded together with the exhalations of the blood. And this I apprehend to be the reason and manner of the deprædation made upon the body by the Vital Heat.

Here no man will I hope, exact from me an accurate *computation* of the daily expenses of this Vital Heat, which like some Governors, rules by exhausting: If any should, I might perhaps applaud his curiosity, but should not be able to satisfy it. For, fo
great

great is the difference among men, in respect of temperament, diet, age, exercise, the season of the year, and various other circumstances, that no definite calculation can be made of this disperse, no not in those who keep to the strictest rules of an *Ascetic* life, weighing themselves and their meat and drink, as *Cornaro* is reported to have done, daily. We may indeed conjecture from the *Static* experiments of *Sanctorius*, that the expense is great; for instance, if forty pounds of meat and drink be suppos'd sufficient to maintain a man of a middle stature, sober, and of good health, for ten days; and about twenty pounds be assign'd to the excrements voided by stool and urine in that time: the other twenty pounds may be reasonably ascribed to insensible transpiration: but still this is mere conjecture. Let it then suffice, that we certainly know the quantity of blood and spirits daily exhausted by the Vital Heat that conserves life in us, is very great: and that the greatest part of the matter of insensible transpirations, is the Vital Spirits, which are continually generated, and continually dispers'd.

How apt and powerful these Vital Spirits are, by reason of their subtilty and brisk motions, to exagitate and disperse the more exsoluble particles of even the nerves, fibres, membranes and other tender and sensible parts; may be in some measure collected from various *diseases* and *symptoms*, that seem to arise from their various depravations or vicious qualities. I shall not therefore goe much out of my way, if I make a short *Digression*, to recount a few of those painful and contumacious Maladies, which are with good reason referrible to the *vices* of the Spirits, rendring the tone of the nervous parts either more *strict* or more *lax* than it ought to be; at least according to the doctrine of *Prosper Alpinus*, not long since reviv'd and illustrated

lustrated by Dr. *Franc. Glisson*, whose name is Elogie sufficient.

If it happens, that the Blood is too *vinose*, i.e. too abundant in Spirits (as in Good-fellows commonly it is) many times it induceth diseases depending upon *Fluxion*. For being by the arteries protruded into the more tender parts with greater force and impetuosity than is fit, it rather invades than cherishes them, by that violence putting their unfixt particles into a flux. And this *Fluxion* usually first invades such parts, as being weaker than the rest, are therefore more dispos'd to receive it. If the prevailing Spirits of the blood be, not only *Vinose*, but *Saline* also; many times there insues the like *Fluxion* conjoin'd with a languor and *laxity* of the tone of the parts, such as is alwayes observ'd in *Catarrhs*, in moist *Coughs*, in *Ebriety*, great heaviness to sleep, the *running Gout*, &c. And 'tis remarkable, that these Fluxions are usually so much the more fierce and vexatious, by how much the more infirm and yielding the nerves and fibres of the part invaded are; because these want strength to make resistance by vigorous contraction of themselves: whereas nerves naturally strong and tense, somewhat repress and break the force of the blood rushing in upon them. Which is perhaps one, if not the chief reason, why men of firm and vigorous nerves are very seldom or never infested by the *Gout*. If this *resolving* fluxion chance to be accompanied with a *Fermentation* of the blood; then commonly the evil consequent is a rheumatic, arthritic, or pleuritic *Fevre*.

On the contrary, if the Spirits that have obtain'd dominion in the blood, be *Sulphureous* or oily; there follows a Fluxion causing a *Constriction* and shutting up of the invaded part. For tho' the arteries poure out blood abounding in impetuous Spirits, and so
cause

cause a Fluxion: yet notwithstanding those Spirits, by reason of their oyliness, neither easily pass through the habit of the parts, as the *Saline* do, nor are dispers'd by insensible transpiration; but remain shut up, as in a close prison, and striving for liberty, raise great tumults and pains. Hence are excited various *Symptoms*, according to the various parts into which the Fluxion rusheth: in particular, if the Fluxion be determin'd upon the *Gutts*, there follow grievous *Colic* pains; if in the *Stomach*, a dire *inflation* of it; if upon the *Limbs*, that sore affect which Physicians generally call a *Rheumatisme*, which is not, as some have erroneously thought, rain'd down from the head, but proceeds only from sulphureous Spirits effused out of the arteries into the habit of the body, and therein imprison'd, their own oyliness making them unapt to transpire; and their tumultuous distension of the parts containing them, causing acute pains. Hence also come wandring *Scorbatic* pains, *Hypochondriac* winds, *rumblings* in the stomach and gutts, *Head-aches*, the *Tooth-ake*, &c. And all these evils are the more aggravated, by how much the more firm and tense the nerves of the part affected are: whereas in *Saline* fluxions the contrary happens, tho' they be no less pernicious in the end, by relaxing, fretting, and as it were melting the tone of the parts affected.

Finally, if the strength of the nerves and fibres be greater than the force of the blood flowing in from the arteries; in that case succeeds a Disease *è diametro* contrary to Fluxion; *viz.* *Obstruction* and *Infarction*, and for the most part transpiration hinder'd. The manner how, seems to be this: The too rigid tension of the nerves and fibres in any part, rendering the passage of the arterial blood through it more difficult than is requisite to the circuit of it freely; the thicker and more viscid parts thereof must
of

of necessity stick in their passage, and so produce *Obstructions*. And this vice alwayes is the more intended, by how much the more languid and sluggish the Vital Spirits are. For when these are copious and vigorous, they easily prevail over the light renitence or reluctance of the nerves, and maugre their opposition carry on the blood in its circuit: but when they flagg and act but dully, they yield to the opposition of the nerves and fibres, and leave the grosser and more viscid parts of the blood sticking in the passages. In a *Cachexy, Dropsy, Asthma, Scorbutic*, obstruction of the pipes of the Lungs, tumors and inflammations of the *viscera, &c.* the nerves commonly are more strict or tense than they ought to be. But if a *Saline* fluxion chance to be conjoyn'd with, or to supervene upon such an excessive tension of the nerves, it either wholly solves the disease, or very much mitigates it at least. Whereas on the contrary, if while the nerves and fibres continue strong, such a constriction of them be accompanied with a *Sulphureous* fluxion, then it causes dismal tempests in the parts affected; *Convulsions, Epileptic fits, Apoplexie, extreme difficulty of breathing, Suffocation, Hysteric* and other the like passions.

Now, if the Genealogie of these *Fluxions* here describ'd, be consentaneous to reason and experience; it doth not a little confirm what hath been deliver'd, touching the depravation of the more easily exsoluble substance of the parts by the Spirits of the blood. For, tho' what happens in a *praternatural* state of the body, be not alwayes a good Argument of what is done in the *natural* state: yet in this case, considering that the motion of the blood, is the same, and that the Spirits also continue Spirits, in both states; so that the whole difference consists only in this, that in the fluxions alleged, the Spirits are suppos'd to be only deprav'd

deprav'd with *Saline* or *Sulphureous* qualities, not wholly alienated from their nature: considering this, I say, the inference I have made, is not ingenuine. For, to argue from the identity of the effect, to the identity of the cause, or *è converso*, is no Paralogifin. And so I conclude this not impertinent *digression*. ¶

FROM the causes and manner of the continual consumption of substance in Animals, we may opportunely proceed to an inquiry into the *causes* and *manner* of the continual *Restauration* of the same by way of Nutrition.

Of this *Restauration*, the *Efficient* principle (or *ἄρχὴ συντηρῆναι ἢ διατηρῆναι*, (as *Aristotle* calls it) is certainly the very same with the *Generant* or *Formative*: because, as I said before, Generation cannot be effected without Augmentation, and Augmentation is Nutrition. Not that I am of their opinion, who hold that Life and Nutrition differ, not *in re*, but only *in ratione*; for the Human Embryo perhaps is nourish't before the *Empsychofis*: but that I conceive, that *Life* consists in and depends upon a continual generation of the Vital Spirits out of the most subtil, active and volatile parts of the blood; and that *Nutrition* consists in reparation or instauration of what is absumed, by apposition and assimilation of consimilar or congenerous matter. So that according to the distinct notions I have of these Twinn, *Life* is maintain'd by *Dispersion* of the most spirituofe parts of the blood: and *Nutrition* is, on the contrary, affected by *apposition* and *assimilation* of new matter.

The *Material* or constituent Principle, I take to be a certain mild, sweet and balsamic liquor, analogous to the white of an Egg, or at least the *Colliquamentum*, out of which the Chick is formed. For, since all Animals

mals are nourish'd with the same out of which they were at first made up, according to that common Axiom, *isidem nutrimur, ex quibus constamus*; and that of Aristotle, *eadem materia est, ex qua augetur animal, & ex qua constituitur primum*: and since they are all corporated *ex colliquamento*: we may well conclude, that the *Succus nutritius, sive ultimum nutrimentum partium*, is in all qualities semblable to the *Colliquamentum* of the white of an Egg. Farre from the white of truth therefore are they who think, that the parts of the body being in substance divers, the parts of the Aliment also ought to be equally *divers*, as if Nutrition were really nothing but *selection* and *similar attraction* of convenient aliment: and that there were not requir'd in every single part a concoction, assimilation, apposition and transmutation of one matter common to all. For, *first*, 'tis a difficult question, whether there be in nature any such thing as *Attraction*, or not; and to prove *Similar Attraction*, is yet more difficult: so that the very fundament of this opinion is merely precarious: and then 'tis most evident from what we have said of the constitution and augmentation of all parts of an Embryo *ex colliquamento*, that the Aliment common to all parts, is *Similar*, not Heterogeneous: it being the proper work of the *Plastic* power, still remaining in every Animal, as to form all the various parts out of the same *Homogeneous* matter at first, so to augment and repair them all, during life, out of like matter, by transforming that into the substance of every part, which is indeed potentially all parts, but actually none; as out of the same rain-water all sorts of Plants receive their nourishment. Which is no more than what the *Philosopher* long since taught, when opposing the doctrine of *Anaxagoras*,

Principium rerum qui dixit Homæomeriam,

he saith expressly, *Distinctio partium non, ut quidam opinantur, propterea fit, quia simile suapte natura ad simile fertur: nam præter alias multas, quas ratio ista habet, difficultates, accidet, ut quævis pars similis seorsum creetur, verbi gratiâ, ossa per se, & nervi, & carnes, si quis eam causam amplectatur, &c.*

Finally, as to the *Manner* how this Homogeneous matter is by the Plastic power accommodated to the Refection of all the various parts of the body; most probable it is, that this admirable work is gradually done by *distribution, apposition, affixion* or *agglutination*, and *assimilation* or *transmutation*: all which acts must be *successivè* perform'd, before the operation can be complete. For the *Succus nutritius* being prepar'd, first in the Stomach and Gutts, and then in other parts to that end ordain'd, must be distributed, brought home and apponed to all parts that need refection; then from contiguity by apposition, it must be advanced to continuity by affixion or agglutination; and in fine made of the same substance with each part, by assimilation or transmutation, which is the perfection or ultimate term of Nutrition.

Now if we reflect upon what hath been here briefly said concerning the double necessity of Nutrition, and concerning the different wayes by which *Life* is maintain'd, and the *substance* of the solid parts recruited; it will plainly appear, that the *expense* of Aliment taken in by the mouth, at least of the *Chyle* extracted from it, is *double*; *viz.* that *one* part of it is converted into the *Succus nutritius*, for instauration of the solid parts; the *other* (much the greater) is chang'd into *Blond*, which is the subject, and as it were, the fuel of the *Vital Heat*. That we may therefore trace the footsteps of Nature in both these so necessary Operations, and at length discover as much of

her whole processes therein, as our poreblind reason will permit us to discern; let us inquire into the Method used by her in the work of *Chylification* first, and then into that of *Sanguification*. For, these being well and diligently explor'd, we shall with the less difficulty comprehend the whole History of *Nutrition* from the beginning to the end.

Begin we then from *CHYLIFICATION*, *i. e.* the turning of all the convertible parts of our Aliment or food into *Chyle*, the common matter of which both the *Succus nutritius*, and the *Bloud* are, tho' by different ways, confected. But because the Organs by Nature fram'd for, and used in this work, are various; and because, as the Chorography of a Countrey is highly conducive to the clearer understanding of the History of it, so the Knowledge of the fabric of those Organs is necessarily prerequisite to our attaining competent knowledge of their respective Actions and Uses: we are therefore obliged first to survey these *Organs* singly, and to examine the nature and frame of each apart; proceeding from one to another, according to their natural order, not of dignity, but of *position*; and Anatomically administering each, (that I may use the words of *Aristotle*, at least if that Book *de Respiratione* by most of his Interpreters ascrib'd to him, be truly his) *ἢ πρὸς τὴν ὄψιν, ἢ πρὸς ἀνελευσίαν*, both to satisfie the *sight* of the Spectators, and to inform the *Understanding*, if our diligence may extend so farre. ¶

HISTORIA GULÆ.

OF these Organs then, the First to be treated of is the *Pipe* or *Funnel* by which the meat and drink is carried from the mouth down into the Ventricle, to which as an Appendix it is continued.

This part hath obtain'd more than one *Name*, as well among the Antient *Græcs*, as among the *Latines*.

By *Hippocrates* 'tis sometimes call'd ὁ τῆς γαστρὸς στόμαχος, *Ventriculi osculum*, the mouth or inlet of the Ventricle, from the narrowness of it; as in *lib. πρὸς Ἀνατομῆς*; and indeed among the *Græcians* the word στόμαχος was common to every thing that was narrow, oblong, and hollow: sometimes, οἰσοφάγος, *quasi solus comedens*, from its devouring faculty; as in *lib. πρὸς τὸ πρῶτον βιβλίου Ἀρθρωτικῶν* to which *Aristotle* seems to allude (3. *de part. animal. cap. 3.*) where describing the *Oesophagus*, it is (saith he) *via, qua cibus & potus devoratur, ideoque nonnullis fistula cibaria dicitur.*

By the *Latines* also, in imitation of the *Græcs*, 'tis sometimes named *Stomachus*; as by *M. T. Cicero* (*lib. 2. de natura Deorum*) where he saith; *linguam autem, ad radices ejus hærens excipit stomachus, quò primum illabuntur ea, quæ accepta sunt ore, &c.* and by *Cornelius Celsus* (*lib. 4. cap. 1. & 5.*) but more often, *Gula*, most probably ἀπὸ τοῦ γούλις, which signifies a little basket or wicker snapsack, wherein souldiers upon a march used to carry their victuals; and which some wrote with a double *n*; so that our *English* name, *Gullet*, from thence deriv'd, comes nearer by a little to the Original than the *French*, *Goulet*, which is abus'd to express the *La-*

vinx or head of the Wind-pipe. But this Latine word *Gula* is not exempt from ambiguity. For, tho' in its native and genuine sense, it denote the part of an Animal now expos'd to sight; yet sometimes 'tis used to signifie the *fore-part* of the *neck*, as in that vulgar phrase, *gulam frangere*; and sometimes, any inanimate body whatsoever, that is (like the Gullet) narrow, oblong, hollow, and ending in an ample cavity; as *gula maris*, *gula montium*, *gula phiale*; and in all Wind-instruments of Music, the neck or narrow part next to the Mouth-piece, is call'd *gula*. Here some perhaps may think I mispend my time upon such Grammatical niceties. If so, I shall only advertise them, that no less man than *Plato*, recorded this as a maxime worthy the remark of a Wise man, *ὅς τὰ ὀνόματα εἰδὼν, καὶ τὰ πράγματα, ἢ ἐξ ἑαυτοῦ, ἢ ἐκ τῶν ἄλλων, ἢ ἐκ τῶν ἀποδείξεων, ἢ ἐκ τῶν ἀποδείξεων, ἢ ἐκ τῶν ἀποδείξεων, ἢ ἐκ τῶν ἀποδείξεων*, *he that understands the names of things, understands also the things themselves.*

In Cratyl.

This *Gula* is not, as *Aristotle* (*de hist. animal. lib. 1. cap. 2. & lib. 4. cap. 3.*) expressly affirms it to be, Common to all kinds of Animals whatsoever: but to all that *respire*. Nor is it consentaneous, that the *neck* was design'd by nature for the elongation of the Gullet; (1.) Because the *Vertebrae* of the neck are of themselves sufficient to evince, that it is subservient to the various motions of the head; and in Animals of very long necks, it serves also to reach their food; as in Cranes, Storks, Swans, &c. (2.) Because many Animals that have Respiration, have yet no neck, as the Toad and Frogg, among the *Amphibious*; and among *Fishes*, the Porcupice, Dolphin, with most, if not all others of the *Cetaceous* tribe: but on the contrary, it seems rather that the Gullet was made long to correspond with the neck, that so it might reach from the Mouth to the Stomach: as in *Birds*. Wherefore *Fabric. ab Aquapendente's* Climax or Ladder, which he made

made of *Aristotles* timber ; viz. “ Those Animals only
 “ have a Gullet, that have a neck ; those only have a
 “ neck, that have a throat and wind-pipe ; those only
 “ have throat and wind-pipe, that have a voice ; those
 “ only have a voice, that have respiration ; those only
 “ have respiration, that have lungs and breast : will
 not bear the weight he layes upon it, every rong al-
 most being instable. Nor can I assent to his doctrine,
 (*in tract. de Gula*) that all *Crustaceous*, and all *Testace-*
ous Fishes want the Gullet ; because my eyes have as-
 sur’d me, that both *Oysters* and *Lobsters* have it, and a
 lively representation thereof is to be seen in the figures
 inserted into *Dr. Willis* his Book *de anima Brutorum, ad*
finem cap. 3. So that the Gullet seems to have been
 granted by Nature to some other Animals also, be-
 sides those that respire ; for neither *Oysters*, nor *Lob-*
sters have respiration.

But much *Difference* of this *Gullet* is observable in
 living creatures of various kinds : and that in various
 respects. (1.) In respect of *Substance* : which in some,
 is more membranose ; as in most feather’d fowl :
 in others, more fleshy ; as in man, in a horse, ox,
 swine, &c. in others, almost horny, as in *Crabs* and
Lobsters, as also in the *Cormorant*, which feeding al-
 together upon fish, and swallowing them whole even
 while they are yet alive, might otherwise have his
 gullet ras’d or cut by the prickles and scales of some
 of them. (2.) In respect of *Length* : for ’tis in some
 longer, as in the *Giraffa*, *Crane*, *Heron*, *Stork*, *Swan*,
Vulture, *Emeu* or *Cassoware*, *Ostrich*, *Onocrotalus* or
Pellican, or most other Fowl of the greater size : in
 others shorter, as in the *Frogg*, *Crevice*, &c. in all, ac-
 cording to the length of the thorax and neck. (3.) In
 respect of *Magnitude* ; which in some is extremely
 great, in proportion to their bodies ; as in the *Gull*,
 Duck,

Duck, Viper, Pike, and all other Animals that devour their prey whole, and swallow great gobbets without chewing: in others mean, as in Man and all other Animals that divide their food into morsels, and break it into smaller pieces by mastication: in others again extremely little in comparison of their bulk; as in the Whale, whose throat (as *Schonfeld in Ichthyologia* tells us) is so narrow as not to admit any fish bigger than a Whiting. (4.) In respect of *site*. For in Man, and in all terrestrial four-footed beasts, it is carried down from the root of the tongue betwixt the *Aspera. arteria* and the spine; and therefore the *Aspera arteria* is made of cartilagineous circles, not perfect, but ending in a membranose substance, where it bears upon the Gullet, that so it may yield and give way to the dilatation thereof in the act of deglutition: but in most *Birds*, it descends on the right side of the *Aspera arteria*, which not resting upon it, is therefore made of perfectly circular cartilages; a pretty contrivance of Nature, and probably conducing to render the voice of singing birds more shrill and musical. Only in the *Bustard*, the Gullet goes winding, like the streaks in the bore of a screw'd gun, one whole turn about the neck. Other differences there are, but of so small moment, that their notice could hardly compensate your patience to hear, or my labour to recount them. Omitting them therefore, I pass to the description of it.

'Tis (ye see) a body round, long, hollow as a pipe, soft and tensil, and therefore easily distended and contracted again both in wideness and length; so that being open'd by the meat and drink passing through, it naturally closes it self again, and the sides come together. The *upper orifice* of it, when not used, is exactly constring'd by a transverse Muscle; as the mouth of a purse is drawn together by the strings: the *lower*
also

also is in like manner shutt, but by the circular fibres of the upper mouth of the Stomach.

Placed it is immediately behind the *Larynx*: not that by reason of this position, some few drops of the drink may slide down into the Wind-pipe to bedew and moisten the sides thereof; as *Fabric. ab Aquaspendente* dream'd; for if we well contemplate the construction of the *Larynx* it self, we may even from thence be convinced, that nature was solicitous to prevent the falling of any the least drop of liquor down into the *Aspera arteria*, and that if any chance to slip down, it is by accident, and against her intention: but rather that the act of deglutition may be the more exactly perform'd, and to prevent the slipping down of any bit of meat into the bore of the Wind-pipe, to endanger the stopping of it; as will be more fully shewn when we come to consider the reason of *swallowing*.

It descends in a streight line betwixt the *Aspera arteria* and the *Vertebra* or Sphondyls of the neck; then enters the *Thorax*, and arriving at the fourth *Vertebra* thereof, inclines by degrees to the right side, to give way to the ascending trunc of the great *Arterie*: but attaining to the ninth *Vertebra*, returns a little to the left side; where climbing over the same Artery, till it come to the eleventh *Vertebra*, it passeth through the nervous part of the *Diaphragm* or Midriff toward the left side, by a hole clearly distinct from that of the great *Artery*.

The *Similar parts* of which this instrument of Deglutition is compos'd, are *Common*, and *Proper*. Of the *first* sort, are the vessels and outward membrane or coat, wherewith it is vested.

Arteries it receives, in the neck, from the *Carotides*; in the *Thorax*, from the *intercostal*; in the *Abdomen*, from the *Coronary* branch of the Stomach: and

Veins

Veins in like manner, in the neck, from the *jugular* ; in the Thorax, from the *Azygos* or *Non-parielle* ; in the Abdomen, from the *Coronarie* vein of the Stomach. *Nerves* it borrows from the sixth pair or *par vagum*, and chiefly from the anterior branches of it. *Lympho-ducts* it hath none, at least none hitherto have been discover'd in it ; tho' some of our Modern Anatomists have conjectured, that the two Glandules on each side connected to it in the Thorax, spew out a certain humor into it, to keep it alwayes slippery and moist. But this Conjecture hath been sufficiently enervated, first by Dr. *Wharton* (*in cap. de gland. Oesophagæis*) and since by Dr. *Glisson* (*in lib. de Ventric. & intest. cap. 1.*) both adferring stronger reasons to prove, that the liquor falling from the *Tonsills* and *glandule Maxillares* is destin'd to the lubrication and humectation of the Gullet, all along from upper to lower end.

The *Exterior Membrane* that, to strengthen and secure it from cruentation, invests it, as the Skarf-skin do's the true skin ; is deriv'd, by some from the *peritonæum* ; by some, from the *Pleura* ; by others, from the *Ligaments* of the sphondyls of the back ; and by others again from the *Diaphragm* ; and in truth it is united to all these parts, so that 'tis difficult to determine from whence it hath its *principium originationis* ; unless it be lawful to say, that it arises from the first *proper tunica* of the *Oesophagus* it self, as the *Cuticula* comes from, and is sustain'd by the *Cutis*. However, consisting of only membranose fibres, and those too extremely slender ; it seems to be of no other use but only to cover the Gullet on the outside, and so to prevent cruentation.

The *Proper* parts, are only two other Membranes, the *Midale* and *Inmost*.

The *Former* is very thick and fleshy, as if it were an oblong

oblong, round Muscle bored through from end to end; whence *Hoffman* took the hint of his assertion, that it is really a *Muscle*, and liable to Palsy and Convulsions. The *Fibres* of it, according to the accurate description of *Steno*, are *Spiral*, and of two distinct orders, mutually decussating or intersecting each other, so as to make two skrews as it were running contre one to the other: and according to *Dr. Willis's* observation, they seem to constitute two compound Muscles, that make four Parallelogramms with fibres tending contrary wayes, and mutually decussate. And this, he saith, may be plainly perceiv'd by the eye, if this middle tunic of the Gullet, being dextrously separated from the other two, be first tyed at both ends, then blown up, and dipp'd twice or thrice in boyling water, to swell or plump up the fibres: which by that means will become so conspicuous, as that two contrary orders with their tendons may be distinctly discern'd. After, if the same tunic be turn'd the inside outward, and again blown up; two opposite orders of ascending fibres will in like manner shew themselves. Lastly, if the Tunic be cut length-ways in the middle of the tendons, and laid flatt upon a plane, two Parallelogramms will appear in one Superfice, and two other lying contrary to them, in the other. Whence it may be inferr'd, that this Middle-Membrane was thus artificially fram'd by Nature, to adapt the *Oesophagus* to all the various *Motions* requisite to its office or use, *viz.* expansion and constriction of its cavity, distension and contraction *secundum longitudinem*, and each of these either downward or upward, and in various degrees, as occasion requires. Nor is it improbable, that the *Descending* order of double fibres is inservient chiefly to deglutition, by constringing the Gullet from above downward; and the *Ascending*, to ructation, expuition,

and vomition, by constringing the Gullet from below upward.

The *later* or *inmost* Membrane lining the Gullet, hath on its inside a kind of Scarf, thinner than Tiffany, woven of threads or fibres extremely fine ; which veils its whole cavity over as it were with a downy superface : but all the rest of it is *nervose*, furnisht with fibres of different kinds and diversly context. This Membrane is continued to that which lines the palate, throat, mouth and lips : and descending to the stomach, covers the mouth thereof round about within, reaching three inches below it : where it appears very thick and of a close texture, discernable from the inmost Tunic of the Stomach, which there it covers, by the extreme whiteness it acquires by a little parboiling. Now from the nervose substance, and delicate interior superface of this Membrane, 'tis not unreasonable to conjecture, that it serves chiefly to render the Gullet of *exquisite sense*. Whence perhaps it is, that we feel somewhat of complacency and pleasure from grateful meats and drinks, after they have pass'd the mouth and palate, and are entering into the Stomach : and on the contrary, of nauseousness and offense from ingrateful, even while they descend, and before they can come to displease the stomach, so as to cause it to complain to the brain of the irritation. And the deep insertion of this membrane into the stomach, even below the upper orifice thereof, may be (as Dr. *Willis* ingeniously guesses) the reason of the intimate commerce betwixt the *Gula* and *Ventricle*, which is so great and quick, that if either be excited to expell what is offensive, the other instantly sympathizes and cooperates to its relief by vomiting, expuition, or eructation.

Having thus surveyed the whole fabrique of the Gullet, 'tis from thence sufficiently manifest, that the pro-
per

per *Action* to which it was adapted, is *Deglutition* or Swallowing, which is thereby chiefly perform'd. I say chiefly; because in truth the whole process of Swallowing consisteth in a certain series of many actions, by an admirable providence of Nature combin'd in order to one end. For, the Faculty or power of transmitting meat and drink from the mouth into the Stomach, is founded, not only in the *Oesophagus*, but in many parts of the Mouth also; in the *tongue*, *palate*, *uvula* and its little muscles; in the *Larynx* and its muscles, as well those that draw it up, as those that pull it down; in the *Pharynx* and its three muscles; and in the *Sphincter* of the Gullet. Yea more, there is farther requir'd also a concurrence of two Humors, one from the *Glandula Salivales*, t'other from the *Tonsils*, to render the mouth and gullet conveniently moist and slippery. For, we have it from the Oracle of Experience, that when these humors fail, as in Fevers they often do, the swallowing of solids becomes more difficult than the swallowing of liquids: and on the contrary, when they are redundant, as in Catarrhs commonly it happens, solids are more easily swallow'd than liquids; because the muscles inservient to this motion, need not be constringed so closely to gripe and depress solids, as to squeeze down liquids.

Now in this Syndrome or concurse of various Actions requisite to the whole work of Deglutition, some are *Præparatory* or antecedaneous: others, *constituent* or proper. The *Præparatory* are (1.) Direction of the meat and drink toward the *fauces* by the tongue and cheeks; (2.) Compression of the Atmosphere, or (as they vulgarly call it) *Suction*; (3.) Compression of the thing to be swallowed, betwixt the tongue and palate, that it may tend inward; and (4.) A double *closure* in the throat, to hinder the same from slipping

any but the right way. All which have been so fully explain'd by Dr. Fr. Glisson (*de ventric. & intestin. cap. 16.*) that 'tis enough for me only to mention them.

The *Proper* also are four, *viz.* (1.) The ascent or raising of the roots of the tongue, and head of the *Larynx*; (2.) The vigation or tension of the muscles of the *Pharynx*, whereby the orifice of the Gullet is open'd, and at the same time drawn up to meet the matter, to be swallow'd; (3.) The Contraction of the *Sphincter* of the Gullet, to press the matter downward; and (4.) The *Peristaltic* or compressing motion of the same Gullet, to continue the protrusion till the matter be thrust down into the Stomach. Each of which actions, as more pertinent to my present theme, I shall endeavor briefly to explicate.

(1.) The elevation or raising up of the roots of the tongue, together with the head of the *Larynx*, necessarily compresses the *bolus* sticking in the throat, and by that compression forces it into the mouth of the Gullet. For, being so environ'd, as that it cannot slip away either by the funnels above leading to the nostrills, or by the palate, it must be cramm'd into the orifice of the Gullet: there being no other way or door left open, by which it may free it self from compression. Nor doth this compression instantly cease, but is continued till the roots of the tongue, and head of the *Larynx* filling up the whole cavity of the throat, have thence driven all the matter contain'd therein, and thrust it down into the Gullet.

(2.) Whilst this action is perform'd, the Muscles of the *Pharynx* being also vigated, *i. e.* set on work by *tension*, cause its membrane closely to embrace the roots of the tongue and head of the *Larynx* in their ascent; but so, as that the orifice of the Gullet is at the

the same time carried upward, and a little forward, to meet the matter to be swallow'd. No wonder then, if the describ'd compression easily squeez into the Gullet all the matter brought into the throat: when the same is promoted by a *clausure* on each side, from below by the ascent of the tongue and *Larynx*, from above by the tension of the muscles of the *Pharynx*; and at the same time the mouth of the Gullet is offer'd, as a door by which it may slip away, and evade the compression.

(3.) No sooner is the matter in this manner thrust down into the orifice of the Gullet, than the *Sphincter* Muscle thereof constringing it self, so girds the orifice, as that it not only prevents the recoiling or slipping back of the matter into the mouth, but squeezes it somewhat farther down. And then

(4.) The *Peristaltic* or Compressing motion of the *spiral fibres* of the Gullet beginning, and by degrees girding the sides thereof farther and farther downward, soon thrusts the matter into the cavity of the Stomach. And this seems to me to be the most reasonable and plain accompt, that hitherto hath been given, how the whole complex work of *Deglutition* is perform'd *Mechanically*.

A work of so great *Use* to the whole body, that all men know and acknowledge it to be absolutely necessary to the conservation of the whole: Experience teaching even the most illiterate, that when it happens to be *abolish'd*, as in various diseases of the throat, chiefly in inflammations, tumors, and palseys of the muscles of the *Larynx* and *Pharynx* it often is, miserable famine and death inevitably insue. It is not then without good cause, that Nature hath (according to her accustomed bounty in works of publick utility, either to the subsistence of individuals, or to propagation of the species)

cies) to the exercise of the faculty of Deglutition annex'd an ample reward, *viz.* a grateful *Complacency* of the instruments therein used, yea a *pleasure* so inviting, that many Animals are thereby allured to hurt themselves by eating more than they can digest; and above all intemperate *Man*, whose diet is in variety of tastes the most delicious. With which vulgar remark I conclude this short and imperfect history of the *Oesophagus*. ¶

PRÆLECTIO

 PRÆLECTIO II.

 HISTORIA VENTRICULI.

THAT we may not in our surveys divide parts that Nature hath so closely conjoyn'd, let us in the next place convert our contemplation upon the principal Organ of Chylification, wherein, as in a publick Kitchin, nourishment for the whole body is prepar'd, *viz.* the *STOMACH*.

This common *Receptacle* of all our meat and drink, and *Laboratory* in which all the profitable parts of both are, by the inimitable Chymistry of Nature, converted into a certain whitish liquor somewhat resembling barley cream, and call'd *Chyle*; hath been by the Antient Græc Physicians describ'd under three divers names. By *Hippocrates* 'tis sometimes call'd *γαστήρ*, from *γαστήρ* *γαστήρ*, which signifies to *receive* or *contain*, because it receives all the Aliment swallowed down; and wherever in his works we meet with the word *γαστήρ*, without addition to appropriate it to the *Head* or *Thorax*, which by him are also named *γαστήρες*, *bellies*, there we are to understand this part alone: sometimes *κοιλία*, *i. e.* *Cavity*; and sometimes *καρδιά*, *Heart*, from the vicinity of the upper

upper orifice of the Stomach to the Heart, and the symptoms thence arising. But of these Appellations, the two first are *common* to all great cavities or receptacles in the body: and the last, in stricter sense, denotes, not the whole stomach, but only the principal and most sensil part of it, the *Mouth*. Among the *Latines* likewise we find an equal variety of denominations. For *Celsus* (*lib. 1. cap. 2. & lib. 4. cap. 5.*) uses the words, *Venter*, *Ventriculus*, and *Stomachus* indifferently to signify this whole part: and *Cicero* (*de nat. Deor. lib. 2.*) expresses the same by *Ventriculus* and *Stomachus* indiscriminately. But now use hath obtain'd, that the diminutive *Ventriculus* (*quasi minor venter*) without a limitation annex, stand for the proper name of what the Vulgar calls the Stomach. For tho' *Anatomists* name the cavities of the Heart and Brain, also *Ventricles*; yet they never do so without adding, for distinction sake, the name of the part, *viz.* Heart or Brain, of which they speak.

This Ventricle then, being an Organical part, of great dignity, but greater necessity; well deserves our strictest scrutiny. Let us then with diligence and patience consider, (1.) The *Structure* or Organization, (2.) The *Elements* or similar parts, and (3.) The *Actions* and *Uses* of it. For if we can attain to a competent knowledge of all these things, I do not see what can remain to hinder us from coming at length to understand the nature of it fully and perfectly.

Begin we then from the *Site* or *situation* of it: which being not the same in Animals of all kinds, but various; requires to be consider'd, first *in genere*, and then *Speciatim*; to the end that *Comparative* Anatomy may go hand in hand with simple or *Positive*.

In all Animals that have blood, Fowls that feed upon corn only excepted, the *Ventricle* is seated in the
upper

upper part of the *Abdomen*. The superior Orifice of it, in Man, in all four-footed Beasts, and in all Fishes that have lungs, is immediately under the Diaphragm: but in all Fishes that respire not, immediately appendant to the mouth; as well because having neither thorax nor neck, they consequently want the Gullet; as because in them the belly is determinated from the mouth, by a certain membranous partition, not much unlike to, and, as to separation, supplying the defect of the midriff. Whereas in Animals that respire, the Gullet is requisite, because of the interposition of the breast betwixt the mouth and the Ventricle; which could not be commodiously placed above the diaphragm in the *thorax*, for more than one reason: *viz.* (1.) Because it would have straitned and compress'd the Lungs, especially when fill'd and distended with food; (2.) Because the *Thorax* being environ'd with strong bones, could not be distended enough to make room for the expansion of the lungs, and repletion of the Ventricle, both at once; and (3.) Because the steams arising from the meat and drink fermenting in the Ventricle, would much infect the vital parts. Which last incommodity, Nature seems to have prudently prevented, both in *Birds* that have the *ingluvies* or *Cropp* placed, not in the lower belly, but under the neck before, and without the *furcula*; and in *Fishes* also that want respiration: by separating the heart from the ventricle with a certain membranous partition, instead of a diaphragm. Again, the same upper orifice of the ventricle, in Man, and in all Quadrupeds, is placed immediately under the diaphragm, to prevent the farther elongation of the Gullet, which would have been unprofitable at least, if not in many respects incommodious.

Nor is the providence of Nature less admirable in
K placing

placing the *Ingluvies* (in Granivorous Fowls we call it the *Kropp* or *Craw*, and the *Gorge* in Carnivorous) of Birds under the neck, betwixt the horns of the *os jugale*, call'd by us the *Fork* or *merry-thought*: she seeming to have had three inducements thereto. (1.) The Crop having no commerce with any part in the Abdomen, but only with the *Gizzard*: to which it is continued by a peculiar pipe or inferior Gullet, and by which the corn steep'd and softned in the Crop is converted into Chyle; there is no necessity why it should be seated therein. (2.) The Crop serves also to keep the body of the Fowl æquilibrated upon the leggs: whereas if it were in the lowest belly, it would, when full of food, make the hinder part much too weighty for the fore part. (3.) Fowls for the most part, chiefly the Granivorous, feed their young with half-digested chyle, or corn macerated, puking it from the crop into their mouth, as is commonly observ'd in Doves and Rooks; which they could not so commodiously have done, if the crop had not been seated so near the mouth.

And as to the situation of the Ventricle consider'd *in Specie*; it is placed in the highest region of the *Abdomen*, partly in the left *hypochondrium*, partly under the pilt of the stomach, having on the right side, the Liver not only accumbent but incumbent upon it; on the left side, the Spleen adhæring to it; at the bottom, the *Omentum* or Kell or Caul fastned all along; and behind, the *Pancreas* subjacent (from thence named by some, the Pillow or Cushion of the Ventricle) and on the fore part, the *Colon*: and in this position it is establish'd by various connexions: the *superior* orifice is continued to the Gullet, and by the mediation thereof firmly annex'd to the midriffe: the *inferior*, united to the *Duodenum*, and by the mediation of the *Omentum*, connex'd to the Liver, Back, Spleen, *Colon*, and *Pancreas*.

The second thing remarkable in the Structure of the Ventricle, is the *Magnitude* or Capacity of it : which being various, not only in Animals of divers kinds, but in some individuals also of the same species, chiefly in men; requires therefore to be consider'd first *Comparatively*, and then *Positively*.

If we compare the Magnitude of the Ventricle, with that of the whole body of the same Animal; we shall find it in weight not to exceed the hundredth part of it. So that we might well admire, that a part so small should suffice to cook provision for the whole; did we not at the same time remember, that the Gutts help it not a little in that office.

If we compare the Ventricle of *Man*, with those of other Animals; we shall find it to be in him less, in proportion to the whole body, than in them. So that *Aristotles* general rule (*de hist. animal. 2. cap. 17.*) *Animalia majora, majorem; -minora, minorem habent ventriculum*; seems not to exclude all exception: and there is reason for us to believe, that Nature adjusted the capacity of the Ventricle in all sorts of Animals, rather to the nature of their proper food, than to the magnitude of their bodies. For (1.) Where the food is coarse, yielding but little nourishment out of a great mass; there much of it is required to satiate the appetite, and recruit the body; and consequently the greater the capacity of the Ventricle. Hence perhaps it is, that the Horse, the Ass, the Ox, Sheep, Goats, &c. that feed upon herbs, grass, hay, stubble, and other the like lean and poor aliments, from a great quantity of which, but little nourishing juice can be extracted, have great bellies. On the contrary, where the food is *rich*, *i. e.* containing much of nutriment in a little; there is requir'd a less quantity of it to satiate the appetite, and repair the body; and by consequence a less ventricle:

as in *Man*, who living upon delicate meats that nourish much in little quantity, hath but a small ventricle, in comparison of his whole body; and 'tis observ'd, that men of a more delicate diet, such as is used at the tables of Princes and Grandees, have generally less Ventricles, than others that live upon coarse fare. (2.) Animals that eat but seldom, ought to have the Ventricle of large capacity, because they devour much at once, to compensate their long fasting. Which is exemplified in Lions, Tygres, Wolves, &c. beasts of prey, which tho' carnivorous, and consequently of an opime or highly nourishing diet, are yet compell'd many times to undergo the sharp pinches of hunger long, till they meet with food: and then they gorge themselves, as if they intended to barrell up in their panches, flesh for many dayes to come; and are to that end furnished with ample stowage in their bellies. The like may be said also of those Men, who are accustomed to eat but *one meal* a day (whether it be a dinner or a supper) and that a *great* one: for by that surcharge, they so distend their stomach, as of necessity to render it in tract of time thinner, and by consequence weaker, than is requisite to health. And hence in all probability it is also, that great *Drinkers* enlarge the capacity of the Ventricle, by stretching the coats of it; till at length they come to destroy the tone and strength thereof by habitual extenuation, and to verifie *Seneca's* saying of intemperate men, (*epist.* 39.) *qua fecere, patiuntur*, they are their own tormentors.

Finally, if we compare *Human* Ventricles among themselves, we shall find the variety to be great, in respect of difference in age, sex, stature, diet, and above all in habitual temperance or intemperance. Greater is the capacity of the Ventricle commonly in men than in women, in proportion to their bodies; and yet women
are

are not, as *Aristotle* believ'd, greater gluttons than men, but rather less; as having less room in their bellies to receive, and less of heat to concoct food. Greater in men of middle age, and of tall stature, than in old, and of low stature. Greater also in Gluttons and Drunkards, than in the Sober. Difficult it is therefore to determine, what is the *Positive* Magnitude of it in men; especially since we are yet uncertain, whether the Ventricle may by strong inflation or pouring in of liquors, after it hath been taken out of the body of a dead man, be brought to hold more than before while he was alive and in health. But if we may be permitted to take the gage thereof from some experiments to that end made, and from vulgar observation; we may conjecture, that the Ventricle of a man of middle age and stature, nor given to excess, cannot contain above seven pints, of sixteen ounces to the pint: and *Leselius* affirms, that he having cleans'd and dried the Ventricle of a man, together with the whole *Oesophagus*, found the weight of both together not to exceed two ounces and two drachms. Considering this, I have often admired what the grave *Plutarch* delivers concerning the draught of wine drank by *Alexander the Great* in the close of his last supper. For, all Historians that have written the life and gests of this great Troubler of Mankind, describe him to have been of mean stature: and the *Scyphus Hercules* or (as *Seneca in Epist. 83.* calls it) *Herculanens*, (a silver bowl or kind of Grace cup, consecrated to *Hercules*, in memory of his excellent faculty in drinking) is expressly said by *Athenæus (lib. 11. cap. 9.)* and by *Budeus* and other Antiquaries vers'd in the Measures of the antient Græcs, allow'd to contain *duos Congios*, two Gallons, or sixteen Pints. A huge Romer to be drank off in the end of a great Supper, and by a little man too, one at least to whom that

(as *Euripides* calls it) or *Dignitas forma* (as *Cicero* 1. *de Offic.*) that majestic stature so commendable in a Prince, was wanting. Let others believe (if they please) that he died by poison; I, for my part, believe, that draught of wine was poison enough to destroy him, and therefore conclude with *Seneca*; *Alexandrum intemperantia bibendi, & ille Herculeus ac fatalis scyphus condidit.* Nor can I believe *Suetonius*, where among other private debauches of *Tiberius*, he relates, that one of his favorites was advanced by him to an office of eminent trust and dignity, *ob epotam in convivio vini amphoram.* *Amphora enim est octava pars ejus vasis, quod modium vini Galli dicunt; quodque vini tricenos senos sextarios Parisinos capit: sextarius autem octonas eas, quas pintas vocant.*

The third thing considerable in the Structure of the Ventricle, is the *Singularity* of it in some kinds of Animals, and *Plurality* in others. To *Man*, the most perfect Animal, Nature hath granted but *one* Ventricle. True it may be indeed, that she sometimes, tho' very rarely, produces men with more than one; as *Riolan.* writes, that twice he had found a double Ventricle in man; and *Sperlinger*, that he had observ'd the like in a woman of *Wittemberg*; and *Thom. Bartholin.* forbids us to doubt there was a double stomach in a man that chew'd the cudd, describ'd by *Salmuth* and others: but such are to be number'd among *Monsters*, of which there are some few among Animals of whatsoever kind.

She hath likewise granted no more than one to all Four-footed Beasts, that either live upon *flesh*, as the Lion, Panther, Tigre, Wolf, Fox, Dogg, Catt, &c. or have *teeth in both jaws*, as the Horse, Ass, Mule, Elephant, &c. to all *Birds of prey*, as the Eagle, Kite, Hawk, Owl, Raven, &c. and to all *Fishes* of what sort soever. Nor doth it consist with her wisdom to multiply

tipliy organs, where a singular may serve the turn as well: chiefly when it is of greater perfection, that one suffices.

I will not therefore say, she hath been more *bountiful*, where she hath doubled, or quadrupled that donative.

In all *Granivorous Fowls*, she hath fram'd *two Ventricles*; the *Crop* and *Gizzard*; the one, membranous; th' other, fleshy and muscular: and the reason seems to be this. These Fowls wanting teeth in the mouth, and for their sustenance swallowing hard grains of corn whole; 'twas therefore requisite, they should have two Ventricles: one, wherein their hard food, mixt with the water they sip in, might be steep'd or macerated, and softned; another, by which the corn so prepar'd, might be broken, and as it were ground. For, the *Gizzard* may with good reason be compar'd to a mill; the opposite sides of its interior coat, being broad, hard, and rough, and so far resembling the upper and nether mill-stones; and by their motion of mutual friction or rubbing against each other, performing the like office that the mill-stones do. Again, the two contrary Muscles investing that hard and rough coat, set and keep the mill a going; by turns contracting and moving themselves, so that the rough sides of the machine rubbing hard one against the other, break and grind the grains of corn lying betwixt them. And hereof, such Fowls seem to be themselves conscious. For they peck up among the grains of corn, small fragments of stones, pebbles, or flints; which being carried together with the macerated grains, out of the *Craw* into the cavity of the *Gizzard*, are there of great use to the more facil and expedite grinding of them into chyle, serving instead of teeth. Nor do they this by chance, but guided by natural instinct. For before they swallow any such small pebble, they try it in their mouth, whether

ther it be angular or sharp edg'd, or not: and then if they find it to be rough and pointed, they swallow, if smooth and blunt, they reject it, as useles. So that doubtless there is Election in the case. Now those two Ventricles being necessary to the preparation and confection of the Chyle in all *Granivorous Birds*; Nature prudently furnished them with more than one: and two sufficing, she furnished them with no more.

But other kinds of Animals there are, on which she hath conferr'd no less than four Ventricles: *viz.* all that have *no teeth in the upper jaw*, as Bievs, Sheep, Goats, in a word all *Quadrupeds* that bear Horns, and all that bear no horns, and yet *chew the Cudd*, as Camels, Dromedaries, Hinds, Does, and some sorts of Sheep: not so much perhaps, because they have no teeth in the upper jaw (for they want them not, as Dr. *Gliffon* well observes) as because they gather their food by whole mouthfulls at once, and so instantly swallow it; the *incisores* or cutting teeth of the lower jaw, serving them instead of cutting-hooks to shear the grass or hey, and the callose gums of the upper, together with the tongue, serving them, instead of hands, to grasp and hold the same steady the while. So that considering, they at first swallow the food whole, they have no need of teeth above, but require to have four Ventricles for the preparation and concoction of it after. To which may be added another Use or final cause of Ruminacion first assigned by Sr. G. *Ent* (*in Diatrib. p. 24.*) in these words: *In hunc finem [viz. succi nutritii copiosiore[m] ex ore ad cerebrum, quod est ejusdem promptuarium, delationem] animalia Ruminantia cibum è ventriculo per œsophagum reducunt, ut succo ibidem expresso bis fruantur: totamque eorum palatum ex conglomeratis exilibus glandulis intus constructur forisque tunica crassa multis minimis foraminulis pertusa, prominentisque papillaribus loricator.*

Of these four Ventracles, common to all Animals that eat the same food twice over, *i. e.* that *Ruminate*, or chew the Cudd, the first *Aristotle* names *μεγάλην κοιλίαν*, the great cavity; the Latines *Rumen*; and we, the *Cudd* or *grass-bagg*: for in this, as in a Kettle, the collected food is macerated, and parboyl'd as it were, before it is return'd up into the mouth to be chew'd: the *second*, *κεκρύφαλον*, *reticulum*, from the resemblance the interior surface of it bears to a caul of net-work; and our Butchers, *the Paunch*; which (according to Dr. *Glisson's* opinion) is a passage either into the first, before rumination, or into the third, after: the *third*, *Omasum*, *ἐχθρον*, from the wrinkles and roughness of it; and we, the *Tripe*; the office of which is, not only to receive the food, after rumination, but farther to soften it, and pressing out the juice by closing its wrinkles, then to transmitt the same into the Fourth, reteining, by reason of its great asperity, the harder and unprofitable dreggs, to be excluded as excrements: the *Fourth*, *Abomasum*, *ἕνυστρον*, *quasi perficiens*; in English the *Hony-tripe*; because the many and great folds of its inmost membrane, intersecting each other, represent the cells of an Honycomb: This Ventricle receives the half concocted juice from the third, and at length perfects the work of Chylification. But this may withal be noted, that in Calfs, and Fawns, and Lambs, while they suck; the first Ventricle remains much contracted, and the third almost empty; but the fourth bigger than the rest, which seem therefore to lye idle till the young beasts begin to feed upon grass. And the reason perhaps may be this, that Milk being very fine aliment, and so requiring no preparation, or defæcation in the other three Ventracles; is convey'd directly into the fourth; where are alwayes found certain reliques of it, curds, whey, and sometimes

milk not yet coagulate ; none of which can be found in either of the other Ventricles.

The fourth considerable in the Structure of the Ventricle, is the *Figure* or shape of it. Which when the cavity is fill'd, nearly resembles a Bagg-pipe, chiefly if the *Oesophagus* and *Duodenum* be taken in to heighten the similitude : partly *round*, that it may have the greater capacity ; partly *oblong*, that it may be adjusted to the latitude of the back. *Before*, it is equally gibbose, and in corpulent men bears up the higher region of the belly ; a thing by all Eastern Nations much affected, as manly and graceful : *behind*, while it remains in its place in the body, it makes two swellings, one on the right side, t'other on the left, giving way in the middle to the *vertebræ* of the back and the trunks of the great *Arterie* and *vena cava*. The *left side* or end of it is greater than the right ; that on the right hand, it may make room for the greatness of the Liver, and compensate the smallness of the Spleen ; perhaps also that it may be more easily exonerated by the *Pylorus*, than by the Gullet ; because the peristaltic or compressive motion is always stronger in a less and oblong cavity, than in one greater and exquisitely round. The *length* of it runs along from the left side to the right, not in a streight, but crooked line, making a semicircular figure representing a crescent. For, the superior orifice almost touches the Midriff ; but the middle parts recede a little from it : and the *Pylorus* recurs toward it as much, yea more, so as to make an arch ; and therefore in truth, what we call the lower orifice of the Ventricle, is the higher of the two. And the reason of this exaltation of the outlet somewhat above the inlet, seems to be, lest the food, chiefly the liquid part of it, should too soon slide down out of the Ventricle ; which would easily happen, if the *Pylorus* were lower.

But

But not in all sorts of Living creatures is the figure of the Ventricle the same. For in *Quadrupeds* that ruminant, the *μεγάλη κοιλία* or Great Ventricle is rather perfectly *round*; because being of so ample capacity, if it were extended longwaies cross the back, as the Ventricle of Man is, it would trouble the situation, not of the Liver only, but also of the other three. *Round* it is likewise in the *Rana piscatrix*, with many cartilagenous nodes on the outside opening inward; and almost round in the Hound-fish or *Galeus piscis*, nearly representing the great earthen jarrs wherein oyl is kept. But in Animals that have one Ventricle, it is for the most part *oblong*. So also is the *fourth* Ventricle even in those that chew the Cudd: perhaps that by its peristaltic motion, which (as I said afore) is more powerful in an oblong cavity, than in a round, it may the more easily expell either upward or downward what is offensive. In the *Lobster*, the figure of the Ventricle is *triangular*, that the three teeth placed within, on each side one, may be brought to touch, and by contrition grind the food.

In the last place occur to our contemplation, the two *Orifices* of the Ventricle, both situate in the upper region thereof. Of these, that on the *left* side is sometimes call'd simply the *Mouth* of the Ventricle, sometimes by way of excellence, the *Stomach*; by the Antients, *καρδία*, the *Heart*; because the Affects of it cause swoonings and other terrible symptoms like those of the Heart when the pulse or motions of it are perturbed or intercepted: and this, both because of the most exquisite sense of this Orifice, which is furnish'd with various nerves: and because the Heart sympathizes with it, as well by reason of vicinity, the Stomach being but a very little distant from the cone of the Heart; as of community of nerves deriv'd from the sixth pair

or conjugation. Wider it is, and thicker than the other; but like a *Sphincter*, keeps it self alwayes contracted even to a point, unless in the time of swallowing, belching, and vomiting.

The *other* on the *right* side, call'd *Pylorus*, *i. e.* the *janitor*, tho' likewise girt about with circular fibres, is not drawn so close together, nor kept so constantly shut; only during digestion, it is somewhat contracted, so as to keep in all solids, and give way to liquids to slide down into the gutts. Dilated it is sometimes, either in great diseases, the *Lienteria*, *Cholera*, and *iliaca passio*; or in great exigents, after solid and indissoluble things have been casually swallow'd; as is evident from many examples of men, women and children, who having swallow'd gold rings, pieces of money, nutts, bullets, lizards, loches alive, &c. voided them by stool intire: tho' sometimes such things stick in the *Pylorus*, and produce dismal torments, and death; a memorable example whereof is recorded by that excellent Anatomist, *Theodorus Kerckringius* of *Amstredam* (*Spicilegii Anatomici observ. 1.*) in a little Girl of five years of age, who died of a stoppage of the *Pylorus*, caus'd by a Dutch *Stiver* she had swallow'd, which in her Ventricle open'd after her death, was found so firmly to have plugg'd up the *Pylorus*, that nothing could pass out by that door. And this is all the shortness of my time would permit me to speak concerning the things chiefly remarkable in the *Organization* of the Ventricle, *viz.* the *situation*, the *magnitude*, the *number*, the *figure*, and the two *orifices* thereof; as well *in genere*, as *in specie*. ¶

We come in the next place to the visible *Elements* or *SIMILAR* parts whereof this so necessary Organ is compos'd.

Of these constituent parts, some are *Common* also to other

other organs; others *Proper* and peculiar to the Ventricle only. To the *former* classis belong the vessels, whether importing, as *Nerves*, and *Arteries*; or exporting, as *Veins*, both sanguiferous, and chyliferous: to the *later* appertain the three *Tunics*, with their *fibres* and *parenchymata*. All which require to be describ'd and consider'd singly. Which I therefore, encourag'd by your patience and attention, will endeavor to do as briefly as is possible: observing the same order in which I have now mention'd them.

The *Nerves* by which the Ventricle is made participant of sense and the invigorating influence of the brain, are all deriv'd from one original, *viz.* the *sixth* pair, or *par vagum*. For, this pair, of all others the most liberal, distributes to the parts below the Midriff, four principal branches; from the anterior two, of which proceed the two anterior and superior nerves of the Ventricle; the left, from the right branch; the right, from the left: and the posterior branches, call'd by Dr. *Willis* (*in Neurologia*) the *Intercostals*, coasting along the spine of the back on each side, descend to joyn with the *superior plexus* of the *Abdomen*; and there uniting with some furcles of the anterior branches, make a little nervous chord, which connects the *Renes succenturiatos* or *glandulas renales*, and from which, as from a common stalk, almost all other parts contain'd in the *Abdomen* receive their nerves. Among the rest, some furcles shooting forth from this complication, and accompanying the *Cæliac Arterie*, distribute themselves, partly to the bottom of the Ventricle; partly to the left prominency of it, and partly to the spleen. The Ventricle then being thus plentifully furnish'd with nerves, and those too continued to the principal branches that send forth furcles to most other parts in the same great cavity contain'd: it seems not difficult to conjecture,

conjecture, that the remarkable consent and sympathy betwixt those parts and the Ventricle, arises chiefly from that community of nerves; nor to give a probable reason, why vomitings usually accompany the *Colic*, *Hypochondriac* winds, and *Hysterick* fits; the irritation being, by continuity of the nerves, easily propagated from one part to another.

The *Arteries* that continually bring in blood and life to the Ventricle, are reckon'd to be in number five, each served by a *vein*, to export the blood after it hath done its office of heating, cherishing, and enlivening. These Arteries and veins are call'd, *arteria & vena pylorica*; *arteria & vena gastro-epiploica dextra*; *arteria & vena gastrica*, from whence proceeds the coronary branch; *arteria & vena gastro-epiploica sinistra*; and the *vas breve arteriosum & venosum*. All the divarications and branchings of which vessels, discernable in the coats of a human ventricle artificially blown up, are most accurately represented in the first table of Dr. *Willis's* Book intitled *Pharmacentice Rationalis*: whether, for expedition sake, I refer the unsatisfied: meanwhile commending to their notice three observables concerning these numerous vessels.

(1.) That they all tend *inwards*, and in their progress subdivided into innumerable spriggs smaller still and smaller, till they dwindle into Capillaries, are at last terminated in the inmost coat or nervous membrane of the Ventricle; infecting the interior surface thereof with redness, as if it were bloodshot. Which will be conspicuous, if after the Ventricle hath been blown up, and dipt a little in boiling water, it be turned the inside outward, and the downy lining neatly separated: for, then the innumerable terminations of the arteries and veins, will appear to cover the nervous membrane, as with a bloody nett.

(2.) That

(2.) That their capillary furcles are *equally* dispers'd upon all parts of each Tunic , as if their uses were thereby signified to be equal in all parts. This also is apparent to sense ; for, tho' all the three Tunics be white, yet in living dissections, wherever the Ventricle is prickt with the point of a needle, there will be seen blood to wozz forth.

(3.) That the Arteries and Veins respectively official to them, are exactly proportionate among themselves, as well in the amplitude of their trunks, as in the distribution of their branches, and in the portion of the Tunic to which they are distributed : so that the vein correspondent to each artery, is adjusted to export as much blood, as the artery imports. Whereas in most, if not all other parts of the body, the arteries are generally observ'd to be less than the reducing veins : because in those, the motion of the blood is stronger and swifter ; in these, weaker and slower. This proportionate distribution is most clearly discernable in the branches of the *Gastric* vein and artery, which in their Coronary divarications, no less than in their trunks, are exactly correspondent each to other. The reason whereof, according to the judgement of Dr. *Glisson*, who seems first to have remarkt the thing, may be because the arteries and veins have their origins near at hand and together, and the three last have theirs from proportionate vessels, the Splenic artery and vein ; not that they bring in any thing from the Spleen to the Ventricle (as the Antients, ignorant of the Circulation of the blood, erroneously held) but that they are more commodiously derived from thence, than they could be from any other vessel whatever ; the vicine situation of the Spleen consider'd.

The *Vene lactea* of the Ventricle appear to be but few, in comparison of the great multitude issuing from

from the Gutts. Dr. *Gliffon* tells us, that those shew'd to him by Dr. *Wharton* in the Ventricle of a Dogg dissected alive, were not many: adding this description of them. They took their original (*saieth he*) from the bottom of the Ventricle, and not far from thence, supported by the anterior membrane of the *Omentum* or kell, they were carried along to the greater Glandule thereof; and after entrance into it, they crept along the right margin of the *Pancreas*; then sustain'd by the *Mesentery*, they went on directly to the Common Receptacle, and into that discharg'd their milky freight. And this perfectly agrees with what I have more than once observ'd, and can visibly demonstrate in living dissections of Doggs. 'Tis somewhat strange then that the curious Dr. *Willis* should never perceive any of these Chyliferous vessels in the Ventricle; or at least, not so much as mention them in his Anatomic history of that part, wherein he pretends to so much accurateness: but much more strange, that he should in the same book teach, that the sanguiferous veins of the Ventricle take in part of the Chyle out of its cavity, and carry it immediately into the mass of blood; when if he had considered the use of the Glandules of the Mesentery, and the separation of the purer parts of the Chyle from the impure and excrementitious, performed in the Gutts; he might have inferr'd from either of those reasons, that while the Chyle remains, either not perfectly concocted, or not sufficiently defæcated, in the stomach, no part of it ought to be so immaturely commixt with the blood. But this is my opinion, and that was his: and therefore every man is free to approve which he thinks most consentaneous.

As for *Lymphaducts*, if we take them as contradictory to the *Vene lactee*; hitherto I have heard of none discover'd, and therefore believe there are none in the Ventricle;

Ventricle ; the rather because there are some *Vena lactea*, which are congenerous to them ; nor is it Nature's use to multiply kinds of vessels, where one kind is sufficient. True it is indeed, that in the Mesentery, both *vena lactea* and *lympheducts* are found : but this objection hath been fully answer'd by Dr. *Glisson* (in *libr. de ventric. & intest. cap. 3. num. 8.*) saying, they those vessels differ more in respect of the liquors that carry, than of the structure or constitution of their similar parts. For, the *Lympha* is a thin, hungry liquor ; the *Chyle* thicker, succulent, and rich : *this* is brought from parts newly recruited with fresh aliment ; *that*, from parts that want refectiōn : though both are discharg'd into the *Common Receptacle*. Wherefore although *Lympheducts* pass through the Mesentery, yet are they not to be reputed the genuine vessels thereof, but aliens travelling along the nearest way through it. And if they staid to bait at any part well stored with Chyle, 'tis probable the liquor they would suck in, would make them of the same milky colour with the true *vena lactea*. And these are all the *Common Similar parts* of the Ventricle. ¶

The *Proper* are (as I said afore) three *Tunic*s or Membranes, with their *Fibres* and *Parenchymata*.

The three *Tunic*s, although they seem to cohære but slightly, so that being moved by a little impulse of the finger any way, they slip one upon another ; are notwithstanding connected with that pretty artifice, that each hath its *Fibres* implicated with those of the next ; which fibres must be dextrously cut off, before the *Tunic*s can be separated, whether the Ventricle be raw or boyl'd.

