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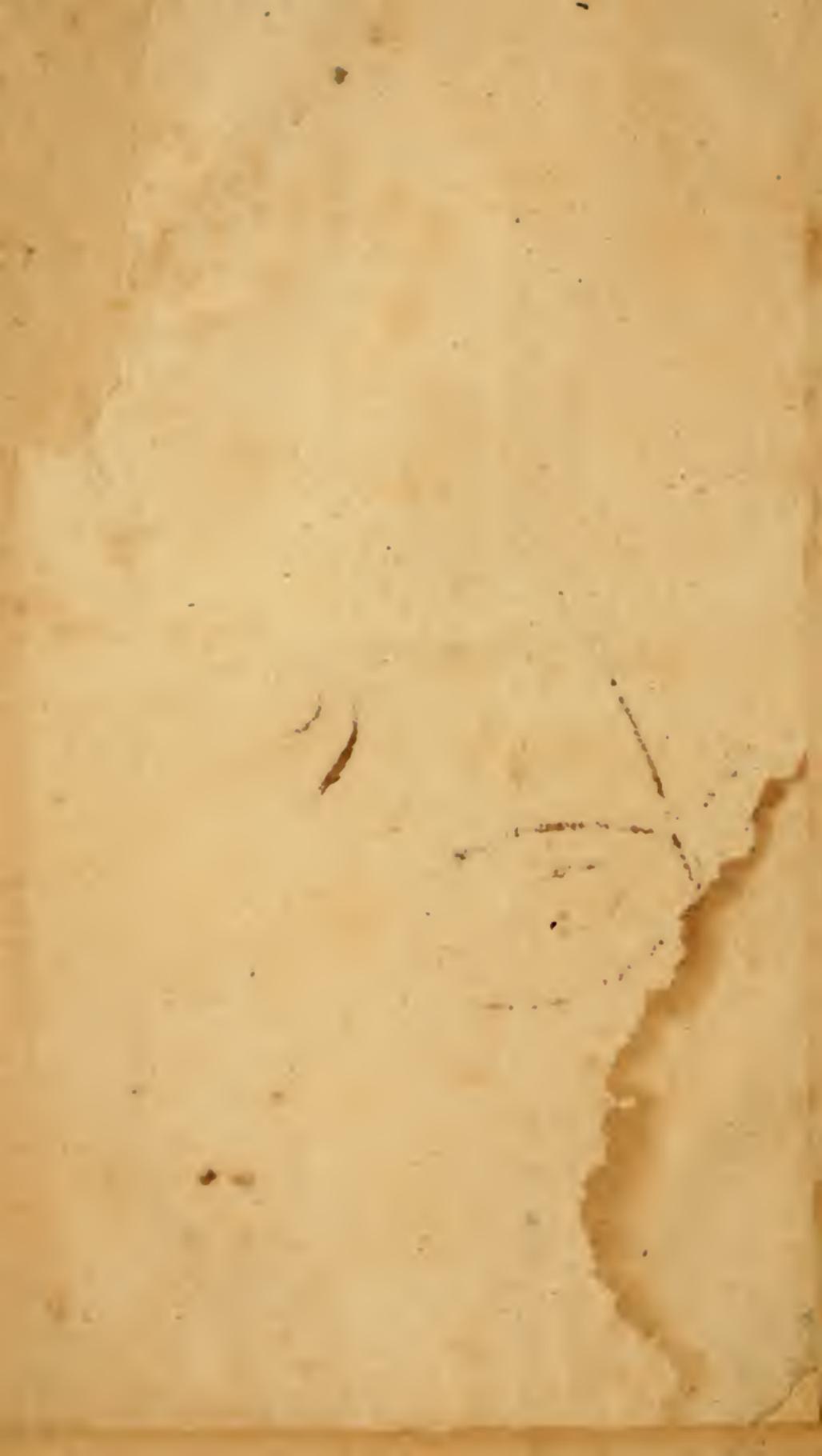




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T H E  
*Christian Philosopher :*  
A  
COLLECTION  
OF THE  
Best Discoveries in Nature,  
WITH  
*Religious Improvements.*

---

By COTTON MATHER D. D.  
*And Fellow of the ROYAL SOCIETY.*

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L O N D O N ;

Printed for EMAN. MATTHEWS, at the Bible in  
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T O

Mr. *THOMAS HOLLIS*,  
Merchant in *London*.

S I R,



HE Learned Author of the ensuing Treatise, has already diffus'd his Name and Reputation in a great Variety of Useful Works; by which the better Part of Mankind do sufficiently know him to be *in Labours more abundant*. The Reader will find in this Treatise, a Collection

A 2

from

from<sup>o</sup> Writers of the first and best Character, both in our own and other Nations; and every Observation improv'd to the Ends of Devotion and Practice. The Remarks that the Author gives, are so mingled with the Discoveries that he has brought together, that as it shows us with what Spirit He has pursued His Enquiries into the Wonders of the Universe; so it is both an Instruction and a Pattern to a serious Mind. He has generally drawn into his Application, all that the Bible saith upon the several Subjects: And thus he lays open the two great Books of God, Nature and Scripture. In this way, our Curiosity is not only entertain'd, but sanctified; *the Invisible Things of God from the Creation of the World are seen*, and improv'd to the Glory of Him whose they are.

Your surprizing Generosity to the Academy in *New-England*, has made this Dedication more proper to you than any other Person. Such a Beneficence

ficence is an Argument how thorowly you desire that the Doctrines of the Gospel, and the Purity of Discipline, may be transmitted to future Generations. And certainly, it is the noblest, and the most divine Application of your Charity, when by it you are a *Fellow-helper to the Truth*. This is given to those from whom you can have no Expectation of Recompence; but as it's all done to the Lord, and not unto Men, so by him it will be remember'd at *the Resurrection of the Just*. You know how much it is against my Temper to give *flattering Words*, and I'm convinc'd that it is against yours to receive 'em. But I have reason to think, that the Reverend Author, and the whole Country where God has placed him, will believe this Dedication well directed, to the BEST of all their Benefactors. *This Administration of Service is abundant, by many Thanksgivings to God, (whilst by this Ministration, they glorify God for your profess'd Subjection to the Gospel of*

*of Christ, and for your liberal Distribution to them and to all Men) and by their Prayer for you.*

I have no more to add, but the Apostle's Wish, that *your Faith may grow exceedingly, and your Charity daily abound; that whatever you do, may be done faithfully to the Brethren, and to Strangers.*

I am,

S I R,

London,  
Sept. 22  
1720.

Your Sincere Friend,

and Obedient Servant,

*Tho. Bradbury.*

## An I N D E X.

<b>T</b> H E Introduction.	_____	_____	_____	page 1
Of the Light,	_____	_____	_____	8
Of the Stars,	_____	_____	_____	16
Of the Fixed Stars,	_____	_____	_____	19
Of the Sun,	_____	_____	_____	25
Of Saturn,	_____	_____	_____	32
Of Jupiter,	_____	_____	_____	34
Of Mars,	_____	_____	_____	37
Of Venus,	_____	_____	_____	38
Of Mercury,	_____	_____	_____	ibid.
Of Comets,	_____	_____	_____	41
Of Heat,	_____	_____	_____	45
Of the Moon,	_____	_____	_____	47
Of the Rain,	_____	_____	_____	52
Of the Rainbow,	_____	_____	_____	54
Of the Snow,	_____	_____	_____	58
Of the Hail,	_____	_____	_____	60
Of Thunder and Lightning,	_____	_____	_____	61
Of the Air,	_____	_____	_____	65
Of the Wind,	_____	_____	_____	69
Of the Cold,	_____	_____	_____	72
Of the Terraqueous Globe,	_____	_____	_____	75
Of Gravity,	_____	_____	_____	81
Of the Water,	_____	_____	_____	88
Of the Earth,	_____	_____	_____	96
Of Magnetism,	_____	_____	_____	104
Of Minerals,	_____	_____	_____	116
Of Vegetables,	_____	_____	_____	122
Of Insects,	_____	_____	_____	141
Of Reptiles,	_____	_____	_____	166
Of the Fishes,	_____	_____	_____	173
Of the Feather'd Kind,	_____	_____	_____	180
Of the Quadrupeds,	_____	_____	_____	198
Of Man,	_____	_____	_____	221

B O O K S lately Publish'd.

**T**HE Necessity of contending for Revealed Religion; with a Sermon on the 5th of *November*, 1719. By the Reverend Mr. *Thomas Bradbury*. With a Letter from the Reverend *Cotton Mather D. D.* on the late Disputes about the Ever-Blessed Trinity. *Pr. 1 s.*

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T H E



T H E  
I N T R O D U C T I O N .

**T**HE ESSAYS now before us will demonstrate, that *Philosophy* is no *Enemy*, but a mighty and wondrous *Incentive* to *Religion*; and they will exhibit that **PHILOSOPHICAL RELIGION**, which will carry with it a most sensible *Character*, and victorious *Evidence* of a *reasonable Service*. **GLORY TO GOD IN THE HIGHEST**, and **GOOD-WILL TOWARDS MEN**, animated and exercised; and a Spirit of *Devotion* and of *Charity* inflamed, in such *Methods* as are offered in these *Essays*, cannot but be attended with more *Benefits*, than any *Pen* of ours can declare, or any *Mind* conceive.

In the *Dispositions* and *Resolutions* of **PIETY** thus enkindled, a *Man* most effectually *shews himself* a **MAN**, and with unutterable *Satisfaction* answers the grand **END** of his *Being*, which is, *To glorify GOD*. He discharges also the *Office* of a *Priest* for the *Creation*, under the *Influences* of an admirable *Saviour*, and therein asserts and assures his *Title* unto that *Priest-*  
B
hood,

hood, which the Blessedness of the future State will very much consist in being advanced to. The whole World is indeed a Temple of GOD, built and fitted by that Almighty Architect; and in this Temple, every such one, affecting himself with the Occasions for it, will speak of His Glory. He will also rise into that Superiour Way of Thinking and of Living, which the Wisest of Men will chuse to take; which the more Polite Part of Mankind, and the Honourable of the Earth, will esteem it no Dishonour for them to be acquainted with. Upon that Passage occurring in the best of Books, Ye Sons of the Mighty, ascribe unto the Lord Glory and Strength; it is a Gloss and an Hint of Munster, which carries with it a Cogency: *Nihil est tam sublime, tamque magnificum, quod non teneatur laudare & magnificare Deum Creatorem suum.* Behold, a Religion, which will be found without Controversy; a Religion, which will challenge all possible Regards from the High, as well as the Low, among the People; I will resume the Term, a PHILOSOPHICAL RELIGION: And yet how Evangelical!

In prosecuting this Intention, and in introducing almost every Article of it, the Reader will continually find some Author or other quoted. This constant Method of Quoting, 'tis to be hoped, will not be censured, as proceeding from an Ambition to intimate and boast a Learning, which the Messieurs du Port-Royal have rebuked; and that the Humour for which Austin reproached Julian, will not be found in it: *Quis hac audiat, & non ipso nominum strepitu terreatur, si est ineruditus, qualis est hominum multitudo, & existimet te aliquem magnum qui hac scire potueris?* Nor will there be discernible any Spice of the impertinent Vanity, which La Bruyere hath so well satirized: 'Herillus will always cite, whether he speaks or writes. He makes the Prince of Philosophers to say, That Wine inebriates; and the Roman Orator, That Water temperates it. If he talks of Morality, it is not he, but the Divine Plato,

who

who affirms, *That Virtue is amiable, and Vice odious.*  
 'The most common and trivial things, which he himself is able to think of, are ascribed by him to *Latin and Greek Authors.*' But in these *Quotations*, there has been proposed, first, a due *Gratitude* unto those, who have been my *Instructors*; and indeed, *something within me* would have led me to it, if *Pliny*, who is one of them, had not given me a *Rule*; *Ingennum est profiteri per quos profeceris.* It appears also but a piece of *Justice*, that the *Names* of those whom the Great GOD has distinguished, by employing them to make those *Discoveries*, which are here collected, should live and shine in every such *Collection*. Among these, let it be known, that there are especially *Two*, unto whom I have been more indebted, than unto many others; the *Industrious Mr. RAY*, and the *Inquisitive Mr. DERHAM*; *Fratrum dulce par*: upon whom, in divers *Paragraphs* of this *Rhapsody*, I have had very much of my *Subsistence*; (I hope without doing the part of a *Fidentinus* upon them) and I give thanks to *Heaven* for them.

'Tis true, some *Scores* of other *Philosophers* have been consulted on this *Occasion*; but an *Industry* so applied, has in it very little to bespeak any *Praises* for him that has used it: He earnestly renounces them, and sollicit, that not only *he*, but the *Greater Men*, who have been his *Teachers*, may disappear before the *Glorious GOD*, whom these *Essays* are all written to represent as *worthy to be praised*; and by whose *Grace* we are what we are; nor have we *any thing but what we have received* from Him.

A considerable *Body* of *Men* (if the *Jansenists* may now be thought so) in *France*, have learnt of *Monsieur Pascal*, to denote themselves by the *French* *Impersonal* *Particle On*; and it was his opinion, that an honest *Man* should not be fond of *naming himself*, or using the word *I*, and *Me*; that *Christian Piety* will annihila-

late our I, and ME, and *Human Civility* will suppress it, and conceal it.

Most certainly there can be very little Pretence to an I, or ME, for what is done in these *Essays*. 'Tis done, and entirely, by the Help of God: This is all that can be pretended to.

There is very little, that may be said, really to be performed by the Hand that is now writing; but only the *Devotional Part* of these *Essays*, tho they are not altogether destitute of *American Communications*: And if the *Virtuoso's*, and all the *Genuine Philosophers* of our Age, have approved the Design of the devout RAY and DERHAM, and others, in their Treatises; it cannot be distasteful unto them, to see what was more generally hinted at by those Excellent Persons, here more particularly carried on, and the more special Flights of the true PHILOSOPHICAL RELIGION exemplified. Nor will they that value the *Essays* of the memorable Antients, *Theodoret*, and *Nazianzen*, and *Ambrose*, upon the *Works of the six Days*, count it a Fault, if among lesser Men in our Days, there be found those who say, *Let me run after them*. I remember, when we read, *Praise is comely for the Upright*, it is urged by *Kimchi*, that the Word which we render *comely*, signifies *desirable*, and *acceptable*; and the Sense of that Sentence is, that *Qui recti sunt, aliud nihil desiderant quam Laudem & Gloriam Dei*. Sure I am, such *Essays* as these, to observe, and proclaim, and publish the *Praises* of the Glorious GOD, will be *desirable* and *acceptable* to all that have a *right Spirit* in them; the rest, who are *blinded*, are Fools, and unregardable: As little to be regarded as a *Monster* flourishing a *Broomstick*! *Vix illis optari quidquam pejus potest, quam ut fatuitate sua fruantur*. For such *Centaur's* to be found in the *Tents* of professed *Christianity*!—Good God, unto what *Times* hast thou reserved us! If the *self-taught Philosopher* will not, yet *Abubeker*, a *Mahometan* Writer, by whom such an one was exhibited more than five hundred Years ago, will

will rise up in the Judgment with this Generation, and condemn it. Reader, even a Mahometan will shew thee one, without any Teacher, but Reason in a serious View of Nature, led on to the Acknowledgment of a Glorious GOD. Of a Man, supposed as but using his Rational Faculties in viewing the Works of GOD, even the Mahometan will tell thee; 'There appeared unto him those Footsteps of Wisdom and Wonders in the Works of Creation, which affected his Mind with an excessive Admiration; and he became hereby assured, that all these things must proceed from such a Voluntary Agent as was infinitely perfect, yea, above all Perfection: such an one to whom the Weight of the least Atom was not unknown, whether in Heaven or Earth. Upon his viewing of the Creatures, whatever Excellency he found of any kind, he concluded, it must needs proceed from the Influence of that Voluntary Agent, so illustriously glorious, the Fountain of Being, and of Working. He knew therefore, that whatsoever Excellencies were by Nature in Him, were by so much the greater, the more perfect, and the more lasting; and that there was no proportion between those Excellencies which were in Him, and those which were found in the Creatures. He discerned also, by the virtue of that more Noble Part of his, whereby he knew the necessarily existent Being, that there was in him a certain Resemblance thereof: And he saw, that it was his Duty to labour by all manner of Means, how he might obtain the Properties of that Being, put on His Qualities, and imitate His Actions; to be diligent and careful also in promoting His Will; to commit all his Affairs unto Him, and heartily to acquiesce in all those Decrees of His which concerned him, either from within, or from without: so that he pleased himself in Him, tho he should afflict him, and even destroy him.' I was going to say, O Mentis aureæ Verba bracteata! But the Great Alsted instructs me,

that we *Christians*, in our valuable Citations from them that are Strangers to *Christianity*, should seize upon the Sentences as containing *our Truths*, detained in the hands of *Unjust Possessors*; and he allows me to say, *Audite Ciceronem, quem Natura docuit*. However, this I may say, *God has thus far taught a Mahometan!* And this I will say, *Christian*, beware lest a *Mahometan* be called in for thy *Condemnation!*

Let us conclude with a Remark of *Minutius Felix*:  
 ‘ If so much Wisdom and Penetration be requisite to  
 ‘ observe the wonderful Order and Design in the Struc-  
 ‘ ture of the World, how much more were necessary  
 ‘ to form it!’ If Men so much admire Philosophers,  
 because they discover a small Part of the *Wisdom* that  
 made all things; they must be stark blind, who do not  
 admire that *Wisdom* itself!





# RELIGIO PHILOSOPHICA;

OR, THE

## Christian Philosopher :

BEING

A Commentary, of the more Modern  
and Certain PHILOSOPHY, upon  
that Instruction,

JOB XXXvi. 24.

*Remember that thou magnify His Work which  
Men behold.*



THE Works of the Glorious GOD in the  
*Creation* of the World, are what I now  
propose to exhibit; in brief *Essays* to enu-  
merate *some of them*, that He may be glo-  
rified in them: And indeed my *Essays* may  
pretend unto no more than *some of them*; for, *Theophilus*  
writing, of the *Creation*, to his Friend *Autolytus*, might  
very justly say, That if he should have a *Thousand*  
*Tongues*, and live a *Thousand Years*, yet he were not

able to describe the admirable Order of the Creation, διὰ τὸ υπερβῆλλον μεγαδοῦς καὶ τὸ πλεῖστον σοφίας τοῦ Θεοῦ. *Such a Transcendent Greatness of God, and the Riches of his Wisdom appearing in it!*

Chrysostom, I remember, mentions a *Twofold Book* of GOD; the *Book of the Creatures*, and the *Book of the Scriptures*: GOD having taught first of all us διὰ ἔργα αὐτῶν, by his *Works*, did it afterwards διὰ γράμματα, by his *Words*. We will now for a while read the *Former* of these *Books*, 'twill help us in reading the *Latter*: They will admirably assist one another. The Philosopher being asked, What his *Books* were; answered, *Totius Entis Naturalis Universitas*. All Men are accommodated with that *Publick Library*. Reader, walk with me into it, and see what we shall find so legible there, *that he that runs may read it*. Behold, a Book, whereof we may agreeably enough use the words of honest *Ægardus*; *Lectu hic omnibus facilis, etsi nunquam legere didicerint, & communis est omnibus, omniumque oculis expositus*.

## ESSAY I. *Of the LIGHT.*

**W**OULD it not be proper, in the first place, to lay down those *Laws of Nature*, by which the *Material World* is governed, and which, when we come to consider, we have in the Rank of *Secund Causes*, no further to go? All *Mechanical Accounts* are at an end; we step into the Glorious GOD *Immediately*: The very next *Thing* we have to do, is to Acknowledge Him, who is the *First Cause* of all: and the CHRISTIAN PHILOSOPHER will on all Invitations make the *Acknowledgments*. The acute Pen of Dr. *Cheyne* has thus delivered them.

I. All *Bodies* persevere in the same State of *Rest*, or of *Moving* forwards in a *strait Line*, unless forced out of that State, by some *Violence* outwardly impressed upon them.

II. The

II. The *Changes* made in the *Motions* of *Bodies*, are always proportional to the *Impressed Force* that moves them; and are produced in the same *Direction* with that of the *Moving Force*.

III. The *same Force* with which one *Body* strikes another, is *returned* upon the first by that other; but these *Forces* are impressed by *contrary Directions*.

IV. *Every Part* of every *Body* attracts or gravitates towards *every Part* of every other *Body*: But the *Force* by which one *Part* attracts another, in different *Distances* from it, is reciprocally as the *Squares* of those *Distances*; and at the same *Distance*, the *Force* of the *Attraction* or *Gravitation* of one *Part* towards divers others, is as the *Quantity* of *Matter* they contain.

These are *Laws* of the Great *GOD*, who formed all things. *GOD* is ever to be seen in these *Everlasting Ordinances*. But now, in proceeding to magnify that *Work of God* which *Men* behold, it seems proper to begin with that by which it is that we *Behold* the rest.

The *LIGHT* calls first for our *Contemplation*. A most marvellous *Creature*, whereof the Great *GOD* is the *Father*;

*Illic incipit DEUM nosse.*

The *Verus Christianismus* of the pious *John Arndt* very well does insist upon that *Strain of Piety*; *GOD* and His *LOVE* exhibited in the *Light*.

It was demanded, *In what Place is the Light contained? By what Way is the Light divided?*

*Aristotle's* Definition of *Light*;  $\Phi\acute{\omega}\varsigma$  ἐστὶν ἡ ἐνέσταια τῆς διαφανῆς, *Light is in the Inworking of a Diaphanous Body*; is worth an attentive *Consideration*.

*Light* is undoubtedly produced, as *Dr. Hook* judges, by a *Motion*, quick and vibrative,

It is proved by *Mr. Molyneux*, That *Light* is a *Body*. Its *Refraction*, in passing thro a *Diaphanous Body*, shews that it finds a *different Resistance*; *Resistance* must proceed from a *Contact* of *two Bodies*. Moreover, it requires

quires *Time* to pass from one place to another, tho it has indeed the quickest of all Motions. Finally, it cannot by any means be *increased* or *diminished*. If you *increase* it, it is by robbing it of some other part of the Medium which it would have occupied, or by bringing the *Light*, that should naturally have been diffused thro some other Place, into that which is now more enlightened.

Sir *Isaac Newton* judges, 'Tis probable, that *Bodies* and *Light* act mutually on one another. *Bodies* upon *Light*, in emitting it, and reflecting it, and refracting it, and inflecting it: *Light* upon *Bodies*, by heating them, and putting their Parts into a *Vibrating Motion*.

All *Hypotheses* of *Light* are too dark, which try to explain the *Phænomena* by *New Modifications* of *Rays*; they depend not on any such *Modifications*, but on some *Congenite* and *Unchangeable* Properties, essentially inherent in the *Rays*.

The *Rays* of *Light* are certainly little Particles, actually emitted from the *Lucent Body*, and refracted by some *Attraction*, by which *Light*, and the *Bodies* on which it falls, do mutually act upon one another. It is evident, That as *Rays* pass by the Edges of *Bodies*, they are *incurvated* by the Action of these *Bodies*, as they pass by them.

And it is now perceived, That *Bodies* draw *Light*, and this *Light* puts *Bodies* into *Heat*: And that the Motion of *Light* is therefore swifter in *Bodies*, than in *vacuo*, because of this *Attraction*; and slower after its being *reflected*, than in its *Incidence*.

*Irradiated* by the Discoveries of the Great Sir *Isaac Newton*, we now understand, That every *Ray* of *Light* is endowed with its own *Colour*, and its different Degree of *Refrangibility* and *Reflexibility*. One *Ray* is *Violet*, another *Indigo*, a third *Blue*, a fourth *Green*, a fifth *Yellow*, a sixth *Orange*, and the last *Red*. All these are *Original Colours*, and from the Mixture of these, all the intermediate ones proceed; and *White* from an equal

ble Mixture of the whole: *Black*, on the contrary, from the small Quantity of any of them reflected, or all of them in a great measure suffocated. It is not *Bodies* that are coloured, but the *Light* that falls upon them; and their *Colours* arise from the *Aptitude* in them, to *reflect* Rays of one Colour, and to *transmit* all those of another. 'Tis now decided, *No Colour in the dark!*

Tho *Light* be certainly a *Body*, it is almost impossible to conceive how *small* the *Corpuscles* of it are. *Dr. Cheyne* illustrates it with an Experiment, That it may be propagated from innumerable different Luminous Bodies, without any considerable Opposition to one another. Their several *Streams of Light* will be together transmitted into a dark Place, thro the least Orifice in the World. Suppose a Plate of Metal, having at the top the smallest Hole that can be made, were erected *perpendicularly* upon an *Horizontal Plane*, and about it were set numberless luminous Objects of about the same Height with the Plate, at an ordinary Distance from it; the *Light* proceeding from every one of these Objects, will be propagated thro this Hole, without interfering.

*Mr. Romer*, from his accurate Observations of the *Eclipses* on the *Satellites* of *Jupiter*, their Immersions and Emersions, thinks he has demonstrated, That *Light* requires one Second of Time to move 9000 Miles. He shews, that the Rays of *Light* require ten Minutes of Time to pass from the *Sun* to us. And yet *Mr. Hugen*s hath shewn, That a Bullet from a Cannon, without abating its first Velocity, would be 25 Years passing from us to the *Sun*. So that the Motion of *Light* is above a million times swifter than that of a Cannon-Ball; yea, we may carry the Matter further than so.

We suppose the Distance of the *Sun* from the Earth to be 12000 Diameters of the *Earth*, or suppose 10000, the *Light* then runs 1000 Diameters in a Minute; which is at least 130,000 Miles in a Second. *Dr. Cheyne* shews,

shews, That *Light* is about six hundred thousand times more swift than *Sound*. Amazing Velocity!

To chequer the Surprize at so *swift* a Motion, I may propound one that shall be as very surprizingly *slow*. *Dee* affirms, that he and *Cardan* together saw an Instrument, in which there was one Wheel constantly moving with the rest, and yet would not finish its Revolution under the space of seven thousand Years. 'Tis easy to conceive with *Stevinus*, an Engine with twelve Wheels, and the Handle of such an Engine to be turned about 4000 times in an Hour, (which is as often as a Man's Pulse does beat) yet in ten Years time the Weight at the Bottom would not move near so much as an Hair's Breadth: And as *Mersennus* notes, it would not pass an Inch in 1,000,000 Years; altho it be all this while in Motion, and have not stood still one Moment: for 'tis a Mistake of *Cardan*, *Motus valde tardi, necessario quietes habent intermedias*.

- ' Behold the *Light* emitted from the *Sun*;
- ' What more familiar, and what more unknown?
- ' While by its spreading Radiance it reveals
- ' All Nature's Face, it still itself conceals.
- ' See how each Morn it does its Beams display,
- ' And on its golden Wings brings back the Day!
- ' How soon th' effulgent Emanations fly
- ' Thro the blue Gulph of interposing Sky!
- ' How soon their Lustre all the Region fills,
- ' Smiles on the Valleys, and adorns the Hills!
- ' Millions of Miles, so rapid is their Race,
- ' To chear the Earth, they in few Moments pass.
- ' Amazing Progress! At its utmost Stretch,
- ' What human Mind can this swift Motion reach?
- ' But if, to save so quick a Flight, you say,
- ' The ever-rolling Orb's impulsive Ray
- ' On the next Threads and Filaments does bear,
- ' Which form the springy Texture of the Air,
- ' That

- ' That those still strike the next, till to the Sight
- ' The quick Vibration propagates the Light :
- ' Still 'tis as hard, if we this Scheme believe,
- ' The Cause of Light's swift Progress to conceive.

Sir Richard Blackmore's *Creation*, Book 2.

The Jews have a good Saying, *Opera Creationis externa habent in se Imaginem Creationis interna.* It will well enough become a *Christian Philosopher*, to allow for that *Image* in his Contemplations, and with devout Thoughts now and then reflect upon it.

Before I go any further, I confess myself unable to resist the Invitation, which, I think, that I have, to insert an Observation of *Hugo de Sancto-Victore*; That every Creature does address a *Treble Voice* unto us: *ACCIPERE, REDDE, FUGE*; indeed, *there is no Speech nor Language where their Voice is not heard.* It is an Exercise highly becoming the *Christian Philosopher*, to fetch *Lessons of Piety* from the whole Creation of *GOD*, and hear what *Maxims of Piety* all the Creatures would, in the way of *Reflection* and *Similitude*, mind us of. In the Prosecution of these *Meleteticks*, what better can be considered, than this *Treble Voice*, from all these Thousands of *Powerful Preachers*, whom we have continually surrounding of us? First, *Accipe Beneficium*: Consider, *What is the Benefit which a Good GOD has, in this Creature, bestowed upon me?* Secondly, *Redde Servitium*: Consider, *What is the Service which I owe to a Gracious GOD, in the Enjoyment of such a Creature?* Lastly, *Fuge Supplicium*: Consider, *What is the Sorrow which a Righteous GOD may inflict upon me by such a Creature, if I persist in Disobedience to Him?* Even a Pagan *Plutarch* will put the *Christian Philosopher* in mind of this, That the World is no other than the *Temple of GOD*; and all the *Creatures* are the *Glasses*, in which we may see the *Skill* of Him that is the *Maker* of all. And his Brother *Cicero* has minded us, *Deum ex Operibus cognoscimus.* 'Tis no wonder then that

# 14 *The Christian Philosopher.*

that a *Bernard* should see this; *Verus Dei Amator, quocunque se vertit, familiarem Admonitionem sui Creatoris habet.* The famous *Hermite's Book*, of those three Leaves, the *Heaven*, the *Water*, and the *Earth*, well studied, how nobly would it fill the *Chambers* of the Soul with the most *precious and pleasant Riches*? *Clemens of Alexandria* calls the *World*, *A Scripture of those three Leaves*; and the *Creatures* therein speaking to us, have been justly called *Concionatores Reales*, by those who have best understood them:

*Obvia dum piæti lustro Miracula Mundi,  
Natura intueor dum parientis Opus:  
Emicat ex ipsis Divina Potentia Rebus;  
Et levis est Cespes qui probat esse Deum.*

But the *Light* now calls for me.

¶ How *Glorious* a *Body*! ‘ But how infinitely, and beyond all *Comprehension* *Glorious* then, the *Infinite GOD*, who has challenged it as *His Glory*! ‘ *Isa. xlv. 7. I form the Light.* The *GOD* of whom we have that *Sublime Stroke*, in the *History* of the *Creation*; he said, *Let there be Light, and there was Light!* The *GOD* whose *Majesty* is within that *Holy of Holies*, where He *dwells in the Light*, that no *Man* can approach unto! *Lord*, thou hast in a wondrous *Display* of thy *Benignity*, afforded the *Benefit* of the *Light* unto thy *Creatures*: *Whatsoever does make manifest, is Light.* How *miserable* should we be, and in what *inexpressible Confusion*, if the *Light* were withheld from us! What could be *manifest* unto us; what *enjoyed* or *performed* by us! O let all that *walk in the Light of the Living*, unite in *Praises* to the *Creator* of the *Light*! O! *give thanks to the Lord, for He is good, and his Mercy endureth for ever.* ‘ But, *Lord*, wilt thou leave my *Soul* in *Darkness*! The *Light* granted unto the *Soul*, in the *Knowledge* of those things, which to know is *Life eternal*, is more *precious and needful*, than that in which our *Body* finds

finds itself so much befriended. *O Father of Glory, let me have the Eyes of my Understanding enlightened.*

‘ I have a most Glorious Redeemer, of whom I am assured, That he is *the true LIGHT, and the LIGHT of the World.* A *Light* which, like other *Light*, carries its own *Evidence* with it: there needs no more to prove, that our Blessed JESUS is the *Son of GOD,* and the *Saviour* of the World, than attentively to *Behold Him.* He can be no other, than what he asserts Himself to be, *The Light of Men.* *Lord, in thy Light I shall see Light.* When I see the *Truth as it is in JESUS,* in such a Revelation and such an Exhibition, as my JESUS gives of it, then I see every thing *in a true Light.* *My Saviour,* thou art more precious, and more needful, and more useful to me than the *Light.* I will walk in thee, and under thy Conduct; so shall I *walk in the Light continually.*

‘ But what signifies the *Light,* unto him that has no *Eyes* to perceive it. *O my Redeemer!* Bestow thou an *Eye* upon me: A *Faculty* to discern the Things that are *spiritually to be discerned.*

‘ For the *Light of Reason,* which *enlightens every Man that comes into the World;* every Man has all possible *Reason* to glorify *GOD,* and never do any thing, whereof any Man may justly say, *It seems to me unreasonable.*

‘ But, *O my GOD,* thou hast favoured us with a rich Conglobation of *Light,* in the *Book* of thy lively Oracles, wherein we have a *Light shining in a dark Place.* I would consider every thing in the *Light* wherein this lovely *Book* sets it before me: But, let me not *rebel against the Light!*

‘ *The Light is truly sweet.* But, what shall I find *the Inheritance of the Saints in Light!* They that are shut out of that *Light,* and cast into *outer Darkness,* and where they shall *never see Light;* Oh! the *Weeping,* and *Wailing,* and *Gnashing of Teeth,* which they must be exposed unto! *My Saviour,* I am under thy  
‘ Conduct,

16 *The Christian Philosopher.*

‘ Conduct, passing through a gloomy Valley into thy  
 ‘ Light; and when *I sit in Darkness, the Lord will be a*  
 ‘ *Light unto me.*

‘ How swift the Motion of the *Light!* But, *O my*  
 ‘ *Saviour,* why no more swift in thy coming to visit  
 ‘ and relieve a World lying in the perpetual Night of  
 ‘ *Wickedness? Why thy Charict so long in coming?*

‘ And, *O my Soul,* why art thou slow in thy Con-  
 ‘ templations of *GOD,* and *CHRIST,* and *HEA-*  
 ‘ *VEN;* fly thou thither, with a Swiftness beyond  
 ‘ that of the *Light,* [for so thou canst] upon all Oc-  
 ‘ casions.’

ESSAY II. *Of the STARS.*

**L**ET us proceed, and, conforming to the End of  
 our *Erect Stature,* behold the Heavens, and lift up  
 our *Eyes unto the Stars.*

The learned *Hugens* has a Suspicion, that every  
*Star* may be a *Sun* to other Worlds in their several  
*Vortices.* Consider then the vast Extent of our *Solar*  
*Vortex,* and into what Astonishments must we find the  
 Grandeur and Glory of the Creator to grow upon us!  
 Especially if it should be so, (as he thinks) that all  
 these Worlds have their *Inhabitants,* whose Praises are  
 offer’d up unto our *GOD!*

*Quantula de Cœli spectanti Vertice celfo*  
*Terra videretur, si Cœli è Vertice Terra*  
*Ulla videretur!*

So *Buchanan.*

His Improvement of the Thought is, How little of  
 this little has vain Man to strive for, and to boast of!

*O Pudor! O stolidi præcepta vesania voti!*

Mr. *Childrey* mentions two Curiosities, which ought  
 to be a little further enquired into. The one is, That  
 between the two Constellations of *Cygnus* and *Cepheus,*  
 there lies cross the *Milky-Way,* a black, long, little  
 Cloud,

*Cloud*, neither increasing, nor abating, nor changing the Place in which it makes its Appearance.

The other is, That in *February*, and a little before and after that Month, in the Evening, when the *Twilight* has near deserted the *Horizon*, there is a very distinguishing Way of the *Twilight*; a *Bright Path* striking up towards the *Pleiades*, and almost reaching them, which is not observed any other time of the Year.

The *Jews* have a Fancy among them, That when the Almighty first bespangled the Heavens with *Stars*, he left a Spot near the *North Pole* unfinished and unfurnished, that so if any other should set up for a *GOD*, there might be this trial made of his Pretensions; *Go, fill up, if you can, that part of the Heavens, which is yet left imperfect.* But without any such Suppositions, we may see enough in the Heavens to proclaim this unto us; *Lift up your Eyes on high, and behold: Who has created these things? None but an Infinitely Glorious GOD could be the Creator of them!*

The *TELESCOPE*; invented the Beginning of the last Century, and improved now to the Dimensions even of *Eighty Feet*, whereby Objects of a mighty Distance are brought much nearer to us; is an Instrument wherewith our Good *GOD* has in a singular manner favoured and enriched us: A *Messenger* that has brought unto us, from very distant Regions, most wonderful Discoveries.

*My GOD, I cannot look upon our Glasses without uttering thy Praises: By them I see thy Goodness to the Children of Men!*

By this *Enlightener* of our World, it is particularly discovered,

That all the *Planets* at least, excepting the *Sun*, are dense and dark Bodies; and that what *Light* these opaque Bodies have, is borrowed from the *Sun*.

That every one of the *Planets*, excepting the *Sun*, do change their Faces like the *Moon*. *Venus* and *Mer-*

## 18 *The Christian Philosopher.*

*cury* appear sometimes like an *Half-Moon*, and sometimes quite *round*, according as they are more or less opposite to the *Sun*. *Mars* has his Times of appearing in a *Curvi-lined Figure*. *Jupiter* has four little Stars, that continually move about him, and in doing so, cast a *Shadow* upon him. *Saturn* has a *Ring* encompassing of him.

That each of these *Planets* have *Spots* in their *Superficies*, like those of the *Moon*.

That not only each of these *Planets*, but the *Sun* also, besides whatever other *Motion* they may have, do move themselves upon their own *Centers*; some of them with a *Motion* of *Revolution*, others by that of *Libration*.

It was a good Remark made by one of the *Antients*, *Quid est Cælum, & totius Naturæ Decor, aliud, quam quoddam Speculum, in quo Summi Opificis relucet Magisterium?*

The *Pagan Tully*, contemplating, *Cælestium admirabilem Ordinem, incredibilemque Constantiam*, the admirable *Order*, and the incredible *Constancy* of the *Heavenly Bodies* and their *Motions*, adds upon it, *Qui vacare Mente putat, ne ipse Mentis expertus habendus est*: Whosoever thinks this is not governed by *Mind* and *Understanding*, is himself to be accounted void of all *Mind* and *Understanding*.

According to *Mr. Hugen*, the *Distance* of the *Sun* from us is 12,000 *Diameters* of the *Earth*. A *Diameter* of the *Earth* is 7,846 *Miles*. The *Distance* of the nearest *Fixed Stars* from us, compared with that of the *Sun*, is as 27,664 to 1: So then the *Distance* of the nearest *Fixed Stars* is at least 2,404,520,928,000 *Miles*; which is so great, that if a *Cannon-Ball* (going all the way with the same *Velocity* it has when it parts from the *Mouth* of the *Gun*) would scarce arrive there in 700,000 *Years*. *Great GOD, what is thy Immensity!*

The *Number* of the *Stars*! The learned *Arndt* has a good *Thought* upon it: *Si Deus tantam Stellarum Multi-*

*Multitudinem condidit, quis dubitet, illum multo majorem Copiam habere Spirituum Cœlestium, sine intermissione illum laudantium?* If the *Morning-Stars* are so many, how many are the *Sons of GOD!*

¶. 'Glorious GOD, I give Thanks unto thee, for the Benefits and Improvements of the *Sciences*, granted by thee unto these our latter Ages. The *Glasses*, which our GOD has given us the *Discretion* to invent, and apply for the most noble Purposes, are Favours of Heaven most thankfully to be acknowledged.

'The World has much longer enjoyed the *Scriptures*, which are *Glasses*, that bring the *best of Heavens* much nearer to us. But, tho the *Object-Glasses* are here, the *Eye-Glasses* are wanting. My GOD, bestow thou that *Faith* upon me, which, using the *Prospective* of thy Word, may discover the *Heavenly World*, and acquaint me with what is in that World, which, I hope, I am going to.

'I hear a *Great Voice* from the *Starry Heavens*, *Ascribe ye Greatness to our GOD.* Great GOD, what a Variety of *Worlds* hast thou created! How astonishing are the Dimensions of them! How stupendous are the Displays of thy *Greatness*, and of thy *Glory*, in the Creatures, with which thou hast replenished those *Worlds!* Who can tell what *Angelical Inhabitants* may there see and sing the *Praises* of the Lord! Who can tell what *Uses* those *marvellous Globes* may be designed for! Of these *unknown Worlds* I know thus much, 'Tis our Great GOD that has made them all.'

### ESSAY III. Of the FIXED STARS.

OUR Great Prospective having made Enquiry, finds a far greater Number of *Stars*, than what we can discern with the naked Eye. The Antients reckon'd only *One Thousand and Twenty Two Stars* in their

their *Fifty* Constellations. *Kepler* augments the Number to *One Thousand Three Hundred and Ninety Two*. *Bayer* carries it on to *One Thousand Seven Hundred and Nine*. Travellers to the Southward increased the Number of their Constellations to *Sixty Two*. The Number of the *Stars*, brought down into our *latest Globes*, is about *Ninetven Hundred*; but those in the Heavens are inconceivably more. Among the *Pleiades*, in a Circle of but one Degree diameter, where our naked Eye sees but *Six*, thus assisted we see *Forty Six*.

The *Milky-Way* is nothing but an infinite Number of *Stars*, which are so small, and lie so thick, as to give but a confused Glare unto us: And so the *Nebulosa*, in the Head of *Orion*.

The *Prasepe* is a Cluster of more than *Forty Stars*. Those adjacent unto the Sword and Girdle of *Orion* about *Fourscore*. Mr. *Derham* suspects, that the *Whiteness* of the *Milky-Way* is not caused by the great Number of the *Fixed Stars* in that Place, but partly by their *Light*, and partly by the Reflections of their *Planets*, which blend their *Light*, and mix it.

It is a little surprizing, that all the *Planets* appear greater in the Glass than to the naked Eye; but the *Fixed Stars* appear smaller there.

The Words of the ingenious *Dr. Cheyne* are worth considering: ‘ Since our *Fixed Stars* are exactly of the same Nature with our *Sun*, it is very likely that they have their *Planets*; and these *Planets* have *Satellites*; and these *Planets* and *Satellites* have Inhabitants, rational and irrational; Plants and Vegetables, Water and Fire; analogous to those of our System.’  
*Ascribe ye Greatness to our God!*

That which renders it probable, that the *Fixed Stars* are Bodies like our *Sun*, is this: ’Tis plain they shine by their own *Light*. It is impossible they should appear so lucid as we see them, from the *Light* of our *Sun* transmitted unto them. ’Tis their astonishing Distance from us that causes the best of our *Telescopes*

to lessen them. Tho we in this Globe approach nearer to them, some 24,000 Diameters of the Earth, or 188,304,000 Miles, one time of the Year than another; yet their *Parallax* is hardly sensible, or any at all: which could not be, if the Distance were not wonderful.

Hence also, it is impossible they should be all in the Surface of the same Sphere, since our *Sun*, which is one of them, cannot be reduced unto this Rule. They are doubtless at as immense Distances from one another, as the nearest of them is from us. Were we at such a Distance from the *Sun*, we should not have the least Glimpse of the *Planets* that now attend it. Their Light would be too weak to affect us, and all their Orbs would be united in that one lucid Point of the *Sun*.

There are discovered *New Stars* in the Firmament, which having appeared a certain Time, do again disappear.

A *New Star* appeared about 125 Years before the Birth of our Saviour.

*Claudian* mentions one which appeared, *A. C.* 388. *Albumazer Haly* mentions one, which appeared in the fifteenth Degree of *Scorpio*, and continued four Months.

In the Year 1571, and the Month of *November*, there appeared in that Constellation, which we call the Chair of *Cassiopeia*, a most notable and wonderful Star of the first Magnitude, which held a Place among the other Stars, not having any *Parallax*, and kept a Course like theirs: It continued sixteen Months; then decreased; anon grew quite invisible. A Noble Person affirms, there was a *black Spot* remaining in the Place where that *Star* appeared.

In the Year 1601, there appeared a *New Star* of the third Magnitude, in the *Swan's Breast*, which continued visible twenty five Years, and then disappeared. Thirty three Years after, it appeared again in its former Magnitude; but went away again in a Year or

two. It re-appeared five Years after, and was extant for several Years, but of no more than the sixth or seventh Magnitude.

In the Year 1671, another *Star*, which arrived unto the third Magnitude, appeared in the *Swan's* Bill; it increases, and then decreases, and is about a Month making its Revolution.

There is an admirable *Star* in the *Whale's* Neck: This first appears as one of the sixth Magnitude, and then increases by little and little, for one hundred and twenty Days together, till it arrives to its full Bigness and Brightness, which is that of the third Magnitude; wherein it continues fifteen Days together: after which, it then decreases until it becomes invisible. It appears every Year in its greatest Lustre, thirty two or thirty three Days earlier than in the foregoing Year; so that its Revolution is completed in about three hundred and thirty three Days.

In the Years 1612, and 1613, there appeared a *Cloudy Star* in the Girdle of *Andromeda*; which disappeared until the Year 1664, and then appeared again.

There is another *Star*, between *Eridanus* and the *Hare*, which also shows itself, and then withdraws, like the former.

There is one *Star* of the fourth Magnitude, with two of the fifth, in *Cassiopeia*, which in all probability are new ones.

Mr. *Cassini* has observed four towards the *Artick* Pole, which are probably new ones too.

Some *Stars* formerly appearing, do now disappear. One such there was in *Ursa Minor*. Another or two in *Andromeda*. One which *Tycho Brahe* inserts in his Catalogue, for the twentieth of *Pisces*. For time out of mind, there were *Seven Stars* observed in the *Pleiades*. The Writer of *Astronomy's Advancement* enquires, whether the *Seven Stars* in the First of the *Revelation* have no Allusion to them. However, at present there are but *Six* to be seen, probably one of them is retired.

Mr.

Mr. *Derham* thinks these *New Stars* may be Planets, belonging to some of the Systems of the Fixed Stars, and those Planets become visible, when they are in that part of their Orbits which is nearest the Earth, and again gradually disappear, as they move in their Orbits farther from us.

It is a surprizing Observation of *Dr. Cheyne*: ‘Supposing that every *Fixed Star* is a *Sun*, and governs in a *Mundane Space*, equal to our System, then there must be only as many *Fixed Stars* of the *First Magnitude*, as there are Systems that can stand round ours. But there are but about twelve or thirteen *Spheres* that can stand round a middle one, equal to them: And so many are the Stars of the first Magnitude. Again, if we examine how many *Spheres* can stand round this first Range of *Spheres*, we shall find their Number between Forty-Eight and Fifty-Two. And so we find the Number of the Stars of the *second Magnitude*. As for the several other Magnitudes, it is not altogether possible to determine their Number, because they are not so distinguishable from those of the other Magnitudes, as the first and second are.’ He adds most reasonably and religiously: *It is impossible for any body seriously to consider in his Mind, what is certain about these Heavenly Bodies, and to hinder himself from being ravished with the Power and Wisdom of the Great GOD of Heaven and Earth!*

Mr. *Derham* supposes the particular Star *Syrius* to be above two Millions of Millions of Miles distant from us.

*Dr. Grew*, from a very probable Computation, makes the Distance of the *Pole-Star* from the Earth to be Four Hundred and Seventy Millions, and Eight Hundred and Forty Thousand Miles.

Considering the mean and vile Fables of the *Pagan Poetry*, yea, and the scandalous Actions of some *Greater Devils* among the *Pagans*, which are commemorated and celebrated in the Names which our *Globes* give

unto the *Constellations*, I cannot but move you, O *Christian Astronomers*, to attempt a Reformation of so shameful an Abuse. For shame, let those Glorious Bodies no longer suffer the Affronts of our *Base Denominations*. To put *Christian Names* on the *Constellations*, and allowing the present *Figures* upon our *Globes* to remain still as they are, nevertheless to transfer them into *Scriptural Stories*, was a thing endeavoured by *Schillerus*, and by *Novidius*.

The Caution used in the antient *Hebraick* and *Arabic* Astronomy, about the Names of the *Constellations*, is well known to all that are versed in *Antiquities*. Dismissing that Reflection, what remains is this: A learned *Frenchman* pretends to tell us, That the *Stars* in the *Heavens* do stand ranged in the Form of *Hebrew Letters*, and that it is possible to Read there, whatever is to happen of *Importance* throughout the *Universe*. Amazing! That so much Learning should be *Consistent* with, and much more, that it should be *Subservient* to such *Futilities*! The true *Reading of the Stars* is to look up, and spell out, the glorious Perfections of that *GOD*, who is the *Father of those Lights*, and who made and moves them all.

¶ I would by no means look up unto the *Stars*, with the foolish *Astrology* of the *Star-gazers*, who try to read, what the Great *GOD* that made them has not written there. But there is very plainly to be read there, the Power and the Grandeur of the Glorious *GOD*. This, this I will observe, prostrate in the Dust before Him. *The Heavens declare the Glory of GOD*; and shall not I observe it? *When I consider thy Heavens, O Lord, and the Stars which thou hast ordained, I cannot but cry out, What is Man, that thou art mindful of him, and the Son of Man, that thou visitst him!*

Unto the Father of the Faithful, my *GOD* said, *Look now toward Heaven, and tell the Stars, if thou be able to number them; so shall thy Offspring be. Glorious*  
 Lord,

Lord, make me one of them. A *Worm* of the *Dust*, filled with the *Love* of *GOD* and of his *Neighbour*, becomes a *Star* in the *Eye* of the *Glorious GOD*: And if he be one of much *Grace*, and one of much *Use*, he is then a *Star* of the *greater Magnitude*.

*GOD*, my *Maker* and theirs, gives me that *Song* for the *Night*, wherein I view them; He tells the *Number* of the *Stars*; He calls them all by their *Names*. 'Tis true of the *Just*, who are to *shine* as the *Stars* for ever and ever. May I be known by the *Lord* as one of that *Number*, and have a *Name* in His *Book* of *Life*!

Are the very *Stars* themselves liable to *Vicissitudes*? And shall not I look for them in this our miserable *World*?

How little can I comprehend the *Condition* and *Intention* of the *Stars*? O *Incomprehensible GOD*, I will not cavil, but adore, when I find *Mysteries* in thy *Providence*, altogether beyond my *Penetration*!

#### ESSAY IV. Of the SUN.

A Most Glorious and most Useful *Creature*! But still a *Creature*!

By Old *Astronomers* call'd, *Cor Planetarum*.

There will be no *Athenians* now to arraign me for it, if I call it, *The Carbuncle of the Heavens*. *Kircher* supposes the *Sun* to be a *Body* of wondrous *Fire*, unequal in *Surface*, composed of *Parts* which are of a different *Nature*, some *fluid*, some *solid*: The *Disque* of it, a *Sea of Fire*, wherein *Waves* of astonishing *Flame* have a perpetual *Agitation*.

*Sir Isaac Newton*, as well as *Dr. Hook*, takes the *Sun* to be a *solid* and *opaque Body*. *Dr. Hook* thinks this *Body* to be encompassed with a vast *Atmosphere*, the *Shell* whereof is all that shines. The *Light* of the *Sun* he takes to be from the *Burning* of the more *superficial*

ficial Parts, which are set on fire, which may be without hazard of being burnt out in a vast Number of Ages. And Sir *Isaac Newton* thinks the *Sun* to be a sort of a mighty Earth, most vehemently hot; the Heat whereof is conserved by the marvellous Bigness of the Body, and the mutual Action and Re-action between *That*, and the *Light* emitted from it. Its Parts are kept from fuming away, not only by its *Fixity*, but also by the *Density* of the Atmosphere incumbent on it, and the vast Weight thereof. The *Light* seems to be emitted much after the manner as *Iron*, when heated unto such a Degree, as to be just going into Fusion, by the vibrating Motion of its Parts emits with Violence plentiful Streams of liquid Fire. So great a Body will continue its Heat a great while, perhaps in proportion to its Diameter.

Upon the Convexity of the Body of the *Sun*, there are observed *black Spots*, which are moveable, and changeable. These move regularly towards the West, and finish their Revolution in about five and twenty Days; and so testify unto us, that the *Sun* turns upon its own Center: the *Axis* of the Motion inclining to the *Ecliptick*.

These *Maculae Solares* are probably Evaporations, which arise from the Body of the *Sun*, somewhat as Vapours do from the Earth; and they form themselves into *Clouds*. That which adds to this Probability, is, that the *Spots* are always changeable in their Bulk, and Form, and Configuration. Sometimes their *Number* is greater, and sometimes lesser, and sometimes there are none at all. Some of them shine, and others that shone, become dark. Diligent Astronomers, who have waited on them for nine or ten Years together, have never found them in all this time to return unto the *same Configuration*. In *Charlemain's* time, every one saw a *Spot* in this great Luminary. And there have been divers Days together, [as in the Year 1547,] wherein the *Sun* has appeared little brighter than the

*Moon* in her total Eclipse, and the *Stars* have been visible at Noon-Day. *Virgil* and *Ovid* intimate such a Darkness upon the *Sun* once for a whole Year together, that the Fruits of the Earth could not be ripened.

The apparent Diameter of the *Sun* being sensibly shorter in *December* than in *June*, it is plain, and Observation confirms it, that the *Sun* is proportionably nearer to the Earth in *Winter* than in *Summer*. It is also confirmed, by the Earth's moving swifter in *December* than in *June*; which it does about five Fifteenths. And for this reason there are about eight Days more from the *Sun's* vernal *Equinox* to the autumnal, than from the autumnal to the vernal.

Mr. *Tempion's* Observations, from the *Equation of natural Days*, render it evident, That the Motion of the *Sun* (if we must speak in those Terms) must be swifter at some times, than at others. Great GOD, the Motion is always under thy Glorious Guidance!

According to *Cassini*, the *Sun's* mean Distance from the Earth is 22,000 Semidiameters of the Earth. And the *Sun's* Diameter is equal to 100 Diameters of the Earth: And therefore the Body of the *Sun* must be 1,000,000 times greater than the Earth.

*Cassini* more directly expresses himself; That the *Sun's* Distance from the Earth is 172,800,000 *English* Miles.

Take Mr. *Derham's* Computation; *Saturn* is computed at 93,451 Miles in Diameter, and consequently 427,318,300,000,000 Miles in Bulk: *Jupiter* at 120,653 Miles in Diameter, and by consequence 920,011,200,000,000 Miles in Bulk. But yet, as amazing Masses as these all are, they are all far outdone by that Globe of Fire, the *Sun*: which, as it is the *Fountain of Light and Heat* unto all the Planets about it, by its kind Influences affording them the great Comforts of Life; so does it in Bulk surpass them all. Its Diameter is computed at 822,148 Miles; and so there

there must be 290,971,000,000,000 Miles in the solid Content of it.

Dr. *Grew* is of opinion, that for ought we know, the *Sun* may afford us his *Light*, without such an intense *Heat*, as has been imagined. The Beams of the *Sun*, he thinks, may first conceive their *Heat*, when they come to be mixed with our *Atmosphere*. There are things intensely *hot*, which give no *Light* at all; but *Rotten Wood*, or *Fish*, and the *Glowworm*, and some other Bodies, give a brisk *Light*, without any *Heat*. *Light* and *Heat*, he thinks, have no necessary Conjunction, at least not in any sensible Proportion. It is known also, how necessary the *Air* is to produce *Fire*, and even *Light* itself, in some of those Bodies that shine in the dark. If the *Sun* were a *burning Body*, and the *Heat* of it so much greater than that we feel of it, as to be in proportion to its Distance; how comes the Substance of it so little to be altered by so intense an *Heat*, and to hold this *Heat* with so great an *Equality* for near six Thousand Years? One way or t'other; either so *luminous* a Body without *Fire*, or so *burning* a Body, not *consumed* or *altered*; it is wonderful!

But Sir *Isaac Newton* supposes, That a very large, dense, and fixed Body, when *heated* beyond such a degree, may emit *Light* so copiously, that by such Emission, and by the Re-action of its *Light*, and by the Reflection and Refraction of the Rays within its hidden *Meatus*, it may come to grow still hotter and hotter, as deriving more *Degrees of Heat* by those Ways, than it can of *Cold* by any other. Thus, he supposes the *Sun* a vast Globe that is vehemently heated, and the *Heat* thereof preserved by its great Magnitude, and the mutual Action and Re-action which there is between it, and the *Light* emitted by it. And its Parts are preserved from evaporating in *Flame* and *Fume*, not only by the Great *Fixity* of its Nature, but also by the mighty Weight and Thickness of the *Atmosphere*,

sphere, which environs it; and condenses its Vapours, whenever they are emitted.

However, behold the *Sun* seated by the Glorious GOD, like a powerful *Monarch*, on his Throne, (as *Dr. Cheyne* expresses it) from thence distributing Light, and Life, and Warmth, in a plentiful Effusion, to all the Attendants that surround him; and that so equally, that the nearest have not too much, nor the farthest too little: His Bulk and Situation so contrived, in respect of the *Planets*, as to have Quantity of Matter just enough to draw round him these Massy Bodies, and their *Satellites*, who are so various in their Quantities, and their Distances, and that in regular and uniform Orbits. The Doctor says well, *These are things that clearly speak the Omnipotence and Omniscience of their Author.*

What a Fancy is that of *Dr. Wittie*! That the SUN is probably the *Seat of the Blessed*; the *Sun*, which is the Center of the *Heavens*, and the Seat of *inherent Light*. It is true, of the Blessed we read, *They shall shine as the Sun*; and their Blessedness is called, *The Inheritance of the Saints in Light*. But this is very short of Demonstration, that the Saints must be lodged there. Tho' the Church Militant were once represented as *clothed with the Sun*, it follows not, that the Church Triumphant must be *Dwelling in the Sun*.

And *Mr. Arndt* propounds a Thought, which cannot be too much dwelt upon: *Sicut Sol Ornamentum est Cæli, ita CHRISTUS est Ornamentum suæ Ecclesiæ.*

*Dr. Cheyne* with good reason apprehends, That the Quantity of *Light* and *Heat* in the *Sun* is daily decreasing. It is perpetually emitting Millions of *Rays*, which do not return into it. *Bodies* attract them, and suffocate them, and imprison them; and they go no more back into their Fountain.

*Mr. Bernoulli*, from the Flashes of the *Light*, in the Vacuity of a Tube accommodated with *Mercury*, whereby a dark Room is enlightned, renders it likely  
that

that our Atmosphere, and all the Bodies on our Globe, are saturated at all times with Rays of *Light*, which never do return unto their Fountain.

'Tis true, this Decrease of the *Sun* is very inconsiderable. It shews that the Particles of *Light* are extremely small, since the *Sun* for so many Ages has been constantly emitting Oceans of *Rays*, without any very sensible Diminution. However, 'tis from hence evident, that the *Sun* had a Beginning; it could not have been from *Eternity*; *Eternity* must have wasted it: It had long e'er now been reduced unto less than the *Light* of a *Candle*.

*Glorious GOD, thou art the Father of Lights, the Maker of the Sun!*

In a late *Act of the Faith*, as they call their inhuman Butcheries, performed by that execrable *Hell upon Earth*, the *Inquisition* in *Portugal*; a Confessor being brought forth to die a grievous Death, as soon as he came into the *Light* of the *Sun*, which he had not seen in some Years before, he broke forth into this Expression, *Who that has Reason in him, could worship any but the Maker of that Glorious Creature!* They gagg'd him immediately!

My Pen shall not be serv'd so. Enjoying the Benefits of the *Sun*, I will glorify him that made it: *Thou alone art for ever to be adored, O thou Maker of that Glorious Creature!*

An eminent Writer of *Natural Theology* has this Remark, That the *Sun* is *Imago illorum qui aliis præsunt*. And that all *Superiours* in every Station, looking towards the *Sun*, should have shot into their Minds the Rays of such Thoughts as these; *What good Influences ought I to dispense unto those that have Dependance on me!*

The Apocryphal Book of *Wisdom* does wisely, to call the *Light* of the *Sun*, *An Image of the Divine Goodness*.

The *Diameter* of the *Earth* is near Eight Thousand Miles; and the *Diameter* of the *Orbis Magnus* Ten Thousand

Thousand Diameters of the Earth. This *Orbis Magnus*, or the Orbit of the Earth, in its annual Revolution about the *Sun*; Dr. *Gregory* makes the Semidiameter of it 94,696,969 *English* Miles: which is the Distance of the *Earth* from the *Sun*. But the Semidiameter of *Saturn's* Orbit is no less than ten times as great. All Astronomers before *Kepler* supposed this Orbit a *perfect Circle*; but he has proved it an *Ellipsis*. If our *Solar System* have such large Dimensions, and if every *Fixed Star* be a *Sun*, that has a *System*, of the like Dimensions perhaps, belonging to it:---

*Great is our GOD, and greatly to be praised: His Greatness is unsearchable!*

How is it possible to consider the *Grandeur* of our *GOD*, without *Annihilating* ourselves before Him, or without Horrour at the View of the *matchless Evil*, in sinning against so Glorious a Majesty!

It is a Passage in a little Treatise, entitled, *The Book of Nature*; not unworthy to be transcribed here: 'If thou never observe the Sky with thine Eyes, but to guess at Rain and Fair Weather; or if thy looking up to Heaven be bounded with the *Starry Firmament*; and, if thou removest from thee the Love and Honour of *GOD*, and the Contemplation of Him who dwelleth in the Heavens, thou hast no cause to raise thyself above the *Brutes*, thy Fellow-Inhabitants of this Lower World.'

And now, let *Hugo de S. Victore* conclude for us: *Quis Solem per hyberna descendere Signa præcipit? Quis rursum per æstiva Signa ascendere facit? Quis eum ab Oriente in Occidentem ducit? Quis iterum ab Occidente in Orientem revehit? Hæc cuncta sunt mirabilia, sed soli Deo possible.*

How Glorious will the Righteous be in that World, when they shall *shine as the Sun*?

## ESSAY V. Of SATURN.

ALL the *Master Planets*, as they may be called; move about the *Sun*, as their *Common Center*. They move with different *Velocities*: but there is this *Common Law* observed in all of them; *That the Squares of the Times of their Revolutions, are proportional to the Cubes of their Distances*. And the *Lunar Planets* observe the same *Law* in their *Motions* about their *Master Planets*. And another *Common Law* with them, is, *That Lines drawn from the Foci of the Curves they move in, to their Bodies, will sweep over equal Area's in equal Times on the Planes of other Orbits*. Who but the *Great GOD* could make and fix these *Laws*? *Lord, they continue this day according to thine Ordinances, for all are thy Servants*.

It is now found, that *Saturn*, besides his round *Body*, has also a luminous *Ring*, which encompasses him, as the *Horizons* of our *Artificial Globes* do usually encompass them; and is flat upon the *Verge*, as they use to be. The *Ring* shews itself in an *Oval*, and at certain times it wholly disappears.

It appears not, however, that *Saturn* revolves upon his own *Center*.

When this *Planet* appears at 20 degr. 30 min. of *Pisces*, and of *Libra*, then 'tis that he appears round; or without his *Ansa*, as they are called, which is once in fifteen Years; or half his *Course*, which every one knows to be compleated in thirty Years, or 10,950 Days.

The *Ring* seems to be *Opake* and *Solid*, encompassing the *Planet*, but no where touching it. The *Diameter* of it is two and a quarter of *Saturn's* *Diameters*; and the *Distance* of the *Ring* from the *Planet* is about the *Breadth* of the *Ring* itself. *Mr. Hugen* takes the *Breadth* of the *Ring* to be about Six Hundred *German Miles*.

The Proportion of the Body of *Saturn* to the Earth, is that of 30 to 1.

The Distance of *Saturn* from the *Sun* is about ten times as great as the Distance of our Earth from him; and by consequence, that Planet will not have above an hundredth Part of that Influence from the *Sun*, which this Earth enjoys.

The Ring of *Saturn*, being distant from him no more than two and a quarter of his Semidiameters, it cannot be seen at the Distance of 64 Degrees from *Saturn*'s Equator, in whose Plane the Ring is placed. So that there is a Zone of almost 53 Degrees broad, towards either Pole, to which this famous Ring does never appear.

*Saturn* is attended with five *Satellites*.

The First *Satellit* makes a Revolution about *Saturn* in 1 Day, 21 Hours, and 19 Minutes; and makes two Conjunctions with *Saturn* in less than two Days. It is distant from the Center of *Saturn*  $4\frac{3}{8}$  of his Semidiameters.

The Second makes his Revolution in 2 Days, 17 Hours, and 43 Minutes. It is distant from *Saturn*  $5\frac{3}{7}$  Semidiameters of the Planet.

The Third is distant from *Saturn* eight of his Semidiameters, and makes his Revolution in almost  $4\frac{3}{5}$  Days.

The Fourth revolves in 15 Days, 22 Hours, 41 Minutes. 'Tis distant from the Center of *Saturn* about 18 of his Semidiameters.

The Fifth is distant from the Center of *Saturn* 54 of his Semidiameters, and revolves about him in  $79\frac{1}{2}$  Days.

Mr. *Huygen*, who first of all discovered the Fourth, (for which cause 'tis called the *Huygenian Satellit*, tho Dr. *Halley* afterwards corrected the Theory of its Motion) thinks, the mighty Distance between the Fourth and Fifth *Satellites* to be a ground for Suspicion, that

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there may be a *Sixth* between them, or that the *Fifth* may be attended with some of his own.

On the Revolutions of the *Planets*, the incomparable Sir *Richard Blackmore*, in his Noble Poem of *Creation*, thus drives us to consider the *First Cause* of all :

- ‘ *Saturn* in Thirty Years his Ring compleats,
- ‘ Which swifter *Jupiter* in Twelve repeats.
- ‘ *Mars* Three and Twenty Months revolving spends,
- ‘ The Earth in Twelve her Annual Journey ends.
- ‘ *Venus*, thy Race in twice Four Months is run ;
- ‘ For his *Mercurius* Three demands ; the *Moon*
- ‘ Her Revolution finishes in One. } }
- ‘ If all at once are mov’d, and by One Spring,
- ‘ Why so unequal is their Annual Ring ?

The Motions of the Heavenly Bodies can be produced and governed by none but an Infinite GOD. It is well argued by *Lactantius* ; *There is indeed a Power in the Stars, of performing their Motions ; but that is the Power of God who made and governs all things, not of the Stars themselves that are moved.* And by *Plato* before him ; *Let us think, how it is possible for so prodigious a Mass to be carried round for so long a time by any natural Cause ? For which reason I assert God to be the Cause, and that ’tis impossible it should be otherwise.*

## ESSAY VI. Of JUPITER.

**J**UPITER’S Globe, according to *Cassini*’s Measures, must be greater than that of the Earth, by 2460 Times. The Periodical Time of his Revolution about the *Sun*, is Twelve Years, or 4380 Days.

In the Body of *Jupiter*, and over against his luminous Part, there are observed three dark Spots, like the Spots which appear in the *Moon*. These Bands or Girdles are near strait and parallel, and extending from East to West, after the manner of the *Ecliptick*. They make a kind of *Equinoctial* with Tropicks. The

*Southern* is larger a little than the *Northern*, and a little nearer to the South than the other is to the North.

Dr. *Hook* has observed also a small and a dark Filament, and the *Zones* growing a little darker, as they draw nearer to the Poles. And some have observed in them something of *Curvity*, tho their Borders are perfectly round.

*Jupiter* has *Four Satellites*, or little Moons, waiting on him.

The nearest is distant from him, according to Mr. *Flamsteed's* most accurate Observations, a little more than Five of his Semidiameters; and finishes his Course in 1 Day, 18 Hours, 28 Minutes, and a few Seconds.

The Second is distant from him about 8 of his Semidiameters, and finishes his Course in 3 Days, 13 Hours, 17 Minutes, and a few Seconds.

The Third is distant from him about 14 of his Semidiameters, and finishes his Course in 7 Days, 3 Hours, and 59 Minutes, and some Seconds.

The Fourth is distant from him about 24 of his Semidiameters, and finishes his Course in 16 Days, 18 Hours, 5 Minutes, and some Seconds.

These *Guards* of *Jupiter* cast a Shadow upon him, when they are found interposed between the Sun and him.

The Fourth would appear to an Eye in *Jupiter*, as big as the Moon does to us. A Spectator there would have also four kinds of Months. In one of *Jupiter's* Years, which is Twelve of ours, there would be 2407 of the least Months; Half that Number for the next *Satellit*: The Months of the Third would be near subduple of the Second, or subquaduple of the First: The Months of the greatest would be about Two Hundred Fifty-four. A Year of *Jupiter* has a great Number of Days; but of the four Sorts of Months,

the least contains only *four Days* and a Quarter; the greatest something more than *Forty*.

Mr. *Cassini* has observed a Couple of *Spots* in the Body of *Jupiter*, which make a Revolution on the Center of this Planet, from East to West, in about 9 Hours, 56 Minutes. Others have lately confirmed it by better Observations. This proves, that the Planet moves about upon its own Center. Behold the *shortest Period* that is made in the Firmament! The Days and the Nights, each of them *Five Hours* a-piece.

*Campani* observed, with a more than ordinary *Telescope*, certain Protuberances and Inequalities in the Surface of this Planet.

We may here insert a Remark upon the Periodical Motions of the *Planets*; both the *Primary* and their *Secondaries*.

One thing very considerable in the Periodical Motion of the *Secondary Planets*, is, That it is mixed with a kind of *Cochleous Direction* towards one or other Pole of its *Primary Planet*; by which means every *Satellit*, by gentle Degrees, changes its Latitude, and makes its Visits towards each Pole of its *Primary*.

We will here break off with the Words of Mr. *Molyneux*. 'From hence may we justly fall into the deepest Admiration, that one and the same *Law of Motion* should be observed in Bodies so vastly distant from each other, and which seem to have no Dependance or Correspondence with each other. This doth most evidently demonstrate, that they were all at first put into Motion by one and the same unerring *Hand*, even the infinite Power and Wisdom of GOD, who hath fixed this Order among them all, and hath established a *Law* which they cannot transgress.'

*Chance*, or dull *Matter*, could never produce such an harmonious *Regularity* in the Motion of Bodies so vastly distant: This shews a Design and Intention in the *First Mover*.'

ESSAY VII. Of MARS.

MARS borrows his Light from the Sun, as well as the rest of his Planetary Brethren. He has his Increase and his Decrease of Light; like the Moon; may be seen almost bisected, when in his Quadrature with the Sun, or in his Perigæon; tho never corniculated or forked, like his Inferiours.

Dr. Hook discovered several Spots in Mars, and particularly a triangular one, which has a Motion. Mr. Cassini afterwards discovered four Spots, the two first on one Face of Mars, afterwards two more that were larger, on the other Face. Upon further Observation it was found, that the Spots of these two Faces turned by little and little from East to West, and returned at the Space of twenty-four Hours and forty Minutes. In such a Term therefore, there is a Revolution of Mars upon his own Axis.

The Year of Mars is near twice as long as ours; his Natural Day a little greater than ours: his Artificial Day is almost every where equal to his Night, besides what belongs to Twilight. Mars as well as Jupiter has a perpetual Æquinox. Hence there can be but little Variety of Seasons in any one particular Place of these Planets.

Whence the Fasciæ, or Fillets observed in Mars? There appear certain Swathes, as we may call them, which are posited parallel to his Æquator. Are they owing to the Heat and Cold there, like our Clouds and Snows?

It is thought that Mars has an Atmosphere, because Fixed Stars are obscured, and as it were extinct, when they are seen just by his Body.

## ESSAY VIII. Of VENUS.

**V**ENUS has various Appearances; *round* sometimes; anon *half-round*; by and by like a *Crescent*.

Mr. *Cassini* discovered certain *Spots* on this Planet, by the Motion whereof it appeared that it moved upon its own Center, and upon an *Axis*, which carries it from North to South; a Motion wholly unknown any where else in the Heavens. *Two Spots* it has, which are very thin, long, uncertainly terminated; and a shining Part belongs to one of them.

He discover'd also, as he judges, a *Satellit* attending this Planet; which Dr. *Gregory* assents to, as more than probable. This is not usually seen, perhaps because it may not have a fit Surface to reflect the Light of the *Sun*; which is the Case of the *Spots* in the Moon.

*Herigone*, and *Keplerus*, and *Rhatensis*, conclude, that *Venus* moves about its *Axis* in about fourteen Hours. Dr. *Cheyne* says in twenty-three.

## ESSAY IX. Of MERCURY.

**T**HE Great *Hewelius* hath observed, That *Mercury* changes his Face, like *Venus*, and like our Moon; appearing sometimes *round*, sometimes *half-round*, sometimes like a *Crescent*.

This Planet has his Abode so near the *Sun*, that as yet there has been little discovered of him.

It appears not yet, whether he revolves upon his own *Axis*, and so what may be the Length of his Days. But it is probable, he may have such a Motion, as well as the other Planets. However, his Year is hardly equal to a Quarter of ours.

Sir *Isaac Newton* has terrible Apprehensions of the Heat in this Planet, as being seven times as much as the

the Heat of the Summer-Sun in *England*; which according to his Experiments made by the *Thermoscope*; would be enough to make Water boil. If the Bodies in this Planet be not enkindled by this Heat, they must be of a peculiar Density. But Mr. *Azout* pretends to prove, That tho this Planet be so near the Sun, yet the Light there is not capable of burning any Objects.

¶. But let us now entertain ourselves with a *Synopsis*, of certain Matters relating to the Planets, as they are determined by the latest and most accurate Astronomers.

*The Distance from the Sun, in English Miles.*

Of Mercury	—————	Miles	32,000,000
Venus	—————	—————	59,000,000
The Earth	—————	—————	81,000,000
Mars	—————	—————	123,000,000
Jupiter	—————	—————	424,000,000
Saturn	—————	—————	777,000,000

*The Diameter in English Miles.*

Of Mercury	—————	Miles	4,240
Venus	—————	—————	7,906
The Earth	—————	—————	7,935
Mars	—————	—————	4,444
Jupiter	—————	—————	81,155
Saturn	—————	—————	67,870
The Sun	—————	—————	763,460

*The Time of the Periodick Revolution.*

		Days		Hours
Of Mercury	—————	87	—————	23
Venus	—————	224	—————	17
The Earth	—————	365	—————	6
Mars	—————	686	—————	23
Jupiter	—————	4,332	—————	12
Saturn	—————	10,759	—————	7
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To this we will add Mr. *Derham's* Account of their Magnitude.

*Saturn* has an Orb of 1,641,526,386 *English* Miles Diameter.

*Jupiter* an Orb of 895,134,000 Miles.

*Mars* an Orb of 262,282,910 Miles.

*Venus* an Orb of 124,487,114 Miles.

*Mercury* an Orb of 66,621,000 Miles.

¶. 'Great GOD, thou hast lifted me up to Heaven:  
' Oh! let me not be cast after all down to Hell.

' The Philosopher, who gazing on the Stars with  
' his attentive Observation, tumbled into a Pit that  
' he observed not, was not so unhappy as he that has  
' visited Heaven on the noble Intentions of *Astrono-*  
' *my*, but by an ungodly Life, procures to himself a  
' Condemnation to that Hell, which is a State and  
' Place of Utter Darknes. Wretched Astronomers!  
' Who are among the wandering Stars, to whom is reserved  
' the Blackness of Darknes for ever.'

We will conclude what we collect about the Stars, with transcribing a Passage out of the *Miscellanea Curiosa*. 'The Honourable Mr. *Roberts* computes the Distances of the *Fixed Stars*; — which he supposes to be so many *Suns* of a different Magnitude. He thinks, that it seems hardly within the reach of any of our Methods to determine it. The Diameter of the *Earth's Orb*, which is at least One Hundred and Sixty Millions of Miles, is but a Point in comparison of it. At least Nine Parts in Ten, of the Space between us and the *Fixed Stars*, can receive no greater Light from the *Sun*, or any of the Stars, than what we have from the *Sun* in a clear Night. Light takes up more time in travelling from the Stars to us, than we in making a *West-India* Voyage, which is ordinarily performed in six Weeks. A Sound would not arrive to us from thence in Fifty Thousand Years

' Years, nor a Cannon-Bullet in a much longer Time.  
' This is easily computed, by allowing ten Minutes  
' for the Journey of *Light* from the *Sun* hither; and  
' that *Sound* moves about *Thirteen Hundred Foot* in a  
' Second.'

ESSAY X. Of COMETS.

'TIS an admirable Work of our GOD, that the many *Globes* in the Universe are placed at such Distances, as to avoid all violent Shocks upon one another, and every thing wherein they might prove a prejudice to one another.

Even *Comets* too, move so as to serve the Holy Ends of their Creator! COMETS, which are commonly called *Blazing Stars*, appear unto later Observations to be a sort of *Excentrical Planets*, that move periodically about the *Sun*.

Sir *Isaac Newton*, from whom 'tis a difficult thing to dissent in any thing that belongs to *Philosophy*, concludes, That the Bodies of *Comets* are solid, compact, fixed, and durable, even like those of the other *Planets*.

He has a very critical Thought upon the *Heat*, which these *Bodies* may suffer in their Transits near the *Sun*. A famous one, in the Year 1680, passed so near the *Sun*, that the *Heat* of the *Sun* in it must be twenty-eight thousand times as intense as it is in *England* at Midsummer; whereas the *Heat* of boiling Water, as he tried, is but little more than the dry Earth of that Island, exposed unto the Midsummer-Sun: and the *Heat* of *red-hot Iron* he takes to be three or four times as great as that of *boiling Water*. Wherefore the *Heat* of that *Comet* in its *Perihelion* was near two thousand times as great as that of *red-hot Iron*. If it had been an Aggregate of nothing but Exhalations, the *Sun* would have render'd it invisible. A Globe of *red-hot Iron*, of the Dimensions of our Earth, would scarce be cool, by his Computation, in 50,000 Years.

Years. If then this *Comet* cooled an hundred times as fast as *red-hot Iron*, yet, since his Heat was 2,000 times greater than that of *red-hot Iron*, if you suppose his Body no greater than that of this Earth, he will not be cool in a Million of Years.

The *Tails* of *Comets*, which are longest and largest just after their *Perihelions*, he takes to be a long and very thin Smoke, or a mighty Train of Vapours, which the ignited *Nucleus*, or the Head of the *Comet*, emits from it. And he easily and thoroughly confounds the silly Notion of their being only the *Beams* of the *Sun*, shining thro the Head of the *Star*.

The Phenomena of the *Tails* of *Comets* depend upon the Motion of their *Heads*, and have their Matter supplied from thence.

There may arise from the Atmosphere of *Comets*, Vapours enough to take up such immense Spaces, as we see they do. Computations made of and from the Rarity of our *Air*, which by and by issue in Astonishments, will render this Matter evident.

That the *Tails* of *Comets* are extremely rare, is apparent from this; the *Fixed Stars* appearing so plainly thro them.

The Atmosphere of *Comets*, as they descend towards the *Sun*, is very sensibly diminished by their vast running out, that they may afford Matter to produce the *Blaze*. *Hevelius* has observed, that their Atmosphere is enlarged, when they do not so much run out into *Tail*.

This *Lucid Train* sometimes, as *Dr. Cheyne* observes, extends to four hundred thousand Miles above the Body of the *Star*.

*Sir Isaac Newton* has an Apprehension, which is a little surprizing, That those Vapours which are dilated, and go off in the *Blazes* of *Comets*, and are diffused thro all the Celestial Regions, may by little and little, by their own proper *Gravity*, be attracted into the *Planets*, and become intermingled with their Atmospheres.

mospheres. As to the Constitution of such an *Earth* as ours, it is necessary there should be *Seas*; thus, for the Conservation of the *Seas*, and Moisture of the Planets, there may be a necessity of *Comets*; from whose condensed Vapours, all that *Moisture*, which is consumed in Vegetations and Putrefactions, and so turned into dry Earth, may by degrees be continually supplied, repaired, and recruited. Yea, he has a suspicion, that the Spirit, which is the finest, the most subtile, and the very best part of our *Air*, and which is necessarily requisite unto the Life and Being of all things, comes chiefly from *Comets*. If this be so, the Appearance of *Comets* is not so dreadful a thing, as the *Cometmania*, generally prevailing, has represented it.

Mr. *Cassini* will thus far allow bad Presages to *Comets*, That if the Tail of a *Comet* should be too much intermingled with our *Atmosphere*, or if the Matter of it should, by its *Gravity*, fall down upon our Earth; it may induce those Changes in our *Air*, whereof we should be very sensible.

*Bernoulli*, in his *Systema Cometarum*, supposes, That there is a *Primary Planet*, revolving round the *Sun* in the space of four Years and 157 Days; and at the distance of 2,583 Semidiameters of the *Orbis Magnus*. This *Primary Planet*, he supposes, either from his mighty *Distance*, or his minute *Smallness*, to be not visible unto us; but however to have several *Satellites* moving round him, tho none descending so low as the Orbit of *Saturn*; and that these becoming visible to us, when in their *Perigæon*, are what we call *Comets*.

*Seneca's* Prediction, That a Time should come, when our Mysteries of *Comets* should be unfolded, seems almost accomplished. However *Seneca* has not obliged us with the *Phænomena* observed by him, which encouraged this Prediction.

No Histories of *Comets* were of service to the Theory of them, until *Nicephorus Gregoras*, a *Constantinopolitan*

*litan* Astronomer, described the Path of a Comet in 1337.

All that consider'd Comets until *Tycho Brahe*, consider'd them as no other than Vapours below the *Moon*.

Anon, the sagacious *Kepler* improving on *Tycho's* Discoveries, came at a true System of Comets, and found, that they moved freely through the Planetary Orbs, with a Motion that is not much different from a *Rectilinear* one.

The incomparable *Hevelius* went on, and though he embraced the *Keplerian* Hypothesis, of the *Rectilinear Motion of Comets*, yet he was aware, That the Path of a Comet was bent into a curve Line towards the Sun.

At last the illustrious Sir *Isaac Newton* arrives with Demonstrations, That all the Phenomena of Comets would naturally follow from the *Keplerian* Principles. He shewed a Method of delineating the Orbits of Comets geometrically; which caused Admiration in all that considered it, and comprehended it.

The most ingenious *Dr. Halley* has made Calculations, upon which he ventures to foretell the Return of Comets; but he observes, that some of them have their Nodes pretty near the annual Orb of the Earth. I will transcribe the Words he concludes with: 'What may be the Consequences of so near an Appulse, or of a Contact, or lastly, of a Shock of the Celestial Bodies, (which is by no means impossible to come to pass) I leave to be discussed by the Studious of Physical Matters.'

The Sentiments of so acute a Philosopher as *Dr. Geyne* upon Comets, deserve to be transcribed.

I think it most probable, that these frightful Bodies are the Ministers of *Divine Justice*, and in their Visits lend us *benign* or *noxious* Vapours, according to the Designs of Providence; That they may have brought, and may still bring about the great Catastrophe of our System; and, That they may be the Habitation of *Animals* in a State of Punishment, which  
' if

‘ if it did not look too notional, there are many Arguments to render not improbable.’

And elsewhere: ‘ ’Tis most likely, they are the Ministers of Divine Justice, sending baneful Steams, from their long Trains, upon the *Planets* they come nigh. However, from them we may learn, that the Divine Vengeance may find a *Seat* for the *Punishment* of his disobedient Creatures, without being put to the expence of a New Creation.’

¶. When I see a vast Comet, blazing and rolling about the unmeasurable *Æther*, I will think;

‘ Who can tell, but I now see a wicked World made a fiery Oven in the Time of the Anger of GOD! The Lord swallowing them up in his Wrath, and the Fire devouring them!’

‘ What prodigious Mischief and Ruin might such a Ball of Confusion bring upon our sinful *Globe*, if the Great GOD order its Approach to us!’

‘ How happy they, that are in the Favour and Friendship of that Glorious Lord, who knows how to deliver the Pious out of Distresses, and reserve the Unjust for a Punishment of a Day of Judgment!’

—*Si fractus illabatur Orbis,  
Impavidum ferient Ruinae.*

## APPENDIX. Of HEAT:

WE should be forgetful, if we take our leave of the *Heavenly Bodies*, and say nothing of *Heat*, whereof they have so much among them.

To the *Heat* of Bodies it is requisite, that the small Parts of it be agitated with much Vehemence and Rapidity; and that the Determinations of the insensible Corpuscles thus agitated be also very *various*; and that likewise the variously agitated Particles be so small, as generally speaking to be singly insensible: for unless they be exceeding fine, they cannot penetrate readily

readily into the Pores of contiguous Bodies, and so warm or burn them.

The Operation of *Heat* upon our Senses, the Result of which we commonly call *Heat*, is usually estimated by its Relation to the Organs of our *Feeling*. If the Motion of the small Parts be more languid in the *Object* than it is in the *Sentient*, we pronounce the Body to be *cold*; but if it be more violent in the *Object* than in the *Sentient*, we say the Body is *hot*.

The *Intenseness* of *Heat* (as of *Light*) always is as the *Density* of the Rays, or Particles of *Fire*, that occasion it; and this *Density* is as the *Distance* from the radiating Point reciprocally.