That which first offers it self to the view, is the *Exterior Tunic* ; which some will have to be borrowed

of the *Midriff*, and others, from the *peritonæum*: both which opinions will be found light, if put in the balance against the moments of reasons brought to refute them, by the most judicious Dr. *Gliffan* (*de ventric. & intest. cap. 4. num. 2.*) who with more justice affirms it to belong to the Ventricle by right of originati- on, as properly as either of the other two; at least in respect of its peculiar *fibres* and *parenchyma*. Thicker it is, and furnish'd with more nervous fibres, and consequently stronger than any membrane deriv'd from the *Peritonæum*: in substance, texture, and course of fibres, exactly resembling the exterior coat of the Gullet; so that if ye remember our description of that, ye will need no other idea of this. The *uses* of it are many, *viz.* (1.) To invest, and corroborate the Ventricle, and to preserve it from cruentation on the convex side; (2.) To sustain the great multitude of vessels that are divided and subdivided into innumera- ble furcles, as they diffuse themselves betwixt it and second or middle coat; (3.) To conserve the heat of the Ventricle, so requisite to concoction; (4.) To concur to the *peristaltic* motion of the same, which it doth by vertue of its transverse fibres contracting or shortning themselves spontaneously. Here recurs to my memory a certain *Pathological* remark added by Dr. *Willis* to his description of this utmost coat of the Ventricle: "I have observ'd (saith he) in the bodies of
 " many who had long languish'd under loss of appetite;
 " continual nauseousness, and frequent vomitings, disse-
 " cted after death; that sometimes a serose humor, som-
 " times an effusion of bile, sometimes an abscess, upon
 " the outside of the Ventricle, had by irritation of it,
 " been the cause of those dismal symptomes. A singular
 " observation, which I the more willingly recount, because
 " 'thas been my luck once or twice to meet with the like."

The second or *Middle* Tunic is much thicker and more fleshy than the first, laced every where with fibres, and consequently both stronger, and more potent to perform the *Peristaltic* motion, to which chiefly it seems to be adapted. The *position* and *course* of these *fibres* are various in the various parts and sides of it. On the *Concave* or inside, strong fleshy fibres run down obliquely from the left hand toward the right, till they arrive at the bottom: so that when they contract themselves, they must of necessity pull the bottom of the Ventricle obliquely upward toward the left orifice; and therefore conduce to vomiting and other expulsive motions by the same. On the *top* or ridge of the same convex side, are many fibres of a distinct order, which hemming in the left orifice of the Ventricle, tend to the right, and rising a little therewith, cover it, and then terminate therein. So that they seem, by their action, which is contraction, to bring the right orifice nearer to the left, which is alwayes done in vomiting: which motion being continued somtimes even to the bottom of the *Duodenum*, both the *Bile* or *Gall*, and *Pancreatic* humor are pumpt up into the stomach, and thence ejected by vomit. On the *Convex* or outside, are likewise fibres of two sorts, tho' both *circular*. For some incircling the mouth of the stomach, where the *Oesophagus* ends, gird it about, and so close it: and others, incomparably more in number, incompass the whole Ventricle, tending from the upper parts, to the bottom, in parallel lines, and thence ascending again from the bottom to the top, like so many *Zones* or *girths*: so that when they are put into action, they must needs bring the bottom of the whole Ventricle nearer to the top, and the sides also nearer together, and so lessen the cavity thereof; so that whatever is at that time contain'd therein, being rais'd upward and pressed on

every side, can hardly evade being expelled by one of the two orifices, or by both; as it often happens from violent irritations of the stomach, and always in the *Cholera*.

Now from these various orders of strong fleshy Fibres wherewith this Middle coat is garded, we may easily collect, that it was so fram'd by Nature, to be the principal instrument of the *Peristaltic* motion of the stomach, as well as to corroborate and defend it.

The third or *Inmost* Membrane, is remotely different from either of the other two. For, in *substance* 'tis, though not wholly *nervose* (as most Anatomists have affirm'd) yet much less *fibrose*, and less *tenacious* or tough, and consequently less *extensible*. Which seems to be the reason, why Nature has made it so much *larger* than either of the two coats that invest it, that when by their compressive motion or contraction, the cavity of the Ventricle is minorated, this falls into many *wrinkles* or plaits, and so remains till the Ventricle be again distended by repletion, and then all the wrinkles disappear: the largeness compensating the want of tenacity, and the wrinkles making it capable of equal extension with its fellows, without danger of rupture. Moreover, the *inner surface* of it is *spongy* or porose, and unequal; as being cover'd with a downy veil consisting of threads extremely fine, and perpendicularly inserted into the coat, resembling the right side of velvet or plush. A singular artifice of Nature, and such wherein she seems to have had more than a single aim. For (1.) This plushy lining serves to *defend* the coat from the injuries of solid and hard meats, which otherwise might, by their immediate contact, offend and irritate it. (2.) It conduces somewhat to the firmer *detention* of the meat, and not yet perfectly concocted Chyle; which otherwise, if the
superfice.

superfice of this coat were smooth and polite, would easily slip down too soon. (3.) It helps to *cover* the extremities of the innumerable arteries and veins terminate in this coat, and so prevents the *cruentation* of it. (4.) It makes way for the *exsudation* of humors brought thither with the blood, by the arteries. For, in Man and all Carnivorous Animals, the Ventricle is alwayes found to be smear'd all over within, with a certain slimy or *pituitose humor*, which sticks so fast to the inner or plushy surface of this Coat, as if it were a kind of vegetable growing out of the pores of it. Which *Mucus* or *Phlegm*, tho' an *Excrement* in respect of the whole mass of blood, from which it was by secretion separated; is nevertheless of great use to the Ventricle into which it is excern'd; and that in three considerable respects. (1.) By lining the concave side of this inmost membrane with its mucilaginous substance, it serves to secure it the more from Cruentation. For though the stomach of a dead man, when invers'd, doth not appear bloody, even after this *Mucus* hath been wiped or scrap'd off; perhaps because the motion of the blood is then ceas'd, and the cold of death hath shut up the pores by which it might wooz out: yet in the living, this *Mucus* cannot be wholly purged away, but cruentation will soon insue; as is seen in the *Dysenterie*, and *superpurgations* by violent and corrosive Medicaments, in which cases bloody stools happen, and yet without the rupture of any vessel, or ulceration of either Ventricle or Gutts. (2.) The same *Mucus* conduceth to render the inside of this coat more *slippery*, so that it may more easily expell any offensive matter, upward or downward, as occasion requires. (3.) By growing *acid* or sovre, it serves, both to excite hunger, and to facilitate the dissolution and fermentation of the meat and drink in the stomach.

Of

Of this *Mucus* much more might here be said, did I not foresee that I shall be obliged to resume it, when I come to inquire into the actions and uses of the Stomach. Meanwhile I must not omit to observe, that the *Convex* side of this Plushy lining of the inmost Membrane thereof, is set thick with small Glandules: which Dr. *Willis* conjectured to be there placed, both to cover the mouths of the arteries and veins there terminated, and to receive and separate some humor, by way of percolation; nor do I dislike that conjecture.

We are now arrived at the two last of the proper constituent parts of the Ventricle, the *Fibres* and *Parenchymata*; which will fully compensate our patience, if we fix our thoughts awhile upon the consideration of them.

The various significations, and more various Etymologies of the Latine word, *Fibra* (about which there has been no little hacking and flashing among Grammarians) I willingly pass by; and with *Salmasius* deriving it from the *Æolic* $\phi\iota\lambda\epsilon\sigma\delta\nu$ *pro*- $\delta\iota\epsilon\sigma\delta\nu$, which according to the interpretation of *Hesychius*, denotes a *soft* and *slender* thread; take it, according to the use of Anatomists, to express a certain similar part, nearly approaching to the nature of a nerve, and continued to one, but much more slender: so that I am apt to believe it to be a single filament elonged from some nerve, after its division into many threads, each as fine as that spun by the Silk-worm, if not finer. The best description of it, that I have hitherto read, hath been given us by Dr. *Glisson* (*de ventric. & intestinis* cap. 4.) which I will therefore recite, as worthy to be known by those who have not perused that most elaborate Book, and to be revived in the memory of those who have.

A Fibre is (saith he) a body in figure like a thread, slender,

Slender, tenacious, tensil and irritable, made of a spermatic matter, and destined to some motion and strength.

(1.) *In figure like a thread, i. e. oblong, round and smooth;* (2.) *Slender, as a Spiders thread;* (3.) *Tenacious, i. e. tough, or whose parts firmly cohæring, are not easily broken;* (4.) *Tensil, i. e. capable of being extended in length, the latitude the while diminish'd, and of being thickned in bredth, the longitude the while abbreviated;* (5.) *Irritable, i. e. such as may be by irritation excited to contract it self, and is naturally apt to relax it self again, when the irritation cealeth;* (6.) *Made of a Spermatic matter, i. e. if it be a naked or simple fibre such as those of all the Muscles;* but if stuff with any parenchyma, perhaps then not made of only a spermatic matter, and such are all the fibres of the Ventricle and Gutts; (7.) *Designed for motion and strength;* because being of a tough consistence, it cannot but add to the strength of a part; and being capable of extension and contraction, it must therefore be destined to motion.

This description, though true and plain, seems yet somewhat too narrow to comprehend the whole nature of Fibres generally consider'd. Let us therefore enlarge it by subnecting a few lines more, concerning the constitution, uses, action and passion of them.

(1.) The *Constitution* of a Fibre is either *instita* or *influens*, native or adventitious. The *Native* is again Similar, or Organical. The *Similar* consisteth in a matter firly disposed, in a just temper, corpulency, cohærence of parts, tensibility, flexibility, continuity, hardness and softness. The *Matter* is wholly *Spermatic*, although sometimes it be stuff'd with a bloody pulp, as is observ'd in the fibres within the Ventricles of the heart. Wherefore the native *temperament* of all fibres is cold and moist indeed, but enrich'd with delicate and noble

noble spirits, however fixt: and consequently they require to be nourish'd with a spermatic aliment. The *Corpulency* or fleshiness of fibres is variable, sometimes greater, as in strong and laborious men; sometimes less, as in weak, lean and sedentary. The *Cohereance* of parts ought to be firm and tough, that they may be extended without danger of divulsion or rupture, and return to their natural posture, by spontaneous contraction, after extension. Their *Flexibility* depends, partly upon their tenacity, partly upon their middle constitution betwixt hardness and softness; that they may be neither rigid or stiff, nor flabby.

The *Organical* native constitution of fibres, consisteth in their due situation, figure, magnitude and continuity; all which are included in their former description.

The *influent* constitution of them, is either *Vital*, or *Animal*. If the *vital* influx be deficient, the force and strength of the fibres soon languishes, as in swoonings and faintings. Yea, if it be but depraved, as in fevers, their vigour in a few hours decays. If the *Animal* influx be intercepted, as in the palsy; they quickly become languid and stupid: yea, if the brain and nerves grow dull and sluggish, the fibres at the same time grow flaccid and loose, unapt for vigorous motion.

(2.) The general *Uses* of all fibres are to corroborate the parts to which they belong, and to move them. The special uses are various, respective to their various formation in divers parts: as (for instance) in the Stomach and Gutts, they serve chiefly to their *Peristaltic* motion.

(3.) The *Action* of Fibres is either Common, or Proper. *Common*, when being invigorated, *i. e.* set on work by extension, which is against their nature, they pull and move the part to which they are connex'd;

as a chord pull'd by a mans hand, pulls a plummet or any other body fastned to it : but this seems to me to be, in strictness of truth, rather *Passion*, than action, in respect of the fibres themselves ; for, they suffer extension, being, notwithstanding their natural renitency, stretcht in length, by the pulling of the nerves from which they are elonged. Wherefore (according to my weak judgment) their *Proper* action is only *Self-contraction*, by which they restore themselves to their natural posture. A motion common indeed to all *Tensil* bodies whatever ; and therefore rightly term'd by Philosophers, motion of *Restitution* ; the cause whereof I take to be the strong cohærence of the parts of which they are compos'd. If so, what need we amuse our selves by striving to deduce the spontaneous Contraction of nerves and fibres, either from *natural Instinct*, which implying I know not what secret suggestion, *pro re nata*, from some forein cause, whether God, or His servant Nature, is to me unintelligible : or (what is equally abstruse) from *Natural Perception*, which supposes even inanimate things, yea every the least particle of matter in the whole Universe, to be naturally endowed with knowledge of what is good or evil to their nature, with appetites to embrace the good, and eschew the evil ; and with power to move themselves accordingly : faculties that my Philosophy will not grant to any but rational creatures ?

(4.) The *Passion* therefore of a Fibre, is the extension of it, which is a passive motion coming from a cause without the essence of the fibre it self. Which cause, unless it actually relax or stupefie the fibres, incites or irritates them to contract themselves : and the more violent the irritation, the stronger is the renitency and spontaneous contraction ; as is observ'd in convulsions. To me it seems impossible, that a simple fibre should

by its own action alone extend it self in length: nor have I wit enough to conceive how this can be done: since all extension is a less or greater degree of force tending to the tearing asunder of the parts of the ten- sible body, against which divelling force the firm co- hærence of the parts makes it strive. And as for the *Cessation* of fibres; that is when they neither act, nor suffer, but rest from all either extension or contraction, having restor'd themselves to their natural posture of laxity. This they attain to chiefly in sleep, when all fibres of the whole body, (those that serve to respira- tion and the motions of the heart, only excepted) are at rest, and thereby refresh'd, acquiring after-labour and weariness, new strength and vigor, from the sweet, mild and balsamic juice dispensed to them from the brain by the nerves.

After this concise survey of the fibres in the mem- branes of the Ventricle, there remains only their pecu- liar *Parenchyma* to challenge our observation: which it may with the greater right pretend to, because there are many who question whether it be real, or imagina- ry; because the whole Ventricle being of a white color, seems therefore to be made up only of fibres and mem- branes. It concerns us then to be certified (1.) Of the real existence, (2.) Of the necessity, (3.) Of the quali- ty, and (4.) Of the various uses of what we call the *Parenchyma* of the Ventricle, as a distinct part thereof.

(1.) To be assured even by our own eyes, that there is really such a thing; we need only to essay the excarnation of the stomach, by laying it extended upon a plain bord, and then scraping it moderately hard with a blunt knife; in the same manner as Sheep skins are scrap'd by those who make Velom and Parchment; or guts by those who make Sawciges. For, by this easie means, you may scrape off so great a quantity of
soft

soft white pulp, as will by nineteen parts of twenty exceed all that you leave behind of membranes and fibres, which will yet remain as strong and tenacious as they were before. Against which experiment, I see not what can be objected. For if the firm cohærence of the fibres of the Stomach be not only not abolish'd, but not at all diminish'd, by this scraping away of the pulp that stuff them; it follows, that the pure fibres, in which alone the strength of the stomach consists, still remain intire, and that nothing but the *Parenchyma* or pulp hath been taken away. From the same experiment it appears also, that the membrane and pure fibres of the Ventricle are in themselves pellucid or transparent; as we see in the skins of Sawciges: and that they owe all their opacity to their stuffing with this *Parenchyma*.

(2.) Which is *necessary* to the constitution of the Stomach, in more than one respect. *Necessary* it seems to fill up and make smooth and plain the inequalities arising from the contexture of the fibres, which running various courses, and riding each over other sometimes, would otherwise render the surfaces of the membranes uneven. *Necessary* it is also to stop the pores of the Stomach, that it may hold liquors the better, and be staunch even to vapors and wind: as linnen cloth is made to hold water by dipping it into melted wax, oyle and turpentine, which fill up the void spaces betwixt the threads, in the same manner as this mucilaginous pulp fills up the interstices betwixt the fibres, and so makes the membranes impervious. *Necessary* it is to the augmentation and extenuation of the fibres themselves. For, the fibres of the Stomach, although seldom or never liable to fatness, are yet easily capable of plumpness and leanness. In men sick of a Consumption, they are alwayes extenuated: in fat men, alwayes plump

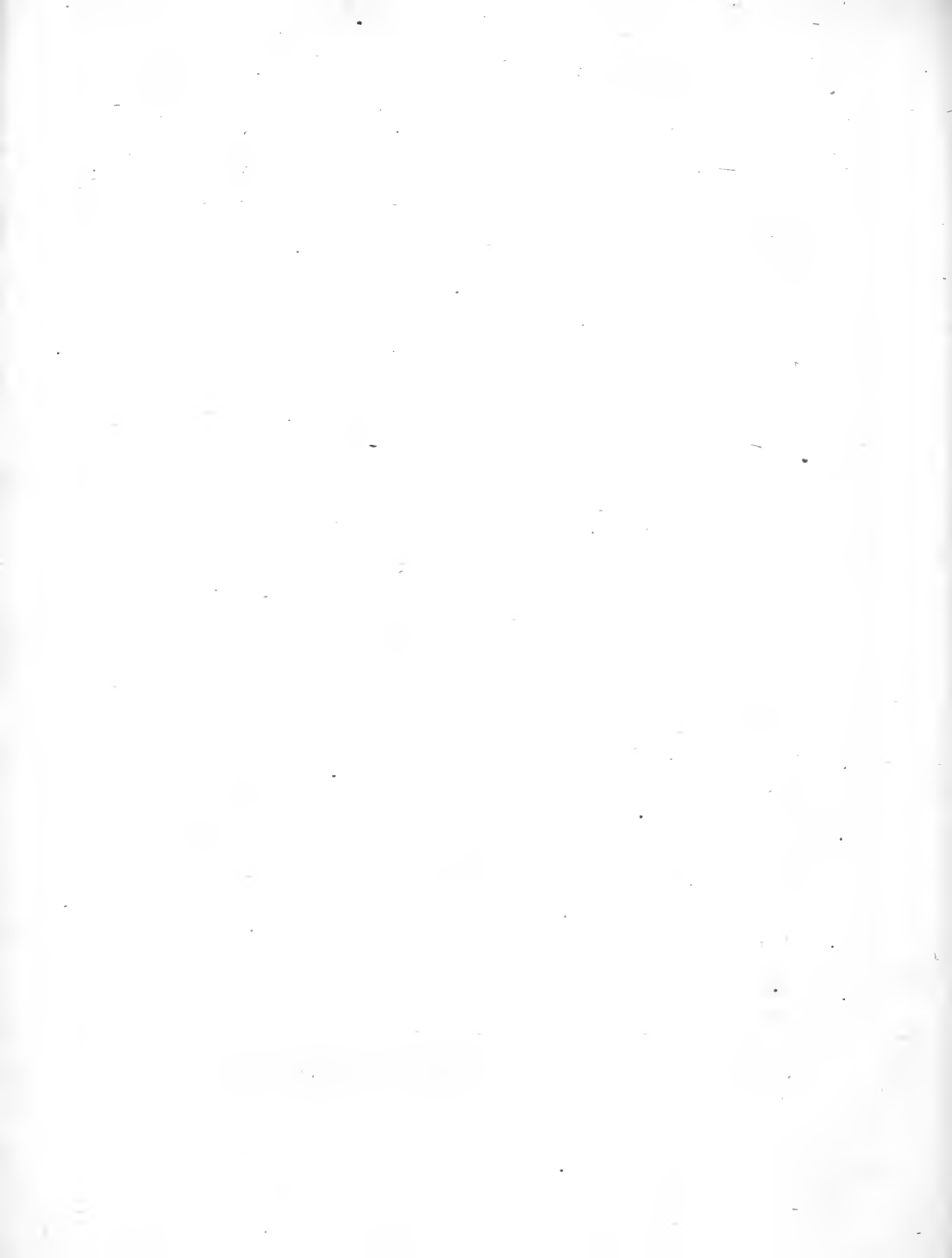
and thick. But these mutations could not so easily happen, if the fibres were not stuff'd with some pulp: for all *Parenchymata* are easily melted away by degrees, but fibres not without great difficulty; nor do I know any thing more apt to colliquate their substance, and destroy their tone, than Brandy and other corroding Spirits, how highly soever extoll'd by Chymists that distill them. We may see in men languishing of Hectic fevers, and ulcers of the lungs, the Tendons of the muscles remaining intire, when the pulp of them is in the mean time almost wholly consumed. Whence 'tis evident, that the fibres, which are more easily obnoxious to augmentation and diminution than other solid parts, have much of a pulpy substance in their composition.

(3.) This *pulp*, if softned and diluted with water, is like a mucilage or gelly; otherwise, tenacious, tensible, and strong, like paste: so as to be impervious to winds and liquors, though apt perhaps to imbibe the thinner and spirituose part of the Chyle. Different from the Parenchyma of the bowels; and from that of the Muscles also: as being neither bloody, but white and spermatic; nor congested into a mass, but spread abroad, like plaister, so as to bear extension and contraction together with the fibres; part of it being stuff'd or cramm'd into the fibres, the rest dawbed upon and betwixt them, so as to fill up and plane their interstices.

(4.) Besides which two *Uses*, it seems to serve also to three others: *viz.* to the safe conduct of the *Vena Lactea* proceeding from the Stomach, which probably have their roots in the *parenchyma* of the inmost tunic thereof, where the small Glandules observ'd by *Steno* and *Malpighius*, are seated: to the separation of the *mucus* or *pituita emortua* from the blood brought by the arteries into the coats of the Ventricle; of which we shall more opportunely inquire, when we come to the

uses of the Stomach : and lastly to make way for a larger current of blood to pass through the membranes of the Stomach, than otherwise they and their pure fibres could through their substance transmitt. For, Fibres, by how much more firm and tenacious they are than the Parenchyma is, by so much more they resist the transition of the blood : and therefore if here were no *Parenchyma*, certainly the Ventricle would be irrigated with more slender streams of blood, and consequently colder than it ought to be. Whereas now no less than five conspicuous arteries discharge themselves into its coats. Certain therefore it is, that a more liberal afflux of blood is requir'd to the constitution of the stomach, than seems possible to be transmitted through the naked membrane and fibres without this pulp.

Having now at length finish'd (I wish I might say, perfected) my survey of all visible Elements, or constituent parts of the Ventricle; I should proceed to the functions, actions and uses of it. But remembering that an empty Stomach hath no ears, and considering that it would be double wrong to you, should I. at once starve both your bodies and your curiosity: I choose rather here to break off the thread of my discourse, than to weaken that of your life, by detaining you longer from necessary refection. ¶



 PRÆLECTIO III.

 Of the ACTIONS and USES
of the VENTRICLE.

AFTER dinner sit a while ; is an old and good precept to conserve health. Let us then (if ye please) now observe it. And that we may repose without idleness, let us calmly inquire into the method, causes, and manner of *Digestion* : resuming the clew of our discourse where hunger and thirst brake it off, when it had brought us to that place, where we might most opportunely consider the *ACTIONS* and *USES* of the Ventricle, whose admirable *Structure* and various *Parts* we had so particularly contemplated, in order to our more accurate investigation of them.

In this disquisition, Nature her self hath plainly mark'd out the steps wherein we are to tread ; having assign'd to the Ventricle eight distinct operations or actions to be perform'd in order successively. These *Actions* are (1.) *Hunger*, (2.) *Thirst*, (3.) The *Peristaltic motion*, (4.) *Reception*, (5.) *Retention*, (6.) *Con-*
coction.

coction, (7.) *Secretion*, (8.) *Expulsion*: each of which hath a peculiar *Faculty* respondent to it ; for every action *in specie* distinct, necessarily implies a distinct power. But because each distinct faculty, and the action respondent to it, are, though in reason different, yet in reality one and the same thing: I shall not treat of them separately, but describe them together under the more familiar name of *action*; the rather because if we can be so lucky to find out the true reason of any one operation here specified, we need search no farther to know the nature of the faculty to which it belongs; all *mechanical operations* conducting our understanding to the knowledge of the proper *powers* by which they are perform'd. Following then the order of Nature in examining these Actions, I begin from the first, *viz.* HUNGER.

I.
HUNGER.

Among the many differences betwixt *Plants* and *Animals*, this is not the least remarkable; that *Plants* are fixt by their roots which serve them also instead of mouth and stomach, in the earth, so that they remove not from their places in quest of nourishment: *Unde facundiss. noster Entius* (in *Antidiatribæ* pag. 5.) *Plantæ*, inquit, *non sunt quidem gressiles, sed humo affixa, secum continuè habitant: quòd pluviam solum ac rore (tenuissimo scilicet victu) pascantur. Ideoque cum ad rivulos potatum ire nequeant, expansis veluti brachiis, facundos imbres à Jove pluvio implorant*: But *Animals* having their Stomach within their bodies, and sucking no juice immediately from the earth, are therefore forced to change their stations, and range from place to place to find food convenient for their sustenance. And because the capacity of their Ventracles and Gutts, is not so great, as at once to contain a quantity of food sufficient to maintain life for many dayes together; necessary

necessary it is, they should often be recruited by eating fresh aliment. To obtain which, they must seek it: and to oblige them to seek it, they must be excited and urged by something within them to that quest: and to that excitation is requir'd an internal goad as it were, and that a sharp one too and irresistibile, the inevitable necessity of their nutrition consider'd: otherwise they would neglect to supply themselves in due time with new sustenance, and consequently soon pine away, and perish. Now the goad that compells them to feed, is *Hunger* and *Thirst*; the one urges them to seek *meat*, the other, *drink*: both by *Aristotle* express'd by the name of *Appetite*; by *Galen* call'd *Sense*; and by *Dr. Glisson* (who from the singular goodness of his nature, took pleasure to reconcile the different opinions of the Antients) more truly defin'd to be, *Appetite* of meat and drink, conjoyn'd with *Sense* of the want of them. For, impossible it is, an Appetite Sensitive should be excited to desire, unless there be represented to it an object to be desired. If therefore, according to *Aristotle*, hunger and thirst involve the Appetite of meat and drink, it præsupposes a sense of the absence of them. And granting a sense of them as things desirable, there is necessarily excited an Appetite of them. For, sense of want is of its own nature querulous and craving: and by how much more important to the conservation of life the thing wanted is, by so much the more urgently doth it stimulate the Appetite to crave it. Whence it follows of necessity, that hunger and thirst are both *Appetite* and *Sense*; *quod erat probandum*.

To dispell all umbrage of doubt that may arise from ambiguity of words, to eclipse this verity; it concerns me to put ye in mind, that *hunger* and *thirst* are each of them taken in a *double* signification; sometimes for the *object* of which the stomach is sensible, sometimes

for the *affect* of the stomach by which its appetite is excited. In the *former* acception, by hunger or thirst is meant only the *want* of meat or drink in the stomach: in the *later*, a *sense* of that want, together with an *appetite* of one of the two. Now according to the *former* of these two notions, the truth is, neither hunger nor thirst can be either *sense* or *appetite*; but the *objective cause* of both: but according to the *later*, each of them is both *sense* and *appetite*. And that this *later* is the most proper and commonly receiv'd notion, is evident even from hence, that frequently there is want of meat in the stomach, when there is no *sense* of that want, and then it is not call'd hunger: as in fevers, and after profuse vomiting. The same is confirm'd by that disease call'd *Appetitus caninus*, a Dogg-like appetite, in which tho' the Stomach be even furcharged with abundance of meat, yet still it craves more, and sends up to the imagination a sad complaint, that it feels hunger, and desires a farther supply of meat. We may therefore from both these opposite instances conclude, that *Hunger* doth properly signify *sense* of *want* of meat; and *Thirst*, *sense* of *want* of drink: and consequently that one includes *Appetite* of meat; the other, *Appetite* of drink, to supply that want.

But what kind of *Sense* is this by which the Stomach perceives the want of food? Is it referrible to any of the five external senses? Or do hunger and thirst constitute peculiar sorts of senses proper only to the stomach?

I answer, that the senses of hunger and thirst seem to have great cognation with the sense of Touching; as also with those of tasting and smelling; and yet notwithstanding are, not only gradually, but *specifically discrepant* from every one of them. For, Faculties are *in specie* different among themselves, if they necessarily require

require absolute Constitutions *in specie* different, in which they may be founded. For a sensitive Faculty is really nothing else, but an *aptitude* of the *sensorium* to perceive: and this aptitude is of necessity diversified, if the absolute constitution, in which it is rooted, be divers. Now that the senses of Hunger and Thirst necessarily require an organ or *sensorium* in a peculiar manner framed, that they may therein be founded; is sufficiently manifest even from this, that no part of the whole body, but the Stomach only, is sensible of the want of meat or drink. In the last degree of a Consumption, call'd *Marasmus*, in which all parts of the body are extremely emaciated, and in want of nourishment; there is no part, but only the Stomach, touched with sense of hunger: and in a fever likewise, though almost all parts be parch'd and dried by heat, yet none feel thirst, but that to which the faculty of thirsting peculiarly belongs, which is the Stomach. Certain it is then, that to the founding of these peculiar Faculties, a peculiar constitution, whether similar, or organical, and such as is diverse from that in which the faculty of Touching is founded, is of necessity required: seeing that the sense of Touching is exquisite in many parts of the body, in which notwithstanding neither hunger nor thirst is ever felt. Wherefore the sense of Touching is of a different kind from those of hunger and thirst.

Besides, the *pain* of the Touching is specifically different from the pain of hunger and thirst: as every man may observe in himself, if he compare the one with the other, either at divers times, or together, in the same organs: if he estimate them at divers times, he shall easily distinguish the gnawing trouble of extreme hunger, from exquisite pain of his stomach: yea it frequently happens, that vehement pain of the stomach

mach prevents hunger, or extinguishes it; and on the contrary, that hunger is then sharpest, when the stomach is free from pain. If he compare them when they are *coincident*, he shall even then perceive a manifest difference betwixt the pain of the stomach, and the craving sense of hunger. Nor is it indeed possible that these sensations should be not specifically discrepant each from the other; because two Accidents of the same species cannot at the same time inhere in the same subject: because one will necessarily drown the other.

As for the senses of Smelling and Tasting; true it is indeed, that they have somewhat more of affinity to hunger and thirst, than that of Touching hath; for they both judge of the qualities of the meat and drink, before they are admitted into the stomach; and hunger hath so powerful an influence upon them, that the taste and smell of the very same viands that are most grateful to an empty stomach, become loathsome to a full one: and yet notwithstanding this affinity, they are senses specifically different from both hunger and thirst, as is most evident even from hence, that they are founded by Nature in organs of peculiar constitutions, and accommodate to the perception of their proper objects. Constant therefore it is, that hunger and thirst are querulous senses, and specifically discrepant from all other senses, and peculiar to the Ventricle. Which is the proposition here examined.

I add, that they are *essentially different also one from the other*, though seated in one and the same organ. But this position being much more nice and intricate than the former, requires us to consider them apart, that we may the more distinctly investigate the peculiar nature and proper essence of each. Begin we then
from

from HUNGER; inquiring (1.) What is the Object of it, and (2.) What the Constitutions of the Ventricle, wherein it is rooted.

The OBJECT of Hunger is either *absent*, or *present*: the *former* of which is, not only specifically different from, but in some sort opposite to the *later*. For, the *present* object is displeasing and troublesome to the stomach: the *absent*, grateful, and when present, satisfactory.

(1.) The *Absent* object proper to hunger, I conceive (with our most excellent Dr. Glisson.) to be that *nutritive Succulencie* or juiciness, which all wholesome meats contain in them more or less, and which being alterable, is apt to be changed into Chyle; *viz.* a certain substance or matter, mild, tender, easily mutable, abounding in sweet and fixt spirits, not destitute of fatness, temper'd with a due portion of earth, and conditied with some salt of its own. These are the qualities of that matter which I call *succulent* and *nutritive*, and which I hold to be the proper absent object of the faculty of feeling hunger. For, all aliments contain in them copious *spirits*, and those for the most part *fixt*; which the stomach, by inducing fermentation upon them, excites, and brings to a certain moderate *fluor*, that they may more commodiously be thence transmitted into the milky veins, and become nourishment, partly to the blood and vital spirits; partly to the spermatic and solid parts of the body. They all contain also some *fat*, more or less, in them; which fat, as the Oracle of experience teacheth, is highly profitable to appease the importunity of hunger, and desirable for nourishment. In fine, they all contain also somewhat of *salt* and somewhat of an *earthy* substance; and without the alloy of these two ingredients, neither could the spirits conserve their fixation, nor the fat
its

its sweetness. Now this nutritive Succulency, the proper object of hunger, is said to be *absent*, not that it is perpetually so, or that it is not perceiv'd when it is present; but only because in the principal action of the Faculty, namely *hunger*, from which the whole is denominated, it is *really absent*. Besides, the utility of things is better understood by the want, than by the full fruition of them: nor should we take notice, that the stomach perceives the meat contain'd in it, and is therewith appeas'd and satiated; unless we were sometimes urged and molested by hunger upon the want of meat. However, most certain it is, that this *Object*, when *present*, is alwayes perceiv'd by the stomach with complacency and delight: and when *absent*, is much more esteem'd: and therefore the object, in hunger, is justly call'd *absent*; and the whole Faculty as justly defined, *Sense* of hunger, and *Appetite* of meat.

(2.) The *Present* object, is that offensive and gnawing kind of pain that molesteth the Stomach, whensoever it wants and craves meat. The formal *Reason* of this ingrateful sensation, seems not to consist (as our Master *Galen*, and the whole Schole of Physicians ever since his dayes have taught) in a certain *Suction*; for neither can any of the constituent parts of the Ventricle cause any such motion in it, nor can the Ventricle suck it self, because no natural Agent can do an action displeasing to it self: but to arise merely from *Acid* humors contain'd in the cavity of the stomach; which by *striction*, *asperity*, *rosion*, and *fretting* of the inmost membrane of the Stomach (as if they endeavor'd to draw forth a tincture from it) cause it to feel a kind of *Vellication* or gnawing, and to complain to the imagination of the want of that mild, sweet and nutritive Succulency, that is requisite to mitigate and extinguish that offensive Vellication, and to induce complacency

in the room of it. And these Acid humors in this manner causing a sense of Vellication in the Ventricle, seem to be, partly the *reliques of meat* still remaining in the cavity thereof, partly the *sourre Phlegm* brought with the arterial blood into the inmost tunic of it, and there separated: of both which we shall have occasion ere long to speak more opportunely. Mean while, having thus concisely propos'd to your more judicious examen, what seem'd to me most probable concerning the *double object* of Hunger; I haste to the *Constitutions* of the Stomach, in which that offensive sense of want of meat is founded.

These *CONSTITUTIONS* are (according to the division of the parts of the Ventricle mentioned in my first Lecture) either *common*, or *proper*. The *Common* are (1.) The *Temperament*, (2.) The firm *Tone*, (3.) The *Cavity*, (4.) The *Asperity* of the inmost coat, (5.) The acute *Sensation*, and (6.) The *Porose* or spongy *substance* of the same inmost coat of the Ventricle.

Among these, the first place is due to the *Temper* of the Stomach; upon the justice of which the natural vigor of this Faculty of craving meat, so necessarily depends, that if but the *influent* temper (to prætermitt the *insite* or native) happen to be deficient, or depraved; the appetite soon comes to be impaired or vitiated accordingly. Of this we have an eminent instance in a *fever*, which no sooner invades, than it dejects all appetite of meat, inducing great thirst in the room of it: and the reason seems to be this, that by the febrile heat of the blood brought into the inmost tunic of the stomach by the arteries, the *acid ferment* therein lodged is destroyed. For *Acids* (ye know) are apt to extinguish thirst, and all inflammations of the blood augment it, by overcoming their acidity.

The

The *second* is due to the *firm Tone* of the membranes and fibres of the Ventricle. For if this *Eutonia* of the whole organ be any way vitiated, the appetite of necessity more or less languisheth, flaggs, and vades: because the stomach, having its fibres relaxed, can neither contract it self enough to embrace the food it receives, nor be duely sensible of the complacency thence resulting. For, both the relaxation, and the infirm coherance of the tone of any part, very much diminish the vigor of it, and induce sluggishness and stupidity instead of it. How requisite to the excitation of a good appetite, the firmness of the tone of the stomach is, may be collected, not only from the experience of great *Drinkers*, who by excessive distension of the coats, by continual soaking the fibres, and by diluting and rinsing away the *Acidum esurinum* (as *Helmont* calls it) of the stomach; have little or no appetite to wholesom and nutritive meats, and at length so ruine the tone of the stomach, that they become insensible of hunger; and dye languishing, most commonly of Dropsies (some of the *Lympheducts* being broken in their bellies) or Consumptions from want of nourishment: but also from our own observation of the diminution of our hunger, in the heats of Summer, and the reviving of it in Winter. The reason of which remarkable alteration and vicissitude, seems to consist in this, that in the Summer, the whole body being as it were dissolved and enervated by immoderate heat, and the spirits continually exhausted by sweats and profuse transpiration, the tone of all parts becomes softer and more lax than it ought to be in the state of health; and consequently the appetite of the stomach to solid meat, dwindles into thirst: but in Winter, when all parts are constringed and render'd more dense by cold, the appetite grows strong again, and craves more of solid meat

meat to satiate it. Which doubtless was well understood by the wise Author of that vulgar Aphorism (*lib. 1. aphor. 15.*) *Ventres hyeme & vere sunt natura calidissimi, somnique longissimi: iis igitur temporibus cibi accessio est adjungenda, &c.* and which holds true also in hot and cold countreys compared together. This may be farther confirm'd from hence also, that as all remedies used by Physicians to relieve languishing stomachs, have somewhat in them of *astriction*; as wormwood, roses, mint, coriander, quinces, pomegranates, and generally all acids: so all that soften and relax the tone of the stomach, weaken the appetite; as syrup of Althæa, violets, conserve of mallows, oyl of sweet almonds, fat pottages, &c.

The *third* constitution requisite to hunger, is a *just capacity* of the stomach. For, if the stomach were not hollow within, it could be neither sensible of emptiness, nor capable of repletion. If its cavity be not of a just magnitude, it can neither crave, nor receive a proportion of food necessary to supply the indigence of the body. Hence it is, that such who have the stomach less than is fit, are commonly subject to frequent vomitings after full meals: and that on the contrary, they who have wide and deep paunches, often eat more than they can digest, and so render themselves liable to surfeits.

The *fourth* is, a moderate *Asperity* or roughness of the inmost membrane of the stomach. For, where this is wanting, as in the *Lienteria* it alwayes is; there the appetite continually languishes, till it be wholly extinct. And all *Lubricantia*, or things that induce a complanation and *slipperiness* upon the inside of the Ventricle, whether they be *alimenta* or *medicamenta*, sensibly blunt the edge of hunger; as Manna, Cassia, Elect. Lenitive, &c. as on the contrary, all things that

conserve or increase the asperity of the lining of the stomach, as verjuice, unripe fruits, pomegranate flowers and rinds, &c. whet the appetite.

The *fifth* is, an acute *Sensation* of the stomach. For, were the stomach a part endowed with a dull sense, how could it be sensible of the vellication of hunger? 'Twas not therefore without singular providence, that Nature made the inner superficies of the Ventricle extremely tender and delicate, and dispers'd so many nerves (more than can be found in any other part) upon the membranes composing it; more particularly upon the superior orifice of it, where hunger seems chiefly to reside. And it hath been observed by Physicians, that in what maladies soever the nerves of the stomach are disaffected by relaxation, stupefaction, or diminution of the Animal influx from the brain; in the same the appetite is equally injured and dull'd; as in the Lethargy, inveterate Scorbute, *Tabes dorsalis*, &c. Manifest it is therefore, that an acute Sensation is requir'd to the perception of hunger.

So is also (in the *sixth* and last place) a *Porosity* or sponginess of the inmost membrane of the stomach. For if the pores happen at any time to be fill'd up with the mucus or dead Phlegm separated from the blood in that membrane, as usually they are in leucophlegmatic Virgins, and such as are troubled with the Green-sickness; or dawb'd over with any viscous humor, and clos'd up, as in all scirrhus tumors of the Ventricle they always are: in either of these cases, the Appetite fails, the membrane ceasing to imbibe the Chyle. Hence most probably it is, that mints, red roses, marmalade of quinces, and other the like grateful Astringents, which are otherwise beneficial to the stomach, prove highly noxious, if used by those who have obstructions in it: when wormwood, wine, steel, and almost

almost all Aperient remedies, in that case excite and revive the languishing Appetite. Evident therefore it is, that to complete the reason of Hunger, is requir'd at least a freedom of the inmost Tunic of the stomach from obstruction.

Having thus run through the *Common* constitutions of the Ventricle, in which Hunger is necessarily rooted, we are arriv'd at the *Proper*: of which there are two *Organic*, and one *Similar*.

Of the *Organic*, the *first* consisteth in the *wrinkles* and *folds* of the inmost membrane of the Ventricle, which being larger, and capable of greater distention than the two that invest it, cannot therefore be constringed by their contraction, without falling into wrinkles or folds. Now this Corrugation both augments the Asperity of the inner surface of this Tunic, and makes it more sensible of emptiness, which is a part of hunger, and such a part, without which the essence of hunger cannot be intire or complete: in both respects not a little conducing to the more easie and effectual perception of the vellication of the fibres by the Acid ferment.

The *other* consisteth in the *nakedness* of the same superface of the inmost membrane, which renders it more apt to perceive, both the ingrateful gnawing of the Acid humors, when it is empty; and the grateful juice of meat, while it is replenish'd; the very nerves lying bare to the touch of both.

The *Similar* (and last) constitution proper, wherein hunger is founded, is a certain *predatory* or devouring *quality* of the same inmost membrane of the Ventricle, consisting in an *acid* imprægnation, by which it is adapted to dissolve, melt, and ferment solid meats, so that being commixt with liquids, they are changed into a milky broth or *Chyle*. Here we find an eminent

instance of that vulgar axiome, that Nature takes the most *compendiose* way to attain to the ends at which she aims, as often as is possible, designing one instrument to various effects. For, this very similar constitution, in which the faculty of *hunger* is chiefly founded, is the fundament also of the principal faculty of the stomach, the power of *Concoction*. And hence it is, that if at any time the *Digestive* power happen to languish, the *Appetite* also grows proportionably dull and weak; and on the contrary, while *that* continues in vigor and full energy, *this* likewise is quick and sharp: as if they were two stalks shooting forth from, and dependent upon the same root, they thrive and decay together. True it is (I confess) that there sometimes occur to the observation of Physicians certain anomalous cases, in which this confederation fails; the Concoctive power of the stomach being much dejected and weakned, while the Appetite is but little diminished; and on the contrary, the Appetite being weak, where the Digestion is good and laudable. But this failure always happens where all the constitutions, in the syndrome or concurse of which the Appetite of meat is founded, are not coincident with that constitution, in which the power Digestive is rooted: in which case commonly men are greedy of, and cramm their stomachs with more meat, than they can digest, to the great detriment of their health, and the generation of crudities, the common feminary of many diseases, the origin of which is to be ascribed to the *disproportion* betwixt the forces of these two confederate powers, the Appetite and the faculty Digestive. Let those therefore, who have this Appetite in excess, to prevent the innumerable evils consequent to surfeits and crudities, observe the good old rule of rising from the table before they have satiated it: because in them, *Satiety* is not the measure of eating, as

it

it is in others, in whom the faculties of hunger and concoction are (as they ought to be) æquivalent. For, according to the institute of Nature,

This *Satiety* is a certain grateful cessation of the sense of hunger, arising from a perception of moderate repletion of the stomach with food. For, the stomach being replete, the sense of inanition immediately ceaseth; because the inanition it self is then taken away. Besides, the succulency and nutritive benignity of the meat, foment as it were, and cherishes the nakedness of the inmost tunic of the stomach, mitigating the querulous sensation of it, and inducing a complacency in the room thereof: and at the same time, the sour reliques of the former repast, and the Acid Phlegm in the stomach, being contemper'd by the mild and sweet juice of the meat, gnaw and vellicate the stomach no longer, but set themselves to act upon the newly receiv'd aliment, and by their acidity to melt and dissolve it. So doth also the Prædatory and Chylific quality of the stomach it self, having new matter whereon to exercise its corrosive and dissolving energie. So that upon this saturity or repletion, the stomach soon finds a kind of delightful satisfaction within it self, and by the mediation of its nerves, communicates that grateful sensation to the brain: and in this manner the industry of Animals, excited by the sharpness of hunger, and employ'd in quest of nourishment, is when they have obtain'd it, fully recompens'd with the pleasure of repletion.

But the government of this mighty Prince, *Hunger*; is (as other Empires) liable to great and dangerous disorders, sometimes too remiss and dissolute, sometimes corrupt, and sometimes tyrannic: whence arise various diseases and symptoms that perturb, pervert, and not seldom also subvert the whole Oeconomy of the body.

These

These may be commodiously refer'd, either to the *Diminution*, or to the *Excess*, or to the Depravation of Hunger: to

Diminution, when the Appetite is *less* than it ought to be: which is commonly call'd, by the Græcs, Ἀνορεξία, by the Latins, *dejectio appetitûs*, and by us, weakness or decay of appetite: and divided into *Simple* dejection, and dejection mixt with *nauseousness* or loathing. The *former* is varied by degrees, according to the less or greater læsion of the faculty, and the variety of the constitutions in which the same is founded; as may be easily collected from the accompt I have given of those constitutions. The *last degree* of Diminution is named by some, Ἀποστία, *prostratio appetitûs*; by others, Ἀπείνα *sive* Ἀπείνη, *fames planè abolita*; by others again, Ἀλιμος, *simplex carentia famis*, but (as hath been well observed by the most accurate Dr. Glisson) improperly, because the word, Ἀλιμῶ signifies rather the *cause* driving away hunger, than the abolition of it. In this extreme debility, the Constitutions of the stomach proper to this faculty are so far infringed and hurt, that they neither perceive the inanition of the stomach, nor complain of the want of food. The *later* is subdivided into *Nauseousness* or loathing *cum materia*, whether meat lately eaten, or vitiose humors congested in the stomach; and *sine materia*, when the prædatory constitution of the inmost membrane of the Ventricle, which consisteth (as I have said) in *Acidity*, is alienated from its nature and proper object; as alwayes it is in fevers, the inflammation of the blood being *è diametro* repugnant to that acidity, and inducing insatiable *Thirst*, in stead of moderate hunger.

The vice opposite to this, is *Augmentation* or *Excess* of hunger; which likewise afflicts in various degrees, the last of which, is distinguished from the rest by the peculiar

peculiar appellation, Βέλμῳ, *vehemens fames*, and κυνώδης ὄρεξις, *appetitus caninus*. In this exorbitant Affection, the prædatory quality of the Stomach is highly intended, and becomes outrageous, even to cruelty: and for the same reason, the Acid phlegm, which the inmost membrane spews out into the cavity of the Ventricle, acquires a greater and sharper acidity, that even corrodes the nerves and fibres, like Worms incessantly gnawing them. Hence the stomach is afflicted with great anxiety, and by reason of the excessive strength of its prædatory constitution, devours, digests, dissolves, dissipates and consumes whatever is brought into it in a trice, and when full, still craves more; seldom ceasing, till surcharged, it be forced to eject, upward or downward, what it hath lately devour'd with insatiate greediness. If therefore any of the *Virtuosi* should interrogate me concerning the monstrous *Voracity* of some Gluttons, such as were *Wood* the great Eater of *Kent*, and *Marriot* (whom most of the Seniors here present (I believe) knew, at least by sight) I should venture to ascribe it, partly to the extraordinary *amplitude* of the stomach in such unhappy men; for otherwise where can they have stowidge for so great a mass of meat, as they usually devour at a meal: but chiefly to a certain piercing and *corrosive Acidity* lodged in the cavity of the stomach, that both renders their hunger insatiable, and dissolves and consumes the meat almost as fast as they swallow it down. And this Conjecture seems to me the more probable, because *Marriot* himself more than once told me, that his Greedy worm (as he call'd it) first began to bite him, within two or three dayes after he had eaten a large break-fast of a salted gammon of Bacon. For, certain it is, that salt, though it retain its native savour, while it continues fixt, doth notwithstanding, when brought to the state

of

of *fusion*, acquire *acidity*; and that so much the more sharp and fierce, by how much the nearer it is, by fermentation or heat, advanced toward the state of *volatility*: nor is any thing more solenne to *Chymists*, than to draw out of salts distill'd, liquors acid and corrosive to the last degree, illustrious examples of which we have in the spirits of common salt, nitre, and vitriol. Why then may it not be supposed, that the like effect may be sometimes produced in the body of man? that the great quantity of salt eaten by *Marriot*, being partly by the heat of his stomach, partly by fermentation therein made, brought to a state of *fluxility*; and commixt with his blood, be farther advanced to so high a degree of *volatility*, as to become extremely *corrosive*? If this be supposed possible, 'twill not be found unreasonable to guess, that the *Mucus* or *pituita emortua* spew'd out by the arteries into the inmost tunic of his Ventricle, and imprægnate with corrosive Acidity, might be the principal cause of his excessive Appetite, and of the quick dissolution and consumption of whatever he devour'd. So that in strict truth, his stomach, not he, was the great Eater; or rather the corrosive acidity of humors contain'd in his stomach.

The *third* enormity incident to this faculty, is *Depravation* of appetite, call'd in the general, *Pica*, in women with child, *Malacia*: seldom afflicting men, frequently women, and among these such chiefly who have either the green sickness, or great bellies; and proceeding in them à *suppressis Catamenis*. Which stagnating *circa uterum*, and acquiring a peculiar kind of corruption; when they have therewith infected the whole mass of the blood, leave such a vitious tincture in the *Mucus* or dead Phlegm thereof, separated from the blood in the inmost coat of the stomach, as that from thence arises a perverse hunger, not of good and wholesom

wholesom meats, but of things absurd and uncouth, such as chalk, loam, charcoal, ashes, unripe and austere fruits, turfs, and other the like trash. If I do not pursue this extravagant Appetite farther in this place, 'tis not because I have no more to say concerning the Conjunct Cause of it; but because the Law of decency obliges me to be reserv'd, where the Argument belongs only to the knowledge of the grave Physician, who alone is priviledg'd to philosophize chastly *καὶ σωφροσύνῃ*. Contenting my self therefore with what hath been said concerning the first *Action* of the Ventricle, *Hunger*; I proceed to contemplate the nature of the *Second*, viz. *THIRST*. ¶

The Faculty of *THIRST* is also necessary to nutrition, as respecting the *Vehicle* of solid aliment, whereby it is diluted, and reduced into a thin and liquid substance, call'd *Chyle*. Yea more, a *Vehicle* is requisite also in respect of the *Bloud*, which would be of too thick a consistence, and unfit to perform its circuits round the body, if it were not now and then diluted by fresh supplies of drink: nor could this Vital Nectar be commodiously purged and defæcated from various impurities and excrementitious parts, namely the *Bile*, *salt*, *tartar*, and *mucus*; unless it were daily rinsed as it were with a sufficient portion of thinner liquor. For, it is by the help of our drink alone, that the saline and earthy excrements of our bloud are driven out by urine. Ye may add yet another use of liquids suggested first by Sr. G. Ent (*in Antidiatribæ pag. 28.*) in these words. *Quo chyli pars tenuior expeditius [è ventriculo per œsophagum, per viam filtrationis, ad cerebrum] sursum ascendat, humectatione opus est; quemadmodum in filtratione usu venit: atque hinc etiam potandi necessitas; sicca enim ascensum hujusmodi frustrantur. Ideoque ardente*

II.
THIRST.

dente febre correpti, quibus lingua faucisque arent, subito macrescunt. And these are the principal reasons that seem to have induced Nature to institute *thirst*, or Appetite of *drink*; in all Animals.

That this Appetite of drink is *seated* in the Ventricle, as in its *subject*, can not be denied: but that it is confined to the Ventricle *only*, can not be granted. (1.) Because drink receiv'd into the stomach, doth not always mitigate thirst: and therefore that part of thirst that remains after a competent quantity of drink, must reside in some other parts vicine to the stomach. For, it is unconceivable that the stomach, when replete with cold and moist, should still feel and complain of want of both. (2.) Because they who in fevers are tormented with insatiable thirst, complain not so much of heat in the stomach, as driness and parching of their tongue, throat and gullet. Nay they find more alleviation and relief from frequent washing of their mouths and throats with fountain water, small beer, and other convenient liquors; than from all the cold drink they can pour in. The like solace they find also from holding in their mouths, such things as any way promote the flowing forth of the *Humor Salivaris* or spittle, though they be neither actually cold nor moist in themselves; such as Prune stones, polish'd Crystal, pieces of gold (all which by their weight and pressure upon the tongue, further the profusion of the spittle) and *sal prunella*, which detain'd only in the mouth, and there slowly melted, palliates the thirst. We may therefore conclude, that the adequate subject of thirst includes not only the *Stomach*, but the *gullet* also, and the *throat*, with the *tongue*: all which are cover'd with one and the same membrane, and must therefore sympathize.

The *OBJECT* of this faculty is (as of Hunger) twofold, *Absent*, and *Present*. The *Absent* Object is in the general, whatsoever liquor is fit to be drunk, and to satisfy thirst. For we thirst after Wine, Water, Beer, Ale, Whey, Cydre, and any other delectable juice or tincture whatsoever. But to render any of these, or any other Potulent matter, the genuine and formal object of thirst, are requir'd these *Conditions* following.

(1.) That it be *liquid*, or *fluid*, like water. For solid bodies are unapt to quench thirst, unless they be such as may be melted or dissolv'd in the mouth, or by irritation cause the glandules of the mouth to discharge the spittle sooner or more copiously, than otherwise they would do: which is but to abate thirst by accident, as a pipe of Tobacco sometimes doth, only by bringing rheum down, that moistens the mouth.

(2.) That it be *Humid* or moist also, at least effectively. For certainly whatsoever potulent matter appeases thirst, doth some way or other moisten the parts that were dry and thirsty before. Vinegre and Sal prunellæ, though in some respect they may be said to be cold and dry; yet being taken into the mouth, may be nevertheless allowed to mitigate thirst, in so much as they dissolve the viscid and adust humors adhering to the surface of the tongue, and open the sluices of the spittle, that were before obstructed.

(3.) That it be *thin*, *penetrating*, and in some sort *cutting* or sharp. *Thin* it must be, to irrigate the thirsty parts the sooner: but not too thin, lest it slide away before it hath moistned them, which perhaps is the reason, distill'd waters, without any other mixture, are ineffectual to quench thirst: but a little thickned with cooling syrups, and contemper'd with acids, they make good julebs to that purpose. It must be *penetrating* also, and *sharp* or acid, to insinuate the deeper into the

membrane which is the seat of thirst, and moisten more than the superficial parts thereof. For, daily experience teaches, that thick, viscid, sweet and heavy drinks, rather increase than abate thirst. It appears then, that the formal reason of drink, in respect of which it is said to be the absent object of thirst, doth consist in its *fluidity, humidity, moderate tenuity, and aptitude to penetrate and cutt.*

If any accuse me of forgetfulness, for that I have here omitted to list *coldness* among the qualities of drink most convenient to extinguish thirst; I intreat such to take notice, that I did it *ex professo*: dissenting from this opinion of the *Peripatetics*, that the absent object of thirst, is *frigidum & humidum*. For, in the Schole of experience I have learn'd, that drinks *actually* hot quench thirst, as well as *actually* cold; witness those many hundreds of men now living in this City, who always warm their ordinary drink, and yet are seldom or never molested with inordinate thirst. And as for drinks *potentially* hot; many of them also mitigate thirst: as several sorts of wines, as well strong and generous, as weak and subacid; as also strong beer, and Hydromel. Notwithstanding these observations I deny not but liquors, whether *actually* or *potentially* cold, *ceteris paribus*, are to be preferr'd by men in health, as to the extinction of thirst.

The *Manner* how we become *sensible* of thirst, seems to be, not positive, but *negative* or privative. For the parts in which thirst is placed, perceiving themselves to be drier than their natural constitution requires, transmit to the brain, by the nerves, their sense of the want of convenient liquor to moisten and relieve them: and this sense of want being thus propagated to the *internal* sense, whose organ is the brain, instantly stimulates it to desire and seek after drink, to supply that want.

The *Præsent* Object, that causes the sensation of this defect of moisture in the external organ, and more urgently solliciteth the phantasy than the *Absent* object doth; consisteth in the adventitious and offensive *driness* of the membrane investing the stomach, gullet, throat and tongue. Which being ordain'd by nature to be perpetually irrigated with a certain mild humor; whensoever that irrigation fails, immediately perceives its natural constitution to be changed, and communicates that ungrateful perception to the nerves, and by them to the brain. But this *Driness* which we conceive to be the præsent object of Thirst, is not so much a *superficial* siccity (though that also is perceiv'd) as a *profound* and *internal* in the membrane therewith affected: and in that very respect clearly differs from that external siccity, that falls under the perception of the sense of *Touching*. For the Touch judges indeed of driness, but only as of an object occurring from without, not as of an intrinsic affection of its own organ, wherewith it is profoundly altered. And hence may be collected that conspicuous and evident distinction between the sense of *Thirst*, and the sense of *Touching*. The Touch perceives the surface dry or moist, of another body: the sense of Thirsting, on the contrary perceives the internal and profound driness of its own organ, the membrane in which it resides. For example, a man in a burning fever, may with his finger feel the driness and asperity of his tongue; but not his thirst: nor is the finger, or any other part of the body, howsoever dry and parch'd, ever sensible of thirst, but only the membrane to which Nature hath confined the sense thereof. Nor doth this membrane perceive thirst by the same sense of *Touching*, by which it feels external objects that touch it, but by a certain faculty proper and peculiar to it self. *Wherein then doth that peculiar Faculty consist?* Certainly

in the syndrome or confederation of its *Constitutions*.

These *CONSTITUTIONS* (as those in which Hunger is founded) are either *Common* or *Proper*. The *Common* are (1.) Exquisite sensibility, (2.) Tenderness, (3.) Mobility, (4.) Permeability, (5.) Cleanliness of the membrane or proper organ. The *Proper* are the native moistness, the proclivity to driness, and impatience of bearing that driness without anxiety, of the same membrane. Of each of which *Constitutions* I shall speak singly, but briefly.

(1.) That the Organ of Thirst is of *delicate sense*, is evident even from this, that it is endowed also with the faculties of touching and tasting : for needs must that part be exquisitely sensible, which is the subject of three several senses. It was not then for nothing, that Nature made it nervous, and furnish'd it with plenty of nerves.

(2.) That *Tenderness* or softness (which is a quality very near of kin to sensibility) also is competent to it, is manifest to the Touch ; and from hence, that if it were not easily alterable, by reason of its fine and delicate contexture, it could not so familiarly be affected by simple driness, which is otherwise but a dull and sluggish quality.

(3.) *Mobility* also, *i. e.* flexibility and tensibility, is requisite to the same membrane, in some sort. For, the subtle motions of the tongue and palate, are sufficiently known from the very articulation of letters ; those of the Gullet, from the deglutition of meat and drink ; and those of the stomach, from its repletion, inanition, ructation, vomiting, &c. And this constitution of it also is hurt by driness.

(4.) The *Permeability* or porosity of this membrane, is in the tongue, pa'ate and throat very conspicuous, as well from the many little asperities every where discernable

nable in it, which adapt it to spew out into the mouth, the spittle which the *glandule sublinguales* brings into them: as from this, that (like a sponge) it imbibes and retains any moisture put into the mouth. And in the stomach too the same porosity is no less evident from the acid phlegm that is daily emitted from the arteries through this membrane, as it were by way of exudation, into the cavity of the Ventricle.

(5.) *Cleanness* also is requisite to the constitution of this membrane. For, in the state of health, it is not polluted with any sordid excrements or impurities, nor obstructed with humors sticking in the pores of it, nor discolour'd with any adventitious tincture, but alwayes neat and clean. And these are the five common qualifications required in the organ of Thirst.

Of the three *Proper*, the *first* is a certain natural *Moder* or moderate moistness: for a perpetual supply of which Nature has placed in the mouth, six conspicuous fountains, the two *ductus Salivales*, the two *Tonsills* or almonds, and two *rivulos catarrhales* bringing moisture from the brain: and not thinking those enough, she hath superadded innumerable *glandulose Asperities* in the tongue, palate and throat, which also with their dew contribute to the perpetual irrigation of this membrane. And therefore this may be reputed, the fundamental Constitution, in which the faculty of Thirsting is grounded, and upon which the two following are superstructed, as complemental additions.

The Second, *Proclivity to exsiccation*, if it be not ever now and then refresh'd with moisture. For the heat in the stomach and gullet, and the vicinity of the heart, contribute much to this arefaction: and in the mouth and throat, the driness of the air inspired, and the heat of the breath expired, concurr to the same effect. But above all these causes, the descent of the Chyle, and

Vene

Vena Lacteæ, introduce drinefs upon the ftomach, by exhaufting the liquors out of it, and confequently by renewing the want of fresh drink, to fupply the Univerfal *Latex ferofus*, which failing, the fources of the *Glandula Salivales*, and other fountains of moifture in the mouth, muft foon be exhaufted. No wonder then, if the natural moifture of this membrane, unlefs now and then recruited, be apt to fail, and arefaction foon fucceed into the room of it.

The *third* and laft, is a certain *impatience of drinefs*, without a querulous fenfation of it. For, fince this membrane ought, according to the inftitute of nature, to be alwayes moiftned; and yet notwithstanding is, for the reafons newly alleged, apt to be left deftitute of its natural moifture; and fince it is, as I have already evinced, of acute fenfe: it follows of neceffity, that it can not but be fenfible of, and impatiently tolerate drinefs, which is fo repugnant to its natural conftitution. And fo at length have we attain'd to the knowledg of the reafon of *Thirft*, and of the manner of its *Senfation*. And as for the various *degrees* of it; they arife from the various degrees of exficcation, and the fhorter or longer continuation thereof.

Having thus found, both the formal reafon, and the proxime caufe of Thirft; it follows, that we inquire into the *remote Caufes* of the fame. Thefe therefore may be all referr'd to fix heads, whereof four are General or more remote, and the other two Particular and lefs remote. The *General Caufes* are (1.) Too long abftinence from drink, (2.) Immoderate heat of the body, and chiefly feverifh diftempers of the blood, (3.) Defect of the general *Latex ferofus*, (4.) Diverfion of the fame *Latex* from the organ of thirft, to other parts. The *Particular* are (1.) Defect of the *Latex* in the Glands that ferve particularly to fupply the membrane

brane with moisture, and (2.) The depravation of the same *Latex* by qualities aliene from its natural constitution. Each of which causes I should particularly have explain'd, had I not consider'd, that a simple enumeration of them may be sufficient to the Learned part of my Auditors, and that I want time fully to explicate them to the rest. Trusting therefore in the memory of those, and the equity of these; I here conclude my jejune discourse of the second action of the Ventricle, *Thirst*; and following the clew of my method, pass to the *third*, viz.

The *PERISTALTIC* or *COMPRESSIVE*
MOTION of the *Stomach*.

The appetites of hunger and thirst being satisfied, the Ventricle pleas'd with that relief, closely embraces the newly receiv'd meat and drink on all sides, spontaneously contracting it self into a narrower compass, and thereby lessning its cavity, so as to compress the contents: and this spontaneous contraction is therefore by *Galen* named in his language, κίνησις περιεσπληνῆ, *motus compressivus circumquaque*; as the faculty or power by which the action is perform'd, is call'd Δύναμις περιεσπληνῆ, *Facultas circum-constrictiva*. The same Faculty is well defined by *Gorrheus* (a faithful Interpreter of *Galen*) in these words; *est que alimentum attractum arctè complectitur, quò melius concoquatur; ministra est virtutis retentricis, atque inde concoctricis*. But this definition, though convenient to the nature of the thing, so far as it extends, and to the notion *Galen* seems to have had of it: is notwithstanding too scanty to comprehend the *formal reason* of the Faculty, or to explain the *Manner* of its operation. Let us therefore seek farther, in hope at length to discover both.