Dr. *Stare* has published surprizing Experiments, of producing *Fire* and *Flame*, from the bare Mixture of two Liquors *actually cold*; a vegetable Oil, and a compound Spirit of *Nitre*.

The incredible Force of *Burning-Glasses*!

A burning Concave, made at *Lusace* in *Germany*, near three *Leipsick* Ells in Diameter, made of a Copper-Plate, scarce twice as thick as the Back of a common Knife; makes Wood in the *Focus* (which is two Ells off) to flame in a moment; and Water in an earthen Pot boil immediately: *Tin* three Inches thick, to be melted quite through in three Minutes; a Plate of *Iron* to be presently red-hot, and very quickly perforated: it will run in five or six Minutes; Tiles, and Slates, and earthen Potsheards, melt in a little time, and run into Glass; a Clod of Earth turns into a *greenish Glass*.

Mr. *Tschirnhaus* makes Convex Burning-Glasses of three or four Foot Diameter, the *Focus* at the Distance of twelve Foot Diameter; which in a moment vitrify Tiles, and Slates, and Pumice-Stones, and earthen Vessels; melt all resinous Things under Water; melt all Metals in a moment, and *Gold* itself is turned into *Glass* of a purple Colour: Of such efficacy are the *Rays*, when strip'd of an *unctious Matter*, which we may suppose them generally clothed with.

¶. 'The antient *Persians* were the Worshippers of the *Fire*: But I will abhor their *Fire-Places*. The *Indians* of my Country, while unchristianized, concluded from the strange Effects of the *Fire*, *It must be a God*. I will adore the Glorious GOD that made the *Fire*. Great GOD, I bless thee for the Benefits, which thy Creatures, and I among them, receive by the *Fire*, which is fetch'd from *Heaven* unto us. May my Zeal for thy Service be always kept boiling in the *Heat* proper for it.

'Since *Fire* is thus irresistible, and *Heat* so insupportable, surely I should beware of that Impiety, which will expose me to the Revenges of GOD. *Who can dwell with such a devouring Fire, such everlasting Burnings?* My GOD, be not thou unto me a *Consuming Fire*. My GOD, who can abide the *Heat* of thine Anger!

I have seen a Book of Devotion, entitl'd, *Christianus per Ignem*; or, *A Disciple warming himself, and owning his Lord*. It is there actually evident, and performed, That this one Object, the *Fire on the Hearth*, will afford a whole *Book-full* of profitable Contemplations.

## ESSAY XI. *Of the MOON.*

WE are now coming down unto our *Terraqueous Globe*. The MOON, a sort of *Satellit* unto this Globe, salutes us in our Way. Paying an Homage to none but her Glorious Maker, we will now behold her walking in her Brightness.

What shall we think of the *Protuberant Parts* observed on that Celestial Body? What of the *Round Hollows*, like Pits or Wells of several Magnitudes, which have been formerly mistaken for *Mountains*?

The Periodical Revolution of the *Moon*, in reference to the *Fixed Stars*, according to Mr. *Flamsteed*, is 27 Days, 7 Hours, 43 Minutes, 7 Seconds.

In the same Space, with a strange Correspondence of the two Motions, it revolves the same way about its own *Axis*; by which the *same Side* is always exposed unto our sight. But because in the Space of a Periodical Month, the Earth is also with this her *Satellit*, moved on almost an entire Sign, the *Moon* can't yet come to a new Conjunction with the *Sun*, but wants 2 Days, 5 Hours of it; which must be passed before the entire *Lunation* will be over, and before the *Moon* has exhibited all her *Phases*. These 2 Days 5 Hours, added unto the Periodical Month, make the *Synodical One*; which is 29 Days, 12 Hours, and  $\frac{3}{4}$  of an Hour.

Those *Librations* of the *Moon's* Body, which occasion that the *Hemisphere* exposed unto our Sight is not always exactly and precisely the same, arise from the Excentricity of the *Moon's* Orbit, and from the Perturbations it suffers by the *Sun's* Attraction, and from the Obliquity of the *Axis* of the Diurnal Rotation of the *Moon's* own Orbit. Without the Knowledge of these Things, the *Phænomena* of the *Moon* would be inexplicable: but upon the Consideration of these, they are very demonstrable.

'Tis very sure, that although it be almost the same Face which the *Moon* turns'to the Earth, yet it is not entirely so. There is a *Libratory Motion*, whence it comes to pass, that sometimes the more Eastern and Western Parts of it, sometimes the more Northern and Southern appear alternately.

According to Sir *Isaac Newton*, the mean Distance of the *Moon* from the Earth, is about 60 Semidiameters of the Earth; or about 24,000 *English* Miles. The mean Diameter of the *Moon* is 32 Minutes, 12 Seconds; as the *Sun's* is 31 Minutes, 27 Seconds. The *Density* of the *Moon*, to that of the Earth, he concludes to be nearly as 9 to 5. And the Mass of Matter in the *Moon*, to that of the *Earth*, to be nearly as 1 to 26.

The *Moon* hath properly no *Atmosphere*, such as belongs to our *Earth*, of *Clouds*, *Winds*, *Thunders*; her *Face* is always clear, and by our *Telescopes* we can see the *Sun's* *Light* pass regularly and uniformly, from one mountainous *Place* to another.

The *Light* of the *Moon* reflected on us, is of such a *Weakness*, that even in the *Full-Moon*, it will be brought by no *Burning-Glass* to afford the least *Degree* of *Heat*. The *Rays* have their *Force* decreased, at least as the *Square* of their *Distance*. The *Force* of the *Sun's* *Rays* reflected unto us from the *Moon*, to those that come to us directly, is decreased, at least in proportion of the *Square* of the *Moon's* *Distance* from the *Earth*, to the *Square* of the *Moon's* *Semidiameter*. And by *Calculation* it will be found, That the *Light* of the *Moon* brought hither, will be in force but the *Fifty Thousandth Part* of what comes hither directly from the *Sun*.

*Dr. Hook* finds, That the *Quantity* of *Light* which falls on the *Hemisphere* of the *Full-Moon*, is rarefied into a *Sphere* about 288 greater in *Diameter* than the *Moon*, before it arrive to us. Consequently, the *Moon's* *Light* is 104,368 times weaker than the *Sun's*; and it would require 104,368 *Full-Moons* to give a *Light* equal unto that of the *Sun* at *Noon*.

There is a *Secondary Light* of the *Moon*; that is to say, the obscure *Part* of the *Moon* appears like to kindled *Ashes*, just before and after the *Change*. This is the *Sun's* *Rays* reflected from the bright *Hemisphere* of the *Earth*, to the dark *Parts* of the *Moon*; and thence again reflected unto the *Earth*, destitute of the *Light* of the *Sun*. This is by *Tacquet* and *Zucchius* more largely discoursed on. When the *Moon* is at *Change* to us, the *Earth* is at *Full* to the *Moon*; and the *Light* of the *Earth* is about fifteen times greater than that of the *Moon*. The *Moon* also being so little, as not to obscure above a twentieth *Part* of the *Earth*, it may be supposed that the *Light* from the *Earth*

may render her a little visible to us even in *Solar Eclipses*.

The *Moon* is almost one Semidiameter of the Earth nearer to us, when she is in the *Meridian*, than when she is nigh the *Horizon*. But why doth she then appear bigger to our sight when she is nigh the *Horizon*, than when she is in the *Meridian*? Dr. *Wallis* agrees with *Des Cartes* in the Solution: the Horizontal *Moon* is capable of being compared with many intervening Objects, Hills, Trees, and the like; but the Meridian *Moon* hath nothing to be compared with.

Tho the *Moon*, as well as the *Earth*, and probably all the Planets, be of a Figure *oblately spheriodical*, that is to say, having its Diameter at the *Æquator*, longer than its Axis; yet the Excess of the *Æquatorial* Diameter in her is so inconsiderable, that she may well enough pass for a Globe. And perhaps this almost spherical Figure of the *Moon* may be the Result of her slow Motion round her Axis; for *Jupiter*, which moves the swiftest of any round its Axis, is of a Figure more *oblate* than any other Planet.

Dr. *Cheyne* observes, If our *Moon* were bigger, or nearer the Earth, or if we had more than one, we should be every now and then in hazard of being drowned. And if our present *Moon* were less, or at a greater distance, or if there were none at all, we should be in hazard of being stifled with the baneful Streams of a stagnating Ocean. It is evident our *Sabbath* is most wisely contrived for our Purposes,—by thee, O our Gracious GOD!

The incomparable Sir *Isaac Newton* has at length obliged the World with a *Theory of the Moon*, which has performed that which all former Astronomers thought almost impossible.

*Huygenius* had Glasses in perfection, and wrote since the accurate Maps of the *Moon*, taken by *Hævelius* and *Riccius*; but he could observe no Seas and Rivers there. It is also argued, That if any such were there, they

they could not but raise a mighty *Atmosphere*, and such *Clouds* as must needs darken the Body of the *Moon*, sometimes in one part, sometimes in another. They carry on their Inferences; if no *Waters* in the *Moon*, then there are no *Plants*, nor *Animals*, nor *Men*. About the Constitution of this *Queen of the Night*, there seems a necessity for us to *remain in the dark!*

For Mr. *Derham* has confuted *Hugenius* with his own *Glasses*, and has demonstrated, that there are great Collections of *Waters* in the *Moon*, and by consequence *Rivers*, and *Vapours*, and *Air*; and in a word, a considerable *Apparatus* for *Habitation*.

But by what *Creatures* inhabited? A Difficulty this, that cannot be solved without *Revelation*.

¶ *My GOD*, I bless thee for that *Luminary*, by which we have the uncomfortable *Darkness* of our *Night* so much abated! That *Luminary*, the Influences whereof have such a part in the *Flux* and *Reflux* of our *Seas*; without which we should be very miserable! That *Luminary*, whose Influences are so sensibly felt in the Growth of our *Vegetables*, and our *Animals!*

These are some of the *Songs*, which *GOD*, the *Maker* of us both, has given me in the *Night*.

The Influences of the *Moon* upon *Sublunary* Bodies, are very wonderful. An *History* of them is yet among the *Desiderata* of our *Philosophy*. With my consent, he shall merit more than the Title of a *Rabbi Solomon Jarchi*, who gives it unto us. *Dr. Grew*, in his *Cosmologia*, has enumerated more than a dozen remarkable *Heads of Effects*, and *Motions*, and *Changes* in the *World*, over which the *Moon* has a sensible *Dominion*. Our *Lunatics* are not the only Instances. Our *Husbandmen* will multiply the Instances upon us, till they make a *Volume*, which neither a *Clumella*, nor a *Tom Tuffer* have reached unto. The *Georges* of my Neighbourhood just now furnish me with two Instances, which have in them something that is notable. It our *Chef-*

*nut-Wood*, whereof we sometimes make our Fuel, be fell'd while the *Moon* is waxing, it will so sparkle in the Fire, that there shall be no sitting by it in safety. If it be cut while the *Moon* is waning, there will be no such Inconvenience. Moreover, we find, whatever *Timber* we cut, in two *Wanes* of the *Moon* in a Year, the *Wane* in *August*, and the *Wane* in *February*, will be for ever free from *Worms*; no *Worms* will ever breed in it. What *Monsieur Andry* relates, confirming the Observation of *Borellus*, about the Success of Medicines for *Worms* in *Human Bodies*, taken in the *Wane* of the *Moon*, is wonderful.

'I am sure, to be under such Influences of the *Moon*, as to see the Great GOD managing many of his Gracious Intentions by such an *Instrument*; and to be awakened to his Praises in the *Night*, when we see the *Moon* walking in her Brightness; would not be a *Lunacy*, that the most *Rational* of Men could be ashamed of.'

## ESSAY XII. *Of the RAIN.*

WE are now coming down into our *Atmosphere*. Here we are quickly surrounded with *Clouds*. And here we quickly find ourselves in the midst of that *Rain*, whereof the Great GOD, in his Book, so often claims the *Glory* of being the *Maker* and *Giver*.

The *Rain* is Water by the *Heat* of the *Sun* divided into very small and invisible Parts; which ascending in the *Air*, till it encounters with the *Cold* there, is by degrees condensed into *Clouds*, and thence descends in *Drops*. A *Mist* is a multitude of little, but solid Globules; which therefore descend. A *Cloud* is a Congeries of little, but concave Globules; which therefore ascend unto that height, wherein they are of equal weight with the *Air*, where they remain suspended, till by a Motion in the *Air* they are broken: and so they come down in *Drops*; either smaller, as in a *Mist*;

or bigger, when many of them run together, as in a *Rain*.

Tho the *Rain* be much of it exhaled from the *Salt-Sea*, yet by this *Natural Distillation*, 'tis rendred fresh and drinkable to a degree, which hardly any *Artificial Distillation* of ours has yet effected.

The *Clouds* are so carried about by the *Winds*, as to be so *equally dispersed*, that no part of the *Earth* wants convenient *Showers*, unless when it pleases *GOD*, for the *Punishment* of a sinful *People*, to withhold *Rain*, by a special *Interposition* of his *Providence*: Or, if any *Land* wants *Rain*, they have a *Supply* some other way; as in the *Land of Egypt*, wherein little *Rain* falls, there is an abundant recompence made for that want, by the annual *Overflowing* of the *River*. *Mr. Ray* well observes, That this *Distribution* proclaims the *Providence* of *GOD*, and is from a *Divine Disposition*. Without this, there would be either desolating *Floods*, or such *Droughts* as that of *Cyprus*, in which no *Rain* fell for thirty *Years* together, and the *Island* was deserted, in the *Reign of Constantine*. The *gradual Falling* of the *Rain* by *Drops*, is an admirable *Accommodation* of it to the *Intention* of watering the *Earth*. 'Tis the best way imaginable. If it should fall in a *continual Stream*, like a *River*, every thing would be vastly incommoded with it.

¶ When *GOD* gives *Rain from Heaven*, he will give also *fruitful Seasons* in our *Minds*, if they be thereby led to due *Acknowledgments* of him. 'Twill bespeak, 'twill procure, the richest *Showers of Blessings* upon us. 'How seasonable will it be for us now 'humbly to acknowledge the *Witness*, which our ' *GOD* gives us of his *Power* and *Goodness*! To see ' the *Paths of GOD* in the *Clouds* which drop *Fatness* ' upon us! To wish for those *Influences of Heaven*, ' which may come upon ourselves like *Rain upon the* ' *Grass*, as the *Showers that water the Earth*, and rain ' down *Righteousness* upon the *World*! To resolve up-

‘ on an Imitation of our merciful GOD, who sends  
 ‘ Rain upon the Just, and the Unjust! To send up our  
 ‘ Desires, that we may not be like the Earth, which  
 ‘ drinks in the Rain that comes often upon it, but bears  
 ‘ Thorns and Briars, rejected, and nigh unto cursing! In  
 ‘ fine, To glorify our GOD with Confessions of this  
 ‘ importance; Can the Heavens give Showers? Art not  
 ‘ thou he, O Lord our God? Therefore we will wait upon  
 ‘ thee; for thou hast made all of these things.’

The Archbishop of Cambray shall express our Sentiments. ‘ If I lift up my Eyes, I perceive in the  
 ‘ Clouds that fly above us, a sort of hanging Seas,  
 ‘ that serve to temper the Air, break the fiery Rays  
 ‘ of the Sun, and water the Earth when it is too dry.  
 ‘ What Hand was able to hang over our Heads those  
 ‘ great Reservatories of Waters! What Hand takes  
 ‘ care never to let them fall, but in moderate  
 ‘ Showers!’

### ESSAY XIII. *Of the RAINBOW.*

AFTER we have given the common Definition  
 of it, *Arcus Caelestis, qui fit ex Solis Luce, in Nubem variè compositam & temperatam, sed ex Diametro Soli ipsi, incurrente ac incidente, pluvioso tempore*; and should add more than there be Colours in the Rainbow, and with the modern Corrections of antient Errors, proceed to the Differences between the *Solar Iris* and the *Lunar*, and between the *Iris* and the *Halo*: we have yet made so little Progress in real and certain Knowledge, that we should be left after all, with the Subject of our Discourse, *still in the Clouds*.

But we are called upon, *To consider the wondrous Works of God*; and particularly that, wherein he causes the Light of his Cloud to shine, that is to say, his Rainbow.

A famous Clergyman of Spalato, in a Book *De Radiis Visus & Lucis*, written before the former Century, began

began mathematically to describe how the *interiour Bow* of the *Iris* is formed in round Drops of *Rain*, by a Refraction of the Sun's Light, and one Reflection between them; and the *Exteriour* by two Refractions, and two sorts of Reflections between them, in each Drop of Water.

*Des Cartes* (who don't use to betray his Tutors) took the Hints from *Antonius de Dominis*, and went on *mathematically*, and with much demonstration, to give us a Theory of the *Iris*, from the Laws of *Refraction*, which lucid Rays do suffer in passing through diaphanous Bodies. He clearly demonstrated the *Primary Iris* to be only the *Sun's Image*, reflected from the concave Surfaces of an innumerable Quantity of small spherical Drops of falling Rain; with this necessary Circumstance, That those Rays which fell on the Objects, parallel to each other, should not after one Reflection, and two Refractions, (to wit, at going into the Drop, and coming out again) be dispersed, or made to diverge, but come back again also to the Eye, parallel to each other. The *Secondary Iris*, he supposes produced by those Rays of the Sun, which fall more obliquely, but after the same manner as before: only in these there are two Reflections, before the Sun's Rays, refracted a second time, and tending towards the Eye in a parallel Position, can get out from the aqueous Globules.

The acute and accurate Mr. *Halley* comes after the *French Philosopher*, and shows how the *Cartesian* Problems were more easily solved, than the Author himself imagin'd. He shows how to determine the Angle, by which the *Iris* is distant from the opposite Point of the Sun; and the *Ratio* of the Refraction being given *geometrically*, or *vice versa*, the *Iris* being given, to determine the refractive Power of the Liquor. And he goes on to cultivate the Subject with the Ingenuity proper to so accomplish'd a Gentleman.

But then comes the admirable Sir *Isaac Newton*, whom we now venture to call the *Perpetual Dictator* of the learned World, in the *Principles of Natural Philosophy*; and than whom, there has not yet shone among Mankind a more sagacious Reasoner upon the *Laws of Nature*. This rare Person, in his incomparable *Treatise of Opticks*, has yet further explained the *Phænomena* of the *Rainbow*; and has not only shown how the *Bow* is made, but how the Colours (whereof Antiquity made but *Three*) are formed; how the Rays do strike our Sense with the *Colours*, in the Order which is required by their Degrees of *Refrangibility*, in the Progress from the Inside of the *Bow* to the Outside: the *Violet*, the *Indigo*, the *Blue*, the *Green*, the *Yellow*, the *Orange*, and the *Red*.

In a Book lately published at *Norimberg*, intitled, *Thaumantiadis Thaumasia*, which has not yet reached *America*; the skilful Author lays together whatever is to be found upon this Argument, among the modern, as well as the ancient Writers.

It is good Advice given by the Son of *Sirach*; *Look upon the Rainbow, and praise Him that made it.*

The Gospel of the Rainbow, offered by *Frytschius*.

*Sic ubi Cœlestem suboriri adspexeris Arcum,  
Quo Cælum melius non Meteoron habet:  
Ille quidem varios ducens è Nube Colores,  
Humano generi conspiciendus adest.  
Hunc ita conspicias, seu veri Pignus amoris,  
Ac olim facti fœderis esto Memor.  
Quod Deus omnipotens Noah sancto contulit ipsi,  
Se servaturum totius Orbis Opus.  
Nec perperurum submersum Fluminis Unda  
Iri Hominem sicut fecerat ante quidem.*

*Englisched:*

When you discern the *Bow of Heaven* to rise,  
The *brighest Meteor* there salutes your Eyes:  
Producing

‘ Producing various Colours on the *Cloud*,  
 ‘ *Mankind* beholds it, and survives the *Flood*.  
 ‘ Behold it, Sirs, a Sign of Heavenly Love,  
 ‘ And of a Covenant made by GOD above :  
 ‘ Almighty GOD did by that *Sign* engage  
 ‘ To keep his *Noah’s* World from Age to Age.  
 ‘ ’Tis thus engag’d, GOD will no more employ  
 ‘ Deep *Waters*, as of old, Men to destroy.

The *Halo* is of so near kindred unto the *Rainbow*,  
 that it claims a mention with it : A Circle that sur-  
 rounds the *Sun*, or the *Moon*, (or a *Star*;) sometimes  
 ’tis coloured like a *Rainbow*. According to Sir *Isaac*  
*Newton*, it arises from the *Sun’s* or *Moon’s* shining  
 through a thin *Cloud*, consisting of Globules of *Hail*  
 or *Water*, all of the same Size. Mr. *Huygens* conceives  
 it formed by small round Grains of a kind of *Hail*,  
 made up of two Parts; one of which is opaque, and  
 inclosed in the other, which is transparent. The same  
 way he accounts for the *Parhelia*. Only there he ap-  
 prehends, that the icy Grains are of an oblong Figure,  
 and rounding at the Ends like *Cylinders*, with round  
 convex Tops.

¶. May we look upon the *Rainbow*, and praise Him  
 that made it! My Readers, will you give me leave  
 to teach you the Use of the *Bow*? *Mercer* tells us, the  
 religious *Jews* in many places, upon the appearance of  
 a *Rainbow*, go forth and fall down, and confess their  
 Sins, and own themselves worthy to be drowned with  
 a *Flood* for them. To us *Christians*, our Lord says,  
*What do you more than they?* ‘ As the sight of the  
 ‘ *Rainbow* should bring to remembrance, *What a woful*,  
 ‘ *what a fearful Desolation*, once came upon a wicked *World*,  
 ‘ *whose Foundation* was overflown with a *Flood*! So  
 ‘ the *Sacramental Importance*, now instamped by the  
 ‘ Will of GOD upon the *Rainbow*, should be acknow-  
 ‘ ledged with us. It should be considered as a *Sign*  
 ‘ and a *Seal* of a *Covenant*, which the Great GOD  
 ‘ has

' has made, That He will not have *this World*, though  
 ' a sinful one, to be *drowned any more*; nor his *Church*  
 ' in the *World*. Upon the *View* of the admirable  
 ' *Meteor*, how proper this *Doxology*? *Bless'd be our*  
 ' *Gracious, and Merciful, and Long-suffering Lord*; who  
 ' *hath sworn, that the Waters of Noah shall go over the*  
 ' *Earth no more!* But then, how can we forget the  
 ' *Glorious CHRIST*, who is our *Head* in the *Cove-*  
 ' *nant*; and about whose *Head* there has been the ap-  
 ' *pearance* of a *Rainbow*, in the *Visions* of his *Pro-*  
 ' *phets*, betokening our *Dependance* upon Him for all  
 ' our *Preservations!* But then we are not excused  
 ' from, but rather excited to these further *Thoughts*  
 ' on this occasion: *That though a watery Flood, which*  
 ' *may drown the World, is no more to be feared*; yet *there*  
 ' *is a fiery Flood, for the Depredations whereof, a misera-*  
 ' *ble World is growing horribly combustible.* We are to  
 ' expect,

' ————— *Affore Tempus*  
 ' *Quo Mare, quo Tellus, correptaque Regia Cxli*  
 ' *Ardeat, & Mundi Moles operosa laboret.*

#### ESSAY XIV. *Of the SNOW.*

**O**F the *Snow*, there are many *Curiosities* observed  
 by the excellent *Dr. Grew*.

It is observed by him, as well as by *Des Cartes*, and  
*Dr. Hock*, That very many *Parts* of the *Snow* are of a  
 most regular *Figure*; they are generally so many *Row-*  
*els*, or *Stars* of *six Points*, being as real, as perfect, as  
 transparent *Ice*, as any one may see upon a *Vessel* of  
*Water*: On each of which *six Points*, there are set  
 other *collateral Points*, and those always at the same  
*Angles* as are the main *Points* themselves.

These are of divers *Magnitudes*; many are large  
 and fair, but some are very minute.

Among these, there are found some irregular ones, which are but *Fragments* of the regular. But some seem to have lost their original Regularity, not by being broken, but by various Winds, first gently thaw'd, and then froze into such irregular Clumpers again.

A *snowy Cloud* seems then to be an infinite Mass of *Icicles* regularly figured, not so much as one of the many Millions being irregular. A Cloud of Vapours is gathered into *Drops*; the *Drops* forthwith descend. On the Descent they pass through a *soft Wind* that freezes them, or a cold Region of the Air, by which each Drop is immediately froze into an *Icicle*, that shoots forth into several *Stiria* from the Center. But still continuing their Descent, and meeting with some sprinkling little Gales of a warmer Air, or in their continual Motion or Waftage to and fro, touching upon each other; some are a little thaw'd, blunted, frosted, clumper'd; others broken: but the most hank'd and clung in several Parcels together, which we call *Flakes of Snow*.

It should seem, that every *Drop of Rain* contains in it some spirituous Particles. These meeting in the Descent, with others of an acido-salinous Nature, the spirituous Parts are apprehended by them, and with those the watery; and so the whole Drop is fixed, but still according to the Energy of the spirituous, as the *Pencil*, and the determinate Possibility of the saline Parts, as a *Ruler*, into a *little Star*.

Though the *Snow* seem *soft*, yet it is truly *hard*; it is *Ice*: but the *Softness* of it is from this; Upon the first touch of the Finger on the sharp Edges, it thaws immediately; the Points would else pierce the Fingers like so many Lancets.

Again, though the *Snow* be true *Ice*, and so hard, and so dense a Body, yet it is very *light*: This is because of the extreme *Thinness* of each *Icicle*, in comparison of the *Breadth*. As *Gold*, though the most ponderous

derous of all Bodies, beaten into Leaves, rides on the least Breath of Air.

We read of Heaven giving *Snow like Wool*. I have known it give a *Snow of Wool*. In a Town of *New-England*, called *Fairfield*, in a bitter snowy Night, there fell a Quantity of *Snow*, which covered a large frozen Pond, but of such a *woollen* Consistence, that it can be called nothing but *Wool*. I have a Quantity of it, that has been these many Years lying by me.

*Res admiranda Nix, & optimarum Rerum in sacro Ser-mone Symbolum*: 'Tis the Expression of the pious and learned Mr. Gale.

¶. 'When we see the *Snow*, that comes down from  
' *Heaven*, and returns not thither, but waters the *Earth*,  
' and makes it bring forth and bud; we cannot but hope,  
' that the Word of our *GOD*, which comes like it,  
' will continue with us, and accomplish the Intentions  
' of it.

' Whereof one, upon the Soul of thy Servant, *O*  
' my *GOD!* is, to produce my Desires, That my *Sins*,  
' which have been like *Scarlet*, may become *white like*  
' *Snow*, in thy free and full Pardon of them. *O wash*  
' me in the *Blood of my Saviour*, and I shall be whiter than  
' the *Snow!* But, Lord, let a Work of real *Sanctifica-*  
' *tion*, at the same time upon me, render me *purer than*  
' the *Snow!*'

## ESSAY XV. *Of the HAIL.*

'TIS *Gutta Pluviae acerrimo frigore congelata.*

*Hail* is very often a Concomitant of *Thunder* and *Lightning*. 'Tis well known, as Dr. *Wallis* observes, That in our *Artificial Congelations*, a Mixture of *Snow* and *Nitre*, or even common *Salt*, will cause a very sudden Congelation of *Water*. Now the same in the *Clouds* may cause *Hail-Stones*; and the rather, because not only in some that are prodigiously great, but also in common *Hail-Stones*, there seems to be something  
like

like *Snow*, rather than *Ice*, in the midst of them. The large *Hail-Stones*, that weigh half or three quarters of a Pound, by the Violence of their Fall manifest that they have descended from a considerable height. And though perhaps in their first Concretion, their Bulk might not exceed the moderate Size of the common *Hail*; yet in their long descent, if the *Medium* through which they fell, were alike inclined unto Congelation, they might receive a great Accession to their Bulk, by perhaps many of them coalescing and incorporating into one.

¶. 'Worse than *Egyptians* they, whom an *Hail-Storm* will not cause to *fear the Word of the Lord*. The *irresistible* Judgments of **GOD** are sometimes compar'd unto *Hail-Storms*, and *great Hail-Stones*. These things come down upon the World with that Voice, *Tremble to be in ill Terms with a GOD, who with a Tempest of Hail, and a destroying Storm, can immediately crush all that is opposed unto him.*

Of all the *Meteors*, both the *fiery* and the *watery*, the Poet has well acknowledged;

*Qui Meteora videt liquido radiantia Cælo,  
Hic videt Æterni facta stupenda Dei.*

Who sees bright *Meteors* in the liquid Skies,  
Has the great Works of **GOD** before his Eyes:

*Christian*, take the Advice; [*'tis honest Frytschius's.*]

— *Rumpe Moras, Meteoraque suspice Cæli.  
Illa aliquid semper quo movearis habent.*

## ESSAY XVI. Of the THUNDER and LIGHTNING.

**HIS** powerful *Thunder*, who can understand? Yet our Philosophy will a little try to see and say something of it.

The

The Account of *Thunder*, given by Dr. *Hook*, is this. The Atmosphere of the Earth abounds with *nitrous Particles* of a spirituous nature, which are every where carried along with it. Besides which sort of Particles, there are also others raised up into the Air, which may be somewhat of the Nature of *sulphureous*, and *unctious*, and other combustibile Bodies. We see Spirit of *Wine*, of *Turpentine*, of *Camphire*, and almost all other combustibile Bodies, will by *Heat* be rarened into the Form of *Air*, or *Smoke*, and be raised up into the Air. All these, if they have a sufficient Degree of *Heat*, will catch *Fire*, and be turned into *Flame*, from the *nitrous* Parts of the Air mixing with them; as it has been proved by Thousands of Experiments. There are also other sorts of such Steams, that arise from *subterraneous* and *mineral* Bodies; which only by their coming to mix with the *Nitre* of the Air, though they have no sensible *Heat* in them, will so ferment and act upon one another, as to produce an actual *Flame*. Of this, the *Mines* are too frequent Witnesses and Sufferers. The *Lightning* seems to be very much of such an Original.

Dr. *Wallis* observes, That *Thunder* and *Lightning* have so much resemblance to *fired Gunpowder* in their Effects, that we may very well suppose much of the same Causes. The principal Ingredients in *Gunpowder*, are *Nitre* and *Sulphur*. Suppose in the Air, a convenient Mixture of *nitrous* and *sulphureous* Vapours, and those to take fire by accident, such an *Explosion*; and with such *Noise* and *Light* as that in the firing of *Gunpowder*, may well follow upon it; and being once kindled, it will run from place to place, as the Vapour leads it, like as in a *Train of Gunpowder*. This *Explosion*, high in the Air, and far from us, will do no considerable mischief. But, if it be very near us, it has terrible Consequences. The Distance of its *Place* may be estimated by the Distance of the *Time*, which there is between seeing the *Flash*, and hearing the *Clap*:

For

For though in their Generation they be simultaneous, yet *Light* moving faster than *Sound*, they come successively to us. That there is a *nitrous* Vapour in it, we may reasonably judge, because we know of no other Body so liable to so sudden and furious Explosion. That there is a *sulphureous* one, is manifest from the Smell that attends it, and the sultry Heat, that is commonly a Forerunner of it.

¶ The *natural Causes* of the *Thunder* do not at all release me from considering the *Interest* and *Providence* of the Glorious **GOD**, concerned in it. It is a Note prepared for the Songs of the Faithful, *The GOD of Glory thundereth*. It is He, who

*Fulmina molitur dextra, quo maxima motu  
Terra tremit, fugere Fera, & mortalia Corda  
Per Gentes humilis stravit Pavor.*

And indeed, as the *Thunder* has in it the *Voice* of God, [*Paganism* itself owned it, as being  $\Theta\omega\nu\eta\ \Delta\iota\delta\epsilon\varsigma$ ] thus there are several Points of *Piety*, wherein I am, as with a *Bath Kol*, instructed from it.

There is this *Voice* most sensibly to be heard in the *Thunder*, *Power belongeth unto God*. There is nothing able to stand before those *Lightnings*, which are stiled the *Arrows of God*. We see Castles fall, Metals melt, Bricks themselves vitrify; all flies, when hot *Thunderbolts* are scattered upon them. The very *Mountains* are torn to pieces, when — *Ferunt summus sua Fulmina Montes*. It becomes me now to say, *The Thunder of his Power who can understand?* An haughty Emperor shrinks, and shakes, and hides his guilty Head, before the powerful *Thunder* of God.

How can I hear the *Voice* of the *Almighty Thunderer*, without such Thoughts as these? *Glorious God, let me, through the Blood of a sacrificed Saviour, be in good Terms with One so able to destroy me in a moment!*

And,

‘ And, let me be afraid of offending Him, who is  
‘ possessed of such an *irresistible Artillery* !

‘ At the same time, do I not see the *Mercy and Pa-*  
‘ *tience* of a Good God to a sinful World? The De-  
‘ solations of the World, how wonderfully would  
‘ they be,

‘ *Si quoties peccant Homines sua Fulmina mittat !*

‘ It is no rare thing for the Children of Men to die  
‘ by a *Thunderbolt* : A *King* has been so slain in the  
‘ midst of his Army. There was a Punishment of  
‘ old used upon Criminals, by pouring hot Lead into  
‘ their Mouths, which was called *Combustio Animæ*,  
‘ and used in imitation of God’s destroying Men with  
‘ *Lightning* ; whereby the *inward* Parts are burnt with-  
‘ out any visible Touch upon the *outward*. This *Com-*  
‘ *busstio Animæ*, a Death by *Lightning*, has been fre-  
‘ quently inflicted. Their being *asleep* at the time  
‘ has not preserved them, though there be a Fancy in  
‘ *Plutarch* that it would ; nor would a Tent of *Seal-*  
‘ *Skin* have done it, though some great ones have re-  
‘ paired unto such an *Amulet* for their Protection. *My*  
‘ *God*, I adore thy *Sovereign Grace*, that such a *Sinner* as  
‘ I have not yet been by *Lightning* turned into *Dust* and  
‘ *Ashes* before thee !

‘ I take notice of one thing, That as Guilt lying  
‘ on the Minds of Men, makes them startle at a  
‘ *Thunder-Clap* ;

‘ *Hi sunt qui trepidant, & ad omnia Fulgura pallent,*  
‘ *Cum tonat, exanimis primo quoque Murmure Cæli :*

‘ So the Miscarriages about which our Hearts do first  
‘ and most of all misgive us in a *Thunder-Storm*, are  
‘ those which most of all call for a *thorough Repentance*  
‘ with us. There are some Writings which I cannot  
‘ read, except I hold them against the Fire ; by hav-  
‘ ing my Heart held up against the *Lightning*, I may  
‘ quickly read *my own Iniquity*.

‘ Impious

‘ Impious People are deaf to Thunder !’

*Herlicius*, in his *Tractatus de Fulmine*, reckons up a considerable number of those, which might be called *Fœlicia Fulmina*. Such will they be that make these Impressions upon us.

ESSAY XVII. *Of the AIR.*

**T**HE *Air* of our Atmosphere, in which we breathe, is a diaphanous, compressible, dilatable *Fluid*; a Body covering the Earth and the Sea, to a great height above the highest Mountains: in this, among other things, differing from the *Æther*, that it refracts the Rays of the Moon, and other Luminaries.

There seem to be three different sorts of *Corpuscles*, whereof the *Air* is composed. There are such as are carried up into the *Air* from other Bodies, as *Vapours* exhaled by the *Sun's Heat*, or by subterraneous. There may be also a more subtile kind, mixed with our *Air*, emitted from the *Heavenly Bodies*, and from the *Magnetick Steams* of the Globe on which we sojourn. But there may be a third sort of Particles, which may most properly merit the Name of *Aerial*; as being the distinguishing Parts of the *Air*, taken in the stricter sense of the Term. These Particles have an *Elasticity* in them; are springy; resemble the *Spring* of a *Watch*. *Elasticity* is an essential Property of the *Air*, and it is thought no other *Fluid* has any thing of it, but only so far as it participates of *Air*, or has *Air* contain'd in the Pores of it. Our *Air* abounds with Particles of such a nature, that in case they be bent, or press'd by the Weight of the incumbent part of the *Atmosphere*, or of any other Body, they endeavour to free themselves from that Pressure, by bearing against the Bodies that keep them under it; and as soon as the Removal of these Bodies gives them way, they expand the whole parcel of *Air* which they composed.

Dr. *Hook* thinks the Air to be little else than a Tincture or Solution of terrestrial and aqueous Particles, dissolved in, and agitated by the *Æther*, and to have something *saline* in their Nature.

Mr. *Boyle* found, that one and the same Portion of Air may take up 52,000 times the Space it doth at another time. He found, that the same Quantity of Air, by only having the Pressure of the Atmosphere taken off in the *Pneumatick Engine*, and without increasing the Spring with any adventitious Heat, would possess above 13,000 times its natural Dimensions. Dr. *Gregory* proceeds, That accordingly a Globe of Air, of one Inch diameter, would at the Distance of the Semidiameter of the Earth from the Earth, fill all the Planetary Regions as far as, and much beyond the Sphere of *Saturn*. Admirable Rarefaction!

The *Weight of Air* was discover'd first by *Galilaus*, who finding that *Water* could not by pumping be raised any higher than 34 or 35 Foot, concluded that the old Notion of an infinite *Fuga Vacui* would never do; and so fell to thinking on the Counterbalance of the *Weight of the Air*. *Torricellius* afterwards pursued and improved the Thought, and as a further Proof of the *Weight of the Air*, invented that which we call the *Torricellian Experiment*.

Mr. *Boyle* found by repeated Experiments, that the Weight of *Air* to *Water* is as 1 to 1000.

Dr. *Halley* rather determines the *Specifick Gravity* of Air to *Water*, to be about 1 to 800. *Mercury* is to Air as 10,800 to 1. And so, a Cylinder of *Air*, of 900 Feet, is equal to an Inch of *Mercury*.

We will, with Dr. *Wainwright*, suppose a cubical Foot of *Water* to weigh 76 Pounds *Troy Weight*. The Compass of a Foot square upon the Superficies of our Bodies, must sustain a Quantity of *Air*, equal to 2660 Pounds Weight. If the Superficies of a Man's Body contains fifteen square Feet, which is pretty near the Truth, he would sustain a Weight equal to 39,900 Pounds

Pounds *Troy*, which is above thirteen *Tun*. The difference between the greatest and the least Pressure of the *Air* upon our Bodies, is equal to 3982 Pounds *Troy*. On which the Doctor says, 'No wonder then we suffer in our Health by Change of Weather; 'tis surprizing that every such Change does not entirely break the Frame of our Bodies to pieces, and be the constant Harbinger of sudden Death.'

*My God, it is because I have obtained Help from thee, that I continue to this Day!*

Sir *Isaac Newton* thinks *true and permanent Air* to be made by Fermentation and Rarefaction of Bodies, that are of a very fixed Nature. And it is plain, those Particles fly and avoid one another with the greatest Force at a distance, which when they are very near, do attract and adhere to one another with the greatest Violence.

The Particles of *true and permanent Air*, being extracted from the densest and most fixed Bodies, will be more dense and crass than those of *Vapour*, and from hence, it's likely, may be heavier than those; and the Parts of an *humid Atmosphere* may be lighter than those of a *dry* one, as in fact they appear to be. He thinks therefore, that the Rarefaction and Condensation of the *Air* cannot be accounted for from the *Spring*, or *Elastick* Forms of the Particles, without a Supposition, that they are endued with some *Centrifugal* Force or Power, by which they fly and avoid one another, and the dense Bodies, from whence they are extracted.

This may be the cause for *Filtration*, and the Ascent of *Water* in small capillary Tubes, to a much greater height, than the Surface of the *Water* in the open Vessel, in which they are placed. The *Air* within the Tubes is much rarer than in more open Spaces, and by that means not pressing so much on the Surface of the *Water* within the Tubes, as without.

It is admirable to consider the Necessity of *Air* to the whole *animal* World; how soon the *vital Flame* does languish and expire, if *Air* be withheld from it! Even the Inhabitants of the Water cannot live without the Use of it. It is evident that the *Air*, at the least that part of it which is the Aliment of *Fire*, and the Fuel of the *vital Flame* in Animals, easily penetrates the Body of Water exposed to it, and with a wondrous Insinuation diffuses itself thro every part of it. Put Fishes into a Vessel of a narrow mouth, full of Water, they will continue to live and swim there whole Months and Years. But if with any Covering you stop the Vessel, so as to exclude the *Air*, or interrupt the Communication of it with the Water, they will suddenly be suffocated; which was an Experiment often made by *Rondeletius*. The *Insects* rather need more *Air* than other Creatures, having more *Air-Vessels* for their Bulk, and many Orifices on each side of their Bodies for the Admission of *Air*, which if you stop with Oil or Honey, they presently die, and revive no more. *Pliny* knew not the reason of his own Observation; *Oleo illito Insecta omnia exanimantur*. Yea, *Malpighius* has discovered and demonstrated, that the *Plants* themselves have a kind of Respiration, being furnished with a Plenty of Vessels for the Derivation of *Air* to all their Parts. *Dr. Hulse*, and *Mr. Ray*, and others, have now also render'd it very evident, That the *Fœtus* in the Womb does receive a measure of *Air* from the maternal Blood, by the *Placenta Uterina*, or the *Cotyledons*. When this Communication is broken off, what is it that now, to preserve the Life of the Animal, speedily raises the *Lungs*, and fetches into them an abundance of *Air*, which causes a sudden and mighty Accension in the Blood, for the Maintenance whereof a far greater Quantity of *Air* is requisite? Certainly some intelligent Being must now interpose, to put the Diaphragm, and all the Muscles that serve to Respiration, into their Motion!

My God, I know thee! And now, as our ingenious *Wallier* sings;

‘ Thus wing’d with Praise, we penetrate the Sky,  
‘ Teach Clouds and Stars to praise Him as we fly.  
‘ For that He reigns, all Creatures should rejoice,  
‘ And we with Songs supply their want of Voice.  
‘ Angels and we, assisted by this Art,  
‘ May sing together, tho we dwell apart.

¶. ‘ The *Syrians* worshipped the *Air* as a *God*. I will worship Him that created it.

‘ I will give Thanks to the Glorious God, for the Benefits with which the *Air* is replenished by his Bounty. It was long since called the *Paranymph*, by which the Espousal and Communion between *Heaven* and *Earth* is carried on.

‘ I breathe in the Favours of God continually. An ungrateful Wretch, if I do not breathe out his Praises!