III.
The *PERISTALTIC*
Motion of the
Ventricle.

To found this Peristaltic Power in the stomach and guts (for we are not now considering any other of the various cavities in the body, all which are also endowed with the like power) five things are of necessity requir'd, *viz.* (1.) A Cavity or receptacle, (2.) Matter contain'd in that Cavity, (3.) Tunics or membranes invironing the same, (4.) Fibres to gird or constringe those membranes, (5.) Distinct orders, and different texture of those fibres. For, in what part soever these five constitutions are concurrent, as they certainly are found in the Ventricle and guts; that part hath a just and clear title to a Peristaltic power, and may exercise it whenever occasion requires. But the two last constitutions are those in which the power is principally founded: the Fibres alone being the active cause of the compressive motion; and the different orders and texture of them, the causes of the differences of the same motion. Our business therefore must be, to inquire chiefly into the actions of the several orders of Fibres formerly described by us in the Tunics of the Ventricle, from the variation of which the various kinds of this compressive motion receive their distinction.

This Motion then is observed to be threefold, (1.) *Downward*, (2.) *Upward*, (3.) *Partly downward*, and *partly upward*: and the last sort is subdivided into (1.) That which is perform'd with a certain *Luctation* or *strife*, and (2.) That which is perform'd, not only without *strife*, but with a kind of *sport*. Besides these differences, there are yet others subordinate to them. The Peristaltic motion with *strife*, is either *equal*, and then it may be call'd *Tonic* or *Equilibrate*; or *unequal*, and then it is in the yielding fibres, *repressing* and *inverting*; in the prevailing, the Peristaltic motion *inverted*. The *Sportive* motion is, from its use, call'd, the *distributive*

butive motion of the Chyle. Moreover all those different sorts of the Peristaltic motion have their various *degrees*, by which also they are remarkably discriminate among themselves: as being sometimes robust, sometimes languid; one while torpid and sluggish, another while vigorous and quick; sometimes placid and sedate, sometimes turbulent and tumultuous. And in handling all these, we are to consider the manner of the conspiracy and co-operation of three orders of fibres: beginning from the Peristaltic motion *downward*, which in the order of nature is *præcedent* to the motion upward; because the matter moved must first descend into the cavity of the stomach, before it can be therein agitated hither and thither. Not that this motion is to be understood to be *downward* in respect of the Centre of the Earth, but of the *ductus* or passage continued from the mouth to the fundament.

This Peristaltic motion *downwards* being sensibly perform'd in the swallowing down of meat and drink, in the descent of the Chyle, and exclusion of the excrements, is sufficiently demonstrated from those actions: and perform'd by virtue of all sorts of fibres.

First, By contraction of the *Transverse* fibres, which like Zones, making intire circles, must by shortning themselves, make less circles, and consequently by drawing the cavity they gird into a narrower compass, compress and squeez out the matter therein contain'd, upward or downward. Supposing then, that they begin their contraction from above, as about the upper orifice of the stomach; 'tis necessary they should depress or squeez down the matter contain'd in the cavity of it. For, the inferior fibres are supposed to be not yet vigorous or put into action, but to give way, and to suffer distention from the matter contain'd: and this very distention it is, that causes them to act by restoring them-

themselves to their natural state of moderate laxity. So that by this means the inferior fibres being successively excited to pursue this motion from above downward, contract themselves successively, till they thrust the matter contain'd quite out of the cavity that contained it.

Secondly, Of the *Right* fibres, which also conspire to this Peristaltic motion downward. For, so soon as the Transverse contract themselves from above, they compress the Right contiguous to them, and thereby incite them to contract themselves upward, by the spontaneous endeavor of restitution; so that they pulling the sides of the cavity upward, cause it to forsake the matter contain'd, and by that means promote the descent of it. For in this case, it is all one, whether the matter contain'd be depress'd, or the cavity containing be drawn upward from it. And this subduction of the cavity or *ductus* from the matter contain'd, answers successively to every descendent contraction of the Right fibres, until the matter be brought thither, whither Nature order'd it should be detrued. Wherefore this complex motion of Transverse and Right fibres, may be not unfitly compared to motion of Earthworms crawling upon the ground. They take hold of the surface of the ground with their foreparts, which are to that end furnish'd with little circular asperities, and then shortning themselves in the middle, draw up their hinder parts towards their foreparts, and so slide over the ground. Exactly so do the Right fibres withdraw the sides of the *ductus* from the matter contain'd in it.

Thirdly, By the contraction of the *Oblique* fibres, which contribute their help too to this Peristaltic motion downward. For, as they obtain a middle situation betwixt the Transverse and Right, so they perform a middle

middle Action : partly depressing the contain'd matter, partly drawing the sides of the cavity upward ; so cooperating with the Transverse fibres, in the depression of the matter, with the Right, in the retraction of the cavity. And in this manner all three orders of Fibres seem to concur to the performance of the Peristaltic motion *downward*.

To which the motion *Upwards* being contrary, and effected by the concurrent constriction of the very same fibres ; the Manner of it must be contrary, *viz.* by *inversion* of order. For, if the contraction of the *Transverse* fibres begin from below, and proceed upward, they must press the matter that they gird, upward : and the *Right* at the same time put into action first from below, must draw down the sides of the cavity from the matter therein contain'd, and consequently help to impell it upward. And as for the *Oblique* ; they, as in the former motion, partly assist the action of the Transverse, and partly promote that of the Right. So that this Peristaltic motion from below *upwards*, is (as I said) coincident in all things with the motion from above downward, unless it be that the order of moving is inverted, and the terms of the motion contrary.

The two contrary Peristaltic motions being thus explain'd, 'tis easie to comprehend the reason and manner of the *Mixt* motion, which is partly downward, partly upward ; and belongs only to the stomach and gutts. Of this, the most acute Dr. *Glisson* hath observ'd three different species ; two with *luctation*, and a third *delightful* : all to be also ascribed to the same three orders of Fibres (for, as ye may remember, there are no more) but moved in different manners, and more complexly. *First*, If it happen, that fibres near in situation to, but sufficiently distinct from each other, superiors.

superiors and inferiors, set upon the work of Peristaltic motion together ; and that some by compression squeeze the contain'd matter downward, others urge it upward: in this case, there must arise, in stead of a concurrence, a luctation or contention of the two mutually repugnant forces, and the Peristaltic motion must be *Laboriosè*.

Secondly, That this *Luctation* may be determined to æquality, or inæquality, 'tis requisite the forces or devoirs of the fibres contending, be æqual or unæqual accordingly. To equality of the forces, are requir'd on both sides circular fibres shutting or closing the *ductus* or cavity. For, if the matter contain'd, should freely slip away, the scope at which Nature aim'd, when she instituted this motion, would certainly be frustrate; *viz.* the *Retention* of the aliment. Which great inconvenience she foreseeing, wisely provided against it, by placing strong circular fibres about each of the two Orifices of the stomach; which seems to be the reason, why in the stomach, and only in the stomach, this luctation is naturally found *Æqual*. I say, *naturally*; because there may happen to be in the Gutts also the like *Æquality*, when they are obstructed both above and below at the same time, so that the matter contain'd in the intermediate space can not be propell'd either upward or downward: but this case is very rare, and præternatural. Notwithstanding this æqual contention be peculiar to the two Orifices of the stomach, we are not to imagine it to be so constant, but that somewhat of the Chyle, during the act of Concoction, or part of the drink also, chiefly if it be spirituose, may now and then slip out through the *Pylorus*, being urged by the delightful strife of the fibres intermediate between the two orifices. We may therefore conclude, that this Peristaltic motion proper to the stomach, is rooted, chiefly
in

in the Annular fibres of its two Orifices, and partly in the fibres intermediate between them: and we may define the same to be a *close comprehension of the meat in the stomach, so equilibrated, that the meat can neither slip thence either upward or downward prematurely, nor remaining there fluctuate.*

But many times there happens as well in the stomach, as in the gutts, an *Unequal and fluctuating* Peristaltic luctation; as may be inferr'd from slow and difficult Concoction, from wind pent in, from a laborious distribution of the Chyle, and many other Hypochondriac affects. And in this motion also, as in the former, the contending fibres are Antagonists, the superior striving on one part, the inferior on the other: those endeavoring to thrust down the matter contain'd, these to impell it upward; but with *unequal* forces: whence it comes, that the matter is agitated up and down by a kind of fluctuating motion: and therefore this *Unæqual* contention is rightly enough call'd a Peristaltic motion *Fluctuating*. Commonly it præcedes, and portends eructation, vomiting, præmature descent of the Chyle, torments of the Gutts, colic pains, fluxes of the belly, and the like symptoms, arising from offensive irritation of the fibres of the stomach and gutts. The fibres concern'd in this turbulent motion, may be divided into two parties, the *Prevailing*, and the *Yielding*. The *Prevailing* fibres do, not only suppress, but also *invert* the Peristaltic motion of the yielding; yea more, they pursue their victory, till either other fibres rise up and repell the force of the former, or they themselves, the irritation by little and little ceasing, become quiet of their own accord. To explain this by an Example; in the *fluctuation* of the stomach, if the Peristaltic motion begin about the upper orifice, it proceeds thence to the fibrosè neck of the lower,

lower, and is there, by reason of the strength of those fibres, repress'd and inverted: then the motion ascends by degrees to the upper orifice, where it is again repress'd and inverted downward; nor doth the fluctuation cease, till the wind be by belching discharged, or the cause of the irritation, whatsoever it be, expell'd, whereupon the contending fibres are appeas'd, and the warre comes to an end. In like manner, if in the gutt *Ileum* the Peristaltic motion begin about the *Colon*, and drives the matter contain'd in the *Ileon* upward; the motion is hardly repress'd, till part of the matter be brought up to the fibrose neck of the *Pylorus*; and then it is not only stopp'd, but inverted. The same may be conceived to happen in the *Colon & intestinum Rectum*, in which the two terms of the motion are the *Valve* of the *Colon*, and the *Sphincter* of the fundament.

The *Third* and last kind of the Mixt Peristaltic motion, is that which *distributes* the Chyle, and which is rather placid and grateful to both stomach and gutts, than tumultuous or offensive. The manner of this subtiler and complex motion may be conceiv'd from an inspection of the gutts of an Animal newly kill'd, and opened while some reliques of the vital heat are yet remaining in them. For one shall see the Gutts variously shortning, wrigling and wresting themselves, like a heap of Earthworms crawling some over others, and striving as it were to creep upward and downward by turns; but without a directing faculty. Now the *use* of this admirable motion is double, *viz.* (1.) An *equal distribution of the Chyle* and other matters contain'd in the stomach and gutts, (2.) The *Agitation of the Chyle it self*. For, all things admitted into the stomach and gutts, require an equal distribution in them; but the Chyle requires also a peculiar agitation, that it may be in all parts of the gutts brought home

home to the very mouths of the *Vene Lactea*.

Finally, as for the *Gradual Differences* of the Peristaltic motion; they are either *simple* or *complex*. The *Simple* arise from the strength, irritability, and actual irritation of the three orders of fibres; and therefore cannot exceed the number of three. For, from the *strength* of the fibres, the Peristaltic motion is said to be strong, moderate, or weak: from the various degrees of their *irritability*, it is named quick, moderate, or sluggish: from the greater or less actual *irritation*, it is call'd tumultuous, moderate, or sedate. The *Complex* proceed from the various combinations of the Simple, and therefore may be collected from our præcedent descriptions of the same. Let this therefore suffice concerning the Peristaltic motion of the Ventricle and guts; and let us progress to that which many excellent Men, in imitation of *Galen*, have call'd, the *Attractive Faculty* of the Stomach. ¶

In hunting after Verity in the works of Nature, they are of all men most liable to error, who neglecting the use of their own sagacity, and shutting the eye of reason, follow the cry of *Authority*, and run on in the tract of their Leaders, without stopping to examine whether it be right or not. Of this, we here are fall'n upon a remarkable example. For, some *Anatomists*, neither few in number, nor of obscure name, blindly adhering to the opinion of their Predecessors, as Geese go in a file to the water, have rashly ascribed to the stomach, I know not what *Attractive Faculty*, by which they imagined the meat and drink to be drawn into it, as iron is by the Vulgar believ'd to be drawn by a Loadstone: placing this power (forsooth) in the *Right fibres* thereof; than which it is not easie to

IV.
The RECEPTIVE
power of the
Ventricle.

find a grosser absurdity. For, this supposed Power is neither necessary, nor probable.

(1.) *Not necessary*; because all meat and drink is brought into the stomach by Deglutition or swallowing alone; and that action is performed (as we have formerly demonstrated) not by way of Attraction, but depression and protrusion. What need is there then of Attraction to do the same work? or is it the custome of Nature to multiply faculties to no purpose?

(2.) *Not Probable*; because perhaps there is really no such thing in nature as *Attraction*; all motions there-to ascribed, being more truly referrible to simple *impulse*. And if there were, the Attraction here imagined, must be either Similar, or Organic. But that there is no *Similar Attraction* in the case, is manifest even from this; that Similar Attraction supposes a certain congregation or spontaneous concurrence of things like to their like: but betwixt the meat and the stomach is, neither spontaneous coition, nor similitude; nay, sometimes it happens, that by deglutition are brought into the stomach things highly ungrateful, and unlike to it, as purging medicaments. Whence we may safely conclude, that the admission of things into the Ventricle is not perform'd by virtue of Attraction Similar, but only of swallowing.

And as for Attraction *Organic*; here are no instruments fit to effect it. These Authors indeed are pleas'd to affirm, that the Right fibres draw down the meat: but they have omitted to shew *how*. Have these fibres hooks to take hold of every bit of meat that comes into the mouth? can they, like chords, pull it down? Should these *Litterati* seek refuge in the old Peripatetic dream of attraction *ob fugam vacui*, they could not defend this their opinion: (1.) Because that fantastic Sanctua-

ry hath long since been demolish'd; (2.) Because the Stomach can not possibly form any such cavity, as is requisite to introduce a competent vacuity. For, if it contract its fibres on all sides, it must of necessity diminish its cavity: and if it relax them, the sides of it instantly flapping, come together: in both postures excluding vacuity. In fine therefore, seeing this Attractive Faculty ascribed to the Ventricle, is neither necessary, nor explicable either by the hypothesis of Similar attraction, or by mechanic principles, or by the Aristotelean supposition of Natures abhorrence from vacuity: what remains to support it? Certainly nothing, but the credulity of those servil spirits, who choole rather to err with their Teachers, than to recede from them; as if Philosophical doctrines were, like the principles of Religion, not to be examined, but implicitly believ'd. Let us then wholly expunge this Attractive power out of the list of Faculties belonging to the Stomach, not only as fictitious, but absurd also and impossible.

This was well understood by our incomparable Dr. *Glisson*, who thereupon endeavor'd, instead of this imaginary faculty of attraction, to substitute another less improbable, which he call'd the *Receptive* faculty of the Ventricle; defining it to be, a certain aptitude of the stomach, by which it relaxes its fibres, and enlarges its cavity, to receive meat and drink brought into it, without reluctance: and the *Reason* that induced him so to do, is this; that whenever the stomach dislikes the thing to be swallow'd, the act of deglutition is perform'd with difficulty, and accompanied with nauseousness and great averfation: but on the contrary, things grateful to the stomach, though bitter perhaps and unpleasant to the Taste, are yet easily swallow'd, and receiv'd by the stomach with complaisance and delight.

Nevertheless, such (I acknowledge) is the dulness of my brain, that I do not yet comprehend the necessity of this substitution. For, although the stomach be, by reason of its cavity, apt to receive meat and drink; it does not necessarily follow, that therefore this Aptitude deserves the name of a *Faculty*: unless ye shall judge it reasonable for a man to say, that because a sack is capable to be fill'd with corn, and a bladder with liquor or wind, therefore they have a *Receptive Faculty*. A Faculty (ye know) implies an Action; but the Receptive faculty here spoken of, seems to me to be a mere *Passion*. Is it not manifest even to sense, that the stomach is alwayes more or less distended, in proportion to the quantity of nourishment brought into it? and whence comes that distension? certainly not from spontaneous relaxation of the fibres of the stomach, but on the contrary, from their forced extension by the weight and bulk of the meat and drink admitted: For, no *Tensile* body whatsoever can extend it self, because extension is an endeavor and degree toward the solution of its continuity; and therefore repugnant to its nature; and no natural Agent can act towards its own destruction. The proper and sole action of all fibres, is spontaneous *Contraction*, whereby they restore themselves to their native posture and quiet, so soon as the stretching they suffer'd, ceases. How then the fibres of the stomach should come to be able to stretch themselves in length, I do not understand. And as for the difficult swallowing of things which the stomach abhors, and the nauseousness accompanying it; why may not that be refer'd to the præjudice of the *Imagination* consequent to the perception of their ungrateful smell or taste? the rather, because when Reason hath master'd that præjudice, as it alwayes doth in men taking vomits, purges, and other ungrateful medica-

ments,

ments, even the most unpleasent things are without difficulty admitted into the stomach. So is Wine also in excessive quantity pour'd in by Drunkards, notwithstanding the reluctance of the stomach. So that it is not constant, that the stomach hath a *Receptive Faculty*, whereby it is empower'd to admit what it likes, and to reject what it dislikes, as this Paradox supposes it to have. This I have taken liberty to say, not from a pe- rulant itch of contradiction, not from vain ambition to have the glory of contending with so great a Cham- pion, but merely from the uncertainty of my judge- ment: which induced me to set before you the argu- ments for and against this opinion of a Receptive facul- ty in the stomach, to the end that I might learn from you, which are the more weighty. Leaving this nice quæstion then to your decision, I proceed to the fifth action, or,

RETENTIVE FACULTY of the Stomach,

V.
RETENTIVE
faculty of the
Stomach.

Which is highly necessary to *Nutrition*. For, the transmutation of the newly receiv'd meat and drink into Chyle, being not perform'd in a moment, but a work of some hours; unless they be retain'd in the stomach a competent time, till that work be finish'd, both the *Concoction*, and the immediately following *Distribution* of the Chyle, without which there can be no *Nutrition*, must be imperfect.

This Retentive power seems to me to be wholly *Or- ganic*, and to consist, partly in a moderate and gentle Contraction of all the fibres of the Stomach, but chiefly of those that close the two Orifices of it; partly in a due Asperity of the inmost Tunic of the same.

(1.) In a *moderate Contraction of all the fibres*; be- cause otherwise the stomach could not closely embrace
the

the food while it is concocted, which requires a *Tonic* motion of all the fibres, and such a one too, as renders their forces in a manner *equal*, in all parts of the stomach; except the two orifices, where the constriction is stronger and closer, and chiefly in the *superior*, which during the whole action of Concoction remains closed even to a point. And this Contraction must be *moderate* and gentle, because all violent and impetuous Contraction, either causeth expulsion, or at least makes the retention tumultuous and inordinate; both which equally frustrate the design of Nature in the work of Chylification. During which the Ring of the *Pylorus* is not so closely shut, but that it gives way to *liquids* to slide down now and then into the gutts; though at the same time it strictly retains whatsoever is *solid*, and not yet converted into Chyle, that it may be farther digested. Nor doth it seem necessary, that *liquids* should undergo any farther concoction, being in that form fit to be admitted into the *Vene Lactea*; whereas Solids are not fit, till they have been melted. Which seems to be the reason, why those who drink the *Spa, Tunbridge*, and other the like subacid *mineral* waters, stay not expecting any concoction of them, but piss them out in a short time after, just such as they drank them. So do Good Fellows for the most part render their wine by urine, almost as fast as they pour it into their stomachs, at least much sooner than it can be digested. And all know, that Wine is no sooner received into the stomach, but in a moment it enters into the veins, cheers the heart (as they say) and recruits the spirits, rendring the pulses stronger than before. From all which instances we may collect, that *liquids*, chiefly such as are full of *spirits*, stay not long in the stomach, but soon slip through the *Pylorus* into the gutts, and insinuate themselves into the *Vene Lactea*, leaving the
grosser

grosser and solid parts of the food behind, to receive farther elaboration.

(2.) In a due *Asperity of the inmost membrane of the stomach*. For, as lubricity and smoothness of any surface favors the slipping away of bodies touching it: so doth the *Roughness* conduce to their adhesion. And all *Astringent* remedies, unless they some way or other induce a loathing or nausea upon the stomach, as they cause a contraction of the fibres, so do they corroborate the Retentive faculty of the stomach: whereas on the contrary, all *Lubricantia* conduce more to Expulsion, than to Retention. Again, in the *Lienteria* there is always too great a *slipperiness* of the stomach and gutts: as too great an *Asperity* in *Costiveness*. Finally, crude or raw food hath always in it somewhat of asperity; but being prepared by fire, becomes more soft, tender and slippery. Which may be the reason, why raw meats generally are more easily retain'd in the stomach, and such as are throughly boil'd, baked, or roasted, are more easily expell'd: those inducing roughness, these smoothness upon the parts of the stomach they touch. So that from all these instances it may be inferred, that to the Retentive power of the stomach, a certain Asperity in the surface of the inmost coat thereof is requir'd.

To these two Organical Constitutions of the stomach, in which it is apparent, that the Retentive power thereof is founded, some have added a *third*, not Organic, but *Similar*, and consisting in a certain *Complacency* or delight, which the fibres receive from the presence and contact of the meat and drink. But this opinion being grounded wholly upon the Hypothesis of *Natural Perception*, which yet seems obscure, intangled with various difficulties, and therefore doubtful; I suspend my assent thereunto, till I shall have learn'd

learn'd from you, whether I ought to embrace, or reject it. Meanwhile I take liberty so far to justify this my suspense, as to allege a reason or two in defence of it.

That not only the stomach, but all other sensible parts of the body are, from the very first moment of their formation, naturally endowed with a certain power, by which they distinguish what is grateful and profitable, from what is ungrateful and noxious; and which is the cause of all those motions and actions by Physicians generally and truly ascribed to irritation; is most certain, and to all men that consider Human nature, evident even from these arguments following.

(1.) In an egg, the very *Vesicula pulsans*, before it is formed into a heart, and a day or two before any the least rudiment of brain or nerve can be discerned; if it be, though never so gently, toucht with the point of a needle, doth instantly contract, and (like the sensitive plant) shrink in it self, as *feeling* the hurt done to it.

(2.) And the first model or draught of the Embryon, while it appears to be a mere mucilage or gelly, before there is any distinction of members, and when the brain is yet nothing but clear water; if it be in any part likewise prickt, contracts, and wreaths it self, like a maggot or caterpillar: demonstrating to the eye of the Spectator, that it feels the puncture, and endeavors to avoid it.

(3.) After the whole work of Formation hath been consummated, from the hour of our nativity to that of our death, there are performed within us many secret motions and actions, which are by Physicians (for distinction sake) call'd *Natural*, because they are done, not only without our knowledge or direction, but even against our will; so that we cannot moderate, accelerate, retard, or inhibit them, as
being

being independent upon the regimen of the Brain : and yet notwithstanding this independency, they must proceed from some kind of Sensation, by which the parts wherein they are done, are incited, irritated and altered. For instance; in the Heart it self there often happens great disorder of its motions, causing palpitations, tremblings, convulsions, faintings, swoonings, and various alterations of the Pulse, in magnitude, celerity, rhythm, &c. and all from some morbidick matter offending the fibres, and hurting their natural sense. For, whatsoever by its own motions endeavors to deliver it self from offences and harms, must certainly be endowed with a power to perceive or feel them.

Nor is the skin it self destitute of this distinct faculty. For, Experience convinceth us, that it easily distinguishes a venenate or poysonous prick, from a simple one; and thereupon constringeth it self, and becomes more dense, so that an inflammation and burning Tumor arises from thence; as may be observ'd in the invisible punctures made by the sting of a Wasp, the tooth of a Spider, or the proboscis of a Gnat. To be the more ascertain'd of this, our most sagacious Dr. *Harvey* made a pretty experiment upon himself, and hath left it upon record in *56. exercitat.* of his incomparable Book *de Generat. Animal.* "I prick'd my
 " hand with a needle, saith he; and soon after rubbing
 " the same needle against the tooth of a Spider, I
 " thrust the point of it into my hand in another place:
 " nor could I perceive any thing of difference betwixt
 " the two little punctures. But in the skin it self there
 " was somewhat that discerned betwixt them. For, in
 " the place where the venenate prick had been made,
 " the skin soon contracted it self into a little hard
 " tumor, accompanied with redness, great heat, in-
 " flammation, and acute pain; as if it fortified it self
 " against

“ against the invading enemy , and strove to expugne it.

To come to the stomach, our præsent subject ; this part also, and the gutts, being offended and provok'd by ill humors, often raise great commotions, nauseousness, belching, vomiting and fluxes of the belly : and as it is not in our power, at pleasure either to suppress, or to promote those disorders ; so neither do we know any sense depending upon the brain, that can excitate those parts to such violent and tumultuous actions. 'Tis wonderful even to a Philosopher, that a little of the infusion of *Crocus Metallorum* should produce such strange commotions in the stomach. We can not distinguish that infusion, from good Sack, by the taste ; nor perceive any trouble or offence in swallowing it : and yet there is in the stomach a certain sense that soon discerns the Antimony from the Wine, that abhors it, and incites the stomach with all its forces to eject it by vomiting. Hence also it is perhaps , that Alum, Vitriol, Salt of Vitriol, and (sometimes) Salt of Steel ; though by their astringency they augment the asperity of the inmost membrane, and the contraction of the fibres of the stomach (which are the two Organical Constitutions , in which the Retentive power of it is, according to my opinion, wholly founded :) are observed notwithstanding commonly to excite vomiting ; and this only, because they have somewhat in them that is highly ingrate and offensive to the natural sense of the stomach.

Now from these Arguments and particular instances (to omit others of the like importance in other sensible parts of the body) it seems most evident, that there is in us a certain sense of Touching , that cannot be refer'd to the *common sense*, nor belong to the jurisdiction of the *brain* ; and therefore is rightly distinguished

guished from the *Animal* sense of Touching. Such a sense we observe in *Zoophytes* or Plant-animals, the Sensitive plant, sponges, and the like. And as Physicians teach, that *Natural actions* differ from *Animal*: so with equal reason may we say, that this *Natural sense* of Touching, whereof we are not conscious; differs from the *Animal* sense of Touching, whereof we alwayes are conscious; and that it constitutes a distinct species of Touching.

This, manifest from its effects, but perplexingly obscure in its origin and essence, *Campanella* (who wrote large and most subtile Commentaries concerning it, now almost neglected) and our Excellent Dr. *Harvey* call'd by the name of *Tactus Naturalis*: but their Equal, Dr. *Glisson*, coming after to consider the thing more Metaphysically, and founding the very life or substantial Energie of Nature wholly upon the same, denominated it *Perceptio Naturalis*, thereby to distinguish it from all the Senses, as well internal, as external; from which he will have it to be really different, as for many other Reasons (alleged *in cap. 15. lib. de Vita Nature*) so chiefly for this; that it is not immediately communicated to the Brain, or Common Sensory, as Nature hath instituted that all Sensations of the Organs of the External Senses should be communicated, before the act of Sense can be complete; though the same Natural Perception may be, and often is, by various degrees, changed into Sense.

Now therefore, that I may draw all the lines of this Digression quite home to the Centre of my present scope; that there is such a thing as Natural Feeling or Perception, I acknowledge: that the name of Natural Perception is more distinctive, and therefore more proper, I confess: I grant also, that this discerning faculty is, by the immense bounty of the Omnipotent Creator,

conferr'd upon all the fenfile parts of the body, and among thefe upon the ftomach in a high degree: I farther grant, that by virtue of the fame, the Retentive Faculty of the Stomach may be, in fome cafes, much aided and promov'd: All thefe things I hold my felf obliged to concede. What then remains to be the fubject of my doubting and fufpenfe? Two things there are, which yet I can not bring my weak reafon to admit, though they have been, and with ftrong arguments too, afferted exprefly by a Man, whole doctrin I often follow, and whole authority I venerate.

The *First* is, that not only the fenfile parts of Animals, but this inanimate, yea, every fingle particle of Matter in the Univerfe, is from the Creation, endowed with this faculty of *Natural Senfe*, or *Perception*, (call it what ye pleafe) and with its infeparable Adjuncts, natural *Appetite* and *Motion*. For, who can believe, that any part of this dead body hath a perception of the knife of the Difector, and that the fibres of the flefh fuffer as much of irritation from the folution of their continuity now, as when the body was animated by a foul, and they were invigorated by the heat of the arterial blood, and the influence of the vital fpirits? Who can be perfuaded, that a marble pillar, when knock'd with a mallet, feels as much pain, as the limbs of an Animal, that is beaten with a cudgel? And yet both thefe things muft be true, if the fuppoftion of Natural Senfe or Perception be fo. What then fhall I do to extricate my thoughts from the perplexing difficulties of this *Ænigmatic Paradox*? My Curiofity urges me to examine them, my Underftanding is unable to folve them, and the Theorem is moft noble in it felf. Wherefore my defire of Knowledge will be alone fufficient to excufe me, if defpairing of fatisfaction from
my

my self, I humbly seek it from the Oracle of your more discerning judgement.

The *Other* (more neerly touching the point in quæstion) is this. I do not perceive any necessity, why *Natural Perception* should be brought in to concur with the two newly explain'd Organical Constitutions of the Stomach, in which the *Retentive Faculty* thereof seems to me to be wholly founded. For (1) that placid quiet which the Stomach is observ'd to enjoy, when satiated with good and wholsom food, may arise only from the cessation of the anxiety and trouble it suffer'd from the vellication or gnawing of Hunger; the biting Acidity of the *Fermentum Esurinum* being now blunted by the benign juice of the Aliment newly receiv'd. After which, the fibres, that before were irritated, gently and placidly restore themselves to their natural posture (as all other *Tensil* bodies also do) and therein attain to quiet and ease. So that the *Complacency* of which the stomach is then sensible, seems referrible to the *Sense of Touching*, common to all sensible parts of the body. For, if *Hunger* be an ungrateful *Sense* of emptiness or want of food; why should not *Satiety* be a grateful *sensation* of the supply of that want? since contraries are ever comprehended *sub eodem genere*. (2) But were the *Complacency* transferr'd from *Sense* to *Natural Perception*, yet would it not be necessarily consequent, that therefore the same is required to consummate the *Retentive faculty*, because usually the meat is retain'd in the stomach a good while, some hours, after the *complacency* ceaseth; and therefore the *Retention* seems, not to depend upon it. And this may be confirm'd from hence, that it is observed, that by how much more delicate and grateful to the stomach the meat receiv'd is, by so much the less while it is therein retain'd. Now these are the reasons that withhold me from

from assenting to that opinion, which placeth the Retentive power of the stomach, chiefly in the Natural Perception of it. But whether they be of weight enough to justify my suspence, or not; I leave to your determination; and here turn over leaf to a new lesson, *viz.*

The CONCOCTIVE Faculty of the Ventricle.

VI.
The CON-
COCTIVE
Faculty of the
Stomach.

WHICH, according to the order of Nature, is next to be consider'd; for all food is swallow'd, receiv'd, and then retain'd by the stomach, in order to its *concoction* or conversion into Chyle.

That this operation is, not organic (as we have shewn all the præcedent to be) but wholly *Similar*, is sufficiently evident from hence; that the Chyle it self, when confect'd, is similar; and all the Actions, by which it is made Chyle, are so too: nor dos the Cavity of the Stomach contribute more to this work, than a pot doth to the boyling of the flesh, that is put in it over the fire.

Most true it is nevertheless, that the Organ in which the work of Chylification is perform'd, is principally the *Ventricle*, in which the Concoctive power is most vigorous, and to which Nature hath committed the most difficult part of the whole operation. I say *Principally the Ventricle*; because I would not wholly deprive the *Gutts* of their right to the like power of changing aliments into Chyle, though they do it less efficaciously than the stomach, and as it were at second hand; that is, if any part of the Chyle happen to descend into them not perfectly elaborate, they farther concoct it, finishing the work the stomach had begun. Hence it is worthy our observation, that the Chyle taken in by *Vena Lactea* immediate'y from the stomach,

is thinner and more spirituofe, than that imbibed from the Gutts; and that receiv'd from the fuperior Gutts, thinner than that exported out of the inferior; and in fine, the thickeft is convey'd out of the *Colon*, and *intestinum rectum*. So that we may conclude, the ftomach is the *primary* feat or place of Chylification, and the Gutts, the *secondary*.

Having thus eafily found, what kind of operation the conversion of meat and drink into Chyle, is; and where it is performed: we are in the next place diligently to inquire (1.) What are the capital Differences of Aliments to be concocted in the ftomach; (2.) What various Mutations or Alterations the food ought to undergo, before it can be brought to the requifite perfection of Chyle; and (3.) What are the Causes, by which thofe Mutations are effected. And thefe are the three general heads of this our difquifition.

As for the *FIRST*, *viz.* the differences of Aliments to be digefted; 'tis well known, that all our food is either *Meat* or *Drink*, *folid*, or *liquid*; and all our drink, either *spirituofe*, or *watery*.

That all *Potulent* liquors require lefs coction in the ftomach, than folid meats, is not to be doubted; becaufe they ferve rather to dilute the thicker aliments, and give them a confiftence requifite to their conversion into Chyle, than to nourishment: and becaufe daily Experience teaches, that by how much the thinner and more penetrating, or diuretic they are, by fo much the fooner they pafs by urine, without any notable alteration; as we have already declared of the *Spa* and *Tunbridge* waters: and *spirituofe* or *vinofe* drinks, (*ceteris paribus*) are fooner digefted, than fuch as are not vinofe; yea more, they are juftly preferr'd for their virtue to promote and accelerate the digeftion

digestion of other things. The reason of which perhaps is, as well because their spirits augment the influent heat of the stomach, as because they soon grow acid, and so quicken the activity of the dissolving ferment therein contain'd. For, most certain it is, that all wines turn acid, almost as soon as they are receiv'd into the stomach; because by the Fermentation therein made, their sweet and more fugitive spirits are dispers'd in a trice: and those being gone, the reliques soon grow sowre, from the operation of the acid ferment upon them; and by that newly acquir'd sharpness, further concoction.

Liquid or spon-meats also, as pottages, milk and the like, are sooner and more easily digested, than solid: because their nutritive parts being actually dissolv'd afore-hand, they require only a light elevation of their spirits, by the fermentation of the stomach, to make them perfect Chyle, and fit to be admitted into the *Vena Lactea*. Provided, that if they be of a thick consistence, as pap, barley cream, frumentry, gellies, butter'd eggs, and such like, they be first diluted with drink, that they may more easily pass into the milky veins.

Solid meats are, as of greatest nourishment, so most difficult of digestion. For, they must pass through all the various Alterations requisite to the concoction of any Aliment whatsoever, before they can be brought to the state of perfect Chyle. While they remain in a solid form, 'tis impossible for them to enter into the inconspicuous mouths of the *Vena Lactea*: and therefore it is necessary, they should be melted, and reduced into the form of liquor, at least that the tincture drawn from them may be such, before they be offer'd to them. ¶

Now those various *ALTERATIONS* requisite to the perfect concoction of solid meats, are (besides those that are common also to liquids) but two, *viz. Liquefaction*, and *Extraction of Tincture*.

By the *first*, they are dissolved into a kind of Gelly or Mucilage. For, bread is by digestion turn'd into a papp, and the softer parts of flesh into a gelly or Consummé. The harder parts of neither are wholly dissolved, but for the most part commixt with the Excrements of the belly, voided whole. Hence it is, that experienc'd Nurses judge of the good or bad concoction of Infants, from inspection of their stools. For, if they therein discern any reliques of flesh undissolved, they truly conclude from thence, that their digestion is imperfect, and that food of easier concoction is more convenient to their weak stomachs, and accordingly abstain from giving them flesh, till they are more able to digest it.

By the *other*, the Tincture of solid meats is extracted: and this Alteration is competent to such tough and stubborn meats, as refuse to be dissolved. Some things indeed are now and then swallow'd down, that by reason of their hardness, are incapable either of dissolution, or of yielding any tincture; such as Cherry-stones, the kernells of grapes or raisins, &c. but these deserve not to be reckon'd among Aliments, nature always rejecting them whole and unchanged, among the Excrements. And these are the two requisite Alterations proper to solid meats: besides which, there remain yet three others *common* to both solid and liquid. Of these

The *First* is *Dilution* or through-mixtion of them with the drink; without which even liquids themselves, if of a consistence tending to thickness, could

never be transmitted into the *Vena Lactea*. To this Dilution of solids is requir'd, at first a small quantity of liquor: because a large draught in the beginning of a meal, doth dissolve, not the whole substance of the meat, but only the more tender and thinner parts of it, and extract them by way of tincture, leaving the rest untouch't. But after the substance of the meat hath been eliquated into a gelly, a larger proportion of drink is requisite to give it a thinner consistence. On the contrary, to the Extraction of a tincture, a copious Menstruum (as Chymists well observe) is requir'd. Which our skilful Farriers and Grooms having from experience learn'd, keep their Horses from water for an hour or two after they have eaten their oats. 'Tis therefore a good rule for conservation of health, to drink sparingly in the beginning of a repast; and freely toward the end of it, when the meat hath been dissolved, and requires to be farther diluted.

The *second* is, an *Exaltation of the spirits* of the meat to the degree, not of Volatility, but *Fusion*, that they may be more easily admitted into the *Vena Lactea*, and passing thence into the blood, serve to recruit the vital spirits. For, the proper office of the stomach is, to make of the food a permanent liquor, not fugitive vapors, that would inflate and torment it: and that permanent liquor ought to be replete with gentle spirits, that the vital spirits, which are continually dissipated and consumed, may be from thence supplied. Whence we may collect what the reason is, that Wine and all vinose drinks do less require this alteration, than other liquors, *viz.* because their spirits are in the state of fusion before they are admitted into the stomach, and so need but little farther elevation.

The *third* and last Alteration common to both solids and liquids, is an *Assimilation* in some measure of the nourishment to the nature of the body to be thereby nourished; at least a bringing of it nearer to the constitution of the body. For, by how much the more of similitude is betwixt two bodies, so much the more easily is the one transmuted into the other. Of this Assimilation are two parts; of which, one takes away the qualities of the food that made it unlike to the constitution of the body assimilant; the other introduces new qualities more agreeable and conform to it. The *first* is *destructive* of the old form; the second *eductive* of a new one. The destructive part consists in, first a gradual debilitation, and then a total subduing or taming of the reliques of the former seminal impressions of the aliments: in all which there certainly remain some *vestigia* or prints as it were of their pristine form, which may properly enough be call'd their *seminal impressions*: and these are to be at least so far subjugated, as to leave the matter capable of, and disposed to admit new specific impressions. Not that it is necessary they should be utterly *abolished* or eradicated, which perhaps is more than either the acid ferment, or heat of the stomach, or both together can do. For, in all Aliments, Vegetables or Animals, there are *Averrhoides, angula & iuxta* (as *Hippocrates de praxia Medicina*, calls them) certain indelible characters, or insuperable qualities, that may be as it were tamed or kept under, but can never be totally destroy'd. Our meat indeed is cookt by fire, broken into small pieces by our teeth, softned by the *liquor salivaris*, boyl'd in the stomach, melted by the acid ferment, exagitated by the peristaltic motion of the gutts, and therein farther elaborated, and separated from its dreggs, squeeze'd into the milky veins, thence transmitted into

the common receptacle, thence propell'd by the Chyliferous pipes into the subclavian veins, and so mixt with the blood, exagitated again by the motions of the heart, and imprægnated with vitality by the powerful energy of the vital spirits; all these alterations, I say, it doth undergo, and yet notwithstanding it still retains much of those invincible reliques of its former nature, which the *Chymists* have named, *media vite characteres*, and others, *Seminales impressiones*. And hence it is, *quòd omnia animalia sapiant alimenta quibus vescuntur*, All Animals, however præpared or cook't, still retain some savor, some ragoust of their usual food: as Birds that live upon little fishes, yield a fishy Haut-goust; and the flesh of Swine fed with Sea-Onions, is apt to cause vomiting in the Eaters of it, &c. Wherefore by this last act of Concoction, we are to understand only such a change of the Aliment, as renders it more familiar and assimilable to the nature of the parts of the body therewith to be nourished: for, a *perfect Assimilation* is not to be expected, till the same shall be intimately united with them. Nor is Chylification, what many have conceiv'd it to be, an absolute *Metamorphosis* of the Aliment, or corruption of its first form, and change of it into a new species; there seeming to be no such thing as *Corruption* in the case, but an *Exaltation* rather, or *Melioration* of the nature of the food, by advancing it from the state of fixation, to that of *Fusion*, that it may be prædispos'd to its succeeding conversion into blood and the *Succus Nutritivus*. True it is indeed, that the meat is sometimes corrupted in the stomach, by vitious humors therein contain'd and depraving it, and by various other causes: but it doth not from thence follow, that absolute Corruption is necessary to the præparation of the Chyle; but rather that the meat, if by accident it be
absolutely

absolutely corrupted in the stomach, is thereby render'd unprofitable to nutrition for the most part. True it is also, that the dreggs of the Chyle, being by way of *Degradation* from their former nature, changed into *Excrements*, put on a new form in the *Colic Gutt*, and differ *in specie* from that part of the meat out of which they are made: and yet notwithstanding, we can not from thence rightly infer, that the *Chyle*, which is by a perfective motion gradually meliorated, is necessarily changed also into a new species, before it can actually nourish.

Is no part of the Aliment then, in the act of Chylification, metamorphos'd from one species to another? I conceive *not*; unless the Version of the *Acidum Vegetabile in Salsum Animale*, be accounted a Specific Mutation. If so, then this must be excepted from the general rule. For, certain it is, and acknowledged even by Chymists themselves, that *Vegetable Salt*, such as is usually extracted from Plants, is no where to be found in the bodies of Animals; neither in their blood, nor in urine, nor in flesh, nor in bones, hairs, nails, &c. and therefore very probable, that every *Acidum Vegetabile* is transmuted *in Salsum Animale*, either in the stomach, or in the descent of the Chyle into the Gutts, or soon after. Nor is it (in my poor judgement at least) a thing of small moment, or lightly to be regarded, that all parts of all Animals, are compos'd of a *Saline principle*, of a divers nature from that of either Vegetables, or Minerals; yea more, that the *Saline, volatile spirits* of Animals, come much nearer to the nature of *Sal ammoniac*, than to that of Salts Vegetable, or Mineral. But whether these saline spirits of Animals may in all things be consistent with the *Nitro-aereous spirit* asserted by the ingenious Dr. *Mayow*; may with good reason be doubted. For, although it be said, that this

Nitro-

Nitro-aereous spirit doth, in passing through the Lungs, put on the genius of *Animal Salt*: yet it remains still to be inquir'd, why Nature should ordain that spirit to be fetch't from without from the Aire, which Animals have in abundance within them, in the Aliments prepared in themselves. This nicety therefore I leave, as I found it, doubtful: and proceed to inquire, *Whence it is, that the Stomach infects all meats and drinks with Acidity.*

This requisite and remarkable quality seems to be superinduced by the Stomach upon the newly receiv'd aliment, by four several wayes, *viz.*

(First) By *educing* and *separating* the *sweet and benign spirits* of the Aliments, from the grosser parts of them; and then either absorbing them into its *Vena Lactea*, or transmitting them by the *Pylorus* into the Gutts, or dissolving them into wind. For all nutritive juices whatsoever, so soon as the sweet and easily dissippable spirits, that præserve them, are exhaled, grow acid: as is commonly observed even in Milk, whose fugitive spirits being for the most part drawn forth by the stomach, and thence discharg'd by belching; the remaining part soon acquires to it self somewhat of acidity. But the truth is, this Education of spirits, though it make way for acidity to succeed, doth not yet produce it in that degree which we frequently perceive in very sour belchings: and therefore we are obliged to advance to the

Second Cause, which consists in this; that the stomach turns liquors sour, by bringing their *Saline principle* or element, to the state of *Fusion*. For, this Saline Principle, while it remains fixt, retains its saltness: but being advanced to the state of fusion, soon becomes *acid*, and that so much the more fiercely, by how much the nearer it is promoted to *Volatility*.

Whence

Whence it is, that meats and drinks long detained in the stomach, are observ'd to acquire vehement acidity. So likewise when any of the *Glandules*, that serve either to *secretion*, or to *reduction*, have, by reason of their obstructions, long detain'd in them the humors that remain to be carried off, after the distribution of the *Succus nutritivus*; they cause them by that means to grow more and more *acid* by degrees, to the no small detriment of health. Of this we have a remarkable Example in sharp and acid *Catarrhs*; which seem to owe their origin to the recrements of the brain and nerves, longer than is fit retain'd in the Glands destined to their secretion and exportation; and by reason of their stagnation, grown acid; and which sometimes become so extremely sharp, as to corrode and ulcerate the Tonsills, throat, nose and other parts they touch. Of this way of converting the fixt salt of mixt bodies into an *Acid*, only by *Fusion*, I should here have said much more, had I not saved myself that labour, by explaining the same expressly and copiously in the seventh Chapter of my Book *de Scorbuto*, where I endeavor to trace out the Genealogie of that sort of *Scorbute*, which seems to arise from the prædomination of *Acid* Humors. Referring therefore the unsatisfied to that discourse, I shall add only this necessary advertisement; that this seems to be the cause, why the reliques of the former meal often contract so great a sharpness, that if they chance to be thrown up by vomit, they set the very teeth on edge, and excoriate the throat by their cutting sourness; and that the natural use of this acid liquor in the stomach, is that, as a kind of Menstruum, it may serve to dissolve the solid meat, or at least to extract a tincture of it the sooner. For, so far is it from being nutritive, that it is on the contrary, a great deprædator, if consider'd

sider'd apart by it self, and not mitigated by commixture with the sweeter parts of the Chyle. It cannot then be design'd by Nature, as requisite to the natural constitution of the Chyle, but only as a fit instrument for the dissolution of solid food. Which is abundantly confirm'd by the very taste of the Chyle, which in its natural state, is always sweet.

(Thirdly) The stomach produces this Acidity, by mixing with the newly receiv'd meat, both the acid reliques of the former meal remaining in it, and the acid Phlegm brought into it from the arteries. Which mixture is yet so far from conducing to the perfection of the Chyle, that it rather renders the same so much the more impure. For the *Vena Lactea* admit not the Chyle, until the pure and sweet part of it hath been separated in the Gutts from the acid: as appears from the sweet and mild taste of the liquor contain'd in them. Which is another argument, that the Acidity contracted in the Stomach belongs not to the nature of the Chyle, but is requisite only to the dissolution of the solid meats.

(Fourthly and Lastly) . The stomach induces acidity, by this, that the principles or elements prædominant in its native constitution, namely *hungry spirits* and a *sharp salt*, being actuated and instigated by the vital influx, act powerfully upon the newly admitted aliments, and (according to the manner of all natural Agents) endeavor to assimilate them to their own nature, *i. e.* to imbue them with their qualities. To effect this, 'Tis necessary they should promote the fixt salt of the food, to the state of *Fusion*: which being once achiev'd, that salt soon grows acid, and comes near to the sharpness of Vinegre, if it be a *Veget.ble* salt, such as is contain'd in bread, sugar, honey, beer, wine, and almost all sorts of drink. For, *Flesh* indeed doth

doth not with equal facility turn fowr, nor suffer its spirits to be so soon exalted. Whence we may learn, that to put flesh into ale, beer, wine, or any other drink, in hope to render the liquor more nutritive and strong, is a vain thing; because it communicates to the liquor, little or nothing of its nutritive virtue. And in the stomach, all flesh is sooner or later dissolved into a kind of gelly, or at least leaves a strong tincture in the drink commixt with it: and if detain'd too long therein, it becomes salt, egre or rancid; the fixt salt of it being fused, acquiring acrimony or rancor, rather than acidity. But this happens, not in the natural state of Concoction, but when the stomach is by some error committed in diet, hinder'd from doing its office rightly.

From what hath been here said, concerning the four Causes of the Acidity induced upon the Aliment, by the stomach, in the act of Chylification, we may collect, That all food consisting of Vegetables, passes through three several States or Conditions, before it is brought to the perfection of Chyle, first it is made Acid, then salt, and at length sweet. How it comes to acquire to it self the first and second of these Qualities, we have already seen. It remains then to be inquir'd, *How the Chyle comes in fine to be sweet.*

To solve this Quæstion, 'tis requisite I should advertise you, (1.) That the *Acidity* of which we have been speaking, is not vehement, but *gentle* and *little*; and consequently the *Saltiness* into which it is resolv'd, is likewise but *gentle* and *weak*: for, both are to be distinguisht, as well from the acid reliques of the former meat, as from the dissolving ferment of the stomach, neither of which are hardly ever elaborated into good Chyle. (2.) That this gentle Acidity when it is converted into as gentle saltiness, loseth it

dominion to the fixt spirit of the meat, which now advanced to the middle degree of Fusion, over-powers and conquers it: and yet this prævailing saltness is no more, than what may just serve to a due conditure of the Chyle. For, as it did not abound in the food before concoction; so neither doth it exceed that proportion after in the Chyle, there being nothing of new salt added to it in this mutation. As therefore, in the ripening of Fruits, there intervenes an *Acid* taste betwixt an *Austere* or *Styptic* and a *Sweet*; and yet nevertheless, as the spirits of the fruits attain to maturity, that *Acid* taste gives place to the succeeding *Sweet*: so it seems probable, that in the Concoction of the stomach, the meat, its fixt salt being fused, and substance melted, doth first become acid; and soon after, its spirits that lay bound up and idle, being excited, become *sweet* again, or is digested into a sweet juice. And this in short is the most rational account I have hitherto met with, of the reason and manner how the *Chyle* at length comes to be *sweet*, after the several changes it hath suffered in the stomach.

But *What becomes of the Acid reliques of the meat, and of the saline dissolving Ferment of the Stomach?* I answer, that as to this particular, I am of their opinion, who hold, that the volatile parts of those *Reliques*, being transmitted out of the Ventricle into the Gutts, and therein exagitated, are receiv'd into the milky veins together with the Chyle, as of further use to the blood it self: and that the *gross* and *unactive* parts, mixt with the unprofitable residue of the Aliments, are excluded with the Excrements of the belly. For, as to the *Volatile* parts; they seem fit to be inservient to Nature even in one of her noblest actions, the generation of *vital spirits* in the blood: which in all Animals consist, partly of *saline* spirits, partly of *Sulphureous*.

Sulphureous. For, in no part of any Animal hath hitherto been found any such spirit, as that which is drawn from Plants after fermentation. This is well known to those *Philosophers by fire* (as they call themselves) who have long sweat in extracting the spirits of blood: and yet notwithstanding have never been able, after all their pains and tedious processes, to draw any thing from thence, but a certain *salt spirit*, not much different from the spirits of Urine, of Harts-horn, or of Sal Ammoniac; unless that perhaps it was somewhat more subtile, less acrimonious, and less ingrate. And certain therefore it is (as I before affirm'd) that whatsoever of *Acid salt* hath not been actually converted into salt in the stomach, is soon after, when the Chyle arrives at the Gutts, changed into *Animal Salt*; no such thing as *Vegetable Salt* being to be found in any part of any living creature. ¶

Having now at length, (with more of haste perhaps, than of satisfaction to my Auditors) run through all the general *Differences* of Aliments to be concocted, and all the various *Alterations* they undergo in the stomach, before they can be brought to the perfection of good and profitable Chyle: we come next to the *Third Head* of our præsent Disquisition, *viz.* the *CAUSES* of those Alterations.

WHICH, though many and of various kinds, may nevertheless be commodiously enough reduced to two general Classes or Orders; *viz.* such as are *Foreign*, or Extra-advenient to, and such as are *Indigenary* or Inbred in the stomach.

To the *First* classis belong all things that any way conduce to the promotion of Concoction, either by *previous Alteration* of the Aliments, or by *fortifying* the *Stomach*.

Of those that remotely conduce to the work of Concoction only by *Præparation* of the food ; some correct the Crudity of it by the help of fire, namely by boyling, roasting, frying, or baking : others render it more mild and tender by maceration, in brines, lixivia's, pickles, vinegre and the like : others make the Aliments more familiar by way of hastning their Maturation : and others again intenerate, and dispose them to dissolution, by mixture of some wholsom and agreeable Ferment. Where it may be observed, that whatsoever Aliments, whether solid, as bread, or liquid, as wine, beer, ale, hydromel, &c. that have undergone Fermentation, before they are receiv'd into the stomach, invite other Aliments, with which they are therein commixt, to fermentation. Hence it is, that good wine, strong beer, vinegre, bread made light by leaven, and the like, help very much to digestion.

Those that do so by *corroboration* of the stomach, are *Peptic* or *Digestive Remedies*, as mints, roses, wormwood, Aromatics, &c. But all these (of both sorts) being only *Accessories* and foreign, require not to be farther prosecuted in this place.

The *Inbred Causes* of Concoction are, either *Instruments* generated in the stomach, or the *Constitutions* of the stomach in which the Faculty of Concocting is founded.

1. The *Instruments* are the *Ferments* contain'd in the stomach, four in number, whereof two are *Principal*, and the other two only *Adjuvant*.

The *Adjuvant* or less powerful, are the *Humor Salivaris*, and the *Acid Phlegm* of the stomach ; both which help somewhat toward the inteneration of the meat. But because they help but little, in comparison of the other two, I content my self with the bare mention of them *en-passant*.

The *More powerful*, are the *Acid reliques* of the former meal, which tho' more efficacious than both the Adjuvant ferments, are yet in comparison of the grand one, less considerable; and therefore I may well be excused, if I pass them also over in silence: and the *proper Ferment of the stomach*, which being the Principal instrument of Concoction, deserves to be particularly consider'd.

The origin and nature of this admirable dissolving Ferment (the only true *Alkalesc* in nature) having been first investigated, not many years past, by the great industry of the learned and judicious *Mæbius*, and professedly proved by convincing experiments and observations, in a prolix dissertation contained in his Book *de Fundament. Medicinæ*; and since that time, much illustrated by our happy Dr. *Glisson* (*de ventric. & intestin. cap. 20.*) all that remains for me to do concerning it, is only to recall to your memory the most remarkable heads of those things ye have read in those discourses, by giving you a *Breviary* of them. This therefore I will do, and in as few words as can with reason be expected.

This Ferment then is nothing else, but the *spirituose* and *saline effluvia* stirr'd up by the vital motion of the arterial blood, effused out of the arteries into the cavity of the stomach and gutts, but chiefly of the stomach, and therein condensed again into a sharp, penetrating and dissolving liquor; apt to dissolve the solid meat, and to cause such a benign *fermentation*, as tends, not to volatilization, but only to *Fusion* of the same; and in fine, acting upon it, not by open force or violent invasion, but (after the manner of *Contagiose ferments*) rather by clancular insinuation, and mixing it self, first with the saline and spirituose parts, and then with the grosser and less exsoluble.

In this concise Abridgement, I have (I confess) omitted two Positions, both zealously asserted by the later of these two excellent Authors, out of whose doctrine I abstracted it. *One* is, that that part of the blood, which is by the *Cœliac* and two *Mesenteric* arteries, dispensed to the stomach and gutts, chiefly to the inmost coat of them, is somewhat more *salt* and *sharp*, than the blood distributed to other parts of the body. The *Other* is, that the Saline and spirituose parts of the Meat newly admitted into the stomach, perceiving that they are ill lodg'd, and that the Ferment with which they there meet, is really semblable or like to them, and with all more noble (as retaining some reliques of vitality, with which it had so lately been ennobled, while it pass'd through the heart and arteries) do easily admit, embrace and conjoyn themselves with it.

But I declare withal, that I omitted these Positions, not from inadvertency, nor for brevity sake; but only because I doubt of the verity of them. For the *first* supposes *Similar Attraction*, or mutual coition of things alike, *ob similitudinem naturæ*; which yet I do not find myself obliged to grant. And the *other* depends upon the Hypothesis of *Natural Perception*, which is not yet establish'd beyond disputation.

However, it seems to me sufficiently probable, that this dissolving Ferment is peculiar to, and generated in the stomach; because nothing like it is to be found in any other part of the whole body: that to the constitution of it, is required a concurse of both salt and sulphureous spirits (such are the vital spirits themselves) but chiefly of Salt (than which nothing is more sharp, penetrating and dissolving): and that therefore it may be call'd, as *Mæbius* named it, *Sal spiritibus imprægnatum, acre ac pungens*; or, as *Dr. Glisson*, *Fermentum Ventriculi-fusorium, seu principale coctionis instrumentum*; because

cause it doth not only efficaciously dissolve the solid parts of the food, but also give it the first degree of Assimilation to the nature of the Animal, out of whose blood the ferment it self is derived. Which may be one reason, why the same Aliment receives a divers præparation in the stomachs of Animals of divers kinds; the ferment being in some sorts different from that in others, respectively to the difference of the blood. And this is all I have to say of the chief *instrument* of Concoction, the proper and inbred Ferment of the stomach.

2. The *Constitutions* of the stomach, in which the Concoctive Faculty seems to be founded, are three; *viz.* Vital, Animal, and Natural. Of these, the two former are influent, the first from the fountain of life, the blood; the second, from the brain: the third, insite or implanted in the stomach it self from its very formation. From all these Constitutions concurrent, and by an admirable contrivance of the Divine Wisdom combined, there results a certain power, which is the Principal Cause of all the operations of the stomach. Hence we properly enough say, the stomach craves meat, and the stomach digesteth. For the Seminal Principle of the stomach, including both the Vital and Animal influences, together with the native Constitution, is the whole, and so the Principal cause of all its operations. But this being a Complex cause, cannot be well understood, unless the three Constitutions here named, of which it is composed, be singly consider'd. What the Vital and Animal are, will be easily collected from what I have designed to say, when I come to inquire concerning life, and the influence of the brain. And as for the insite or congenite Constitution; that consisteth in the *Temperament*, in the *Habit*, in the *Tone*, and chiefly in the *implanted spirit* (as the *Galenist* calls it) or (as the *Chymists* and *Helmontians*) *Archeus*, which

which assisted by the influent vital heat, and by the Animal influx, is doubtless the grand cause of Concoction, and together with the newly describ'd Ferment, performs the whole work. Which being accomplish'd, there immediately succeeds another operation equally necessary to Nutrition, *viz.*

The DISTRIBUTION of the Chyle.

VII.
DISTRIBU-
TION of
the Chyle.

WHICH is perform'd by three distinct actions of the Distributive Faculty of the stomach and Gutts, *viz.* (1) the Exclusion of the Chyle out of the stomach into the Gutts: (2) The *Agitation* of it to and fro by the Peristaltick motion, partly in the stomach, but chiefly in the gutts; and (3) the *Transmission* of it into the Milky Veins. The reason and manner of all which actions I shall endeavor briefly to explain; supposing them to be *Organical*.

As to the *FIRST*, *viz.* the *Transfusion* of the Chyle out of the stomach into the gutts, I conceive it to be effected by a double motion of the Chyle; one, *impress'd* upon the Chyle; the other, *natural* to it, or spontaneous: The first, *upward*; the second, *downward*. The *impress'd* and *upward* motion, by which the Chyle is elevated to the *Pylorus*, I ascribe to the *Constriction* or closing of the whole stomach. For, all the fibres of the stomach, by the motion of self-restitution (common to all Tendons, after they have been extended in length) more and more contracting themselves by degrees, of necessity lessen the cavity in which the Chyle is contain'd; and this coangulation of the cavity, of equal necessity raises it up to the *Pylorus*, and (the other orifice remaining closely shut up, while the whole act of Concoction lasteth) forces it out at the same: in the same manner

manner as the liquor of a Clyster is squeez'd out at the pipe, only by compression of all parts of the bladder including it. The *natural* and *downward* motion, by which the Chyle slides down into the gutts, is to be attributed to its *Gravity*, which causes it to descend from the *Pylorus* into the gutts spontaneously.

But this later motion belongs not to that part of the Chyle, which is carried off immediately from the stomach by the milky veins that are proper to it. Which yet cannot be much, perhaps not the hundredth part of the whole mass of Chyle, because the *Vena Lactea* of the stomach are but few, their number scarcely holding the proportion of a hundred to one, with the great multitudes of those that take in their freight from the Gutts.

Nor is all the other part of the Chyle devolved into the gutts together and at once, but by *degrees*, as it comes to be concocted. For, it is constant from the dissection of Animals alive, that the Chyle, when it is concocted, is fluid or liquid, and visibly distinct, yea easily separable from the solid meats not yet dissolved; as broath is in a pot distinguishable from the flesh boyl'd in it. And because the solid meat is for the most part heavier than the liquor, and therefore sinks to the botom of the stomach; it must needs by pressure cause the liquor to rise to the Pylorus, to give way to what presses it: So that the thinner part of the Chyle is always first express'd. For the two orifices of the stomach are of equal height, and both a little higher than any other part of the same. Whence may be collected one good reason, why 'tis more conduisible to health, to sit or stand, than to lie down, upon a full stomach. For in a man that keeps the Trunc of his body in an erect posture for some time after meat: the load of the stomach creates little or nothing of trouble to the orifices of it, but beareth only

upon the bottom and sides. Whereas he that lies down soon after he has fill'd his belly, inverts the order of his meat, and turns the liquid part out by the Pylorus, before it hath been sufficiently concocted; and so fills his body with crudities, than which I scarce know any thing more pernicious to health. And this seems to me sufficient to explain the reasons and manner of the *devolution* of the Chyle into the gutts, which is the first act of the Distributive Faculty.

As to the *SECOND*, viz. the *Agitation* of the Chyle to and fro; this equally distributes the Chyle to all the gutts, as is not only convenient, but of absolute necessity to Nutrition. For, since Nature hath dispens'd *Vena Lactea* equally to all the Gutts, 'tis fit the Chyle also should be equally distributed to them all, sooner or later, that each one may have its share of the dividend. Again, since only the outward superfiice of the matter contain'd in the stomach and gutts, bears against the orifices of the *Vena Lactea*, and since the *Vena Lactea* do not hang forth, or stand strutting into that matter, but are terminated in the interior membrane: 'tis requisite, the matter should be turned and revolv'd to and again, that the whole may at length be brought to their doors and offer'd to them.

Now this is effected wholly by an operation *Organical*, and the Efficient is the *Peristaltic Motion* of the stomach and gutts, proceeding from the alternate contraction and extension of their Fibres, as we have this day shewn, when we describ'd the Peristaltick motion, and gave a Mechanic account of it. Choosing therefore rather to exercise your Memory, than to abuse your Patience by a vain repetition of the same things; I will here consider only the *Congruity* of the figures.

figures of the stomach and gutts, to the Distribution of the Chyle, by virtue of this Agitation.

As the stomach has the advantage in the office of Concoction, so is the power of the Gutts, paramount in the business of Distribution: and therefore Nature, which conferr'd these powers in different degrees upon them, and always accommodates her instruments to their proper uses and ends, fram'd them of Figures most commodious respectively to their peculiar functions. In particular, she made the *stomach* more ample, but *shorter*: and therefore fitter to Fermentation of the aliment: because by how much the more profound any Cavity is, by so much more contracted is the superficies of the matter therein contain'd (supposing the quantity equal) and consequently so much the less of it comes to touch the sides of the cavity within; and *è contra*. The *Gutts* she made *slenderer*, but *longer*; and therefore the apter to Distribution; because gracility conjoin'd to longitude, promotes Distribution, in three several respects. (1) The narrow or slender cavity of the Gutts, wanting deep profundity, applies it self to the more parts of the Chyle contain'd in it at once: (2) by reason of its great length, it affords room sufficient to the greater number of Milky veins to range themselves in the interior superficies of it, and (3) by reason of the gracility and length conjoyn'd, the Chyle is more easily commoved from the centre to the circumference. Hence then we come to understand the reason, both of the gracility, and of the length of the Gutts.

The *Use* of this distributive motion is threefold. (1) The reduction of all things contain'd, whether in the stomach or in the Gutts, to an equal diffusion, so that they may not lie congested in one place, and be deficient in another: (2) The opportune admotion of

the whole mass of Chyle to the orifices of the Milky veins : (3) the facilitation of the descent of the Chyle. Of these Uses, the first and second are more eminent in the Gutts by much, than in the stomach : because (as I said but even now) but very little, scarce the hundredth part of the Chyle is brought to the orifices of the *Vena Lactea* in the stomach ; the main stream of it running down into the Gutts. But the Third is more conspicuous in the stomach : because the Chyle that is by this motion devolved to the *Pylorus*, rarely slips back again, but falls down by that aperture into the Gutts, to the end it may be thence transmitted into the *Vena Lactea*, which is the

THIRD and last act of the Distributive Faculty, and seems to me to be done, chiefly by Constriction of the Gutts, and partly by their compression by the Muscles of the Abdomen assistant to Respiration ; not by Attraction or Exsuction of the Chyle by the *Vena Lactea*.

First I say, chiefly by *Constriction* or *Contraction* of the Gutts ; because 'tis evident to sense, that the chyle coming into the gutts, fills their cavity, swells them up, and distends their membranes ; and consonant to reason and the law of all nervous and fibrous bodies, that the fibres of the Gutts, irritated by that distension, should endeavour to recontract themselves to their natural state and position. Now this they cannot do, but they must at the same time gird in the membranes, and streighten the cavity of the gutts : nor can the cavity containing be lessened, without pressing the liquor contained, and forcing it to recede some way or other. Upwards it cannot retire, because the mouth of the stomach is barricadoed against it : downward it cannot evade, that gate being shut by the *Sphincter* of the fundament : other way there is none ;

none, but only that which leads into the *Vena Lactea*. This way then the Chyle must take, to deliver it self from pressure by the spontaneous Constriction of the Gutts. Whence I am apt to conclude, that the Chyle is transmitted from the gutts into the *Vena Lactea*, by way of *Expression*: and that the proxime and principal cause of that Expression, is the spontaneous Constriction of the fibres of the gutts.

Secondly I say, partly by *external Compression of the gutts*, by the Muscles of the *Abdomen* cooperating to the motions of Respiration: because 'tis most certain, that by the contraction of these Muscles, the Gutts are compress'd almost on all parts; and no less certain, that this compression helps them to squeeze out whatsoever is contain'd in them: as appears in exclusion of the excrements of the belly, in breaking wind, in belching, &c. If the Contraction of these Muscles (such I mean, as is ordinarily made in *Expiration*) be thought too weak to compress the gutts to a degree requisite to express the Chyle; I can justly call in the depression of them by the *Diaphragm in Inspiration*, to the assistance thereof: and that hath been held of so great force to the Expression of the Chyle out of the gutts into the Milky veins; even by *Monsieur Pecquet* himself (a man of solid Erudition, an acute judgement, and curious to explicate natural things by Mechanic principles) that writing of the motion of the Chyle (in *dissertationis Anatomicæ cap. II.*) he fear'd not to ascribe very much to it, in these words. "*Ad respirationem redeo, in qua dum pulmones dilatantur, etiam deorsum diaphragma premunt, jecurq; quod tum pistillum agens, succutientis per intervalla molis gravamine, non solum adigit chylum è ventriculo per Pylorum in intestina secedere; sed eorundem distendit porulos, illâq; subtilissimam impellit in lacteas alimentari substantiam.*"

If it be *objected*, that the depression of the stomach and guts by the Midrif, cannot concur with the Compression of them by the Muscles of the Abdomen; because the contraction of these, is not Synchronic or coincident with the distension of that: I have this to *answer*. True it is indeed, that these motions are alternate, that is, when these Muscles are contracted, the Midrif is relax'd upward, and by filling the lower part of the chest, expels the breath upward; and so *Expiration* is perform'd: and on the contrary, when the Midrif is distended, at the same time these Muscles are relaxed, the bowels depress'd, the cavity of the chest enlarged, and the air rushes into it from without, and so *Inspiration* is made. This, I say, is true: but this truth seems not to impugn the opinion I now defend. For, as often as the Compression of the Stomach and guts by the Contraction of these Muscles, is intermitted; so often is their Depression by the distended diaphragm, repeated or renewed: So that though these motions be alternate, the pressure of the guts, and consequently of the Chyle contain'd in them, is continued; and as to the Expression of the Chyle into the *Vene Lactea*, 'tis all one whether the pressure be from above or on the sides. I have seen young Lads at *Paris*, for sport, take the skin of a Snake, neatly stript off from head to tail, fill it with water, then prick it through with a needle in many places, and in fine by either pressing the water from one end toward the other, or compressing it hard in the middle, force it to flow forth in as many slender streams, as the needle had made holes in the skin. And this (methink) is a pretty lively representation of the manner of the Expression of the Chyle out of the guts into the Milky veins.

Thirdly

Thirdly I say, not by *Attraction* or *Exsuction*, as is generally believ'd. For (1) Natural Philosophers are not yet agreed upon the point, whether there be in nature any such thing as Attraction, properly so call'd, or not: and they that are on the Affirmative part, seem to me to have the worst end of the staff; it being much more probable, that all the motions attributed to Attraction, are really perform'd by *Impulsion*. (2) Although it were granted, that some bodies may be moved by others by way of Attraction; yet would it still remain extremely difficult to find, what should cause the motion of the Chyle, of which we are now speaking, by the same way. Of all Attractions mentioned by Philosophers, there are (if my weak memory deceives me not) but three differences or sorts, *viz.* Attraction *ob fugam vacui*, Attraction *Organic*, and Attraction *Similar* or *ob similitudinem substantiæ*. But no one of these seems to have place in the effect here propos'd. Not the *first*; because the *Vene Lactæa* are not, by reason of their exiguity, capable of such a *vacuum coarctatum*, as the *Aristoteleans* require to cause attraction of even fluid bodies: nor do they contain any *disseminate vacuities* (as they call them) when they are not fill'd with Chyle; because then they close themselves and draw their sides together, in so much that they wholly disappear. Here then is no danger of vacuity, and consequently no necessity of Attraction for avoidance of it. Not the *Second*; because the *Vene Lactæa* have no hooks, chords, or other instruments, wherewith to take hold of the Chyle, and draw it into their mouths out of the gutts. Nor the *Last*; (1) because all Similar Attraction supposes *Natural Perception*, than which nothing is (to me at least) more doubtful: (2) because the affinity or similitude of nature required to be betwixt the Attractant, and the thing to be attracted,

is here wanting; for, what is there of *Resemblance* in substance, or qualities, betwixt the Milky veins, on one part, and the Chyle, on the other? This is a *fluid*, those are *solid* bodies: the Chyle is a liquor composed of *heterogeneous* or dissimilar parts; the *Vena Lactea*, on the contrary, are *Similar*, spermatic parts. Wherein then consists the *ὁμοίωσις* or *Analogy*, that should cause an attraction of the one by the others? If it be said, that, not the *Vena Lactea* themselves, but the reliques of the former Chyle remaining in them, attract the new Chyle, *ob similitudinem substantiæ*. First we may deny, that, in the state of health, any thing of Chyle is to be found remaining in the Milky veins, after the work of distribution is finished; and justify this our denial by the testimonies of all Modern Anatomists who have written of the motion of the Chyle, and of the *Vena Lactea*. And then we may ask of the Patrons of Attraction Similar in this case, Why the Chyle contain'd in the gutts, being vastly more in quantity, should not rather attract the supposed reliques left in the *Vena Lactea*? Besides all these reasons daily Experience assures us, that not only pure and nutritive Chyle, but the particles of Purging and other ungrateful and offensive Medicaments, are received into the *Vena Lactea*; which they would never admit, in case they attracted the Chyle *Electivè*, by election or choice, as the supposition of *Similar attraction* implies. To conclude therefore; it was not without reason I said, that the Chyle is not transferred from the gutts into the Milky veins by way of Attraction or Suction, but only of *Expression*.

This may be confirmed by the very manner of the transmission of the Chyle into the *Vena Lactea*, which seems to be, not immediately from the cavity of the intestines, but through the inmost Tunic of them, and that by way of *percolation*.

First

First I say, *not immediately from the cavity of the stomach and guts* ; because 'tis demonstrable even to sense, by various Anatomic experiments made in the bellies of Animals alive or dead, that the *Vena Lactea* do not perorate or pass through the stomach and guts, but are all terminated in the inmost coat that lines them. For, neither by *injection* of liquors, nor by *inflation* with air, nor by the strongest *compression* whatsoever, can any thing be made to pass from the stomach or guts into the *Vena Lactea*, whether the Animal be open'd alive or dead, full or fasting. Whence 'tis sufficiently manifest, that these veins do not open themselves into the cavity of the stomach, or into that of the intestines; for, if they did, what can be imagined to hinder the ingress of liquors, or air, when vehemently urged by compression, into them? Wherefore I say

Secondly, that the Chyle is transmitted by *percolation*, through the very *Parenchyma* of the stomach and guts, *tanquam per manicam Hippocratis*, as through a streiner. For, it is not the custom of Nature to institute any secretion or separation of humors without a *Colatory*: nor doth she use, where there is need of a streiner, to ordain a single membrane, but some peculiar *Parenchyma*, to that purpose; much less to delegate that office to the naked orifices of vessels of what kind soever. For, the orifice of a vessel, as simply such, *i.e.* as a mere organ, promiscuously admits whatever is brought to it; not separating one liquor from another, the thinner from the thicker, the pure from the impure, but taking in without discrimination all that comes. Seeing therefore that Nature for the separation of different liquors confus'd, is always observ'd to use some *Parenchyma* as a *Colatory* or Streiner; and seeing no other sufficiently noble and considerable use can be assign'd to the *Parenchyma* of the inmost Tunic of the stomach and

Z

guts,

guts, but this I now attribute to it: these things (I say) duly consider'd, I think it most probable, that the *Parenchyma* of this *Tunic* doth perform the office of a Streiner to the Chyle, receiving and conveying into the Milky veins, the thinner parts thereof, and excluding the gross and excrementitious; as an *Hippocras* bag transmits the Wine, but retains the Spices infused in it.

Now this very *Percolation* of the Chyle doth (as I just now hinted) not a little confirm my former assertion, that it is distributed from the cavities of the Ventricle and guts, not by Attraction or Exsuction, but only by *Expression*. For, what can be imagin'd more likely to impell it, or drive the thinner parts of it into, and through the Streiner, than *Pressure*? or whence can that pressure come, but from the *Spontaneous Constriction* of the stomach and guts, conjoyn'd with the alternate *Compression* of them by the *Diaphragme* in inspiration; by the Muscles of the *Abdomen*, in expiration?

Why then should not Anatomists be able, by compression or any other way whatsoever, to force the Chyle, or other liquor injected, through this *Parenchyma* or supposed Streiner?

I answer (*First*) that the *Mechanic Ration* of this *Colatory* being not yet (for ought I know) discover'd, even by those curious Dissectors, who have with the best Microscopes contemplated the texture of it; I dare not pretend to understand the true reason of the difficulty objected. (*Secondly,*) that if I were permitted to declare my present conjecture concerning the same, I should venture to say; that the impediment to the *manual expression* of liquors out of the guts into the Milky veins, in Animals dissected alive, may perhaps consist in one of these two things: either that of the
several

several causes or motions, in the state of health and ease or indolency, concurring to this complex and organic operation, one (or more) is wanting; and the Mechanism of the principal Organ, the interior Membrane of the gutts, altered and vitiated, in the præternatural and dolorose state of the Animal dissected: or, that by reason of the cruel torments the miserable Beast feels, the *Tone* of the gutts becomes so strongly contracted and rigid, as to be wholly impervious. Which is the more probable, because 'tis well known, that great and acute pain always irritates nervous and fibrous parts to contract themselves, even to rigidity; which is opposite to the gentle compliance and yieldingness requir'd to permeability. Which may be one cause, why Nature hath endow'd all *Glandules* ordain'd for *Secretion*, with so little sense; viz. lest otherwise, being sensible of every light irritation, they might be apt to shrink and condense themselves, to the interruption and hinderance of their office. And for Animals dissected after death; I should guess, that in them, the Colatory of the Chyle is rendered impervious by *Cold*, which by strong constriction or constipation shuts up all slender and inconspicuous passages of the body, that had been kept open by the heat and motions of life. But these are my private Conjectures (as I have already declar'd) offer'd rather to your examen, than to your belief. So is whatsoever I have said in this disquisition, concerning the *Distribution* of the Chyle; which I here conclude. ¶

There remain yet two other *Faculties* of the *Stomach* to be consider'd, viz. the *SECRETIVE*, by which it separates from the blood brought into its membranes by the Arteries, a certain slimy and sub-

acid *mucus*, call'd *pituita emortua*, dead Phlegm, because the spirits thereof being exhausted, it is of no further use to the blood: and the *EXCRETIVE*, by which it exonerates it self of that dead Phlegm, of the lowre reliques of the food, of its own decay'd Ferment, and in fine of whatsoever else is unprofitable or offensive; and that either upward, by Eructation, or by Vomit; or downward into the *intestines*. But because the explication of the Constitutions of the stomach upon which these Powers are chiefly founded, and of the different motions and ways by which they are respectively executed, is less pertinent and requisite to the short History of Nutrition at this time by me design'd, than those precedent are, upon which I have hitherto insisted; and because the Sands in my glass are a good while since all run down: therefore I find my self doubly obliged to pretermit the explanation of them; lest I should at once, both rove from my principal scope, and further transgress the law of this *Royal Colledge*, which hath set bounds to all Exercises of this kind when here perform'd.

By the *later* of which reasons I am hinder'd also from tracing the *Chyle* in the narrow, obscure, and anfractuose ways, through which it passes, before it can attain to the end of its journey; and from observing particularly the *Mutations* it undergoes, the *Exaltation* and *Refinement* it gradually acquires, and the *Secretion* of its unassimilable parts, made in Organs by Nature to that use ordain'd. Let it therefore at present suffice, if to gratifie the Curiosity of the Younger Students of Anatomie, I set before their eyes, not an accurate Map, but a rude *Landskip* of the *Galaxy* or Milky way, in which the greater part of the *Chyle* glides along through the *purple Island* of the body, to replenish the ocean of blood.

The *Chyle* being now (as I said) squeez'd out of the stomach and gutts, into the slender pipes of the *Vena Lactea*, flows gently on in them from the Circumference toward the Centre of the *Mesentery*; the precedent parts of it being necessarily push'd forward by the succedent (*ut unda undam pellit*) till it enter into certain *Glandules* there placed. And this may be call'd, the *First* stage of the Chyles progress through the *Galaxy*. Extruded from thence, partly by more Chyle crowding in, partly by compression of the *Glandules*, by the distended *Midriff*, and contracted *Muscles* of the *Abdomen*, it flows into the *Common Receptacle* or Cistern, first discover'd by the Curiose and fortunate *Monsieur Picquet*, and thence call'd by his name. Which I account, the *Second* stage or remove of the Chyle. From the *Common Receptacle* (which consisting of a membranose substance, situate at the very root of the *Mesentery*, upon the spondyls of the *Loins*, and filling up the space between the *Muscles Psoa*, is incumbent upon the two long and fleshy productions of the *Diaphragm*) the *Chyle* is transferr'd into the *Ductus Chyliferus*, which running upward, near the spine of the back, and continued quite home to the *Subclavian* branches of the *Vena Cava*, exonerate themselves into them, and commix the Chyle with the blood: and this also seems to be done by *impulse* or protrusion. Because the two Productions of the *Diaphragm*; lying immediately under the *Common Receptacle*, cannot be distended (as together with the *Diaphragm* they always are, in every *inspiration*) but they must force the Chyle therein contain'd, to give way, by ascending in the pipes that from thence tend upward; after the same manner as in artificial fountains, the water is mounted into pipes, only by pressing the surface of that in the Cistern. Perhaps the so often

men-

mention'd *Compression* of all parts included within the *Abdomen*, by constriction of the Muscles thereof, may not a little contribute to this *Elevation* of the Chyle; which is the *Third* remove of it. Next, the Chyle, by the said *Subclavial* veins brought into the *Ascendent* trunc of the *Vena Cava*, is immediately imported, together with the blood therein descending, into the right ear, and ventricle of the *Heart*. Which by its *Systole* or contraction, squeezes it into the *Lungs*, where by their *Reciprocations* it is more perfectly mixt with the blood, and whence it^s is devolv'd into the *Left* Ventricle of the *Heart*, and finally thence squirted into the *Arteries*, so soon as it hath receiv'd the form and name of blood. Which is the *Fourth* and last stage of its journey; at least of so much of it, as is ordain'd to recruit the mass of blood, and afford matter for the supply of the *Vital spirits* or *Heat*.

For, I blush not here to declare my adherence to the doctrine of that great Light and Ornament of this College, Sir *George Ent*, that a considerable portion of the most delicate and spirituose Chyle, is never brought, through the *Galaxy* newly by me describ'd, into the blood; but detach'd, and by other ways, by membranes and nerves and fibres (perhaps by way of *Filtration*, as the nourishing juice of Plants seems to ascend from the roots up to the top of the highest spriggs) transferr'd to the brain, and by *Meteorization* refin'd into the last aliment of the *Spermatie* parts. Which I do, not because I have hitherto zealously asserted this doctrine, both in *Exercitat. 10. lib. de Oeconomia Animali*, & *lib. de Scorbuto cap. 8.* but only because the Arguments and Experiments brought against it, by *Deusingius* and some other Defendents of that antique Placit of *Aristotle*, *Sanguinem esse ultimum alimentum partium*; are not (in my judgement) half so weighty

weighty and cogent, as those brought to recommend it to the belief of an equal Arbitrator. Of all the *Objections* hitherto put into the opposite end of the balance, the most ponderous seems to be that, which hath been, by way of induction, alleged by my Learned Collegue, Dr. *Lower*, from a remarkable Anatomic Experiment made by himself, and recorded in his Book *de motu Cordis & Sanguinis*, cap. 5. Whence he infers, that the whole revenue of the *Chyle* is certainly expended upon the blood: and yet notwithstanding, I dare affirm, that though the Experiment be true and ingenious, the inference is more than can be, according to the Laws of right ratiocination, from thence deduced.

The *Experiment* it self is (in short) this. If in a Dogg, or any other Animal, fed about three hours before, the pipe leading from the *Common Receptacle*, then fill'd with newly imported *Chyle*, be broken (as without much difficulty it may, by making a convenient incision betwixt the two lowest ribs of the right side, and tearing the Receptacle with the nail of the fore-finger) so as the course of the *Chyle* into the *Thoracic* vessels be intercepted; the poor Animal, how plentifully soever supplied with food, will nevertheless perish by *famine*, within few dayes after; and in his breast will be found a deluge of *Chyle*.

The *Inference*, this. Certain it is therefore, that the Animal, though abounding with *Chyle* in the stomach, gutts, and milky veins, dies nevertheless of *famine*, by reason that the *Chyle* cannot ascend, by the *Thoracic* pipes, into the *Subclavial* veins, but is intercepted by the way: and by consequence, that the whole stock of *Chyle* is imported, by the chyliferous vessels, into the blood. Which to me seems to be a *Paralogism*.

For,

For, granting, that whatever of Chyle is brought from the *Common Receptacle* into the mass of blood, passes thither by no other way, but through the *Thoracic* pipes : it will not therefore necessarily follow, that the whole provision of Chyle made in the Ventricle, is convey'd thence into the Common Receptacle, and so into the blood. For, why may not some part of it be *diverted* into other wayes, from the Ventricle by the membranes thereof, from the *Glands* of the *Mesentery*, from the *Lumbares*, and others vicine to them ? Chiefly when the wayes of that diversion or detachment are sufficiently probable ; as I have many years past shewn, *ex professo*, in my Exercitation *de distributione Succo Nutritii per membranas & nervos* : and when otherwise the *Spermatie* parts of the body would all be destitute of requisite nourishment ; the blood being so unfit to repair their exhaustion, that in all probability it rather preys upon, and consumes them ; as hath been with many nerveous reasons asserted by Dr. *Glisson*, in *lib. de Anatom. Hepat.* Nor is it necessary, because the Doggs upon which this Experiment hath been tried, died within few daies after, that therefore they died of *famin*. For, why might not so great a wound, penetrating into the cavity of the Thorax, be sufficient of it self to destroy them, in that space of time ? Why is it not more consentaneous to conceive, that in those Doggs the blood it self being depriv'd of the requisite afflux of new Chyle daily, and so alienated from its vital constitution, as to have been no longer fit to afford a continual recruit of spirits, became vappid ; and so infer'd death, in a few dayes ? though the solid parts were not defrauded the while of their portion of the Chyle brought to them by other wayes. That in long fasting, when new Chyle is wanting, the blood doth

doth usually estuate, grow acrimonious, and prey upon the substance of the body: is a truth so well known by common experience, that it needs not farther probation. But how long after the wounds had been inflicted, did the Doggs live? That our *Author* forgot to record; leaving the number of the dayes undefin'd, notwithstanding the Circumstance of time be of great moment toward the strengthening his supposition, that they perish'd meerly by *famin*. For, if they surviv'd but two, three or four dayes, 'tis more improbable they should be in so short time *starv'd* to death, than that they perish'd only by the *wounds* they had receiv'd. Again, 'twas necessary, that by so great quantity of Chyle effused into the cavity of the *Thorax*, the motions of the *Diaphragm*, *Heart*, and *Lungs*, should be highly impeded; that from the putrefaction of the same Chyle, an acute fever should be soon kindled; and that the whole Oeconomy of Nature should be, in so great streights, perverted into mortal confusion, in those suffering Animals. There are then (you see) other causes, besides the interception of the Chyle, to which the death of the Doggs may be with more of verisimilitude ascrib'd. Where then is the necessity of that conclusion, that *Famin* alone kill'd them? or how doth this Experiment demonstrate, that the *whole revenue* of Chyle is, as a due tribute, paid into the Exchequer of the blood? I am therefore to be excus'd, if I deny this mighty *Objection* to be of force enough to subvert the doctrine of the *Nutrition* of all the *spermatie* parts by the *Succus nutritius*, clearly distinct from the blood.

More considerable it is, that even that Great Man, *Franc. Glisson*, who had (*in lib. de Anat. Hepat.*) with so many, and so strong arguments of clear reason and observations, propagated this

doctrine; hath notwithstanding, in his last and most elaborate work (*de Ventric. & intestin. cap. 8.*) taken occasion to retract it, in these very words. "*Hic tres Errores à me olim admissos ultrò agnosco & revoco. Conjectabam quidem tunc (1.) Materiam succi nutritii esse selectissimam Chyli partem; (2.) Hanc per viam secretionis in glandibus quibusdam, potissimum Mesenterii, à reliquo chylo separari, & per nervos ad cerebrum transmitti; (3.) Nervos splenicos è liene succum quendam tenuem & mitem, qui sit vehiculum prioris, eligere sive exsugere. Hisce tribus sententiis hìc valedico, & argumenta, in quantum iis stabilendis inserviant, improbo; & similiter Corollaria, si quæ sint, in quantum ab iis solis dependeant, rejicio.*" This *Palinodia* of his did, I confess, not a little surprize me, when first I read it: but my amazement lasted not long. For, when I had found, that as to the *Reasons* inducing him to make that Recantation, his silence had left me wholly in the dark; and that in the lines immediately following he had subjoin'd this *limitation* of it, "*Interim non nego, quin detur verus succus nutritius à cerebro per nervos ad omnes partes spermaticas dispensatus; aut quin sit subjectum spirituum animalium. Sed aio, generari hunc succum in solo cerebro, inter corticem ejusdem & medullam, per viam secretionis; & sanguinis mitiorem partem magisque spermaticam esse materiam, &c.*" I perceiv'd, that though he had, by his Authority, shook some part, he had not yet demolish'd the whole of that fair structure by himself formerly erected. And I have reason to believe, that he had never affirm'd, that the true *succus nutritius* is deriv'd out of the blood; had not Fate, thinking the honor he had before acquir'd by other noble discoveries in Nature, sufficient to give him immortal renown, reserv'd the glory of farther revealing

the myserie of Nutrition, for Sr. *George Ent.* Who, in his incomparable *Antidiatriba* lately publish'd, hath eternally obliged the world by declaring his sentiments concerning the *Matter, conditions,* and *generation* of the true *succus nutritius*; as also concerning the *Manner* and *Wayes* by which the same is distributed to all parts of the body thence to be recruited. To that Aphoristical Book therefore I referr all those of my *Auditors*, who desire to be more fully satisfied in this matter: and so conclude this my imperfect History of *Nutrition.* ¶.

PRÆLECTIO.



PRÆLECTIO IV.

Of Life.

THe Climax or Scale of Nature, by which she advances in her Works from less to greater Dignity and Perfection, and distinguishes all things Animate into three general Orders, consisteth (as ye well know) of only three Rungs or Degrees: of which the first is simple *Vegetation*, to which all Plants are confined; the second, *Sense*, which includes Vegetation, and is the *Ne ultra* to all brute Animals; the third, *Reason*, which comprehends both Vegetation and Sense, as inferior and subordinate, and Constitutes the royal Prærogative of Man, above all his fellow Creatures that are [τὰ ἐμψυχὰ] composed of Soul and Body. To each of these degrees *LIFE* is annexed; for even Plants themselves are, by Universal consent of Mankind, allowed to *live* and *dye*, as well as Sensitive and Rational Creatures: and ζῶον dicitur ἀπὸ τῆς ζῆν. Sic Plato (in Timæo) quicquid τῆς ζῆν, i. e. vivendi particeps est, jure Sane ζῶον (quasi vitale dixeris) id est animal rectissime appellari potest. Insunt autem & plantis ipsis facultates vivendi, nutriendi, crescendi, suiq; simile producendi. Sic etiam Arist. (de gen.

Animal. l. 2. c. i.) *Sive planta, sive Animal est, inquit; æque omnibus inest, quod vim habet vegetandi, sive nutriendi, &c.* but not Life of one and the same kind; for the Life of Brutes is more Energetic, and consequently more Noble than the Life of Plants; and the Life of Man much more Noble than that of Brutes. And this of absolute Necessity, because a sensitive *Soul* is endowed with more and higher Faculties or Powers, than a Vegetative; and a rational Soul, with more and more excellent, than a Sensitive: and therefore the *Life* which results from the Conjunction of either of these Souls with its proper Body, conveniently Organiz'd, must be accordingly different from the Life of the other two. Which *Aristotle* well understanding, first defines Life in general to be, *Anima, ejusq; organici corporis, per conjunctionem & unionem utriusq; actus & Vigor*; and then teaches particularly, that Plants live by the Sole act of their vegetant Soul, namely by Nutrition; Brute Animals, by the Sole act of their Sentient, which includes the former; and Man by the act of Reason, or λογισμῶν, that is by Cogitation or Ratiocination, which as Supreme, præsupposes both Vegetation and Sensation.

Let this Scale of Nature then be our Method. Let us, who have proposed to our selves to follow her steps, as near as our poreblind Reason shall permit us, ascend from the Life of Vegetation, to the Life of Sense; from the Life of Plants, to that of Animals, and among them, of the most perfect Animal, Man himself, who is our principal Subject. And that we may the more directly conduct our present inquiries by the clew of her observable operations, let us consider diligently (1) What Life is, (2) Whence it originally proceeds, (3) What is the Subject wherein it primarily Subsists, (4) how it is perpetually generated.

ted a new, from the first moment of its accension, to that of its total extinction or period. (5) how it is continually diffused or Communicated from its Fountain to all parts of the Body.

But because the Fundament of right Ratiocination is placed in the true signification of Names, 'tis therefore requisite, that before I proceed to investigate the nature and formal reason of Life, I should recount and explain the various *Names* by which it hath been call'd: not only to prevent Ambiguity, by fixing their signification; but also in hope of gaining from them somewhat of Light toward my Disquisition.

From Holy Scriptures then I begin, both from the Veneration due to those Divine Oracles, and because they are of all Books whatsoever, most likely to afford me hints of the abstruse thing after which I am searching.

The Writer of the Book of *Genesis*, in the short History of Mans Creation (*Cap. 2. v. 7.*) expresses the manner of it in these Words, according to the Græc Text of the *Septuagint*. Καὶ ἐπλασεν ὁ θεὸς τὸν ἄνθρωπον, ἔξω ἀπὸ τῆς γῆς. καὶ ἐνεφύσῃσεν εἰς τὸ πρόσωπον αὐτοῦ πνοὴν ζωῆς, καὶ ἐγένετο ὁ ἄνθρωπος εἰς ψυχὴν ζώσαν. Which the Vulgar Latin version renders thus. *Formavit igitur Dominus Deus hominem de limo terræ, & inspiravit in faciem ejus Spiraculum vitæ, & factus est homo in animam viventem*: and our latest Translation thus. "And the Lord God formed Man of the Dust of the Earth, and breathed into his Nostrils the Breath of Life; and Man became a living Soul. Here then by πνοὴ ζωῆς *Spiraculum vitæ*, Life is signified: but whether the Author by those Words intimated or not, that God kindled Life in the Heart of *Adam* by a vital Breath blown by his Nostrils into his Blood, as fire is propagated by blowing; or whether he meant only, that *God gave*

to *Adam* Life, as some have interpreted them; is not for me, who pretend not to interpretation of sacred Writ, to determine. Nevertheless I hope I shall not be thought to usurp the Province of Theologues, if I take the innocent liberty of believing, that this admirable act of *Vivification* done by the Omnipotent Creator upon *Adam*, was done by way of *Inspiration*; by which, according to the genuine and proper Sense of the word, is to be understood, a blowing in of some subtil and energetic substance, into a place where before it was not, *viz.* into the Nostrils of the human Body newly formed of the Dust of the Earth. Which will perhaps be found somewhat the more reasonable, if the manner and circumstances of the miraculous *Revivification* of the good Shunamites Son, by the Prophet *Elisha* (*Kings* 2. *Cap.* 4.) be well considered. For, we read, that after the Prophet had layn some time, and much bestirred himself upon the Body of the dead Child, putting his Mouth upon his Mouth, and his Eyes upon his Eyes, and his Hands upon his Hands, and stretched himself again and again upon him; [διεθεράμηντι ἢ σάξεν τῷ παιδαγωγῷ] the Flesh of the Child waxed warm, and he Needed seven times, and opened his Eyes. So that from thence it seems inferrible, that as the first Man was *inlivened*, so this Child was revived by *Inspiration*. Both acts doubtless were done miraculously, because by the same divine Agent, God: yet with this difference, that the former was performed immediately by God himself; the latter, mediately by his Instrument, the Prophet; to whose Breath blown into the Childs Mouth, and to whose Heat communicated to the Childs Flesh, and consequently to his Blood, the Author of Life was pleased to give a Virtue so Efficacious, as to restore and renovate the Vital motions of the Blood, Heart, Lungs,

and

and Diaphragm of the Child, that had been stopped by the cold Hand of Death: and those Motions being recommenced, and the Brain reinvigorated by a fresh influx of arterial Blood, replete with vital Spirits; by strong contraction of its Membranes, as it were by a Critical Motion, expell'd the material and conjunct cause of the Disease, by Sternutation seven times repeted, before the Child opened his Eyes. For, that the Seat of that most acute Disease was in the Brain, is manifest even from the Childs complaint to his Father; [τὴν κεφαλὴν μὲ, τὴν κεφαλὴν μὲ] *my Head, my Head.* I am not ignorant, there are some, who expressly affirm, that the word *inspiration* is in sacred Scriptures used only *Metaphorically*; whether truly or not, let Divines dispute. Meanwhile I am certain, the word *Spirit*, upon which *inspiration* depends, is in many places of the holy Bible used to express Life. In Job. (c. 27. v. 3.) *quamdiu spiritus Dei est in naribus meis*, signifies, *so long as I shall Live*, or have Life. And in *Ezech* (c. 1. v. 20.) *Spiritus vite erat in rotis*, seems to me to say, *the Wheels were living*. Other Instances I might easily collect, if these were not sufficient to my Scope, and if I were not obliged to hasten to other appellations and Characters of Life less liable to controversy, and used by Philosophers.

By *Hippocrates*, Life is *per periphrasin*, call'd ἐμφοτον πῦρ, *ignis ingenitus*; & ἢ ἐν τῇ καρδίᾳ τῆς ψυχῆς ἐμπύρωσις, *accensio anime in corde*, by *Aristotle*. The *Hebrews* express it sometimes by *nephesch*, sometimes by *neschama*; both which words indifferently signify *Soul*, or *Life*. The *Gracians*, whose Language is more copiose, name it either ψυχὴ, which is derived ἀπὸ τῆς ψυχῆιν, which signifies to *Breathe*, or refrigerate by blowing; nor unfitly, because to *Breathe* or respire, is proper to living Creatures: or βίος *aliàs βιωσις*; or

ζωή; to which *Hesychius* addeth *περσολα*. The *Latines*, commonly *Vita*; which is deflected from the Græc *βιωτή*, by cutting off the Vowel *ι*, and changing *β* into *v*, as is usually done; and sometimes *Anima*, which is from *ἀνεμος*, which signifies Wind; an Etymology owned by *Horace* himself in this odd expression of his, *Impellunt animæ lintea Thracia*; in *Carmin lib. 4. Ode 12.* and before him by *Lucretius* (*lib. 6.*) in these Words;

*Ventus ubi, atq; animæ subito vis maxima quadam
Aut extrinsecus, aut ipsa ab tellure coorta.*

Who often calls the Soul, *Ventum Vitalem*.

FROM the various Names, we come to some few *Notions* that eminent Philosophers have formed to themselves of Life; such as among many others, seem to me more memorable than the rest, as well for the credit they have obtained in the Schools, as for the great renown of their Authors.

Cardanus (a man of admirable Subtility of Wit, in his lucid intervalls) defines Life to be, the *Operation or action of the Soul*: and (as *Ful. Scaliger*, in *Exercit. 102 Sect. 5.* not without Signs of envy, observes) hath therein many Followers. In the number of whom I must not list my self. (1) because if Life be an action of the Soul, the Body cannot be truly said to live. (2) if Life be an action, there must be an action of an action; for the actions of Life in Man, are (as *Arist. 2. de anima*, truly teaches) to understand, to have Sense, to move voluntarily, to be nourished, to speak, &c. and to suppose an action of an action, is manifestly absurd. In this point therefore I declare my self to be no disciple of *Cardans*.

Fernelius (equal to *Cardan* both in time and fame, nor

nor inferior in Sagacity of Spirit) defines life thus; *Lib. de anime facultat. cap. 26*
Est Animantium vita, facultatum actionumq; omnium conservatio. But this definition is too narrow for the thing, as taking no notice of the Body, which yet is participant of Life, and upon whose Organs the exercise of all the faculties and actions of the Soul depends.

Ludovicus Vives describes Life to be, *Conservatio instrumentorum, quibus anima in corpore utitur*: because (saith he) when the instruments are corrupted, life ceaseth. But neither in this description is it safe to acquiesce. (1) because Life is conserved, not so much by the integrity of the Instruments, as by the Faculties, which are before the Instruments, and upon which all the Functions proximately depend. (2) The conservation of the Instruments doth not make or constitute Life, but rather follow it, as an effect. (3) if Life were only the conservation of the Instruments, then would it necessarily follow, that part of Life is lost or destroyed, when any of the Instruments are corrupted or cut off: which is absurd; life being indivisible, and daily experience attesting, that one or more of the Organs of the Body, as Hands, Feet, &c, may be cut off, without diminution of Life. Which even *Lucretius* himself acknowledged in these elegant Verses.

*At manet in vita, cui mens animusq; remansit,
 Quamvis est circum-cæsis lacer undiq; membris:
 Truncus, ademptâ animâ circum, membriq; remotis;
 Vivit, & aetherias vitaleis suscipit auras &c.*

Lib. 3.

Neither of these three Select Definitions proving in all points absolute and Scientific; some here perhaps expect, that I, who am so bold as to reject them, should dare

dare also to substitute in the room of them, some new one of my own excogitation, if not more perfect, yet at least less culpable. To these expecting Gentlemen therefore I say, that much less of skill and strength being required to demolish, than to build; a Pigmy may be able to pull down, what Giants have raised; and that to form a true and complete definition of any the most obvious thing in Nature, much more of Life, which is extremely abstruse, would puzzle a much stronger Brain than mine. Well then may I be excused, if conscious of my imparity to a task so desperate, I forbear farther to expose my weakness by attempting it: and choose rather to leave them to collect, what my sentiments are of the nature of Life, from my following discourse.

WHICH being designed only as a modest disquisition of the natural causes of *Human Life*, I professedly pass by what that over-curious nation of *Scholemen*, impensly addicted to notions abstracted from all commerce with the Senses, and to Speculations Metaphysical, have delivered of the Life of *Spirits*, of *Angells*, *Demon's*, and other *Beings* of that kind, subject neither to the Laws of Nature, nor to the Empire of Fate. And this I do, because some of their Doctrines far transcend the capacity of my narrow Wit, others seem more fine than useful, and all are remote from my present institute.

I omit also what our equally acute *Dr. Glisson* hath with admirable subtilty of Wit, and immense Labour of Meditation excogitated, and not many Years before his Death, divulged, of the *Energetic Life of Nature*, and its Faculties; by virtue of which he supposed, that even the most minute particles of this aspectable World do naturally perceive, desire, move themselves with Counsel, and (what is yet more wonderful) frame Bodies for themselves to inhabit, animate or inform them,
and

and perform other most noble operations. Which I do, not only because this opinion, how favorable soever, hath not yet been received as canonical by common assent of Philosophers; but also because I humbly conceive it to be in all things (the Name only excepted) the same with that antique *Dogma* first delivered by *Plato*, and after asserted by his Followers, that all things in the Universe are *Animate*, that is, are naturally endowed [*ἄισθησει ἢ αὐτοκίνησις*] with *Sense* and *Self-motion*; which hath been sufficiently impugned by *Aristotle*, *Lucretius*, *Gassendus*, and all others, who have refuted *Plato's* Doctrine de *Anima mundi*, upon which it is grounded. Not that I reject this opinion of natural Sense, or Perception attributed to all things, but that I am not yet convinced of the truth of it: & *Insuperantis est, aliis dogmata illa aut commendare, aut convellere, de quorum veritate ipsemet adhuc dubitat.* And well may I suspend my assent to this opinion, which gives to things inanimate such Faculties, which my Philosophy will not grant to any but rational Creatures. Nor indeed would either *Lucretius*, or *Des Cartes*. For the former, though, according to the *Epicurean Hypothesis*, which he in all things followed, he attributes to *Atoms* (or as he calls them) *Solida Primordia rerum*, a *Spontaneous Mobility*; nevertheless denies, that they are naturally moved with *Knowledge* or *Design*; in these Verses. (Lib. 2.)

“ *Nam neq; consilio debeat tardata morari,*

“ *Nec perscrutari primordia singula quæq;*

“ *Ut videant, qua quidq; geratur cum ratione.*

And the *Later*, in one of his Epistles to *Mersennus* (*Epistol. parte 2. epist. 44.*) where he strictly examines the Doctrine of a certain *Monk*, that ascribed to even

the most minute particles of Matter, a Power of moving themselves, and other ingenite propensions (the very same, I guess, with those supposed to be inseparably conjoyn'd with *Natural Perception*) plainly declares his Judgment of the unreasonableness thereof, in these Words. *Non probo indivisibilia ista, neq; naturales, quas illis tribuit, propensiones; istiusmodi enim propensiones absq; intellectu concipere nequeo, & ne irrationalibus quidem animalibus tale quidquam tribuo: Sed quicquid in illis appetitus, aut propensiones vocamus, per solas Mechanicæ regulas explico.*

These two præliminary Advertisements premised; I come into the direct way of my intended disquisition. That the *Life* of *Man* doth both originally spring, and perpetually depend from the intimate conjunction and union of his *Reasonable Soul* with his *Body*; is one of those few Assertions in which all Divines and natural Philosophers unanimously agree. And they have reason. For, while the rational Soul continues in the *Body*, so long *Life* continues; and when the same is separated from the *Body*, in that very moment of Time, *Death* succeeds.

Now this rational Soul being by most wise Men granted to be a pure *Spirit*, or substance merely *Spiritual*; it is from thence necessarily consequent, that the *Life* of it is *Substantial*, that is, the very substance of it, considered (as Metaphysicians love to speak) *non in ordine ad esse per se, sed in ordine ad operationes*. For, we dull-brain'd Mortals, to whom it is not granted, to be able to conceive the nature of Beings purely *Spiritual*, by notions adequate to it; according to the Module of our understanding, distinguish even in *Angels*, their *substance Fundamental*, from their *Energetic Nature*: although in reality both are the same substance, but diversly considered. For, this substantial *Life*, though it may be, as to its *Operations*, by the same Divine Power

Power that gave it, suspended; cannot yet be wholly taken away, so, as that it should after continue to be a Spirit. Because if a Spirit be supposed to be deprived of Life, the very substance of it must also be supposed to be at the same time *annihilated*. For, who can conceive so gross a contradiction, as a *dead Angel*? The same may be as truly said also of a *Rational Soul*, which is allowed to be a *Spirit* too. Wherefore the *Life* of it is (as I affirmed) *Substantial* and *Essential*, and consequently incapable to be taken away, unless the Soul or Spirit it self be at the same time annihilated. Which the Omnipotent Creator can indeed, when he shall so please, do: but it doth not appear from any place of holy Scripture, that he either hath done, or ever will do it: and therefore let no man doubt of the *Immortality* of his Soul.

Sic etenim lethi praeclusa est janua menti.

From this our fundamental position then, that the Life of a Man is in his rational Soul essentially; it follows of necessity, that the same Life cannot be in his Body too essentially, but by way of *Participation* or *Communication*. Nor is it difficult to conceive in our mind, that the Life of the Body, being separable from it, is only communicated to it, or derived from another thing of a different Nature. For, if a substance essentially living, be intimately united to another substance of its own nature void of Life; the thing composed of those two substances so united, must have Life: but so, that the first part live *substantially* or by virtue of its Essence; the other, only by *participation* of that essential Life. Certain therefore it is and evident, that the *Life* of a *Man* comes immediately from, and depends upon the *Presence* of his *rational*

Soul in his Body. Which is the Truth we fought after. I say, *immediately*; because the Life of the Soul is originally from God, who created it a living Substance.

Of the Souls of *Brute* Animals, the same may not be affirmed: For though it be true indeed; that their Souls also are the Principle or Fountain whence Life is communicated to the Bodies they inform; yet 'tis equally true, that these Souls being Material or Corporeal, their Life cannot be essential to the matter, of which they are composed, but flows from, and depends upon the determinate Modification of that matter, from which their Souls Result. So that in Brutes, as it is the Mode or manner of the disposition of the Matter, not simply the matter it self, that constitutes the Soul: So it is the Hypostasis or subsistence of the same Mode, upon which alone the Life, that is, the Act, Energy and Vigor of the Soul depends. No wonder then, if we believe the Souls of all Brutes to be by their nature Mortal, and to be actually dissolved, together with their Bodies, by Death.

That I may explain what I understand by the *Modification* of the matter which is here supposed to constitute the Soul of a Brute; give me leave, in this place to make a short halt (for it is not a digression) while I briefly declare what my sentiments are concerning the Souls of Brutes.

I humbly, and with Submission to wiser Heads, conceive (I) That the diversity of kinds observed among Brutes, proceeds immediately from the divers Modifications of the common matter of their Souls, and the respectively divers Organizations of their Bodies: from both which by admirable artifice conjoined and united into one complex System or Machine, various faculties and proprieties must of necessity result, by which those several kinds are among themselves distinguished!

guished. (2) That the Specific or determinate Modification of the Soul, and respective Organization of the Body, in every distinct kind ; is to be wholly attributed to the *Plastic virtue* or formative Power innate and affixed to the Seed of the Generants. (3) That this *Plastic virtue* is originally founded in the still efficacious *Fiat* pronounced in the act of Creation, by the Divine Architect of all things : who commanding all Animals to increase and multiply, gave them at the same time power to fulfill that Command, by endowing their Seed with an active Principle to form, and impressing upon that Agent, a certain idea or exemplar; according to which it is obliged and directed how to form, and not otherwise; provided the Matter upon which it operates, be obedient and susceptible of that Idea. So that the Idea first conceived in the Divine Intellect, and then prescribed as a Pattern to the Plastic Spirit, with which the genital matter is impregnated ; being not in all kinds, nay not in any two kinds of Animals one and the same, but a peculiar Idea assigned to each kind: it comes to pass, that the Plastic Spirit thus directed, regulated, and confined by the Law of Nature, doth out of that genital matter form the Soul, and Organize the Body of every Brute Animal of any one of those numerous kinds, exactly according to the prototype of that kind. And by this means I conceive all Brutes to be generated; both Soul and Body ; and their distinct Species, without confusion, or innovation, conserved throughout all ages.

If I conceive amiss, be pleased to consider, that many excellent Wits, treating of the same Subject, have done so before me ; and that the Theorem it self is so abstruse, that, as *Cicero* (2. *Tusculan.*) said of the various Opinions of Philosophers about the nature of a Soul, *Harum Sententiarum quæ vera sit, Deus aliquis viderit* ;

derit; qua verisimillima, magna questio est: so may I say, Man may dispute, what is most probable, but God alone knows what is true, concerning the Souls of Beasts, and their production.

Notwithstanding this darknes of my way, I must adventure to go a little farther in it, and endeavor to explain (1) What the *Substance* of a *Sensitive* Soul is, or of what Particles it is contexed; (2) In what the *Life* or Act and Vigor of it consisteth; and (3) What are the primary *Functions* and *Operations* of it.

As to the *First* then, it seems highly probable, that a *Sensitive* Soul is not a pure Spirit (such as the rational Soul of Man is) but a meer *Body*, yet a most subtile and extremely thin one, as being context of most minute and most subtile Corpuscules or Particles. For, if it were *Incorporeal*, it could neither act, nor suffer in the Body which it animate's or informs: not *Act*, because it could not touch any part; not *Suffer*, because it could not be touch't by any part of the Body. But that it doth both act and suffer in the Body, is most evident from its Sensations of external Objects, from its affects or Passions consequent to those Sensations, from the motions it causeth in the Members respective to those Passions, and from its Union and consension with the Body in all things. I call it therefore a *Body*, and say, that it is composed, or by an admirable contexture, made up of *most thin* and *most subtile* Particles, such perhaps as are most smooth and most round, like those of Flame or Heat: because otherwise it could not diffuse it self so swiftly through, nor cohere within with the whole Body and all parts of it; and because when it departs out of the Body, the Body is not perceived to lose any the least thing of its former Bulk, Figure, or Weight; no more than a Vessel of Wine loses by the exhalation of its Spirits, or a piece of Amber-Grise loses

loses by emission of its Odor. So that we may imagine, that if the whole sensitive Soul of an Elephant were conglomerated or condensed, it might be contained in a place no bigger than a Cherry-stone.

These constituent particles or Elements of a Sensitive Soul, I suppose to be for the most part analogous to the nature of *Fire*: because the natural heat of all Animals comes from the Soul, and their Life consisteth in that Heat.

I also suppose them to be at first contained in the *genital matter*: the most spirituous or active particles of which are in the act of formation, by the Plastic Virtue Selected, Disposed, Formed, and as it were contended into a little Soul; and the *grosser* or less agile framed by degrees into an organical *Body* of competent dimensions, and of Figure answerable to the Specific Idea by the Divine Creator pre-ordained and assigned to that Species, to which the Generants belong. And this I suppose, because the brisk, vigorous and swift motions of the Soul in the Body, require it to be composed of particles most subtile and active; and because as well the Soul, as the Body, is by all Philosophers granted to be formed of the seminal matter; and because otherwise Brutes cannot be properly said to generate their like *in Specie*, and by consequence, the Power to that end entailed upon them, by the first and universal command of God; *increscite ac multiplicamini*, would be rendr'd of no effect.

I farther suppose, that this Embryon Soul after this manner newly formed, or as it were kindled, is daily *augmented*, by accession and assimilation of like Particles, as the Body is augmented out of the grosser and less fugitive Parts, of the Aliment: till both Soul and Body have attain'd to the standard of Maturity, or perfection of growth; thenceforth slowly declining in Vi-

gor, by degrees answerable to those of their ascent, till they arrive at their final Period, Death, which dissolving the system or contexture of the Soul, leaves the Particles of which it was composed, to fly away, and vanish into Aire; and the Body to be resolved into its first Principles, by slower corruption. For, Nutrition and Augmentation are (as yesterday I proved) Operations of the Plastic Virtue continually reforming the whole Animal: and the duration or subsistence of the Soul is the *Vinculum* of the whole composition or concretion. So that the Soul may be, by an apposite Metaphor, called the *Salt* or Condiment that preserves the fleshy parts of the Body from putrefaction; as the Spirits of Wine preserve the whole Mass of Liquor through which they are diffused, from losing its Vigor and generous quality: and according to that oraculous saying of *Hippocrates*, *Ψυχή ἀεὶ φέται μέχρι θανάτου*, *the Soul is always generated anew till Death*. Which very thing is argument enough to evince, that if it be not really a most thin Flame, finer and more gentle than that arising from the purest Spirit of Wine burning within a paper Lantern, it is at least very like to Flame. For, as this, so that is every moment regenerated, at once perishing and reviving: perishing by continual dissipation of some Particles, and reviving by continual accension of others out of its proper aliment; the more subtile and sulphureous Particles of the Blood serving to repair the decays of the Soul, as the grosser Particles of the *succus nutritius* are convenient to recruit the exhausted substance of the Body. So that it was not without reason, that *Democritus*, *Epicurus*, *Lucretius*, and *Hippocrates*, among the Antients; and among the Moderns, *Fernelius*, *Heurnius*, *Cartesius*, *Hogelandus*, *Honoratus Faber*, and *Dr. Willis*, held the Soul of a Brute to be of a fiery substance: and that *Aristotle* himself

himself called it πῶς νοεῖον; and that the *Ld. Chancellor Bacon* (*natural Hist. centur, 7.*) makes one of the two radical differences between Plants and Animals, to consist in this, that *the Spirits of living Creatures hold more of Flame.*

Finally I conceive, that this sensitive Soul, however it be a thing mixt or compos'd of Particles among themselves in Magnitude, Figure, Position, and Motion somewhat various, is notwithstanding by admirable Artifice so constituted, and the parts of it so temperate and context, that it is made one most *thin*, and yet *continued* and *coherent* substance, diffus'd through the whole Body. Nor can its component Particles, while it subsists in the Body, be dissociated (otherwise than by their own evolation, which is instantly supplied by the accession and union of others) no more than the natural smell, colour, or taste can be separated from an Apple, Peach or any other Fruit. This universal *diffusion* of it through the Body, is what the *Ld. Chancellor Bacon* calls, *Branching* of the Spirits (in *Nat. Hist. Cent. 7. Paragraph. 1*) where he saith, *the Spirits of things Animate are all continued with themselves; and branched in Veins and secret Canales, as Blood is; and what Dr. Willis calls, Coextension* of the Soul to all parts of the Body. Granting then, that this most thin, continued and diffus'd Substance is contain'd in the Body, and as it were coherent with the same, thereby sustained and bounded; we may with the more probability conceive, that it is to the Body the cause of all the Faculties, Actions, Passions, and Motions belonging to its Nature, as the Organ of such a Soul; that it keeps the Body together, at once both conserving, actuating, managing and governing it; and that it can be no more separated from the Body, without the dissolution thereof, than the Odor can be separated

from Frankincense, without destroying the nature of it. And this I think sufficient to explain what I conceive of the *first* question proposed, *viz.* of what *Substance* the Soul of a Brute is, and of what *Particles* composed.

As to the *Second*, *viz. wherein the Life of such a Soul doth consist*; it seems to me probable, that since Life, according to the general notion of it, is nothing but *Usur a quedam vigoris, mobilitatisq; facultatum activarum ejus rei, cui inest*; the Life of a sensitive Soul is immediately founded in a certain *Motion* of the active and spirituous Particles of which it is composed: as the Life of an Animal consisteth in the continuation of the same determinate Motion of those Spirits, by which it was at first kindled; and of the actual exercise of the Faculties that emerge or result from the union of the Soul with its Body, by the Fabrick of the various Organs thereof adapted to perform all the various Functions, Offices and Actions requisite to consummate the nature of such an Animal *in Specie*. What kind of Motion that is, in which, as in its Origine, I conceive this Life to be founded; I shall by and by declare, when I come to enquire what is the immediate *Subject* or Seat of Life; having first endeavor'd to solve the

Third Question proposed, *viz. what are the principal Faculties and Operations of a sensitive Soul*. These then are (as ye well know) all comprehended in *Life, Sense*, and motion Animal: of which I shall here consider only the *Second*, reserving the *First* till by and by, and the *Last* till the Clew of my method hath brought me to treat of it in its proper place.

As to the Faculty of *Sense* therefore, which constitutes the chief difference between living Creatures and things inanimate, which *Lucretius* elegantly call's *animam ipsius animæ*, and the extinction or total privation

tion of which is Death; since I have supposed a sensitive Soul to be *Material* or Corporeal, I must seek for this noble Power, whereby she is qualified, not only to perceive external Objects, but to be also conscious of all her Perceptions, in *Matter* after a certain peculiar manner, so or so disposed or modified; and in nothing else, lest I recede from that supposition. But in what matter is it most likely to be found, whatsoever the determinate modification requisite to create such a Power shall at length be imagined to be: in the Matter of the *Soul* herself, or in that of the *Body* she animates. Truly, if we distinctly examine either the Soul or Body of a Brute, as not conjoined and united into one *Compositum*; we shall have a hard task of it, to find in either of them, or indeed in any other material Subject whatsoever, any thing to which we may reasonably attribute such a Power of *perceiving* and *self-moving*. But, if we consider the *whole* Brute, as a Body animated, and by Divine Art of an infinite Wisdom designed, framed and qualified for certain actions, Uses and ends: then we may safely conclude, that a Brute is, by the law of the Creation or institute of Almighty God, so made and compared, as that from such a Soul and Body united, such a confluence of Faculties should result, as are necessary and convenient to the uses and ends for which it was designed. Do but convert your thoughts awhile upon *Mechanic Engines*, and seriously contemplate the motions, powers and effects of them. Composed they are all indeed of gross, solid and ponderose Materials; and yet such is the designe, contrivance and artifice of their various parts, as that merely from their Figures, positions and motions of them conjoin'd into one complex Machine, there do necessarily result certain and constant operations, answerable to the intent and scope of the Artists, and far transcending

ing the forces of their divided ingredients. Before the invention of Clocks and Watches, who could expect, that of Iron and Brass, dul and heavy Metalls, a Machine should be framed; which consisting of a few Wheels indented in the circumference, and a Spring commodiously disposed, should in its motions rival the Celestial Orbs, and without the help or direction of any external mover, by repeted revolutions, measure the successive spaces of Time, even to Minutes and Seconds, as exactly almost as the revolutions of the Terrestrial Globe it self? And yet now such Machines are commonly made even by some Black-Smiths, and Mens admiration of their pretty artifice long since ceased. If then in vulgar Mechanics, the contrivance and advantageous dispositions of matter, be more noble and efficacious than matter it self: certainly in a *living Automaton* or Animal consisting of an active Soul and organic Body intimately united, the Powers emergent from the force of such a Soul, and from a conspiracy and cooperation of so many, and so various Organs, all so admirably formed, ought to be esteemed incomparably more noble, more Energetic. If the art of *Man*, weak and ignorant Man, can give to Bodies, of themselves weighty, sluggish and unactive, figure, order, connexion and motion fit to produce effects above the capacity of their single Natures: What ought we to think of the Divine art of the Creator, whose Power is infinite, because his *Wisdom* is so? *Cum magnes (cui Thales propterea animam attribuit) ferrum ad se attrahit, domitrixq; illa rerum omnium materia (ut ait Plinius, l. 36. c. 16.) ad inane nescio quid currit; & acus ferrea eidem affricta, mundi cardines perpetuo respicit: cum horologia nostra singulos diei noctisq; horas constanter indicant: an non corpus aliud (prater elementa) idq; divinius participare videntur? Quid si ex artis do-*
minio

minio & gubernatione, tam præclara quotidie supra rerum ipsarum vires efficiantur; quid ex Naturæ præcepto ac regimine fieri putabimus, cujus ars solum imitatrix est? Et si hominibus serviendo, tam admiranda perficiant; quid, queso, ab iis expectabimus, ubi instrumenta fuerint in manu Dei? Harv. in lib. de generat. Animal. exercit. 70. Could not He, think ye, who by the voice of his Will call'd the World out of *Chaos*, and made so many myriads of distinct beings out of one and the same universal Matter; could not He, I say, when he created Brutes, so fashion and organize the various Parts and Members of their Bodies, thereto adjust the finer and more active contexture of their Souls, and impress such motions upon them, as that from the union and cooperation of both, a syndrome or confederacy of Faculties should arise, by which they might be qualified and inabled to live, to perceive, to know their perceptions, to move and act respectively to the proper ends and uses of their Creation? Undoubtedly He could; and 'tis an Article of my belief, that He did.

When ye hear a *Church Organ*; is it not as delightful to your Mind, as the Musick is to your Ear, to consider how so many grateful Notes and Consonances, that compose the charming Harmony, do all arise only from Wind blown into a set of Pipes, gradually different in length and bore, and successively let into them by the apertures of their Valves? and do ye not then observe, the effect of this artificial instrument highly to excell, both the Materials of it, and the Hand of the Organist that play's upon it? The like Harmony perhaps ye have sometimes heard from a *musical Water-Work*, that plaid of its self, without the Fingers of a Musician to press down the Jacks, merely by the force of a Stream of Water opening and shutting

ting the Valves by turns, and in an order predefign'd to produce the harmonical Sounds, Consonances and Modes requisite to the composition, to which it had been fet.

Now to this *Hydraulic Organ* ye may compare a Beast, whose Soul being indeed, by reason of a certain *modification* of her matter, qualified to perceive the various impressions made by objects upon the Nerves of the instruments of the Senses; and to perform many trains of Actions thereupon: is yet so limited in her Energy, that she can perform no other actions, but such as are (like the various parts of an harmonical Composition) regularly prescribed (as the Notes of a Tune are print down on the tumbrell of our Instrument) by the Law of her Nature, and determin'd for the most part to the same scope, the *Conservation* of herself and the Body she animates. So that she seems qualified only to produce a Harmony of *Life, Sense* and *Motion*: and this only from a certain *texture* of the spirituose Particles of the matter of which she is made, and from the respective *Organization* of the Body in which she acts.

But from what kind of *texture* or *modification* of the supposed Particles, doth the faculty of *Perceiving* or discerning Objects arise? For, what I have hitherto said, is too general to explain the particular reason of the thing here inquired, *viz. qua ratione fiat, ut res sentiens creetur ex rebus insensilibus*; whence it is, that a corporeal Soul, composed of matter in it self wholly void of Sense, acquires the power of Sensation.

I say therefore, that this is indeed the difficulty that remain's here to be solved: but such a difficulty, that I dare not attempt to solve; having much more reason to believe, that it will to the end of the World remain *indissoluble*. For, to comprehend, what particular

Mode of composition or contexture of *insensil Matter*, that is, that gives to it the nature or essence and faculties of a *sensitive Soul*; seems to me far to transcend the capacity of human understanding: and whosoever shall with attention and Judgment read what that most acute, and no less profound Philosopher, *Gassendus* hath written on this *Ænigmatic Question*, *Qui sensile gigni ex insensilibus possit?* (*in lib. 10. Diogen. Laertii*) will (I presume) with him conclude, *Hanc rem videri omni humanâ perspicaciâ, & sagacitate superiorem.* Leaving then this Problem, as I found it, desperate; and ending the halt I, with your permission, made, to consider the nature, Life and Principal Faculties of a sensitive Soul: I proceed to the *THIRD* capital Enquiry designed in this discourse. ¶

WHAT Opinions I at present hold to be most probable, as well concerning the nature of Life in general, as touching the different origines of Human, and Brutal Life in particular; ye have with obliging patience heard. Be pleas'd with like patience to hear also what I have to say, concerning the *SUBJECT* wherein the Life both of Man and Brutes seems primarily to *Subst.*

That the Life of all Animals is originally as it were kindled in their *Blood*, we may learn from the wisest of Men and Kings, *Salomon* himself. Who in his Book of *Wisdom* (*Cap. 2. v. 2.* according to the Græc version of the *LXX* Interpreters.) introduceth impious Men discoursing among themselves of the short, incertain and easily extinguishable Life of Man; in this manner; *ὅτι καπνὸς ἢ πνὸν ἐν εἴσιν ἡμῶν, καὶ ὁ λόγος σπινθήρ ἐν κινήσει καρδίας ἡμῶν;* *quoniam fumus est afflatus in naribus nostris, & sermo scintilla in motu cordis nostri;* which our last Translators have thus englished; *for the*
Breath

Breath in our Nostrils is as Smoke, and a little Spark in the moving of our Heart. For if by $\kappa\alpha\pi\nu\delta\varsigma$ ἢ $\pi\nu\delta\iota\alpha$, & δ $\lambda\omicron\gamma\omicron$, *Life* be understood; we may from this remarkable text safely infer, that *Salomon* was not far from holding the same Opinion concerning the Fountain or Origine of Life, that is asserted by all our modern Anatomists, *viz.* that *Life first ariseth from, and is perpetually as it were kindled anew by the motion of the Blood:* though it be scarce probable, he had any the least knowledg of the perpetual *Circuition* or *Circulation* of the Blood, first discovered to the World by our thence immortal *Dr. Harvey.*

And by one infinitely greater than *Salomon*, even by the Author of Truth, and giver of Life, *God* himself, we are certainly taught; that the Life of all Animals, of what kind soever, is seated primarily, and doth continually subsist in the *Blood, tanquam in subjecto suo primordiali*; or at least in some certain humor analogous to Blood, and therefore not unworthy to be call'd a *vital* Humor. For (in *Levit. cap. 17. v. 14.*) He saith expressly, $\text{Ἄμα πλοῦς σαρκὸς ἔφαγεσθε, ὅτι ἡ ψυχὴ πλοῦς σαρκὸς ἅμα ἀπ᾽ ἐσσι:}$ *Ye shall eat the Blood of no manner of Flesh; for the Life of all Flesh is the Blood thereof.*

Being then by Divine Authority assured, that Life is the Of-spring of the Blood, and perpetually resident therein; we may with good reason distinguish Life into *Original*, and *Influent*.