‘ How justly might the Great God fill the Air with invisible *Arrows* of Death, and such deleterious *Miasms*, and pestilential *Poisons*, as might suffer the *Unholy* and *Unthankful* to breathe no longer in it!’

### ESSAY XVIII. Of the WIND.

WHAT better Definition of the *Wind*, than the *Stream of the Air*? *Plato* long since defin’d it, *The Motion of the Air about the Earth*.

Other Hypotheses for this Current of the Air not well answering all *Phænomena*, the learned *Mr. Halley* recommends this to Consideration, as the Cause of it; The Action of the *Sun-beams* on the *Air* and *Water*, as the *Sun* passes every day over the *Oceans*, consider’d with the Nature of the *Soil*, and the Situation of the *Continents* adjoining.

According to the Laws of *Statics*, the *Air*, which is less rarefied and expanded by *Heat*, and consequently

quently more ponderous, must have a Motion round those Parts thereof; which are more rarefied and less ponderous, to bring it into an *Æquilibrium*. The Presence of the *Sun* also continually shifting to the Westward, that Part unto which the *Air* tends, by reason of the Rarefaction made by his greatest Meridian Heat, is with him carried Westward, and consequently the Tendency of the whole Body of the *lower Air* is that way. Thus a general *Easterly Wind* is formed. From this Principle, the *Easterly Wind* on the *North Side* of the *Æquator*, should be to the *Northwards* of the *East*; and in *South Latitudes*, it should be to the *Southwards* thereof: inasmuch as near the Line, the *Air* is much more rarefied than at a greater distance from it. Here all the *Phænomena* of the general *Trade-Winds* are answer'd for; which if the whole Surface of the Globe were Sea, would undoubtedly blow all round the World, as they are found to do in the *Atlantick* and *Ethiopic* Oceans. But since great Continents interpose, and break the Continuity of the *Oceans*, regard must be had to the Nature of the Soil, and the Position of the high Mountains, which cause the Variation of the Winds, from the general Rule that has been propos'd. If a Country, which lies near the *Sun*, prove to be low, flat, and sandy, the *Heat* occasion'd by the Reflection and Retention of the Sun-beams there, will so rarefy the *Air*, that the denser and cooler *Air* will run thither, to restore the *Æquilibrium*. Hence may be the *constant Calms* in that part of the Ocean, called *The Rains*. This Tract being placed in the middle, between the *Westerly Winds* blowing on the hot Coast, and the *Easterly Winds* that blow to the Westwards, the Tendency of the *Air* there is indifferent to either, and so stands in *equilibrium*, between both; and the Weight of the incumbent *Atmosphere* being diminished by the continual contrary Winds blowing from hence, the *Air* here holds not the copious Vapour it receives, but lets it fall into frequent *Rains*. It

It is very hard to conceive, why the Limits of the *Trade-Wind* should be fixed about the thirtieth Degree of Latitude all round the Globe, and that they should so seldom transgress those Bounds, or fall short of them.

Behold the *Wings of the Wind!*

The inquisitive and ingenious Mr. *Derham* found by many Trials, That the *Wind* in a great Storm does move about *fifty or sixty Miles* in an Hour; That a common brisk *Wind* moves about *fifteen Miles* an Hour. But so gentle is the Course of many Winds, that they do not exceed *one Mile* an Hour.

Dr. *Grew* observes, That there are Winds, (besides the *Trade-Winds*) especially from the West, which blow sometimes two or three Days upon one Point, and will in this time drive before them a Ship an hundred and fifty Leagues, or four hundred and fifty *English Miles*.

The *Wind* is of great Use to ventilate the Air, and to dissipate contagious Vapours; which if they should stagnate, would produce grievous Diseases on the animal World. ---*Si non ventosa, venenosa*. It also transfers the *Clouds* from one place to another, for the more commodious watering of the Earth. It likewise tempers the *Heats* of many Countries, which else would be excessive. It carries *Vessels* on their Voyages to remote Countries. *Windmills* are driven by it, whereof there are many Benefits. But as the excellent Mr. *Ray* observes, That it is rarely so violent, as to destroy all before it, and overwhelm the World; this proclaims a superiour Power moderating of it, the *Wisdom* and *Goodness* of Him, who brings the *Wind* out of his *Treasures*.

What amazing things the *Winds*, called the *Tuffoons* (or *Typhons!*) and how irresistibly furious! But our merciful God *stays the rough Winds*.

The *Hurricanes* in the *West-Indies*, and their Brethren the *Monsoons* in the *East*; what flocking Stories

do the Travellers give us of them! How direful Effects are sometimes caused by them! They blow down mighty *Trees* by the *Roots*. They chase mighty *Ships* up into the *Woods*. They make every thing to tremble, and give way, that is in their way. *Great God, who dwelst on the Wind, and makest it move which way thou shalt please; who can stand in thy sight, if thou art angry!*

¶. Whatever Point of the Compass the *Wind* blows upon, it may blow some Good Thoughts into our Minds; and then it will be no *Ill Wind* unto us.

‘We ought certainly to consider *the stormy Wind*, as fulfilling the *Word of God*. And there are *Tempests*, and *Whirlwinds* of the *Divine Wrath* to be deprecated. But then there are Influences of *Heaven* to be desired, which are, *As the Wind bloweth where it listeth, and we hear the Sound thereof, but cannot tell whence it cometh, nor whither it goeth.*

### ESSAY XIX. *Of the COLD.*

THERE is much Dispute about the *Primum Frigidum*. None, I hope, about the *First Cause* of the *Cold*, which sometimes mortifies us.

It is questioned by some, whether the *Cold* be any thing that is *positive*, and not a mere *Privation*. The *Coldness* of any thing, they say, signifies no more, than its not having its insensible Parts agitated so much as those of our *Sensories*, by which we judge of *Tactile Qualities*. To make a thing become *cold*, there needs no more, than that the *Sun*, or *Fire*, or some other *Agent*, that more vehemently agitated its Parts before, do now cease to do it.

But then, on the other side, there are Instances of *Cold* produced by vehement Agitations.

To some there seems to be a mighty store of *Corpuscles*, a little a-kin to *Nitre*, exhaled from the terrestrial *Globe*, (of the Figure which *Philoponus* tells us,

*Democritus*

*Democritus* assigned to *Frigorifick Atoms*) which may more than a little contribute to our *Cold*.

That *Cold* (and so *Freezing*) may arise from some saline Substance floating in the Air, seems probable from this; That all *Salts*, but some above others, when mixed with *Snow* or *Ice*, do prodigiously increase the Force of *Cold*. And all *saline Bodies* produce a *Stiffness* in the Parts of those Bodies, into which they enter.

The Force of the *Cold* is truly wonderful. *Olearius* tells us, in *Muscovy* their Spittle will freeze e'er it reach the Ground. So violent the *Cold* there, that no *Furs* can hinder it, but sometimes the *Noses*, the *Ears*, the *Hands*, and the *Feet* of Men will be frozen, and all fall off. 'Tis reported by *Fletcher* and *Herberstein*, That not only they who travel abroad, but many in the very Markets of their Towns are so mortally pinched, as to fall down dead with the *Cold*. Captain *James* and *Gerat de Veer* tell us frightful things of the *Cold* they found in their Northern Coasting. *Beauplan* adds, That without good Precautions, the *Cold* produces those *Cancers*, which in a few Hours destroy the Parts they seize upon. What mighty Rands of *Ice* (the *magnum Duramen Aquarum*, as *Lucretius* calls it) have been encounter'd by such Navigators as *Munchius* and *Baffin*, who found some *Icy Islands* near three hundred Foot high above the Water! In the River of *Canada* sometimes are seen *Icy Islands*, computed four-score Leagues in length.

The irresistible Force of *Congelation*!

*Congelation* seems to be from the Introduction of the *Frigorifick Particles*, into the Interstices between the Particles of the Water; and thereby getting so near to them, as to be just within the Sphere of one another's attracting Force, on which they cohere into one solid Body.

Was it not then a Mistake in *Pliny*, when *Ice* was defined by him, *Aquæ Copia in Angusto*? The *Dimensions*

sions of Water are increased by *Freezing*; and with such a Force in the Expansion, that the *Weights* raised by it, the *Stones* broke in it, the *Metals* obliged to give way to it, were hardly credible, if these Eyes had not seen them!

¶. 'When we consider the *Cold*, especially if we have it under our more *sensible* Consideration, we cannot but subscribe to that Word, *Who can stand before his Cold!* How naturally are we now led to a *Dread*, and a *Deprecation* of lying under the *Displeasure* of the *Glorious God*, who by that one Part of his *Artillery*, the *Cold* alone, can soon destroy his *Enemies!*

The *Mitigations* of our *Cold*, and our *Comforts* and *Supports* against the *Assaults* of it, bespeak our thankful Praises to our *Glorious Benefactor*: That we are not, as *Livy* says of the *Alps*, *Æternis damnati Nivibus!*

It is observable, That the *Degrees* of *Cold* in several *Climates* are not according to their *Degrees* of *Latitude*. Some have met with very tolerable *Weather* under the *Arctick Pole*. But *Martinius*, in his *Atlas Chinensis*, reports of *China*, *Majus in hac Provincia Frigus est, quam illius poscat Poli Altitudo*. The *Country* lies in little more than *forty Degrees* of *Latitude*, and yet for four *Months* together in the *Year*, the *Rivers* there are so frozen, that the *Ice* will bear the *Passage* not only of *Men*, but of *Horses* and of *Coaches* too upon it. The like *Report* could I give of my own *Country*, which lies in the same *Latitude*. In my warm *Study*, from the *Billets* of *Wood* lying on a great *Fire*, the *Sap* forced out at the ends of the short *Billets* by the *Fire*, has frozen there, and been turned into *Ice*, while the *Wood* has been consuming. However, our *Cold* is much moderated since the opening and clearing of our *Woods*, and the *Winds* do not blow such *Razours*, as in the *Days* of our *Fathers*, when *Water*, cast up into the *Air*, would commonly

be turned into *Ice* e'er it came to the Ground. I have sometimes wished, that Wise-Men would make the Reflection of *Petronius* upon this Matter: *Incultis asperisque Regionibus, diutius Nives hærent; ast ubi Aratro domesacta Tellus nitet, dum loqueris levis Pruina dilabatur. Similiter in Pectoribus Ira confidit; Feras quidem Mentis obsidet, Eruditas præterlabitur.*

ESSAY XX. Of the Terraqueous GLOBE.

THE Distance at which our *Globe* is placed from the *Sun*, and the Contemperation of our Bodies and other Things to this Distance, are evident Works of our Glorious GOD!

According to the accurate Observations of the *English Norwood*, and the *French Picart*, the Ambit of our *Globe* will be twenty-four thousand nine hundred and thirty Miles. Wherefore supposing it spherical, the whole Surface will be 197,831,392 Miles; which in the solid Content will be found no less than 261,631,995,920 Miles. The cubick Feet will be 30,000,000,000,000,000,000,000. The *Earth*, with her Satellit the *Moon*, moving about the *Sun*, this *Orbis Magnus*, as 'tis usually called, according to our *Derham*, is a Space of more than 540 Millions of Miles in Circumference, or 172 Millions of Miles in Breadth.

The *Copernican Hypothesis* is now generally preferred, which allows a *Diurnal* and an *Annual* Motion to our *Globe*, rather than to the *Sun*. According to this, the *Diurnal* Motion of our *Globe* is near 1,039 Miles in an Hour.

The Arguments that prove the Stability of the *Sun*, and the Motion of the *Earth*, have now render'd it indisputable. It is impossible to account for the Appearances of the *Planets*, and their *Satellites*, and the *Fixed Stars*, in any tolerable manner, without admitting the Motion of the *Earth*; or to account for *Comets*;

ments; or for that Analogy of the *Periodical Times*, to the *middle Distances*, which is the necessary Consequence of the establish'd Law of *Gravitation*. Unless we would subvert the whole System of *Astronomy*, and (as Dr. *Cheyne* observes) disprove the Causes of all the *Celestial Motions*, we shall never be able to assert, that the *Earth stands unmoved*. Nor is there any Objection against the Motion of the *Earth*, but what has had a full Solution.

These Motions, performed so regularly for near six thousand Years, how much do they oblige us to cry out, *Great GOD, thou that art the Creator, art also the Governour of the World!*

Even a *Pagan Cleanthes*, as his Brother *Cicero* will tell us, would assign this as a sufficient Cause for a Belief of a Deity; *Æquabilitatem Motus, Conversionem Cæli, Solis, Luna, Syderumque omnium Distinctionem, Varietatem, Pulchritudinem, Ordinem; quarum rerum Aspectus ipse satis indicaret, non esse fortuita*. And *Plutarch* says, This Observation was the first that led Men to the Acknowledgment of a GOD.

The Prophet *Habakkuk* mentions the Stop to this Course in the Days of *Joshua*, as a real Matter of Fact. The same *Infinite Power* that gave the *Motion*, gave the *Check*.

The Circumvolutions of the *Globe* are of admirable *Conveniency*, yea, of absolute *Necessity*, to the Inhabitants. As *Tully* notes, *Conseruat Animantes*.

The *Spherical Figure* of our *Globe* has numerous and marvellous *Conveniencies*, whereof no Man that seriously considers it can be insensible. How incommodious must an *Angular Figure* have been; or such an one as many of the Antients, and particularly the *Epicureans*, with Stupidity enough imagin'd?

It is admirably well order'd, (as Dr. *More* observes) That the *Axis* of the *Globe* should be steady, and perpetually parallel to itself; not carelessly tumbling this way and that way, as it might happen: and that

the Posture of the *Axis* be inclining as it is, and not perpendicular to a Plane going thro the Center of the *Sun*, or coincident. Hence comes the *Globe* to be so habitable in all Parts; and even under the *Line* itself, as 'tis noted by Sir *Walter Raleigh*, the Parts are as pleasant, and as fruitful, and as fit for a *Paradise*, as any in the World. And the *Longevity* of the Natives there does rather exceed the rest of Mankind, as we learn from the Relations of *Piso*, and *Rochefort*, and *Pirard*, and *Le Blanc*, and other Testimonies. Yea, Mr. *Keill* demonstrates, that from the present Position of the *Globe*, and the Inclination of its *Axis* to the Plane of the *Ecliptick*, we reap this Advantage; They who live beyond forty-five Degrees of Latitude, and have most need of it, have more of the Heat of the *Sun* throughout the Year, than if he had shined always in the *Æquator*: Whereas in the *Torrid Zone*, and even in the *Temperate*, almost as far as forty-five, the Sum of the *Sun's* Heat, in Summer and Winter, is less than it would be, if the *Axis* of the *Globe* were perpendicular to the Plane of the *Ecliptick*. He very well adds, This Consideration cannot but lead us into a transcendent Admiration of the *Divine Wisdom*! Yea, were the whole Creation surveyed, it would be every where found, as Mr. *Ray* observes, *That God has chosen better for us, than we could have done for ourselves.*

And then, the Collection of the *Waters* on the *Globe* into such vast *Conceptacula*, wherein the innumerable *Fishes* are nourished, and whereon *Voyages* are performed; and the Distinction of the *Dry Land*, furnished with so many *Vegetables* and *Animals*: What can it be any other than the Result of Counsel, of Design, of *Infinite Wisdom*! How blind art thou, *O Man*, and under what a brutal and fatal Darknes, if thou see it not!—*The Brutish among the People will not be wise.*

The *Figure* of our Globe is most probably that of an *Oblate Spheroid*. It swells towards the *Æquatorial* Parts, and flats towards the *Polar*; according to Sir *Isaac Newton*, the *Diameter* of the Globe is about thirty-four Miles longer than the *Axis*.

Dr. *Gregory* shews, that this is the reason why the *Axis* of our Globe does twice every Year change its *Inclination* to the *Ecliptick*, and as often return back again to its former Position.

The most accurate Astronomer, Mr. *Flamsteed*, found the *Distance* of the *Pole-Star* from the Pole, to be greater about the *Summer Solstice* than about the *Winter*, by about forty or forty-five Seconds. He found also, by repeated Observations, a sensible annual *Parallax* in others of the *Fixed Stars*. This proves our Globe to move annually about the *Sun*.

Mr. *Halley* shows the annual Motion of the Earth to be so swift, as far to exceed that of a Bullet shot out of a Cannon, and to be after the rate of 210 Miles in a Minute, and 12,600 Miles in an Hour.

Our Globe is nearer to the *Sun* in *December* than in *June*. Its *Perihelion* is in *December*. The *Sun's* apparent *Diameter* is greater then; and our Globe then has a *swifter Motion* by a twenty-fifth Part. Hence there are about eight Days more in the *Summer Half-Year*, than in the *Winter Half-Year*. The colder and more Northern Places of our Globe are indeed brought some hundreds of thousands of Miles nearer the *Sun* in *Winter* than in *Summer*.

### Upon the Occurrences of the whole GLOBE.

‘ O MAN! we are now come down into thy *Ter-*  
 ‘ *risories*. How many *SERVANTS* may MAN  
 ‘ here see himself attended and surrounded with!  
 ‘ The most *reasonable Thing* in the World is for MAN  
 ‘ hereupon to contrive and resolve in this manner;  
 ‘ O that my *Service* to the *Glorious GOD* may be as obe-  
 ‘ dient,

dient, as willing, as ready, as what his Creatures yield to me!

It has been excellently well propos'd; *Cum ceteræ Creaturæ universæ omnibus Viribus, in Hominis Utilitatem committuntur, discat hinc Homo, similiter ex totis Viribus DEO servire, ad illumque se convertere, qui omnes Creaturas usui, servitioque suo destinavit.*

But then, to this we will annex a further Disposition of Piety: Can a Man be profitable to GOD? My Service to Him does not advantage Him. When I have done all, I am an unprofitable Servant. Wherefore let me study to transfer to my Neighbour, the Service which by the Creatures of GOD is done to me. Yea, let me so far as my Tenuity can attain to it, labour to do to my Neighbour such Things as the Great GOD pleases to do to me. In this Charity, there will be that Image of the Glorious GOD, which is the Glory of the MAN that arrives to it.

One says well, *Quocunque vertamus Oculos, ecce Testimonia, Oratores, & Laudatores Dei, qui totum Librum Mundi Laudum suarum Historiam, & Panegyricum esse voluit.*

MAN, let the Glorious GOD have Praises from thee, and have thy Homage and Service. Hereby the Creatures will be returned and united to GOD their Maker, and it will be brought about, that they shall not be made in vain. It was a wise Thought; *Per Hominem, & illius Religionem, omnes Creaturæ cum Deo connectuntur, ne frustra à Deo sint creatæ.*

There is another pathetick Remark, made more than an hundred Years ago, but worthy to be forever thought upon; *Omnes Creaturæ naturaliter Deum plus amant, quam seipsas, dum illius Mandata exequendo, seipsas consumunt; solus autem Peccator seipsum impensius quam Deum amat.* Every Creature, but only the wicked Sinner, loves GOD more than it loves itself.

‘ Two Instructions of the pious *Ægardus* will be worth remembering here.

‘ The one; *Dulces tibi sint Creaturae, propter Deum, a quo sunt; sed dulcior ipse Creator, qui omnibus major, & melior.*

‘ The other; *In quibus plus Dei, in iis plus sanctæ sit Voluptatis, & cum iis te conjungi cupias.*

‘ GOD must be the Sweet of all Creatures to me; and the more of GOD in any Creatures, the more must be my Regard, the more my Relish for them.’

¶ As we go along, we cannot well avoid a Touch upon *Cohesion*. We see two very plain, smooth, well-polish'd Bodies, will firmly *cohere*, even in an *exhausted Receiver*. This renders it evident, that *Cohesion* is not owing to the *Gravity*, nor to any other Property of the *Air*. What appears in the Surfaces of cohering Bodies upon their breaking, shows us, That a necessary Condition of *Cohesion* is a Congruity of Surfaces; and such as excludes any *Fluid* from lying between them. We may suppose, with *Dr. Cheyne*, that some of the *Primary Atoms*, whereof Bodies are constituted, are terminated with plain and smooth Surfaces on all sides; which will produce Bodies of the strongest *Cohesion*: Others are partly terminated with plain and smooth, and partly with *curve* Surfaces, which will produce Bodies of a *manner Cohesion*. Others are entirely terminated with *curve* Surfaces, which will produce *Fluids*; and between these entirely plain and smooth, and entirely *curve*, there are infinite Combinations of Surfaces, plain, and smooth, and *curve*, which will account for all the various Degrees of *Cohesion* in Bodies, in respect of their Figures. But now the *Cement*, which hinders the Separation of Bodies, when the Points of their Surfaces are brought into Contact; [this] can be nothing but the *universal Law of Attraction*, whereby all the Parts of *Matter* endeavour to embrace one another, and cannot be separated but by

by a Force, that shall be superiour to that by which they attract.

Being arrived here, we are gotten within a little of the Glorious GOD. The very next Step we take must be into Him, who is the immediate Cause of Weight in Matter. None but He producing, imprinting, preserving that Property in Matter, is to be now considered. We will go on to take notice of that Property.

ESSAY XXI. Of GRAVITY.

TO our Globe there is one Property so exceedingly and so generally subservient, that a very great Notice is due to it; that is, GRAVITY, or the Tendency of Bodies to the Center.

A most noble Contrivance (as Mr. *Derham* observes) to keep the several Globes of the Universe from shattering to pieces, as they would else evidently do in a little Time, thro their swift Rotation round their own Axes. Our Globe in particular, which revolves at the rate of above a thousand Miles an Hour, would, by the centrifugal Force of that Motion, be soon dissipated, and spirtled into the circumambient Space, were it not kept well together by this wondrous Contrivance of the Creator, Gravity, or the Power of Attraction. By this Power also all the Parts of the Globe are kept in their proper Place and Order; all Bodies gravitating thereto do unite themselves with, and preserve the Bulk of them entire; and the fleeting Waters are kept in their constant Equipoise, remaining in the Place which God has founded for them, a Bound which He hath set, that they may not pass, that they turn not again to cover the Earth. It is by the virtue of this glorious Contrivance of the great God, who formed all Things, that the Observation of the Psalmist is perpetually fulfilled: Thou rulest the raging of the Sea; when the Waves thereof arise, thou stillest them.

Very various have been the Sentiments of the Curious, what *Cause* there should be assign'd for this great and catholick Affection of Matter, the *Vis Centripeta*: I shall wave them all, and *bury* them in the *Place of Silence*, with the *Materia Striata* of *Descartes*, which our *Keil* has very sufficiently brought to *nothing*; and perhaps the *Fluid* of *Dr. Hook* must go the same way. 'Tis enough to me what that incomparable Mathematician, *Dr. Halley*, has declar'd upon it: That, after all, *Gravity* is an Effect insolvable by any *philosophical Hypothesis*; it must be religiously resolv'd into the *immediate Will* of our most wise CREATOR, who, by appointing this *Law*, throughout the material World, keeps all Bodies in their proper Places and Stations, which without it would soon fall to pieces, and be utterly destroy'd.

All Bodies descend still towards a Point, which either is, or lies near to, the *Center* of the *Globe*. Should our Almighty GOD change that *Center*. but the two thousandth part of the *Radius* of our *Globe*, the Tops of our highest Mountains would be soon laid under Water.

In all Places equi-distant from the *Center* of our *Globe*, the Force of Gravity is nearly equal.

Indeed, as it has been proved by *Sir Isaac Newton*, the *Equatorial* Parts are something higher than the *Polar* Parts; the difference between the Earth's *Diameter* and *Axis* being about thirty-four *English* Miles.

*Gravity* does equally affect all *Bodies*. The *absolute Gravity* of all is the same. Abstracting from the resistance of the *Medium*, the most *compact* and the most *diffuse*, the *greatest* and the *smallest*, would descend an equal Space in an equal Time. In an exhausted Receiver a *Feather* will descend as fast as a *Pound of Lead*. But this resistance of the *Medium* has produc'd a *comparative Gravity*. And upon the difference of *specifick Gravity* in many Bodies, the Observations of our Philosophers have been very curious.

According

According to the exquisite *Halley* and *Huygens*, the *Descent of heavy Bodies* is after the rate of about *sixteen Foot* in *one Second* of Time.

Nevertheless this Power *increases* as you descend to, *decreases* as you ascend from the *Center* of the Globe, and that in proportion to the *Squares* of the Distances therefrom reciprocally; so as, for instance, at a double distance to have but a quarter of the Force. A *Ton* Weight on the Surface of the Earth, raised Heaven-wards unto the height of one *Semidiameter* of the Earth from hence, would weigh but one quarter of a *Ton*. At three *Semidiameters* from the Surface of the Earth, it would be as easy for a Man to carry a *Ton*, as here to carry little more than an hundred Pounds. At the distance of the *Moon*, which suppose to be *sixty Semidiameters* of the Earth, *3600 Pounds* weigh but *one Pound*; and the Fall of Bodies is but *sixteen Foot* in a whole Minute.

I remember I have somewhere met with such a devout Improvement of this Observation: 'The further you fly towards *Heaven*, the more (if I may use the *Falconers* Word) you must *lessen*. There is great reason why it should be so. *Defamations* particularly will be Things by which you must be *lessen'd*: you must meet with *heavy* Things; *Defamations* are in a singular manner such; they are not easy to carry; 'tis not easy to carry it well under them; some of them are a *Ton* Weight. But, *my Friend*, if you were as near *Heaven* as you ought to be, you would make *light* of them; you would bear them wonderfully!'

The acute *Borelli* has demonstrated that there is no such thing as *positive Levity*, and that *Levity* is only a lesser degree of *Gravity*. But how useful is this, not only to divers Tribes of *Animals*, but also to the raising up of the many *Vapours*, which are to be convey'd about the World? The *Evaporations*, which, according to *Mr. Sedileau's* Observations, and others, are the

fewest in the Winter, and greatest in the Summer, the most of all in windy Weather, and considerably exceed what falls in *Rain*, many being tumbled about and spent by the Winds, and many falling down in Dews.

The ingenious *Halley* has yet a suspicion that there may be some certain Matter, which may have a *Conatus* directly contrary to that of *Gravity*; as in *Vegetation* the Sprouts directly tend against the *Perpendicular*.

Dr. *Gregory* demonstrates, that the antient Astronomers were not ignorant of the heavenly Bodies *gravitating* towards one another, and being preserv'd in their Orbits by the Force of Gravity.

Mr. *Keil* shews, that the Force of *Gravity* to the *centrifugal Force*, in a Body placed at the Equator of our Globe, is as 289 to 1; so that by the *centrifugal Force* arising from the Earth's Rotation, any Body placed in the Equator loses a 289th part of the Weight it would have if the Globe were at rest. And since there is no *centrifugal Force* at the *Poles*, a Body there weighs 289 Pounds, which at the Equator would weigh but 288. On our Globe the decrease of *Gravity*, in going from the Poles towards the *Equator*, is always as the *Square of the Cosine of the Latitude*. — *Quod facit Natura* (to use *Tully's* Words) *per omnem Mundum, omnia Mente & Ratione conficiens*.

Mr. *Samuel Clark* observes, 'Tis now evident that the most universal Principle of *Gravitation*, the Spring of almost all the great and regular inanimate Motions in the World, answering not at all to the *Surfaces* of Bodies, by which alone they can act one upon another, but entirely to their *solid Content*; cannot possibly be the result of any *Motion* originally impressed on *Matter*, but must of necessity be caused by something which penetrates the very Substance of all Bodies, and continually *puts forth in them* a Force or Power entirely different from that by which *Matter* acts on *Matter*. This (he adds) is an evident *Demonstration*, not only of the  
World's

World's being made originally by a supreme intelligent Cause, but moreover that it depends every moment on some superior Being, for the Preservation of its Frame, and that all the great Motions in it are caused by some immaterial Power, not having originally impressed a certain Quantity of Motion upon Matter, but perpetually and actually exerting itself every Moment in every Part of the World: which preserving and governing Power gives a very noble Idea of PROVIDENCE.

Dr. Cheyne demonstrates, That Gravity, or the Attraction of Bodies towards one another, cannot be mechanically accounted for. The Planets themselves cannot continue their Motions in their Orbs without it. It is not a Result from the Nature of Matter, because the Efficacy of Matter is communicated by immediate Contact, and it can by no means act at a distance. Whereas this Power of Gravitation acts at all Distances, without any Medium or Instrument for the Conveyance of it, and passes as far as the Limits of the Universe. Matter is indeed entirely passive, and can't either tend or draw, with regard unto other Bodies, no more than it can move itself. And what is essential to Matter cannot be intended or be remitted; but Gravity increases or diminishes reciprocally, as the Squares of the Distances are increased or diminished. 'Tis plain this universal Force of Gravitation is the Effect of the Divine Power and Virtue, by which the Operations of all material Agents are preserved. They that press for a mechanical Account of Gravity, advance a Notion of a subtile Fluid, unto the Motion whereof they would ascribe it. But then still those Parts of Matter must be destitute of Gravity, which were very unlikely! And this Hypothesis would still remove us but one Step further from immechanical Principles; for the Cause of the Motion of your subtile Fluid, this, Gentlemen, you must own to be immechanical. Since you must admit a first Cause, you had as good be sensible of it in this place. 'Tis He who does immediately impress on

*Matter* this Property. There never was yet afforded unto the World (as my Doctor observes) a *System of Natural Philosophy* which did not require *Postulates*, that are not *mechanically* to be accounted for. The fewest any one pretends to, are, *the Existence of Matter*, and *the Impression of rectilinear Motions*, and *the Preservation of the Faculties of natural Agents*. No Man has pretended to fetch from the Principles of *Mechanism* an Account for these. The *Impression of an attractive Faculty upon Matter*, is no harder a *Postulate* than the rest. It is a *Matter of Fact*, that *Matter* is in possession of this Quality. And it can be referred unto nothing, but the Influence of that Glorious ONE, who is the *first Cause* of all Things.

Behold, a continual Opportunity for a considerate and religious Man, to have a *Sense* of a Glorious GOD awaken'd in him! And what is a *Walk with God*, but that *Sense* kept alive in every Step of our *Walk*? I am continually entertain'd with *weighty Body*, or *Matter* tending to the *Center of Gravity*; I feel it in *my own*. The *Cause* of this *Tendency*, 'tis the Glorious GOD. *Great GOD, Thou givest this Matter such a Tendency, and thou keepest it in its Operation*. There is no other Cause but the *Will* and *Work* of the Glorious GOD. I am now effectually convinc'd of that antient Confession, and must with Affection make it, *He is not far from every one of us*. When I see any thing moving or settling that way that its *heavy Nature* carries it, I may very justly think, and I would often form the Thought, *it is the Glorious GOD, who now carries this Matter such a way!* When *Matter* sinks downward, my Spirit shall even therefore mount upward, in acknowledgment of the God who orders it. I will no longer complain, *Behold, I go forward, but He is not there, and backward, but I cannot perceive Him; on the Left-hand, where He doth work, but I cannot behold Him; He hideth himself on the Right-hand, that I cannot see Him*. No, I am

now

‘ now taught where to meet with Him, even at every  
‘ *turn.* He knows the way that I take. I cannot stir for-  
‘ ward or backward, but I perceive Him in the *Weight*  
‘ of every *Matter*; on the *Left-hand* and on the *Right* I  
‘ see Him at work. My way shall be to improve this  
‘ as a *weighty* Argument for the Being of a God. I  
‘ will argue from it, Behold, there is a God, whom I  
‘ ought for ever to love, and serve, and glorify. Yea, and  
‘ if I am tempted to the doing of any wicked thing, I  
‘ may reflect, that it cannot be done without some  
‘ Action, wherein the *Weight of Matter* operates. But  
‘ then I may carry on the Reflection, How near am I  
‘ to that Glorious G O D, whose Commands I am going to  
‘ violate! Matter keeps his Laws; but, O my Soul, wilt  
‘ thou break ’em! How shall I do this Wickedness, and  
‘ therein deny the God, who not only is above, but also is  
‘ most sensibly now exerting His Power in the very Matter,  
‘ upon which I make my criminal Misapplications!’

¶. Before we go any further, it appears high time to introduce an Assertion or two of that excellent Philosopher Dr. Cheyne, in his *Philosophical Principles of natural Religion*. He asserts, and with Demonstration, (for truly without that he asserts nothing!) that there is no such thing as an *universal Soul*, animating the vast System of the World, according to *Plato*; nor any *substantial Forms*, according to *Aristotle*; nor any omniscient *radical Heat*, according to *Hippocrates*; nor any *plastick Virtue*, according to *Scaliger*; nor any *hylarchick Principle*, according to *More*. These are mere *allegorical Terms*, coined on purpose to conceal the Ignorance of the Authors, and keep up their Credit with the credulous Part of Mankind. These *unintelligible Beings* are derogatory from the Wisdom and Power of the Great G O D, who can easily govern the Machine He could create, by more direct Methods than employing such subservient *Divinities*; and indeed these Beings will not serve the Design for which we invent them, unless we endow them with Faculties

above the Dignity of *secondary Agents*. It is now plain from the most *evident Principles*, that the Great GOD not only has the *Springs* of this immense *Machine*, and all the several Parts of it, in his own Hand, and is the *first Mover*; but that without His *continual Influence* the whole Movement would soon fall to pieces. Yet besides this, He has reserved to Himself the power of *dispensing* with these *Laws*, whenever He pleases.

My Doctor has made it evident, That it is not essential to *Matter* to be either in *Rest* or in *Motion*: But tho there is in *Matter* a *Vis inertiae*, by which all Bodies resist, to the utmost of their power, any *Change* of their State, whether of *Rest* or *Motion*; yet this *Vis* is not essential to *Matter*, but a *positive Faculty* implanted therein by the Author of Nature. It is therefore evident that the Preservation of a *Body* in *Rest* or in *Motion* (after the first Instant) absolutely depends on the Almighty GOD, as the Cause. No part of *Matter* can move itself, nor when put into *motion*, is this *Motion* absolutely essential to its Being, nor does depend upon itself; and therefore the *Preservation* of this *Motion* must have its Dependance on some other Cause. But there is no other Cause assignable besides the *omnipotent Cause*, who preserves the Being and Faculties of all natural Agents.

Great GOD, on the Behalf of all thy Creatures, I acknowledge in Thee we move and have our Being!

## ESSAY XXII. Of the WATER.

PURE Water is a Fluid void of all Sapor, and seems to consist of small, smooth, round and porous Particles, that are of equal *Diameters* and equal *Gravities*. There are also between them Spaces, that are so large, and ranged in such a manner, as to be on all sides pervious. Their *Smoothness* accounts for their sliding easily over the Surfaces of one another. Their *Roundness* keeps them from touching one another

ther in more Points than one. So great is their *Porosity*, that there is at least forty times as much *Space* as *Matter* in *Water*. For *Water* is nineteen times specifically lighter than *Gold*; but *Gold* will by Pressure let *Water* thro its Pores, and has doubtless more Pores than *solid Parts*.

Dr. *Wainwright* observes, The compounding Particles of *Water* are less than those of *Air*; the former will pass thro several Bodies that the latter will not; it will force itself thro the *Skins* of Animals, even after they are dried and converted into *Leather*. Fasten a strong Rope, of what length you please, to an *Hook*; at the bottom of the *Cord* hang any *Weight* short of what will break it, tho' ever so great; you will find the *Weight* will rise in moist Weather, and sink in dry. You may also raise the *Weight*, by moistening the sides of the *Cord* with a wet *Sponge*. Thus a few Particles of *Water* may overcome any finite *Resistance*, if a *Cord* will bear it. Now since there is but a little Quantity of *Water* in this Experiment, and this is driven into the sides of the *Cord* with a Force no greater than the *Weight* of a *Cylinder* of *Air* incumbent on the *Water*, therefore the *Water* must act by a Property, whereby its Force is greatly augmented; and this can be no other than that of the *Cuneus*: And the Forces of *Wedges* are to one another reciprocally proportional to the *Angles* their Edges do make. But in *Spheres* the greater or lesser Degree of *Curvity* is to be considered as their *Angles*, when *Spheres* are considered as *Wedges*, and the Degrees of *Curvity* in *Spheres* are reciprocally as their *Radii*. Now the Particles of *Water* being so inconceivably small, much less than those of *Air*, they must, when acting as *Wedges*, have their Powers inconceivably increased, so as to overcome any finite *Resistance*.

If such Power is in a Particle of *Water*, what is Thy Power, O Thou infinite Maker of that, and all things!

Dr.

Dr. *Cheyne* observes, That the Quantity of *Water* on the outside of our Globe doth daily decrease, part of it being every day turn'd into *Mineral, Vegetable,* and *Animal* Substances, which are not easily dissolved again into their component Parts.

It is a Curiosity demonstrated by *Mariotte*, in his *Du Mouvement des Eaux*, That a *Jet-d'eau* never will rise as high as its Reservatory, but always fall short of it by a Space, which is the *subduplicate Ratio* of that *Height*.

In the *Congregations of Water*, and the *Distributions* of it over our Globe, we cannot but see the wonderful Wisdom and Goodness of our GOD. *The great and wide Sea, wherein are swimming Things innumerable, 'tis full of Thy Riches, O our GOD!* And the Uses of it are marvellous. *The Waters are in the Place which Thou, O our God, hast prepared for them: Thou hast set a Bound that they may not pass over.*

A fanciful and presumptuous Gentleman having made his Exceptions against the Proportion of *Water* to *dry Land* on our Globe, is well answer'd by Mr. *Keil*; That the Objections proceed from a deep Ignorance of *Natural Philosophy*. For if there were but half the *Sea* that now is, there would be but half the *Vapours*; and we should soon find our miserable want of these.

Mr. *Ray* assures us, That where the bottom of the *Sea* is not rocky, but *Earth, Ouze,* or *Sand*, which is incomparably the greatest part of it, it is by the Motion of the Waters, as far as the Reciprocation of the *Sea* extends to the bottom, every where brought unto a Level; that is to say, it has an *equal and uniform Descent* from the Shores to the Deeps.

That the *Motion of the Water* descends to a good Depth, is proved from the *Plants*, that grow deepest in the *Sea*; which all generally grow flat, in manner of a *Fan*, and not with Branches on all sides like *Trees*: a thing that is contrived by the Divine Providence, for that the Edges of them do in that posture, with most ease,

ease, cut the Water flowing to and fro. Probably in the greater Depths of the Sea there grow no *Plants* at all; the Bottom is probably too remote for the external *Air* to pass in a sufficient Quantity thither. Nay, we are told that in those *deep Seas* there are no *Fish* at all; their Spawn would be lost there: being lighter than the Water, it will not sink thither; and the Climate there may be too cold for the quickening of it.

According to Mr. *Halley's* Experiment, *Water* as warm as the *Air* in the Summer, will in *twelve Hours* exhale the *tenth part* of an *Inch*. This Quantity will be found abundantly sufficient for all the *Rains*, and all the *Dews*, and all the *Springs* in the World; and will account for the *Caspian Sea*, and our vast *Canadian Lakes*, being always at a stand; and for the *Current*, said always to set in at the Streights of *Gibraltar*, tho the *Mediterranean Sea* receive so many Rivers. Every *ten square Inches* of the Surface of the Water, yields in Vapour *per diem* [we allow it only for the time the *Sun* is up] a *Cube Inch* of Water. Every *Mile* will yield 6914 Tons. A square Degree of sixty-nine *English Miles* will yield thirty-three Millions of Tons. If the *Mediterranean Sea* be estimated at forty Degrees long, and four broad, which is the least; the whole *Mediterranean* must lose in Vapours in a Summer's-day at least 5280 Millions of Tons. And yet sometimes the *Winds* lick up the Surface of Water faster than it exhales by the Heat of the Sun. The *Mediterranean Sea* receives nine considerable Rivers. We will suppose each of them to bring down ten times as much Water as the River *Thames*, which they do not; but this will allow for the small Rivulets. The *Thames*, allowing the Water to run after the rate of two Miles an Hour, may yield 20,300,000 Tons *per diem*. Allow as before, and all the nine Rivers bring down 1827 Millions of Tons in a day. This is but little more than a  
Third

Third of what is proved to be evaporated out of the *Mediterranean* in twelve Hours time.

The astonishing *Flux* and *Reflux* of the *Sea*, what Benefits it affords unto the World! If the *Ocean* once were stagnated, first all the Places towards the Shore would be turned into a *Mephitis*; and then by degrees it would yet further corrupt, until the whole became as poisonous as the Lake of *Sodom*. The *Fishes* would be first hereby destroyed, and by the poisonous Steams, anon the *Plants* and *Animals* would share in the Destruction. In the *Tide* of the *Sea* the Waters are lifted up in an Heap, and then let fall again. So the fear'd Corruption is prevented: And how many Conveniences afforded for our *Navigation*! But what? Oh! what the Original of it? Where's the *Zaphnath Paaneah* who shall enlighten us?

On our Globe all Bodies have a Tendency towards the *Center* of it. And such a *Gravitation* there is towards the Center of the *Sun*, and of the *Moon*, and of all the *Planets*. There is cause to suspect that the Force of *Gravity* is, in the Celestial Globes, proportional to the Quantity of Matter in each of them. The *Sun*, for instance, being more than ten thousand times as big as the *Earth*, its *Gravitation*, and the attracting Force of it, is ten thousand times as much as that of the *Earth*, acting on Bodies at the same Distances.

If our Globe were alone, or not affected by the Actions of the *Sun* and the *Moon*, the Ocean, equally pressed by the Force of *Gravity* towards the Center, would continue in a perfect *Stagnation*, always at the same height, without ever *ebbing* or *flowing*. But it is demonstrated, that the *Sun* and the *Moon* have a like Principle of *Gravitation* towards their Centers, and our Globe is also within the Activity of their Attractions. Whence it will follow, that the Equality of the Pressure of *Gravity* towards the Center will be thereby disturbed. And tho' the Smallness of these Forces, in respect of the *Gravitation* towards the Center

ter of the Earth, render them imperceptible, yet the *Ocean* being fluid, and yielding to the least Force, by its *rising* shews where there is the least Pressure upon it, and where it is most pressed, by *sinking*. Accordingly we shall find, that where the *Moon* is perpendicularly either above or below the *Horizon*, there the Force of *Gravity* is most of all diminished, and consequently that there the *Ocean* must necessarily swell, by the coming in of the Water from those Parts where the Pressure is greatest, namely, in those where the *Moon* is near the *Horizon*. The *Sea*, which otherwise would be *spherical*, upon the Pressure of the *Moon* must form itself into a *spheroidal* or *oval Figure*, whose longest *Diameter* is where the *Moon* is vertical, and shortest where she is in the *Horizon*; and the *Moon* shifting her Position as she turns round our *Globe* once a day, this *Oval* of *Water* shifts with her, occasioning thereby the two *Floods* and *Ebbs* observable in each five and twenty Hours. The *Spring-Tides* upon the *New* and *Full Moons*, and the *Neap-Tides* upon the *Quarters*, are occasion'd by the attractive Force of the *Sun* in the *New* and *Full*, conspiring with the Attraction of the *Moon*, and producing a *Tide* by their *united Forces*. Whereas in the *Quarters* the *Sun* raises the *Water* where the *Moon* depresses, and on the contrary; so as the *Tides* are made only by the difference of their *Attraction*. The *Sun* and *Moon* being either conjoin'd or opposite in the *Equinoctial*, produce the greatest *Spring-Tides*. The subsequent *Neap-Tides* being produced by the *Tropical Moon* in the *Quarters*, are always the *least Tides*.