The *Former* is that, which is perpetually as it were kindled in the Blood passing through the Ventricles of the Heart, not from the influx of any adventitious Principle, but by the Sole power and energy of the *vital Spirit* itself contained in, and ruling the Blood. For, the *vital Motion* itself comes immediately from no other Principle but that ruling Spirit: and therefore

fore the *Act* of the same Spirit is, by consequence, *Vital*. And forasmuch as the reason of the actual *Heat* of the Blood, consisteth only and wholly in that vital *Motion*; that *Heat* also must be *Vital*, and the regent *Spirit*, that suscitates that motion, first in it self, and then in the Blood, must be the true Fountain and Origin of the *vital Heat*. This great truth certainly was not unknown to the Antients. For *Virgil* seems to more than hint it in that Verse of his (*Æneid. lib. 10.*).

Una eademq; via sanguis animusq; sequuntur :

And *Suidas*, where he saith, *ἄνιμα, τὸ ζωτικὸν τῷ οὐρανῷ*; also (as *Aristotle* relates) *Critias*, who held, *Sentire, maxime proprium esse animæ, atq; hoc inesse propter sanguinis naturam*. To these may be subjoyned *Thales Milesius*, *Diogenes*, *Heraclitus*, *Alcmaeon* &c. who all consented in this position, *id animam esse, quod sua natura vim movendi obtineret*. Evident it is then, that this Doctrine, that the vital Spirit is the principle of motion or heat, and consequently of Original Life in the Blood, was taught by some of the antient Philosophers; though probably not so clearly and fully, as by the Anatomists of our Age, who have had the advantage to know the whole mystery of the *Circuition* of the Blood, whereof the former seem to have been ignorant.

Hence it appears, how far those of our late Writers have erred from the Truth, who permitting their Phantacy to overrule their Judgment, and indulging I know not what Chymical shall I say, or Chimerical Hypotheses drawn from the contrariety between *Alchali's* and *Acids*, have confidently taught, that Life ariseth from a conflict or Fight, of two Antagonists,

whether of an *Acid* or *Saline* and a *Lixiviose*; or of a *Saline* and *Sulphureose*; or of the *Bile*, *Chyle*, or *nitroaereal Spirit* and the *Blood*. For, the *vital Motion* really proceeds (as I said) from the very nature of the thing which causeth it; that is, in the *Blood*, from the *vital Spirit* regent of the *Blood*; which being naturally agil, active and votatil, and alwaies endeavoring to extricate itself, necessarily contends with the grosser parts that clogg and restrain it, and by that contention excites motion in the *Blood*, and such a motion upon which the vitality of the *Blood* depends. Impossible therefore it is, that *Life* should come to the *Blood* from a mutual conflict of extraneous or forein Principles, whatsoever they are supposed to be.

The *Later* or *Influent* *Life* is communicated from the *Blood* now impregnated with *vital Spirits*, to all parts of the *Body*. Of which much remains to be spoke in its proper place.

Meanwhile, that we may know what is to be understood *per curriculum vite*, the *race* or *cours* of *Life*; 'tis necessary for us to run through all the *Uses* and *Acts* of the *Blood*, while it flows in a *Circle* to and through all parts of the *Body*. For, these being attentively survey'd, will at last reward our diligence with *Light* enough to direct us to judge more clearly of the *Power* and *Energy* of as well *Original*, as *Influent* *Life*. But first (for perspicuities sake) we must advert, that *Arteriose* *Blood* seems to differ from *Venose*, chiefly in this; that in *Arteriose* *Blood*, the *Heat* or *Motion* *Vital* (for both are one thing, and so we shall by and by find them to be) is *actual*; in *venose*, only in the way or *disposition* to become actual; as will appear from our following discourse concerning the *Acts* of the *Blood* in the *race* of *Life*.

Which are accompted in number five, *viz.* (1) *Actual*

al Generation of Original Life, or of vital motion or heat in the Blood itself; (2) Excitation of the Pulse of the Heart and Arteries; (3) Distribution of the Blood by virtue of that pulsation; (4) Communication of Life to all parts of the Body, by means of that distribution; and (5) Reduction of arteriose Blood to the state of Venose; the exhalations of it being first, partly consumed, partly condensed and absorp't into the Lympheducts. Of each of the Acts we must particularly enquire.

The *FIRST* Act, viz. the *Generation of Original Life in the Blood it self*, seems to be perform'd in this manner. The vital Spirit, rector of the Blood, by its own natural force and expansive energy endeavors to exagitate and expand the Blood now again brought into the Ventricles of the Heart: while the grosser parts of the Blood, by their nature more sluggish and unactive, resist and hinder that endeavor to expansion. From this resistence or checking, instantly arises a certain Colluctation or mutual striving between the expansive motion or endeavor of the vital Spirits, on one part; and the renitency of the grosser parts of the Blood, on the other. And from this Colluctation, an actual *Heat* is quickly excited or kindled in the Blood: actual Heat being nothing else but an expansive Luctation of the Particles of the Body or Subject in which it is; as the illustrious Lord Chancellor *Bacon* hath with admirable sagacity, from many instances collected, in *historia calidi, in novi Organi Pag. 218*. Seeing therefore, that this motion of the Blood consisteth in the expansive endeavor of the Spirits, and the reluctation of the other parts of it; this Motion, consequently is *actual Heat*. But, because this expansive Luctation is not hostile or noxious, but Amicable, Benign, and tending not only to the conservation of the Blood, but al-

fo to the exaltation of all its Faculties and Operations ; and becaufe it comes (as I faid a little before) from within, from the Spirit contained in, and ruling the Blood : therefore the Motion or Heat thence refulting, is alfo *Vital*. For in that very expansive motion of the Blood, doth the formal reason of Life originally confift.

This being a Theorem not a little abftrufe, and of very great Moment, chiefly to Phyficians ; 'tis requifite, I fhould endeavor both to clear and eftablifh it. That I may do fo, I begg leave to fet before you a fhort Series or Train of certain *Propofitions* ; of which the fubfequent depending (like the Links of a Chain) upon the antecedent, they may at length convince you of the Truth from thence to be concluded.

P R O P O S . I .

That Heat is only Motion.

THe verity of this is apparent (1) From Flame ; which is perpetually and violently Moved. (2) From the like agitation of all parts of fervent or boyling Liquors ; (3) From the incitation and increment of Heat caufed by Motion ; as in blowing up Fire by Bellows or Winds : (4) From the very extinction of Fire and Heat by all ftrong compreffion, which arrefteth the Motion thereof, and infantly caufeth it to ceafe : (5) From hence, that moft Bodies are deftroyed, at leaft fenfibly altered by all Fire, and by ftrong and vehement Heat ; which introducing a Tumult, Perturbation, and rapid Motion upon their Parts,

parts, by degrees totally dissolves the cohesion or continuity of them. Nevertheless this Proposition is to be understood with due limitation, or as it stands for the Genus of Heat: not that Heat generates Motion, or that Motion generates Heat always (tho both these be in some things true (but that Heat it self, or the very essence of Heat is Motion, and nothing else; yet a certain peculiar sort of Motion, or limited by the differences to be subjoyned.

P R O P O S. I I.

That Heat is an Expansive motion, by which a Body strives to dilate it self, and recede into a larger space, than what it before possessed.

THis also is evident (1) In Flame, where the Fume or Fat Exhalation manifestly widens itself, and spreads into Flame; (2) In all boyling Liquors, which sensibly swell, rise up, and emit Bubbles; still urging the process of self-dilation, untill they become more extense, and are turned into Vapor, or Smoke, or Aire; (3) In Wood and all other combustibile matter set on Fire, where is sometimes an exudation of moysture, alwaies an evaporation; (4) in the melting of Metals; which being most compact Bodies, do not easily swell and dilate themselves; and yet the Spirit of them, being once excited by Fire, begins instantly to dilate itself, and continues to push away and drive off the grosser parts, till their coherence being interrupted, they become liquid: and if the Heat be more
and

and more intended, it dissolves and converts much of the fixed Metal into a volatil Substance; -Gold only excepted: (5) in a Staff of Wood or Cane, which being heat in hot Embers, becomes easily flexible; a sign of internal dilatation: (6) In Aire above all things, which instantly and manifestly expands itself by a little Heat: (7) In the contrary nature of Cold; which contracts most Bodies, forcing them into narrower spaces, and shrinking their dimensions; so that in extreme Frosts, Nayls have been observed to fall out of Doors, and Vessels of Brass to crack, with many other admirable effects of great Cold, noted by the Honourable *Mr. Boyle* in his most accurate *History of Cold*. So that Heat and Cold, though they do many actions common to both, are yet *à diametro* contraries in this; that Heat gives a Motion expansive and dilating, but Cold gives a Motion contractive and condensing.

P R O P O S.

P R O P O S. III.

That Heat is a Motion expansive, not uniformly through the whole Subject, but through the lesser Particles thereof; not free, but checkt, hinder'd, and repulsed or reverberate: So that the Motion becomes interrupt, alternative, perpetually trembling, and striving, and incited by that resistance and repuls. Whence comes the Fury of Fire and Heat pent in and opposed in their Expansion.

OF this we have instances. (1) In Flame, boiling Liquors, melted Metals, glass Furnaces &c. all which perpetually tremble, swell up, and again subside alternately: (2) In Fire, which burns more fiercely, and scorches more ardently in frosty Weather: (3) in common Weather-glasses; in which when the Aire is expanded uniformly and equally, without impediment or repuls, no Heat is perceived: but if you hold a Pan of burning Coals near the bottom, and at the same time put a Cloth dipped in cold Water upon the top; the check and repuls thereby given to the expansion of the Aire, will cause a manifest trepidation in the Water, and intend the borrowed Heat of it. (4) In Winds pent in, which though they break forth with very great violence, so that their motion must needs be extremely rapid and dilating; do not yet from thence conceive any sensible Heat: because the motion is in all the particles of them equally,

ly, and proceeds uniformly, without check or interruption: whereas in the burning Wind, from thence called by *Aristotle* (*in Meteor.*) $\pi\epsilon\upsilon\sigma\eta$, great heat seems to be generated from the frequent repulses and repercussions of its rapid Motion, insomuch that it scorches where it blows; chiefly in narrow and deep Vallies, where it is kept in on both sides, and wheel'd about into eddies or Whirle-Winds. (ζ) In the very manner of *Ustion* or burning, which is always tranſacted through the minute Pores of the Body burnt; so that *Ustion* doth always undermine, and penetrate, and prick, as if it were done by the points of a great many Needles. Thence it seems to come also that *Aqua Fortis*, *Chryſulca* and other dissolving Liquors (if proportionate to the Body on which they act) do the work of Fire, by their penetrating, purgent, and corroding Motions.

P R O P O S . I V .

That this expansive, repuls'd, alternative and penetrating Motion requisite to the generation of Heat, ought to be also rapid; and to be made by Particles, minute indeed, but not reduced to extreme subtilty.

THe verity of this proposition may be collected (1) From a comparison of the works of *Fire*, with the works of *Time* or *Age*. For, *Age* dries, consumes, undermines, and incinerates, no less than *Fire*, yea far more subtilly: but because the motion that

that causes these effects, is both very slow, and performed by Particles extremely minute; therefore no sensible *Heat* is thereby produced. (2) from comparing the dissolution of *Gold*, with that of *Iron*; the first, in *Aqua Regis*; the other in *Aqua Fortis*. For *Gold* is dissolved calmly, without tumult or effervescence raised in the dissolvent: *Iron*, not without vehement excitation of *Heat*: probably because in *Gold*, the ingress of the *Water of Separation* is slow, mild, and subtilly insinuating, and the yielding of the parts of the *Gold* easy; but in *Iron*, the ingress is rough, difficult, and with conflict, the parts of the *Iron* with greater obstinacy resisting the motion of the dissolvent. (3) From *Gangrens* and *Mortifications*; which invade and spread without inducing much either of heat or pain, by reason the motion of putrefaction is both slow, and performed by Particles extremely subtil; otherwise it would certainly cause Pain in the part affected.

Now from these Propositions (the three latter of which are certain necessary Limitations of the first) we may deduce this genuine conclusion; That *Heat is a certain Motion, expansive, checkt or repuls'd, striving, quickned or incited by opposition, perform'd by minute Particles, and with conflict and some impetuosity.*

Which to me (I declare) seems to be so perspicuous and convincing, that I dare promise, that if any man be able to excite a Motion tending to dilatation or expansion of the Movent, and then to repress that motion, so as the dilatation may not proceed equally and uniformly, but prevail and be repulsed alternately: he shall thereby most certainly generate *Heat* in the Body whose parts are so moved, of what kind or constitution soever the Body shall be. For, whether it be a Body Elementary (as they speak) or luminose or

opaque; rare, or dense; locally expanded, or contain'd within the bounds of its first dimensions; tending to dissolution, or remaining in its state; whether it be Animal, Vegetable, or Mineral; Water, or Oyl, or Aire, or any other substance susceptible of the Motion described; it will make no difference, as to the effect aimed at, the production of actual *Heat*.

Why then should I not believe, that Nature hath instituted such an actual Motion or Heat in the Blood of Animals, that Life Original might be therein perpetually generated: since to make that actual Heat also *Vital*, nothing more is required (as I said before) but that it arise from an internal Principle or Mover, *viz.* the vital Spirits ingenite in the Blood; and that it be amicable, benign and placid, as in the State of Health it always is; and since both those requisite conditions or qualifications are found in the motion of the Blood? If in the assertion of the precedent Propositions, or in the deduction of my conclusion from them, I have from weakness of Judgment, admitted any Paralogism; I shall receive the discovery thereof as a singular favor from any man of greater perspicacity, and more skilful in the art of reasoning rightly, and will ingenuously acknowledg and retract my error. Meanwhile I acquiesce in this persuasion, that the vital Heat of Animals, is an expansive Motion of the Spirits of the Blood, somewhat checkt or repulsed, but still endeavoring with sufficient force, and alternately prevailing: which I owe, partly to the Ld. Chancellor *Bacon* (*in novo Organo, ubi agit de prerogativis instantiarum, in vindemiatione* 1.) partly to his equal sectator, *Dr. Glisson*, who had the felicity to improve whatsoever he had borrowed, and to raise illustrious Theories from obscure hints.

But hold a little, and give me space to reflect upon
what

what I have lately said. Have I not in this place incurred the danger of being accused of contradicting myself? 'Tis not half an Hour since I declared my assent to that common Doctrine of all Theologs, and most Philosophers, that the Life of a Man doth originally spring from, and perpetually depend upon the union of his rational Soul with his Body. And now I affirm, that the Life of all Animals (Man himself not excepted) consists in the expansive motion of the Spirits in their Blood. Are not these two assertions to be numbred among ἀσυστά, things inconsistent, yea manifestly repugnant each to the other? If either of them be true, is not the other necessarily false?

To obviate this formidable accusation, I say; that these two positions, though seemingly opposite, are yet really capable of reconciliation each to the other; and by consequence, both may be true. For (1) well known it is to all versed in the Jewish Commentaries upon the *Pentateuch*, that the most learned *Rabbins*, interpreting these words in the History of Mans Creation; *Deus inspiravit in faciem hominis spiraculum vite*; to shew the excellency of Man above all his fellow Creatures, give this Paraphrase upon them: *Homini Deus in creatione imaginem suam indidit, & inspiravit halitum vite duplicis, mortalis & immortalis*. So that according to the Sense of this Paraphrase, at least if I understand it rightly, God was pleased to give to Man a *double* Life, not two lives successive, one before Death, the other after; but two *conjoyn'd* in the Body: one *Immortal*, which can be no other but that which is essential to the rational Soul, and communicated to the Body, by virtue of the intimate union of those two so different substances; the other *Mortal*, common to Brutes also, and extinguishable by death, which I deduce from the expansive motion of the Spirits of the

Blood. Nor hath this interpretation of the *Fewists* Doctors been (for ought I know) rejected by the *Christian* Scholes, as unfound, much less as Heretical: and therefore I humbly conceive, it is not unlawful for me to embrace it.

(2) That in this Life, every individual Man hath also *two* distinct Souls; one *Rational*, by which he is made a reasonable Creature; the other, *Sensitive*, by virtue of which he becomes a Sensitive Animal: and that these are coexistent, conjunct, and cooperating in him, untill death, which delivers the *first* into a free enjoyment of her essential immortality, but dissolves the *latter* into the Elements or matter, of which it was composed; is an opinion very antient, highly consensaneous to reason, and defended, not only by many eminent *Philosophers* as well antique as modern, but even by some *Divines* of great learning, Piety and Fame; among whom I need name only *Gassendus*, of the Roman, and *Dr. Hammond*, of our Church. The former of which hath professedly asserted it in *Physiologia Epicuri, cap. de Anima sede*: the other in Notes on the 23. Verse of the 5 Chap. of St. Pauls first Epist. ad Theff. Where interpreting these Words of the divinely inspir'd Author; το ὀλοκληρεν ὑμῶν τὸ πνεῦμα, καὶ ἡ ψυχὴ, καὶ τὸ σῶμα, *integer vester spiritus, & anima, & corpus* &c; he conceived, that the Apostle divides the whole Man into his three constituent parts, viz. the *Body*, which comprehends the Flesh and Members; the *Sensitive* or *Vital Soul*, which is common also to Brutes; and the *Spirit*, by which is denoted the reasonable Soul originally created by God, infused into the Body, and from thence after death to return to God; and this his exposition he confirms by agreeing Testimonies of many Ethnic *Philosophers*, and some antient *Fathers*. Much more I should here have

have said in defence of this opinion, had I not thought it less labour to direct the unsatisfied, to a little Treatise intitled a *Natural History of the Passions*, publish'd about three Years past, where the Author professedly handles it. Now if either of these two recited opinions be granted to be true (and 'tis no easy task to refute either of them) then both my positions, that occasioned my recital of them, may be also true ; and so the supposed inconsistency of them solved. Presuming then, that what I have said concerning the *First Act* of the Blood, or the Generation of Original Life in the Blood, and the manner how it is performed, is probable, and sufficient to explicate the Theorem ; I here conclude my discourse of it. ¶

The *SECOND ACT* of the Blood in the race of Life is, the *Excitation of the Motion or Pulsation of the Heart and Arteries*, which seems to be done in this manner. The Blood descended partly out of the Trunc of the *Vena Cava*, partly from the *Arteria Venosa*, into the *Ears* or Portals of the Heart ; and there beginning its expansive motion, fills them even to distention ; and by that distention irritates or incites their Fibres, which are numerose and strong, to contract themselves, by the motion of *Restitution*. By this constriction of the Fibres on all sides, the cavities of the *Ears* of the Heart are necessarily closed or streightned ; and by consequence, the Blood newly admitted into them is sequeez'd out into the two *Ventricles* of the Heart, forcing the *Valves* called *Tricuspides*, or *Trisulce*, which are seated at the Gates or Mouths of the Ventricles, and open from without inward, to open themselves and give way. The Blood thus propull'd into the Ventricles of the Heart, and somewhat increasing or intending its expansive Motion, fills them even to

to distention, and to the shutting of the Valves, which it so lately open'd, so that at that time no more Blood can be admitted, nor what is admitted, recoil or return by the Wicket through which it enter'd. The Ventricles of the Heart being thus filled and distended, and by virtue of their Fibres spontaneously contracting themselves into a much narrower compass, strongly compress the Blood contained in them, and force it to thrust back three other Valves call'd *Sigmoides*, which open outwards, and to rush forth, partly into the *Vena Arteriosa* leading it into the Lungs from the right Ventricle, partly into the *Aorta* or great artery from the left. By this constriction of the two Ventricles of the Heart, which is their proper and natural Motion, the *Circulation* (as they call it) of the Blood is chiefly effected: that Blood which is out of the right Ventricle express'd through the *Vena Arteriosa* into the Lungs, being impell'd forward till it arrive in the *Arteria Venosa* that brings it into the left Ventricle; and that which is expell'd from the left Ventricle into the great Artery, being by the Branches thereof distributed into all the parts of the Body. The Blood being in this manner squirted out, and the irritation ceasing; the *Ventricles* instantly restore themselves to their middle position, and make way for the reception of more Blood from the *Ears* of the Heart, as before; and then being by the Influx and expansive Motion thereof, again distended and irritated, repeat their *Constriction*, and thereby eject it: and this reciprocation or alternate dilatation and constriction, or *Diastole* and *Systole* of the two Ventricles of the Heart, together with the Arteries continued to them, is what we call their *Pulsation*, and the grand cause of the perpetual *Circuit* of the Blood: as the alternate *expansion* and *repression* of the Spirits, during that pulsation, is that motion which

which *Dr. Gliffon* first named, the *Mication* of the Blood, comprehending the double motion in that single appellation.

The Blood then it is, that alone excites the Pulsation of the Heart and Arteries by distending them; not by reason of any actual *Ebullition*, or any considerable *Rarification*, it undergoes in either of the Ventricles, or in their avenues; but (as I humbly conceive) merely by its *quantity* rushing in.

Not by *Ebullition* or *Effervescence*, as *Aristotle*, who gave it the Name of *δύναμις*, believ'd; (1) Because no ebullition of any Liquor whatsoever, proceeding either from external Heat, or from intestine Fermentation, is constantly *equal* or *uniform*; whereas the Pulse of the Heart and Arteries, and consequently the motion of the Blood that causeth it, is in Men healthy, temperate, and undisturbed by Passion, constantly equal or of the same tenor and rhythm. (2) Because the greater the Ebullition of the Blood, the greater would be the pulsation of the Heart: but in burning Fevers, though there be a very great effervescence of the Blood, arising from an extraordinary effort of the vital Spirits contending against oppression by the putrefactive or febrile Ferment; yet the Pulse most frequently is low and weak, as *Galen* himself observed. (3) Because, in living dissections, if either of the Ventricles of the Heart, or the great Artery be pierced with a lancet; pure and florid Blood indeed will spring from the Wound, in every *Systole*; but not *frothy*, not *boiling*, nor meteorized; nay, not to be, by any sign of difference, distinguished from Blood at the same time emitted from the *Vena Cava* of the same Animal. An Argument certainly of itself sufficient to subvert the Ebullition of the Blood in the Ventricles of the Heart, excogitated by *Aristotle* (at least if he were Author
of

of the Book *de Respiratione* vulgarly ascribed to him) to solve the Phænomenon of the Pulse, and to this day obstinately defended by many learned men, seduced by the Authority of his great name. (4) If the Blood suffer'd any such Ebullition, an immersion or plunging of the Body into cold Water, would depress and calm it, and consequently repress the motion of the Heart: but the experience of divers attesteth the contrary. For these reasons, therefore, among many others here, for brevities sake, omitted, I reject the supposed *Ebullition* of the Blood passing through the Ventricles of the Heart.

I reject also the suddain and impetuous *Rarification* attributed to it by the greatest of *Aristotle's* Rivals, *Monsieur des Cartes*, and strenuously propugned by *Regius* and others his Disciples. For (1) If you open the *Thorax* of any more perfect Animal alive, and while the Heart yet continues to beat strongly, thrust an incision Knife into either of the Ventricles, or into the great Artery; the Blood thence issuing will not appear spumose or rarified at all, but indistinguishable from Blood taken out of the *Vena Cava*, just at its entrance into the right Ear of the Heart. (2) If you cut out the Heart itself, and squeez out all the Blood contained in it; you shall observe it to vibrate itself a little, and to continue the rhythm of its Pulses, till it be grown cold; and this, not from Blood rarified, for now there remains none within its Ventricles; but most probably from the reliques of the vital Spirits, which yet inhering in the Fibres and little Pullies of the Heart, are the cause that they alternately contract and relax themselves. (3) The muscloses Flesh of the Heart is of a contexture too firm and solid, to be inflated by a little Froth; and a greater force is requir'd so nimbly to agitate so massive and ponderose a Machine.

chine. (4) If the Blood were so impensly rarified in both the Ventricles of the Heart, doubtless the Orifices both of the *Vena Arteriosa*, and of the *Aorta*, ought to be much larger; because the rarified Blood would require more of space to its egress, than to its ingress. (5) There would arise a confusion of the motion of the Heart and its Valves; for the diastole of these would be coincident with the diastole of that, which would annihilate the use of the Valves: both which are repugnant to experience, and to the institute of Nature. (6) No reason, why the Blood should be pufft up by great rarification in the Heart, only that it may sink and be condensed again, so soon as it is thence emitted into the Arteries: for, what use can there be of the supposed rarification, which the very next moment ceaseth? These then are the reasons that hinder me from believing, that a drop or two of Blood can be, by the heat of the Heart, so extremely rarified, as to replenish and distend the Ventricles thereof, when the Cavity of the least of the Ventricles, in a Man of middle Age and Stature, will easily contain, according to *Dr. Harvey's* accompt, two Ounces; much more, according to *Dr. Lower's* (*lib. de corde cap. 3.* and when I am fully convinced, that in the State of Health and Quiet, the whole mass of Blood is transmitted through the Heart at least thirteen times in the space of an Hour, supposing no more than 2000 Pulses in that time: which would be impossible, if only a few Drops were received into each Ventricle, in every *Diastole*, and expel'd again by the following *Systole*. For, evident it is even to Sense, that in the *Diastole*, both Ventricles of the Heart are filled with Blood even to distention; so that if you feel them at that time with your Hand, they will be found tense and hard: and that by the *Systole*, all the Blood re-

ceiv'd is express'd; the Sides being then strongly drawn together, and the Cone pull'd up toward the Basis, so that little or no room can be left within to contain Blood. If you open an Eel or Viper alive, you may observe the Heart to become *white* in the *Systole*, because all the Blood contained in it, is then squeez'd out: and *red* again in the *Diafsole*, from new Blood admitted and filling it. Nor are we to doubt, but the same happens in the Hearts of greater Animals also, though the Parenchyma or muscular Flesh of the Heart be in them so thick, as to hinder the Eye from discerning the like alternate change of Colours, in their constriction and dilatation.

Taking then the total Repletion of the ventricles in every *Diafsole*, and the total Exinanition of them, by every *Systole*, for granted; and Supposing, that in a Man of a middle size, each of the Ventricles of the Heart contains about two ounces of Blood, when it is fill'd; and that the Pulses of the Heart made in the space of an Hour, exceed not the number of 2000 (which yet is the lowest computation I have hitherto met with among Anatomists) it will necessarily follow, that no less than 4000 Ounces of Blood are transmitted through the Heart in the space of an Hour, which amount to 332 Pints at 12 Ounces to the Pint; whereas the quantity of Blood contain'd in the Body of a Man of a Sanguine complexion, tall Stature, and plentiful Diet, is not allowed by accurate Anatomists to exceed 25 Pints at most. Let us therefore grant our Man to have that proportion of 25 Pints, to be transmitted through his Heart by 2 Ounces at every pulsation: and the consequence will be, that the whole Mass of his Blood must pass and repass through his Heart thirteen times in the space of an Hour, or else the pulsation of his Heart, and his Life too must cease,

for

for want of Blood to continue the Motion. But since few Men have either so much Blood, or (in the state of Health) so few Pulses, as we have now supposed; 'tis highly consentaneous, that in most Men all their Blood runs through the Heart oftner than thirteen times in every Hour. Now to come to the scope or use of this Computation; if only a few drops of Blood rarified be transmitted through the Heart of a Man at every Pulse, 2000 pulses could not transmit so much as a fourth part of 25 Pints in an Hour; and in the mean time all the rest of it must stagnate, and grow cold; and then what would become of his Life, which depends upon the actual Heat and perpetual Circuition of the Blood? This argument certainly is, if not apodictical, yet morally convincing, that *Monsieur des Cartes* his opinion of the immense *Rarification* of the Blood, in the Ventricles of the Heart, is manifestly erroneous.

There remain's then nothing to which the *Diastole* of the Ventricles of the Heart can be reasonably attributed, but the *Quantity* of Blood flowing into and distending them. For, the substance of the Heart being, as well without as within, Musculose, Robust, Thick, and intertext with Fibres of all orders or positions; and furnish't also with fleshy Columnes, which being commodiously placed in the Ventricles, help much to the constriction of them: so soon as the Blood flowing in, hath distended them, they being thereby irritated, instantly begin to contract themselves, by that contraction girding in the Ventriclès, and squeezing out the Blood. After the same manner, that the Stomach, Gutts, Bladder, Womb, &c. membranose and fibröse Cavities of the Body, when they are above measure fill'd and distended, do, by spontaneously constringing themselves, forcibly expell whatever irritates them.

And that in every *Diastole* of the Heart, Blood rushes into the Ventricles in a quantity *sufficient* to distend them; seems inferrible even from this, that it is abundantly brought in, both by the *Vena Cava*, and by the *Arteria Venosa*; and that it is continually driven on thitherward, partly from the habit of the Body, by the tonic motion of the parts, partly from the Lungs by help of their motion, according to the fundamental Laws of its *Circuition*. But why do I insist upon Reasons, when an easie *Experiment* offers itself to determine the Question? In a Dog opened alive, if the two Vessels that bring Blood into the Heart, namely the *Vena Cava* and *Arteria Venosa*, be girt with Ligatures, so that the course of the Blood be there intercepted; the Ventricles by three or four *Systoles* emptying themselves, their orderly pulsation will cease, only a little undulating Motion, and irregular vibration will thereupon immediately succeed: and upon solution of the Ligatures, and influx of Blood, the Heart will instantly repete its pulsation. I conclude therefore, that the Blood causeth the Dilatation of the Heart, not by its Ebullition, nor by its Rarification, but only by its replenishing and distending the Ventricles thereof: and that the Heart, by its spontaneous contraction expresses the Blood into the Lungs and great Artery; and so the motion of both is perpetuated.

I admit nevertheless a certain gentle and pacate expansive Motion of the Blood to be excited in the Ears and Ventricles of the Heart, as necessary to the generation of Original Life, though not of force sufficient to move the whole Machine of the Heart. For the *vital Spirits* in the Blood, though brisk and vigorous in their endeavor to expansion, chiefly when they are agitated by the motion of the Heart, are notwithstanding somewhat checkt and repulsed by the reluctancy
of

of the groffer Particles of the Blood; and therefore it cannot be imagined, they should suffice to dilate the Heart also.

I admit also a constant invigoration of all the Fibres and fleshy Columns or Pullies of the Heart, by a continual *Influx from the Brain*; that they may the more expeditely and strongly, and without lassitude, perpetuate the *Systole* of the Heart. For, that such an Influx is necessary every Moment to recruit their Vigor, and conserve the due firmness of their tone, is evident from this singular *Experiment*. If the Nerves of the *eight pair* be constringed closely by ligatures, in the neck of a Dog; ye will admire what a suddain and strange mutation will thereupon ensue. The Heart, which before performed its motions moderately and regularly, will instantly begin to tremble and palpitate, and the poor Animal will labour of anxiety and extreme difficulty of breathing, while the ligatures continue on the Nerves above: but upon removing them, all those dismal Accidents (which are perhaps to be ascribed to the surcharge of the Heart and Lungs by Blood not so fast discharged, as it is imported; and that by reason the Systoles are readred weak and languid; the influx from the Brain, that should invigorate the contracting Fibres and Pullies, being intercepted) all the Accidents, I say, will soon cease, and the Heart renew its pulsation, as before. To this Anatomic Experiment I might have added Arguments of the same importance, drawn from the *Palsie* and *Convulsions* to which the Heart itself is liable, had not the industrious *Dr. Lower*, Author of the alleged experiment; prevented me, *lib. de motu cordis cap. 2.* and were I not conscious, that I have staid too long upon the cause and manner of the Excitation of the Pulsation of the Heart and Arteries, or

second

second Act of the Blood in the race of Life. ¶

Proceed we therefore to the *THIRD*, viz. the *Distribution* of the Blood into all parts of the Body; which is an act wholly *Mechanic*, and to be attributed to the *Systole* of the Heart and Arteries thereto continued. To the *Constriction* of the Heart, because the Blood contained in the right Ventricle, is thereby of necessity express'd into the *Vena Arteriosa*, and so into the Lungs; and that in the left, is thence expell'd into the great *Arterie*, and driven on through the Branches thereof into all the parts of the Body. Nor can it seem strange, that this Constriction of the Heart should be effected with force sufficient to impell the Blood in a continued stream through the Pipes of the Arteries, till it arrive at the extremities of them; yea till it enter into the very substance of the parts in which they are terminated. For if we attently consider (1) the structure of the heart, that it is a Muscle of a substance Solid, thick, and firmly compacted; every where intertext with various Fibres, and corroborated within with fleshy Columns and fibrose Pullies; and of a Figure fit to perform vigorose Motions: (2) that if you put your Hand upon the Heart of any large Animal open'd alive, you shall find it hard and tense, not easily yielding to the Gripe: and if you thrust a Finger into either of the Ventricles, you shall feel it to be with great violence girt and pincht by the *Systole* thereof: (3) that if you pierce the great Arterie near the Original of it, with a Lancet, the Blood will be in every contraction, squirted thence with incredible impetuosity, and to great distance: (4) that in some Men the Heart invaded by Convulsions, hath vibrated itself with such stupendous Force, that the very Ribbs have been thereby broken; as the observations recorded by

Fernelius,

Fernelius, Hollerius, Forestus; and Carolus Pifo attest: (5) that in Horses and Doggs, after they have run, the beating of their Hearts may be plainly and distinctly heard to a considerable distance: If (I say) we consider these things, we shall soon be induced to believe, that the *Systole* of the Heart is more than sufficient to impell the Blood to the extreme arteries. And as for the spontaneous *Constriction* of the *Arteries*; that also must needs contribute somewhat to the *Pulsion* of the Blood, by less'ning the Pipes through which it flows. Remarkable it is, that the *Contraction* of the *Arteries* is not *Synchronical* or coincident with the contraction of the Heart. For, the *Systole* of the Heart is perform'd in the time of its contractive Motion; and the *Diastrale*, in the time of the remission thereof: but on the contrary, the *Diastrale* of the *Arteries* is perform'd when they endeavor to contract themselves; and their *Systole*, when they remit that endeavor: The reason is, because the exclusion of a sufficient quantity of Blood out of the *Ventricles* of the Heart being perform'd, the first cause that impugned the contraction of the *Arteries*, *viz.* their distention by that Blood rushing into them, instantly ceases, and the three *Semilunar Valves* are shut; to prevent the regress of it; and at the same time, the rest of the Blood in the *Arteries* remits its expansive Motion, which was the other cause that hinder'd the *Arteries* from contracting themselves, and those two impediments removed for that time, the *Fibres* of the *Arteries* now prevail, and by contracting themselves, return to their middle posture of quiet; by that contraction pressing the Blood forward on its Journey, till it be impell'd into the substance of the Parts.

From, whence after it hath done its Office, it is soon forced to *return* toward the Heart, through the
Veins;

Veins ; partly by more Blood flowing after and pressing it behind ; partly by the renitency and tonic Motion of the parts ; partly by the tension of the Muscles in the habit of the Body ; and in fine, by the Pulsation of the *Vena Cava*, which though but light, is yet perceptible at its approach to the Heart, where (to that end) it is furnisht with fleshy Fibres ; so that from thence *Waleus* (in *Epist. de motu Sanguinis*) concluded, that the circular Motion of the Blood beginn's from that-part of the *Vena Cava*. If I do not here particularly explain the reason and manner how each of these various Causes conduceth to the effect ascribed to their Syndrome or concurse ; it is because I presume, that the whole History of the Circuition of the Blood, with all its helps and circumstances, is well known to the greatest part of my Auditors ; and because I hast to the

FOURTH Act in the race of Life, which begins where the distribution of the Blood through the Arteries end's: and is the Communication of Life from the Blood distributed, to all parts of the Body. For these receiving the Blood impregnate with Original Life, are thereby in a moment heated anew, invigorated, incited to expand themselves, and made participant of Life Influent ; *i. e.* they are stirred up to the actual exercise of Augmentation or nutrition, and of all other their Faculties. And this Participation of Life is that vital Influx, with so great Encomiums celebrated by Anatomists; and the Heat of the Body, both actual and vital ; and the general cause (at least *Sine qua non*) of all the noble Actions of the whole Body. I say, the *General Cause* ; because it is this influent Vital Heat, that revives and stirrs them up to activity, when without it all parts would be dull, flaggy and torpid: and yet notwithstanding it is not sufficiently able of itself to produce

produce those Effects, unless so farr forth as it is at the same time contemperated and determinated to this or that particular effect, by that which some call the *peculiar temperament*, and others the *Spiritus insitus*, of that Member or Part, whose proper Office it is to cause that effect. For, this vital Heat, or general enlivening and invigorating influence operates one thing in the Liver, another in the Spleen, another in the Stomach and Gutts, another in the Kidneys, & *Sic de cæteris*: assisting and promoting the faculties of all parts, so that no one can execute its proper function without it: as, the irradiation of the Sun is requisite to make the Ground fruitful, and to excite the Seeds of all Vegetables lying in it; and indeed this vital Heat is to Animals, the *Sun* within them, their *Vesta*, perpetual Fire, *familiar Lar*, *Calidum innatum*, *Platonic Spark* perpetually glowing: not that (like our common Fire) it shines, burns and destroys; but that by a circular and incessant Motion, from an internal Principle, it conserves, nourishes and augments, first itself, and then the whole Body. *Unde* (Entius *noster* (in *Antidiatribæ* pag. 6.) *in hunc finem extractum est cor; quod calentis sanguinis rivulis totum corpus perpetim circumluit.* *Cumq;* *Plantæ omnes, à Solis benigna irradiatione vigorem, vitamq;* *adeo suam præcipue mutuuntur: animalibus cæteris cordis calor innascitur; unde, tanquam à Microcosmi sole, partes omnes jugiter refocillantur. Ac propterea minus placet, quòd plantarum germen Corculi nomine indigitaveris.* Good reason then had our most *Sagacious Harvey*, to sing so many Hymns, as it were, to this *Sol Microcosmi*, that continually warms, comforts, and revives us. Discoursing of the Primogeniture of the Blood in an Embryon (*Lib. de Generat. Animal. exercit. 50.*) he falls into this elegant encomium of it. *Ex observatis constat, Sanguinem esse par-*

“tem genitalem, fontem vitæ, primùm vivens & ultimò
 “moriens, sedemq; animæ primariam; in quo (tanquam in
 “fonte) calor primò, & præcipuè abundat, vigetq; & à
 “quo reliquæ omnes totius corporis partes calore influente
 “foventur, & vitam obtinent. Quippe calor Sanguinem
 “comitatus, totum corpus irrigat, fovet, & conservat.
 “—— Ideoq; concentrato, fixoq; leviter sanguine (Hip-
 “pocrates, ἀπόληψιν τῶν φλεβῶν, nominavit) veluti in li-
 “pethymia, timore, frigore externo, & febrim insultu
 “contingit; videas illud totum corpus frigescere, torpere,
 “& pallore livoreq; perfusum languescere: evocato autem
 “rursum sanguine, hui! quam subito omnia calent denù,
 “florent, vigent, splendentq;? —— Nec jecur munus
 “suum publicum exsequitur, sine influentia sanguinis & ca-
 “loris per arteriam Celiacam. Imò vero Cor ipsum, per Ar-
 “terias Coronarias, influentem unà cum sanguine calidi-
 “tatem vitamq; accipit. Quippe nullibi est caloris afflu-
 “entia, citra sanguinis influxum per arterias. —— Sanguis
 “deniq; totum corpus adeo circumfluit, & penetrat, omni-
 “busq; ejus partibus calorem & vitam jugiter impertit;
 “ut Anima primò & principaliter in ipso residens, illius
 “gratiâ, tota in toto, & tota in qualibet parte (ut vul-
 “gò dicitur) inesse, meritò censeatur. In another place
 (Exercit. 51.) vindicating the Supremacy of it over all
 parts of the Body, he breaks forth into this memorable
 expostulation: “Si Neoterici quidam verè dicant, ani-
 “malium semen coitu emissum, esse animatum; quidni pa-
 “ri ratione affirmemus, animam esse in sanguine; cumq;
 “hic primò generetur, nutriatur, & moveatur; ex eodem
 “quoq; animam primùm excitari, & ignescere? Certè
 “sanguis est, in quo vegetativæ, & sensitivæ operationes
 “primò elucent; cui calor, primarium & immediatum a-
 “nimæ instrumentum, innascitur; qui corporis animæq;
 “commune vinculum est; & quo vehiculo, anima omni-
 “bus totius corporis partibus influit. In a third place,
 (Exercit.

(*Exercit.* 70.) where he, with cogent reasons, refutes the vulgar error *de calido innato*, he puts an end to all false notions, and all disputes concerning that Subject, and then concludes in these words: “*Solus sanguis est calidum innatum, seu primò natus calor animalis.* — “*Habet profectò in se animam primò ac principaliter, non vegetativam modò, sed sensitivam etiam & motivam: permeat quoquoversum, & ubiq; presens est; eodemq; ablato, anima quoq; ipsa statim tollitur: adeo ut sanguis ab anima nihil discrepare videatur; vel saltem substantia, cujus actus sit anima, estimari debeat.* These remarkable texts I have recited, not to prolong my discourse, but to confirm whatsoever I have said of the generation of Life original in the Blood, and of the communication of influent Life, from the same Blood to all parts of the Body; that so I might with more assurance leave this fourth Act of the Blood fully explain’d, and pass to the ¶:

FIFTH and last. Which consisteth in the diffusion of the *exhalations* of the Blood, raised by the expansive Motion or actual Heat of it; and which reduceth it from the State of Arteriose Blood, to that of Venose. For the Blood newly impregnate with Life, and kept a while in restraint by the thick Walls of the Heart, and firm Coats of the Arteries, no sooner arrives at the habit of the parts, but instantly it begins to disperse its more volatile Particles in Steams or Exhalations: and those being diffused, it becomes calm and sedate, and is in that composed condition transferred into the capillary Veins, to be at length brought again to the Heart. Of these Exhalations, the more subtil and fugitive part expires into the Aire by insensible transpiration; the rest striking against membranose and impervious Parts, or perhaps against the very Parenchyma of them, is stop-

ped and repercus'd, and condensed into a Dew. Which after it hath moistned the parts, is by their tonic motion squeez'd into the *Lympheducts*, and by them carried off toward the Centre of the Body. In the mean time, the Blood after this manner calmed and recomposed, returns quietly and slowly toward the Heart, therein to be quickned, heated and impregnated anew by the expansive Motion of its Spirits: being driven on all the way by more Blood continually following and pressing it, and by other concurrent Causes, by me a little before particularly mentioned. And this I believe to be the manner and reason of the perpetual *Circuition* of the Blood during Life.

Now reflecting upon the five Acts of the Blood described in the circular Race of Life; the *Sum* of all my perplex and tedious disquisition concerning it, amounts to no more but this. That the *Mication* of the Blood proceeds originally from the expansive motion of the Spirits of it, somewhat restrain'd and repulsed by the gross and less active parts, and incited by that opposition: that from this Mication, *Life Original* is as it were kindled in the Blood passing through the Heart: that *Life influent* is communicated to all parts of the Body, from the Blood transmitted to them through the Arteries; and from the union of the vital Spirits contain'd in the Blood, so brought into them, with the *Spiritus insitus* of every part that receives it: that to that noble end, Nature hath ordained, that the Blood should be speedily *distributed* to all parts through the Arteries, by the Heart spontaneously contracting itself: and so soon as it hath done that its grand Office of reviving them, and diffused its *exhalations*, be brought back again to the Heart, therein to conceive vital Heat anew: and in fine, that the Life of all Animals depends immediately or primarily upon the regular Mication, and
next

next upon this perpetual Flux and reflux of the Blood, by the glorious Inventor of it, *Dr. Harvey*, rightly called (not the Circulation, but) *CIRCUITIO* N of the Blood,

Quòd ejus semper redeat labor actus in orbem.

How probable these things are, Ye, who are Philosophers and Anatomists, have indeed a right to Judge: but ye must pardon me, if I adventure to say, that ye have no right to Judge, whether they be true, or not. For, what *Seneca* (*Natural. Quest. lib. 7. cap. 29.*) with great Wisdom and Modesty, spake of his own reasonings about the nature and causes of *Comets*, may be with equal reason applied also to mine concerning *Life* (which in more then one thing resembles a Comet) *viz. Quæ an vera sint, Dii sciunt, quibus est scientia veri. Nobis rimari illa, & conjecturâ ire in occulta tantum licet, nec cum fiducia inveniendi, nec sine spe. Huc item referri potest, quod Atheniensis hospes respondebat Clinio apud Platonem: τὸ μὲν ἀληθὲς διχουρίζεσθαι, πάντα ἥτις ἔχειν, πολλῶν ἀμφισβητούντων, θεῶν: Vera hæc esse approbare, cùm multi de iis ambigant, solius Dei est.* If you grant them to be consentaneous to right reason and observations Anatomic; I may then not impertinently conclude this Disquisition with the same Sentence with which my Master *Gassendus* is said to have concluded his Life;

Quantula res est vita hominis? ¶:

EPILOGUE.

EPILOGUE.

AUGUSTUS (ye know) notwithstanding he had long enjoyed whatever the greatest part of mankind calls Happiness, could not yet, when dying, afford to call Human Life by any better Name than that of a Comedy or Farce: asking his Friends that stood by him, *Ecquid iis videretur mimum vitæ commodè transegisse?* And that this Farce consisteth of five natural Acts too, I have endeavored in my precedent Discourse to evince.

Why then may not ye expect, that I should, in keeping of Decorum, so far persue this double Analogie, as to my short History of Life, to subjoyn an Epilogue? Supposing therefore that ye do, I hold myself obliged to add one; such as seems to me to be neither indecent, nor impertinent. It shall be a short History or Tale (call it whether ye please) Written by Philostratus in lib. 4. cap. 16. de vita Apollonii Tyanei: Which, I, through haste forgot to touch upon in its due place, and in which there occurs more than one thing worthy to be remarked. Be pleased then to hear, first the Story itself, in the Authors own Words; and then my brief reflections upon the things therein chiefly considerable. The Story is this.—

The things I thence collect, are these.

I. That the Maid was not really Dead, but only seemed to be so: and consequently that the raising of her by Apollonius was no Miracle. For the Author himself, though in the first Line so bold as to call it, *θαύμα*, a Miracle;

is yet so modest in the second, as to render it doubtful, by these Words; *Κόρη τανύτοις ἔδδκει*, *Virgo mori viva est*, the Maid seemed to be Dead, i. e. She was not really Dead: and after in his Philosophical descant upon the act of her resuscitation, in these; *Utrum verò scintillam animæ in ipsa [Apollonius] invenerit, quæ ministros, medicosq; latuerat; an decidens forte pulvis disperfam, & penè jam extinctam animam calefaciens, in unum congregaverit, difficile conjectatu est.* Which is a plain confession, that probably she was only in a Swoun; because the Rain that fell upon her Face might raise her.

2. That 'tis probable, the Maid lay intranced from a violent fit of the Mother. For, this terrible Accident invaded her, *ἔν ἄρα γάμος*, in the very Hour of her Marriage: a time when Virgins commonly are most prone to have their Blood and other Humours violently agitated: by various Passions, which many times cause great commotions Hysteric, and contractions of the Nerves descending ad uterus,

3. That the custom of sprinkling cold Water upon the Face of Women in Swouns, is more antient than Philostratus. Otherwise he could not have been so easily inclined to believe, that a few drops of Rain that fell upon the Maids Face, might conduce to her restoration; especially when the reason he brings, why an effect so considerable should proceed from so mean a cause, is weak and trivial; and when a sprinkling with hot Water might have been more efficacious.

4. And lastly. That Philostratus nevertheless shews himself no small Natural Philosopher in this very Phrase; *ἢ τὸ ἀπνεύμα τῆς ψυχῆς ἔσπευ ἐν αὐτῇ*, an *scintillam animæ in ipsa invenerit*: than which none could have been more proper, more significant, more emphatic; at least if the notion of Original Life, inkindled and perpetually glowing.

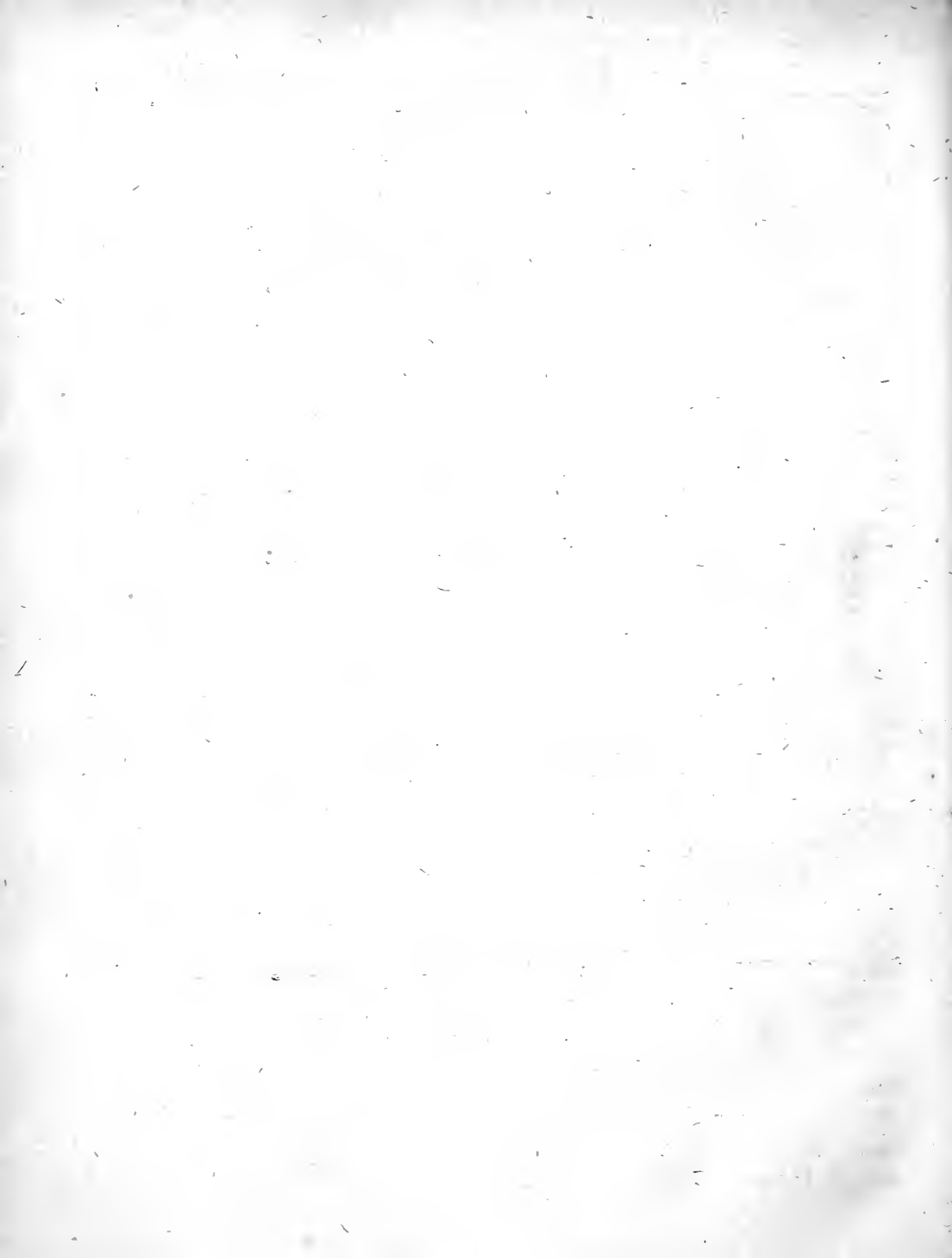
glowing in the Blood, which I have laboured here to explain, be consentaneous to Truth. And ye may remember, that Salomon uses the very same Word, Σπινθηρ, in his description of Life, in the forecited place of Ecclesiastes. Which is alone sufficient, as to give credit to the Expression itself, so also to excuse my induction of this Story into the place of an Epilogue. Now this Animæ Scintilla is liable to Languors and Eclipses, chiefly in Women of more frigid and delicate Constitutions, i. e. of little Heat: and certainly, in every Syncope there is *ἄσυχρον*, or (as Plato calls it) *ἄσυχρον ἀσθενές*, animula infirma; the vestal Fire in the Heart dwindling into a Spark. Whence it is, that, at such times, all parts of the Body, wanting a due influx of warm Blood, during the cessation of the Heart, become pale, wan, lifeless, and torpid, imitating the Cold of Death. But when the same Vital Spark begins to glow again, and renew the Mication of the Blood; it soon restores to the whole Body that vividam *ἔκλαμψιν*, or brisk Effulgency, whereof it was deprived, during the Eclipse. And this probably was the case of our Virgin. No wonder then, if Apollonius, either perceiving by her feeble Pulses, the Mication of her Blood not utterly extinguished; or coming luckily in the very Article of Time, when the same began to be more discernible to the touch, than it had been awhile before to the Physicians that were retired; made his advantage thereof, pretending to restore her to life by Miracle: He being an Impostor of singular cunning; and watching all occasions to raise his reputation among the credulous Vulgar, by appropriating to himself the causing of Events, which in truth, though perhaps rarely contingent, were yet nevertheless merely Natural. For, who can believe, that this Spark of Life, when once utterly extinct, can ever be rekindled in whatsoever Animal; unless by a Power that can reverse, change, and surmount the fundamental Laws

Laws and Constitutions of Nature? and that any such supernatural Power was at any time given to Apollonius, Philostratus himself was not able to prove. Safely then may we conclude, that this Bride was not really, but seemingly Dead, when Apollonius came to her. The same I dare say also of those Animals, which Malpighi, and some of our English Virtuosi have imagined, and written, they had restored to Life after Strangulation, only by blowing Air, sometimes into their Lungs, sometimes into the Ductus Pecquetianus. For, that those Animals had been propemodum suffocata, or brought by the Experimentors and confinium usq; mortis; is easy to believe: but that they were quite dead, and then revived; extremely difficult to a Philosopher, who knows, that the Laws of Nature permit no regress to habit from total privation. I conclude therefore with Sr. G. Ent's most judicious reflection upon this so magnified Experiment “(Antidiatribæ pag. 143.) *Mirandum sanè magis, illis [Authoribus] cum Atropo, fatalia abscindente stamina, eam intercessisse necessitudinem, ut ipsum mortis articulum tam accuratè persentiscerent; &c. For, in Patients oppressed by the Apoplexy, Epilepsy, Lethargy, Syncope, or Hysteric Passion; chiefly where no Pulse is perceptible, and the outward parts of the Body are grown cold and stiff; tis extremely difficult to distinguish, utrum scintillula illa vitalis tantum delitescat, an sit in corde penitus extincta. So that even Physicians themselves, and those too of the highest classis for learning, Experience and Judgment, have sometimes mistaken the Living for the Dead. Of which we have an eminent example in that Prince of Anatomists, but most unfortunate Man, Andreas Vesalius: who (as Hubertus Languettus hath left upon record, in an Epistle to Casper Pucerus; and Melchior Adamus, in vita Vesalii) dissecting the Breast of a certain Grandee of Spain, whom*

be thought to be dead the Day before, found his Heart yet panting, to his own and the spectators astonishment, to his eternal disgrace, the danger of his Life, and exile, in which he miserably perisht upon the Shore of the Island Zant, in his return from Palestine. Doth any Man here expect from me other Examples of the like Mistakes? Let him seek them in Pliny (Nat. hist. l. 7. C. 52.) Georgius Pictorinus (Sermon. Convival. l. 1.) Alexander Benedictus (Practic. l. 10. c. 10.) Paræus, Forestus, Albertus Bottonus, Schenckius, Levinus Lemnius, Fabricius Hildanus, &c. for now I have not time to recount them. Prudenter itaq; faciunt Magistratus (saith Hildanus, Observat. Chirurgic. centur. 2. observ. 95.) (uti ego Genevæ, & in quibusdam aliis locis observavi) qui neminem sepeliri permittunt, nisi prius à quodam viro artis Medicæ perito, & ad hoc negotium destinato, inspecto atq; explorato Cadaverè.

For the same reason, I approve not the vulgar Custome of setting great Pewter Dishes, Turfs of Earth; or other the like cold and ponderose things, upon the Breast and Belly of Men newly defunct. For by that means, though the putrefaction and consequent fermentations of Humors congested within those Cavities, may perhaps be somewhat checkt and retarded, chiefly in Dropsies, and great Apoplems: yet in other cases, and where the person is not really, but only in appearance Dead; the spark of Life, which is only eclipsed, and otherwise may shine forth again, is liable to be totally extinguished. Nor am I singular in this opinion. For I could at this very instant of time convert my eye upon one of the most Eminent Physicians, not only of this Royal Colledge, but of the whole World; who languishing of a grievous and long Sicknes, and well prepared for a decent Exitus: did nevertheless, in my hearing (for I had the honour of watching with him that night) give order to his Attendants, to omit that kind

*of treatment of his Body, after all signs of Life should cease in him; adding the very same Reason I have here given. And this I have good reason to believe he did, not from fear of Death, but only from his deep insight into the Nature of Life; of which he ceased not to Philo-
phize, even when he expected to arrive at the Period of his own within few Hours after. ¶:*



 PRÆLECTIO V.

Of Fevers.

IT is the custom of Mathematicians (as ye, most *Candid Auditors*, well know) when from a Series of Propositions premised and verified, they have inferred the conclusion they sought; to add, as overplus, certain useful Theorems or consecutaneous Speculations, by the Græcs called *πελοματά*, and *Consecutaria sive Corollaria* by the Latins; the knowledg. of which is many times of equal moment with that of the Verity on which they depend. Give me leave then (I beseech you) so far to imitate this Method of those great Masters in the art of Reasoning rightly, as from my discourse on *Saturday* last in the morning, concerning the *Primordia*, perpetual Source, and circular race of Life; to deduce a few *Pathological Consecutaries*, such as may perhaps afford some glimpses of Light toward the discovery, and nature, and causes of a certain *Malady*, which is of all others incident to Mans frail Body, the most common, most grievous, and most dangerous. And this Leave I with the greater confidence ask, because I intend not to abuse it, by digressing impertinently from either my present Subject, or my Duty.

For,

For, the Subject of my Speculation designed, is the same with that of my antecedent disquisition, *viz.* the Blood: and to find out the most probable Causes, and reason of curing great Diseases, is the principal scope and end of all our Enquiries, as well Physiologi- cal, as Anatomical. Of which none can be ignorant, who hath perused that little, but oraculous Book of *Hippocrates de Prisca Medicina*, where he teacheth; that it is the great Duty of all Physicians, who desire to render themselves worthy of that honourable appellation [*μη λόγῳ μόνον, ἀλλὰ καὶ ἔργῳ ἰητρικῆ νομίξει σθαι*] not by discours alone, but also by their Works and real succoring of the Sick; to be solicitous about investigating the true Nature, Causes and Remedies of Maladies, above all things. Nor is it new, to find in the Writings of Anatomists, Pathological reflexions subjoyned to the description of the part, which is known to be the primary Seat of the preternatural Affections incident thereunto. Secure then, that what I have resolved with my self at this time to speak, cannot in the end be justly esteemed a *Parergon*, or beside the principal purpose I have taken in hand; and conceiving great Hope, both from the frequency, and from the benign Aspect of this learned Assembly, that hitherto my dulness hath not been able wholly to overcome your Patience: I will presume, ye are not unwilling to grant my so equitable Petition.

In my last Exercitation, I endeavored to evince (as ye may be pleased to remember) that the *Vital Heat* or *Motion* of the Blood doth formally consist in a certain expansive luctation of the spirituose Particles thereof, with the less moveable or unactive, repulsed and prevailing alternately; but mild, amicable, benign, and conducing to the exaltation of all the faculties and Uses of the Blood. Now I come to *add*,
that

that it is not only possible, but that it often happens, that this Vital Motion, although proceeding only from the Spirits that conserve and rule the Blood, is by causes beside the institute of Nature invading it, *perturbed, interrupted, perverted,* and sometimes also wholly *extinguished*: the vital Oeconomy being thereby sooner or later utterly subverted. Of this we have instances almost innumerable. Nor is there any one kind of preternatural Causes assignable, by which Nature may not be impeded in her production of this Vital Motion, and more or less perturbed: as we cannot but observe it within our selves to come to pass, sometimes from the immoderate Heat of the Aire surrounding us, as in *Ephemera*; sometimes from Meats and Drinks potentially too Hot, as in Surfets and drunkenness; sometimes from vehement Passions of the Mind, as in anger, Fear, Grief, &c. Sometimes from a fermentation of the Blood, as in putrid Fevers; sometimes from venenate *effluvia* of Bodies, as in pestilential and contagious Fevers; sometimes from a simple solution of continuity of the Parts, as in Wounds: so that in fine, to enumerate all the various causes, by the hostility of which this Life-conserving work of the vital Spirits may be hindered and perverted, is a thing extremely difficult, if not plainly impossible. But in all these so various cases, this is worthy to be noted, as a general verity; that the vital Spirits of the Blood are always *preternaturally* affected, and that the disorder from thence emergent, ought to be imputed to a *p. n.* Cause. Every thing then that *pollutes* the Blood, and that puts Nature to an effort or essay to separate and eject it from thence, as alien and hostile; is wont more or less, according to the diversity of its Nature and Malice, to impugn and repress the vital Motion of the Blood. But nothing hath been observed to do it,

either

either more frequently, or more contumaciously, than *impurities* arising from *Crude Humours* congested in the Mass of Blood, which cannot be separated and extirpated without previous Concoction or Digestion. For, these constituting a certain peculiar *Inquinament* or Pollution of the Blood, put on the nature, and acquire to themselves the efficacy of a *Ferment*; not indeed such as the Leven of Bread, or as the Yest of Ale and Beer; but such, that being in our Bodies mixt with the Blood, which perpetually conceives new vital Heat in itself, produceth the like commotions therein, that those domestic Ferments do in their respective Subjects; and may therefore be not unfitly called a *Ferment*, according to the Name given to it by all Modern Physicians.