But then from the *Shoalness* of the *Water* in many places, and from the *Narrowness* of the *Straits*, by which the *Tides* are in many places propagated, there arises a mighty Diversity, which, without the Knowledge of the Places, cannot be accounted for.

Dr. *Cheyne* has taught me to take notice of one thing more. If our *Earth* had any more than one *Moon* attending

tending it, we should receive probably a Detriment from it, rather than an Advantage. For at the *Conjunction* and *Opposition* with one another, and with the *Sun*, we should have *Tides* that would raise the Waters to the Tops of our Mountains, and in their *Quadratures* we should have no *Tides* at all.

*O my Soul, beholding the Moon above, look up to God, who hath so wisely proportion'd her, for the Designs on which He placed her there.*

The *Sea* is the grand Fountain of those *fresh Waters*, which supply and enrich the *Earth*, and by convenient Channels are carried back to the place from whence they came; the *perpetui Fontes, vitæque perennis Imago*: How equally are these fresh Waters distributed? How few *Antigua's* in the World? How agreeably are they disposed? And what a prodigious Run have many of the Rivers? The *Danube*, in a sober Account, as *Bohun* computes, runs fifteen hundred Miles in a strait Line from its Rise to its Fall. The *Nile*, according to *Varenius*, allowing for Curvatures, runs three thousand Miles; and the *Niger* two thousand four hundred; the *Ganges* twelve hundred; the *Amazonian* above thirteen hundred *Spanish Leagues*.

¶ 'But is it not high time for us to hear the *Voice* of many *Waters*!

'One celebrating the Bounty of our God unto us in the *Water*, so expresses it: *Quo Thesauro vel unicum Elementum Aquæ, si Deus illud in Sanguinem, ut olim in Egypto, converteret, possemus redimere?* The Contemplation may be carried unto the Element that is next above it.'

An excellent Person, who writes *Augustissimam Natura Scholam*, has thus rendred something of it articulate: *O Homo, ne imitare Equos & Mulos, qui me quidem bibunt, sed tantum bibunt. At tu, cui melior est Anima, ita me bibe, ut non tantum bibas, sed benedicentem Deum habeas dum bibis. Habebis autem si agnoscas ipsius Majestatem, eamque colas.*

Long since have we been taught such Notes as these. 'O Lord, how manifold are thy Works! In Wisdom hast thou made them all. The Earth is full of thy Riches. And so is the great and wide Sea, wherein are swimming things innumerable.'

'But can we look on the Sea, and not see a Picture of a troublesome World; see and be instructed.'

## A P P E N D I X.

§. WE can scarce leave the *Water* without some Remarks on our *Fluids*; and we will be more particularly indebted to Dr. *Cheyne* for hinting them first. How frugal is Nature in Principles, and yet how fruitful in Compositions and in Consequences! The primary *Fluids* are but four, *Water* and *Air*, and *Mercury* and *Light*. 'Tis but seldom that three of these are much compounded with others. 'Tis *Water* alone, 'tis *Lymph*, that is mostly the Basis of all other Mixtures; and it is the Parts of solid Bodies floating in this Fluid that produce all our pleasant and useful Varieties of Liquors.

Again, How vast the difference between the *Specific Gravities* of our *Fluids*! *Mercury* is about eight thousand times heavier than *Air*. *Air* must have choak'd us, if it had been half so heavy as *Mercury*. And yet Mankind, in its present Circumstances of the *Blood-Vessels*, under frequent *Obstructions*, could not well have done without such an heavy Fluid as *Mercury*.

Thirdly, All *Fluids* agree in the condition of the direction of their *Pressure* upon the sides of the containing Vessel. This *Pressure* is for ever communicated in Lines perpendicular to the sides of the containing Vessel. This beautiful and uniform Property of all *Fluids* necessarily follows from the *Sphericity* of their constituent Particles.

Our Doctor's Conclusion is as I would have it.  
 ' Now could any thing but the Almighty *Power* of  
 ' God have rounded those infinite numbers of small  
 ' Particles whereof *Fluids* consist? Or could any thing  
 ' but his *Wisdom* have assigned them their true Di-  
 ' mensions, their exact Weights, and required Solidi-  
 ' ties?'

I beseech you, *Sirs*, by what *Laws of Mechanism* were all the Particles of the several *Fluids* turned of differing *Diameters*, differing *Solidities*, differing *Weights* from one another; but all of the same *Diameters*, and *Solidities*, and *Weights* among themselves? *This is the Finger of God!* It is a just Assertion of *Dr. Grew*, *The Regularity of Corporeal Principles shews that they come at first from a Divine Regulator.*

### ESSAY XXIII. Of the EARTH.

**T**HE Lord by *Wisdom* has founded the *Earth*. A poor Sojourner on the *Earth* now thinks it his Duty to behold and admire the *Wisdom* of his glorious Maker there.

The *Earth*, which is the Basis and Support of so many Vegetables and Animals, and yields the alimentary Particles, whereof *Water* is the Vehicle, for their Nourishment: *Quorum omnium (as Tully saith well) incredibilis Multitudo, insatiabili Varictate distinguitur.*

The various Moulds and Soils of the *Earth* declare the admirable *Wisdom* of the Creator, in making such a provision for a vast variety of Intentions. *God said, Let the Earth bring forth!*

And yet,

*Nec vero Terræ ferre omnes omnia possunt.*

It is pretty odd; they who have written *de Arte Combinatoria*, reckon of no fewer than one hundred and seventy-nine Millions, one thousand and sixty different sorts of *Earth*: But we may content ourselves with

with Sir John Evelyn's Enumeration, which is very short of that.

However, the *Vegetables* owe not so much of their Life and Growth to the *Earth* itself, as to some agreeable Juices or Salts lodg'd in it: Both Mr. *Boyle* and *Van Helmont*, by Experiments, found the *Earth* scarce at all diminished when *Plants*, even *Trees*, had been for divers Years growing in it.

The *Strata* of the *Earth*, its *Lays* and *Beds*, afford surprizing Matters of Observation; the *Objects* lodged in them; the *Uses* made of them; and particularly the *Passage* they give to *sweet Waters*, as being the *Calanders* wherein they are sweetned. It is asserted that these are found all to lie very much according to the *Laws of Gravity*. Mr. *Derham* went far to demonstrate this Assertion.

The *vain Colts of Asses*, that *fain would be wise*, have cavill'd at the *unequal Surface of the Earth*, have open'd against the *Mountains*, as if they were *superfluous Excrescences*; but *Warts* deforming the *Face of the Earth*, and Proofs the *Earth* is but an *Heap of Rubbish and Ruins*. *Pliny* had more of Religion in him.

The sagacious *Dr. Halley* has observed, That the *Ridges of Mountains* being placed thro the midst of their *Continents*, do serve as *Alembicks*, to distil fresh *Waters* in vast *Quantities* for the *Use of the World*: And their *Heights* give a *Descent* unto the *Streams*, to run gently, like so many *Veins of the Macrocosm*, to be the more beneficial to the *Creation*. The generation of *Clouds*, and the distribution of *Rains*, accommodated and accomplished by the *Mountains*, is indeed so observable, that the learned *Scheuchzer* and *Creitlovius* can't forbear breaking out upon it with a *Mirati summam Creatoris Sapientiam!*

What *Rivers* could there be without those admirable *Tools of Nature!*

*Vapours* being raised by the *Sun*, acting on the *Surface of the Sea*, as a *Fire* under an *Alembick*, by raising

refying of it, makes the lightest and freshest Portions thereof to rise first; which *Rarefaction* is made (as *Dr Cheyne* observes) by the insinuation of its active Particles among the porous Parts thereof, whereby they are put into a violent Motion many different ways, and so are expanded into little Bubbles of larger Dimensions than formerly they had; and so they become specifically lighter, and the weightier *Atmosphere* buoys them up. The Streams of these *Vapours* rest in places where the Air is of equal *Gravity* with them, and are carried up and down the *Atmosphere* by the course of that Air, till they hit at last against the sides of the *Mountains*, and by this Concussion are condensed, and thus become heavier than the Air they swum in, and so gleet down the rocky Caverns of these *Mountains*, the inner parts whereof being hollow and stony, afford them a *Basin*, until they are accumulated in sufficient Quantities, to break out at the first *Crany*: whence they descend into Plains, and several of them uniting, form Rivulets; and many of those uniting, do grow into *Rivers*. This is the Story of them; this their *Pedigree*!

*Minerals* are dug out of *Mountains*; which, if they were sought only in level Countries, the Dells would be so flown with Waters, that it would be impossible to make *Addits* or *Soughs* to drein them. Here is, as *Olaus Magnus* expresses it, *Inexhausta pretiosorum Metallo-  
rum ubertas.*

A *German* Writer, got upon the *Mountains*, gives this Account of them: *Sunt ceu tot naturales Fornaces Chymicae, in quibus Deus varia Metalla & Mineralia excoquit & maturat.*

The *Habitations* and *Situations* of Mankind are made vastly the more comfortable for the *Mountains*. There is a vast variety of *Plants* proper to the *Mountains*: and many *Animals* find the *Mountains* their most proper places to breed and feed in. *The highest Hills a Refuge*

to the wild Goats! A Point Mr. Ray has well spoken to.

They report that *Hippocrates* did usually repair to the *Mountains* for the *Plants*, by which he wrought the chief of his Cures.

*Mountains* also are the most convenient Boundaries to Territories, and afford a Defence unto them. One calls them the *Bulwarks of Nature*, cast up at the Charges of the *Almighty*; the *Scorns and Curbs of the most victorious Armies*. The *Barbarians in Curtius* were confidently sensible of this!

Yea, we may appeal to the Senses of all Men, whether the grateful Variety of *Hills and Dales* be not more pleasing than the largest continued *Plains*.

'Tis also a *salutary Conformation* of the Earth; some Constitutions are best suited *above*, and others *below*.

Truly these massy and lofty Piles can by no means be spared.

*Galen*, thou shalt chastize the *Pseudo-Christians*, who reproach the Works of God. Say! — *Accusandi sanè meâ Sententiâ hic sunt Sophistæ, qui cum nondum invenire neque exponere Opera Naturæ queant, eam tamen inertia atque inscitia condemnant.*

Say now, O Man, say, under the sweet Constraints of Demonstration, *Great G O D*, the Earth is full of thy Goodness!

And Dr. *Grew* shall carry on the more general Observation for us. 'How little is the Mischief which  
' the *Air, Fire, or Water* sometimes doth, compared  
' with the innumerable *Uses* to which they daily serve?  
' Besides the *Seas and Rivers*, how many *wholesome*  
' *Springs* are there for one that is *poisonous*? Are the  
' *Northern Countries* subject to *Cold*? They have a  
' greater plenty of *Furs* to keep the People warm.  
' Would those under or near the Line be subject to  
' *Heat*? They have a constant *Easterly Breeze*, which  
' blows strongest in the Heat of the Day, to refresh  
' them: And with this Refreshment *without*, they  
have

‘ have a variety of excellent *Fruits* to comfort and cool  
 ‘ them *within*. How admirably are the *Clouds* fed with  
 ‘ Vapours, and carried about with the *Winds*, for the  
 ‘ gradual, equal, and seasonable watering of most  
 ‘ Countries? And in those which have less *Rain*, how  
 ‘ abundantly is the want of that supplied with noble  
 ‘ *Revers*?’

Even the subterraneous *Caverns* have their *Uses*. And so have the *Ignivomous Mountains*: Those terrible things are *Spiracles*, to vent the *Vapours*, which else might make a dismal *Havock*. Dr. *Woodward* observes, That tho’ Places which are very subject unto *Earthquakes* usually have these *Volcano’s*, yet without these fiery *Vents* their *Earthquakes* would bring more tremendous *Desolations* upon them.

Those two flammivomous Mountains, *Vesuvius* and *Ætna*, have sometimes terrified the whole World with their tremendous *Eruptions*. *Vesuvius* transmitted its frightful *Cinders* as far as *Constantinople*, which obliged the Emperor to leave the City; and *Historians* tell us there was kept an Anniversary Commemoration of it. *Kircher* has given us a *Chronicle* of what furious things have been done by *Ætna*; the melted Matter which one time it poured forth, spreading in breadth six Miles, ran down as far as *Catanea*, and forced a Passage into the Sea.

*Asia* abounds in these *Volcano’s*. *Africa* is known to have eight at least. In *America* ’tis affirmed that there are no less than fifteen, among that vast Chain of Mountains called the *Andes*. One says, ‘ Nature  
 ‘ seems here to keep house under ground, and the  
 ‘ Hollows of the *Mountains* to be the *Funnels* or *Chim-  
 ‘ neys*, by which the fuliginous Matter of those ever-  
 ‘ lasting Fires ascends.’

The *North* too, that seems doom’d unto eternal Cold, has its famous *Hecla*. And *Bartholomew Zenet* found one in *Greenland*, yet nearer to the Pole; the Effects whereof are very surprizing.

A reasonable and religious Mind cannot behold these formidable *Mountains*, without some Reflections of this importance: *Great GOD*, who knows the Power of thine Anger? Or what can stand before the powerful Indignation of that God, who can kindle a Fire in his Anger that shall burn to the lowest Hell, and set on fire the Foundations of the *Mountains*!

The *Volcano's* would lead us to consider the *Earthquakes*, wherein the *Earth* often suffers violent, and sometimes very destructive Concussions.

The *History of Earthquakes* would be a large, as well as a sad Volume. Whether a *Collection of Minerals* in the Bowels of the *Earth* is the cause of those direful Convulsions, may be considered: As we know a Composition of Gold which *Aqua Regia* has dissolved; *Sulphur Armoniack*, and *Salt of Tartar*, set on fire, will with an horrible crack break thro' all that is in the way. But Mankind ought herein to tremble before the Justice of God. Particular *Cities* and *Countries*, what fearful Desolations have been by *Earthquakes* brought upon them!

The old sinking of *Helice* and *Buris*, absorbed by *Earthquakes* into the Sea, mention'd by *Ovid*, or the twelve *Cities* that were so swallow'd up in the Days of *Tiberius*, are small things to what *Earthquakes* are to do on our Globe; yea, have already done. I know not what we shall think of the huge *Atlantis*, mentioned by *Plato*, now at the bottom of the *Atlantick Ocean*: But I know *Varenius* thinks it probable, that the Northern Part of *America* was joined unto *Ireland*, till *Earthquakes* made the vast and amazing Separation. Others have thought so of *England* and *France*; of *Spain* and *Africa*; of *Italy* and *Sicily*.

Ah, *Sicily*! Art thou come to be spoken of? No longer ago than t'other day what a rueful Spectacle was there exhibited in the Island of *Sicily* by an *Earthquake*, in which there perished the best part of two hundred thousand Souls!

Yea, *Ammianus Marcellinus* tells us, in the Year 365, *Horrendi Tremores per omnem Orbis Ambitum grassati sunt.*

O *Inhabitants of the Earth*, how much ought you to fear the things that will bring you into ill Terms with the Glorious GOD! Fear, lest the *Pit* and the *Snare* be upon you! Against all other Strokes there may some Defence or other be thought on: There is none against an *Earthquake*! It says, *Tho they hide in the top of Carmel, I will find them there!*

But surely the *Earthquakes* I have met with will effectually instruct me to avoid the Folly of setting my Heart inordinately on any *Earthly Possessions* or *Enjoyments*. Methinks I hear Heaven saying, *Surely he will receive this Instruction!*

A modern Philosopher speaks at this rate, 'We do not know when and where we stand upon good Ground: It would amaze the stoutest Heart, and make him ready to die with Fear, if he could see into the *subterraneous World*, and view the dark Recesses of Nature under ground; and behold, that even the strongest of our Piles of Building, whose Foundation we think is laid firm and fast, yet are set upon an Arch or Bridge, made by the bending Parts of the Earth one upon another, over a prodigious Vault, at the bottom of which there lies an unfathomable Sea, but its upper Hollows are filled with stagnating Air, and with Expirations of sulphureous and bituminous Matter. Upon such a dreadful Abyss we walk, and ride, and sleep; and are sustained only by an arched Roof, which also is not in all places of an equal Thickness.'

Give me leave to say, I take *Earthquakes* to be very moving Preachers unto worldly-minded Men: Their Address may be very agreeably put into the Terms of the Prophet; O *Earth, Earth, Earth, hear the Word of the Lord!*

' *Chrysoftom*

‘ *Chrystom* did well, among his other Epithets, to call the Earth *our Table*; but it shall teach me as well as feed me: May I be a *Deipnosophist* upon it.

‘ Indeed, what is the Earth but a *Theatre*, as has been long since observed? *In quo Infinita & Illustria, Providentiæ, Bonitatis, Potentiæ ac Sapientiæ Divinæ Spectacula contemplanda!* But I must not forget that this *Earth* is very shortly to be my *sleeping-place*; it has a *Grave* waiting for me: *I will not fear to go down, for thou hast promised, O my Saviour, to bring me up again.*’

## A P P E N D I X.

§. HAVING arrived thus far, I will here make a Pause, and acknowledge the Shine of Heaven on *our Parts of the Earth*, in the Improvements of our *modern Philosophy*.

To render us the more sensible hereof, we will propose a few Points of the *Mahometan Philosophy*, or Secrets reveal'd unto *Mahomet*, which none of his Followers, who cover so much of the Earth at this Day, may dare to question.

The *Winds*; 'tis an *Angel* moving his *Wings* that raises them.

The *Flux* and *Reflux* of the *Sea*, is caused by an *Angel's* putting his Foot on the middle of the *Ocean*, which compressing the *Waves*, the *Waters* run to the *Shores*; but being removed, they retire into their proper Station.

*Falling Stars* are the *Firebrands* with which the good *Angels* drive away the *bad*, when they are too saucily inquisitive, and approach too near the *Verge* of the *Heavens*, to eves-drop the *Secrets* there.

*Thunder* is nothing else but the cracking of an *Angel's Whip*, while he slashes the dull *Clouds* into such and such places, when they want *Rains* to fertilize the *Earth*.

*Eclipses* are made thus: The *Sun* and *Moon* are shut in a *Pipe*, which is turned up and down; from each *Pipe* is a *Window*, by which they enlighten the *World*; but when *God* is angry at the *Inhabitants* of it for their *Transgressions*, He bids an *Angel* clap to the *Window*, and so turn the *Light* towards *Heaven* from the *Earth*: for this *Occasion* *Forms of Prayer* are left, that the *Almighty* would avert his *Judgments*, and restore *Light* unto the *World*.

The thick-skull'd *Prophet* sets another *Angel* at work for *Earthquakes*; he is to hold so many *Ropes* tied unto every *Quarter* of the *Globe*, and when he is commanded, he is to pull; so he shakes that part of the *Globe*: and if a *City*, or *Mountain*, or *Tower*, is to be overturned, then he tugs harder at the *Pulley*, till the *Rivers* dance, and the *Valleys* are filled with *Rubbish*, and the *Waters* are swallowed up in the *Precipices*.

*May our Devotion exceed the Mahometan as much as our Philosophy!*

#### ESSAY XXIV. Of MAGNETISM.

SUCH an unaccountable thing there is as the *MAGNETISM* of the *Earth*. A Principle very different from that of *Gravity*.

The *Operations* of this amazing Principle, are principally discovered in the communion that *Iron* has with the *Loadstone*; a rough, coarse, unsightly Stone, but of more Value than all the *Diamonds* and *Jewels* in the *Universe*.

It is observed by *Sturmius*, That the *attractive Quality* of the *Magnet* was known to the *Antients*, even beyond all *History*. Indeed, besides what *Pliny* says of it, *Aristotle* speaks of *Thales*, as having said, the *Stone* has a *Soul*, "ὅτι τὴν ἀσθενὴν κινεῖ" because it moves *Iron*.

It was *Roger Bacon* who first of all discovered the *Verticity* of the *Magnet*, or its Property of pointing towards the *Pole*, about four hundred Years ago.

The Communication of its Vertue to *Iron* was first of all discovered by the *Italians*. One *Goia* first lit upon the Use of the *Mariner's Compass*, about *A. C.* 1300. After this, the various *Declination* of the *Needle* under different Meridians, was discovered by *Cabot* and *Norman*. And then the Variation of the *Declination*, so as to be not always the same in one and the same place, by *Hevelius*, *Auzot*, *Volckamer*, and others.

The inquisitive *Mr. Derham* says, The *Variation* of the *Variation* was first found out by our *Gellibrand*, *A. C.* 1634.

And he himself has added a further Discovery; That as the *Common Needle* is continually varying towards the *East* and *West*, so the *Dipping Needle* varies up and down, towards the *Zenith*, or fromwards, with a *magnetick* Tendency, describing a Circle round the Pole of the World, or some other Point; a Circle, whereof the *Radius* is about 13 Degrees.

In every *Magnet* there are two *Poles*, the one pointing to the *North*, and the other to the *South*.

The *Poles*, in divers Parts of the Globe, are diversly inclined towards the *Center* of the Earth.

These *Poles*, tho contrary to one another, do mutually help towards the *Magnet's* Attraction, and Suspension of *Iron*.

If a *Stone* be cut or broke into ever so many pieces, there are these two *Poles* in each of the *pieces*.

If two *Magnets* are spherical, one will conform itself to the other, so as either of them would do to the *Earth*; and after they have so turned themselves, they will endeavour to approach each other: but placed in a contrary Position, they avoid each other.

If a *Magnet* be cut thro the *Axis*, the Segments of the Stone, which before were joined, will now avoid and fly each other.

If the *Magnet* be cut by a Section perpendicular to its *Axis*, the two Points, which before were conjoined, will become contrary Poles; one in one, t'other in t'other Segment.

*Iron* receives Vertue from the *Magnet*, by application to it, or barely from an approach near it, tho it do not touch it; and the *Iron* receives this Vertue variously, according to the Parts of the Stone it is made to approach to.

The *Magnet* loses none of its own Vertue by communicating any to the *Iron*. This Vertue it also communicates very speedily; tho the longer the *Iron* joins the Stone, the longer its communicated Vertue will hold. And the better the *Magnet*, the sooner and stronger the communicated Vertue.

*Steel* receives Vertue from the *Magnet* better than *Iron*.

A *Needle* touch'd by a *Magnet*, will turn its Ends the same way towards the Poles of the World as the *Magnet* will do it. But neither of them conform their Poles exactly to those of the World; they have usually some *Variation*, and this *Variation* too in the same place is not always the same.

A *Magnet* will take up much more *Iron* when arm'd or cap'd than it can alone. And if the *Iron Ring* be suspended by the *Stone*, yet the magnetical Particles do not hinder the Ring from turning round any way, to the Right or Left.

The best *Magnet*, at the least distance from a lesser or a weaker, cannot draw to it a piece of *Iron* adhering actually to a much weaker or lesser Stone; but if it come to touch it, it can draw it from the other. But a weaker *Magnet*, or even a little piece of *Iron*, can draw away or separate a piece of *Iron* contiguous to a better and greater *Magnet*.

In our Northern Parts of the World, the *South Pole* of a *Loadstone* will raise more *Iron* than the *North Pole*.

A Plate of *Iron* only, but no other Body interposed, can impede the Operation of the *Loadstone*, either as to its attractive or directive Quality.

The Power and Vertue of the *Loadstone* may be impair'd by lying long in a wrong posture, as also by Rust, and Wet, and the like.

A *Magnet* heated *red-hot*, will be speedily deprived of its *attractive* Quality; then cooled, either with the *South Pole* to the *North*, in an horizontal position, or with the *South Pole* to the *Earth* in a perpendicular, it will change its *Polarity*; the *Southern Pole* becoming the *Northern*, and *vice versa*.

By applying the Poles of a very *small Fragment* of a *Magnet* to the opposite vigorous ones of a larger, the Poles of the Fragment have been speedily changed.

Well temper'd and harden'd *Iron Tools*, heated by Attrition, will attract Filings of *Iron* and *Steel*.

The *Iron Bars* of *Windows*, which have stood long in an erect position, do grow permanently *magnetical*; the lower ends of such Bars being the *Northern Poles*, and the upper the *Southern*.

Mr. *Boyle* found *English Oker*, heated red-hot, and cooled in a proper posture, plainly to gain a *magnetick* Power.

The illustrious Mr. *Boyle*, and the inquisitive Mr. *Derham*, have carried on their Experiments, till we are overwhelmed with the *Wonders*, as well as with the *Numbers* of them.

That of Mr. *Derham*, and *Grimaldi*, That a piece of well-touch *Iron Wire*, upon being bent round in a Ring, or coiled round upon a Stick, loses its Verticity; is very admirable.

The Strength of some *Loadstones* is very surprizing.

Dr. *Lister* saw a Collection of *Loadstones*, one of them weighed naked not above a *Dram*, yet it would raise a *Dram and half* of *Iron*; but being shod, it would raise *one hundred and forty and four Drams*. A smooth *Loadstone*, weighing 65 Grains, drew up 14 Ounces; that  
is,

is, 144 times its own weight. A *Loadstone* that was no bigger than an Hazel-nut, fetch'd up an huge bunch of Keys.

The *Effluvia* of a *Loadstone* seem to work in a *Circle*. What flows from the *North Pole*, comes round, and enters the *South Pole*; and what flows from the *South Pole*, enters the *North Pole*.

'Tho a minute *Loadstone* may have a prodigious force, yet it is very strange to see what a *short Sphere of Activity* it has; it affects not the *Iron* sensibly above an Inch or two, and the biggest little more than a Foot or two. The *magnetick Effluvia* make haste to return to the Stone that emitted them, and seem afraid of leaving it, as a Child the Mother before it can go alone.

On that astonishing Subject, *The Variation of the Compass*, what if we should hear the acute Mr. *Halley's* Proposals?

He proposes, That our whole Globe should be looked upon as a *great Magnet*, having four *magnetical Poles*, or Points of Attraction, two near each Pole of the Equator. In those Parts of the World which lie near adjacent unto any one of these *magnetical Poles*, the Needle is governed by it; the nearer Pole being always predominant over the remoter. The Pole which at present is nearest unto *Britain*, lies in or near the Meridian of the Lands-end of *England*, and not above seven Degrees from the *Artick Pole*. By this Pole the Variations in all *Europe*, and in *Tartary*, and in the *North Sea*, are principally governed, tho' with some regard to the other *Northern Pole*, which is in a Meridian passing about the middle of *California*, and about fifteen Degrees from the *North Pole* of the World. To this the Needle pays its chief respect in all the *North America*, and in the two Oceans on either side, even from the *Azores* Westward, unto *Japan*, and further. The two *Southern Poles* are distant rather further from the *South Pole* of the World; the one

one is about sixteen Degrees therefrom, and is under a *Meridian* about twenty Degrees to the Westward of the *Magellanick Streights*; this commands the Needle in all the *South America*, in the *Pacifick Sea*, and in the greatest part of the *Ethiopic Ocean*. The fourth and last Pole seems to have the greatest Power and the largest Dominions of all, as it is the most remote from the Pole of the World; for 'tis near twenty Degrees from it, in the *Meridian* which passes thro *Hollandia Nova*, and the Island *Celebes*. This Pole has the mastery in the South part of *Africa*, in *Arabia*, and the *Red Sea*, in *Persia*, in *India*, and its Islands, and all over the *Indian Sea*, from the *Cape of Good Hope* Eastwards, to the middle of the great *South Sea*, which divides *Asia* from *America*.

Behold, the Disposition of the *magnetical Vertue*, as it is throughout the whole *Globe* of the *Earth* at this day!

But now to solve the *Phænomena*!

We may reckon the external Parts of our *Globe* as a *Shell*, the internal as a *Nucleus*, or an *inner Globe* included within ours; and between these a *fluid Medium*, which having the same common *Center* and *Axis* of diurnal Rotation, may turn about with our *Earth* every four and twenty Hours: only this outer Sphere having its turbinating Motion some small matter either swifter or slower than the internal Ball, and a very small difference becoming in length of Time sensible by many Repetitions; the internal Parts will by degrees recede from the external, and not keeping pace with one another, will appear gradually to move, either Eastwards or Westwards, by the difference of their Motions. Now if the exterior Shell of our *Globe* should be a *Magnet*, having its Poles at a distance from the Poles of diurnal Rotation; and if the internal *Nucleus* be likewise a *Magnet*, having its Poles in two other places, distant also from the *Axis*, and these latter, by a slow and gradual Motion, change their place  
in

in respect of the external, we may then give a reasonable account of the *four magnetical Poles*, and of the *Changes of the Needle's Variations*. Who can tell but the *final Cause* of the Admixture of the *magnetical Matter*, in the Mass of the terrestrial Parts of our Globe, should be to maintain the concave Arch of this our Shell? Yea, we may suppose the Arch lined with a *magnetical Matter*, or to be rather one great *concave Magnet*, whose *two Poles* are fixed in the Surface of our Globe? Sir *Isaac Newton* has demonstrated the *Moon* to be more solid than our *Earth*, as nine to five; why may we not then suppose four-Ninths of our Globe to be Cavity? Mr. *Halley* allows there may be Inhabitants of the lower Story, and many ways of producing *Light* for them. The Medium itself may be always luminous; or the concave Arch may shine with such a Substance as does invest the Surface of the *Sun*; or they may have peculiar *Luminaries*, whereof we can have no Idea: As *Virgil* and *Claudian* enlighten their *Elysian Fields*; the latter,

*Amissum ne crede Diem; sunt altera nobis  
Sydera; sunt Orbés alii; Lumenque videbis  
Purius, Elysiumque magis mirabere Solem.*

The Diameter of the Earth being about eight thousand *English Miles*, how easy 'tis to allow five hundred Miles for the Thickness of the Shell! And another five hundred Miles for a Medium capable of a vast Atmosphere, for the Globe contained within it! — But it's time to stop, we are got beyond *Human Penetration*; we have dug as far as 'tis fit any *Conjecture* should carry us!

It is a little surprizing that the Orb of the Activity of *Magnets*, as Mr. *Derham* observes, is larger or lesser at different times. There is a noble and a mighty *Loadstone* reserved in the Repository at *Gresham-College*, which will keep a Key, or other piece of

*Iron,*

Iron, suspended unto another, sometimes at the distance of eight or ten Foot from it, but at other times not above four.

[A *Digression*, if worthy to be called so!]

§. But is it possible for me to go any further without making an *Observation*, which indeed would ever now and then break in upon us as we go along?

Once for all; *Gentlemen Philosophers*, the **MAGNET** has quite *puzzled* you. It shall then be no indecent *Anticipation* of what should have been observed at the Conclusion of this Collection, here to demand it of you, that you glorify the infinite Creator of this, and of all things, as *incomprehensible*. You must acknowledge that *Human Reason* is too feeble, too narrow a thing to comprehend the *infinite* God. The Words of our excellent *Boyle* deserve to be recited on this Occasion: 'Such is the *natural Imbecillity* of the *Human Intellect*, that the most piercing Wits and excellent Mathematicians are forced to confess, that not only their own *Reason*, but that of Mankind, may be puzzled and nonplus'd about **QUANTITY**, which is an Object of Contemplation natural, nay, mathematical. Wherefore why should we think it unfit to be believed, and to be acknowledged, that in the *Attributes* of God [it may be added, *and in His Dispensations towards the Children of Men*] there should be some things which our finite Understandings cannot clearly *comprehend*? And we who cannot clearly comprehend how in ourselves two such distant Natures, as that of a *gross Body* and an *immaterial Spirit* should be so united as to make up *one Man*, why should we grudge to have our **REASON** Pupil to an *omniscient Instructor*, who can teach us such things, as neither our own mere Reason, nor any others, could ever have discovered to us?'

I will now single out a few plain *Mathematical Instances*, wherein, Sirs, you will find your finest *Reason* so transcended, and so confounded, that it is to be hoped

hoped a profound Humility in the grand Affairs of our holy Religion will from this time for ever adorn you.

Mr. Robert Jenkin discoursing on the Reasonableness of the Christian Religion, gives two Instances how much we may lose ourselves in the Speculation of material things.

First, Nothing seems more evident, than that all Matter is divisible; yea, the least Particle of Matter must be so, because it has the Nature and Essence of Matter: it can never be so divided that it shall cease to be Matter. But then, on the other side, it is plain, Matter cannot be infinitely divisible; because whatever is divisible, is divisible into Parts; and no Parts can be infinite, because no Number can be so. A numberless Number is a Contradiction; all Parts are capable of being numbred; they are more or fewer, odd or even. It is not enough to say, that Matter is only capable of such a Division, but never can be actually divided into infinite Parts; for the Parts into which it is divisible must be actually existent, tho they be not actually divided. And last of all to say, these Parts of Matter are indefinite, but not infinite, is only to confess we know not what to say.

Secondly, We all agree that all the Parts into which the Whole is divided, being taken together are equal to the Whole. But it seems any single Part is equal to the Whole. It is granted, that in any Circle a Line may be drawn from every Point of the Circumference to the Center. Suppose the Circle to be the Equator, and a million lesser Circles are drawn within the Equator, about the same Center, and then a right Line drawn from every Point of the Equator to the Center of the Globe; every such right Line drawn from the Equator to the Center, must of necessity cut thro the million lesser Circles, about the same Center: consequently there must be the same number of Points in a Circle a million of times less than the Equator, as there is in the Equator itself. The lesser Circles may be multiplied into as many as there are Points in the Diameters; and

to the *least Circle* imaginable may have as many *Points* as the greatest; that is, be as big as the greatest, as big as one that is millions of times as big as itself.

Yet more; What will you say to this? Let a *Radius* be moved as a *Radius* upon a *Circle*; 'tis a Case of *Dr. Grew's* proposing: whether we suppose it *wholly* moved, or but *in part*, the Supposition will bring us to an *Absurdity*; if it be in a part *movent*, and in a part *quiescent*, it will be a *curve Line*, and no *Radius*; if it be *wholly movent*, then it moves either *about* or *upon* the Center; if it moves *about* it, it then comes short of it, and so again is no *Radius*: it cannot move *upon* it, because all motion having parts, there can be no motion upon a *Point*.

More yet; We cannot conceive how the *Perimeter* of a *Circle*, or other *curve Figure*, can consist without being infinitely *angular*; for the *parts* of a *Line* are *Lines*: But we cannot conceive how those *Lines* can have, as here they have, a different direction, and therefore an inclination, without making an *Angle*. And yet if you suppose a *Circle* to be *angular*, you destroy the *Definition* of a *Circle*, and the *Theorems* depending on it.

Once more; I will offer a Case of my own. The *Line* on which I am now writing is a *Space* between two *Points*; it will be doubtless allowed me, that my *Pen* in passing over this *Line*, from the one point unto the other, must *pass over the half of the Line before it passes over the whole*; and so the *half* of the remaining half, and so the half of the quarter that remains: so still the half of the remaining space, the *half before the whole*; and yet when it comes to execution, you find it is not so. If the *Position* you allowed me had been true, my *Pen* would not have reach'd unto the *end* of the *Line* before the *End* of my *Life*; or in a *Term* wherein it might have written ten *Books* as big as old *Zoroaster's*, or more *Manuscripts* than ever were in the *Alexandrian Library*.

It is then evident, that all Mankind is to this day in the dark as to the *ultimate Parts of Quantity*, and of *Motion*.

Go on my learned *Grew*, and maintain [who more fit than one of thy *recondite Learning?*] that there is hardly any one thing in the *World*, the *Essence* whereof we can perfectly comprehend. But then to the natural *Imbecillity* of *REASON*, and the *moral Depravations* of it, by our Fall from God, and the *Ascendant* which a corrupt and vicious *Will* has obtain'd over it, how much ought this Consideration to warn us against the Conduct of an *unhumbled Understanding* in things relating to the *Kingdom of God*? I am not out of my way, I have had a *Magnet* all this while steering of this *Digression*: I am now returning to that.

¶ God forbid I should be, *Tam Lapis ut Lapidum Numen inesse putem*. To fall down before a *Stone*, and say, *Thou art a God*, would be an *Idolatri*, that none but a *Soul* more senseless than a *Stone* could be guilty of. But then it would be a very agreeable and acceptable *Homage* unto the *Glorious GOD*, for me to see much of Him in such a wonderful *Stone* as the *MAGNET*. They have done well to call it the *Loadstone*, that is to say, the *Lead-stone*: *May it lead me unto Thee, O my God and my Saviour!* *Magnetism* is in this like to *Gravity*, that it leads us to *GOD*, and brings us very near to Him. When we see *Magnetism* in its Operation, we must say, *This is the Work of God!* And of the *Stone*, which has proved of such vast use in the Affairs of the *Waters that cover the Sea*, and will e'er long do its part in bringing it about that the *Glory of the Lord shall cover the Earth*, we must say, *Great God, this is a wonderful Gift of Thine unto the World!*

I do not propose to exemplify the *occasional Reflections* which a devout Mind may make upon all the *Creatures of God*, their *Properties*, and *Actions*, and *Relations*; the *Libri Elephantini* would not be big enough to contain

contain the thousandth part of them. If it were lawful for me here to pause with a particular *Exercise upon the Loadstone*, my first Thoughts would be those of the holy *Scudder*, whose Words have had a great Impression on me ever since my first reading of them in my Childhood: 'An upright Man is like a *Needle* touch'd with the *Loadstone*; tho he may thro boisterous *Temptations* and strong *Allurements* oftentimes look towards the Pleasure, Gain and Glory of this *present World*, yet because he is truly touch'd with the sanctifying Spirit of God, he still inclineth *God-ward*, and hath no Quiet till he stand *steady towards Heaven*.'

— However, to animate the Devotion of my *Christian Philosopher*, I will here make a Report to him. The ingenious *Ward* wrote a pious Book, as long ago as the Year 1639, entitled, *Magnetis Reductorium Theologicum*. The Design of his Essay, is, to lead us from the Consideration of the *Loadstone*, to the Consideration of our SAVIOUR, and of his incomparable *Glories*; whereof the *Magnet* has in it a notable Adumbration. In his Introduction he has a Note, worthy to be transcribed here, as religiously asserting the Design, of which our whole Essay is a Prosecution. *Hic præcipuus & potentissimus Creaturarum omnium Finis est, cum Scæle nobis & Alæ fiunt, quibus Animæ nostræ supra Dumeta & Sterquilinia Mundi hujus volitantes, facilius ad Cælum ascendunt, & ad Deum Creatorem aspirant.* For what is now before us, if our *Ward* may be our Adviser; *Christian*, in the *Loadstone* drawing and lifting up the *Iron*, behold thy *Saviour* drawing us to himself, and raising us above the secular Cares and Snares that ruin us. In its ready communication of its Vertues, behold a shadow of thy *Saviour* communicating his holy Spirit to his chosen People; and his *Ministers* more particularly made Partakers of his *attractive Powers*. When *Silver* and *Gold* are neglected by the *Loadstone*, but coarse *Iron* preferred, behold thy *Saviour* passing over the *Angelical World*, and chusing to take our Na-

ture upon him. The *Iron* is also undistinguished, whether it be lodged in a fine *Covering*, or whether it be lying in the most squalid and wretched *Circumstances*; which invites us to think how little *respect of Persons* there is with our *Saviour*. However, the *Iron* should be *cleansed*, it should not be *rusty*; nor will our *Saviour* embrace those who are not so far *cleansed*, that they are at least *willing to be made clean*, and have his *Files* pass upon them. The *Iron* is at first *merely passive*, then it *moves* more feebly towards the *Stone*; anon upon *Contact* it will fly to it, and express a marvellous *Affection* and *Adherence*. Is not here a *Picture* of the *Dispositions* in our *Souls* towards our *Saviour*? It is the *Pleasure* of our *Saviour* to work by *Instruments*, as the *Loadstone* will do most when the *Mediation* of a *Steel Cap* is used about it. After all, whatever is done, the whole *Praise* is due to the *Loadstone* alone. But there would be *no end*, and indeed there should be *none*, of these *Meditations*! — Our *Ward* in his *Dedication* of his *Book* to the *King*, has one very true *Compliment*. *Hoc ausim Majestati tuæ bonâ fide spondere; si unicus unicum possideres, Mundi totius te facile Monarcham efficeret.* But what a *Great KING* is He, who is the *Owner*, yea, and the *Maker* of all the *Magnets* in the *World*! *I am a Great KING, saith the Lord of Hosts, and my Name is to be feared among the Nations!* May the *Loadstone* help to carry it to them.

### ESSAY XXV. Of MINERALS.

**O**PERUM Dei Cognitionem (says my dear *Arndt*) quilibet ex sincero erga Deum amore & gratitudine, sibi acquirere studeat, ut sciat, quæ Deus nostri causa creaverit. He smiles at the trifling *Logicians*, who, *totam atatem inter inanes Subtilitates transigentes*, wholly taken up with *Trifles*, overlook the glorious *Works* of *God*.

Our *Earth* is richly furnished with a *Tribe* of *Minerals*, called so because dug out of *Mines*; and because

cause dug, therefore also called *Fossils*. Many things to be written of these, ought to have a *Nimok* in the Margin!

The *adventitious Fossils*, which are but the *Exuvia* of *Animals*, have been erroneously thought a sort of *peculiar Stones*. These must be excluded.

But then the *Natives of the Earth* are to be found in a vast variety. The inquisitive *Dr. Woodward* has prepared us a noble *Table* of them.

There are near twenty several sorts of *Earth*. Of these, besides the *Potter's Earth*, and the *Fulver's Earth*, how exceedingly useful is the *Chalk* to us! 'Tis a πολυχρησον.

There are above a dozen several sorts of *Stones*, that are found in *larger Masses*.

What *Vessels*, what *Buildings*, what *Ornaments*, do these afford us; especially the *Slate*, the *Marble*, the *Free-stone*, and the *Lime-stone*?