For, it causeth a manifest Tumult, or intestine War in the Blood, after this manner. The *inquinament* of the Blood, by reason of the crudity and viscosity of its parts, impugnes and hinders the benign expansive Motion of the Spirits, in which I have declared the Generation of the vital Heat of it to consist: and the Spirits, on the contrary, by their natural tendency to expand themselves, oppose that repressive Force, and strive to defend themselves from oppression; producing by their energy, a continuation of the Mication of the Blood, imperfect indeed, and mixt with Fermentation, but the best they are able, till they have gained the Victory, to produce. So that the Fermentation of the Blood in Fevers, seems to proceed, not from the impurities mixt with the Blood alone; but partly from them, and partly from Nature, *i. e.* from the vital Spirits conserving the vitality of the Blood. For, while *these* are impugned, checkt, and hindred, by *those*; the Motion resulting from that conflict, is indeed a certain Mication of the Blood, but tumultuous, violent,

lent, unequal, and interrupted with little Bubbles and Froth. I say therefore, that this civil War in the Blood, as it includes a certain Vital, though imperfect and irregular Mication of the Blood; cannot be denied so far forth to be the work of Nature: but as that Mication is supposed to be tumultuose, seditiose, hostile, and unequal; it must be, in that respect, the product of the Fermentation arising from the inquinament or corruption of the Blood.

This *Fermentation* certainly is the very same thing that the Antient Physicians meant by the *Putrefaction* of the Blood in Fevers: calling, for distinction sake, all such Fevers, which they conceived to arise from thence, *Putrid* Fevers. For it is not credible, that Men of so acute Judgment, and so curious in observing, as their Writings declare them to have been; by the Word *Putredo*, intended to signify that fordid and noysom Corruption observed in dead and rotting Carcases, which is absolutely inconsistent with the Principles of Life; but only a more mild manner of dissolution of the Blood, and such as doth impugn and hinder, but not wholly suffocate the vital Expansion of it. And of this we are certain, that they used to affix the Epithet, *Putrid*, to whatsoever doth by a swift Motion degenerate into the nature of *Pus* or *Quitter*. Which is generated, either slowly, by degrees, by a gentle and long process, and also without tumult; as when any Humour is, without a Fever, digested and converted into purulent matter: or speedily, and with great Tumult and disorder of the State of the Body; as in putrid Fevers, when the *Materia Febrilis*, or inquinament of the Blood hastens to Concoction, and the Disease runs through all its Times quickly and swiftly. Of these two so different ways of producing Purulent Matter in the Body, the

former, which is alway simple and without a Fever, is called by the Antients, *πεπαισμός*, *Maturation* or *Ripening* of the Matter: the *Later*, which is alwaies with a Fever, is called *σάπεια* & *σάπρωσις*, *Putredo*. Whence that Aphorism of *Hippocrates* (*lib. 2. aph. 47.*) *Dum pus conficitur, dolores atq; febres incidunt magis, quam jam confecto.* In their Sense therefore, *Putredo*, is the very motion of the matter of a Fever tending to purulency: and this Motion is the very same, that most of the *Neoterics* Name *Fermentation*. For, in Fevers, it is the *Fermentation*, that brings the impurities to digestion or *Concoction*, and disposes them to separation from the Blood: and therefore the *Putrid* Matter, and the *Fermenting* Matter signify one and the same thing; and by consequence, the *Materia Febrilis*, and *Fermentum Febrile*, are but two different Names of the Cause whence the Fever or fermentation of the Blood comes. Now if this be granted to be consentaneous to Reason and Experience. (as to me it seem's to be) We need no longer amuse ourselves with inquiring; either wherein the formal reason of a putrid Fever consists, or how those two Enemies, *Life* and a *Fever* can subsist together in the same Subject, the Blood; for what I have said may serve to expound both those riddles.

Confiding therefore in the firmness of this Foundation, I design to erect thereupon a short *Theory* of the nature, causes, differences, and principal Symptoms of *Fevers*; and that according to the *Model* left to us by that most accurate Surveyor of Natures Works, *Dr. Fr. Glisson*, in his last incomparable Book; reputed it well worth my diligence, to paraphrase upon the Text of so great an Author.

And because to Physicians accurately investigating the differences of preternatural causes inducing Fevers, there

there occur to be considered more than one kind, as of *Crudities*, so likewise of *Ferments*: that I may not leave myself sticking in the shallows of Ambiguties, 'tis requisite that I clearly and distinctly explain, first what I understand by *CRUDE HUMORS* commixt with the Blood. Which I take to be generally the *Material* Causes of putrid Fevers; and then what I mean by the *Fermentum FEBRILE*, which I suppose to be the *Efficient* cause of them, for by this means, the Fogg of Equivocations being discussed, we shall by a clearer light of distinct notions, contemplate the nature of the things sought after.

As to the *FIRST* thereof, *viz.* the *CRUDITY* of Humours; 'tis well known, that Physicians observing two kinds of *Concoction* or Digestion performed by Nature in the Body, *viz.* One of what is *natural* and familiar, of the *Aliment* requisite to the continual reparation of the Body; which they call $\pi\epsilon\psi\iota\varsigma$: the other, of what is *preternatural* and hurtful, as the material cause of Diseases; which is named, for distinction sake, $\pi\epsilon\pi\omicron\sigma\mu\acute{o}\varsigma$: have accordingly constituted two sorts of *Crudity*, one *Alimenti*, the other, *Inquinamenti*. Of which the *former*, that respects nutrition, is ordinary; arising for the most part from some error committed in the use of the six Nonnaturals, and consisting chiefly in this, that the Spirits of our Food are either not sufficiently excited, or if excited, yet not sufficiently tamed and subdued by the concoctive faculty of the Stomach, to serve to promote the vital mication of the Blood.

The *Later*, *viz.* *Cruditas inquinamenti*, is in the general, any pollution or corruption of the Blood whatsoever, arising from defect of its due preparation and fitness to admit the vital Mication. And this, being the Mother of Fevers, is that intended by *Hip-*

procrates in that most remarkable Aphorism; *πέποινα
καρπυκτέων ην κινέων, ην άποδ;* *Concocta medicamento
purgare ac movere oportet, non cruda*

This Crudity is subdivided into two sorts; one *Simple*, which consisting only in defect of due preparation of the Blood, may be corrected *per pepasimum* or maturation, necessarily previous to Evacuation either natural, or artificial: the other *Malignant*, which always includes certain seminal Reliques of some precedent form of the matter mixt with the Blood, highly Hostile to the vital Spirits, and incapable of correction or mitigation, and many times of expulsion. Now from this Malignant crudity of matter mixt with the Blood, ariseth a *Malignant* Fever; and from the simple Crudity, comes a *Putrid*. Of both which we shall speak more copiously, when we come to consider the *differences* of Fevers.

As to the *SECOND*, *viz.* the difference of *FERMENTS* incident to our Bodies; I advertise, that they also may be (as to my present disquisition) commodiously referred to two kinds. Of which the *one* may be called *Fermentum irritans*, because it doth primarily, by it self, and directly irritate the vital Spirits of the Blood, to begin an extraordinary commotion, and seditious Tumult, with the grosser parts of it; and to endeavor to deliver themselves from confinement, and by dissolving the common Bond of the whole Mass thereof, to fly away. And under this kind are comprehended all fermenting mixtures abounding with saline Spirits, highly volatile, and not easily tameable by the digestive faculty of the Stomack: among which the *Stum* of Wine is eminent.

The *other* deserves to be named *Fermentum Opprimens*; because it at first and immediately oppresses the vital

vital Spirits of the Blood, impugning their expansive Motion; tho' afterward, secondarily, and by accident, it irritates them to a *Pneumatic* Fermentation; not to dissolve the whole mixture thereof, and so to make way for themselves to fly away: but only to attenuate, discuss, eject and exterminate the Ferment, that by clogging and oppressing them, hinders their spontaneous expansion, and the vital Mication of the Blood thereon depending. And this to me seems to be that kind of Ferment, by which a Fermentation of the Blood is wont to be excited in putrid Fevers; and which for that very cause, ought to be nominated *Fermentum Febrile*. It seem's also to consist of any crude humor whatsoever commixt with the Mass of Blood. For, this doubtless is that *Crudity*, which *Hippocrates* (in the newly cited Aphorism) forbids to be importunately attempted by purging Medicaments, until Nature hath mitigated, tamed, and prepared it for evacuation, by gradual digestion.

Of which Counsel, though many reasons have been, by the learned Commentators on his Aphorisms, chiefly by *Cardan*, alleged; yet the most credible, and therefore the most considerable seems to be this; *That Nature hath provided no Organs for the Separation or Secretion of such Crude Humors from the Blood, the Spirits of which are not yet exhausted.*

Most true indeed, and evident it is, that Nature has with admirable Wisdom and Providence taken care to preserve the Blood pure and undefiled; and to that end framed, and most advantagiously placed three conspicuous *Secretory* Organs, for the purification of it, *viz.* the *Liver*, *Kidneys* and *Stomach* with the conjoin'd *Intestines*: and yet it is no less true, that none of these is, by her primary institution destined to separate and drein from the Mass of Blood, any matter

matter yet remaining in the state of *Crudity*, or no yet despoiled of its Spirits ; but all three ordained, lest the Blood, after it hath spent and consumed the sweet and profitable Spirits of the Aliment, and becomes thereby effete and ungenerose, should be longer detained in the Body ; and like a dead Body bound to a living, pollute and infect the Blood newly made of Chyle lately imported, and replenish'd with sweet and useful Spirits.

Now the Humors here by us supposed to be both the antecedent and conjunct Causes of Fevers, are not such as have already been spoiled of their Spirits, and apt to turn vappid ; but such as abound with Spirits yet unvolatilized, and infect to the vital Mication of the Blood. For, the matter not sufficiently digested, altered, and elaborate in the Stomach, becomes at length apt to produce Fevers, in this respect only, that the Spirits contained in it, are either not sufficiently excited, or not sufficiently subdued and tamed. Likewise the matter that grows crude and apt to generate Fevers, either from defect of due eventilation by insensible transpiration, or from want of free motion, is not vitiose, because the Spirits of it are already dissipated, but only because they are, contrary to the institute of Nature detained, and because they at the same time impede and somewhat suppress the vital Mication of the Blood. In fine, the *Seminia heterogenea*, unalterable reliques of some precedent form remaining in the crude Matter commixt with the Blood, cause a *Malignant* Fever ; not because the Spirits of that matter have been already exhaled, but because they are hostile, highly insense and pernicious to the Vital Spirits, and incapable of being tamed. We have reason then to believe, that the material causes of Fevers are not the dead, useles and excrementitious parts
of

of the Blood: not the *Phlegm*, not the *Bile*, nor that thin Humor consisting of the *Serum*, Salt and Tartar of the Blood, which is separated in the Kidneys: for all these have their peculiar *Secretory* Organs, by which they are daily separated and carried off: nor do they require any other Preparation to their Separation, but what consists in their transmutation into those Humors *in Specie*. Which is done only by the gradual *deflagration* of the Blood, by which the vital Heat is sustained: For, hence it is, that in tract of Time, the nobler parts of the vital Juice are dissipated and consumed, and the remaining Parts, which they had before kept united, divided into various parties, and becoming excrementitious, pass some into *Bile*, some into *Phlegm*, and more into the matter of *Urine*: and all these now unprofitable Humors, being brought together with the Blood, to the respective Organs in which they ought to be separated, are there by way of percolation discerned, and by their proper excretory Vessels carried off and ejected.

If this be admitted for true, what then are we to think of the long-lived and even to this Day flourishing Doctrine of the *Antients*, that attributes *tertian* Fevers to *Choler*, *Quotidian* to *Phlegm*, and *Quartan* to *Melancholy*?

I answer (with *Dr. Glisson*, who in all arguments endeavor'd, as far as his Devotion to Truth would permit him, to sustain the aucturity of the *Antients*) that those Humors were, or at least might be taken, either for the *reliques* of the Stale and vapid Blood, or for Humors *analogous* to them.

The *Reliques* of the Blood are (as was just now said) resolved into *Bile*, *Phlegm*, and *Urine*; in the last of which are contained four other kinds of Excrements, *viz.* the *potulent matter*, *Salt*, *Serum*, and a certain

earth

earthly liquamen, commonly distinguished by the name of *Tartar*. But as for *Melancholy*, no place is to be found for it among the reliques or stale and rejected parts of the Blood. For in the whole Body we find no peculiar Organ provided by Nature for the Secretion, reception and exclusion of any such Humor: and therefore, saving the respects and veneration due to those Fathers of our Art, the interest of Truth, which is still more sacred and venerable, obliges us to affirm, that they erred most egregiously, when they assigned that Office to the *Spleen*.

The Humors *Analogous* to the newly enumerated Reliques of the Blood, are signified by the same Names; in particular, the viscid, insipid, and white part of the Blood, is called *Pituita* or *Phlegm*; the hot, drie, acrimonious, and pungent or corroding, *Bilis* or *Choler*; the cold, drie, blackish, and adust, *Melancholy* (if at least any such Humor may be admitted to lye concealed in the Mass of Blood.) For, we must confess, we usurp more than a Physical License, when we call this an Analogous Humor, to which nothing that holds any the least resemblance or analogie, can be any where in the whole Body found: and yet nevertheless it may be lawful to say, that the Analogie that some parts of the Blood seem to have to that fictitious Humor, which the Antients imagined to be separated and received by the Spleen; may serve to excuse us, if, out of compliance with custom and the vulgar Doctrine of the Schools, we retain the denomination, while we rectify the Notion of Melancholy. For, though the *Analogatum* be wanting; yet if in reality a thing respondent thereto, hath existence in Nature; the supposed Analogy is enough to justify the appellation.

Considering this, I assert, that in the Mass of Blood
are

are most commonly contained. (1) A sharp, pungent or corrosive *Serum*, such as is wont to be cast out by exudation, in an *Erysipelas*, and in the little Bladders or Blisters raised by Epispastic emplasters; which answers to the *Bile* or *Choler*. (2) A whitish and fibrose *Grumus*, that resembles *Phlegm*. (3) A dusky or blackish and friable *Grumus*, comparable to the *Melancholy* of the Antients; for other Humor that may deserve that Name, there is none to be discerned in the Blood.

Now, that we may see how far these Elements or constituent Principles of the Blood, can be brought to consist with the Humors of the Antients; let us equitably compare these with those. According to their several Characters or descriptions, the pure and natural *Serum*, by which mixt with the *Lympha*, the Blood is made and kept fluid, seems to be the same with the natural and pure *Biliosè* Humor of the Antients; and the same corrupted, and thereby grown acrimonious and corrosive, what they understood by *Choler*, analogous to the *Gall*. (2) The white and viscid *Grumus*, while uncorrupt and in a natural State, seems to agree with their natural *Phlegm*; when degenerate and corrupt, with that morbidic Humor, which they called *Pituita Analoga*. (3) The black and friable *Grumus*, when pure and sincere, is the *Humor Sanguineus* specially so called, and that very part of the Blood, which impregnate with vital Spirits and the nitrosè Spirit of the Air, gives it a florid red Colour: but despoiled of those Spirits, and receding from that Scarlet toward a footy or black (whence probably it received the Name of *Melancholy*) is the *Melancholy* they imagined to be like the Humor of the Spleen. This *Parallelism* being granted, there seems to remain no difficulty in reconciling the

Doctrine of the Antients concerning the Humors contained in the Blood, with the constituent Parts of it now observed by us: and by consequence, nothing hinders, but these *Analogous Humors*, as we have distinguished and described them, may be the *Material* causes of putrid Fevers: yea more, tis necessary, that one or more of them be peccant in every putrid Fever. Which is what we sought, toward the establishing our present Genealogy of putrid Fevers, without demolishing what the Antients have delivered of the same. ¶:

Let us then proceed to enquire into the Origine of *Malignant* Fevers, which ought to be deduced from a certain Ferment of another kind, not yet described. For, malignant Fevers being by their Nature alwaies more pernicious, than simply putrid; and often also contagious: it must be therefore, that they take their Original from some Ferment more malicious, and more grievously hostile to the vital Motion of the Blood. This Ferment then, whatsoever we shall at length discover it to be, may justly be named in the general, *FERMENTUM MALIGNUM*; as coming neer to the nature of *Poison* properly so called, about the reason of whose fierce and pernicious Operation upon the very principles of Life, Physicians are strangely divided in their Opinions. Omitting all which, I humbly conceive, that the deleterious or deadly force of any Poison whatsoever, doth consist, not in any manifest quality, but in some *Seminal* Nature highly adverse and destructive to the Mication of the Blood in Man, upon which his Life immediately depends. There are, (I must confess) too many other things, that with equal speed and cruelty break asunder the slender Ligaments of Life, even by

by their manifest qualities, if once admitted into the Stomach; as Fire, Oyl of Vitriol, strong Spirit of Salt, *Aqua Fortis*, Lixivial Caustics, Arsenic, Sublimate, &c. Which by reason of the extreme subtility and most rapid Motions of their Particles, and of their force of Penetrating, cutting, corroding and dissolving almost all Bodies to which they are applied, are as mortal as a Sword or Bullet: but all these, if they be sufficiently *diluted*, lose their fatal Virtue, and become innoxious; nor can they be rightly reckned among *Venoms*, no more than a Dagger or Halter, because they destroy by manifest Qualities, and wayes evident to the Sense. But *Poyson*, whose Power is founded in a *seminal Nature*; secretly repugnant and pernicious to human Nature, whether it be bred in the Body, or introduced by contagion or otherwise, is always more or less noxious in a small quantity, and in a full Dose deadly; so that tis dangerous to trust to a dilution of any such Venom. And to this kind are the *Malignant Ferments*, of which I am now speaking, to be referred: though some of them be more venomous than others, and some more contagious. For, the *Malignity* of all seems to consist in a Seminal Nature, which being communicated to the Blood, is apt to impugn, retard, oppress, and (when it prevails) totally extinguish the expansive Motions of the vital Spirits that conserve it. ¶

HAVING thus concisely explained the formal reasons, and distinct proprieties of both sorts of Febrile Ferments, the Putrid and the Malignant, that work immediately and *per se*, by way of *Oppression* of the vital Spirits; 'tis opportune for us to inquire into the Nature of them considered, first *absolutely*, and then *respectively* to the manner of

their Operation upon the Blood in generating Fevers.

I advertise therefore, that when I speak of *Crude Chyle* brought into the Mass of Blood, and by degrees inducing putrefaction or Fermentation upon it, as I have briefly shewn in the Paragraph concerning putrid Humors rendering the Blood impure; I do not call such Chyle *Crude*, because I think it wholly unfit to afford some nourishment to the solid Parts, though impure and imperfect; but because it is not sufficiently concocted and prepared, so as that being united with the Blood, it should be made the immediate Subject of the vital Spirits, or (which is the same thing) be impregnated with *Vitality*. Now Chyle in this sense *Crude*, hath not yet attained to a degree of inquinament high enough to give it the nature and force of a *Febrile Ferment*; which strikes at the very Root of the vital Motion or Heat. For it consisteth in a certain *Appetitude* to infringe, diminish, retard, oppress, and (if not overcome and expell'd by the Spirits of the Blood) utterly extinguish the vital Mixture of the Blood, whence Life results. For, consentaneous it is both to experience and to reason, that this appetite is not acquired in a few moments of time after Crudities have been commixt with the Blood; nor doth it actually attack the vital Spirits so soon as the Ferment is diffused, but doth exert its Power slowly, by insensible degrees, and as it were by creeping on, like an Enemy that designs to steal a Victory. First it gently, and by little and little insinuates itself into the Mass of Blood, and diffuses itself equally through all the parts of it. Then it comes to be united with the Spirits that conserve the Blood, as if it were a natural ingredient of the mixture. That done, if either the quantity or contumacy of it be so great,

great as that the vital Spirits be unable to moderate and reduce it to conformity, or to expel and dissipate it; it begins to operate, to weaken, and suppress them, affecting them with a kind of *Torpor*, and clogging them so as they cannot with requisite Vigor endeavor to expand themselves, and then the *Fever first invades*, as shall be more fully explicated when we come to examine the process of Fermentation in the Paroxysm of an intermittent Fever.

In the mean time it follows to be inquired, wherein this Aptitude of the *Fermentum Febrile* to fix the Spirits of the Blood, doth chiefly consist. I conceive with *Dr. Glisson* that it is radicated in a certain *Lentor* or *clamminess* of the Crudities mixt with the Blood; analogous perhaps to that viscosity observed in Wine and Beer not perfectly fermented, which are therefore call'd *Pendula*, or *Ropy*; nor can they be ever corrected unless by a new Fermentation, which exciting the oppressed and sluggish Spirits contained in the Liquor, and dissolving the clamminess of the grosser Parts, quickly clarifies it. For, what can be imagined more apt to Clog, oppress and fix the Spirits of the Blood, so as to hinder their expansive Motion, than such a pendulous clamminess of Crude Humors diffused through the whole Mass of it? I believe therefore, that the formal reason of every febrile Ferment in putrid Fevers, doth consist in such a *Lentor* of the Blood. As for that kind of it, that arises from defect of Concoction in the Stomach, and that may therefore rightly enough be distinguished by the Name of *Crude Chyle*; it seems not at first to be affected with the pendulous Clamminess here described, but only with a certain disposition or tendency toward it, by reason the Spirits of the Chyle have not been sufficiently excited and exalted from the State of Fixation

to that of moderate fluxility, as they ought to have been : and yet this tendency may be sufficient by degrees to induce a clamminess upon the whole Mass of Blood, when crudities are daily increased and accumulated, as commonly they are before a Putrid Fever is generated. Other kinds of it are almost all derived, either from transpiration intercepted, or from extravasation of Humors, as in internal Apostems and in the Dropsy ; or from inflammations and tumors, where the course of the Blood is stopt. For part of the Blood so arrested, and for want of due Motion corrupted, being at length carried off by the Veins, and remixed with the whole Mass thereof, must of necessity more or less pollute it,

But if we convert the Eyes of our Curiosity upon the *Effects* of this febrile Ferment, and consider the manner and process of its acting upon the Blood ; we shall soon find, that what hath been said of the *narcotic* and *fixative* Power of it, will be sufficiently consentaneous and evident to engage our Belief. For, from thence it will appear, by what reason and way the Ferment is wont to exert its forces, and exercise its tyranny upon the Vital Spirits, in the divers times of a *Paroxysm* or fit of a Fever, *viz.* in the beginning or *invasion*, in the *augment* or increase, in the vigor or *Achme*, and in the *declination*.

I say then, that before the actual invasion of a Paroxysm, the febrile Ferment is already diffused through the Blood, and united with the vital Spirits. Upon this, it of necessity comes to pass, that the Spirits being clogg'd and as it were inviscated by the pendulous clamminess thereof, remit somewhat of their vigor and endeavor to expansion: and consequently with less briskness irritate the Ears and Ventricles of the Heart, and Arteries conjoined to them, to contract

tract themselves, in order to the distribution of the Blood. Hence it comes, that the free transpiration of the *halitus* or steams of the Blood is more or less checkt, and render'd more slow and weak than it ought to be. And this makes the *first* insult or surprize of the *Cold Fit*, which though scarcely perceptible in the beginning, comes creeping on more and more, till the Eclipse it brings upon the vital Spirits, be manifest from the weakness and languid Motion of the Pulse, and from the chilness of the whole Body, and dead paleness of the Face, &c.

A little after, the Pulse is more retracted and languid, and the Eclipse increasing, the Nayles of the Fingers become pale and of a leaden Blew, the extreme parts grow sensibly cold, and all the other symptoms grow more strong and vexatious, so that the Patient is now compell'd to feel the Attacque his Enemy is making upon the Guards of his Life. And this is the *second* step of the cold Fit.

Which ceases not yet, but is continued a good while after its first sensible Invasion; the depression of the vital Spirits, the retraction of the Pulse, and the consequent diminution of Heat, still by degrees increasing. Nevertheless, soon after the beginning, the irritation of the vital Spirits to rise up and oppose their intestine Enemy, and to repell it by their spontaneous expansion, begins. For, first they strive to resist oppression by the clamminess of the febrile Ferment, and to shake off the Clogg, by their natural agility. Then the Mass of Blood, being slowly and heavily diffused into the parts of the Body, doth in some degree stagnate in the Avenues of the Heart, and by its resistence burden the Heart and Arteries, and so incite them to make more frequent Pulses, to discharge it. Then the *Effluvia* of the Blood, being by inter-
cepted

cepted transpiration retained, and by the Veins returned to the Heart, serve somewhat to excite the Spirits, and to discuss a little of the clammy Ferment repressing them. But yet these three irritations conjoined, are not from the beginning of so great Moment, as quickly to hinder the increase of the Cold, or farther depression of the vital Motion: only they so far avail, as to hinder the influent Life from being wholly eclipsed. And at this time it is, that the first certain Signs of actual Fermentation of the Blood, shew themselves to Physicians accurately observing them. For, so soon as the certain Signs of an universal oppression of the vital Spirits appear; we may from that time date the commencement of the Fermentation immediately consequent thereunto: because they declare that the Ferment hath already actually begun its Work.

These *Signs* and *Symptoms* then are (as I have said) *first*, *retraction* of the Pulse, *chilness*, *paleness* and sometimes *blewness* of the extreme Parts, chiefly of the Nails, tipp of the Nose and Lips, and some light *constriction* of the whole Skin. Because at that time there happens some oppression of the vital Heat, which governs the Pulse, renders all parts actually hot, gives a vivid and grateful tincture of red to all, and plumps up the Skin that otherwise would shrink itself up.

Secondly, a troublefom Sense of Cold, accompanied with a *Horror*, *trembling*, *shivering* or *shaking*. All from the difficult passage of the Blood through the habit of the Parts. For the Blood being but weakly emitted from the Heart, and passing slowly through the substance of the muscular Parts, hurts and offends them by vellication or attrition.

Thirdly, a weak and quivering *Voice*, and shortness of

of *Breath* for the most part trembling and unequal: which seem to arise, partly from a depression of the vital Heat, partly from Cold unequally affecting the Lungs, and hindring the free ingress and egress of the Air; and partly from the difficult passage of the Blood, either through the Lungs themselves, or through the Muscles, helping to move them.

Fourthly, the *moisture* of the Mouth, and in the Glands circumjacent, begins to be dried up, and thereupon ensue *thirst* and *driness* of the Tongue. The reason of which seems to be this, that the *Latex Serosus* is, in the febrile Fermentation, so confounded with other Humors, that it cannot be separated from them in the Glandules destined to the Secretion of it. Other Effects or Signs of the Fermentation observable in this beginning of the Paroxysm, I reserve till we come to the *Augment*, in which they become more conspicuous.

In the *AUGMENT* therefore, no new Motion arises, only the former are either by degrees lessned, or increased. Those that belong to the simple *depression* of the vital Spirits, are gradually diminished: but those that are referrible to the *incitation* or suscitation of them, are by little and little augmented. Of the former sort are, *Chilness*, Sense of Cold, *shivering*, *trembling*, *quaking*; all which by degrees cease and vanish: because upon the raising of the Pulse, the Blood is transmitted more briskly and speedily through the habit of the Parts. The *Voice* also becomes more strong and uninterupt, and the *respiration* more frequent and equal, for the same reason. On the contrary, the provoked vital Spirits now rising up against their intestine Enemy, cause a manifest increase of the febrile Fermentation and Tumult. For, the expansive luctation grows more and more fierce and exorbitant,

bitant, and recedes farther from the natural State, till it becomes turbulent, hostile, and frothy, and unequal. The *consequents* of these irregular Motions are (1) *inquietude*, *jestigation*, and sometimes *Pain* of the outward parts, but chiefly of the *Head*; all from the difficult transmission of the Blood through them. (2) *Frequency* of the Pulse, and now and then *robust* vibration of the Heart and Arteries; probably from the intercepted course of the Blood, and the augmentation of Heat. (3) *Diminution of Transpiration*; which though now somewhat greater than from the beginning, continues much less than it ought to be, considering the abundance of *Effluvia* or exhalations of the Blood raised by the intense Heat. (4) *Greater Consumption* of the *Latex* in all parts of the Mouth, and consequently more grievous *Thirst*. (5) *Nauseousness*, and sometimes *vomiting* or *Flux* of the Belly. For the Stomach and Gutts are of all parts most troubled and offended by the tumultuose afflux of the Blood, as well because of their nervous Texture, and their exquisite Sense thence arising; as by reason of the matters contained in their Cavity, which (the containing Parts being irritated) fluctuate, and so become more apt to be moved and ejected upward or downward: and for the same Causes, the same parts are often molested with *Winds* and *Eructions*; all *Pneumatic* Fermentations (in the number of which our febrile Fermentation hath a place) conducing much to the generation of Winds. During this time of the Paroxysm, the Fermentation and Heat, and all the consequents of them here recounted (excepting perhaps the last) are augmented by degrees, till they arrive at the *Achme* or *State*. But so soon as the Transpiration comes to be more free, and answerable to the abundance of Exhalations steaming from the Blood;

so as they no longer recoil by the Veins to increase the estuation of the Blood; the Augment ends, and the *State* of the fit succeeds.

In which the Fermentation and Ardor persist a while in their Violence and Fury. And though at this time some parts of the oppressing Ferment, begin to be dissolved and expelled by laboriose Sweat: yet the vital Spirits are by that tumultuouse Motion so profusely spent and exhausted, that nature suffers almost as much of loss by that exhaustion, as she receives relief from the Victory and Expulsion. Whence perhaps it comes, that yet the conflict appears doubtful and equal, till the beginning of the Declination, when the febrile Heat, and all its concomitants are by degrees mitigated.

And then it is, that the Victory of the vital Spirits being complete, the remaining parts of the febrile Ferment are by an universal Sweat flowing without any considerable detriment of the strength of the Patient, dispersed and exterminated. For, this Sweat is a kind of despumation of the impurities of the Blood that caused the Paroxysm; whereupon soon ensue a remission of the burning Heat, a cessation of anxiety and Pains, and a fresh diffusion of the *Latex Serosus* into the Throat and Mouth for the quenching of Thirst, and in fine a Cessation of all other vexatious Symptoms of the late Conflict; and so at length the Paroxysm is ended. Now from this our congruous Solution of all the *Phenomena* of the fit of a Fever, ye may easily judge of the reasonableness of the precedent *Hypothesis*, according to which I have endeavored to explicate them; and how far the same may deserve your approbation, or dislike. ¶

Nevertheless I am willing, ye should suspend your Sentence, till I have carried on the Hypothesis farther.

For there yet remain many other Appearances to be solved: I proceed therefore to the primary *DIFFERENCES* of Fevers, in hope that they also may be commodiously deduced from the same Principles.

Forasmuch as it is probable from what hath been said of the nature of a Fever in general, that all Fevers arise from, and essentially consist in a Fermentation of the Blood: We may with reason infer, that the diversity of Fevers, how great soever it be, proceeds from nothing else but the divers fermentations of the same Blood. For the diversity of Effects is for the most part respondent to the diversity of efficients. And since it is scarce possible, but that from various Ferments, various kinds of Fermentations should arise; it necessarily follows, that the various sorts of Fevers are to be deduced from equally various Ferments actually hindring the vital mication of the Blood. And I hold, that there are so many differences of febrile Ferments, as there are divers Natures or Dispositions of Crudities incident to the Blood, and apt to inquniate it. To know all these distinctly, and to explicate each of them by a particular discription, is perhaps impossible: so great is the variety of crude Humors that may be admitted into the Blood, and so manifold the Combinations of them that may happen to pollute it. Let it suffice then, if reflecting upon the chief sorts of *Crudities* already described, we shall from thence congruously derive the *Primary, i. e.* the most frequently observed *Differences* of Fevers.

By *Crudity* I here understand any inqunament or depravation of the Blood whatsoever, proceeding from defect of due preparation thereof, for the generation of vital Spirits; as I before declared. Now the mat-

ter in this Sense *Crude*, may be distinguished into *Ordinary* or familiar to human Nature, such as arises from the erroneous use of the six non-naturals: and *Extraordinary* or alien and hostile to human Nature. From the *former* come all Fevers call'd *simply Putrid*: from the *Later*, *Malignant* and *Contagiose* or *Venose*.

The *Ordinary* may be subdivided into (1) *Recent* or lately generated, such as is either carried out of the Stomach and Guts in the form of crude Chyle, or reduced from some part or other inflamed or otherwise corrupted: and (2) *Inveterate* or in a long tract of time by little and little congested, and adhering to the substance of the solid Parts. The *former*, if it happens to pass into a febrile Ferment, produces a Fever putrid indeed, but of only *one* Paroxysm. The *Later* likewise generates a Fever Putrid, either accompanying some other Malady, or Symptomatic; but each of them, either *Continual* of uncertain exacerbation, or *intermittent* of uncertain Paroxysms.

The *Extraordinary* or *Malignant* which includes some certain seminal Principle dangerous and hostile to human Nature, is also *double*, viz. either it is disseminated by contagion, or is primarily bred in the Body affected. The *Former*, though resolved into an exhalation and dispersed through the Air, still retains its poisonous Virtue, as the *Miasma Pestilentielle*, or infection of the Plague. The *other* is either not resolved into exhalations, as *Arsenic*; or is, in the very resolution, despoiled of its seminal malignity, as the Breath of a *mad Dog*, which seldom or never infects alone, without the *Saliva* in forth.

Having exhibited to your consideration this plain and brief Scheme of the different material Causes, from which I suppose the principal differences of Fe-

vers to proceed; I must reflect upon the Heads thereof more particularly, and in the first place resume the explication of Crudity not Malignant; as that which both more frequently occurs to our observation, and is less obscure.

The *Matter* of *Putrid Fevers Not-Malignant*, proceeds (as I lately insinuated) either (1) From defect of Concoction of the Chyle in the Stomach and Intestines, or (2) From defect of due eventilation and free motion of the Blood in its Circuit.

Defect of Concoction of the Chyle, is a thing so common, and so fully explained by Physicians in their practical Writings, that it is sufficient for me to name it. And indeed in all Fevers, the concoctive faculty of the Stomach is wont so much to languish, that scarce any thing of aliment can be, without detriment, taken into the Stomach already troubled and iniquated with vitious and corrupt Humors. For then the Food is not digested, but whatever of either Juice or Tincture is drawn from it, remains crude, and turns to the Augment of the matter of the Fever. Whence it comes, that fasting and a thin Diet are so much commended by all, in putrid Fevers. Only in Pestilential, a Diet less spare, is sometimes allowed with good Success: because the benignity and sweet Spirits of the Aliment, are found to counterpoise the *Seminium Pestiferum*, and reduce it to a milder disposition. Not of *these* Fevers therefore, but only of *those* are we to understand the Counsel given by Hippocrates (*Aphorism. n. Lib. 2.*) *Corpora impura quò plus alimenti assumunt, eò pluribus damnis augentur: & (Aphor. 7. Lib. 1.) si morbus sit peracutus, tenuissima diæta est utendum.*

Defect of due Transpiration, or Eventilation, and of free Circuitian of the Blood, is sometimes the Cause, sometimes

sometimes the Effect of Fermentation therein. The Cause, if no other vice, before disposing the Blood to Putrefaction, hath given fit matter for the Generation of a Fever: for, want of free Transpiration and Interception of the course of the Blood in any part of the Body, is alone sufficient to infer putrefaction upon the Blood; but then the Fever is for the most part easily discussed, and with one universal Sweat wholly solved. It ariseth commonly from the diminished perspirability and permeability, either of the whole Body, or of some private part, whose inconspicuous pores are constipated, or obstructed; and this happens either with, or without extravasation of Blood. With extravasation, comes a *Tumor*, if not an *Aposteme*, which most commonly produces a Fever of uncertain Exacerbation; as is frequently observed in great Obstructions and Abscesses of the Lungs.

Having concisely recounted the Procatartic or Antecedent Causes of crude Matter apt to induce putrid Fevers, I must come to explain what I said of the *Aptitude* of crude Chyle received into the Blood, to corrupt it *Miasmate Febrili*. That I may do this with perspicuity and coherence, two things occur here to be considered. *One* is, *when* that supposed Aptitude or Disposition of Chyle imperfectly concocted, comes to be matured or exalted to an actual fermentation of the Blood: the *other*, *where* that crude Chyle is wont to lurk or lie concealed; until attaining to ripeness, it hath acquired forces sufficient to induce fermentation upon the Blood.

To the *FORMER* of these two questions therefore I answer, that crude Chyle, though from its first admission into the Blood it continually tend toward a febrile Ferment; doth yet notwithstanding rarely attain to that last Degree of depravity, where it meets
not.

not with an *Apparatus* of like matter before congested in the Body, sufficient to augment its Forces, and serve for convenient Fuel to a Fever. For, it is by long experience found, that very few fall into any simply putrid Fever, unless after many errors admitted in the use of the six Non-naturals: nor is the febrile Ferment it self wont, so soon as it is existent in the Body to kindle a Fever, by breaking out into acts of open hostility upon the sudden, but by secretly creeping on, as it were, and passing through certain degrees of operation successively. First, it is insensibly diffused through, and intimately commixt with the whole Mass of the Blood, after the manner of other Ferments. Then inwrapping the vital Spirits by little and little with its clamyness, it diminishes their Agility, and disposes them to sloth. After this, it endeavours to inviscate, bind, and as it were suffocate them; and then it is, that from their expansive reluctance, the conflict and fermentation commences. All which may be collected from intermitent Fevers, at least, if it be true (what many eminent Physicians hold) that the whole Febrile Matter that causes a Paroxysm, is as it were burn'd out and consumed in that Paroxysm: as in an intermitent Tertian, there intervenes a whole day of vacancy from a Fever, and of quiet betwixt every two Paroxysms; during which interval, the febrile Ferment is only dispositive, and preparing to unite it self intimately with the vital Spirits. But in a simple Quartan, two whole days intervene betwixt the precedent Paroxysm and the Subsequent; the febrile Ferment all that while recruiting its Forces. From whence it is highly probable, that the crude matter doth not presently produce a Fermentation, but by degrees, and by way of disposition. Which may be sufficient to solve the *first Question*, viz. *When the crudities commixt with the Blood come to acquire the*

he degree of exaltation requisite to induce an actual fermentation upon the Blood.

As for the *OTHER*, viz. *Where* the same crude Matter is wont to be congested, and to lye in ambush till that time; if the whole matter of the precedent Paroxysm, be spent and consumed in the Paroxysm, as hath been supposed: then it necessarily follows, that the matter of the subsequent Paroxysm, must either be generated anew, in the time intervenient betwixt the two Fits, or lie conceal'd somewhere in the Body, either in the Vessels carrying the Blood, or out of them; from whence, as from its *Fomes*, it may after certain intervals of Time, sally forth to infect the Blood and invade the vital Spirits. For both these, cannot be true; and therefore it remains to be inquired, which of the two is most likely to be so. My Opinion is, that the matter of every subsequent Paroxysm is not *generated anew*; and my *Reasons* are these.

(1) So soon as any Paroxysm is ended, the very essence of the Fever ceases for that time, and the Blood quickly returns to an *Apprexia*. Now if the Cause be extirpated together with the Disease, nothing will be left remaining in the Body to continue it: and by consequence, every new Paroxysm will be a new Fever; which no experienced Physician, who hath observed the Disease to be of the same genius or nature from the first Fit to the last, will easily be brought to grant. (2) The same may be confirmed by this, that intermittent Fevers, even in poor Country People, frequently run through all their times regularly, by degrees ascending to their State, and thenceforth gradually tending to their Declination, when no Physician is called to Succour Nature: So that merely from diligent Observation of the motion of the Fever, a cer-

tain prognostication of the State and final cessation of it, may be collected, which would be impossible, if the matter of the Disease were every Day generated *de novo*: for who could foresee, when that new Generation would Cease?

(3) The cause of the Fever coming *ab extra*, is accidental, and depends on a less or greater Error committed in Diet, and is constituted *extra Febris essentialiam*; nor can any *indication* be from thence deduced. And our *Dr. Glisson* affirms, that he knew a Man, who being of a strong Constitution, and afflicted with a *Tertian Intermittent*, obstinately abstained from all Meat and Drink, from one Fit to another; and yet could not thereby elude the return of his Fever. It may be therefore with good reason inferred, that putrid Fevers have an internal *Focus* some where in the Body, whence the material Cause of them breaking forth, and gathering fresh Forces, invades and irritates the Vital Spirits again and again, even till the *Fomes* be utterly exhausted and consumed.

There are (I confess) many great Wits, who in every intermittent Fever, seek for a *peculiar Fomes* or Seat of the Cause. I confess also, that sometimes such a particular and partial *Fomes* may be found; as for Instance, in the Stomach, or in the Pancreas, or in the Mesentery, and other Parts of the Abdomen; and an inflammation of the Lungs, is in some sort the *Fomes* of a *Peripneumonia*; an inflammation of the *Pleura*, the *Fomes* of a *Pleurisy*, and *sic de multis aliis partibus*: So that it cannot be denied, but both intermittent and continual Fevers may arise from particular Seats; and that an *Aposteme*, chiefly an *Empyema*, may minister Fewel to a Fever; yea more, that an inflammation repercuss'd from the outward parts, and a Gangrene in any the remotest Member of the Body, may produce

duce a continual Fever, by sending forth corrupt matter to pollute and infect the Blood. All this (I say) must be confessed. And yet nevertheless it must be acknowledged, that besides these particular *Fomites* of Fevers, there is a certain *General one*, common to all putrid Fevers: and this general *Fomes* I hold to be the very *Parenchyma* of the Parts nourished out of impure Juices.

For this *FOMES* is of all others hitherto supposed, most consistent with the Circuition of the Blood, by which it is commodiously carried to all Parts; and diffused universally: whereas other impurities can scarcely be so accumulated in the Solid Parts, but they must, when extravasated, obstruct the free course of the Blood. If they be supposed to stick, and be congested in the capillary Vessels, or in the inconspicuous Pores of the Parts; they must be a manifest and intollerable Obstacle to the pertransition of the Blood. If out of the Vessels, they stagnate in the habit of the Parts, they must induce, not a Fever, but a *Cachexia*, or an *Anasarcha*. Compelled therefore we are to fly to the very *Parenchyma* of the Parts; which in every putrid Fever are necessarily fused or melted by degrees, and being fused, as necessarily become Fuel to continue the Fever. For, in *continual* Fevers, the substance of the Parts amass'd out of Crude and impure Chyle, is *continually* melted, and so maintains the fermentation without intermission, until all the Fuel be consumed, and then the Fever is extinguished. But in *intermittent*, the same impurities are melted by turns, or *Intervals*; and in every Paroxysm, some portion of them is colligated into a kind of *Sanies* or putrid Matter; which being remixed with the Blood, becomes, in a *Tertian*, the Fuel of a Paroxysm to recur on the *third* Day from its Fusion; in a *Quartan*, of a Paroxysm

ysm to invade on the *fourth*; in a *Quotidian*, of a Fit to return on the *next Day*; & *sis de cæteris*,

And as to the *Duplication* and *Triplication* of these intermittent Fevers: 'tis probable, that when of a *Simple Tertian*, is made a *double* one, the Simple is not the direct Cause of the double: but the later arises from Causes like to those, from which the former took its beginning: So that a double Tertian may be rightly enough accounted to be *two single Tertians* alternately succeeding and complicated with each other. And the same, *mutatis mutandis*, may be said, with equal congruity, also of the origin of a double and treble *Quartan*.

But there remains yet another *Difficulty* greater than either of the two precedent; *viz.* concerning the *Suspension* of the Action of the crude Matter, to the time of the Paroxysm, in which it is actuated. That the State of which *Question* may be the better understood, let us (for instance Sake) suppose, that in a double Tertian, *A. B. C. D.* are four distinct crude Matters, melted and set afloat in the Mass of Blood in four successive Paroxysms. Let us suppose also, that this Fever first invaded the Patient upon Munday, and that in the first Fit, it melted so much of the crude *Parenchyma* of the solid Parts, as may suffice to produce a new Fit on Wednesday following. Let us suppose farther, that on Tuesday another Tertian began, and during that first Fit in like manner melted so much of the Crude *Parenchyma*, as may be sufficient to raise a second Fit on Thursday following. These things being supposed; the Question is, why the crude Matter *B.* melted on Tuesday, is not dissipated or corrected on the Wednesday following, when the crude Matter *A.* causing a Fit, is by the Fermentation rarefied, and expelled by Sweat: Why,

I say, the Matter *B.* being remixt with the Blood all Wednesday, when the Matter *A.* was fermented, is not by that Fermentation corrected and dissipated at the same time; but suffered to lye dormant, and cause a Fit on Thursday following.

To untie this Knot therefore, I say, that the febrile Fermentation doth not much alter any crude Matter, that doth not yet *actually* impede the vital motion of the Blood. For, the Fermentation is regulated by the vital Spirits, which in the Case proposed, chiefly oppose and dissipate the Matter *A.* which alone by its clamminess actually hinders their expansive Motion. Hence it is, that in the Fermentation hapning on Wednesday, the vital Spirits are not much offended with the new Matter *B.* then melted and floating in the Blood, because it is not actually Febrile, nor doth it oppress them, so as to incite them to vindicate their Liberty by their expansive Motion. And thus the difficulty seems to be solved. ¶

WHAT hath been said a little before, of the general *Fomes* of all putrid Fevers, as well continual, as intermitten, *viz.* that it is in the very *Parenchyma* or Substance of the solid parts amassed out of crude or impure Chyle; may perhaps to some of my Auditors, long accustomed to the vulgar Doctrine of Physicians, concerning the Genealogy of Fevers, seem to be only precarious, and as easily denied, as affirmed: because it still remains doubtful, *how Chyle crude or impure can be, instead of good and laudable Succus Nutritius, or Aliment, converted into the substance of the solid parts.* To obviate this their doubting therefore before it settle into a prejudice more difficult to be removed, it concerns me to assert, that there is many times an *imperfect* Nutrition, or Vegetation and Augmentation, as well as a perfect,

fect, observ'd in the Bodies of Men ; and consequently, that the *Succus Nutritius*, or proxime Aliment of all parts, is either *pure*, i. e. perfectly concocted ; or *impure*, i. e. imperfectly concocted. Whence it comes, that the Bodies of some Men are even vulgarly said to be more or less *pure* than those of others.

Those few, who are so happy as to have Bodies in all parts *pure* and clean from crude and vitiose humours, do not only from the right use of the six Non-naturals, enjoy perfect health ; but have this farther advantage, that their solid parts not being augmented by the accretion of crude matter, they carry in them neither any *Febrile Fomes* congested in the habit of their solid parts, nor the least disposition to any other Disease. When on the contrary, *impure* Bodies, either through intemperance, or too full Diet, Surfeits, Compotations, and other Debauches and Disorders ; or from want of exercise to correct and dissipate the crudities they have congested ; are cramm'd and plump'd up with impure nourishment, and perhaps also augmented to an unprofitable and unwieldy Bulk. These then must of necessity abound with a great stock of crude Matter, accumulated chiefly in the Substance of their solid Parts. Which when a Fever comes, from what cause soever, are melted by degrees, and dayly afford new Matter, to serve as prepared Fuel to the long and dangerous Fever, whether continual, or intermitent. But Bodies clean and pure, though perhaps liable to be surpris'd with a light feverish Distemper ; are in much less Danger from thence : because their solid Parts have not been imperfectly recruited with impure Nourishment ; and consequently the *Liquamen* of them is not so *Crude*, as to suffice to renew often, or long continue the *Fermentation*. From the Testimony of our very Senses it is evident, that in all putrid

trid Fevers, the parts of the Body are more or less extenuated and colliquated: and that the Crude *Liquamina* of them are the material Causes of new Exacerbations in continual Fevers, and of new Paroxysms in intermittent, is highly consentaneous to reason. Hence it is, that Men recovering from long Fevers, if they manage their Health circumspectly and with temperance, attain to a renovation as it were of their Youth: because all the substance of their Parts, that was amass'd out of Crude and impure Matter, being by the Fever consumed, their Bodies are now repaired with pure and convenient Juices, such as abound with sweet Spirits duly exalted and excited by Concoction in the Stomach. Hence also we are led to a clear understanding of the true Reason of that *Aphorism* commended to our Observation by *Hippocrates*: *Si febricitanti, nec omnino leviter, suo in statu maneat corpus, nihilq; concedat morbo; aut hoc etiam plus equo gracilescat, calamitosum: hoc enim agri infirmitatem significat, illud vero diurnitatem morbi.* For, the prognostic holds certain, *ratione tum cause, tum signi.* If the habit of the Body be not extenuated in proportion to the Violence or duration of the Fever, the Cause must lye either in the abundance, or in the contumacy, that is the great viscidty or clamminess of the crude Matter congested and affixt to the *Parenchyma* of the Parts: and therefore an observing Physician may from thence safely predict, that the Fever will prove of long continuance at best, if not fatal in the end. On the other side, if the extenuation be too great, it must come from the great force of the heat or fermentation in the Blood, that dissipates all things, not only the crude Matter preëxistent in the habit of the Parts, but even the vital Spirits themselves, and the insite Spirits, that being intimately u-

nited

nited with the Vital, should reinvigorate the Parts with Life and conserve them. And therefore such impetuous Extenuation, is likewise both cause and signe of extreme Calamity. *Exhaustis enim supra modum & spiritibus, & partibus Solidis, omnis ratio pepasmi desideratur.*

All these Reasons duely consider'd, it must be granted that Bodies cannot possibly continue in all points pure and clean, if they be nourish'd with impure or crude Juices. Sound indeed and healthy they may be said to be at present, because they seem to foster no proxime Cause of Sicknes discernable by a Physician: and yet nevertheless, since they carry about Crudities secretly congested in the very substance of the solid Parts, which by occasion of any light feverish Distemper, that would not otherwise last above a Day or two, may be melted and remixt with the Blood, and long protract that Distemper: we are obliged to acknowledg, that such Bodies are really foul or impure, and contain in them a *Disposition* to a Fever more or less remote. Otherwise it will follow that all Bodies actually found, are in respect of the habit of their Parts, either equally disposed, or equally indisposed to Fevers, and to the continuation of them: than which nothing certainly can be more false. For, have we not observed frequently, that Fevers, as well continual as intermitten, have in the beginning appear'd mild and gentle, so long as they were fomented only by Matter before contained in the Veins and Arteries: and yet afterward, when they began to be supplied with new Matter or Fuel from the colliquated Crudities that had been long congested in the habit of the Body, they have raged in extremity, and continued long before Nature, however accurately assisted and succour'd by our Art,

could

could bring them to a *Crisis*? Conclude we therefore, that in putrid Fevers, there is no other *Fomes*, but the described Crudities, by long intemperance and other errors in Diet, congested in the habit of the solid Parts. For, these are in all putrid Fevers daily resolved or fused into a certain *Sanies* or corrupt Matter, and constitute a new *febrile Ferment*: which is the thing we have gone so far about to find.

But yet I must not omit to subjoin, that these *Liquamina* of the solid Parts imperfectly nourisht, are not confined within the narrow compass of *one* single *Genus*, but diffused through a large Field of indefinite *variety*. For, as indulgent Nature hath granted to us various kinds of *Aliments*, each of which is in its peculiar qualities or proprieties in some sort distinct from all the rest; and as the *Juices* or *Tinctures* extracted from them by the concoctive Faculty of the Stomach, are in diversity respondent to the diversity of our Meats and Drinks: So must it be granted, that the *Crudities* after imperfect digestion admitted, first into the Blood, and then into the habit of the Body, and there affix'd to the solid Parts, and at length resolved into a certain kind of *Sanies*, that is most apt to afford Fuel to putrid Fevers (as hath been often affirm'd) cannot be all of a Sort, but some different from others, respectively to the different matters of which they were generated. And of these doubtless the variety is greater than can possibly be known by any Physician however curious; so far are we from hope to reduce them all to Computation. It were hard then for me, if any here present should exact from me an account of more of these obscure Differences, than what my present institute requires me briefly to explain: and all my learned Hearers will (I presume) be contented, if I do my devoir to

reduce them in general to the *Analogous Humors* of the Antients above described, namely *Choler*, *Phlegm*, and *Melancholy*; not pure or natural, but *Corrupt*. For, from *these Humors* taken in the Sense afore explicated, may be commodiously and congruously deduced, both the principal *differences* of putrid Fevers, and the most probable *causes* of those Differences.

First therefore, I must put you in remembrance of what I have more than once asserted, *viz.* That the Humors by this Hypothesis assigned to putrid Fevers for their Causes both antecedent and conjunct, are such which are not *exolate* or stale and despoiled of their Spirits, and grown vappid; but sufficiently *stored with Spirits*, noxious and infect to the vital mication of the Blood:

Then I with good reason suppose, that when the *Crudities* received first into the Mass of Blood, and after into the substance of the Parts, come near to the nature of the *Serum* of the Blood, now corrupt, and by that putrefaction render'd acrimonious and well nigh Corrosive (which emulating the Bile contained in the Bladder of Gall, makes the *Choler* of the Antients) there is congested and prepared Matter most apt and disposed to produce *Biliose* Fevers, as they are call'd *Tertians*, either continual or intermittent.

That in case the congested Crudities neerly resemble the white and viscid *Grumus* of the Blood (which makes the Analogous *Phlegm* of the Antients) but corrupt: then there is laid up Fewel most convenient to foment *Pituitose* Fevers, *Quotidians* continual or intermittent.

That if it happens, that the Crudities congested be of such a Nature and Condition, as to be affine to the Analogous *Melancholly* of the Antients, *i. e.* to the *blackish Grumus* of the Blood, degenerate from
its

its natural purity, and corrupt: then the Bodies carrying them about are obnoxious and prone to a *Quartan* ere long to invade them. And this may suffice to explain the Sentiments suggested to me by *Dr. Glisson's* new Doctrine, concerning the most general and obvious Differences of Crudities apt to produce Fevers, so far forth as they may be taken for the *Conjunct* Causes of putrid Fevers. ¶:

I come then to the Fundament of the so often mentioned division of putrid Fevers into *CONTINUAL* and *INTERMITTENT*; that we may opportunely investigate, what that is, on which this remarkable difference seems immediately to depend. This in probability is nothing else but the very *Fermentation* of the Blood, in which alone the formal Reason of all Fevers doth consist; and which by vehemently exagitating the whole Mass of the Blood, sometimes *continually*, sometimes by *Intervals*, and those one while *certain* and *ordinate*, another while *uncertain* and *inordinate*; induces that Intense and afflicting *Heat*, in which alone the Antients have unanimously placed the essence of a Fever; and renders the Pulses of the Heart and Arteries *more frequent* than they ought to be; so that from thence alone, as from a Pathognomonic Sign, a Physician may certainly conclude of the presence of a *Fever*.

A continual Fever therefore is that which from the first Moment of its Invasion, to the last of its duration, continnes and afflicts without Intermission, never coming in all that time to a perfect *Apyrexia* or utter Extinction. This Fever, if it be mild, gentle, unaccompanied with grievous Accidents or Symptoms, and but of one days continuance; is thence call'd an *Ephamera* or *Diaria*: if in like manner mild,

but of two, three, or four Days duration, it is denominated accordingly a *Diaria* of a few Days, or more properly, *Synochus Simplex*.

An *Intermittent* Fever is that, in which the febrile Fermentation doth not dure from the beginning to the end continually, but is *intermitted*, and returns with diverse Paroxyfms after Intervals, now *shorter*, now *longer*: and these Paroxyfms running through their peculiar times, namely their beginning, augment, state, and declination, there alternately, *i. e.* after the end of every single Paroxyfm, fucceds an *Apyrexia*, not perfect perhaps, but *quoad Sensum*. From this viciffitude, or rather from the various *Intercalation* of the Paroxyfms, various sorts of intermittent Fevers have, for diftinction fake, obtain'd various *Names*. In particular, when a new Fit, in proportion respondent to the former, returns dayly, *i. e.* once in every twenty four Hours, the Fever is named an intermitting *Quotidian*. When a Paroxyfm recurs every other Day, or on every third Day, tis called a *Tertian*, and by the Vulgar, a *third-Days Ague*. When the Paroxyfm recurs not till after two whole Days of intermiffion, 'tis call'd a *Quartan*, or *fourth-Days Ague*: and fo forward; for there have been observ'd alfo *Quintans* and *Sextan's*, though very rarely. Here give me leave *en passant* to note, that the word *Ague*, by which the common People understand an intermittent Fever, is derived from the *French* adjective, *Aigu*, which fignifies *Acute* or *sharp*: perhaps becaufe an intermittent Fever is *acute* during the Paroxyfm at least, and afflicts the Patient with *sharp* Pains; though by Physicians, refpecting rather the duration, than the vehemency of this Difcafe, it is number'd, not among acute, but among *Chronic* Fevers. How properly therefore the Englifh call an intermittent

tent Fever, an *Ague*, I leave you to judge, while I return into my way.

There is yet another *Species* of Fevers referrible neither to continual, nor to intermittent, but *compounded* of both kinds; which though it continually augment the natural heat of the Blood, nor ever comes to an absolute *Apyrexia*, no not so much as *quoad sensum*, before it be wholly judged or ended; and in that respect may pretend to a place among *continual* Fevers: yet hath certain *Exacerbations* and *remissions* of burning by intervals, and those sometimes every day, sometimes every third, sometimes only every fourth; and in that respect seems to belong to *Intermittent*. Hence it is, that such a Fever is call'd a *continual Quotidian*, or a *continual Tertian*, or a *continual Quartan*, according to the time of its *Exacerbation* or grieving anew.

Besides these three kinds of simple Fevers, Physicians have in all former Ages believed, that there are others, *compounded* of two or more intermittent. Of this sort are supposed to be.

(1.) *Double*, or *Triple Quotidians*; when on one and the same Day, two, or three Paroxysms invade, in proportion respondent each to other successively.

(2.) *Tertians double*, or *triple*; believ'd hitherto to consist of two, or three *Tertians*, whether in a double, two Paroxysms return in one Day, or single Paroxysms recur every third Day: or whether in a Triple, two Fits come in one Day, and a third on the next Day after; or three in one day, and none the next Day. An intermittent Fever of this sort is distinguished from a *simple Quotidian*, by the time of its invasion, by the time of its duration, and by the Symptoms that are wont to accompany it. For, in all these Circumstances, the *first* Paroxysm answers to the *third*,
and

and the *third* to the *fifth*; but the *second* is respondent to the *fourth*, and the *fourth* to the *sixth*, and so forward. Whensoever therefore we shall observe this Analogy betwixt the Paroxysms alternately invading, we may with confidence pronounce, that the Fever is of that sort, which Physicians call a *double Tertian*. When we observe on the other side, that the first Fit is in all things like the second, the second like to the third, and so forward through the whole course of the Fever; we may certainly judge, that the Patient labours under a *simple Quotidian*. Besides these Characters of distinction, Physicians have recorded one more, and 'tis this: If a simple Tertian hath preceded: recurring every third Day, and after return every day; we may be sure, the Fever is of that kind, which heretofore hath been taken for, not a simple Quotidian, but a *double Tertian*.

Here perhaps ye will interrogate me about a *Simple Quotidian*, so frequently mentioned by me; namely, *Whether there be any such thing in nature, or not?* And ye have reason; there being a kind of Civil War among the Sons of *Æsculapius* upon the question. For, some of the Princes among them have with great eagerness contended to blot out of the Catalogue of Diseases, the very name of a *Quotidian*, as if really there were no such intermittent Fevers: and others no less renowned, as fervently, but somewhat more modestly, maintain, that of six hundred sick Men that suffer new Paroxysms every day, scarce one is afflicted with a *Quotidian*. I answer therefore, that true it is indeed, that a *Quotidian* hath been by some Authors, of great fame, banished into the darksome Island of *Chimeras*; but unjustly, and by those who being carried away by prejudice, and the authority of their Predecessors, rather than conducted by the light either of certain Experience, or of right

right Reason, have by their prevarication entangled their Followers in a gross and dangerous error: as I hope to evince, when I shall come to explain the causes of intermittent Fevers in particular; if what hath been delivered just now of the distinct signs of a simple Quotidian, be not thought sufficient to end the Dispute. For now I must hasten to the *third* sort of supposed compound Intermittents, *viz.* (3) *Quartans, double, or triple.* For as often as it happens, that a sick Man, remaining free from a Fit only one day, is afflicted with two new Fits on the two days next following: so often it is concluded, that he hath a *double Quartan.* And when a new Fit recurs every day; but so, that the first Fit answer to the fourth, the fourth to the seventh; the second to the fifth, and the fifth to the eighth; in fine, the third to the sixth, the sixth to the ninth, and so forward: they conclude, that of a simple Quartan produced, first is made a *double*; and then of a double, a *triple* Quartan. And this seems to be confirmed (as *Sylvius* rightly observes) sometimes from the reason of *curing* such Fevers; *viz.* if one Fit be first taken away, and then on the two consequent days the Fits yet return, one day of intermission interposed; or if two Fits be taken away, one only remaining, and returning every fourth day: but more frequently from the symptoms, namely, the shivering, quaking, long-lasting cold, &c. which being more proper to Quartans, seldom occur in Tertians, and never but where the Tertians decline toward the nature and type of Quartans.

Besides all these sorts of intermittent periodical Fevers, there have been observed *others*, intermittent also, but of uncertain Periods; which they have therefore named *Inordinate* and *Wandering* or *Erratic.*

Having thus briefly run through all the most remarkable differences of putrid Fevers, simple and malignant,
 continuall

continual and intermitten, intermitten ordinate and inordinate, single and double or triple; and deduced the causes of those differences from diversity of febrile Ferments operating upon the Blood, either without or with intermission, by certain or uncertain intervals: pursuing the *Glissonian Hypothesis* I design'd to assert and explain; it remains, that to prevent misunderstanding of what hath been said of the *duplication* and *triplication* of intermitten Fevers, according to the vulgar doctrine of Physicians, as if I adhered thereunto; I repete what was before said of that nice point: namely, that when a double or triple Intermitten follows upon the Heels of a single, the single is not (as hath been heretofore believed and taught) the direct cause of the double or triple: but the double or triple arises from the causes of its own, like to those whence the single at first arose. So that every double or triple intermitten ought to be accounted for two or three single or simple intermittents of the same Species, alternately complicate among themselves. ¶

COROLLARIUM THERAPEUTICUM.