How helpful the *Warming-stone*?

How needful the *Grind-stone* and *Mill-stone*?

To the *Service* of our Maker we have so many *Calls* from the *Stones* themselves, [for if *Men* should be silent at proclaiming the *Glory of God*, the *very Stones* would speak] that a learned and a pious *German* so addresses us: *Audis tibi loquentes Lapidés; tu ne sis Lapis in hac parte, sed ipsorum Vocem audi, & in illis Vocem Dei.*

The *Whetstone* gives me a particular *Admonition*, which I have somewhere met with: *Multi multa docent alios, quæ ipsi præstare nequeunt.* The worst *Motto* for a *Divine* that can be! *Lord, save me from it!*

How astonishing the *Figures*, which *Dr. Robinson* and *Mr. Ray* report, as naturally delineated upon several kinds of *Stones*; almost every thing in *Nature* described in them, so as could not be out-done by any *Sculptor* or *Painter*! The *Colaptrice*, such as no *Human Skill* could arise to!

Yea, in *Stones* there has been sometimes found so much of an *Human Shape*, that every thing really in it has been astonished at it. *Zeiler* and *Kircher* mention some famous *Rocks*, which so resemble *Monks*, that all People call them so. *Olaus Wormius* was Possessor of a large *Stone*, which had exactly the *Head, Face, Neck* and *Shoulders* of a *Man*. *Monconny*s and others relate the several *Parts* of a *Man*, which many *Stones* have exactly exhibited. *Oh! how happy we, if Men and Stones had less Resemblance!*

There are many sorts of *Stones* found in *lesser Masses*.

Of these there are many who do *not* exceed the hardness of *Marble*.

Seven or eight of these are of an *indeterminate Figure*.

Twice as many have a *determinate Figure*.

Among these the Wonders of the *Osteo-colla*, to join and heal our *broken Bones*.

But then there are others which *do* exceed *Marble* in hardness.

To this Article belong those that are usually called *Gems* or *precious Stones*.

[*Pebbles* and *Flints* are of the *Agate-kind*.]

Some of these are *opaque*.

Three of the *opaque* have a *Body* of *one Colour*.

Here the Wonders of the *Nephritick Stone!*

Three of the *opaque* have *different Colours* mixed in the same *Body*.

Here the Wonders of the *Blood-stone!*

Some are *pellucid*.

Two with *Colours changeable*, according to their different position in the *Light*.

Nine or ten with *Colours permanent*.

Some are *diaphanous*.

Two *yellow* (or partaking of it.)

Three *red*.

Three *blue*.

Two *green*.

Four *without any Colours*.

‘ But

‘ But an excellent Writer observing, *Deus est Figulus Lapidum*, carries on his Observation, That the God who makes *precious* as well as *common Stones*, has made *Men* with as much of a *Difference*, and not altogether without such a *Proportion*.’

‘ Good God, Thy heavenly Graces in the Soul are brighter Jewels than any that are dug out of the Earth! A poor Man may be adorn’d with these; those who are so, they shall be mine, saith the Lord, in the Day when I make up my Jewels.’

‘ How often have I seen a Jewel in the Snout of a Swine!’

‘ And how many Counterfeits in the World!’

There are seven sorts of *Salts* to be met withal.

But the *Salt* of our *Table*, of how much consequence this to us! The *Uses* of it are too many to be by any reckoned: Very many are well known to all. To which add the *Experience* which *Bickerus* affirms the Army of the Emperor *Charles V.* had, that they must have perish’d on the *African Shore*, if they had not found a Grain of *Salt* in their Mouths; an Antidote not only against *Thirst*, but *Hunger* too.

He deserves to be herded with the Creatures, which *Animam habent pro Sale*, who shall be so *insipid* an Animal, as to be insensible that the Benefits of *Salt* call for very great Acknowledgments. My God, save me from what would render me *unsavory Salt*!

There are three liquid *Bitumens*, six or seven solid.

There are about a dozen *metallick Minerals*. *Mercury* is one of these, but how astonishing an one! The Particles whereof how small, how smooth, how solid! The *Corpuscles* of it have *Diameters* much less than those of *Air*; yea, than those of *Water*; and not much greater than those of *Light* itself!

At last we come to *Metals*; *Iron*, with its Attendants; *Tin*, *Lead*, *Copper*, *Silver* and *GOLD*.

‘ I shall not consider the Reasons which moved *Cardan* to assert that *Metals* have a *Soul*; but I am

‘ sure that I myself have a *Soul*, and am one that is  
 ‘ *reasonable*; if so, what can be more agreeable to me,  
 ‘ than a Consideration which I find hinted by a curi-  
 ‘ ous Writer of *natural Theology*: We should admire  
 ‘ the *Munificence* of one who would bestow a conside-  
 ‘ rable Quantity of enriching *Metals* upon us. But  
 ‘ then how much cause have we to adore the *Munifi-*  
 ‘ *cence* of our bountiful *GOD*, who has enrich’d us  
 ‘ with *Metals* in so vast a Quantity, and with so much  
 ‘ Profusion from His *hidden Treasures*! *Quotusquisque*  
 ‘ *est qui non videt, quid Ratio officii sui postulat?*’

How amazingly serviceable is our *Iron* to us! In our *mechanical Arts*, in our *Agriculture*, in our *Navigation*, in our *Architecture*; in all, I say, all our *Business*! What a *sordid Life* do those *Barbarians* lead, who are kept ignorant of it! Unthankful for this, *O Man*, you deserve *Heaven* should become as *Iron* over you.

It is from *GOD* that the *Metals* of most necessary *Uses* are the most plentiful; others that may be better spared, there is a rarity of them.

That one single *Metal*, *Iron*, as *Dr. Grew* observes, it sets on foot above an hundred sorts of manual *Operations*.

Tho the *Love of Money* be the *Root of all Evil*, yet the ingenious *Dr. Cockburn* has discoursed very justly on the vast Importance whereof the *Use of Money* is to *Mankind*. And indeed where the *Use of Money* has not been introduced, *Men* are brutish and savage, and nothing that is good has been cultivated.

There is a surprizing Providence of *GOD* in keeping up the Value of *Gold* and *Silver*, notwithstanding the vast Quantities dug out of the Earth in all Ages, ever since the Trade begun of *effodiuntur Opes*; and so continuing them fit *Materials* to make *Money* of.

Among the marvellous Qualities of *Gold*, its *Ductility* deserves to have a particular Notice taken of it.

The *Wire-drawers*, to every 48 Ounces of *Silver*, allow one of *Gold*. Now two Yards of the superfine  
 Wire

Wire weigh a *Grain*. In the Length of 98 Yards there are 49 Grains of Weight. A single Grain of *Gold* covers the said 98 Yards. The 10000th part of a *Grain* is above one third of an Inch long, which yet may be actually divided into ten; and so the 100000th part of a *Grain of Gold* may be visible without a *Microscope*.

It is a marvellous thing that *Gold*, after it has been divided by corrosive Liquors into *invisible Parts*, yet may presently be so precipitated, as to appear in its own *golden Form* again.

But, as Dr. *Grew* observes, the same *Immutability* which belongs to the Composition of *Gold*, much more belongs to the *Principles of Gold*, and of all other Bodies, when their Composition is destroyed. *Dampier*, an ingenious Traveller all round the Globe, has an Observation; *I know no Place where Gold is found, but what is very unhealthy.*

‘ Possessor of *Gold*! Beware lest the Observation be verified in the *unhealthy Influences* of thy *Gold* upon thy *Mind*; and lest the *love* of it betray thee into many *foolish and hurtful Lusts*, which will drown thee in *Destruction and Perdition*.’

‘ The *Auri sacra Fames* is the worst of all Distempers.’

*My God, I bless Thee*; *I know something that is better than fine Gold, something that cannot be gotten for Gold, neither shall Silver be weighed for the Price thereof.*

If *Gold* could speak, it would rebuke the *Idolatry* wherewith Mankind adores it, in much such Terms as I find a devout Writer assigning to it. *Non Deus sum, sed Dei Creatura*; *Terra mihi Mater*. *Ego servio tibi, ut tu servias Creatori.*

¶. ‘ Finally, The antient Pagans not only worshipped the *Host of Heaven*, [justly called *Zabians*] but whatsoever they found comfortable to Nature, they also deified, even, *Quodcunque juvaret*. The River *Nilus* too must at length become a Deity; yea, *Nascuntur in kortis Numina.*’

‘ And

‘ And according to *Pliny*, a Man that helps a Man becomes a God.’

‘ God save us from the Crime stigmatiz’d by our Apostle, to adore the Creatures more than the Creator ! By no means let us be as *Philo* speaks, *Κοσμὴν μᾶλλον ἢ κοσμοπόσιον θαυμάσαντες*, more admiring the World, than the Maker of the World.’

‘ We will glorify the GOD who has bestowed things upon us ; for the Silver is mine, and the Gold is mine, saith the Lord of Hosts.’

## ESSAY XXVI. Of the VEGETABLES.

THE Contrivance of our most Glorious Creator, in the VEGETABLES growing upon this Globe, cannot be wisely observed without Admiration and Astonishment.

We will single out some Remarkables, and glorify our GOD !

First, In what manner is *Vegetation* performed ? And how is the Growth of *Plants* and the Increase of their Parts carried on ? The excellent and ingenious Dr. *John Woodward* has, in the way of nice Experiment, brought this thing under a close Examination. It is evident that *Water* is necessary to *Vegetation* ; there is a *Water* which ascends the Vessels of the *Plants*, much after the way of a *Filtration* ; and the *Plants* take up a larger or lesser Quantity of this Fluid, according to their Dimensions. The much greater part of that fluid Mass which is conveyed to the *Plants*, does not abide there, but exhale thro them up into the *Atmosphere*. Hence Countries that abound with bigger *Plums* are obnoxious to greater Damps, and Rains, and inconvenient Humidities. But there is also a *terrestrial Matter* which is mixed with this *Water*, and ascends up into the *Plants* with the *Water*. Something of this Matter will attend *Water* in all its motions, and stick by it after all its Percolations. Indeed the

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Quantity of this *terrestrial Matter*, which the Vapours carry up into the *Atm. sphere*, is very *fine*, and not very *much*, but it is the truest and the best prepared *vegetable Matter*; for which cause it is that *Rain-Water* is of such a singular Fertility. 'Tis true there is in *Water* a *mineral Matter* also, which is usually too scabrous, and ponderous, and inflexible, to enter the Pores of the *Roots*. Be the *Earth* ever so rich, 'tis observed little good will come of it, unless the Parts of it be loosened a little, and separated. And this probably is all the use of *Nitre* and other *Salts* to Plants, to loosen the *Earth*, and separate the Parts of it. It is this *terrestrial Matter* which fills the *Plants*; they are more or less nourished and augmented in proportion, as their *Water* conveys a greater or lesser quantity of proper *terrestrial Matter* to them. Nevertheless 'tis also probable that in this there is a variety; and all Plants are not formed and filled from the same sort of *Corpuscles*. Every *Vegetable* seems to require a *peculiar and specifick Matter* for its Formation and Nourishment. If the Soil wherein a Seed is planted, have not all or most of the Ingredients necessary for the *Vegetable* to subsist upon, it will suffer accordingly. Thus *Wheat* sown upon a Tract of Land well furnish'd for the Supply of that *Grain*, will succeed very well, perhaps for divers Years, or, as the Husbandman expresses it, *as long as the Ground is in heart*; but anon it will produce no more of that *Corn*; it will of some other, perhaps of *Barley*: and when it will subsist this no more, still *Oats* will thrive there; and perhaps *Pease* after these. When the Ground has lain fallow some time, the *Rain* will pour down a fresh Stock upon it; and the care of the *Tiller* in manuring of it, lays upon it such things as are most impregnated with a Supply for *Vegetation*. It is observ'd that *Spring-water* and *Rain-water* contain pretty near an equal charge of the *vegetable Matter*, but *River-water* much more than either of them; and hence the Inundations of *Rivers* leave upon their

Banks

Banks the fairest Crops in the World. It is now plain that *Water* is not the *Matter* that composes *Vegetables*, but the *Agent* that conveys that *Matter* to them, and introduces it into the several parts of them. Wherefore the plentiful provision of this Fluid supplied to all Parts of the Earth, is by our *Woodward* justly celebrated with a pious Acknowledgment of that *natural Providence* that superintends over the Globe which we inhabit. The Parts of *Water* being exactly spherical, and subtile beyond all expression, the Surfaces perfectly polite, and the Intervals being therefore the largest, and so the most fitting to receive a *foreign Matter* into them, it is the most proper Instrument imaginable for the Service now assign'd to it. And yet *Water* would not perform this Office and Service to the *Plants*, if it be not assisted with a due quantity of *Heat*; *Heat* must concur, or *Vegetation* will not succeed. Hence as the *Heat* of several *Seasons* affords a different face of things, the same does the *Heat* of several *Climates*. The *hotter* Countries usually yield the *larger Trees*, and in a greater variety. And in *warmer* Countries, if there be a remission of the *usual Heat*, the Production will in proportion be diminish'd.

That I may a little contribute my *two Mites* to the illustration of the way wherein *Vegetation* is carried on, I will here communicate a couple of Experiments lately made in my Neighbourhood.

My Neighbour planted a Row of Hills in his Field with our *Indian Corn*, but such a Grain as was colour'd *red* and *blue*; the rest of the Field he planted with Corn of the most usual Colour, which is *yellow*. To the most *Windward-side* this Row infected *four* of the next neighbouring Rows, and part of the fifth, and some of the sixth, to render them colour'd like what grew on itself. But on the *Leeward-side* no less than seven or eight Rows were so colour'd, and some smaller impressions were made on those that were yet further distant.

The same Neighbour having his Garden often robb'd of the *Squashes* growing in it, planted some *Gourds* among them, which are to appearance very like them, and which he distinguish'd by certain adjacent marks, that he might not be himself imposed upon; by this means the Thieves 'tis true found a very bitter *Sauce*, but then all the *Squashes* were so infected and embitter'd, that he was not himself able to eat what the Thieves had left of them.

That most accurate and experienc'd Botanist Mr. *Ray* has given us the *Plants* that are more commonly met withal, with certain characteristick Notes, wherein he establishes twenty-five *Genders* of them. These *Plants* are to be rather filed *Herbs*.

But then of the *Trees* and *Shrubs*, he distinguishes five *Classes* that have their *Flower* disjoined and remote from the *Fruit*, and as many that have their *Fruit* and *Flower* contiguous.

How unaccountably is the *Figure* of *Plants* preserved? And how unaccountably their *Growth* determined? Our excellent *Ray* flies to an intelligent *plastick Nature*, which must understand and regulate the whole *Oeconomy*.

Every particular *part* of the *Plant* has its astonishing *Uses*. The *Roots* give it a *Stability*, and fetch the *Nourishment* into it, which lies in the *Earth* ready for it. The *Fibres* contain and convey the *Sap* which carries up that *Nourishment*. The *Plant* has also larger *Vessels*, which entertain the proper and specifick *Juice* of it; and others to carry the *Air* for its necessary *respiration*. The outer and inner *Bark* defend it from *Annoyances*, and contribute to its *Augmentation*. The *Leaves* embrace and preserve the *Flower* and *Fruit* as they come to their *explication*. But the principal use of them, as *Malpighi*, and *Perault*, and *Mariotte*, have observed, is, to concoct and prepare the *Sap* for the *Nourishment* of the *Fruit*, and of the whole *Plant*; not only that which ascends from the *Root*, but also

what they take in from without, from the Dew, and from the Rain. For there is a *regress* of the *Sap* in Plants from above downwards; and this descendent Juice is that which principally nourishes both Fruit and Plant, as has been clearly proved by the Experiments of Signior *Malpighi* and Mr. *Brotherton*.

How agreeable the *Shade* of *Plants*, let every Man say that *sits under his own Vine, and under his own Fig-tree!*

How charming the Proportion and Pulchritude of the *Leaves*, the *Flowers*, the *Fruits*, he who confesses not, must be, as Dr. *More* says, *one sunk into a forlorn pitch of Degeneracy, and stupid as a Beast.*

Our Saviour says of the *Lillies* (which some, not without reason, suppose to be *Tulips*) that *Solomon in all his Glory was not arrayed like one of these.* And it is observed by *Spigelius*, that the Art of the most skilful Painter cannot so mingle and temper his *Colours*, as exactly to imitate or counterfeit the *native* ones of the *Flowers of Vegetables.*

Mr. *Ray* thinks it worthy a very particular Observation, that *Wheat*, which is the best sort of Grain, and affords the wholesomest Bread, is in a singular manner patient of both Extremes, both Heat and Cold, and will grow to maturity as well in *Scotland*, and in *Denmark*, as in *Egypt*, and *Guiney*, and *Madagascar*. It scarce refuses any Climate. And the exceeding *Fertility* of it is by a Pagan *Pliny* acknowledged as an Instance of the Divine Bounty to Man, *Quod eo maxime Hominem alit*; one Bushel in a fit Soil, he says, yielding one hundred and fifty. A German Divine so far plays the Philosopher on this Occasion, as to propose it for a Singularity in Bread, that *totum Corpus sustentat, adeo, ut in unicâ Buccellâ, omnium Membrorum totius externi Corporis, nutrimentum contineatur, illiusque Vis per totum Corpus sese diffundat.* A Friend of mine had *thirty-six Ears* of Rye growing from one Grain, and on one *Stalk.*

But of our *Indian Corn*, one Grain of *Corn* will produce above a *thousand*. And of *Guiney Corn*, one Grain has been known to produce *ten thousand*.

The *Anatomy of Plants*, as it has been exhibited by the incomparable Curiosity of *Dr. Grew*, what a vast *Field of Wonders* does it lead us into!

The most inimitable *Structure* of the *Parts*!

The particular *Canals*, and most adapted ones, for the conveyance of the lymphatick and essential Juices!

The *Air-Vessels* in all their curious Coylings!

The *Coverings* which befriend them, a Work unspeakably more curious in reality than in appearance!

The strange *Texture* of the *Leaves*, the angular or circular, but always most orderly *Position* of their *Fibres*; the various *Foldings*, with a *Duplicature*, a *Multiplicature*, the *Fore-rowl*, the *Back-rowl*, the *Tre-rowl*; the noble *Guard* of the *Films* interposed!

The *Flowers*, their *Gaiety* and *Fragrancy*; the *Perianthium* or *Empalement* of them; their curious *Foldings* in the *Calyx* before their *Expansion*, with a *close Couch* or a *concave Couch*, a *single Plait* or a *double Plait*, or a *Plait and Couch* together, or a *Rowl*, or a *Spire*, or *Plait and Spire* together; and their luxuriant *Colours* after their *Foliation*, and the expanding of their *Petala*!

The *Stamina*, with their *Apices*; and the *Stylus* (called the *Attire* by *Dr. Grew*) which is found a sort of *Male Sperm*, to impregnate and fructify the *Seed*!

At last the whole *Rudiments* and *Lineaments* of the *Parent-Vegetable*, surprizingly lock'd up in the little compass of the *Fruit* or *Seed*!

*Gentlemen of Leisure*, consult my illustrious *Doctor*, peruse his *Anatomy of Plants*, ponder his numberless *Discoveries*; but all the while consider that rare *Person* as inviting you to join with him in adoring the *God of his Father*, and the *God* who has done these excellent things, which ought to be known in all the *Earth*.

Signior *Malpighi* has maintain'd it with cogent Arguments, that the whole *Plant* is actually in the *Seed*; and he answers the grand Objection against it, which is drawn from a degeneracy of one *Plant* sometimes into another. One of his Answers is, *Ex morboſo & monſtroſo affectu, non licet inferre permanentem ſtatum à Natura intentum.*

But there is no Objection to be made againſt *Ocular Obſervation*. Shew us, *Lewenhoeck*, how it is? He will give us to ſee, a ſmall Particle no bigger than a Sand, contain the *Plant*, and all belonging to it, all actually in that *little Seed*; yea, in the *Nux vomica* it appears even to the naked Eye, and in an aſtoniſhing Elegancy! Dr. *Cheyne* expreſſes himſelf with good aſſurance upon it: 'We are certain that the *Seeds* of *Plants* are ' nothing but *little Plants* perfectly formed, with Branches and Leaves duly folded up, and involved in ' *Membranes*, or ſurrounded with *Walls* proper to defend them in this tender ſtate from external Injuries; ' and *Vegetation* is only the unfolding and extending ' of theſe Branches and Leaves, by the force of Juices ' raiſed by *Heat* in the ſlender Tubes of the *Plant*.'

Thoſe *capillary Plants*, which all the Antients, and ſome of the Moderns, have taken to be deſtitute of *Seeds*, are by *Bauhinus* and others now pronounced *Spermatophorous*. Mr. *Ray* ſays, *Hanc Sententiam veriſſimam eſſe Autopſia convincit.*

*Fr. Cæſius* claims to be the firſt who diſcovered the *Seeds* of theſe *Plants*, with the help of a *Microſcope*. One Mr. *Cole* has proſecuted the Obſervation, and is aſtoniſhed at the ſmall Dimensions of the *Seeds*. The *Boxes* or *Veſſels* that hold the *Seeds* are not half, perhaps not a quarter, ſo big as a Grain of Sand; and yet an hundred *Seeds* are found in one of theſe. *Tantum Plantam è tantilo Semine produci attentum Obſervatorem merito in Admirationem rapiat!*

Sir *Thomas Brown* obſerves, That of the *Seeds* of *Tobacco* a thouſand make not one Grain; (tho *Otto de Gueric,*

*Gueric*, as I remember, says, fifty-two Cyphers with one Figure will give the Number of those, which would fill the Space between us and the Stars!) A Plant which has extended its Empire over the whole World, and has a larger Dominion than any of all the *Vegetable Kingdom*.

Ten thousand Seeds of *Harts-tongue* hardly make the Bulk of a *Pepper-corn*. But now, as *Dr. Grew* notes, the Body, with the Covers of every Seed, the ligneous and parenchymous Parts of both, the Fibres of those Parts, the Principles of those Fibres, and the homogeneous Particles of those Principles, being but moderately multiplied one by another, afford an hundred thousand millions of Atoms formed in the Space of a *Pepper-corn*. But who can define how many more!

The Uses of *Trees* in various Works were elegantly celebrated, as long ago as when *Theophrastus* wrote his fifth Book of the *History of Plants*.

And what *stately Trees* do sometimes by their glorious *Height* and *Breadth* recommend themselves to a more singular Observation with us! The *Cabbage-tree* an hundred and forty or fifty Foot high, as if it were aspiring to afford a Diet to the Regions above us; how noble a Spectacle!

The *Trees* which are found sometimes near twenty Foot, or perhaps more, in circumference, what capacious *Canoes* do they afford, when the Traveller makes them change their Element? Near *Scio* there is an Island called *Long-Island*, and on this Island (as *Jo. Pitts* tells us) there is a Tree of a prodigious bigness; under it are *Coffee-houses*, and many Shops of several Intentions, and several Fountains of Water; and it has near forty Pillars of Marble and of Timber to support the Branches of it. It is a Tree famous to a Proverb all over *Turkey*.

Even the most *noxious* and the most *abject* of the *Vegetables*, how useful are they! As of the *Bramble* *Dr. Grew* notes, *If it chance to prick the Owner, it will*

also tear the Thief. *Olaus Magnus* admires the Benefits which the rotten Barks of Oaks give to the Northern People, by the Shine, with which they do in their long Nights direct the Traveller. And *Dr. Merret* celebrates the Thistles, and the Hop-strings, for the Glass afforded by their Ashes!

The frugal Bit of the old Britons, which in the bigness of a Bean satisfied the most hungry and thirsty Appetite, is now thrown into the Catalogue of the *Res deperdita*.

The peculiar Care which the great God of Nature has taken for the Safety of the Seed and Fruit, and so for the Conservation of the Plant, is by my ingenious *Derham* considered as a loud Invitation to His Praises.

They which dare shew their Heads all the Year, how securely is their Seed or Fruit lock'd up in the Winter in their Gems, and well cover'd with neat and close Tanicks there!

Such as dare not expose themselves, how are they preserved under the Coverture of the Earth, till invited out by the kindly Warmth of the Spring!

When the Vegetable Race comes abroad, what strange Methods of Nature are there to guard them from Inconveniences, by making some to lie down prostrate, by making others, which were by the Antients called *Æschynomena*, to close themselves up at the Touch of Animals, and by making the most of them to shut up under their guard in the cool of the Evening, especially if there be foul Weather approaching; which is by *Gerhard* therefore called, *The Countryman's Weather-wiser!*

What various ways has Nature for the scattering and the sowing of the Seed! Some are for this end winged with a light sort of a Down, to be carried about with the Seed by the Wind. Some are laid in springy cases, which when they burst and crack, dart their Seed to a distance, performing therein the part of an Husbandman. Others by their good Qualities invite themselves

selves to be swallowed by the Birds, and being fertiliz'd by passing thro their Bodies, they are by them transferred to places where they fructify. *Theophrastus* affirms this of the *Mistletoe*; and *Tavernier* of the *Nutmeg*. Others not thus taken care for, do, by their Usefulness to us, oblige us to look after them.

It is a little surprizing, that *Seeds* found in the *Gizzards* of *Wild-fowl*, have afterwards sprouted in the Earth; and *Seeds* left in the *Dung* of the *Cattel*. The *Seeds* of *Marjoram* and *Strammonium*, carelessly kept, have grown after seven Years.

How nice the provision of Nature for their Support in standing and growing, that they may keep their Heads above ground, and administer to our Intentions! There are some who stand by their own Strength; and the ligneous parts of these, tho' like our Bones, yet are not, like them, inflexible, but of an elastick nature, that they may dodge the Violence of the Winds: and their Branches at the top very commodiously have a tendency to an hemispherical Dilatation, but within such an Angle as makes an *Æquilibration* there. An ingenious Observer upon this one Circumstance, cannot forbear this just Reflection: *A visible Argument that the plastick Capacities of Matter are govern'd by an all-wise and infinite Agent, the native Strictnesses and Regularities of them plainly shewing from whose Hand they come.* And then such as are too weak to stand of themselves, 'tis wonderful to see how they use the Help of their *Neighbours*, address them, embrace them, climb up about them, some twisting themselves with a strange convolving Faculty, some catching hold with *Claspers* and *Tendrels*, which are like Hands to them; some striking in rooty *Feet*, and some emitting a natural *Glue*, by which they adhere to their Supporters.

But, Oh! the glorious Goodness of our GOD in all these things! Lend us thy Pen, O industrious Ray, to declare a little of it. *Plantarum usus latissimè patet, & in omni Vitæ parte occurrit. Sine illis cautè, sine illis com-*

modè, non vivitur; ac nec vivitur omnino: quacunque ad victum necessaria sunt, quacunque ad Delicias faciunt, è l'cupletissimo suo Pentu abunde subministrant. Quanto ex iis Mensa innocentior, mundior, salubrior, quam ex Animalium Cæde & Laniena! Hòho certè Naturâ Animal carnivorum non est; nullis ad Pradam & Rapinam armis instructum; non Dentibus exercis & serratis, non Unguibus aduncis. Manus ad Fructus colligendos, Dentes ad mandendos comparati. Non legimus ei ante Diluvium Carnes ad esum concessas. At non victum tantum nobis suppeditant, sed & Vestitum, & Medicinam, & Domicilia, aliaque Ædificia, & Navigia, & Supellectilem, & Focum, & Oblectamenta Sensuum Animique. Ex his Naribus Odoramenta & Suffumigia parantur: Horum Flores inenarrabili Colorum & Schematum Varietate & Elegantia Oculos exhiberant, & suavissima Odorum quos expirant Fragrantia, Spiritus recreant. Horum Fructus, Gulæ illecebræ Mensas secundas instruunt, & languentem Appetitum excitant. Taceo Virorem Oculis Amicum, quem per Prata, Pascua, Agros, Sylvas spatiantibus objiciunt; & Umbras quas contra Æstum & Solis Ardores præbent.

Indeed all the Plants in the whole Vegetable Kingdom are every one of them so useful, as to rise up for thy Condemnation, O Man, who dost little Good in the World. But sometimes the Uses of one single Plant are so many, so various, that a wise Man can scarce behold it without some Emulation as well as Admiration, or without some wishing, that if a Metamorphosis were to befall him, it might be into one of these. Plutarch reports, that the Babylonians out of the Palm-tree fetch'd more than three hundred several sorts of Commodities.

The Coco-tree supplies the Indians with Bread, and Water, and Wine, and Vinegar, and Brandy, and Milk, and Oil, and Honey, and Sugar, and Needles, and Thread, and Linnen, and Clothes, and Cups, and Spoons, and Besoms, and Baskets, and Paper, and Nails; Timber, Coverings for their Houses; Masts, Sails, Cordage, for their Vessels; add, Medicines for their  
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Diseases; and what can be desired more? This is more expressively related in the *Hortus Malabaricus*, published by the illustrious *Van Draakenstein*.

The *Aloe Muricata* yields the *Americans* all that their Necessities can call for. *De la Vega* and *Margrave* will inform us how this alone furnishes them with Houses and Fences, and Weapons of many sorts, and Shoes, and Clothes, and Thread, and Needles, and Wine, and Honey, and Utensils that cannot be numbred. *Hernandes* will assure us, *Planta hac unica, quicquid Vita esse potest necessarium facile prestare potest, si esset rebus humanis modus.*

What a surprizing Diversity from the *Cinnamon-tree*!

Some will have the *Plantane* to be the *King of all Fruit*, tho the Tree be little more than ten Foot high, and raised not from *Seed*, but from the *Roots* of the old ones. The *Fruit* a delicate Butter, and often the whole Food that a whoie Family will subsist upon.

Among the *Uses of Plants*, how surprizing an one is that, wherein we find them used for *Cisterns*, to preserve Water for the needy Children of Men!

The *Dropping-tree* in *Guiney*, and on some Islands, is instead of *Rains* and *Springs* to the Inhabitants.

The *Banduca Cingatensum*, at the end of its Leaves has long Sacks or Bags, containing a fine limpid Water, of great use to the People when they want *Rains* for eight or ten Months together.

The *wild Pine*, describ'd by *Dr. Sloane*, has the Leaves, which are each of them two Foot and an half long; and three Inches broad; so inclosed one within another, that there is formed a large *Bason*, fit to contain a considerable quantity of Water (*Dampier* says, the best part of a Quart) which in the rainy Season falling upon the utmost parts of the spreading Leaves, runs down by Channels into the *Bottle*, where the Leaves bending inwards again, come so close to the *Stalk*, as to hinder the *Evaporations* of the Water. In the

mountainous, as well as in the dry and low Woods, when there is a scarcity of Water, this *Reservatory* is not only necessary and sufficient for the nourishment of the Plant itself, but it is likewise of marvellous advantage unto Men and Birds, and all sorts of Insects, who then come hither in Troops, and seldom go away without Refreshment.

What tho there are *venomous Plants*? An excellent *Fellow of the College of Physicians* makes a just Remark: '*Aloes* has the Property of promoting *Hæmorrhages*; but this Property is good or bad, as it is used; a *Medicine* or a *Poison*: And it is very probable that the most dangerous *Poisons*, skilfully managed, may be made not only *innocuous*, but of all other *Medicines* the most *effectual*.'

What admirable Effects of *Opium* well *smegmatized*! Even *poisonous Plants*, one says of them, It may be reasonably supposed that they draw into their visible Bodies that malignant *Juice*, which, if diffused thro the other *Plants*, would make them less wholesome and fit for Nourishment.

In the *Delights* of the *Garden* 'tis not easy to hold a *Mediocrity*. They afford a Shadow for our *celestial Paradise*. The King of *Persia* has a *Garden* called *Paradise upon Earth*. The antient *Romans* cultivated them to a degree of *Epicurism*. Some confined their *Delights* to a single *Vegetable*, as *Cato*, doting on his *Cabbage*. The *Tulipists* are so set upon their gaudy Flower, that the hard Name and Crime of a *Tulipomania*, is by their own Professors charged upon them; a little odd the Humour of those Gentlemen, who affected Plantations of none but *venomous Vegetables*.

But finally, the vast Uses of *Plants* in *Medicine*, are those which fallen and feeble Mankind has cause to consider, with singular Praises to the merciful God, who so pities us under the sad Effects of our Offences.

Among the eighteen or twenty thousand *Vegetables*, we have ever now and then a single one, which is a *Polychrest*,

*Polychrest*, and almost a *Panacea*; or at least such an one as obliges us to say of it, as Dr. Morton speaks of the *Cortex Peruvianus*; 'tis *Antidotus in Levamen Ærum-narum Vita humana plurimarum divinitus concessa*. And, *In Sanitatem Gentium proculdubio a Deo optimo maximo condita*.

Among the Antients there were several Plants that bore the Name of *Hercules*, — called *Heracleum*, or *Heraclea*; probably, as *Le Clerc* thinks, to denote the extraordinary Force of the Plants, which they compared to the Strength of *Hercules*.

*Cabbage* was to the Romans their grand *Physick*, as well as *Food*, for six hundred Years together.

*Mallows* has been esteemed such an *universal Medicine*, as to be called *Malva Omnimorbia*.

Every body has heard,

*Cur moriatur homo cui Salvia crescit in hortis?*

The six favourite Herbs distinguish'd by Sir *William Temple* for the many Uses of them, namely, *Sage*, and *Rue*, and *Saffron*, and *Alehoof*, and *Garlick*, and *Elder*, if they were more frequently used, would no doubt be found vastly beneficial to such as place upon *Health* the Value due to such a Jewel.

The *French* do well to be such great Lovers of *Sorrel*, and plant so many Acres of it; it is good against the *Scurvy*, and all ill Habits of Body.

The Persuasion which Mankind has imbib'd of *Tobacco* being good for us, has in a surprizing manner prevail'd! What incredible Millions have suck'd in an Opinion, that it is an useful as well as a pleasant thing, for them to spend much of their Time in drawing thro a Pipe the *Smoke* of that lighted Weed! It was in the Year 1585, that one Mr. *Lane* carried over from *Virginia* some *Tobacco*, which was the first that had ever been seen in *Europe*; and within an hundred Years the *Smoking* of it grew so much into fashion, that the very

Customs of it brought *four hundred thousand Pounds a Year* into the *English Treasury*.

It is doubtless a *Plant* of many *Virtues*. The *Ointment* made of it is one of the best in the *Dispensatory*. The *Practice* of *smoking* it, tho a great part of them that use it might very truly say, *they find neither Good nor Hurt by it*; yet it may be fear'd it rather does more *Hurt* than *Good*.

' May God preserve me from the indecent, ignoble, criminal *Slavery*, to the mean *Delight* of *smoking a Weed*, which I see so many carried away with. And if ever I should *smoke* it, let me be so wise as to do it, not only with *Moderation*, but also with such *Employments* of my *Mind*, as I may make that *Action* afford me a *Leisure* for !'

Methinks *Tobacco* is but a poor *Nepenthe*, tho the *Takers* thereof take it for such an one. It is to be feared the *caustick Salt* in the *Smoke* of this *Plant*, convey'd by the *Salival Juice* into the *Blood*; and also the *Vellication* which the continual use of it in *Snuff* gives to the *Nerves*, may lay *Foundations* for *Diseases* in *Millions* of unadvised *People*, which may be commonly and erroneously ascribed to some other *Original*.

It is very remarkable, that our compassionate God has furnish'd all *Regions* with *Plants* peculiarly adapted for the relief of the *Diseases* that are most common in those *Regions*. 'Tis Mr. Ray's Remark, *Tales Plantarum Species in quacunqve Regione a Deo creantur, quales Hominibus & Animalibus ibidem natis maxime conveniunt.*

Yea, *Silenander* affirms, that from the *Quantity* of the *Plants* most plentifully growing in any place, he could give a probable *Guess* what were the *Distempers* which the *People* there were most of all subject to.

*Benetvinius* has written a *Book*, on purpose to shew that every *Country* has every thing serving to its *Occasions*,

casions, and particularly Remedies for all the Distempers which it may be afflicted with.

Can we be any other than charmed with the Goodness appearing in it, when we see the *Plants* every where starting out of the *Earth*, and hear their courteous Invitation, *Feeble Man, I am a Remedy, which our gracious Maker has provided for thy Feebleness; take me, know me, use me, thou art welcome to all the Good that is to be found in me!*

Yea, such are the Virtues of the *Vegetable World*, that it is no rare thing to see a whole Book written on the Virtues of one single *Vegetable*.

How long is *Rosenbergius* on the *Rose*, in his *Rhologia*! *Whitaker* will have the *Vine* to be the *Tree of Life*, in his Treatise on the *Blood* of it. *Alsted* has entertained us with a yet greater variety on that *Plant of Renown*.

I was going to mention the *Anatomia Sambuci*, written by a *German Philosopher*.

But I presently call to mind such a vast Number of Treatises published, each of them on one single *Vegetable*, by the *Naturæ Curiosæ* of *Germany*, that a Catalogue would be truly too tedious to be introduced.

If the *Coral* may pass for a *Vegetable*, *Garencieres* has obliged us with a whole Treatise upon it.

But then we have one *far-fetch'd* and *dear-bought* Plant, on which we have so many Volumes written, that they alone almost threaten to become a *Library*. TEA is that charming Plant. Read *Pecklinus's* Book *de Potu Theæ*, and believe the medicinal and balsamick Virtues of it; it strengthens the *Stomach*, it sweetens the *Blood*, it revives the *Heart*, and it refreshes the *Spirits*, and is a Remedy against a World of Distempers. Then go to *Waldschmidt*, and you'll find it also to brighten the *Intellectuals*. When *Prose* has done its part, our *Tate* will bring in *Verse* to celebrate the sovereign Virtues of it.

*Innocuos Calices, & Amicam Vatibus Herbam  
Vimque datam Folio.*

At last it shall be the very *Ωειά* of the Poet.

*Whilst T E A, our Sorrows safely to beguile,  
Sobriety and Mirth does reconcile :  
For to this Nectar we the Blessing owe,  
To grow more wise as we more chearful grow.*

There is a Curiosity observed by Mr. Robinson of Ousby, that should not be left unmentioned ; it is, that Birds are the *natural Planters* of all sorts of Trees ; they disseminate the *Kernels* on the Earth, which brings them forth to perfection. Yea, he affirms, that he hath actually seen a great Number of Crows together planting a Grove of Oaks ; they first made little Holes in the Earth with their Bills, going about and about, till the Hole was deep enough, and then they dropt in the *Acorn*, and cover'd it with Earth and Moss. At the time of his writing, this young Plantation was growing up towards a *Grove of Oaks*, and of an height for the Crows to build their Nests in.

In *Virginia* there is a Plant called *The James-Town-Wied*, whereof some having eaten plentifully, turn'd *Fools* upon it for several Days ; one would blow up a Feather in the Air, another dart Straws at it ; a third sit stark naked, like a Monkey, grinning at the rest ; a fourth fondly kiss and paw his Companions, and sneer in their Faces. In this frantick State they were confined, lest they should kill themselves, tho there appear'd nothing but Innocence in all their Actions. After eleven Days they return'd to themselves, not remembering any thing that had pass'd.

My Friend, a *Madness* more senseless than that with which this *Vegetable* envenoms the Eaters of it, holds thee in the stupefying Chains thereof, if thou dost not behold

behold in the whole *Vegetable Kingdom* such Works of the glorious Creator, as call for a continual Admiration.

¶ It is a notable Stroke of Divinity methinks which *Pliny* falls upon, *Flores Odoresque indiem gignit Natura, magna (ut palam est) Admonitione hominum.*

‘The Man began to be cured of his *Blindness*, who could say, *I see Men, like Trees, walking.* That Man is yet perfectly *blind* who does not *see Men, like Trees*, first *growing and flourishing*, then *withering, decaying, dying.*’

‘The *Rapa Anthropomorpha*, and some other *Plants*, that have grown with much of an *Human Figure*, to be fancied on them, have been *odd things*. But there are Points wherein all *Plants* will exhibit something of the *Human Figure.*’

‘The *Parts* of *Plants* analogous to those in an *Human Body*, are notably enumerated by *Alsted* in his *Theologia Naturalis*. The Analogy between their States and ours would be also as *profitable* as *reasonable* a Subject of Contemplation.’

‘And I hope the *Revival* of the *Plants* in the *Spring* will carry us to the Faith of our own *Resurrection* from the *Dead.*’

‘And of the *Recovery* which the *Church* will one day see from a *Winter* of *Adversity*; the *World* from a *Winter* of *Impiety*: The *Earth* shall one day be filled with the *Fruits* of *Righteousness*, however barren and horrid may be the present *Aspect* of it.’

‘A Man famous in his day (and in ours too) thought himself well accommodated for devotionary Studies, tho he says, *Nullos se aliquando Magistros habuisse nisi Quercus & Fagos.*’

‘I will hear these *Field-Preachers*, their loud Voice to me from the *Earth*, is the same with what would be uttered by *Angels* flying thro the midst of *Heaven*; Fear God, and glorify him!

‘One

One thus articulates the Vegetable Sermons: *Ecce nos, O increduli filii hominum, nuper mortui eramus, at nunc reviximus. Vetus nostrum Corpus ac Vestimentum deposuimus, & nova Creatura facta sumus. Facite vos nunc aliquid simile.* And again, *Dum in hac miserrima Vitâ estis, nolite de Corpore esse solliciti; nostri memores estote, quas Creator honestissime coloratis Vestibus induit, quotannis per tot Millenarios, jam inde ab exordio Mundi.* And once more, *Ecce vires vestrae, non nobis ipsis, sed vobis deserviunt. Non nostro Bono floremus, sed vestro. Imo Divina Bonitas vobis floret per nos, ut dicere possitis, Dei Benignitatem in nobis florere, suoque Odore suavissimo vos recreare.*

A famous German Doctor of Philosophy declares, that he found it impossible for him to look upon the *Vegetable World* without those Acclamations, *Psalm cxxxix. 6. The Knowledge of these things is too wonderful for me, it is high, I cannot attain to it.*

The pious Arndt observes, that every Creature is enstamp'd with Characters of the Divine Goodness, and brings Testimonies of a good Creator. Our *Vine* so calls upon us, *Scias, O homo, hanc Liquoris mei Suavitatem, qua Cor tuum recreo, a Creatore meo esse.* Our *Bread* so calls upon us, *Vis ista, qua famem sublevo, à Creatore meo, & vestro mihi obtigit.* It is a Saying of *Austin's*, *Deum Creaturas singulas guttula Divinae suae Bonitatis aspersisse, ut per illas homini bene fit.*

A devout Writer treats us with such a Thought as this: Our God is like a tender Father, who, when the Infant complies not presently with his Calls, allures him with the Offer of pleasant *Fruits* to him. Not that the Child should stop in the Love of the *Apple*, the *Plumb*, the *Pear*, but be by the *Fruits* drawn to the Love and Obedience of the *Father* that gives them. Our heavenly Father calling on us in his *Word*, gives us also *Rain from Heaven*, and fruitful *Seasons*, to engage our Love and Obedience. *Quæ sanè Beneficia aliud nihil sunt, quam tot*

‘ manus & Nuncii Dei, parati ad ipsum Deum nos deducere, illiusque amorem altius animis nostris insinuare, ut ipsum tandem Datorem in Creaturis & Donis suscipere discamus.’

‘ Among other Thoughts of Piety upon the *Vegetable World*, some have allow’d a room for this; the strong Passion in almost all Children for *Fruit*; — by tending *Fruits* to them, you may draw them to any thing in the World. May not this be a lasting *Signature* of the *first Sin*, left upon the Minds of our Children! An Appetite for the *forbidden Fruit*. When we see our Children greedy after *Fruits*, a remembrance and repentance of *that Sin* may be excited in us.’

Add this: *Quid prodest ope Creaturarum vivere, si Deo non vivitur?*

A good Thought of a German Writer :

*Sol & Luna, totusque Mundus Sydereus, luce sua Deum collaudunt. Terra Deum laudat, dum viret & floret. Sic Herbae & Flosculi Opificis sui Omnipotentiam & Sapientiam commendant Odore, Pulchritudine, & Colorum varia Pictura: Aves Cantu & Modulatione; Arbores Fructibus; Mare Piscibus; omnes Creaturae laudant Deum, dum illius mandata exequentur. Colloquuntur nobiscum per divinitus ipsis insitas Proprietates, manifestantes opificem suum, & exhortantes nos ad ipsum laudandum.*

## ESSAY XXVII. Of INSECTS.

WE are hastening into the *Animal World*. Here we soon find a Tribe vastly numerous, called by *Aristotle* *Ἔρση*. and by *Pliny* therefore *Insecta*, because of their having certain Incisures and Indentings about their Bodies.

The *French Philosopher* does well to rebuke us for calling these *imperfect Animals*, for they want no Parts, either *necessary* or *convenient* for them; they are *complete* in their Kind, and the Divine Workmanship is astonishing!

nishing! *Pliny* shall here correct us, *In his tam parvis atque nullis, quæ Ratio, quanta Vis, quam inextricabilis perfectio!*

Even the poor *Ephemeron*, whose whole Period of Life is but six or seven Hours, who is bred and born, and lives, and goes thro all his Operations, and expires, and goes into his Grave, all within this little Period, must not be thrown into a Class of *imperfect Animals*; nor may it be said of it, that it is *made in vain*.

We enjoy an excellent *Ray*, who in his *Methodus Insectorum* has distinguish'd to us the several Kinds of *Insects*.

Of *Insects*, there are some which do *not change* their Form.

Some of these *Ἀμεταμορφώτα* are *without Feet*; these are either *terrestrial*, produced *on the Earth* or *in the Earth*; (whereto *Snails* may be referred) or within the *Bowels* of *Animals*; or else *aquatick*, whereof some are *greater*, which have a peculiar way of moving, by first fixing their *Head* on the *Ground*, and then drawing up their *Tail* towards it; some are *lesser*, having a different way of crawling; and among these there are both *round* ones and *flat* ones.

But then there are some *having Feet*.

There are *Hexapoda*, or six-footed ones; of these there are some *terrestrial* ones, both of a *larger* sort, and of a *smaller*: of the *smaller*, there are about *five* which molest the *Bodies* of other living *Creatures*; and as many that give not that *Molestation*. There are other *aquatick* ones.

There are also *Octapoda*, or eight-footed ones; of these there are some that have a *Tail*, as the *Scorpion*; and some that have none, as the *Spider*; whereof one sort spins no *Web*; three sorts are *Spinsters*. To these add the *Ticks*, and the *Mites*.

Yea, there are *Tessareskaidcapoda*, or fourteen-footed ones; particularly the three sorts of *Aselli*. More than

than so, there are *twenty-four-footed* ones, whose eight Fore-Feet are lesser ones, and sixteen Hinder-Feet are larger ones.

More than this, there is a sort of *thirty-footed* ones : but as being tired with specified Numbers for the Feet of these curious things, the rest we call *Polypoda*, or many-footed ones ; of these there are some on the *Land*, and others in the *Water*.

Of *Insects*, there are others who do *undergo a Change*. Tho *Squammerdam* (who has given the best Account of these) observes, that this is improperly affirmed of these *Μεταμορφώμενα*, since there is no real *Transformation* of these, but only an Explication of the Parts of the Animal, which were before latent in *Miniature*, and like the Plant in the Seed.

Of these there are some, in whose Transmutation there is no *Rest* or *Stop* between the old and the new Form, and who don't lose their Motion at the time of their shifting the *Pellicula*. And there are some, in whom the *Vermiculus* leaving the former Shape of the *Nympha*, with which it appeared in the Egg, and subsisted without Food, now beginning to feed, hath its Parts visibly increased and stretched out, and takes the Form of a new *Nympha*, which is not without motion, and from thence becomes a *Flyer*.

To the former *Species* of Transmutation there belong many sorts, thirteen at least ; to the second a vast multitude more. And among the rest, the multitudinous Armies of *Butterflies*, which being divided into *diurnal* and *nocturnal* ; of the former sort alone there is about *fifty* several Kinds observed in *England*.

There is a third *Species* of Transmutation, which is a sensible Change from a *Vermiculus* to a *flying Insect*, but yet with a sensible *Rest* or *Stop* between one Form and the other. The *Flesh-Flies* belong to this, and so do some other Kinds.

Before we go any further, we will make a pause upon an Observation, thus expressed by Mr. *Barker* in his

his *Natural Theology*; for it is upon a Matter which occurs in the View of all Creatures, that now remain for our Contemplation; yea, the *Vegetables* too have themselves exemplified it. 'Whence is it that those two natural Principles of *Self-Preservation* and *Self-Propagation*, are so inviolably founded in the Nature of all living Creatures, even those that have *no Reason*, as well as those that have; both which are necessary to the Subsistence of the Universe? May not we hence easily argue, that surely this was done *intentionally* for such an *End*? And if *intentionally*, then it is done by *Reason*; and if by *Reason*, it must be by His *Reason* that first made this Universe.'

Dr. *Gorden* adds to the Assurances which all the Inquisitive before him have given us, that no *Insects* are bred of *Corruption*, but all *ex Ovo*.

He also observes, that the Females of all *Flies* put their Spawn in or near those places where the *Eruca's*, which are hatch'd out of them, are to have their *Food*.

He observes likewise, that there is a kind of *Gluten*, by which the Females fasten their *Eggs* to the bearing Buds of Trees, at such a rate, that the *Rain* cannot wash them off.

And he observes, that these *Eggs* will not be hurt by the greatest *Frost* that can happen.

Mr. *Andry* in his Book, *De la Generation de Vers dans le corps de l'Homme*, takes notice of a Mistake in the Antients, who denied *Breath* to the *Insects* on the score of their wanting *Lungs*; for *Insects* have a greater number of *Lungs* than other Animals. 'The Antients also thought that the *Insects* had no *Blood*, because many of them had not a *red Liquor* like ours; but this too was a Mistake, 'tis not the *Colour*, but the *Intent* of the *Liquor* that is to be considered in this Case. It was likewise the Belief of the Antients, that the *Insects* had no *Hearts*; whereas our *Microscopes* now convince us of the contrary. And the *Silk-worms* particularly have a con-

continued Chain of *Hearts*, from the Head almost to the extremity of the Tail. And it is the number of *Lungs* and *Hearts* that occasions those *Insects* to give signs of Life a long while after they are divided into several parts.

Mr. *Poupart* affirms, that the *Earth-worms* and the *Round-tail'd Worms*, which are found in the *Intestines* of Animals, as also *Snails* and *Leeches*, are *Hermophrodites*; but such *Worms* as become *Flies* are not so, rather they are of no Sex, but are *Nests* full of Animals.

The *Spontaneous Generation* of *Insects* has at last been so confuted by *Redi*, and *Malpighi*, and *Squammerdam*, and our excellent *Ray*, and others, that no Man of Sense can any longer believe it. Indeed such a *Spontaneous Generation* would be nothing less than a *Creation*. That all Animals are generated of *Parent Animals*, is a thing so cleared up from Observation and Experiment, that we must speak of it in the Language of those who have lately writ of it, *Nous croyons absolument*. And of their *Generation* any other way, we cannot but use the Language of *Dr. Lyster*, *Non inducor ut credam*. If an *Insect* may be *equivocally generated*, then, as *Dr. Robinson* justly enquires, *why not sometimes a Bird, yea, a Man? Or why no new Species of Animals now and then? For there is as much Art shewn in the Formation of those, as of these*. *Dr. Cheyne* assures us, nobody now-a-days, that understands any thing of Nature, can so much as imagine, that any Animal, how abject soever, can be produced by an *equivocal Generation*, or without the Conjunction of Male and Female *Parents*, in the same or in two different Individuals. And there are very few who have considered the Matter, but what own that every *Animal* proceeds from a *præ-existent Animalcule*, and that the *Parents* conduce nothing but a convenient *Habitation* to it, and suitable *Nourishments*, till it be fit to be trusted with Light, and capable of enjoying the Benefits of the Air. There is nothing in the *Animal Machine*, but an inconceivable number of branching and winding *Canals*, filled with Liquors

of different natures, going a perpetual round, and no more capable of producing the wonderful Fabrick of another Animal, than a thing is of making itself. There is besides in the *Generation* of an Animal, a necessity that the *Head, Heart, Nerves, Veins and Arteries*, be formed at the same time, which never can be done by the motion of any Fluid, which way soever moved.

*Great G O D, Thou art the Father of all things; even the Father of Insects, as well as the Father of Spirits: And Thy Greatness appears with a singular Brightness in the least of Thy Creatures!*

Concerning *Frogs* generated in the *Clouds*, there has been a mighty Noise; the *Thunder* scarce makes a greater! But Mr. *Ray* says well, it seems no more likely than *Spanish Gennets* begotten by the *Wind*, for that has good Authors too. He adds, *He that can swallow the raining of Frogs, hath made a fair Step towards believing that it may rain Calves also; for we read that one fell out of the Clouds in Avicen's Time. Fromondus's Opinion, that the Frogs which appear in great multitudes after a Shower, are not indeed generated in the Clouds, but are coagulated of Dust, commix'd and fermented with Rain-water, is all over as impertinent. It is very certain that Frogs are of two different Sexes, and have their spermatick Vessels; and their Copulation is notorious (per integrum aliquando Mensen cominuata) and after the Spawn must be cast into the Water, where the Eggs lie in the midst of a copious Gelly; then must appear a Feetless Tadpole, in which Form it must continue a long while, till the Limbs be grown out, and it arrives to the perfect Form of a Frog. To what purpose all this, if your way, Gentlemen, [Fromondus, and the rest] may suffice?*

*Frogs* appearing in such multitudes upon *Rains*, do but come forth upon the Invitation which the agreeable Vapor of *Rain-water* gives to them. And for some such reason we are commonly entertain'd with such

Armies

Armies of them in the cool *Summer-Evenings*, that we wonder where they have been lurking all the Day. Monsieur *Perrault*, upon the Dissection of the *Falling-Frogs*, which the *equivocal Gentlemen* so teaze us with, found their *Stomachs* full of Meat, and their *Intestines* of Excrement. The inquisitive Mr. *Derham*, on his meeting with *Frogs* in a prodigious Number, crossing a sandy Way just after a Shower, pursued the Matter with his usual Exactness, and he soon found the Colony issue from an adjacent Pond, who having pass'd thro their *Tadpole-State*, and finding the Earth moistned for their March, took the opportunity to leave their old *Latibula*, where they had now devour'd their proper Food, and seek a more convenient Habitation. Or what if we suppose them, at least in their Spawn, fetch'd up into the *Clouds* by the *Sun*, and kept there till grown into the State wherein they fall down from thence, as it has been affirmed they have on Vessels at Sea?

As to the *Worms* and other Animals bred in the *Intestines* of Man and Beast, it is Dr. *Robinson's* Remark, *I think it may be proved, that the vast variety of Worms found in almost all the Parts of different Animals, are taken into the respective Bodies by Meats and Drinks.*

Even the *Maggots* which grow in the Back of the common *Caterpillar*, are by their Parents lodg'd there, as a proper Apartment for them.

The *Toads* found in the midst of *Trees*, nay, and of *Stones*, when they have been sawn asunder, no doubt they grew of a *Toad-Spawm*, which fell into that Matter before the Concretion thereof.

The vulgar Opinion, that the *Heads* or *Clothes* of uncleanly People do breed *Lice*, or that *Mites* are bred in *Cheese*, Mr. *Ray* notes, is a *vulgar Error*: he affirms, that all such Creatures are produced of *Eggs* laid in such places by their *Parents*; Nature has endued them with a wondrous Acuteness of Scent and Sagacity, whereby they can, tho far distant, find out such pla-

ces, and make towards them; and tho they seem so slow, yet it has been found that in a little time they will march a considerable way to find out a convenient Harbour. Here Mr. Ray makes a *Pause of Religion*; says he, 'I cannot but look upon the strange  
' Instinct of this noisome and troublesome Creature  
' the *Louse*, of seeking out foul and nasty Clothes to  
' harbour in, as an Effect of Divine Providence, de-  
' sign'd to deter Men and Women from Sordidness  
' and Sluttishness, and provoke them to *Cleanliness*.  
' God himself hates *Uncleaness*, and turns away from  
' it, [*Deut. xxiii. 12, 13, 14.*] But if God requires,  
' and is pleas'd with *Bodily Cleanliness*, much more is  
' He so with the *Pureness* of the *Mind*. *Blessed are the*  
' *pure in Heart, for they shall see God!*'

The *Eyes* of *Insects* have in them what is very admirable! Their great necessity for accurate Vision is, in the reticulated *Cornea* of their *Eyes*, admirably provided for; it is a most curious piece of Lattice-work, in which every *Foramen* is of a lenticular nature, and enables the Creature to see every way without any  
' Time or Trouble; probably every *Lens* of the *Cornea* has a distinct Branch of the Optick Nerve ministering to it.

*Spiders* are mostly *oſtonocular*; some, as Mr. *Willoughby* thought, *ſenocular*. *Flies* are *multocular*, having as many *Eyes* as there are Perforations in their *Cornea*. The greatest part of the Head of that prædatious Insect, the *Dragon-Fly*, is possess'd by its *Eyes*.

Tho we say, *As blind as a Beetle*, Mr. *Leuenhoeck* has discover'd at least *three thousand Eyes* in the *Beetle*.

*Insects* have their *Antenna*, by which they not only cleanse their *Eyes*, but also guard them; their *Eyes* being fitted mostly to see *distantial Objects*, these *Feelers* obviate the Inconvenience of their too rashly running their Heads against *Objects* that may be very near to them.

And

And many of them are, as Mr. *Derham* observes, most surprizingly beautiful.

The Mechanism in those that *creep* is most exquisitely curious.

What can exceed the *Oars* of the *Amphibious Insects*, that *swim* and *walk*? Their hindmost Legs are made most nicely, with commodious flat Joints, and Bristles on each side thereof towards the ends, serving for *Oars* to swim; and nearer the Body are two stiff *Spikes*, to enable them to walk, as they have occasion.

An incomparable provision is made in the *Feet* of such as walk or hang on smooth Surfaces; divers of these, besides their acute and hooked *Nails*; have also skinny *Palms* on their Feet, which enable them to stick on Glass, and other smooth Bodies, thro the Pressure of the *Atmosphere*.

The great Strength and Spring in the *Legs* of such as *leap*, is very notable; and so are the well-made *Feet* and strong *Talons* of such as *dig*.

Admirable the Faculty of some that cannot fly, to convey themselves with Speed and Safety, by the help of their *Webs*, or some other Artifice that renders their Bodies lighter than the Air! How pleasantly do the *Spiders* dart out their *Webs*, and *sail* away by the help thereof; whereof Dr. *Lyster* and Dr. *Hulse* were some of the first who made a discovery? There seems to be an hint of their *darting* in *Aristotle*, and in *Pliny*; but the Antients knew nothing of their *sailing*. Some other little Animals may have their ways of *Conveyance* as unknown to us, as heretofore has been that of the *Spiders*; Creatures found in very new Pits, and Holes in the Tops of Houses, where they were never bred by any *equivocal Generation*. The *green Scum* on the Surface of stagnating Waters, which is nothing but prodigious Numbers of Animalcules; how come they there? And when gone, where do they go?

What can be better contriv'd than the *Legs* of *Insects*, most incomparably fitted for the intended Service?

Or than their *Wings*, distended and strengthened with the finest *Bones*, and these cover'd with the lightest *Membranes*, whereof some are adorned with the most beautiful *Feathers*; for the elegant Colours of *Moths* and *Butterflies* are owing to neat *Feathers* on their *Wings*, that are set in Rows with great Exactness, and all the good Order imaginable? And some are provided with *Articulations*, for their *Wings* to be withdrawn, and fold'd up in Cases, and again readily spread abroad upon occasion: *Scarabs* and other that have *Elytra*, are thus accommodated. That their Body may be kept steady and upright, there is the admirable Artifice of *Pointels* and *Poises*, under those who have no more than two *Wings*, (whereas the *four-wing'd* ones have no such things:) These *Poises* in the bipennated Insects are for the most part little *Balls*, that are set at the top of a slender Stalk, which they can move every way at pleasure to obviate *Vacillations*. If one of the *Poises* be cut off (or if the *four-winged* have lost one of their secondary or auxiliary *Wings*) the Insect will fly as if one side over-balanc'd the other, till it fall to the ground.

How *minute*, but how astonishingly *curious*, must be the Joints, the Muscles, the Tendons, and the Nerves, necessary to perform the Motions of these marvellous Creatures! These things concur, even in the *smallest* Animalcules, and such as cannot be seen without our *Microscopes*.

When *Galen* had admired the Skill, *quod declarant Opifices cum in Corporibus parvis aliquid insculpant*, instanced in the *Phaeton* in a Ring, where the Legs of the *Horses* were no bigger than those of a *Gnat*, he yet very justly cries out, their Make did not come up to those of a *Gnat*: *Major adhuc alia quadam esse videtur Artis ejus, qui Pulicem condidit, Vis atque Sapiencia*; and is amazed that *Arts tanta in tam abjectis Animalibus appareat*.

Among

Among the celebrated Pieces of Human Art, there was the *Cup* that *Oswald Nerlinger* made of a *Peppercorn*, that held twelve hundred little Ivory Cups, all gilt on the Edges, and having each of them a Foot, and yet afforded room for four hundred more. But our *Derham* justly celebrates the more stupendous Art, which plainly manifesteth the Power and Wisdom of the infinite Contriver of the inimitable Fineries in the Bodies of our little *Insects*; they must have *Eyes*, a *Brain*, a *Mouth*, a *Stomach*, and *Entrails*, and other Parts of an Animal Body, as well as *Legs* and *Feet*: and all these must have their necessary *Nerves* and *Muscles*; all these are cover'd with an agreeable *Tegument*, whereof how neat the *Imbrications* and other Fineries! All this Curiosity many times lying in a Body much smaller than the smallest *Grain* of Sand. A *Drop of Water* is a sort of an *Ocean* to them! Mr. *Derham* in a *Drop* of the *green Scum* upon Water, a *Drop* no bigger than a *Pin's-head*, sees no fewer than an hundred frisking about. How vastly many more in a *Drop* of *Pepper-water*! How vastly many, many, many more, in a *Drop* of the *Leuenhoeckian Examination*! Dr. *Harris* affirms, that not only in *black Pepper-water*, but also in Water wherein *Barley* and *Oats*, but especially *Wheat*, hath been steeped for about four or five Days, he hath seen prodigious Numbers of them. Great G O D, we are amazed!

The *Jews* have a foolish Notion, tho' advanc'd by a *Rabbi Solomon*, (upon the *Egyptian Plague* of *Lice*) *Quod Diabolus non dominatur super Creaturam, quæ Grano Hordei sit minor*. Indeed a Man who by *Humility* shrinks himself into less than the *light Dust* of the *Balance*, may take the comfort of the Notion. But then in *Philosophy* what a mighty Army of Animals less than a *Barley-corn* are found under the Dominion of the glorious GOD, who also has all the *Devils* as much under His Command as the least of these. I have read of a *Flea*

in a *Chain*, *Beelzebub* is no more before the Almighty Maker of the *Flies*, and all the other *Insects*.

The *Sagacity* observable in the generality of *Insects*, for their Provision against the Necessities of the *Winter*, is never enough to be admired.

Some having fed and bred themselves up to the Perfection of their *Vermicular State* in the Summer Months, then retire to a Place of Safety, and there throw off their *Nympha*, and put on their *Aurelia-state* for all the Winter, in which they have no occasion for any Food at all; this is done by all the *Papilionaceous*, as well as divers other Tribes.

Others, in their most perfect State, are able to subsist in a kind of *Torpidude*, without any Food at all; being at no *Action*, they are at no *Expence*, but can lie and sleep whole Months without any Sustenance. 'Tis remarkable that it is not any Stress of Weather which drives them into their intended Retirement, but they go to it in the *proper Season*, towards the end of Summer. 'Tis also remarkable, that every *Species* betakes itself to a convenient Receptacle, whereof there is a vast variety, where the *Frost* cannot come at them.

There are others who need *Food* in the Winter, and it is astonishing to see what a Foresight their glorious Creator has given them to lay up accordingly.

One of these Providers is the BEE, reckon'd by *Aristotle* among the *Ζῷα Πολιτικά*, of *Civil People*. Prepare now for a Scene of Wonders! Every Colony of *Bees* has a *King*, whereof *Pliny* gives this true Description: *Omnibus semper forma egregia, & duplo quam ceteris major, Pennæ breviores, Crura recta, Ingressus celsior, in Fronte macula quodam Diademate candicans, multum etiam Nitere a vulgo differunt.* This majestic *Bee* has a *Sting*, which he can use without losing it; but his Majesty rarely finds occasion for it. The *common Bees* (which have their four *Wings* and six *Legs*) are divided into *Bands*, which have their *Officers*, all working for the Good of the Whole, and as long as they live. But then

then there are *Drones*, which are bigger than they, and are Servants and Nurses under the *Honey-Bees*, in the hatching of their Brood. A *Bee*, as *Rusden* observes, the first day of his flying abroad is an exquisite *Chymist*, or at least a diligent Purveyor and Collector of the *Honey-dews*, provided by Heaven for him on the Leaves of the Plants in the Field, which he lays up in convenient *Cells*, and there preserves it in a Covering of *Wax*, as foreseeing that a Winter is coming. How indefatigable the Pains of these industrious and marvellous Creatures! If they have *no King*, they pine, they die, they yield themselves a Prey to Robbers; but they will not bear *two*. *Butler* observes, they abhor *Polyarchy*, as well as *Anarchy*. Their King oppresses none, is a Benefactor to all; so their Loyalty to him is inviolate. His Place of Abode makes a Court, a noble Retinue of *Bees* attends him.

— Rege incolumi Mens omnibus una est,  
 Amisso rupere fidem. —  
 Ille operum custos; illum admirantur; & omnes  
 Circumstant fremitu denso, stipantque frequentes,  
 Et sæpe attollunt humeris, & Corpora bello  
 Obstant, pulchramque petunt per Vulnera mortem.

They have the *Orders* of their *King* for all the Work they do; and they never *swarm* without his *Orders*. The chief cause of their *Swarm* is the want of room. He usually goes himself with them, as in view of a more flourishing State, and leaves his decaying and unpleasent Kingdom, with the noisome old Combs, to such Successors as he has left alive. If the old one dies in his going forth, they return home to the Prince whom they had relinquish'd. And the King sometimes gives his Consent to a *second Swarm*, tho there be no lack of room, out of his respect to some of his Royal Lineage. In their *Hives* they are mighty just to one another, tho the fear of being robb'd makes

makes them kill any Strangers that break in upon them. *Colonies* are sometimes engaged in Wars; the *King* usually orders the *Battel*, and animates them with his *Voice*, and like a *General*, for whose *Defence* they unanimously expose themselves: They neither give nor take any *Quarter*, and they distinguish one another by their *Smelling*. Spurt any thing among them that may make them *smell all alike*, and their *Hostility* ceaseth. The *King* is the only *Male* among the *Bees*. Each particular *Cell* in the *Honey-comb* is a *Matrix*. The *King* walks from one *Cell* to another, and injects a *Seed* into each of them; the *Honey-Bees* mix with it a *generative Matter*, which they have lodg'd there, and add *Water* to it, and cover it with *Wax*, which is not opened till the young *Bee* opens its way out of it. The *Drones* are also begotten by the *King* in like manner, but on a *generative Matter* something different, and in *deeper Cells*. The *Drones* are for no purpose, but only to lie at home close to the *Combs*, where the *young Bees* are breeding, and hatch the young *Brood*, as a *Capon* does the *Eggs* assign'd to him. Hence the time for breeding the *Drones* is deferr'd till near the fall of the *Honey-Dews*, because they would have the use of them at as little charge of feeding as they can. But such is the Nature of the *Drones*, that if the *Bees* do not kill them, as they generally do, when they can be no further serviceable, they do by the Coldness of the Season in *September* die of themselves.

But now how many *moral Instructions* would the *Commonwealth of Bees* afford to a *Mind* willing to be instructed of *God*, by the *Ministry* of this *mysterious Insect*! *Honest Purchas* has with an *Imitation* of it gather'd no less than three *Centuries* of them; and yet these are but a few of the things which these *aculeated Preachers* would advise us of: I will single out but this one peculiar *Document* from them for myself, which

*Pliny*

Pliny takes notice of: *Nullus Apibus, si per Cælum licuit, Otio perit Dies.*

Another of these Providers is the ANT, whereof the Wise-Man says, they are *exceeding wise; a People not strong, yet they prepare their Meat in the Summer.*

Sir Edward King having been curious in examining their Generation, wonders to find them lying in Multitudes on their Eggs (which they industriously gather together) by way of Incubation. He wonders to see them in the Morning bringing them up towards the top of the Bank, and for the most part on the South-side of it; but at Night, especially if it be cool, or likely to rain, you may dig a Foot before you can find them. Indeed all is wonderful!

There is the *Field-Ant* and the *Wood-Ant*; the *Field-Ant* feeds upon small Seeds. They have their *Leaders* and *Rulers*, which they follow along their little *Paths* in exact Order, and return the same way; they all go out light, but all return home heavy laden, with their *Burdens* on their Backs. The *Wood-Ant* feeds upon Leaves. You may see sometimes great *Paths* made by them, three or four Inches broad, and as beaten as the *High-ways*; they march stoutly under such Loads, that you cannot see their Bodies; a *Path* looks perfectly *green* with them.

In two Months of the Year they take *Wing*, and fly abroad in the warm Sun, to take their Pleasure, after the *Fatigue* of their *Labour* is over.

And how unparallel'd the Tendernefs, the Diligence, the Forecaſt of this little Animal, for the Safety of their *young ones*! A *ſpectacle*, that filled *Squammerdam* with an unſpeakable Pleaſure at the view thereof; *Non ſine Jucunditate ſpectabam!* 'Tis very diverting to ſee how they carry about their *young ones*, and expoſe themſelves to any *Dangers*, rather than leave their *young ones* expoſed; and how they remove them from one place to another, as they find occaſion.

Some-

Sometimes the *Ants* in the *Indies* will have Nests most artificially placed between the Limbs of huge *Trees*, and these Nests as big as an *Hogshead*; here is their *Winter Habitation*.

They will ransack strangely for Provisions, and in mighty Troops, which all follow wherever the foremost goes.

Excellently well Mr. *Derham* hereupon: 'That the great *Wisdom* discernible in this little *Animal*, is owing to the Infusions of the great Conservator of the World, is evident; because either this *Wisdom* and *Forecast* is an Act of the *Animal* itself, or of a Being that hath *Wisdom*: but the *Animal* being *irrational*, 'tis impossible it can be its own *Act*, but it must be deriv'd or receiv'd from some *wise Being*. And who! — What can that be, but an infinite *L O R D*, and Conservator of the World!'

An *Ant-hill*, 'tis a Seat of a very curious Contrivance. *Johnston* makes it an Article of his *Thaumato-graphy*, and says very truly, *Vix ullius Urbis artificiosior Structura*. If you read the Description of the *quadrangular City*, four Foot long, and a Foot wide, the Streets wisely laid out, the convenient Granaries provided, the Civility of the Citizens to one another, as *Aldrovandus* has given it, you would see nothing in any *Strabo* more entertaining.

I wonder not that the *Wisdom* of God sends me thither: *Go to the Ant, thou Sluggard*; may I learn her *Ways and be wise!*

But we are passing into a Theme, whereon there is no end of the *Wonders!* The Care of the *Insects* about their *Off-spring*.

Singular their Providence for their Young, in finding or making fit Receptacles for their *Eggs* or *Seed*, where they may enjoy a sufficient Incubation, and have ready an agreeable and sufficient Food for their Education.

They

They to whom *Flesh* is proper Food, lay their Sperm in *Flesh*; from which Nursery of *Maggots*, *S. Redi* has for ever banish'd the old Whimsy of *anomalous Generation*, by incontestable Experiments.

Others, to whom the Fruits or Leaves of the *Vegetables* are a *Food*, find a Repository there.

Some take this *Tree*, some take that *Herb*; and one Family still always the same.

If the *Cochineel* were not accommodated with a Fruit like a *Prickle-Pear*, which opens after the Flower which protected it is by the Heat of the Sun scorched away, when the small *red Insects* are come to maturity, and would die and rot for want of more Food, if the *Indians* did not now come to shake them out; *Gentlemen*, where would you be supplied with your so much esteemed *Scarlet*?

Others require a greater degree of Warmth in their Lodging, and those look out the *Bodies* of *larger Animals*, that they may be lodged there. Many, if not most sorts of *Birds*, have their *Lice* in their Feathers; and several sorts of *Beasts* have peculiar *Lice* in their Hairs, all distinct from the two sorts wherewith *Man* is infested. It has been pretended that the *Ass* is free, and an odd reason assigned for it; but it has been rather supposed from a Passage in *Aristotle*, the *Chronology* whereof won't well suit with the *odd Reason* I refer to.

Some work themselves into the very *Scales* of the *Fishes*. There *Lumbricus innascitur, qui debilitat*; it was observed as long ago as the Days of the *Stagyrite*. They find them even in the *Stomach* of *Cod-fish*.

The *Sheep* complains of them in his *Nose*; the *Kine* have them on their Backs; the *Horses* in their *Guts*.

Those in the *Heads* of *Deer* are often mentioned by antient Writers.

*Worms* of many Yards long are bred in the *Legs* of *Men*, and in other Parts of their Bodies; in their *Tongues*, their *Gums*, and their *Noses*, as 'tis reported  
in

in our *Philosophical Transactions*; in their *Eyes*, and their *Eyebrows*, as in the *German Ephemerides*. *Mouffet* and *Tyson* will set before you what *Worms* the *Stomach* and *Bowels* of *Men* have often breeding in them. Lately in my *Neighbourhood* a poor *Man* reaching to vomit, a monstrous *Worm* thrust up one end of itself, which the *Man* seizing on, fell to pulling of it, as a *Fisherman* hauls up his *Line*, and pull'd till the *Worm* lay in an enormous heap; whence being drawn into its length and measured, the *Worm*, in the full extent of it, made about *one hundred and fifty Foot* long. I may say, *Hicse ipse vidi Oculis*. Yea, *Dr. Lyster* affirms true *Caterpillars* to have been vomited from thence. And *Mr. Jessop* affirms true *Hexapods* to have been also thrown up with a *Vomit*. Entertain unquestionable *Accounts* from *Germany*, and you will see *Toads*, and *Frogs*, and *Lizards*, cast up from an *Human Stomach*, no doubt from the drinking of their *Spawn*. The *Livers* and *Kidneys* of *Animals* have had their *Worms*: yea, *Verzascha* has found them (without a *Metaphor*) in the *Brains* of *Men*; probably they were laid in the *Laminae* of the *Nostrils*, and gnawed their way into the *Brains* thro' the *Os Cribriforme*.

*Wierus* found them divers times in the *Gall-Bladder* of *Persons* whom he had opened. In divers *Fevers* the *Blood* has been found straggely *vermiculated*, as *Kircher* and several others have upon *Examination* reported; [so *one Worm kills another!*] *Verminous* *Collections* are found in the *Small-Pox*, as *Lange* and *Borellus* testify; and in *pocky Scabs* there are incredible *Multitudes* of them.

Others who make themselves *Nests* by *Perforations* in the *Earth*, or in some *Wood*, or in *Combs* of their own building; 'tis admirable to see how they lay in, and seal up the *Provisions* that will be necessary for their young ones there. So divers *Ichneumonæ* carry in *Maggots*, which they take from the *Leaves* of *Trees*,  
which

which they sagaciously put up close into their Nests. *Aristotle* says they carry in *Spiders* too.

Their *Nidification* is astonishing! When their *Eggs* are on the Leaves of Plants, or other Materials on the *Land*, how commodiously are they laid! Always carefully *glued* on, with one certain End lowermost, and handsome *Juxta-positions*.

When in the *Water*, in what beautiful *Rows*! In a *gelatine Matter* so fasten'd, as to prevent its *Dissipation*.

Single out but *Pliny's* Instance of the *Gnat*, a contemptible Animal, the Story of his Proceedings would give you a thousand Astonishments!

They who must perforate hard Bodies, to make their Lodgings there, have their Legs, Feet, Mouth, yea, their whole Bodies, very strangely accommodated to the Service.

But for them who build or spin their *Nests*, their Art, as *Mr. Derham* expresses it, *justly bids defiance to the most ingenious Artist among Men so much as tolerably to copy them*. The geometrical *Combs* of some, the terrestrial *Cells* of others; the *Webs*, the *Nets*, the *Cases*, of divers. A Bishop of *Paris* long since observed, *Nascitur Aranea cum Lege, Libro, & Lucernâ*; the very *Spider* knows its Lesson.

There is a *natural Glue* afforded by the Bodies of several to consolidate their Work. The *Wasps* have this, as well as the *Tinea Vestivora*, the *Cadew-worm*, and several others; what *Goedart* also observes of his *Eruca*, this can be by some darted out at pleasure, and woven into silken Balls. *Mr. Boyle* mentions an *oval Case* of a *Silk-worm*, which a Gentlewoman of his Acquaintance drawing out all the *silken Wire* that composed it, found it above *three hundred Yards*, and yet weighed no more than *two Grains and an half*. That wondrous Insect the *Silk-worm*! It has no *Eyes*, but how fine its Performances. Let the *Historia Singularis* of them, written by *Libavius*, be perused, it will be found a Collection of Wonders. Good God, shall thy  
Silk-worm

*Silk-worm* adorn me, and shall he not instruct me too! There is another *Worm*, which would at least learn this of him, to spin out of his own Bowels, from his own Experience and his own Meditation, such things as may be useful to those to whom they shall be communicated. But, O vain Person, proud of the *silken Attire* that is rustling upon thee; is it possible that in a little *Worm* thy *Pride* should find a Nourishment!

There are others of these little Animals which make Nature itself serviceable to their Purpose, and make the Vegetation of *Trees* and *Herbs* the Means of building their little Habitations. They build in the *Galls* and *Balls* of the *Oak*, the *Willow*, the *Briar*, and other Vegetables, and are furnished with a *Piercer*, to prosecute their Business. Among these we will single out what the *Ichneumon-Fly* does to the Leaf of the *Nettle*. The Parent-Insect, with a stiff setaceous Tail, terebrates the Rib of the Leaf when tender, and makes way for its Egg into the very Pith or Heart thereof, and probably lays in therewith some Juice of its Body, which will pervert the regular Vegetation of it. From this Wound arises a small *Excrescence*, which (when the Egg is hatch'd into a *Maggot*) grows bigger as the *Maggot* increases, and swells on each side the Leaf, between the two Membranes, and extends itself into the parenchymous part thereof, till it is grown as big as two Grains of *Wheat*. In this Mansion there lies a small, white, rough *Maggot*, which turns to an *Aurelia*, and afterwards to a very beautiful, green, small, *Ichneumon-Fly*.

A peculiar Artifice, and so far out of the reach of any mortal Understanding, that here must be, as Mr. *Derham* justly pauses upon it, the Concurrence of some great and wise Being, that has from the beginning taken care for the Good of the Animal! The Formation of these Cases is quite beyond the Cunning of the Animal itself, but it is the Act partly of the Vegetable, and partly of some Virulency in the Juice or Egg of the

Animal repositèd on the *Vegetable*; which *Malpighi*, in his Description of the *Fly* bred in *Oaken-Galls*, has notably confirm'd to us. *Erunt Plantarum Tumores, morbosa Excrescentia, vi depositi Ovi à turbata Plantarum compage, & vitiato humorum Motu excitata, quibus inclusa Ova & Animalcula, velut in Utero foventur & augetur; donec manifestatis firmatisque propriis partibus, quasi exoriantur novam exoptantia auram.*

It is a just Thought of one well skill'd in *Cosmology*, That *Men* themselves, and much more *other Creatures*, may do many things which aptly serve to some certain *End* whereof they have no consideration. *Creatures* may be directed and constrained by a *strong Fancy* which they have of such and such *Works*, and of *Actions* that belong to them. Well, but who has imprinted it? It is the Great *GOD*, who will have *such Works* to be done. *Great GOD, shall we contrive what Service of thine thy nobler Creature MAN may thereby be helped to!* My excellent *Philosopher* concludes: *The Divine Reason runs like a Golden Vein through the whole Leaden Mine of Brutal Nature.*

There is one thing more to be added: That the Numbers of *Insects* and *Vermin* may not be too offensive to us, *Providence* has ordained many *Creatures*, especially such as are in superior *Orders*, to make it their business to destroy them, especially when their Increase grows too numerous and enormous. As in the *Indies*, where they are sometimes exceedingly punished with *Ants*, there is the *Ursus Formicarius*, whose very business is to devour them. Hideous *Armies* of *Worms* do sometimes visit my *Country*, and carry whole *Fields* of *Corn* before them, and climbing up *Trees*, leave them as bare as the middle of *Winter*. Our *wild Pidgeons* make this the *Season* of their *Descent*, and in prodigious *Flocks* they fall upon these *Robbers*, and clear the *Country* of them.

The *Destruction* and *Death* of *Animals* does proclaim the *Fame* of the *Divine Wisdom* in adjusting of it!

The *Locusts*, that have sometimes proved so devouring a *Plague*, do also prove a *Dish* to the People that suffer from them. In *A Voyage round the World*, I read, That in the *East-Indies*, when these Creatures come in great Swarms to devour their Fruits and Herbs, the Natives take them with Nets, and parch them over the fire in an earthen Pan, on which their Wings and Legs would fall off, and their Head and Backs turn red, but their *Bodies* being full, would eat moist and sweet enough, and their *Head* a little crackle in one's Teeth; a Dish that People might subsist upon: tho the Condition of the *Acridophagi*, mentioned by *Diodorus*, and by *Strabo*, would not encourage one to be confin'd to it.

Even the more noxious *Insects* and *Vermin* are such, that we may consider in them *the Finger of God!* The *Sufferings* they inflict upon us, may be considered as the *Scourges* of God upon us for our Miscarriages, and be improved as Excitations to *Repentance*. I have read somewhere a Passage to this purpose: 'I would carry  
' on the Matter to so much of *Watchfulness*, in my ap-  
' prehending Opportunities for *Thoughts of Repentance*,  
' that the Provocations that may happen to be given  
' to my *Bodily Senses* at any time, shall provoke such  
' *Thoughts* in my Soul. — If I happen to lodge  
' where any *Insect* or *Vermin* assaults me, it shall hum-  
' ble me. I will think *I have been one among the Enemies*  
' of God in the World. *These uneasy Creatures are part of*  
' *the Armies which the Lord of Hosts employs, and with some*  
' *Contempt, against his Enemies!*

The *Worms* which, especially in places where the salt and fresh Water meets, do in such horrid Swarms eat into the Bottoms of our *Ships*, and render them even like *Honey-combs*; the Coasts that are not infested with them, ought to acknowledge the Favour of Heaven in it; and the Merchant and Mariner that suffers by them, ought to consider *what Rebuke of Heaven up-*

on their Dealings or Doings may lie at the bottom of such a Calamity!

How wretched would our Condition be, if we were constantly infested with *Flies*, like the poor *winking People* of *New-Holland* in the *East-Indies*! To be exempted from the Mischiefs which the *Justice* of God sometimes *inflicts* on People that do not acknowledge Him, 'tis what calls for our Acknowledgments of His *Goodness*.

If the *Lord of Hosts* please to single out from his *Armies*, whereof *there is no Number*, no other *Legions* than those of *Insects*, even those *Velites* commanded by Him, how would they *embitter*, and even *extinguish* our Lives! *Locusts* alone make whole Nations tremble: *Worms* have destroyed *Kings*; and *Flies* have scattered *Kingdoms*.

But then the reverse: O *Cantharides*, how many Millions of Lives are continually saved by your *epispastick* Applications! *GOD is to be acknowledged in the Good which is done by a poor green Fly to the Children of Men!*

Honest Mr. *Terry* tells us, That among the *Persees* in the *East-Indies* they profess this Devotion: That the first Creature of *Sense* and of *Use* which they behold in a Morning, they employ still as a Remembrancer to them all the Day following, to draw up their Thoughts in *Thanksgiving* to the Almighty God, who hath made such a Creature for our Service.

*My God, shall the Pagan rise up and condemn the Christian! If we should not from the View of thy Creatures have our Hearts drawn up to thy Praises, we should to our confusion find it so!*

¶. 'For what ENDS are all these little Creatures made? Most certainly for great ENDS, and for such as are worthy of a GOD!'

'The exquisite Artifice which is conspicuous in the Make of these Creatures, does proclaim a marvellous and matchless Wisdom in the Maker of them; and Wisdom will make nothing in vain.'