MY *Pathologic* disquisition being now at length ended, before all the Sands in my Hour-glass are fall'n down; I cannot (as I think) employ the short remainder of my time more profitably, than if I subjoyn a brief *Therapeutic Corollary*, pertinent to my precedent discourse, and useful to Younger Students in Medicine; for whose instruction chiefly it was, that the wise and prudent Authors of the Statutes of this our so worthily renowned *Colledge*, first instituted and ordained *Anatomic*

tomic Lectures to be therein read by the learned *Fellows* thereof, whensoever it should seem fit to the venerable *President*.

I will therefore do my devoir to explicate, wherein chiefly consists that *Pepasmus* or *Concoction* of crude Humors, which Nature, and her great Minister, *Hippocrates*, require to their opportune Evacuation in putrid Fevers; and by what kinds of *Remedies* the same may be best assisted and advanced. For, these things being well understood, will afford much of Light toward the direction of the younger Sons of Art, in the true and most rational method of *curing* Fevers; in which no error can be little, no caution too great.

I begin from that never to be forgotten precept of the *Divine old Man*, afore recited: *πέποινα φαρμακείναι, καὶ κινεῖν, μὴ σμᾶ, μὴδ' ἐν ἀρχῆσιν, ἢν μὴ δευᾶ*: *Concocta medicamento purgare oportet, ac movere; non cruda; neq; ineunte morbo, nisi materia turgeat*. To which *Seneca* seems to have had respect, when he said, *in morbis nihil est magis periculosum, quàm immatura medicina*: and *Livy*, when he affirmed, *Medicos plus interdum quiete, quàm movendo & agendo proficere*.

The *Concoction* or digestion here meant, is by *Hippocrates* expressed sometimes by the word *πέποισις*, sometimes by *πέποισις*, to contradistinguish it from *πέψις*, which properly signifies the digestion of Aliment; as I have before advertised: and according to the general Notion of all learned Physicians, Antient and Modern, it is, *eorum quæ sunt in corpore præter naturam, ad moderatam & securam expulsionem per commodam temperiem deductio*. In which Sense *Duretus*, the most faithful interpreter of the Oracle of *Celsus*, expounds that place (*Lib. 1. Epidem. Anutii Foesii edit. Pag. 365.*)

πεπασμὸς τῶν ἐπιόντων συνοπέσθαι; *eorum quæ exeunt, concoctiones spectandas esse.* Upon which Galen copiously commenting, gives this memorable definition of the thing: πέλις γὰρ τίς ἐστὶ τῶν παρὰ φύσιν, ὁ πεπασμὸς τῆ νοσήματος; *nempe coctio est quedam eorum quæ sunt præter naturam, morbi maturatio.* And most rightly. For the Word πεπασμὸς, was properly used by the Græcians to express the *ripeness* of the Fruits of Trees, by which they are advanced from the State of Crudeness or immaturity, to that of maturity or perfection; and *metaphorically*, to signify that maturity of the matter of Diseases, which Nature by degrees induces, in order to the seasonable and beneficial expulsion of it, when she attempts a *Crisis* by ways most convenient.

Not that this Maturation is *always* to be expected in acute Diseases. For we are to remember, there are two sorts of *Crudity* of Causes apt to induce Fevers: *one* capable of being brought to moderation and ripeness; as that of the Blood in a *Phlegmon*, of the phlegm in a *Quotidian*, of Cholera in a *Tertian*, &c. *Another*, incapable of correction and mitigation; as the Febrile Ferment that causes *Malignant* and *Pestilential* Fevers, which being by its seminal Nature and unalterable Form, pernicious to the very principles of Life in Man, is sometimes by the force of Nature expelled and utterly exterminated out of the Body, but never can be so changed and brought into subjection, as to be made less hostile to the vital Spirits that conserve the Blood. And therefore in such Fevers, wise Physicians are not wont to stay expecting Maturation of the Poyson mixt with and fermenting the Blood, in the mean time losing the Opportunities of relieving Nature by proper *Alexiterial* and *Sudorific* remedies.

To come then to the Marrow of the *Question* proposed.

posed. Considering: (1) That the Crudity of Humors inducing Fevers simply putrid, consisteth only in this, that the Spirits lodged in them are not sufficiently educed, excited, and prepared, so as to be fit to promote the vital mication of the Blood; (2) that all Fevers are essentially founded in the fermentation of the Blood; and (3) That the vital Motion or Heat of the Blood is always more or less impeded and perturbed, and often utterly extinguish'd by that Fermentation: considering these things, I say, tis not difficult thence to infer, that the *Pepasmus* or *Concoction* requisite in all Fevers simply putrid, *i. e.* not *Malignant*, must consist chiefly in three things *è diametro* opposite to those now mentioned; namely (1) In the *Dissipation and Consumption* of the *crude Spirits* mixt with the Blood; (2) In the *Moderation* of the *Fermentation* begun; and (3) In the *Conservation* and *Corroboration* of the *vital Powers*. And these certainly are the three principal Scopes to which a Physician ought to direct his Counsels, in the cure of putrid Fevers; and which for their great importance, require to be singly explain'd.

To the *first* of these principal Scopes, *viz.* the *Dissipation and absorption of crude Spirits*, and requisite eventilation of the Blood by them inquinatèd, we may most commodiously attain, by fasting, at least by a thin Diet; by Remedies extenuating, acid, predatory and conducing to leanness; by Diaphoretics, Sudorifics, and by letting of Blood. For (1) *Fasting* tends directly to dissipation of the crude Spirits; because the Spirits, if not by intervals recruited out of new supplies of Aliment, must necessarily be soon exhausted and resolv'd into Air. But no mortal being able long to abstain from all sorts of Meat and Drink, or to endure absolute fasting; we are therefore compell'd

pell'd to substitute a *thin and spare Diet*, in the place of strict abstinence; for the most part thin Broths made of things moistning, cooling, not prone to corruption, subacid, and of easie digestion. To these (2) are added moderate and grateful *Acids*, apt to attenuate, resolve and dissipate the Crudities congested in the habit of the Parts, and therefore predatory. (3) *Diaphoretics*, which promoting insensible Transpiration, must conduce to the dispersion and exhalation of the same Crudities. (4) *Sudorifics*, which do the same thing, but by a more expedite and conspicuous operation, at once rendring the Crudities fluxile, and exciting Nature to drive them forth by Sweat. For Medicaments of this Family, by the tenuity and mobility of their Particles, penetrate the inmost Recesses and slenderest Pores of the Body, cut, attenuate and rarefie Humors into Vapors, and irritate the Parts to expel them together with the *Serum* of the Blood, in the form of Sweat. But in the use of these *Hidrotic* Medicaments great circumspection is required, lest the matter of the Fever, being not yet mature and prepared for this evacuation, be both importunely and with too much Violence exagitated, to farther corruption of the Blood, and increase of the Fermentation. So that they cannot be safely administerd to impure Bodies, in the beginning, nor indeed in the augment, until certain Signs of some Concoction have been observed. (5) *Letting forth of Blood* by opening a Vein, which evidently detracts part of the Crude Matter floating in the Blood, and makes room for the remainder to be more freely fermented, and prevents eruption of the Blood out of its Vessels into some noble part.

To satisfie the *Second* capital Intention, various things are required; *viz.* such as may *facilitate* the Motion of Fermentation in the Blood; such as may *moderate* the same,

same, when it is excessive in point of velocity; such as may incite nature to quicken and *accelerate* it, when too slow; such as may keep it within due Bounds, lest it bring a dangerous flood upon any noble part. For, the motion of Fermentation is sometimes too *turbulent* and tumultuouse, and in that respect exceedingly *laboriose*, requiring remedies to make it more sedate and easie: sometimes too *dull* and *slow*, and to be quickened; sometimes it threatens a *Flux* upon some nobler parts, and then ought to be restrained. In particular, (1.) The *laboriose* Fermentation (which the Ancients seem to have meant by the name of *Orgasmus* or *Turgescencia*) indicates remedies apt to compose it, and render it less prone to molest and offend the Vessels containing the Blood: such as taking away some Blood by *Plebotomy*, which by diminishing the Mass, lessens the burden of nature, and makes room for the freer Fermentation of the rest; such also are *Acids* and *Refrigerating*, and *Moistning* Juleps (not given actually cold, but lukewarm, nor in the least vinose) all which allay the ebullition of the Blood, and make it less prone to be frothy.

(2.) The *too swift* or vehement Fermentation, which makes the Fever more acute than the strength and spirits of the Patient can well bear, and by consequence ought to be moderated; requires remedies that may somewhat *retard* it, and procure a truce to nature, that she may have respite to recollect and rally her Forces. Of which sort are *Blood-letting*, *Anodynes*, *Hypnotics*, and sometimes even *Narcotics*, either taken in the Mouth, or applied outwardly to places convenient.

(3.) On the contrary, the *too slow* and lingering Fermentation, such as causes *Lent* Fevers, calls upon the Physician for Spurs to incite and stimulate nature to accelerate the Conflict. In this case therefore he ought

to have recourse sometimes to *Purging Medicaments*, to be by Intervals repeated; sometimes to *Sudorifics*, and those pretty hot, efficacious, vinose or rich in spirits: for all these *quicken* the Fermentation, and dissolve the clammyness of the Febrile Matter, and in both those respects bring great relief to the Patient. (4.) The *Turgent* Fermentation, which threatens a Flux upon some noble part and imminent danger thereupon; directs to the speedy use of the best means for *Diversiōn*. Here therefore the most urgent Symptom is without delay to be opposed, by Remedies *Revolent*, *Divertent*, *Repellent*; as *Phlebotomy*, *Cupping-Glasses*, *Leeches*, *Ligatures*, *Vesicatories*, and other *Topics*.

In fine, the *Conservation of the vital powers*, is in putrid Fevers of greatest moment; because the Febrile Matter tends directly to the oppression of the vital Mixture of the Blood, and the Fermentation it self proceeds no less from the Luctation of Nature, endeavouring to continue that motion in which life consists; than from the Ferment that hinders it. Hence it comes, that the lighter causes of Fevers are sometimes discussed by *Cardiacs* only, by a bitter decoction of Chamomil Flowers, and the tops of Wormwood, by *Carduus Benedictus* boiled in Posset-Drink, and the like *Euporista* or domestick Remedies. For, if the expansive motion of the vital spirits be so far assisted and corroborated, as to enable it to overcome the clammyness of the febrile Ferment, that tends to the suppression of it; Nature certainly will soon obtain the Victory, and easily exterminate her Enemy. Here then is the opportunity of giving *Cordials* (as they are call'd) *Antidotes*, and *Specifics* or *Appropriate* remedies, vulgarly so named: all which conduce to the *Conservation of the vital Faculty*. ¶

Besides the just now described preparation of the matter in putrid Fevers offending, to the opportune expurgation of it, there is required also a certain preparation of the *WAYS* or passages, through which the same is to be most commodiously carried off, that so the evacuation, whether by nature her self critically, or by her Minister the Physician artificially instituted, may be not only seasonable, but easie too and beneficial. For, these being, either by their *asperity*, or by their *narrowness*, or by *obstruction*, less passable than they ought to be; to attempt purgation, is vain and unsafe. Of which our Law-giver, *Hippocrates*, being fully conscious, left us this most prudent counsel (*Aphor. 10. lib. 2.*) τὰ σώματα χεῖν, ὅς ἀν τις βέλῃται καὶ σαλεῖν, ἐν ῥοῇ ποιεῖν; *Si quis corpora purgare voluerit, meabilia ut reddat, est necesse.* But how is the Body to be made more permeable? By opening all the passages of it, and by cutting, dissolving and attenuating the gross and viscid humours that stick in them: which may be best effected, by Remedies *Lubricant*, *Abstergent*, and *Aperient*: the particular reasons of all which I shall endeavour briefly to explain.

(I) *Lubricantia* certainly render the ways more fit to give passage to humors that require purgation; by smoothing their roughness, and inducing instead thereof a manifest *slipperiness*; so that the humours slide along through them without any sensible renitency or attrition, which always causeth *Gripes* in the Stomach and Belly. Now of these Medicaments that are apt to induce slipperiness, some are simply *Aqueous*, and remove asperity only by their moisture, as Barley Water, thin Broaths, Whey, &c. Others are *Mucilagineous*; smoothing the ways with a certain friendly and pleasing Lentor, as the Syrups of *Althea*, of the Flowers of Mallows, *de Mucilagibus*, of Jujabs, &c. Others *Oleagineous*,

Oleagineous, as Oil of sweet Almonds, Linseed Oil, fresh Butter, Lard, &c. Others, *Saline*, as the Salt, Cream, and Magistery of Tartar. Others, *Spirituose*; as New-laid Eggs, but little boiled, the Pulp of ripe Fruits. Again of these, some *loosen* the Belly also; as the Pulp of *Cassia* and *Damasco* Prunes, which above all things contemperate the roughness of purging Medicines, being for that reason chiefly admitted into the composition of the *Diaprun. Solut.*

(2) *Abstergentia* seem to have the like good effect, in facilitating the operation of purging Medicaments; as Soap hath in cleansing of Linnen. For, whatsoever sticks to the inside of the Stomach and Guts, they wipe away; and are found, in that respect perhaps, to conduce much to the correction of strong and churlish Cathartics; by preventing their rough and grating Particles from pertinaciously adhering to the Coats of the Ventricle and Intestines, and so inducing Gripes and Contorsions. Hence 'tis familiar to Physicians to tame fierce Purgers with Salts, *viz. Sal Gemmae*, Salt of Tartar, of Nitre, Spirit of Vitriol, and of Nitre dulcified, *Cremor Tartari*, and the like. Not that they confer to the bridling of the fierceness of stronger Cathartics in this name only, but because they are usually prescribed chiefly to this end.

(3) Nor are *Aperient*, i.e. cutting and attenuating Medicaments of less utility in this business, where the ways through which peccant humours are to be educated, are obstructed by any vitiose matter cramm'd into them. For, remedies of this *Classis*, by reason of the great tenuity, acuteness and agility of their Particles, penetrating into the smallest Vessels and Pores, and attenuating viscid and tenacious humours therein sticking, open all passages in the Body. No wonder then, if by rendring the clammy matter of Fevers more thin, fluid,
and

and more obedient to nature endeavouring, upon irritation by Purgers, to expel it; they conduce mightily to the more facile, and more successful operation of Purges. Nevertheless, we are to advert, that not all sorts of humours are to be made fluxil, before any be exterminated by artificial purgation: but that we are, in pertinacious obstructions of the *Viscera*, to act with *Aperients* and gentle *Cathartics* by turns. For, as there are degrees of Concoction, so likewise ought there to be degrees of evacuation; and so soon as any part of the peccant matter is concocted and prepared; we must attempt to carry it off; to the end that nature being thereby exonerated of part of her Load, may with more facility digest the Remainder; at least when we perceive her to be oppressed by too great weight. Of *Aperients* some are *hot*, which ought to be administered to Men of robust Bodies, and cold complexion, and such as labour of inveterate Oppilations: some *cold*, which are proper for persons of hot constitutions, and prone to abound with Bilious or Choleric Humours: others *Temperate*, and therefore most convenient to tender, soft, delicate and crazy Bodies. But these three sorts being judiciously temperate, mutually refract each the others qualities, so as to reduce them to mediocrity. Other differences of *Aperients* there are, which I must lightly touch. *Some* remove Oppilations by *attenuating simply*, without the least of Astriction; as the five opening Roots, the Bark of Tamarisc, and of the Roots of Capers, the Leaves of Maiden-hair, Hearts tongue, Ceterach, and Fern Roots, &c. *Others* both *open*, and *moderately bind*; as Endive, Cichory, Agrimony, Rhubarb, Sage, &c. *Others* again are endowed with an aperitive faculty, but are withal *vehemently astringent*; as Steel, which hath no fellow. Now, as to the seasonable use of these differences; in the *beginning*, *Ape-*

rients without Aftriction are moft convenient; becaufe they beft difpofe the humours to fluxility, and clear the paffages: yet are they to be prefcribed with this caution, that the tone of the parts be not by the importune ufe of them diffolved, or irritated to a cruentation. The fafer way therefore is, to mix with them one or two of the *second Tribe*, that have fomewhat of Aftriction in them. *Aperients moderately aftringent*, are indeed in themfelves moft fafe; but they are given with beft fuccefs after a general Evacuation: And more *vehement Aftringents* are to be kept in referve, to *finifh* the cure, by reftoring the weakned parts to their priftine tone and vigor.

But is it not plainly diffonant to reafon, ye will fay, that the fame remedies fhould be at once both *Aperient* and *Aftringent*? I *answer*, therefore, with Doctor *Gliffon*; that *Aperients* and *Aftringents* are not directly *opposite* each to the others. For, the contraries to *Aperients* are *Obftruents*; and to *Aftringents*, *Laxants*. Befides, in a Cachexy and Dropfie, which either proceed from, or are commonly accompanied with great Obftructions; the natural tone of the parts is always relax'd more or lefs. It muft be confefled indeed, that in thofe maladies the tenfion of the Nerves is for the moft part too great, by reafon of their continual irritation by vitiofe humours: but nevertheless it cannot be denied, that their natural tone is lefs firm than it ought to be. If therefore *Obftruction* may confift with *Laxity*, why may not *Deoppilation* as well confift with *Aftriction*?

And thus have I run over the three principal things prærequisite to Evacuation in putrid Fevers, *viz.* correction of the peccant matter, confervation of the vital Mication of the Blood, and permeability of the ways. It remains only, that I adjuft what hath been faid

said, to a certain Rule of *Hippocrates*, that seems to render it doubtful. The precept is this (*Aphor. 29. lib. 2.*) Ἀεζομένων τῶν νόσων, ἢν τι δευκὴν κινεῖν, κινεῖ; *Ineuntibus morbis, si quid movendum videatur, move*: Which some perhaps may think plainly repugnant to the former Aphorism, upon the explication whereof I have so long insisted.

To reconcile therefore these two equally true Aphorisms, I must acknowledge, that it is *not always* requisite to expect a *Pepasmus*, or maturation of the Motibific Matter in Fevers simply putrid. For, there are various cases, in which whether they happen to be single, or concurrent; the counsel of this latter Aphorism is to be preferred to that of the former. And all these Cases may be reduced to the number of five.

The *FIRST* is, when any vitiose humor, either by its abundance, or irritating quality, or motion doth molest the patient, in the first region of the Body, that is, in the Stomach, or Guts, or Pancreas, or Liver, &c. which requires to be speedily expelled upward or downward. For 'tis not to be doubted, but that a Physician may, and ought, in this case, to relieve molested nature, as soon as is possible, by carrying off the irrequiet humor [διὰ τῶν ἐμπροσθεν ἰσχυρίων] by ways most convenient. And by the Oracle of frequent experience we are taught, that not only intermittent, but continual Fevers also, are much diminished, if not totally eradicated by safe Vomits or Purges administered in the beginning. For, the foveat cause being taken away, the proxime cause is much more easily discussed; which seems not to be any humor stagnating or congested, either in the *Viscera* themselves, or in their Confines, as hath been already shewn; but floating in the Mass of Blood within the Arteries and Veins. This therefore is not to be attempted by any purging Medicament,

cament, until Concoction hath preceded : and the *latter* Aphorism advising Purgation in the beginning of putrid Fevers, is restrained to crude humors contained in the first Region of the Body ; nor doth it respect the times of Diseases, so much as the strength of the sick, (which is very rarely exhausted in the beginning) according to the judgment of *Galen* (*libr. ad Thrasymbulum, cap. 38.*) who gives this reason of the Aphorism, *Quod natura, adhuc satis valida existens, detractâ oneris quo premitur, parte, quod reliquum est & facilius ferre, citiusque concoquendo mitigare possit.* Hence it is, that not only *Glysters*, that rinse the Guts, but gentle *Solutives* also, such as may without any great tumult or commotion carry off any vitiose humor lodged in *primis viis* ; are commended by the most experienced Physicians in the beginning of putrid Fevers.

The *SECOND* Case is, when any matter incapable of mitigation by Concoction, begins to shew its *Turgescence*, i. e. either from its abundance, or from its malign quality, flying from place to place, induceth a frequent mutation or shifting of Symptoms : all which *Hippocrates* comprehended in the word *ἀεγν*, which signifies *rage* or *fury*. Which for the most part happens in the beginning of the Fever ; and then arise various Symptoms, and dangerous, according to the various Temperament, Irritability, Action, Use, and Situation of the part upon which the turgent matter rusheth. As for instance, in *Phrenetic* Patients we observe an admirable change of Symptoms, sometimes their Sight, sometimes their Hearing, sometimes their Tongue being invaded and disordered by the wandering humor that causes their *Delirium*, and often shifts the scene of its tragical fury. And the Reason seems to be this, that the intruded matter of the Disease is so highly offensive to Humane Nature, that no part of the whole

whole Body can suffer it so much as one moment of time, without uniting the Forces of all its irritated Fibres to squeeze it out, so that it is transmitted from some parts to others in a trice. If it happen therefore, that any crude humor be in this impetuous manner transmitted to any *Secretory* Organ (even though it be not redundant in the whole Body (a considerable part of it may be, by help of purging Medicaments, respective to that Organ, speedily carried off to the preservation of the Patients life. For, the humor, so turgent, and rushing into the Organ, doth by its very motion irritate the Fibres of it to contract themselves vigorously to expel it; no less than if it were redundant in the whole Body. If the storm then fall upon the *Stomach*, the danger thence impendent may be easily prevented by a moderate *Vomit*, given before the humor be removed to some other part; if upon the *Guts*, a convenient *Purge* may serve to turn it downward. And yet I must confess, that such early Evacuations are commonly tumultuous and painful; as promiscuously educing all humors they meet with; and therefore never to be instituted, but where the matter of the Disease is turgent.

The *THIRD* Case is, when some little portions of any one, or more of the *Analogous* Humors formerly described, chance to be carried, together with the stale and dead recrements of the Blood, to the *Secretory* Organs. In particular, when some of the acrimonious and corroding *Serum* of the Blood, is by nature therewith offended, transmitted, together with the *Bilious* Excrement of it, to the *Liver*: or some of the whitish and viscid *Grumus* of the Blood, together with the *Pituita emortua*, to the *Stomach*; or finally, some of the aqueous or potulent matter, with that of the *Urine* to the *Kidneys*. Because Nature tends that way, and ba-

ing

ing assisted by a convenient *Purge* in the *first* Case ; in the *second*, by a gentle *Vomit* ; and by temperate *Diuretics* in the *third* ; may continue the same course, until she has brought the remainder of the peccant matter to a perfect *Crisis*.

The *FOURTH* is, when any vitiose matter yet crude, is so redundant in the Blood, that nature, reduced to her last shift, is compelled to exclude it by parcels, by any *Secretory* Organ, not by that which is most proper and congruous to the nature of the humor. As it happens in the *Yellow Jaundise*, when part of the corrupt *Choler* is separated from the Blood in the Kidneys; and makes the Urine thick, turbid and yellow : and in that dreadful Disease call'd *Cholera*, all the *Bilis* ejected upward and downward, is not concocted and truly felleous, but for the greater part crude and only analogous to that which is separated from the Blood in the Liver, and thence brought into the Bladder of Gall, and seems to be generated by a certain malign or venenose corruption of the Blood. For, improbable it is, that so prodigious a quantity of biliose matter hath been separated, in so little time, by the Liver, or excreted by the *Porus Biliaris* ; but most probable, that the same is separated from the whole Mass of Blood in the inmost Coat of the Stomach and Guts. In like manner, they who drink Mineral Waters, or Wine profusely, make Urine indeed in abundance, but thin and crude.

The *FIFTH* and last Case is, when the Febrile Fermentation appears to be slow and lingering. For, here 'tis lawful, by just intervals, to ordain Evacuati-
ons by milder Cathartics ; not only in respect of the *Focus*, which in such Cases is wont to be recruited often, and therefore requires to be subtracted by repeted Evacuati-
ons ; but also that the Fermentation it self may

be

be quickned, and so nature excited to perform her work of digesting the Crudities with more vigor and expedition. Besides, since in lent and lingering Fevers, the crude matter is not brought to the state of maturation all at once; but first some part, and then more and more successively: 'tis fit the same should be evacuated *per Epicrasim*. or part after part accordingly: and this, lest that part of the matter that is first digested, remain still mixed with the Blood, and inqurate it; or at least, being separated in the inmost Coat of the Stomach and Guts, pervert either the Concoction or Distribution of the Chyle, and so foment the Disease.

And thus have ye at length succinctly set before you all the *opportunities* in which it is not only lawful, but expedient for a Learned Physician, directing his judgment [*καὶ τῶν τέκμαστων*, as our Master *Hippocrates* speaks] by certain observation of Signs and Symptoms in the sick; to institute convenient Evacuations, at least by milder purging Medicaments, even in the beginning of putrid Fevers. Nor doth any thing else remain for me now to subjoyn concerning this Argument; but this brief *admonition*, that no young Practitioner be so rash, as to purge, where he finds not one or more of these opportunities offered to him. For, if he attempt *crudé* matter by strong and fierce *Catharticks*; 'tis ten to one, but he will exhaust much of the vital spirits, colliquate the Blood, and render the Disease mortal. ¶.

CONCLUSION.

CONCLUSION ANAGNOSTICK.

'Tis the custom of Travellers (ye know) when they have with panting Breast, and painful Steps, ascended to the top of a steep Mountain, to turn about, and look back upon the places and ways they have with so much labor and patience pass'd: and this, not only to take breath a while, but to imprint more deeply in their memory, the Images of whatever things they had *in transitu* observ'd; uncertain whether or no Fortune may ever bring them that way again. Let us then (most judicious, and most candid *Auditors*) who are all *Travellers* too in the most darksome and rocky ways of Natural Knowledge, follow their Example; and having now at length attain'd to the end of this Mornings Journey, take a short review of the things offer'd to your notice, as we pass'd along: to the end ye may the more easily recall them to mind, whenever ye shall be pleas'd to think them not altogether unworthy your *Examen*; it being unlikely, that I shall at any time hereafter have the honour to serve you, in the quality, not of a Guide, but *Torch-bearer* in this place.

The Heads therefore of the various things proposed by me to your consideration, are these. I shew'd in the first Stadium,

(1.) That the *vital motion* of the Blood is sometimes disorder'd, impeded, and impugned by causes *præternatural*

natural; and chiefly by *crude* humors constituting a peculiar *Fermentative Inquinament* of the Blood: and that from thence arises a duel or conflict between the *vital spirits*, on one side, and that *Inquinament* on the other; which conflict, in putrid Fevers, is call'd by the Ancients, *Putrefaction*; and *Fermentation*, by the Moderns. (2.) That the same Ferment, in Fevers, tends naturally to the *oppression* of the vital Mication of the Blood, in which life it self immediately consists. (3.) That the *crudity* of humors generating that Ferment, and consequently Fevers, doth consist chiefly in this; that the spirits of our food receiv'd into the Stomach, either have not been by the concoctive faculty thereof sufficiently *exalted* (which always happens in Fevers *simply putrid*) or though excited, have not been *subdued* and *tamed*, so as to become useful and fit to promote the vital Mication of the Blood (which always happens in *Malignant* Fevers. (4.) That the principal reason, why in putrid Fevers it is unsafe to purge, before nature hath *concocted* the crude matter mixed with the Blood, seems to be this; that in the whole Body are no *Secretory* Organs destined peculiarly to the separation of humors yet crude, from the Mass of Blood. (5.) That the *Analogous* Humors of the Ancients are coincident with the Elements, by the Moderns supposed to constitute the Blood: and that it is plainly necessary, that in every Fever, of whatever sort, some one, or more of those Analogous Humors be in fault. (6.) That the formal reason of a *Malignant* Ferment is radiated in some *seminal nature* pernicious to the principles of Life in Man.

In the Second,

(1.) That the *oppressive Energy* of the Febrile Ferment

Q q q

ment

ment described, comes immediately from the *pendulous Lentor*, or clamminess of it, by which it is apt to render the Blood foul and *ropy*, and to inviscate the vital spirits, that should by their expansive motion conserve its purity. (2.) That these vital spirits are incited to raise a Fermentation, not by the exhalations of the Blood retained, but only by the said *clamminess* of the crude matter inducing the Fever.

In the Third,

(1.) That the *Symptoms* contingent in the *beginning* of a Febrile Paroxysm, may be most commodiously referred to the aforesaid *Conflict* or Colluctation betwixt the expansive endeavour of the vital spirits, and the opposite clamminess of the Febrile Ferment. And (2.) that the *Symptoms* succeeding in the *Augment*, *State*, and *Declination*, may be with equal congruity solved by the same Hypothesis.

In the Fourth,

(1.) That the cardinal *Differences* of Fevers are most probably derived from the *Different Ferments* that induce them immediately. (2.) That the *Origin* of all Fevers, simply putrid, *i.e.* free from all Malignity, may be most congruously deduced mediately from *defect*, either of *Chylification*, or *Transpiration*, and *free motion* of the Blood, whether this happen with, or without extravasation thereof. (3.) That the Blood, when inquinated by crude Chyle, doth not presently conceive a Fermentation, but after some time, and *by degrees*. (4.) That in *intermittent* Fevers, the matter of each single Fit is not generated anew; but comes from a *general Fomes*, existent in the very *substance* of the solid parts

parts imperfectly nourish'd with crude juices. (5.) That this very substance of the solid parts is melted into a kind of *Sanies* or putrid matter, and remixt with the Blood, in all putrid Fevers. 6. That the *Analogous* Humors of the Ancients, result from various *Crudities* mixed with the Blood : and that from thence arise various sorts of Fevers ; namely, *biliose*, *pituose*, and *melancholic*. (7.) That the division of Fevers into *continual*, and *intermittent*, doth immediatly depend upon the Fermentation, sometimes continual, sometimes ceasing and recurring diversly by intervals. (8.) That an intermittent Fever *simple*, is not the direct cause of an intermittent *double* or *triple*.

In the Fifth, and Last,

(1.) That to the *Maturation* of the crude matter, are required three things, *viz.* Dissipation and Consumption of the unexcited spirits therein remaining, Moderation of the Fermentation already begun, and Conservation of the Vital Faculties. (2.) That in order to safe and opportune *Evacuation* of the same peccant matter, is required also due preparation of the *Ways* or Passages, by which it is to be educed ; and that by Remedies *Lubricant*, *Abstergent*, *Aperient*. (3.) That sometimes even in the beginning of putrid Fevers, *Purgation* is requisite ; specially when vitious humors molest in the first Region of the Body, or when the Febrile Matter is turgent, or when part of it is transmitted, together with the stale Recrements of the Blood, to any one or more of the three Secretary Organs ; or when Crudities are highly redundant in the Mass of Blood ; or finally, when the Fermentation it self is too sluggish and lingring : but in no other case whatsoever.

And this, *most candid Auditors*, is the Sum of what

hath been in this Session said concerning *Fevers*. Nor have I any thing more to add, but only this ; that if I have, by offering you this Abridgement, usurped the Office of your *Anagnostes* ; it was not from a vain conceit, that the positions therein contained, are worthy *your* belief : but only from hopes, that ye might be thereby more easily inclined, to let me understand from your judgment of them, how far they may be worthy *mine*. For, in this Argument, (as in all others, whether *Physical*, or *Pathological*) I pretend not to know truth, but to *seek* it : nor to seek it contumaciously and arrogantly, but *modestly* and *doubtingly* ; as becomes a *Man*, a *Philosopher*, and a *Fellow* of this Royal Colledge of Physicians, into which I entered with no other ambition, but that of being more and more instructed in *Natural Science* and all other *Virtues*. ¶

PRÆLECTIO

PRÆLECTIO VI.

O F

MOTION VOLUNTARY

IN the beginning of time, when it pleas'd the Divine Majesty to call this visible University of things, the World, out of nothing, and to create Subjects whereon to exercise his infinite goodness; having indowed all living Creatures with *Appetites* requisite to the conservation of their peculiar Beings; and accommodated them with *Objects* proportionate to those Appetites: He saw it convenient, to consummate that Emanation of his Bounty, by furnishing them also with *Faculties*, by which they might be impow'rd, not only to discern what Objects are good or convenient, what evil or inconvenient to their particular Natures; but also to *pursue*, or *avoid* them accordingly. Now, among these so necessary Faculties, *that* by which all Animals are enabled to prosecute what is presented to them under the appearance of Good, and to eschew what they apprehend to be Evil; is what Physiologists call *Δυναμὴ κινήσεως*, the faculty *LOCOMOTIVE*; and rightly enough define to be, the Power by which a "living Creature is enabled to move or transferr
"from place to place, either is whole Body, or any Part thereof at pleasure. TO

To the putting this noble Power into Act, are required as absolutely necessary, besides the Member or part of the Animal to be moved, three things; which according to the Order of their Succession, are,

(1.) The Object, ὀρεκτόν (as *Aristotle Lib. de communi Animalium motu cap. 7.* terms it) τὸ δραντόν, that which Invites; or τὸ φευκτόν, that which Offends.

(2.) The *Efficient*, call it what you please, the Soul, Mind, or Intellect, in Man; the Imagination, Phantasia, or Brain, in Brutes; or Locomotive, Animal Faculty, in both: which being invited, or offended by the Object, moves the whole Body; or some Member of it, in pursuance or avoidance thereof: and,

(3.) the *Instrument* used by the Efficient; which seems to be double: *viz.* *Mediatum*, that, by the mediation or intervention of which the Appetite, Soul, or Imagination doth as it were dispense its Command, and Communicate Virtue motive to the Organ to be used: and *Immediatum*, that by which immediately the Command given is executed, and the intended Motion performed.

As for the Necessity of the *first* and *second* of these three requisites to animal or voluntary Motion; I think it needless for me to insist upon the explication thereof: because it is most evident, and on all Hands confessed, that the *Soul*, whether Rational, or Irrational, is the *primary Agent* in all voluntary Motions; and that the same is thereunto incited by the good, or evil appearing in the Object.

But as for the *Instrumentum mediatum sive primum*, that upon which the Soul or Appetite immediately acting, doth by the help thereof produce a Motion, first in the *ultimate Instrument* (which undoubtedly

is the *Muscle*) and then in the Member, whose Motion conduces to the attainment of its end; it is a *Question*, and a great one too, whether there be in truth a *necessity* of any such thing, or not.

The *Antients* (tis well known) unanimously taught, that the Soul effects Motion in the Muscles, at pleasure, by transmitting from the Brain, by the Nerves, into them, a certain most thin, most subtil, and most agil Substance, (which they call therefore *Animal Spirits*) by whose swift and copiose Influx the Muscles to be moved being in an Instant as it were inflated and distended *Secundum latitudinem*, they are forced to contract or shorten themselves *Secundum longitudinem*, and by that Contraction to pull and move the Members to which they are fastned. And this Opinion hath been without any dispute embraced and asserted, through a long train of Ages, down to this in which we live.

But in this our more illuminate Age, Fate has brought forth some Physicians of this Nation and Colledge, of most profound Learning, and admirable sagacity of Spirit; who laying aside that so antique Hypothesis of *Animal Spirits*, as both improbable and unnecessary: hold it to be sufficient to solve all the *Phenomena* of voluntary Motion, if it be supposed, that the dictates of the Soul are transmitted from the Brain to the Nerve and Muscle to be used, not by emission of any Substance whatsoever, but by a mere contraction of such Fibres of the Brain as are continued to that Nerve. For the Nerve (say they) having its origin from the Fibres of the Brain, and being at one end continued to them, at the other inserted into the Head of the Muscle; so as to make one continued Cord all along: if a Motion be excited, *ad nutum animæ*, in the Fibres of the Brain, the same must

their original by Motion, begun in the Fibres of the Brain, by the Soul: it being no less difficult to conceive, how an *incorporeal Agent* can Act upon a *Corporeal Organ*, by way of simple contact or impression than how it can communicate a force by Transmission of Spirits most subtile, most active: nay more, I may adventure to say, this latter supposition is so much the less inconceivable than the former, by how much more easily a most *light* and most *agil* Substance is put into Motion, than a *heavy* and *gross* one.

Secondly, evident it is, that the motive Power of which we are speaking, is not inherent in the Muscles themselves, nor in the Nerves inserted into them; but derived and immitted into them from the Brain, *ad nutum animæ*, as she has occasion to use them. If so, what notion can we have for such a Power, unless we conceive it to be a certain invigoration or force, suddainly communicated to, or impress'd upon the Fibres of the Muscles? and wherein can we imagine that invigoration to consist, if not in a distention of those Fibres, by some influx from the Brain? This very consideration seems to have induced that great Man, *Galen*, to deliver this for an undoubted truth (*in lib. de motu musculor. cap. 2.*) *Adeo certè magna quedam vis est in nervis, supernè à magno principio affluens: non enim ex seipsis eam; neq; connatam habent, &c.*

Thirdly, if there be no invigorating Influx from the Brain through the Nerves; how comes it, that an Obstruction, or Compression of any one of them forthwith causes a *Palsy* in that part, to which the obstructed or compress'd Nerve belongs? Is it not only from hence, that the intercourse betwixt the Brain and Muscles of that part, is wholly stopped? If the Nerves were designed and framed by Nature to do the office of *Strings* or *Cords* only; why were they not
made

made of one continued Substance, but of many slender Filaments or Threads? And why were not these small Threads closely twisted together into a strong Cord, but extended, as parallels, side by side, and intercepted with many narrow *Canales* or passages betwixt them, and all inclosed within a membranous Coat extremely thin and tender? Certainly, if we attently contemplate the artifice of Nature, in the Figure and contexture of a Nerve; we shall find our selves almost obliged to acknowledge, that the *Fibres* were so disposed in Parallels, with small *Canales* running along betwixt them, to give free and quick passage to the subtile influence to be transmitted from the Brain into the Muscles, for the invigoration of their Fibres. And *Galen* reflecting upon this, that if a Nerve be cut asunder, the Muscle into which it was inserted, becomes ever after incapable of being used to voluntary Motion; from thence with great assurance concludes; *Nervi igitur, rivorum in morem, à cerebro, seu ex quodam fonte, deducunt musculis vires.* Where 'tis remarkable that he compares the Nerves, not to Strings or Cords, but to *rivulets* or *Conduit-Pipes*, framed for the conveyance of the invigorating influence, or *πρώτη ὄρμη* (as he calls it) first *impetus*, from the Brain, as from a Fountain. And what could he have said, either more intelligible in it self, or more favorable to the doctrine of animal Spirits?

Fourthly and lastly, it is not unworthy consideration, that the voluntary Motion [τῶν ἀπόδαν] of *Reptils*, such as Earth-Worms, Snails, and such like (whose progression the Greeks call by a most proper Word, *ἰλύσπαισι* and *ἰλύσπαιμα*; most accurately described by *Aristotle*, *lib. de incessu animal. cap. 9.*) is performed by the help of a certain *aerial* or *spirituouse* Substance issuing from their Heads; discernable, in

Snail, by the sight. For, if you put a large grey Snail into a clear glass Phial, and hold him up against a good Light; you may plainly perceive, that when he begins to creep, a Chain of little Bubbles will come from his Tail, and move along one after another to the middle of his Back, and thence up to his Head. When the Snail remains quiet, the motion of the Bubbles ceaseth: and as he again begins to advance, they also begin their Course anew; passing, by a kind of slow Circulation, from the Tail to the Head, along the Back; and from the Head to the Tail, along the Belly. So that it seems probable, that these Bubbles being protruded or propelled in the manner described, are instrumental to the Motion of the Snails forepart, to which he after draws up his hinderpart, *arcuatim*, making an Arch in the middle; and so advances. *Quia postquam priore parte processerit, mox posteriorem ad illam, se convolvendo, trahit; ita ut videatur arcuatim & annulatim progredi;* as the many-tongued *Monsfr. Bochart* saith, in his description of the Motion of a *Horse-leech*; in *Hierozoic. lib. 5. cap. 19*: Now, though Nature be observed to diversifie the Instruments of voluntary Motion, in various Sorts of living Creatures, according to the diversity of their Bulks, Shapes, Functions, and necessities of Life; and therefore to infer a parity of contrivance of them in more perfect Animals, from an observation of the Action of those in less perfect, be but an inartificial Argument: yet forasmuch as she seldom varies her more general ways of formation, but upon necessity; and when she doth, her deflections from her common Method, are never so wide, but still they carry some Analogie to them: it seems not improbable, that as the progressive Motion of Reptils is performed by the help of an Aerial Substance, so likewise our muscular Motion is made by the help of a spirituose

Influx

Influx from the Brain into the Nerves and Muscles.

And this is the sum of the principal Arguments urged, partly by the Antient, partly by the modern *defenders* of animal Spirits, and of their necessary use in voluntary Motion.

I will now, according to my promise, change my Person, and putting on that of an *Opponent*, plead a while against both their *Existence*, and their supposed *use*: taking the liberty to allege, what at present I remember to have been said by others, and what I humbly conceive may with reason be said, to weaken at least, if not wholly subvert the former doctrine.

We Physicians indeed speak magnifickly of *Spirits Animal*, as of the plenipotent and immediate instrument of the Soul in all her operations upon the Body: confidently attributing to them, *veluti Demiurgis quibusdam*, whatever of designed Motions are performed by the Nerves and Muscles, whatever of natural Motions are performed by the Diaphragm, and Heart, whatever of violent Motions happen in our exorbitant Passions, in fine, whatever of commerce or communication there is betwixt the Brain and all inferior Parts, in the state of Nature, as if we assented to the Dream of *Heracitus Ephesius*; *πάντα ψυχᾶν ἔβου και δαιμόνων πλήρη. Diog. Laert. in vita.* Yea more, in a *Preternatural* State also we make them only not omnipotent. For, what Disease of the Brain can ye name, which hath not been referred to their Vices, either to their defect, or excess; to their stupidity and sluggishness, or their fury and tumults; to their interception; or too copiose and impetuose Influx; to their fixation, or incessant exagitation; to their depravation by exotique and inconvenient Mixtures, to their dissipation by Opiates and Narcoticks; or to some other of a thousand accidents, to which they are supposed to be Obnoxious.

Nay

Nay some have gone yet much farther, and (were it not indecent to divert to Romantic Writings) I could quote an *Author* of no small Fame, who hath not many Years past enrich'd the Commonwealth of Philosophy with a whole Legend of the Empire of Animal Spirits, their Laws and Constitutions politick, their quickness of perception, presagation of Dangers, Passions of Love, Anger, Hate; their Seditions, Tumults, Insurrections, military Rangings, Sallies, Excursions, Combates, Incampings, Marches and Countermarches, Explosions or Fireings, Retreats in order, confused Flights, and infinite other admirable things, such as I, for my part, should not have had Wit enough to ascribe to any but *Reasonable* Creatures. Nor shall I blush to confess, that when I was reading this Fanciful Book, I could not but recall to mind many of the Witty Fictions of *Lucian* (*verar. historiarum Lib. I.*) concerning the *Militia* and adventures of his *Hippogypi*, *Lachanopteri*, *Cencroboli*, *Scorodomachi*, *Psylloroxota*, *Anemodromi*, *Struthobalani*, *Nubecentauri*, *Aeroculices*, *Solarii*, *Lunarii*, *Nephelococcygians*, and other chimerical Nations by him in Drollery described; and all the pleasant Dreams of a certain great Lady, recounted in her most delightful Histories of the *Blazing World*, and of the *Kingdoms of Fayries* in ever Mans Brain: though I at the same time considered, that *Lucian* and the *Lady* had written only in Jest, to exercise their Wit: but the other, in serious earnest, and with design to reform the State of Physic, by new discoveries. So true is that saying of a late ingenious Writer; *Ubi semel occupatum ingenium est novis Hypothesibus, licet solis innitantur conjecturis; in infinitam conceptuum libertatem se diffundit: ne disputare quidem cum rei veritate amplius sustinet. Tam irrequieto & exultante impetu stimulat in ulteriora voluptas gloriosa.*

And

And yet notwithstanding, after all our speciose discourses of these Emissaries of the Soul, Animal Spirits; we are distracted by various Opinions concerning them: still anxiously inquiring, of what *matter*, in what *place*, and *how* they are generated; what are their *Qualities*, *Motions*, *Ways*, and *Manner*, of acting; and in fine, uncertain, whether they be *real Creatures* of Nature, or only the *Idols* of human Imagination. *Risum teneatis amici, an lachrymas? Certè res est haud perfunctoriè lugenda.*

Some have affirmed, that the *Fluid* contained in the Pores and Fibres of the Nerves, is the more subtil part of the Blood, separated and sublimed in the Brain; giving it the noble Name of *Spirits*: but they have not yet by certain reasons or Experiments, taught us, to which of all the Fluids that are known to us, that is like. *Others* therefore proceeding somewhat farther, pronounce that these Spirits consist of *Saline* and *Sulphureous* Particles highly analogous to the Spirits of Wine. But this is to feed our curiosity with fine Words, that signify little of certainty. True it is indeed, that upon drinking a little Glass of Spirit of Wine, we find our Strength suddainly recruited: but whether from the Humor we call Spirit, or from that other Matter that makes that Spirit Fluid, or is perhaps for some other reason joyned to it; who hitherto has determined? Besides, the animal Spirits (if any such there be) seem to be so far remote from the *subtility*, *Acrimony*, and *volatility* of Spirit of Wine; that we want not just reasons to convince us, they are not volatile, nor actually Rarefied into Exhalations; nor aerimonious. *Not Volatil*, because if they were such, certainly they would offend and trouble the Brain; as may be inferred from the Lassitude, Headach, giddiness and other Symptoms that commonly invade

Mem

Men next Morning after a Debauch with Wine; all which come from the volatile Spirits of the Wine. Not *actual Exhalations*; because in that State, being mixt with other Humors of the Body, they would produce Bubbles or Froth, or cause also an inflation of the Parts containing them: neither of which is to be endured, Not *Acrimonious*, pungent, or offensive by asperity of their Particles; because if such, they would continually irritate, prick, and corrode the Brain and Nerves, and necessarily force them into Convulsions, and other tumultuose Motions. I add, that they are not (as *Fr. Sylvius* imagined them to be) apt to *Ferment*; because if such, they could not but fret and dissolve the soft and tender Substance of the Brain, and the Pith of the Nerves.

By these and other Reasons induced, our most excellent *Dr. Glisson* (*de Ventric. and Intestin. Cap. 8. num. 7.*) formed his animal Spirits of a constitution exempt from all these inconvenient Qualities. He describes them to be *Mild, Placid, Sedate, Fixt, Sweet, Nutritive, Corroborating*, and apt to *consolidate*; and in all these respects exactly like the Spirits contained in the white of an Egg. Their *Subject* he held to be, the true *Succus Nutritivus*, distributed from the Brain, through the Nerves, to all spermatick Parts: which he would have to be generated only in the Brain (*corticem inter & medullam*) by way of *Secretion*; and that the matter of which they are in that manner generated, is the more *mild* and *spermatick* part of the Blood; the *acrimonious* and more elaborated Part being reduced thence by the Veins, for that purpose perhaps distributed into the *Cortex* of the Brain: concluding, that the select part is changed into animal Spirits, not by sublimation or meteorization (as all others held before) but by *mitigation, refrigeration,*
and

and *Whitening*. So that in fine, if their Nature agree with this Character; I do not see by what right they can be called *Spirits*, according to the common notion Men have of all things known by that Name.

In so dense a Mist of our understanding, in so great and irreconcilable a dissention of Opinions, concerning the matter, generation, and qualities of animal Spirits; how shall we discern the truth? Whom can ye give me, so sagacious, so happy above all other Mortals, in explicating the Secrets of the Oeconomy of mans Brain; as to be able, by clearly defining what they are, whence they proceed, and how they are generated, to put an end to the Dispute? For, till this be done, we shall still be to seek, how they can conduce to invigorate the Nerves and Muscles in voluntary Motion. In the mean time we can be certain only of this; that so great a War of Opinions among the Princes of Phylosophy, is a strong Argument, that the thing about which they contend, is not yet sufficiently understood.

Equally uncertain it is, by what kind of *Motion* these invisible Emissaries are transmitted from the Brain through the Nerves; whether they fly *swiftly*, or creep along *slowly*. For, some there are, who fond of the Chimera's of their own Imagination, and carried away by affectation of Glory from the invention of I know not what new Theories in Physic, as if Philosophers were, like young Ladies, best pleased with Novels; have confidently taught, that these Spirits are not only moved most rapidly in the Brain and Nerves, as Lightning is darted through the Air; but as it were shot out, at command of the Phantasia, into the Nerves, and recall'd again by the same ways, in an instant, according to the exigence of the Actions to

be performed by them. - And yet neither of these seems consonant to right Reason.

Not the *Former*; because in their supposed Motion from without inward, by which these *Gent.* would have all sensation to be made; the perception of a tangible Object (for example) which is made in the top of a Finger, is in the very same Moment perceived within in the Brain: and the Action of the Finger, and the Action of the Brain, make one continued total sensation of the whole Object. Which could never be, in case that Sensation were performed immediately by the Ministry of Animal Spirits. For, these Spirits, so soon as they are informed in the external Organ of Touching, of what nature the Object is; cannot bring in tidings of what is done there unless they recur and fly in to give an account of their Embassy, and at the same time desert the outward Organ: So that the action of the outward Organ cannot be *coincident* with the action of the Brain: unless you can obtain of them, that the very same animal Spirits are in the Finger, and in the Brain, at the same time; which is manifestly absur'd. Evident therefore it is, that Sensation cannot be made by the mediation of animal Spirits, as these Positive Wits have defined.

Not the *Later*; because we do not find, that Nature hath any where in the Body instituted contrary Motions of the same *Fluid* in the same Vessels; unless in the branches of the Wind-pipe, and in the Guts. In *respiration*, the Air is both received into the Lungs, and thence quickly emitted, together with the Vapors of the Blood, by the *aspera arteria*: which being to that end made of round or circular Gristles, is alwaies open; and the *Thorax* is always organically dilated and contracted alternately. In the *Gutts*
also

also Nature hath ordained a Flux and reflux of the Chyle; but they have a *Peristaltic* motion granted to them, to that end, in order to the frequent inversion, and more expedite distribution of the Chyle. But in the *Nerves* there occurs no sufficient reason, why the Spirits should be carried sometimes outward, and sometimes inward; unless we attribute to them a Peristaltick motion, or imagine that the Spirits themselves, like Gnats playing in the Air, fly to and fro in the Nerves, at their own pleasure. Farther, to what end should they *recur* to the Brain through the Nerves? To relate to the common Sense what is done in the external Organs? If so, with what Tongue can they deliver their relation? By what signs can they give notice of their meaning? Do they bring in with them the *idea* of the impression made by the Object upon the external Organ? Certainly, the *idea* in the outward and inward Organ, is one continueate representation, as the Object represented is one. But the sensation of the same Object doth sometimes dure two or three Hours together. Do the Animal Spirits all that while run forth and back unceffantly, to continue the sensation both without and within? These truly are to me inextricable difficulties, Riddles never to be expounded, or rather extravagant fictions, such as might dissolve even *Heraclitus* himself into laughter.

No wonder then if *Dr. Glisson*, plainly discerning the incongruity of this most rapid and reciprocal motion attributed to the animal Spirits, not only wholly rejected it, but excogitated another plainly *contrary* thereunto. For, he concludes, that the Spirits lodged in the *Succus Nutritius*, are carried from the Brain through the Nerves by a Motion, not impetuosè or rapid, but *gentle*, *Slow*, and *placid*, imperceptible by

the Sense, and tending only *outward*; as the nourishing Juice of Plants is believed to creep up from the Roots along by their Fibres: and that they do not immediately move the Muscles, but by recruiting their Vigor, and corroborating the tone of their Fibres, render them habil to execute their Offices promptly and strongly. He adds, that in all voluntary Motion, the Fibres of the Muscles do, by their own proper vital Motion, abbreviate or contract themselves; needing no copiose and suddain afflux of Spirits, either Animal or Vital, to shorten them by way of *inflation*, and put them upon performing the Motions commanded by the Phanſie.

How then are the votes or mandates of the Ruling Faculty in the Brain, communicated and made known to the Fibres of the Muscles destined to put them in execution?

He *answers*, that the motion of the Brain from *within outward*, by which it rules the Fibres of the Muscles, is made known to the Fibres to be moved, not by sense (for the *Intellect* hath no notice or cognizance of it at all) but only by *Natural perception*: and consequently that the Brain, by mediation of this Perception Natural, doth, at command of the Phanſie, excite the Fibres of the Muscles to Motion, and recompose them, at pleasure. And to explain more clearly his sentiments concerning this supposed motion of the Brain *ad extra*, that is, to the originals of the Nerves, which he seems first to have excogitated: he soon after subjoins, that the Motion is not to be understood of the whole Brain, but only of that little part of it, the Fibres of which are conjoynd to the Fibres of the Nerve peculiarly designed to perform the action commanded by the Phanſie; and that this Motion is no other but a certain *Striate* or Streakt invigoration, running along the

the Threads of the Brain, toward the beginning of the Nerve to be excited, and requiring a Motion of the Nerve conform thereunto: By invigoration, meaning a Motion tending to a greater contraction of the part of the Brain then acting, than before. *Contractio enim hic requisita (saith he) fortasse ducentesimam partem crassitie digiti transversæ non superat; nec refert; quàm exigua sit mutatio situs, modò tensura sit nervo perceptibilis, & gradibus variari possit, prout appetitus fortiozem aut debiliorem actionem à nervis exigit.* An Hypothesis (I must confess) most subtle, and worthy the sublime Wit of the Author, and perhaps coming neerer to Truth, than any other hitherto excogitated.

And yet notwithstanding, had not fate, by taking the Author from us, prevented me; I should ere this have taken the liberty to beg his pardon of my foolishness, if out of an honest desire of learning from him, I presumed to trouble him with one or two Questions about things delivered in this Hypothesis, which to me seem doubtful, and extremely difficult to be conceived.

The *first* is this. He supposes the Brain, not only to have power of moving itself at pleasure, but (what is yet more amusing) to be also the principle of our cogitations, of our Appetite and Motion Animal: which I cannot (such is my dulness) comprehend. For, though it be granted, that the medullary substance of the Brain, however soft and tender to the touch, may nevertheless, in respect of the small Fibres of which placed in streaks it is composed, be capable of some Tension and Remission: yet do I not see, by what reason it can, either think, desire, or move itself at pleasure, in order to voluntary Motion. Hitherto I have been so great a Bigot in the catholick Doctrine of Philosophers, as to believe the *Brain*

to be merely an Organ of the Soul (whether Rational, or Sensitive) and govern'd, and invigorated to motion by the Mandates thereof, not by it self alone: and that it is of the Nature of every Organ, as an Organ, not to give Motion to it self, as absolute and independent, but to receive Motion from that, whose Organ it is; never so much as dreaming, that the Brain itself hath the Faculties of *thinking* and *desiring*, which I always took to belong of right to the Soul alone. "But now I hear one of the Princes of "Anatomists expressly teaching the *contrary*, viz. *Cerebrum per se percipere, & quia sic percipit hoc vel illud objectum esse bonum vel malum, etiam appetere hoc fugere, illo frui; & quia sic appetit, mox se movere, ut quod appetit, consequatur*: and yet am not able to discern, how this new Doctrine can possibly be brought to consist with that antient and universally granted *Axiom* Physical; *nihil corporeum à seipso moveri, sed ubiq; in universitate rerum dari movens & mobile inter se quidem distincta; ita tamen, ut movens & mobile sint simul, motusq; hoc modo sit compositum quid ex utroq;*.

Ye will here tell me, I presume; that my most facacious Author speaks in this place, not of *Animal*, but *Natural* Perception, Appetite and Motion; which three Faculties he asserts to be by so firm a confederation colligued, as to be inseparable, and to render their Subject sufficiently instructed to perform every work congruous to its Nature.

I say therefore; that although we should grant to the Brain this supposed *Natural Perception*, with its inseparable adjuncts; yet this would by no means suffice to excite and cause *Animal* or Voluntary Motion, first in the Fibrills of the Brain, then in the Nerves, and after in the Muscles: because this Motion

is far *nobler* than any Motion meerly spontaneous, and proceeds from, and depends upon a principle incomparably more sublime and energetic; namely the *Soul*, which (if all Mankind be not most grossly deceived,) is Author of all Motion directed by Counsel and design to this or that certain end; and which is always excited by the appearance of Good or Evil in the Object, when an Animal desires what is convenient, or flies the contrary, and accordingly moves to obtain, or eschew it. Otherwise, or I am shamefully sottish, or no living Creature would need a Soul to excite him to intend and perform Motions convenient to his nature and end: Because the Brain it self, endowed with natural Perception and its Concomitants, would alone serve to do all the Offices of a sensitive Soul. And this is one of the two doubts, that hath hitherto perplext my weak Head, and with-held me from assenting to this new Hypothesis: chiefly when I recall'd to mind, that a Chicken begins to move himself in the Egg on the sixth day of the incubation; though at that time nothing of Brain, besides clear Water included *in vesicula*, can be discerned.

The other, this; *How so small a contraction of the Fibrils of the Brain, in that part which is moved by the Appetite, as He supposes not to exceed the 200th. part of a Fingers breadth, can suffice to make a much greater Contraction in the Nerve destined to perform the action commanded.* For, since the Fibrils of the Brain are not only conjoyned with the Fibres of the Nerves, thence produced along to the Tendons of the Muscles, but so united also, as to constitute so many little Strings or Cords continued from their Original to their ends or insertions; and since it is from mechanic experiments constant, that all Cords, when pull'd or stretch'd at one end more or less, are equal-
ly

ly extended all along quite home to the other; and this is by reason of the continuity of their Parts: considering these two certain and evident Truths, I cannot conceive, how in the said little Cords of the Brain and Nerves any Contraction or Tension can be made, that shall be in one of their Extremes, at least two hundred times less than in the other. It is indeed, among *Physico-mathematicians*, a mighty controversie, whether or no the Strings of a Lute, Viol, Harp or any other musical Instrument, when wound up, be equally stretch'd or strain'd in all their Parts; because when they are strain'd above their strength, they are for the most part broken at the ends, rarely in any other part: which yet seems to happen only from hence, that the Strings are at both ends weakned by winding up the Peggs, and being tyed in a knot, whereby their coherence of Parts being violated, they must needs be more fragil there, than in any other part to which that Violence hath not extended. Nevertheless, that a Lute-String stretcht by a Plummet hung perpendicularly at one end, and held by a Mans Fingers at the other, is extended in all parts alike; is beyond all controversie. And that is sufficient to my purpose. For from thence it is most evident, that howsoever, and in what part soever a Nerve is contracted, the contraction must be equal in all Parts of it: not only a Hairs bredth at one end, and two or three Inches perhaps at the other.

But perhaps the Sense of my most judicious Author is this. That even the least vigation of the Brain (which he supposed to be the principal part of the whole Animal, the original of Cogitation, Appetite and Motion, composed of Fibrills, and endowed with a faculty of stretching and relaxing itself by turns,

at

at-pleasure) may suffice to excite a much greater contraction in the Nerves; not so much by immediately contracting them, as by so affecting their perception natural, as they may presently contract themselves by spontaneous Motion, and that so much as is sufficient to execute strenuously the command of the Phansy.

Admitting therefore this interpretation of his words, I enquire, if that *Δύναμις ὀρμητικὴ*; or invigorating Virtue which he confers upon the Brain, consist only in the tonic Motion of its Fibrils, to which the Fibres of the Nerves are continued; if this be so, I enquire (I say) first, *whence it is, that a greater and stronger Force or Vigor is excited in the Threads of the Nerves, than in the Fibrils of the Brain that move them?* Is the *Spontaneous* Motion of the Nerves, (always conjoyned with natural perception) more potent than the *animal*-Motion of the Fibrils of the Brain, injoynd or commanded by the Will, or Phansie? so, certainly, it must be granted to be by all who embrace this Hypothesis; because a far greater Contraction is supposed to be made by the natural or spontaneous Motion, than by the animal or commanded Motion: and because it is of absolute necessity, that this disparity of the Effects arises from the like disparity in the Powers of the Agents. But to me (I confess) it seems alien from all belief, that Nature, whose Wisdom and Providence is so admirable in all things else, hath taken so little care of the Oeconomy of Mans Brain, as to subject the principal Instruments of voluntary Motion, the Nerves, more to the simple instinct of natural perception, than to the Empire and rule of the Will conceived from the dictates of Reason: chiefly when it is most evident, that the same Nature has granted to us a power of varying, intending, and remitting our voluntary Motion, as

we please; without control or impediment from the instinct of natural perception, of which we are not conscious. I inquire also, *whether the so often mentioned Fibrils of the Brain have requisite Notice, both of the command given by the Phansy, and that it is their Office to put the same in execution?* My Author expressly affirms, they have: deducing the knowledge of *this* from their natural perception, and the notice of *that*, from their Tension by the Phansy. His Words are these; *Cum hæ fibræ tensiles sint, & naturali perceptione advertant, executionem voti cupiti ad suum officium spectare; mox (cum simul sint agentia naturalia, nec delibèrent) se vigorant, & nervos, quibus continentur, ad consimilem motum excitant. Naturalis enim perceptio (seu Archeus) innumera propè novit, quæ sensum latent; & totam fabricam corporis, quam ipsa formaverat, & usum omnium partium, modumq; quo omnia peragenda sint, callet.* But if this be granted, certainly either the Phansie must be deprived of its dominion over the Fibres of the Brain, or (what seems to be no less unjust) there will be set up in the Brain a new Government by a kind of *Duumvirate*, the Regimen being divided betwixt the *Will* and *natural Perception*, so that neither of them can, without the assent of the other, excite any the least animal Motion. And how unstable, how obnoxious to Divisions must that State be, that hath two Heads?

Other Knots there are in this most intricate Hypothesis, which my weak Reason is not able to untie. But I pretermit them; those two I have touched, seeming sufficient to evince, how little, how uncertain that knowledge is, which even the greatest Wits have attained unto, of the regiment of the Brain, of the Motion of animal Spirits, and of the reason of voluntary Motion.

Perhaps then we are equally uncertain, whether there be *in rerum natura* any such things as animal Spirits, of a distinct Species from the vital Spirits, or not. Truly, my Opinion is, that we are so: and no less Man than *Dr. Harvey* expressly denied their Existence; *de generat. animal. exercit. 70. Nihil sanè in corpore animalium, (inquit) sanguine prius aut præstantius reperitur; neq; spiritus, quos à sanguine distinguunt, uspiam ab illo separati inveniuntur.* So do all the *Peripatetiques* hold against *Galen*, *unum esse duntaxat Spiritum, vitalem singulis partium omnium officitiis deservientem.* *Joan. Imperial. de ingen. human. pag. 52. And Scaliger (exercit. 339. Sect. 2.) affirms, Animam non egere spiritibus ad motum. Etenim si anima opus est instrumento ad movendum; etiam opus erit instrumento ad movendum instrumentum.* And *Sr. G. Ent (Antidiatribæ p. 141.) Ego, præter unum sanguinis calorem, nullos in animali Spiritus agnosco: sed in partibus singulis privum hospitari sensum, qui ad animæ imperium excitetur.* So doth that most excellent Man here present, to whose incomparable Pen *Dr. Harvey* owes half his Glory, and to whose diving Wit both Natural Philosophy and Anatomy owe the hints at least of the best part of their new Discoveries. And truly if any man shall seriously, and without prejudice consider the great bulk, cold temperament, various parts, fabrick and texture of the Brain; he will at length find but little reason to believe, that Nature hath framed it chiefly for a Laboratory of Spirits. They tell us, that these spirits are made of the most subtile, most refined, and volatilized parts of the arteriose blood, by way of *sublimation*. But can a part so dense, so cold, so clammy, and to like a bog, as the brain seems to be, be thought an instrument fit for sublimation or rectification of a spirituose substance? What

Chymist hath at any time attempted to rectifie spirit of wine in a vessel whose head was stuffed with damp raw silk, or other the like villose matter, more apt to repercuss and condense, than to refine it? Sure I am, that even *Malpighius* himself, a most accurate Enquirer into the structure of the brain, hath after all his Microscopic researches, made this ingenuous confession “ (*de structura viscerum, pag. 66.*) *Ut verum fatear, quò magis manifesta mihi elucescit cerebri structura, eò magis tot mirabilium operationum explicandi methodum spes excidit. Simplicem tandem dum agnosco cerebri structuram, ineptum omnino ad exponenda sensuum, & tam nobilium operationum phænomena reor. Ita ut hoc tantum conijcere possim, à Cerebri & Cerebelli glandulis incontinuos nervos separari succum quendam, sicut in cæteris glandulis proprio vase Excretorio ditatis &c.* A poor account of so long and diligent a scrutiny! and yet would I could see the man that is able to give a better.

Were it not a *Parergon*, I might here recount many observations, recorded by Eminent writers, of men, who retain'd the use of all their Senses, imagination, memory, reason, and voluntary motion; even to the last minute of life; and yet notwithstanding, in their heads opened after death, there was found (as in most fishes) but very little of brains, and that too altogether confus'd and diluted with water. For a memorable Example of this kind, give me leave to put you in mind of that register'd by *Nichol. Tulpus*, an Author of good credit (*observat. Medicar. lib. 1. cap. 24.*) Who thereupon gravely concludes with this Laudable acknowledgment of his ignorance. *Quantum est, quod nescimus! velut namq; in aliis, sic certè credibile est, potissimum nos cacutire in genuino Cerebri regimine: Cujus opera multo fortassis sunt diviniora, quam quispiam hætenus suo comprehendit captu.* Ye may add

two other Examples no less wonderfull : one observ'd by *Gregor. Horstius*, of a man who after a great abscess or aposteme in the head, and the taking away of a vast quantity of his brain, yet retain'd the use of all the Animal faculties: the other, by *Kerckringius* (*observat. anatomic. 46.*) of an infant, whose skull he had found full of a mucosè water, in the place of the brain. Hither may be brought two other examples: one from *Fontanus* (*resp. med. & annot. in Vesal.*) of a boy, *cui caput erat cerebro vacuum*; another from *Arnoldus Villanovanus* (*in Spec. intr. med.*) of a man whose skull was found likewise empty. Now if these be true Histories, what will become of the supposition; that the Animal spirits are generated in the brain? Can they be made, and conserv'd in water; and after most part of the brain hath been taken away? Here I am at a stand; wanting the wit of *Thom. Bartholin*. Who (*in observat. centur. 6. Hist. 91.*) having told a very strange story of a Swedish Ox, whose brain was wholly converted into a stone; and desirous still to prop up the antique opinion of Animal spirits, which that observation impugned: was first so ingenuous as to suspect, and after so lucky as to find certain holes and open passages reserved for them in the petrified brain, through which they might freely pass into the nerves to carry the heavy headed beast to and fro in the meadows for pasture. A wonderful providence of Nature this, to continue both the poor Animal in motion; and the doctrine of the spirits in reputation. And therefore lest ye should think I do the learned Author wrong, I am obliged to recite his very words "in the clause of the History. *Quum prima ad nos facta rem novam & hactenus inauditam deferret, dubitare capi, & hinc inde cogitationes volvere, quomodo iteger bovi remanserit motus ad horam usq; à lanione dictam,*

lib. de morb. contagiosis par. 2.

“ *dictam, cerebro lapideo ; suspicabarg; in vivi bovis*
 “ *cerebro indurato sinus patulos remansisse, per quos liberè*
 “ *spiritus animales ex arteriis nervisq; commearent ; a-*
 “ *liòqui bovi omnis fuisset motus dudum ademptus. Nec*
 “ *vana fuit conjectura. Testabatur enim mihi Illustris*
 “ *Bielkius, foraminula hinc inde in lapide nominato con-*
 “ *spici dispersa & perforata, per quæ paleæ possint intrudi.*
 Here to question the truth of his relation, would be *Incivility* ; to believe all parts of it, shameful *credulity* ; and to conclude from thence, that there are Animal spirits, down right *folly* : the Author having omitted to bring any good *reason* to support his conjecture, that the holes observed in the petrified Brain, had been left for no other cause, but only to give free passage to them. I add, that in the head of the *Rana piscatrix* which yet is a fish of singular cunning in taking his prey, and of great strenght, no Brain, but only clear water, is to be found.

To come then to a conclusion of this desperate Argument ; from what hath been said, it sufficiently appears, that we are still in great uncertainty, not only of the *matter, generation, Nature, qualities, and motion* of Spirits Animal ; but of their very *existence* also. I had reason therefore to appeal to your more discerning judgment, for a decision of this so difficult controversie concerning them : being my self unable to determine what I ought to conclude, of the Antient, and at this day vulgar opinion, of their being absolutely requisite, both to all sensation, and to all voluntary motion ¶

Nor do I blush to acknowledge this my ignorance of a thing which Nature seems to have wrapt up in clouds of impenetrable darkness, *ne veritatis Inaccessibilis lux teneram ingenii humani aciem splendore nimio*.

nimio perstringeret : But frankly confess with *Lucretius*;

*Multa tegit sacro involucre Natura neq; ullis
Fas est scire quidem mortalibus omnia. Multa
Admirare modò, nec non venerare : neq; illa
Inquires, quæ sunt arcanis proxima. Namq;
In manibus quæ sunt, hæc nos vix scire putandum est ;
Est procul à nobis adeo præsentia veri.*

“ And enquire with *Casper Barlaeus* (*de anim. Hu-*
“ *man. admirandis*) *Qua ratione, et quibus apparitoribus*
“ *mandata mentis deferri possint momento ad membra*
“ *remotissima ? cum nec membra hæc, nec spiritus inter-*
“ *nuncii, aut mandata capiant aut mandantem norint. Volo*
“ *Currere pedes ? currunt : quiescere ? quiescunt. &c. Quin*
“ *illud omni sapientiâ humana majus est, quomodo pul-*
“ *santes citheram digiti, pari motu celerimas cogitationes*
“ *assequantur ; ut nec a mente digitus, nec a digito mens*
“ *relinquatur.*

But this my ignorance must not deter me from proceeding in the administration of my province. I come therefore to the *instrumentum proximum sive ultimum*, by which immediately and sensibly the act of voluntary motion is performed. This all men rightly hold to be the *MUSCLES*: in which there occur three Generals to be chiefly considered by the Anatomist; viz. their common *Constitution* and structure ; their principal and sensible *Differences* ; and the *Reason* by which they move the parts to which they are affixt. For, these things being duely explain'd, may perhaps bring us at length to such a degree of knowledge of the manner of voluntary motion, as may, if not satisfy our Curiosity yet at least advance the noblest of all our intellectual delights, the grateful admiration of the

the infinite Wisdom of our *Creator*. Which as it is the principal End of our *Being*: so ought it to be also the grand scope of all our *studies* and *Natural inquiries*.

Concerning the *FIRST*, therefore; obvious it is to every mans reason, that the immediate organ of voluntary Motion ought to be of such a *Constitution*, as may render it apt both to receive invigoration, i. e. to be excited to motion, by the Brain, at the command of the will, appetite, or fancy: and to move the member or part to which it is affixt. Manifest therefore it is, that a hard inflexible, rigid and bony substance is so far incompetent to both those uses, that *Galen* (*de motu muscular. lib. 1. cap. 2*) affirmed, that any part casually becoming hard and stiff, though only from a thick cicatrice or skar, is thereby rendred unfit for motion: and that consequently, the substance of a Muscle ought to be, as Nature has made it, *soft, rare, flexible, extensibile*, and furnished with great store of *fibres*.

Requisite it is also, in respect of the distance betwixt the Brain and the Muscle, that there should be some third thing intermediate and continued to both, by which the *πρότη ὀρμη*, or first impetus in the former, may be communicated [*κατὰ τὸ συνεχές*] to the other, whether the invigoration be effected by influx of any substance from the Brain, or by *Dr. Glissons* way formerly described. And the *Nerves* being the only part of the whole body qualified for this use, Nature hath therefore most prudently inserted one, or more of them into each Muscle. Now these two parts, *Flesh* and *Nerves*, are the principal ingredients requisite to compleat the essence of a Muscle: as may be infer'd from hence, that there are some perfect Muscles, particularly those of the Forehead, the Temples, Bladder, the fundament &c. In the composition of which

which neither Tendon, nor Ligament is to be found.

But because there is in some parts to be moved, by reason of their greater Gravity, a greater resistance to Motion, than the musculous Flesh, in respect of its softness and tenderness, is of itself able to overcome, chiefly in some positions: therefore ought there to be an addition of some stronger and tougher Substance, which being connected or united to the Flesh of the Muscle, may both corroborate the same, and more firmly conjoyn it to the Bones, so as to inable it to overpower that resistance. Hence it is, that some Muscles, especially such as are destined to bear great stress, in surmounting the weight of great Members, or in strong Motions; are furnished with *Ligaments*, as well for their better firmation to the Bones, as for augmentation of their strength. All which *Galen* (*de usu partium lib. 12. cap. 2. & de motu muscul. lib. 1. cap. 2.*) "intimates in these few words; *Vinculo enim tuto quodam opus erat musculis, cum osse ab ipsis movendo; nec erat aliud ad hoc aptius Ligamento.*

But this necessity not extending to all Muscles, and a ligament being of it self immoveable and insensible, and the Nerves being, in respect of the softness and laxity of their Substance, not sufficiently strong to pull great and heavy Bones, without some accession of strength: it was requisite, there should be of both those parts composed a *Third*, that might be firmer and stronger than a Nerve, but softer and weaker than a Ligament. Such is a *Tendon*, which in Sense, and Aptitude to Motion much exceed's a ligament; and in strength a Nerve: and is therefore made a part of many Muscles. I say, of many Muscles, not of all: because some have no need of Tendons, as the Muscles of the *Tongue*, of the *Testicles*, of the *Penis*, *Lipps*, *Forehead*, and all *Sphincters*; but those only that are

framed for Motions either strong or continual. Those that were destined to the motion of Bones, do all end in Tendons, greater or less; and are inserted, not into the Syntax or conjunction of two Bones, nor into the end of the same Bone from which they arise; but near to the Head of another which they are to move. Those which are to be kept long in Motion, have likewise need of Tendons both to corroborate and facilitate their Motions: as is most evident in the Muscles of the *Eye*, all which are furnished with Tendons. Hence we come to understand, why Tendons are by Nature conferr'd upon all Muscles designed to perform strong Motions in Flexion, in extension, and in that which holding a part in a stiff and steady Posture, is termed *Motus Tonicus*: as in the Arms and Leggs, and in the Back for erection of the Spine, &c. and why other Muscles are made up without Tendons, being as in their Originals, so likewise in their ends, only *Fibrosæ*.

That these four parts of a Muscle, namely Flesh, Nerve, Ligament, and Tendon, might not want either Covering, or Combination; Nature has providently invested and bound them together with a proper *Membrane* or Coat: which seems to have these two farther Uses; to cause Muscles touching or incumbent upon each other, to slip up and down smoothly, easily, and without interfering; and to unite the force of all the Fibres when they act.

And finally, because the whole Organ requires to be continually supplied with Life, as *being Pars Corporis Vivens*; therefore is it copiously furnished with *Arteries* and *Veins*: those to bring in Blood, by whose vital Heat all parts are impregnated with influent Life; these, to return the same Blood to the Heart, after it hath performed that Office. And this may

be sufficient to explain the Constitution of a Muscle: upon which if we reflect, we may conveniently enough define a Muscle to be; an *organical part of an Animal, participant of Life, composed (always) of Flesh and a Nerve, and (many times also) of a Tendon and Ligament; covered with its proper Membrane; and so framed to be the proxime instrument of voluntary Motion.* ¶:

As for the *SECOND* general to be considered, namely the *DIFFERENCES* observed among various Muscles; these are many, as being defumed from their diversity in *Substance, Quantity, Figure, Position, Origination, Insertion, Parts, Actions and Uses*: all which I will run over lightly.

In respect of *Substance*; some Muscles are mostly *Carnose*, as all the *Sphincters*, the Muscles of the Tongue, &c. others, mostly *nervose* or *membraneous*, as the *fascia lata*, abducing the *Tibia*, the *Quadratus*, call'd by *Galen* *πλάτυσμα μυώδες, muscosa expansio*, by others, *Distortor oris*, because it is first contracted involuntarily in that Convulsion named *Spasmus Cynicus*; and some others.

In respect of *Quantity* (which comprehends all the three dimensions of *Longitude, Latitude, and Profundity*) some are *Long*, as the *Rectus abdominis*, the *Longissimus dorsi*, the *Sartorius* in the Thigh, &c. Others, *short*, as the *Pyramidales* in the bottom of the Belly; Surrogates of the oblique ascendent Muscles, and by a peculiar right conducing to compression of the Bladder of Urine, when we make Water: Others, *broad*; as the *Oblique* and *Transverse* Muscles of the *Abdomen*, the *Latissimus dorsi*, depressing the Arm, &c. Others, *narrow*, as those of the Fingers and Toes: Others, *thick* and bulky; as the two *Vasti* of the Thigh, the *Glutei* of the Buttocks, &c. Others, *thin* and

slender, as the *Gracilis* bending the Legg, &c.

In respect of *Figure*, some are *Triangular*, some *Square*, some *Pentagonal*, some *Pyramidal*, some *Round*, some of other Shapes; as is exemplified in the *Deltoides*, *Rhomboides*, *Scalenus*, *Trapezius*; &c.

In respect of the *Position* or course of their Fibres, some are *Oblique*, some *Transverse*, some *above*, some *below*, some *before*, some *behind*, some on the *Right*, others on the *Left* Side. Where we may observe in the general, that all *oblique* Muscles serve to oblique Motions, all *Right*, to direct flexion or extension; all *internal*, to flexion; all *External*, to extension.

In respect of their *Origination*, some arise from *Bones*; and that either from the *Heads* of them, as most of the greater Muscles do; or a little below, or from some *Glene*, some *Sinus* or small cavity in the Bone: some only from *one* Bone, some from *two* or *three*: others from *Cartilages* or Gristles, as the Muscles proper to the *Larynx*: others from the *Membrane* insheathing the Tendons, as the *Musculi Vermiculares sive Lumbricales* in the Hands and Feet: and others again from other Parts, as the *Sphincters*.

In respect of their *Insertion*, some are inserted into *Bones*, some into *Cartilages*, as the Muscles of the *Eyelids*, and of the *Larynx*; others into a *Membrane*, as the Muscles moving the *Eye*; others into the *Skin*, as those of the *Lips*: some arising from divers parts are inserted into *one*; and on the contrary, others single in their Original, are divided in their terminations.

In respect of their *Parts* (by which we are now to understand, not only the Parts constituent already particularly described, but those also into which a Muscle is commonly divided in dissection, *viz.* the Beginning or *Head*, the Middle or *Belly*, and the
Tail

Tail or *Tendon*.) The differences are various : most Muscles have but one head, yet some have two, some three ; whence they are named *Bicipites* and *Tricipites*. Most have but one *Venter*, yet some are double bellied, as the Muscle shutting the lower Jaw, that of the *Os Hyoides*, whence they are called *Digastrici* and *Biventres* : Of some the *Tails* are broad and membranose, of others round and slender ; of some short, of others long ; of some perforate, of others entire ; of some single, of others double, triple, &c. In some places are found two, three, or more Muscles ending in one common *Tendon*, as the *Gemelli* in the Leg, and the *Soleus* are united into one Cord above the heel : In others, though contiguous, single and distinct Tendons ; as the *Plantaris*, though concealed betwixt the *Gemelli* and the *Soleus*, from a fleshy beginning dwindles into a long *Tendon*, that spreading it self again covers the whole plant of the Foot, and is inserted into the Roots of the Toes. Lastly, some borrow their Names from the parts upon which they are seated, as the *Crotaphita* or Temporal Muscles, the *Rachita* or *Spinati* of the Spine, the *Iliaci*, &c.

In fine, in respect of the diversity of their *Actions*, the Muscles admit of a triple difference. The first this, that some are *Confederates*, both concurring to one and the same motion either of Flexion or of Extension ; one being placed on the Right the other on the Left of the Member : Others Antagonists, which perform motions contrary each to the other ; and indeed there are but few Muscles that have not their Opponents ; to every *flexor* is opposed an *extensor*, to every *adductor* an *abductor*, to every *Elevator* a *Depressor* ; excepting only the *Sphincters*, the *Cremasters*, and the *Oesophagus*. The *Confederates* generally are equal in magnitude, number, and strength ; the Antagonists not, but different according

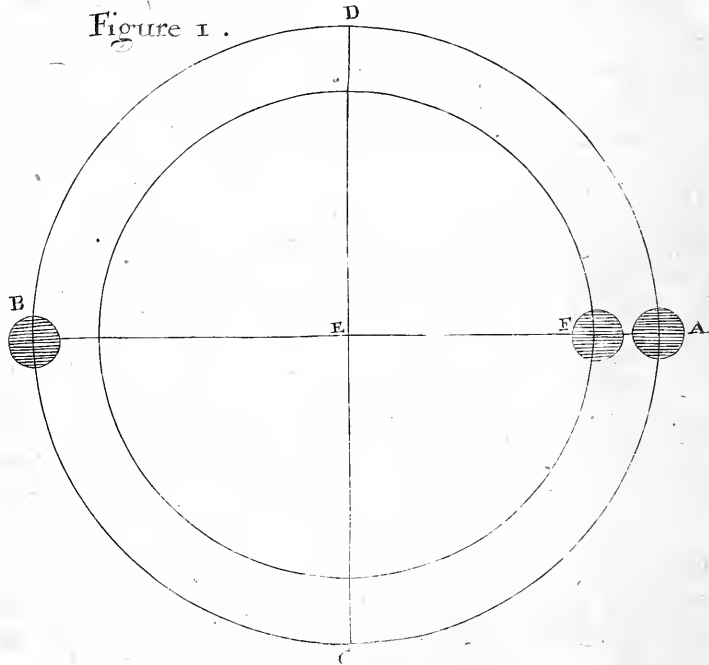
according to the weight of the part to be moved, and to the force of the motion. Thus the Muscles that bow down the head are but two; when there are twelve to lift it up: Likewise those that pull up the lower Jaw are many, but no more than two suffice to draw it down, because the weight of heavy parts makes them easily fall down of their own accord. The *second* difference consisteth in this, that some of the Muscles move only themselves as the Sphincters, others move *other parts* besides themselves. The *third* and last difference arises from their proper motions; whence some are named *Flexores*, others *Extensores*; some *Elevatores*, others *Depressores*; some *Adductores*, others *Abductores*; some *Rotatores*, some *Masseteres*, some *Cremasteres* or *Suspensores*, some *Constrictores*, &c. And this is more than enough concerning the *differences* of the Muscles. ¶

As for the *last* general Theorem, namely the *REASON* and *MANNER* of the Muscles moving the parts to which they are affixt, when themselves are invigorated by the Will or Appetite; forasmuch as the *loco-motion* of the whole body or any part thereof, if considered *per se*, *i. e.* merely as motion; must be considered either as it is a certain Commensuration of the length of space, betwixt the *terminus à quo* and the *terminus ad quem*; or as it is a countervailing of *Gravity*: In both these respects it requires to be explained by the help of Principles *Mathematick*. Let me therefore deprecate your impatience, if in compliance with this necessity, I now and then bring you to reflect occasionally upon a few *Geometrical* Propositions of *Euclid* and *mechanick* fundamentals; such from whence we may borrow some beams of light to lessen, if not wholly overcome the obscurity of our subject.

In the *First* place then, I observe: That every Muscle hath

hath a double motion, the one *Natural*, in which the Fibres spontaneously retracting themselves, return to their native Position, after the cessation of that force that extended them; as all other *Tensil* Bodies do by the motion of Restitution: The other *Animal*, in which the same Fibres are farther contracted or abbreviated by a force communicated to them from the brain, in order to the performance of some Action intended by the Will or Appetite.

Now that the *Natural* Contraction of a Muscle is not sufficient to motion voluntary, though we should suppose it to have been at first made upon the stretch, is evident from hence, that betwixt every Muscle and its Antagonist, the natural power of retracting or relaxing themselves is equal, according to that remarkable Assertion of *Galen*, (*de motu musculor*, lib. 1. cap. 9.) *Musculum suapte natura in extremam contractionem progredi, quantum in structura corporis est positum. Cum enim per sectionem solutus fuerit continuitate, quam habet cum osse obnitente, tunc quasi vinculo solutus, & perfectè liber factus, suam ipsius naturam ostendit: Quamdiu verò à Musculo in opposito constituto pars retrahitur, qui & ipse eandem naturam habet, ut statim ad extremam contractionem festinet, alter Musculus ab altero equaliter privatur coitu in seipsum. Atque ita contingit, oppositorum in membris musculorum utrumque in dimidio contractionis ladi.* So that betwixt two contrary powers drawing equally, the Member must remain *tanquam in equilibrio*, unmoved. The Reason of which Equilibration, may be illustrated by that proposition of *Vitruvius*; *qua corpora equalia equaliter & sub uno diametro à centro distant; illa secant perpendicularem lineam ad angulos rectos*: And may be thus demonstrated.



Page 528

Let two bodies of equal weight be placed, the one at A, the other at B, upon the Diameter of the Circle, whose Centre is at E; and neither of them shall move because their Gravity is equal at that distance from the Centre E; but supposing both to move, they shall hasten to the Centre of Gravity with equal velocity, because A and B make equal Angles with the Perpendicular D E C.

Necessary it is then, that in voluntary motion of a Member,

Member, æquibrated by two Antagonist Muscles of equal force, one of the opposite Muscles overpower the other; not by its natural or spontaneous contraction which is equal on both parts; but by the *animal* force derived from the Brain, which makes the natural contraction greater, and the invigorate Muscle to prevail: Whence it comes to pass, that the Member, which before the accession of the animal force was held unmoved, and as it were, suspended betwixt two contrary equal powers; is determined to Motion according to the Command of the Will or Appetite. Which is much more elegantly expressed by *Galen* in these few words: *Æquipollens motus ipsius corporis Musculorum fit, quando neuter tonum Animalem habet auxiliarem, non æquipollens verò, quando alter solus dominatur: Quare necessum est ut vincat contractio illius Musculi, qui ab Animalis facultate adjuvatur, de motu Musculor. lib. 1. cap. 9.*

I observe *Secondly*, that in all voluntary motion of whatsoever Member, there are *two Terms* to be acknowledged: *One* is the part *quiescent* or *fulciment*, to which the head of the acting Muscle is fastned; because all motion is made upon something that is at rest, according to that Maxim of the Philosopher: *ἀνὶ μεταβάλλει τὸ κινούμενον, ἀπὸ στασιζόμενον πρὸς τὸ υποκείμενον αὐτῷ, quicquid movetur, movetur super aliquo, cui innititur.* The *other* is in the part *moved*, at the *insertion* of the Muscle moving, and from whence the same Muscle doth, by contracting it self, draw the Member toward it self. And this is sometimes less sometimes more, elonged or remote from the Fulciment, according to the less or greater resistance of gravity in the Member to be moved, and according to the less or greater vehemence required to the motion it self. Which Nature (whose Art is not more admirable in any thing, than in proportioning the length of the Insertion of every Muscle, from the *Hypomochlion*

or point of Rest, to the weight of the part thereby to be moved,) respecting, hath, with great sagacity, suppli- ed the little strength of many slender Muscles, by insert- ing them at great distance from the Centre of their mo- tion, or that point about which the Member whereto they belong, is to be moved. The *Reason* of which me- chanical Contrivance seems to be this; that all such re- mote insertions, by subtracting part of the length of the Bone to be moved, subtract also part of the weight of it, and so render the Muscle able to countervail the re- maining weight with less force. For, since there is no motion in the Centre, according to that proposition in Mechanics, *In centro omnis gravitas cessat, adeo ut ne- que grave, neque leve ad centrum deprehendatur*: We may easily understand, why in many Muscles designed for strong motions, the *Terminus stabilis* is farther elon- ged from the *Terminus mobilis*, than in others destined to motions less strong, *viz.* that by even a small force, the Muscle (which considered in its proper bulk, or in- serted at less distance, would be insufficient to the effect intended) might contrevail and elevate a great weight; as is exemplified in the Muscles of the Hand, Arm, Thigh, and some other parts.

Whence that excellent Mathematician and Painter, *Lionardo da Vinci* of *Florence*, seems to have deduc'd that universal maxim of his, deliver'd in *Trattato de le Pittura*, *cap. 199.* Concerning the tardity and velocity of Ani- mals in the motion of their Legs. *Quell' animale harà il* "centro delle gambe suo sostentacolo tanto più vicino al per- "pendicolo del centro della gravità, il quale sarà di più tar- "di movimenti; e così di converso, quello harà il centro de "sostentacolo più remoto dal perpendicolo del centro della "gravità sua, il quale sia di veloce moto.

Now this Reason may be both confirm'd and illustrat- ed, by three *mechanick Propositions*; of which the first

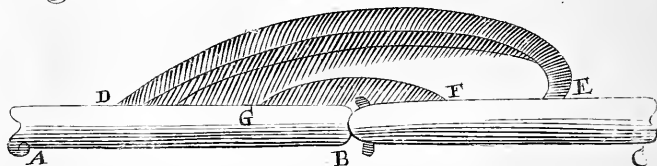
is this: *Omnis potentia motus variatur ratione centri ad peripheriam.* The second is this, *Quò quid remotius à centro, eo velocius movetur:* The third this, *Quo circuli peripheria est major, eo major est diameter, & motus velocior.* Which may be demonstrated from the former diagram, supposing a weight to be placed first at F upon the Diameter A B, and then at A; for this weight falling from A, will be carried to the Centre C with greater velocity, than if it fall from F, by reason of its greater distance from E; the degrees of Velocity and consequently of facility of the motion, always holding proportion to the degrees of Elongation from the point of rest or Centre E.

For the same reason, (*viz.* to augment the force of some Muscles, considered simply without the advantage of Position) it was also that Nature has in many bones superadded to their ends, certain *Knobs* or *buttings* out, called *Epiphyses* and *Apophyses* to which the Muscles are fastned: Nor doth it seem to be of simple conveniency alone, that she has thus contrived the Originals of all great, and most other Muscles, higher or more elevated (more or less) than their insertions, but of absolute necessity: For

First, were the Head of any Muscle incumbent upon another, or upon any other sensible part, placed *lower* than its Tail or Tendon; the Muscle could not be contracted without manifest *pressure* and pain of the subjacent part. For demonstration sake,

Suppose

Figure II.



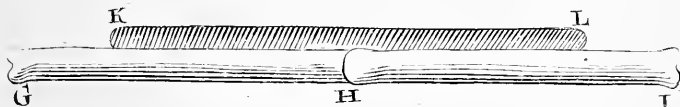
Page 532.

Suppose A B to be the bone to be moved or pull'd upward, and B C to be another bone, upon which as the Fulcrum or Rest, the first is to be moved, and from which the two contiguous Muscles D E, and F G arise; having their Heads at E F, and their Tails or Insertions at D and G. I say then, that the contraction of the incumbent Muscle D E, shall not press upon the subjacent Muscle F G, because the Head of it at E is raised higher than the Tail D. Whereas if we should invert the position of the incumbent Muscle, and make it lower at its Original E, than at its insertion D; it could not possibly be contracted or abbreviated toward E, without pressure of the subjacent Muscle F G: which is an incommodity inconsistent with the Providence of Nature, and which she has wisely prevented by elevating the Heads of all incumbent Muscles higher than their Insertions.

Secondly, Had the Head of any Muscle designed for the elevation of a bone, been placed upon the same level, or in a straight line with the Tail of it; then could not the Muscle have been contracted at all, nor consequently could the bone, into which it is inserted, have been rais'd upward;

upward, because the *Fulciment* or Bone from which the head of the Muscle arises, being in a direct line to the other Bone that is to be raised, and into which the Tail of the same Muscle is inserted; the ends of the two Bones must necessarily press one the other in a direct line; and by their mutual resistance hinder the contraction of the Muscle; as may be thus demonstrated.

Figure III



Page 533.

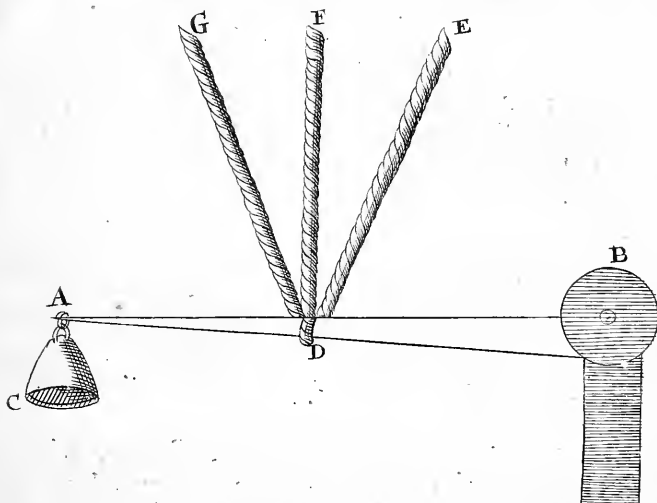
Let us imagine G H to be the Fulciment or immoveable Bone, and H I to be the other Bone, to be raised by the Muscle K L, whose Original is at K on the first Bone, and Insertion at L on the second: Then because the line K L is parallel to the lines G H, or the Original of the Muscle K, upon the same level with its insertion L; if the Muscle pull toward K, the Bone H I must either penetrate the Bone G H, or oppose and wholly hinder the contraction of the Muscle. But the penetration of one Bone by the head of the other being impossible; the contraction of the Muscle must be impossible also, which is what I affirmed. Safely we may then conclude, that both to prevent pressure of the subjacent parts, and to facilitate the contraction of the Muscles themselves; it

was,

was of absolute necessity, that the Originals of all muscles destined to the motion of Bones, especially great and heavy bones, should be elevated above their insertions.

But Nature perhaps had yet another reason of this mechanick Artifice, which I conjecture to be this: Forasmuch as the use of all Muscles is to move the parts into which they are inserted, and that they cannot move those parts that stand in a direct Line with their Insertions, but by bringing them to make obtuse Angles with the Bone upon which they rest; and that obtuse Angles cannot be made by contraction of the muscles, unless their Originals be higher than their Insertions, as was just now demonstrated; therefore was it necessary they should be so framed: For where the Bone to be moved, is articulated in a direct Line with the Bone that remains quiet, as the Bones of the Limbs generally are, the movable Bone cannot possibly be moved, but it must make an Angle first more obtuse, and then less and less obtuse, until it come to a right Angle with the other Bone, that is the *Hypomochlion* or Rest. For the motion of a Bone made by contraction of a muscle, is but an Elevation or Translation of it from its former position in a right line with the superior Bone to which it is articulate, toward a perpendicular or right Angle with the same. And that Transition from a posture *direct* to a position *rectangular*, is made by Angles less and less obtuse successively betwixt the two Bones: And as for the *elevation* of a heavy Bone, by a muscle, in this manner; that cannot be effected, where the force moving is either in a line parallel to, or lower than the Bone to be moved (as hath been demonstrated.) But where the *movent* is superior or higher, and by how much the higher the *movent* power is placed above the bone to be moved, by so much more easily is the motion performed; as may be evinced by this *mechanick* Demonstration.

Figure IV.



Page 535.

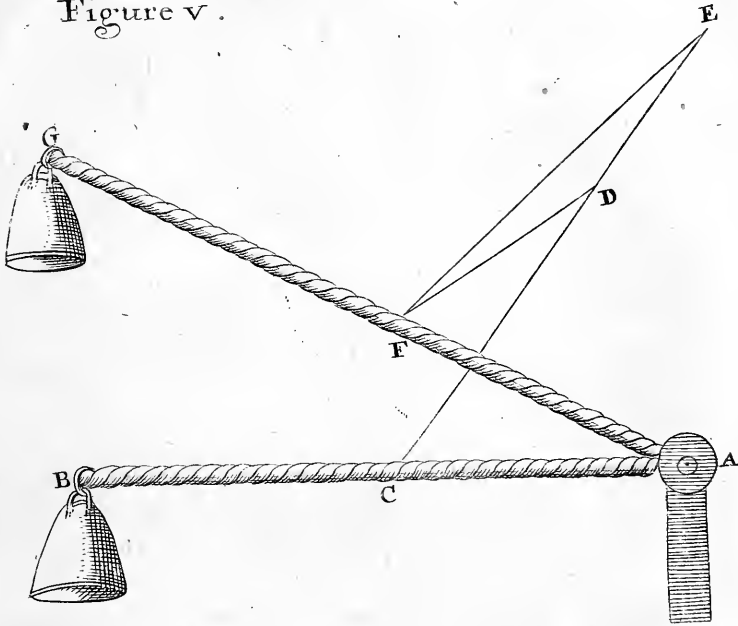
Let A B represent a Vectis or Leaver, C a weight hung at the end of it under A, B the fulciment or rest, D F a perpendicular Cord, and D G and D E two other Cords, but oblique. I say then, that the weight C, and the end of the Vectis A, are much more easily or with less force lifted up by the perpendicular Cord D F, than by either of the oblique Cords D G and D E: For since the power placed at E draws by the line E D; when the Vectis A B is pulled toward its fulciment B, part of the power is employed.

employed against the fulciment, the drawing of the oblique cord DE rather bringing the *Vectis* to bear against the Fulciment, than raising the weight C, and by consequence a great part of the force is spent in vain upon the Fulciment. But when the perpendicular Cord FD is pull'd, the whole force is employed only in raising of the weight; and therefore by how much nearer to the perpendicular F, the points G and E are advanced; by so much the more easily is the *Vectis* moved and the weight elevated: And on the contrary, by how much the farther they recede from the perpendicular toward a parallel with the *Vectis*, by so much the greater force is required to raise the weight; because, in a position parallel, the Traction or Force is either directly from, or directly toward the *Fulciment*, and consequently can never raise the *Vectis*.

Whence we may easily collect the *Reason*, why the Muscles generally have their Originals somewhat *higher* than their Insertions; and why their motions are so much the stronger, by how much the higher their Heads are raised; which is what was to be inquired.

There is yet another *mechanick* artifice of Nature, both to facilitate and corroborate the force of Muscles, designed to effect strong motions or elevate weighty bones, and that is (as hath been before hinted) by prolonging their Tendons to greater length, than those of other Muscles: For although, to the sustaining of a weight upon a *Vectis*, it be all one whether the sustaining Cord be shorter or longer, provided the same degree of its advance toward a perpendicular be observed; yet to the elevation of it by traction, the traction of a *long* oblique cord, is more powerful than that of a *short* oblique cord, which may be thus demonstrated.

Figure v.



Page 537.

Imagine A B to represent a *Vectis* whose Fulciment is at A, and upon whose other end B a weight is hung; C D a shorter oblique cord, and C E a longer in the same degree of Obliquity. Now to the sustaining of this weight at the end of the *Vectis* B, both these oblique cords are equally accommodate, as being equally remote from a parallel with the *vectis*, according to the Angle D C A, or E G A. But as to the *raising* of the same weight, there is need of a less force to draw by the longer cord E C,

Y y

than

than to draw by the shorter cord DC; for let the *vectis* be raised from B to G, and the point C to F, and then the cord DC will be transferred to DF, and the cord EC to EF; and because the cord EF is more elevated over the *vectis* than the cord DF (for the Angle EFA is greater than the Angle DFA) by the proposition newly demonstrated, the weight will be raised with less force by the longer cord EF, than by the shorter cord DF; and by consequence a Muscle with a longer Tendon, is more powerful to motion, than it would be if it had a shorter. *Quod erat probandum.*

Again, as in the *fuze* of a Watch, the greatest strength of the Spring is made to work upon the shortest *Vectis*, and the least upon the longest, so as to adjust the whole traction to an equality; so has Nature contrived the like artifice in the traction of Muscles upon two bones, with a turning joynt between their ends: For the two Bones, and the Muscles moving them, make a *Triangle*; of which the acting muscle is the *Basis*, subtending the angular joynt; and in the act of pulling the muscle is strongest, where the *vectis* is smallest, as lying most obliquely; and *vice versa*, when the muscle moving and the Bone moved, come to make a right Angle.

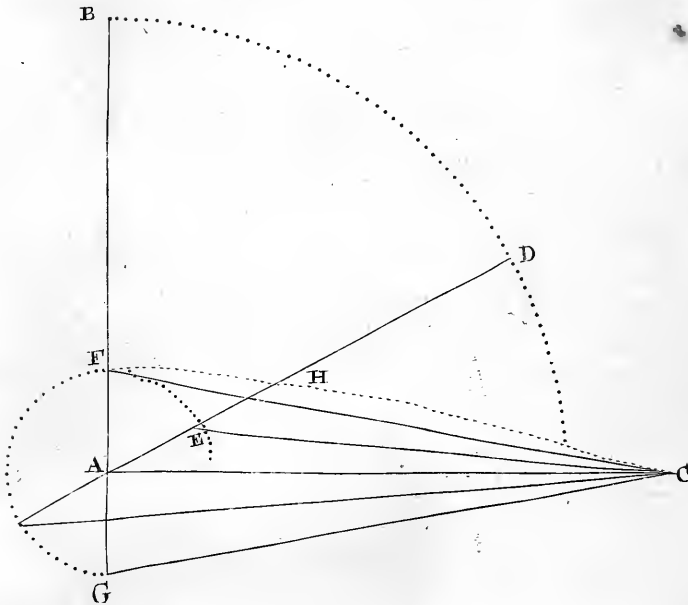
These things being explained, I observe in the *Third* place, that no motion voluntary (nor indeed involuntary) can be effected, but the *Figure*, both of the muscle moving, and of the member moved, must be at the same time *changed*: The *Reason* of which Necessity may be drawn from that well known Proposition Geometrical of *Euclid*, *Angulos aequales in triangulis, aequalia latera subtendunt.*

And because the alteration of Figure depends on the alteration of Angles, therefore must we admit a triple Figure, according to the triple difference of Angles; namely a *Right*, in which neither of the two Antagonist

or opposite muscles acteth ; an *Obtuse*, which being greater than a right, is consequently subtended by a greater side ; and an *Acute*, which being less than a right, requires a less subtending Line.

Taking it then for granted, that in the *middle* Figure no motion can be made, because therein both the opposite Muscles are equally contracted by their *Nixus* or natural contraction : It remains to be inquired, how motion is effected in each of the extreme Figures. Now certainly this is done, when one of the two Antagonist Muscles is more contracted by the animal virtue or invigoration derived from the Brain, than the other is by its natural tendency to restitution, whence it necessarily comes to pass, that the Figure of the prevailing muscle is at the same time altered, and the Angle of Articulation made more or less acute by that animal contraction ; and the segment detracted from the line, is in proportion to the space comprehended by the member moved. To explain this by an Example,

Figure VI.



Page 540.

Imagine the upper half of the Arm from the Shoulder to the Elbow to be CA , and the Cubit or lower half from the Elbow to the Hand to be AB , the Muscle bending the Arm to be CF , and its Antagonist extending the Arm to be CG , and the Object to be apprehended by the Hand at D . Now I say, while these two opposite Muscles CF and CG , remain equally contracted, the Appetite must continue unsatisfied, *i. e.* the Hand cannot be brought up to lay hold of the Object desired, because

because the Figure of the Arm, or Angle of Articulation is kept unchanged. But that the Hand may be raised to the object at D, it is necessary that Angle be made more *acute*, by a farther contraction of the Muscle CF, and an extension of its Antagonist CG, in proportion to the motion of the Line BD; and because that Angle is less than the former right Angle, therefore is the side subtending it also proportionately less or shorter, according to the *Sixth Proposition of the First Book of Euclid*. Again, Since the Line or Arch EF, is in proportion to the Arch DB; it follows, that just so much is detracted from the length of the Muscle bending the Arm: Not that so much is really defalk'd from the body of the Muscle, because then the Muscle would be incapable of Motion ever after; but only that by the animal contraction of its Fibres it is made so much shorter, the Line CF that was before straight, being now changed into the Arch CH; which is what I proposed to myself to prove.

In the *Fourth* and last place I observe, that notwithstanding this alteration of the Figure of a Muscle by its contraction, yet is not the belly of it *swell'd* or *augmented* in bulk, as hath been believed by all, who held the Muscles when they act, to be inflated as it were by a Gale of Animal Spirits immitted into them from the Brain: But on the contrary rather *lessened*, as may appear from the *Experiment* described by Dr. *Glisson* (*de Ventric. & Intestin. cap. 8. numer. 9.*) which is this.

Let there be provided a Tube of Glass, in length and bore capacious enough to hold a mans Arm; and to the upper Orifice of it on the outside, affix another Tube of Glass of about an Inch Diameter in the Bore, shaped like a common Weather-glass, only with a wide mouth like a Tunnel; so as the lower end may open into the greater Tube whose bottom is firmly stopp'd: Then having

Z z z

erected

erected both Tubes, let a Man of strong and brawny Muscles thrust his whole naked Arm into the greater Tube up to the very Shoulder, about which the Orifice of the Glass must be closely luted, that no water may flow out that way. This done, let as much water be poured in by the Tunnel as both Glasses will receive, leaving only a little space at the top of the lesser, empty. In fine, let the man strongly vigo-rate all the Muscles of his Arm by clinching his Fist, and relax them again by turns; and you shall observe that when he vigo-rates his Muscles, the water in the less Tube will sink somewhat lower, but rise again when he relaxes them: Whence it is evident, that the Muscles do not swell up, nor are inflated at the time of their invigoration or acting; but rather are minorated and contracted in all their three dimensions, otherwise the water would at that time, not descend, but ascend in the Neck of the Tunnel. Good reason then had Dr. Lower to affirm, (*lib. de corde c. 2. pag. 76.*) *Musculum in omni motu [voluntario] admodum arctè, & in sese introrsum constringi, minorari, & durefcere; adeoque motu inflationi prorsus contrario moveri.*

There is then (it seems) no necessity of any influx of Animal or Vital-Spirits, to puff up the Muscles when they act; but that their Fibres, invigorated by motion begun in the Brain, perform their work by simple *abbreviation*. But how this abbreviation can be made, without augmentation of the Muscles, either *secundum latitudinem*, or *secundum profunditatem*, or *secundum utramque*, in proportion thereunto; seeing that all *tensile* Bodies have somewhat more of depth, or breadth, or both, when they are contracted, than when they suffer extension in length: This (I confess) I do no more comprehend, than I do how the Soul causeth the Abbreviation: it self. To say with Dr. Glisson, *Musculorum Fibres proprio vitali motu se abbreviare*; seems to me rather to farther:

farther intangle, than untie the Gordian knot; amusing us with the Hypothesis of *Natural Perception*, and yet not solving the difficulty here pressing us, *viz.* how the Fibres lose somewhat of all their dimensions, in the act of their Contraction or Abbreviation. Leaving therefore this Problem to the consideration of wiser Heads than mine, and sitting down content with my Ignorance, lest I should farther expose it, I hast to a Conclusion.

Reflecting upon what hath been said, we may easily understand, why most Muscles have their proper *Antagonists*, there being *contrary* motions to be successively performed by every Member, and it being impossible that one and the same Instrument should serve to *both*. Of these Antagonists, one *bends* the member by being it self contracted; the other *extends* it again by being in like manner contracted successively, and both extend each other alternately. The contracted Muscle always *acteth*, the extended always *suffers*, and is transferred with the part moved.

Some Muscles there are that have no Antagonists, because they need none, such are all *circular* Muscles, the reason of whose motion is very obvious: For, having circular Fibres, and all contraction being necessarily made *secundum continuitatem linea*; 'tis most evident, that all Muscles of that figure close or draw together the parts to which they are affixt, by contraction of their Fibres toward their Centre, as is exemplified in the *sphincters* of the Bladder and Fundament, and in the *shutter* of the Eyelids.

Nevertheless it may be inquired, why the Sphincters have no Antagonists, when to the *clausor palpebrarum* is opposed the *Elevator*? The *reason* of which difference seems to be this, that the neck of the Bladder and the Fundament are forced open, not by Muscles, but by the excrements themselves, which being strongly pressed

downward by the Midriff and the Muscles of the *Abdomen*, thrust open the sphincters by extending their circular Fibres from the Centre to the Circumference; so that in strictness of truth, the excretion of the Urine and excrements of the Guts, is not an action altogether and immediately *voluntary*, as the closing of the Eye-lids is.

And this is all the shortness of my time permits me to say at present, concerning the *mediate* and *immediate Instruments* of voluntary motion, concerning their common *differences*, and concerning the *reason* and *manner* of their Actions in general. If in my devoir, to explain some few of the many Geometrical and Mechanical contrivances of Nature in the Fabrick of the Muscles, both to facilitate their motions and to augment their Forces; I have not so well acquitted my self as the Argument deserves, and as ye expected; I must intreat you to believe, that what I have adventur'd to deliver touching this Theme, extremely abstruse in it self; nor yet sufficiently handled by any man; was designed only as an *Essay*, rather to excite the Industry, than to prescribe to the curiosity of the more perspicacious and more learned, to whose judgment mine shall be always ready to Conform. Mean while I content my self with this hope, that what hath now been said, may suffice to raise up the minds of my Auditors to a just and pious admiration of the infinite Wisdom of our Omnipotent CREATOR, all whose works both in the greater World and in the less, the Body of Man, are most exactly adjusted by *number*, *weight*, and *measure*. *How manifold are thy works, O Lord, in Wisdom hast thou made them all.* *Psal.* 104. v. 24. ¶

EPIPHONEMA.

INunc, quisquis Affecla es Epicuri, & dic, casu id factum, quod non potuerit fieri sapientius: quodque si factum aliter fuisset, in hunc ipsum quo jam se habet modum, ut rectè haberet, necessariò restituendum fuisset. Scilicet, ut tibi casu factum detur, finge saltem fieri debuisse ex industria; & agnosces fieri non potuisse præclarius; agnoscendumque idcirco industrium potius Artificem, quam temerariam fortunæ manum.

Quid de Humano ulterius corpore, quod jam dissectum hic, & ad intima usque vitæ sensusque penetralia reclusum vidisti, dicam? Cum illius ne una quidem pars sit, in qua ubi molem, substantiam, formam, connexionem, situm, ac officium simul usumve consideraveris; esse te captum mente oporteat, nisi extemplò agnoscas, nihil esse fortuitum, nihil non provisum, nihil non à solertissima sapientissimaque mente destinatum. Ac si una quidem, alteravè aut pauca tantum essent partes, ex quibus foret corpus hominis; tum esset fortassis minùs obstupescendum. At verò esse in ipso, ac una sub cute, varietatem propè infinitam partium inter se commistarum, durarum cum mollibus, solidarum cum cavis, quiescentium cum motis, fixarum cum fluentibus, excipientium cum subeuntibus, &c. ac nullam tamen nulli esse vel minimo obstaculo; quinimò mutuas esse vices, coadjuvantesque operas; & sic quidem ut si cuiusquam magnitudinem augeas, vel imminuas, si figuram mutes, si cohestionem solvas, si situm invertas, si in tota demum machina quid moveas: tum omnia pejùs habitura, vel etiam pessum ruitura sùnt; quomodo id tandem stuporem non creet? Horum equidem cogitatione adedè mihi confusum esse animum sentio, ut æquum sit, imo planè necessum hic conticescam.

Mentis enim vocisque meæ præcluditur usus.

Nihil vos moramur, Patres conscripti; discedite.

E I N I S.

Books to be Sold by Robert Boulter, at the Turks-
Head in Cornhil, over against the Royal-Ex-
change.

F O L I O.

Rushworth's Collections.
Baronage of *England*, in two parts, by *Wil-*
liam Dugdale, Esquire.

Hooker's Ecclesiastical Policy.

Cursellei Opera.

Spiritual refinings, in two parts, by *Anthony Burgess.*

— His 145 Sermons on *John* 17.

— His Treatise of Original Sin.

Curia Politia, or the Apologies of several Princes,
justifying to the World their most eminent Actions by
Reason and Policy.

Reynold's Works.

Sturmy's Magazin.

Sixty five Sermons by the Right Reverend Father in
God *Ralph Brownrig*, late Lord Bishop of *Exeter*, Pub-
lished by *William Martin* M. A. sometime Preacher at
the *Rolls*, in two Volumes.

Q U A R T O.

An Exposition with Practical Notes and Observations
on the five last Chapters of the Book of *Job*, by *Jos.*
Caryl.

Husbandry spiritualized, or the Heavenly use of
Earthly things, by *F. Flavel.*

A Treatise of the Sabbath, in four parts, by Mr.
Dan. Cawdry.

Vindicia

Vindicia Legis, or a Vindication of the Law and Covenants from the Errors of Papists, Socinians, and Antinomians by *Anthony Burgess*.

The Saints Everlasting Rest, or a Treatise of the Blessed State of the Saints, in their enjoyment of God in Glory, by *Richard Baxter*.

— His plain Scripture proof of Infant-Baptism.

Theſaurus medicinae practicae, ex praestantissimorum tum Veterum tum Recentiorum Medicorum Observationibus, Consultationibus, Cunsiliis et Epistolis, summa diligentia collectus ordineque Alphabetico dispositus, per *Tho. Burnet*.

A Treatise of the right use of the Fathers, by *John Daily*.

Annotations on the Book of *Ecclesiastes*, by a Reverend Divine.

Norwood's Works.

Lightfoot in Lucam.

Seamans Kalendar.

The Doctrine of Justification by Faith, by *John Owen*,
D D.

Man of Sin, or a Discourse of Popery; wherein the numerous and monstrous Abominations in Doctrine and Practice of the Romish Church are by their own hands exposed to open sight, that the very Blind may see them. By no Roman, but a reformed Catholick.

De Origine, Moribus & rebus Gestis Scotorum Libri decem: Authore Joanne Lestao Episcopo Rossensi.

Large OCTAVO.

A Discourse of Growth in Grace, in sundry Sermons; by *Samuel Slater*, late of *St. Katherine's* near the *Tower*.

The Grounds of Art, teaching the perfect work and practice of Arithmetick, both in whole Numbers and Fractions, by *R. Record*.

A Cloud of Witnesses, or Sufferers Mirrour; made up of the Swanlike Songs, and other choice Passages of several Martyrs and Confessors, to the sixteenth Century, in their Treatises, Speeches and Prayers, by *T. M. M. A.*

Norwood's Epitome.

Philip's Manual.

Hon's Blessedness of the Righteous.

Wilson of the Scripture.

A Treatise of the Divine Promises in five Books, by *Edw. Leigh*, Esquire.

The unreasonableness of Infidelity, in four parts, by *R. Baxter*.

A Discourse of the State of Health in the Island of *Famaica*, by *Tho. Trapham*, M.D. Coll. Med. Lond. Soc. Hon.

Quakerism no Christianity clearly and abundantly proved out of the Writings of their chief Leaders, with a Key for the understanding their sense of their many usurped and unintelligible words, by *Fohn Faldo*.

ΗΕΙΟΔΟΥ ΑΕΚΡΑΙΟΥ ΕΥΠΙΕΚΟΜΕΝΑ. *Hesiodi ASCRÆI* quæ extant, Cum notis *Cornelii Scriverlii*.

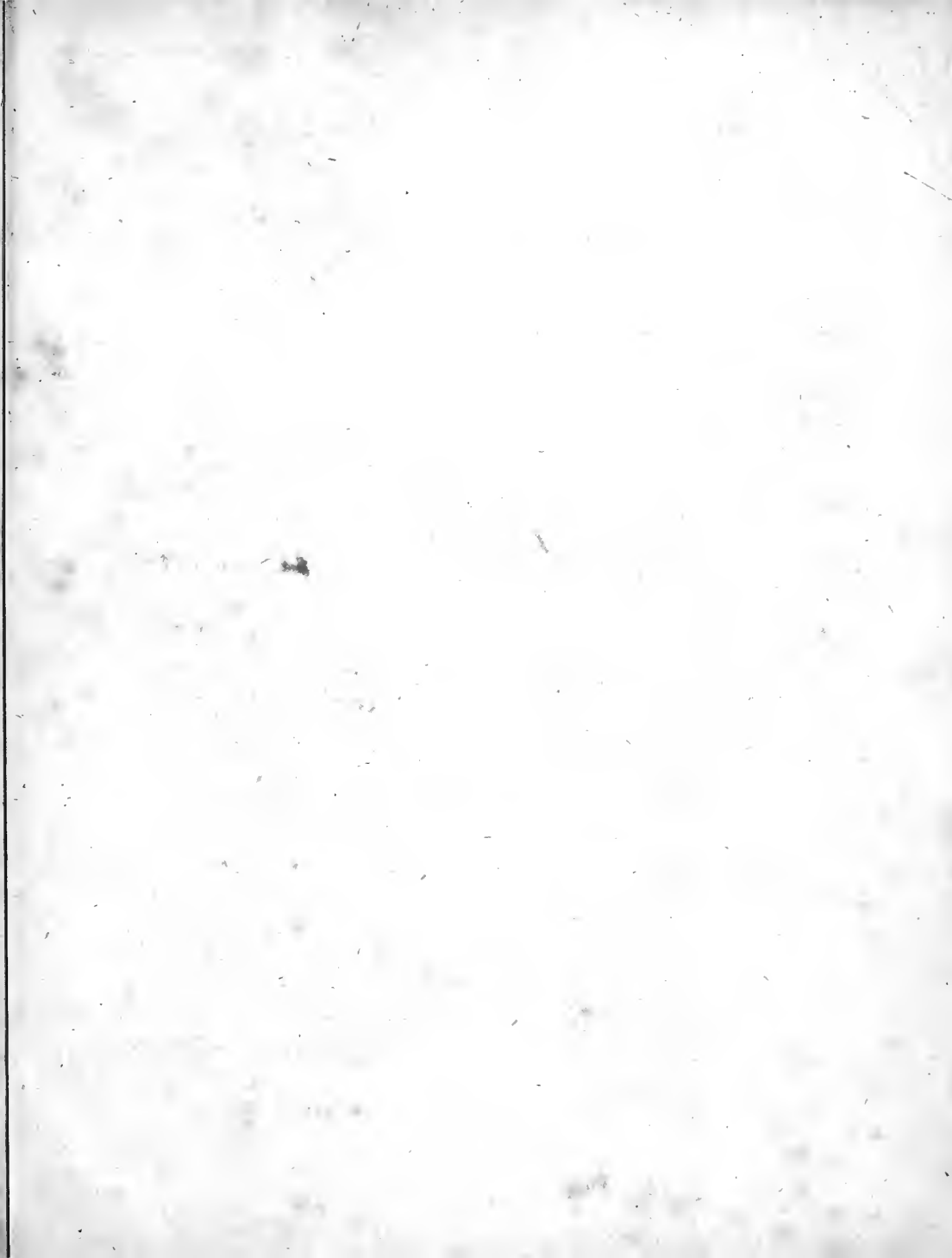
A Treatise of the *Bulk and Selvedge of the World*, wherein the Greatness, Littleness, and Lastingness of Bodies; are freely handled, with an Answer to *Tentamina de Deo*, by *N. Fairfax*, M. D.

Small OCTAVO and DUODECIMO.

Saint indeed, or the great Work of a Christian opened and pressed from *Prov. 4. 23.* by *F. Flavell*.

Artificial Arithmetick in Decimals, shewing the Original, Ground, and Foundation thereof, by *R. Fagar*.

F I N I S.



dq: Cephalica

dq: Phalybrata

dq: Camm comp:

dq: Cucumoris comp: & uina

dq: Lact Doctoral

dq: Lact Scorbatica

Bals: Saborinat

Cataplafma Myoplochient & Caprafo

Catapl Gnanthicum sub monto adh:

Catapl: Postitential:

Conuicia Scorbatica

Scrophularia

torralis

Docod Anear Pura:

Antimonialo

Turohemum Angorin

Jhoricum

Linacum

Do no sum Canj sulidi

Rhabarbari

Do Anmay

Doco: Do Fufim

Doco Paralyticus Epitropticus

Doctoralo

Camphoral

Do Anmay

Synanchiu

torrifigum Lithonther

Inoma Colicum

Dyfonticis

Epipargia foliifiga

Extrae Ephractiu: Ichia

Poly dethitium

Scorbity:

Jarg: Scorbicium

Synanchiu

Infus: Ichonica

Lincty Synanchiu

Podul Hypozium

d Paralyticum

Palla Hypoglossida x

Pil Rhopica

Pil Antipedregico
de Costa Palmari

Hydropica

Hystorica

Leontoptica

Rhizophora

de Pico Sinapina

Tart. Korti

Pulo Ethiopica

Thiana Cathartica

Pulo ad Calum

Criso Antim Comp:

Pulo Cornachini

Laborali Colic

Theriacalis

Sp: de Pyrrh Chalybat:

Tabul Althosa

Homoptica

Tabul infantu

Tuctor Hy. Totid

Tuctor Rozoanti

Tuctor Coluar. Comp

Paralytica

Kubarboni

Vino Arthriticu

Arthrit Purgans

Vino Chalybatum

Vino Ephraichu

Viporinu

ung Cephalicum:

Digitatis

ad Lumbricos

Epilepticu

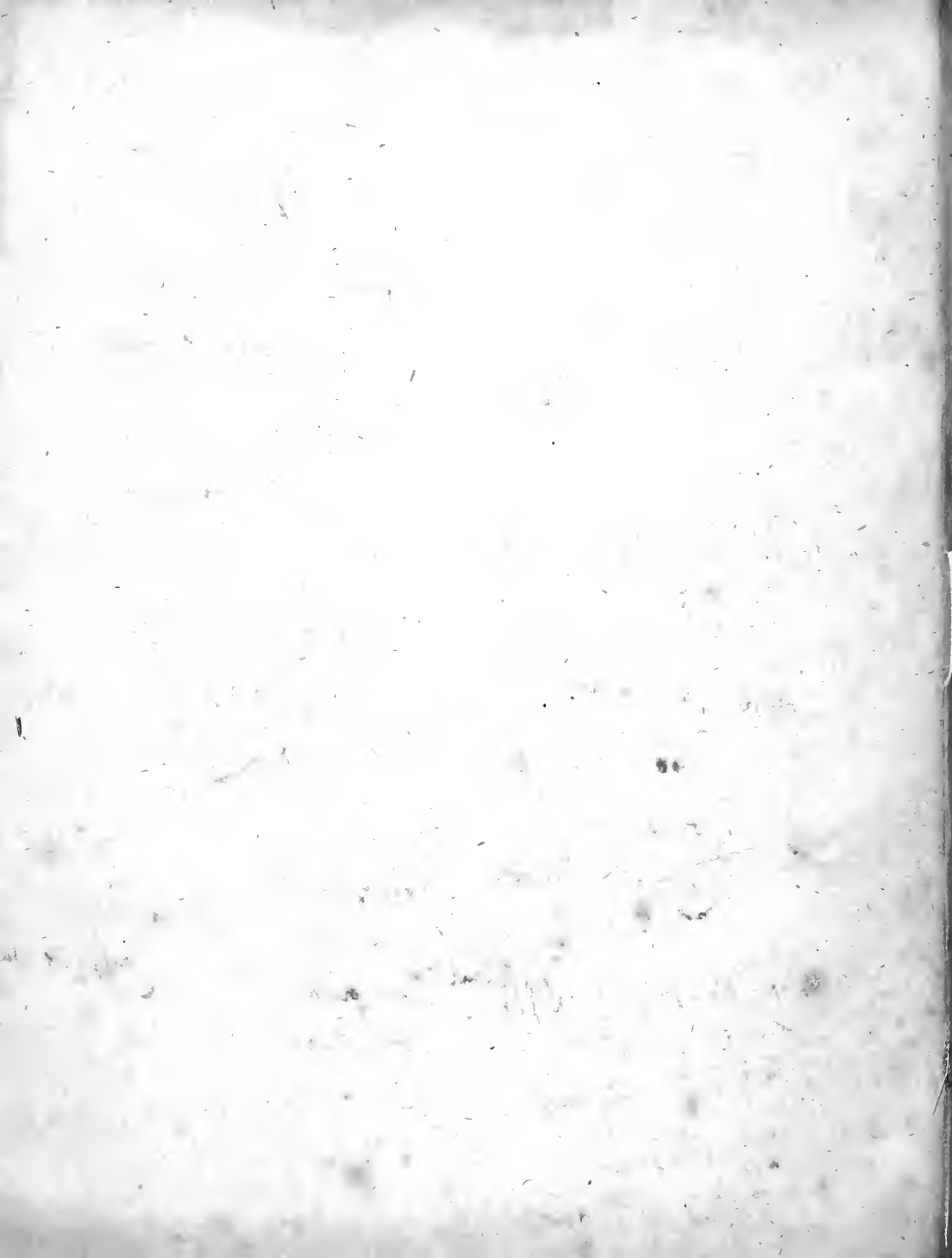
Pulo Drularis:

Stomachus

Verminifugus:

Mira Dialth

Confolid red.



1. Me. 392

COUNTWAY LIBRARY OF MEDICINE -

QP
145
C38

RARE BOOKS DEPARTMENT