‘ Tho the more *special Uses* of these Creatures be as yet unknown to us, the *only wise God* sends to us this Advice concerning them: *What I do thou knowest not now, but thou shalt know hereafter.*’

‘ However, this we know *NOW*; for these and all Creatures this *END* is great enough, *that the Great God therein beholds with pleasure the various and curious Works of His Hands.* Behold a sufficient *END*, as well for a *World* as for a *Worm*, that the infinite God may with delight *behold His own Glories* in the Works which His Hands have wrought. *My Readers*, let us come to a Consort in the *Doxology*, *O Lord, thou hast created all things, and for thy Pleasure they are and were created!* The Great God has contrived a mighty *Engine*, of an Extent that cannot be measured, and there is in it a Contrivance of wondrous *Motions* that cannot be *numbred*. He is infinitely gratified with the View of this *Engine* in all its *Motions*, infinitely grateful to Him so glorious a Spectacle! when it becomes grateful to *us*, then we come into some Communion with Him. I will esteem it a sufficient *END* for the whole Creation of God, *that the Great Creator may have the Gratification of beholding His own admirable Workmanship.* And I will esteem it a part of the Homage I owe to His Eternal Majesty, to be satisfied in such an *END* as this.’

‘ I will transfer this *Meditation* to the Exercises which are to fill a *Life of Piety*. Have I not *Reason* enough, *Motive* enough, to abound in all the Exercises of a *pious Life*, even the most *secret* of them, and a Guard upon the *Frames* and *Thoughts* of my Heart within me? *The Great GOD is the Beholder of my whole Behaviour, He knows the way that I take; and I chuse the things that please Him in what I am now a doing.*’

§. Finding myself now entred into the *Animal World*, I will take this opportunity to insert and pursue

be an Observation of the acute Dr. *Cheyne*; which is, That the *Production of Animals* is a thing altogether *inconsistent* with the *Laws of Mechanism*: from whence I infer, that it must be from something *superior* to them.

For first, the *Blood* is by the Force of the *Heart* squeezed from the *left Ventricle*, thro the *Arteries*, to the *Extremities* of the *Body*, and is thence returned by the *Veins* into the *right Ventricle*, thence by the *Arteria Pulmonalis* into the *Lungs*; from the *Lungs* by the *Vena Pulmonalis* again into the *right Ventricle*. The *Motion of the Heart* is caused by the *nervous Juices* mixing with the *Blood*, in the *muscular* part thereof; and these *nervous Juices* are both derived from the *Blood*, and forced into the *muscular* part of the *Heart*, by the *Motion of the Heart* itself, the *Texture* of the containing *Vessels*, and perhaps by the *Pulsation* of the *Arteries* upon the *Nerves* of the *Brain*. Here now, the *Heart* is the cause of the *Motion of the Blood* in the *Arteries*; and the *Motion of the Blood* in the *Arteries* urging their *Juices* thro the *Nerves*, is the cause of the *Motion of the Heart*: which is a plain *Circulation of Mechanical Powers*, a *Perpetuum Mobile*, a thing unknown to *Nature*! An *Epicurean* cannot contrive a *Water-Machine*, wherein the *Water* should move the *Machine*, and the *Machine* move the *Water*, and the same *Water* continually return in a *Circle* to move the *Machine*.

Great G O D, it is thy immediate Influence on the Powers of Nature in me that keeps my Heart in motion. Oh! that I may love thee and serve thee with all my Heart! In thee I live! To glorify thee, should be the Business of my Life!

Again, In all *Animals* how small, how fine the *Organs*! How indefinite the *Number* of them! *Sensation* is performed by the mediation of *Organs* arising from the *Brain*, and continued thro the part affected. Now there is not the least imaginable solid part of the *Vessels* or *Muscles* but what we find sensible; wherefore

the Number of *Organs* that convey *Sensation* must be inconceivable! *Nutrition* is also performed by *Organs*, thro which a Supply is conveyed to the place to be nourished. Now there is *no Part* of the Body but what may be *increased* or *lessened*; so then in every *individual Point* of the Body there is the Termination of *Organs*, thro which a *Nourishment* may be conveyed. Furthermore, the *Canals* do all augment, and may all decay; and therefore every assignable part of these *Canals* must be the Termination of some *secretory Duct*, separating a *Fluid* fit for the repairing of their Losses, and these again must have others to repair their Losses; and how shall we conceive where to stop? Moreover, the most exquisite *Glasses* can discover nothing in the several parts of the Vessels and Muscles, but *Canals* amazingly slender; the better the Glasses, the more of these *capillary Pipes* are discovered. In short, all the *solid Parts* of the Body are nothing but either *Tubes* to convey some *Fluid*, or *Threads* in Bundles, tied by others that surround them, or going from one Fibre to another, or spread into thin Membranes; but each of these how *inconceivably* minute! the *Doctor* does not scruple to say, *infinitely*!

*O infinitely Great G O D, I am astonished! I am astonished! For all those things hath my Hand made, saith the Lord.*

## ESSAY XXVIII. Of REPTILES.

LET us now handle the *Reptils*, which are a sort of *Animals* that rest one part of their Body on the Earth, while they advance the other forward.

In our way of doing it we shall *take up Serpents, and it shall not hurt us.*

Concerning the meanest of these, namely, the *Earth-worm*, Dr. *Wilis* makes this Remark: *Lumbricus terrestris, licet vile & contemptibile habeatur, Organa Vitalia,*  
*necon*

*necnon & alia Viscera, & Membra Divino artificio admirabiliter fabricata sortitur.*

And the *spirial Motion* of it is admired as well as described by *Dr. Tyson*.

The *Motion of Reptils* is extremely curious.

Their *Food* and their *Nest* lies in the next Clod, Plant, or Hole; or they can long bear Hunger and Hardship.

So their *sinuous Motion*, perform'd with as much Art as what is in the *Legs* or *Wings* of other Creatures, and as curiously provided for, is found sufficient for the conveying of them.

There is abundance of *geometrical Neatness* and *Niceness* in the *Motion of Serpents*; their *annular Scales* lie cross their *Belly*, contrary to what those in the *Back* and the rest of the *Body* do: the *Edges* also of the *foremost Scales* lie over the *Edges* of the *following Scales*; and every *Scale* has a *distinct Muscle*, one end of which is tack'd to the middle of the *Scale*, the other to the upper *Edge* of the following *Scale*.

The *Snails* have neither *Feet* nor *Claws*, but they creep with an undulating motion of their *Body*; on which *Dr. Lyster* has written: and by a *Slime* emitted from their *Body*, they adhere to all *Kinds* of *Superficies*.

The *motive Parts* of *Caterpillars* are admirably contrived, not only to serve their progression, but for gathering of their *Food*.

The *Spine*, and *Muscles* co-operating with the *Spine*, in such as have *Bones*; and the *annular* and other *Muscles* in such as have none; are incomparable *Contrivances*.

The *Magnitude* whereto some *Serpents* have grown, is prodigious. *Bochart* will astonish you with a Collection of *Relations* found in *Antiquity* concerning *Serpents*, and particularly *Dragons*, of a most enormous *Magnitude*. *Gesner* too will quote us *Authors* for

some so big, that the little Book I am now writing will afford no room for them.

Yea, *Suetonius* affirms, that one was expos'd by *Augustus*, which was no less than fifty Cubits long. *Dio* comes up with him, and affirms, that in *Hetruria* there was one that was fourscore and five Foot long, which, after he had made fearful Devastations, was kill'd with a Thunderbolt. *Strabo* out-does him, and affirms, that in *Cælo-Syria* there had been one which was an hundred Foot long, and so thick, that a couple of Men on horseback, on each side of him, could not see one another. Yea, one that was an hundred and twenty Foot long, was kill'd near *Utica* by the Army of *Regulus*. Well might *Austin* say of these dreadful Animals, *Majora non sunt super Terram*.

'Tho, if I might be allowed the Benefit of a *Metaphor*, I would say, *I have known where to find a greater than all of these!* But,

*Ye Dragons, whose contagious Breath  
Peoples the dark Retreats of Death,  
Change your dire Hissings into heavenly Songs,  
And praise your Maker with your forked Tongues.*

'Tis what occurs in my Lord *Roscommon's*  
Paraphrase on Psalm cxlviii.

The *poisonous Tribes* have been 'made an Objection against the Divine Providence, as being destructive to the rest of the World

The *Poison* of a *Viper* is found by *Dr. Mead*, on a microscopical Examination, a parcel of small Salts, nimbly floating in the Liqueur, but quickly changed, and shot out into Crystals, of an incredible Tenuity and Sharpness, with something like to Knots here and there, from which they seem'd to proceed: it lies in a Bag in the Gums, at the upper-end of the Teeth; these Teeth are tubulated, for the conveyance of the Poison into the Wound which they make. *Galen* says, *Mountebanks* did use to stop these

these Perforations of the *Teeth*, before they would let Spectators behold the *Vipers* to bite them.

Let it be considered, that the venomous Creatures have their great *medicinal Uses*; we see a *Treacle* fetch'd out of a *Viper*; the *Viper's* Flesh cures *Leprosies*, and obstinate *Maladies*. The *Gall* of a *Rattle-snake* (which we take out of him in the more early Months of his yearly appearance, and work into *Troches* with *Chalk* or *Meal*) is a rich *Cordial* and *Anodyne*, for which purpose I have often taken it, and given it: it invigorates the Blood into a mighty *Circulation*, when fatal *Suppressions* are upon it; it is highly *alexipharmick*, and cures *Quartan-Agues*. And yet this *Rattle-snake*, such a venomous Wretch, that if he bite the Edge of an *Axe*, we have seen the bit of *Steel* that has been bitten, come off immediately, as if it had been under a *Putrefaction*.

The very Steam of the *Serpents* in the famous *La Grotta delli Serpi*, at *Sassa* in *Italy*, celebrated by *Wormius* from *Kircher*, and strangely discovered by a *Leper* happening to sleep there, does wondrous things.

Moreover, *ubi Virus, ibi Virtus*; 'tis observed, the bruised *Flesh* of the *venomous* Creatures applied to their *Bites*, cures the *Venom* of them.

But, as *Mr. Derham* observes, 'There would be no Injustice in God for to make a Set of such noxious Creatures, as *Rods* and *Scourges*, to execute the Divine Chastizements on sinful Men.' He adds, 'I am apt to think, that the Nations which know not God are the most annoyed with those noxious *Reptils*, and other pernicious Creatures.'

There is a strange Story related and asserted by *Franzius*, That *Anno Christi* 1564, vast Armies of *Serpents* appeared in *Hungary*, and occupied their Fields of *Corn*; and when the People were with a particular Contrivance by *Fire* going to destroy them, one who was bigger than the rest lifting up his Head, articulately cried out, *Nolite hoc facere, quia non nostro Arbitrio,*

*trio, sed a Deo huc missi sumus, ad perdendas Segetes.* If the Story should be but a *Fable*, yet the *Moral* is wise and good.

It may be they that have been thought *venomous*, have not had in them so much *Venom* as has been thought for. Sir *Theodore Mayern* laughs at the Poison of a *Toad*, and says, 'tis no worse than a *Frog*; he had himself without mischief eaten several.

There is one *Mr. Robinson* of *Cumberland*, who offers it as a probable *Conjecture*, that the *venomous Creatures* lick up the *Venom* of the *Earth*, which, if it were diffused, might be more dangerous than their *Bite* or *Sting*.

The same Gentleman observes concerning the *crawling Worm*, which is despised, as the most uselefs among all the *Creatures* of *God*, that the *Earth* abounds with a gross, fat, luxuriant *Slime* at the time when these *Vermin* are engendred, and these *Vermin* then feed upon it; this, if it were not suck'd up, and contracted into the *Bodies* of these diminutive *Animals*, but were diffused thro the *Grass* and *Herbage*, would occasion *Murrains* in *Beasts*, and perhaps *Diseases* in *Men*, whose *Diet* is much upon *Herbage*.

*A Worm now makes a pause, and adores the Divine Workmanship appearing in the Constitution of his Brethren!*

What amazing *Effects* follow on the *Bite* of the *Tarantula*! The *Patient* is taken with an extreme difficulty of *breathing*, and heavy *Anguish* of *Heart*, a dismal *Sadness* of *Mind*, a *Voice* querulous and sorrowful, and his *Eyes* very much disturbed. When the violent *Symptoms* which appear on the first *Days* are over, a continual *Melancholy* hangs about the *Person*, till by dancing, or singing, or change of *Age*, the poisonous *Impressions* are extirpated from the *Blood*, and the *Fluid* of the *Nerves*: but this is an *Happiness* that rarely happens; nay, *Baglivi*, this wicked *Spider's* Countryman, says, *there is no Expectation of ever being perfectly cured.* Many of the *Poisoned* are never well

but

but among the *Graves*, and in *solitary places*; and they lay themselves along upon a *Bier*, as if they themselves were *dead*: like People in despair, they will throw themselves into a *Pit*; *Women*, otherwise chaste enough, will cast away all *Modesty*, and throw themselves into very exposing and indecent Postures; they love to be toss'd in the Air, but some will be mightily pleas'd with rolling themselves, like *Swine*, in the *Dirt*; and others cannot be pleas'd except they be soundly drubb'd on their hinder Parts. There are some Colours agreeable to them, others offensive, especially *Black*; and if the Attendants have their Clothes of ungrateful Colours, they must retire out of their sight. The *Musick* with the *Dancing* which must be employ'd for their Cure, continues three or four Days; in this vigorous Exercise they *figh*, they are full of Complaints; like Persons in drink, they almost lose the right use of their Understanding: they distinguish not their very Parents from others in their treating of them, and scarce remember any thing that is past. Some during this Exercise are mightily pleas'd with *green Boughs*, of *Reeds* or *Vines*, and wave them with their Hands in the Air, or dip them in the Water, or bind them about their Face or Neck; others love to be handling *red Cloths* and *naked Swords*. And there are those who, upon a little intermission of the *dancing*, fall a digging of Holes in the *Ground*, which they fill with *Water*, and then take a strange satisfaction in rolling there. When they begin to *dance*, they call for *Swords*, and act the *Fencers*; sometimes they are for a *Looking-glass*, but then they fetch many a deep Sigh at the beholding of themselves. Their Fancy sometimes leads them to *rich Clothes*, to Necklaces, to Fineries, and a variety of *Ornaments*; and they are highly courteous to the By-standers that will gratify them with any of these things; they lay them very orderly about the place where the Exercise is performed, and in *dancing*.

cing please themselves with one or other of these things by turns, as their troubled Imagination directs them.

How miserable would be the Condition of Mankind, if these Animals were common in every Country! But our compassionate God has confined them to one little Corner of *Italy*; they are existing elsewhere, but no where thus venomous, except in *Apulia*. *My God, I glorify thy Compassion to sinful Mankind, in thy Restraints upon the Poisons of the Tarantula!*

But who can behold the Dispositions of the poor *Tarantulates*, and not behold at the same time with Horror, a lively Exhibition of the *Follies* whereto *vicious People* are disposed? Perhaps the Thought well pursued would give such an Illustration of the *Venom* that befools, depraves, and enslaves *vicious People*, as to lead us into some very right Notions of the Methods, wherein the *evil Spirits*, to whose Conduct they have resign'd themselves, do, thro a just Judgment of God, operate upon them.

*Vicious People*, if you are not so *Tarantulated*, that it will fright you to look into a *Looking-glass*, bethink yourselves, and in the Condition of the Miserables that are stung with a *Tarantula*, behold as in a *Looking-glass* your own Behaviour and Confusion.

¶ That the *least* and the *worst* of the Creatures may do *Man* the Service of leading him to God, a renowned Writer has demonstrated, in singling out the Example of a *Toad*. A Gentleman saying, that in every one of the *Creatures* he could see Invitations to the *Praises* of GOD, one ask'd him, What! in a *Toad*? *Quomodo in Bufone potes laudare Deum?* He made this good Answer, *This; That a good God has advanced me above the Baseness and Venom of that contemptible Animal!*

The Bishops who in their Travel to the Council of *Constance*, found a poor Country-man in the Tears of *Praises* to God at the sight of a *Toad*, were struck into

‘ into just Reflections, whereof this was one, *Surgunt  
‘ Indocti, & rapiunt Cælum.*’

ESSAY XXIX. Of the FISHES.

THE Fishes of the Sea shall declare to thee!

Let us become *Divers*, and visit the watery *World*; there we shall see, as Mr. *Derham* truly says, a various, a glorious, an inexhaustible Scene of the Divine Power, Wisdom, and Goodness.

The *Variety* of the Creatures that are the *Inhabitants* of the *Waters* is very considerable. *Pliny* in the eleventh Chapter of his thirty-second Book reckons up one hundred and seventy-six Kinds of them: indeed he is very short in his Account. Our Christian *Pliny*, the excellent *Ray*, raises the Number of the *Fishes* to five hundred, excluding the *Shell-fish*; but of the *Shell-fish* more than six times the Number, and yet he thinks there may be but half the Species of the *Fishes* yet known to us.

If you'll believe *Pliny* and Company, *Vera est vulgi Opinio, Quicquid nascitur in parte Naturæ ulla, & in Mari esse, præterque multa quæ nusquam alibi.*

Mr. *Willoughby* says *Aristotle's* Division of the *Fishes* is the best, [better than *Rondelerius's*] into three Kinds, the *cetacious*, the *cartilaginous*, and the *spinous*.

He gives us a Catalogue of *ninety-three* several sorts of our *English Fishes*.

The *Shape* of their Bodies, long and slender, or else very thin, is admirably accommodated to their Action of *swimming*, wherein they are to *divide the Waters*.

The *Air-bladder*, wherewith most of the *Fishes* are furnished; this is what cannot be beheld without Astonishment! By this they poise their Bodies, and keep them equiponderant to the Water; without it they would fall to the bottom, and lie groveling there, as it has been found, when that *Wind-bladder* has been broken. By *contracting* or *dilating* this Bladder, they are able

able to sink or to raise themselves at their pleasure, and continue in any depth of Water they please.

*Fishes* are sensible of *Sounds*, but whether they hear, or only feel the *Sounds*, is very much disputed. *Athanasius Kircher* observes, That tho' the *Fishes* that have *Lungs* have also *Ears*, yet by what *Organs* the hearing of the rest is performed, à nemine adhuc penitus exploratum est.

Their *Fins*, made of gristly *Spokes*, connected by *Membranes*, like our *Fans*, and furnished with *Muscles* for motion, these do partly serve them for progression, but chiefly to hold the Body upright: when these are cut off, as they were by *Borelli*, they waver to and fro, and when they die, their Belly turns upwards.

The great Strength, by which they dart themselves forward with an incredible Celerity, lies in their *Tails*; almost the whole musculous part of their Bodies is bestowed upon them, to assist the Vibration thereof. How *Fishes* row themselves by their *Tails*, and other Curiosities relating to *swimming*, you may read in *Borelli's* ingenious Discourse *de motu Animalium*.

It is remarkable to see how *Fishes* have the *Center of Gravity* always placed in the fittest part of their Bodies, which is a Point of great Consideration in their fluid Element.

Consider the *Food* of these Animals; they neither chew their Meat in their Mouths, nor grind it in their Maws: but in their *Stomach* they are furnished with a *dissolvent Liquor*, which does corrode their Food, and reduce it, Skin and Bones and all, into a *Chylus* or *Cremor*; and yet it is very marvellous, the Taste can perceive in this Liquor nothing of *Acidity*: it will manage Flesh as *Aqua-fortis* does Metals, and yet no sensible *Sharpness* in it!

But where shall they find their Food? *Lord*, these wait all upon thee, that thou mayst give them their Meat in due Season: what thou givest them, they gather; thou openest thine

*thine Hand, they are filled with Good. How rich a Promptuary is this unlikely Element! From the largest Leviathan which playeth in the Seas, to the smallest Mite in the Lakes and Ponds, all are plentifully provided for; as is manifest (which Mr. Derham notes) from the Fatness of their Bodies, and the Gaiety of their Aspects and Actions.*

There is a Germination of divers *aquatick Plants* in the Waters; the Waters are also a sort of a *Matrix* to many Animals, particularly *Insects*, not only such as are peculiar to the Waters, but also many pertaining to the Air and the Land; who, by their near alliance to the Waters, delight in being about them, and so become a Prey to the Inhabitants thereof. *Dr. Schuyt* mentions the Horror of the *Water turned into Blood at Leyden*, from nothing but the infinite Swarms of *Pulices* upon it; besides these, what mighty Shoals do we find of *lesser Animals* there, which the *greater* feed upon!

What a vast Supply of our Food have we in *sucking the Abundance of the Seas*? How many Millions of the *Fish* are every Year fetch'd out of their Element, and interr'd in the hungry Bowels of *Men*? Some of these very delicious, particularly the *White-fish*, whereof such infinite Shoals in the vast Lakes of the *North America*, which has this very singular Property, that all sorts of *Sauces* do but spoil it; it is always eaten, either boil'd or broil'd, without any manner of *Seasoning*.

You, *Gentlemen*, who think your own Country of *England* worth visiting with your *Travels*, as methinks you should before you go abroad, find the little River *Trent* in *Staffordshire* affording *thirty* several sorts of *Fishes*; you'll be ready to affirm of it, as the *Hungarians* do of their *Tibiscus*, two parts are *Water*, the third is *Fish*.

*My God, when in our Necessities we ask of our Father a Fish, our heavenly Father feeds us, how agreeably, how plentifully!*

As the *smallest* Animals are bred in the Waters, witness those in *Pepper-water*, so are the *largest*; those of the *cetaceous* Kind are there.

*Pliny* mentions the *Balana* of the *Indian Sea*, which were nine hundred and sixty Foot long; and he mentions *Whales* that were six hundred Foot long, and three hundred and sixty broad, which came into a River of *Arabia*. In the second Chapter of his ninth Book he offers a Reason why the *largest Animals* are bred in the Sea.

But I love to pass from him to a more trusty and modern *Pliny*, our industrious *Ray*; and we will now see something of his Remarks upon these *Bellua Marina*: The *Tail* in these has a different position from what it has in all other *Fishes*; it lies parallel to the *Horizon* in these, and it is perpendicular in the rest; hereby it supplies the use of the hinder pair of *Fins*, which these Creatures lack; and it serves both to raise and sink their Body at their pleasure. It is necessary that these Creatures frequently ascend to the top of the Water to *breathe*, and therefore they should be furnished with an Organ, by which their ascent and descent might be facilitated. The turning of their Bodies in the Water they perform like the *Birds*, by the motion of one of their *Fins*, while the other is quiescent. It is very remarkable that their whole Body is compass'd round with a copious *Fat*, which we call the *Blubber*, whereby their Bodies are poised, and rendered equiponderant to the Water, and the Water also is kept off at some distance from the *Blood*, the immediate Contact whereof might else have had some chilling force upon it; it serves likewise, as our Clothes do for us, to keep the *Fish warm*, in reflecting the hot Steams of their Body, and so redoubling the Heat thereof: hence they can abide the greatest Cold of the *Northern Seas*, to which they chiefly resort, not only for the Quiet which they enjoy there, but because the *Northern Air*, which is more fully charged with the

Particles

Particles which we suppose to be *nitrous*, and that are the Aliment of Fire, is fittest of all to maintain their vital Heat in that Activity, which may be sufficient for to move such an unwieldy Bulk as theirs. The *stupendous Magnitude* of these Animals! Thou *Antitype* thereof, among the *Poets* which adorn our Age, describe them to us.

*While the vast Whale takes in the Deep his place,  
Prince of the Waters and the finny Race;  
Rolling in Sport, the Billows he removes,  
And, like a floating Isle, the Ocean shoves:  
Now in his weedy Court he lies at ease,  
Now spouts against the Skies exhausted Seas.*

And yet one says very well concerning him; he is *minima quadam operum Dei, particula ac velut mica.*

Let what I gave you of the *nine hundred and sixty Foot* pass for a *Plinyism*; and so what *Basil* in his *Hexameron* reports of *Whales* equal in bigness to the greatest Mountains, let the Censure of *Brierwood* pass upon it, as an *intolerable Hyperbole*: We will write more sober things. Passing by what *Ælian* affirms of the *Whale* being five times beyond the largest *Elephant*, we find *Rondeletius* assigning him sometimes *thirty-six Cubits* of length, and *eight* of height. *Dion* is a grave as well as an old Writer, and he reports a *Whale* coming to Land out of the *German Ocean* *sixty Foot* in length, *twenty* in breadth. But *Gesner*, a later, affirms a *Whale* to have landed near our *Tinmouth-Haven*, in the Year 1532, which was *ninety Foot* in length, and the breadth of his Mouth *six Yards* and an half, and his Belly of such a compass, that one standing on the Fish, and slipping into his Belly, very narrowly escap'd being drown'd there.

But then, if we may take *Hartenius* for a Voucher, among the *twenty* several Kinds of *Whales* by him enumerated, he reckons one sort that is *thirty Ells* long,

and hath more than *seventy Teeth*, so large as to make Handles of Knives and other Instruments. He reckons another sort that is *forty Ells* long, and overwhelms Vessels that come in his way. He proceeds to some *eighty Ells* long, and some of *ninety*.

All these proclaiming the *Grandeur* of their *Great Creator*!

Even in the *cold Sea* too, what a *Warmth* of Parental Affection do the *old ones* express for their *young ones*, and how distinguishing! When the *Seals* are hundreds of thousands of them lying in a Bay coming out of the Sea, they bleat like Sheep for their Young; and tho they pass thro hundreds, yea, thousands of other young ones before they come to *their own*, yet they will suffer none but *their own* to suck them. *Even the Sea-Monsters draw out the Breast, they give suck to their young ones. Monstrous Parents, that are without natural Affection!* These Inhabitants of the *Sea* with open Mouth cry out against you.

¶. 'I remember a *Crassus*, of whom 'tis reported, that he so tamed a *Fish* in his Pond, as to make him come to him at his calling him; verily, I shall have a Soul deserving *his Name*, and be more stupid than the *Fish*, if I do not hear the Calls which the *Fish* give to me to glorify the God that made them; and who has in their *Variety*, in their *Multitude*, in their *Structures*, their *Dispositions* and *Sagacities*, display'd his Glories. The *Papists* have a silly and foolish Legend of their *St. Anthony* preaching to the *Fishes*; it will be a Discretion in me to make the reverse of the *Fable*, and hear the *Fishes* preaching to me, which they do many Truths of no small importance. As *mute* as they are, they are *plain* and *loud* Preachers; I want nothing but an *Ear* to make me a profitable Hearer of them.'

'It is a good Wish to be *in virtute Delphinus*, to use the Dispatch of the quick *Dolphin* in all good Purposes.'

‘Tho ’tis the way of the Sea for the greater to devour the lesser, and the Wisdom of Heaven is conspicuous in it; yet I deprecate this way of all the Earth: for indeed the Fish, who devour not those of their own particular Kind, therein condemn the cursed Rapacity too often seen among the Children of Men.’

‘To catch Fish is an Employment whereby many support themselves, a Diversion wherewith many refresh themselves; in managing this Fishery what an opportunity for many useful Reflections! In the Means of Good bestow’d upon us, the Glorious-One does *Retia Salutis pandere*. How happy we, if taken in the Nets of Salvation! We are so when effectually persuaded to the embracing of our Saviour, and of his Religion.’

‘Alas! the Ministers of the Gospel now fish, not with Nets, but with Rods; and after long angling, and baiting, and waiting, how few are taken!’

‘In the Temptations to Sin and Vice which are offer’d to me, I see the Hooks with which the Destroyer proposes to take me, that I may be thrown into the Perdition of ungodly Men. My God, let not the Satanick Baits have any Power over me!’

‘How suddenly is the Fish caught and killed, and with what a Surprize, when the poor Animal has not the least thought of such a Fate coming upon him! One moment sporting, taken the next; he pull’d away, his Fellows not at all regarding it! He was a wise Man who long since took notice of this; Man knoweth not his Time: As the Fishes that are taken in an evil Net, so are the Sons of Men. My God, help me to think seriously of Death every day, as not knowing but it may be my dying-day.’

‘At our Tables we are now welcome to all the Fish we can fairly come at, whether they have any Fins or Scales or no; but methinks it gives a special relish to the Dish, ’tis a Dish which my admirable Saviour sometimes tasted of.’

## ESSAY XXX. Of the FEATHERED.

THE BIRDS now invite us to *soar* and *sing* with them in the Praises of our God.

These ought immediately to follow the *Fishes*, not only for the *Order* of their *Creation*, but also because, as *Basil* notes, there is a Συγγένεια τοῖς πλωμένοις πρὸς τὰ ὄντα, *Volantibus Affinitas cum Natantibus*.

These are either *Land-Fowl* or *Water-Fowl*. Of the *Land-Fowl* some have *crooked Beaks* and *Talons*, whereof some are *carnivorous*, called *Birds of Prey*.

And some are also *frugivorous*, called by the general Name of *Parrots*.

Others have their *Bills* and *Claws* more *streight*; of which there are some of a *larger* Size, which cannot fly at all.

Some are of a *middle* Size, and have either a *bigger* or *longer* Bill; some whereof do feed promiscuously, some only on *Fish*, some on *Insects*: or a *smaller* and *shorter* Bill, whereof some have a *whiter* *Flesh*, others a *blacker*.

Some are of a *lesser* Size, called the *small Birds*; which are either the *soft-beak'd*, that feed mostly on *Worms* or *Flies*; or the *hard-beak'd*, that feed mostly on *Seeds*.

The *Water-Fowl* are either such as *frequent* the *Waters* for their *Food*, these are all *cloven-footed*, and generally have *long* *Legs*, and those *naked* for a good way above the *Knees*, that they may the more conveniently wade in the *Waters*; or they are such as do *swim* in the *Waters*, the most of these are *whole-footed*: some have but *three* *Toes* on a *Foot*, but most of them *four*; these either all connected by intervening *Membranes*, or more usually with the *back* *Toe* loose. Most *Water-Fowls* have a *short* *Tail*.

In *Birds* the *Shape* and *Make* of their *Body* is incomparably adapted to their *Flight*; *before* sharp, to pierce

pierce and make their way thro the Air, and then rising to their *full Bulk* by gentle degrees.

Their *Feathers*, how artificially placed, for facilitating the motion of their Body! Being placed any other way than what they are (as they would have been if meer *Chance* had placed them) they would have gathered *Air*, and been an Incumbrance to the Passage of their Body thro the *Air*; whereas in the neat *Order* wherein they are now placed, they are like a Boat new dress'd and clean'd, making its Passage thro the Waters. At the same time they have the Security of an admirable *Cloathing* in them, with a soft and warm *Down* next to their Body, but those next to the *Weather* of stronger Consistence, and closed most curiously. And then there is a most surprizing Accession to all this in the Art with which those Animals do *preen* and *dress* their *Feathers*, and the wondrous *Oil-bag* with which they are for this purpose accommodated. There is usually one *Gland* (Mr. *Willoughby* sometimes found a couple) in which there are divers little *Cells*, ending in two or three larger ones, which lie under the Nipple of the *Oil-bag*; this Nipple is perforated, and being press'd or drawn by the Bird's Bill or Head, emits a liquid *Oil* in some, an unctuous *Grease* in others, which being employ'd on their *Feathers*, contributes to their *nimble gliding* thro the Air.

How commodiously their *Wings* are placed! They that fly much, or have most occasion for their *Wings*, have them in the very best part imaginable, to balance their Body in the Air, and give them a swift progression. Alter their *Equipoise*, by cutting a *Wing*, or hanging a *Weight*, and how they reel! Such as have as much occasion for *swimming* as for *flying*, have their *Wings* therefore set a little out of the *Center* of their Body's Gravity; and for such as have more occasion for *diving* than for *flying*, these for that reason have their *Legs* more backward, and their *Wings* more forward.

The incomparable Curiosity of every *Feather*! The *Shaft*, hollow below, that it may be the stronger and the lighter; above a *Pith* filling it, which is also both strong and light; the *Strength* marvellous! The *Vanes*, how nicely gauged! broader on one side, narrower on the other, in both contributing to the progressive motion of the Fowl, and closeness of the *Wing*. The *Vanes* of the *Flag-feathers* of the *Wing*, the *Edges* of the exterior bending downwards, of the interior upwards, by which means they lie close to one another when the *Wing* spreads, and not one *Feather* misses its full *Impulse* on the Air; yea, the very *sloping* of the *Tips* of these *Feathers* is a *Nicety* to be wondred at.

Let an Eye assisted with Glasses view the *textrine Art* of the *Plumage*, and, as Mr. *Derham*, who has given us a more particular Account of it, justly says, it will be found so exquisite, that it cannot be viewed without *Admiration*!

‘ My P E N, thou art fetch’d from the *Wing* of a Bird; thou wast one of the *Feathers*, which thou art now writing of! How surprizing an *Engine*! How surprizing, how extensive, how powerful thy *Operations* in the World! Never shall my *Pen* be employed in any thing but the Service of the glorious God, to whom I am indebted for it.’

Admirable the *Apparatus* of the strong, but light *Bones* in the *Wings*! The *Joints* which move so as to answer all Occasions! The Strength of the *pectoral Muscles* in *Birds* is greater than in any things not made for *flying*. *Borelli* observes, that the *pectoral Muscles* in *Men* are very small, and they don’t come up to the fiftieth part of all the *Muscles*; but in *Birds* the *pectoral Muscles* are very large, & equant, imo excedunt, & magis pendent, quam reliqui omnes Musculi ejusdem Artis simul sumpti. For which cause our *Willoughby* observes, that if *Men* would propose to prosper in their vain Project for *flying*, their *Wings* must be fastned not to their *Arms*,

*Arms*, but their *Legs*, the *Muscles* being much stronger there.

The *Tail* of the Bird, which has been thought a sort of a *Rudder*, 'tis proved by *Borelli* that this is the *least use* of it; but it serves wonderfully to assist the *Ascent* and the *Descent* of the Bird in the Air, and obviate the *Vacillations* of the Body and Wings.

The *Flight* performed according to the strictest Rules of *Mechanism*! The untaught Artist gives a motion to his Wings, than which the acutest Mathematician could not give one more agreeable.

*Blind Philosopher, canst thou see no GOD in all of this?*

View next the *Feet* and *Legs*, which minister to their other motion.

Both of them very light, for their easier *Transportation* thro the Air.

In *Water-Fowl* how exactly do their *Feet* and *Legs* correspond to their way of living! Some of them have their *Legs* pretty long, that they may wade in the Waters, in this case their *Legs* are without Feathers a good way above their *Knees*, which is a *Conveniency*; their *Toes* also are all broad: and in the *Mudsuckers* two of the *Toes* are somewhat joined, that they may not easily sink in walking upon boggy places. Those that are *whole-footed*, or have their *Toes webbed* together, have their *Legs* generally short, which for *swimming* is most convenient; and it is pretty to see how artificially they gather up their *Toes* and *Feet* when they go to take their *Stroke*, and as artificially again extend or open their *Feet* when they drive themselves forward in the Waters.

*Rapacious Birds*, as they have *hooked Beaks*, thus they have strong, and sharp, and pointed *Talons*, fitted for the *Rapine* they are so intent upon, and for the tearing the *Flesh* that falls into them; and, as our *Willoughby* and *Ray* observe, they have robust and brawny *Thighs*, for striking down their *Prey*.

By the way; of this Kind there is a sort of *white Crows* (we must believe some who tell us this!) which they call *King-Carrion-Crows*; and it is affirmed, that when a great number of *Crows* are assembled about a Carcase, if a *King-Carrion-Crow* be among them, he falls on first, and none of the rest will taste the least Morsel till he has fill'd his Belly, and is withdrawn. I hope these *Crows* do no hurt by breaking in upon a Paragraph that is treating upon other Matters, especially if they effectually teach us, that the want of *good Manners* will never want a *Condemnation*.

*Birds* that climb, as the *Wood-pecker* Kind are, how fitted for the purpose! Their *Thighs* very strong, their *Legs* very strong, but yet very short; their *Toes*, two forwards, two backwards, and so closely joined, that they may firmly lay hold on the *Tree*: an hard and a stiff *Tail*, bending downwards, on which they lean, and so bear themselves up in climbing.

How conveniently are the *Legs* of *Birds* curved, for their easy perching, and roosting, and rest! And to help them up upon their *Wings* in taking their *Flight*, and then to be so tuck'd up to the *Body*, as not to obstruct the *Flight*!

It is admirable that such *Birds* as are *Fin-toed* are naturally directed and carried to the *Water*, and fall to swimming there; thus *Ducklings*, tho' hatch'd and led by an *Hen*, when they come near a *Pond* of *Water*, in they go, tho' they never saw such a thing before, and tho' the *Hen* clucks and calls, and is in a mighty *Agony* to keep them out, as *Pliny* expresses it, with *Lamenta circa Piscinæ stagna, mergentibus se pullis, Natura duce*.

There is a considerable *Observation* of *Aristotle*, *ἄνεν μὲν ἰδέειν*. There is no *Flyer* but what has *Feet* as well as *Wings*, a power of *walking* or *creeping* on the *Earth*; 'tis because there is not always a sufficient *Food* to be had for them in the *Air*, nor could the *Birds* take any rest, for without *Feet* they could not perch on the *Trees*; and if they lit on the ground, they

they could not again easily raise themselves; and where could they sit, hatch, and breed their Young? The Story of the *Bird of Paradise*, received even by the Learned in the former Age, is now found a *Fable*; that Bird has *Legs* and *Feet*, and those great and strong, and armed with *Talons*, as being a *Bird of Prey*.

The *Bill* of Birds, how suited for gathering *Food*, and other *Uses*?

The *Eye*, how commodiously situated! (It is, by the way, a thing so remarkable, that nothing less than *Astonishment* can be the result of the *Observation*; that the *Fowls* in their *Tribes* have their *Centinels*, especially in the *Night*. The *Watchfulness* of the *Scart* is true to a *Proverb*: One, by surprizing the *Centinel*, has caught three hundred in a *Night*.)

And the *Ear*, which would obstruct the *Flight* of it, were it like that of other *Animals*; the *inner Ear*, largely described by *Mr. Derham*, is a *Contrivance* that is a very amazing one.

*Willis* admires the *Points* wherein the *Brain* of *Birds* and *Fishes* agrees, differing from the *Brain* of *Man* and *Beasts*.

To *Steno* there appears *Elegans Artificis liberè agentis indicium*, in the *Bifurcation* of the *Aspera Arteria* in *Birds*, which is not in other *Animals*, and which fits them for their *singing*.

In the *Swan* particularly, *Bartholin* celebrates it, as being *admirandæ Structuræ*, by which means it may continue half an *Hour* under *Water* without any danger of *choaking*.

Read *Blasius* and *Coiter*, and admire the *Tongue* of the *Wood-pecker*, especially the sharp, horned, bearded *Point*, and the *glewy Matter* at the end of it, the better to stab and stick into the little *Maggots*, and to draw them out of the *Wood*.

The several ways the *Birds* have of purveying for their *Food*, call for our *Consideration* as we go along: but how can they be considered without some surprize  
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of Pleasure at the view thereof. Among all these, that of the *Man-of-War Bird*, mention'd by *Dampier*, is very singularly diverting. He sees a Bird called a *Booby*, and flying at him, gives him a *Blow*, which causes him immediately to disgorge the *Fish* he has in his *Crop*; and this he seizes on, perhaps before it can in its fall reach the Earth or Water. 'Tis in effect what *Men* do to one another, when the Justice of Heaven uses them to make *Seizures* on one another's Possessions. Have not the *French* in the late and long Wars, been *Men-of-War Birds*, on our *English* Nation!

Wonderful the Provision in the *Bill*, for the judging of the *Food*! It has peculiar *Nerves* for the purpose. These are smaller and less numerous in them that have the assistance of their *Eye*: but they are more numerous and thickly branched about, to the very end of the *Beak*, in such as hunt for their Food out of sight, in *Water*, in *Mud*, or under Ground. *Flat-billed Birds*, as *Mr. Clayton* and *Dr. Moulen* have observed, they that *gripe* for their Meat have three Pair of *Nerves* that come into their Bills, whereby they accurately distinguish what may be proper for their Food.

Shall we stop a Moment, and consider how useful the *carnivorous* Birds of Prey become, even in prosecuting their voracious Inclinations? If the number of *lesser Birds* were not by their means lessened into such a Proportion, those *lesser Birds* would overstock their feeding; and then also, should those *lesser Birds*, which are so numerous, die of Age, they would leave their *Carcases* to rot upon the Ground, and their *Stink* would corrupt the Air, and become insupportable.

*Dr. Grew* observes, both *Birds* and *Beasts* having one common use of *Spittle*, are therefore furnish'd with the *parotid Glands*, which help to supply the Mouth with it; but the *Wood-Pecker*, and other *Birds* of that Kind, because they prey upon *Flies* which they catch with their *Tongue*, therefore in the room of the said *Glands*, they have a couple of *Bags* filled with a *viscous*

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*Humour*;

*Humour*; a sort of natural *Bird-lime*, which being by small *Canals*, like the *Salival*, brought into their *Mouths*, they dip their *Tongues* in it; and with the help thereof, they attack and master their *Prey*.

Pass from the *Mouth*, to its near Ally the *Stomach*. 'Tis admirable in its *Duplicity*; one to *soften*, another to *digest*! Admirable in its *Variety*, suited unto a diverse *Diet*: *membranous* in some that are *carnivorous*; *musculous*, with a *Strength* agreeable, where *Grain* must undergo a *Comminution*!

The *Gizzard* has a *Faculty* of *grinding*; to which purpose the *Bird* swallows rough *Stones*, which when grown smooth, it throws up again as uselefs. *Dr. Harvey* says, this *grinding* may be heard in *Eagles* and some other *Fowls*, if you lay your *Ear* close to them when their *Stomachs* are empty.

In *Birds* there is no *Mastication* or *Comminution* of the *Meat* in the *Mouth*; but in such as are not *carnivorous*, it is immediately swallowed into the *Crop* or *Craw*, or at least a kind of *Ante-Stomach*, (which *Mr. Ray* observed, especially in the *Piscivorous*) where it is moisten'd and mollified by proper *Juices*, from the *Glandules* there distilled in, then transferred from thence into the *Gizzard*.

Their *Lungs* adhere to the *Thorax*, and have little play; which is a good *Provision* for their *steady Flight*.

Wanting the *Diaphragm*, instead of it they have diverse *Bladders*, made of thin transparent *Membranes*, with pretty large *Holes* out of one into the other. These *Membranes* contain *Air* in them, and are also *Braces* to the *Viscera*. The *Lungs* have large *Perforations*, thro which the *Air* has a *Passage* into the *Belly*. Doubtless the *Body* is hereby made more or less buoyant, and their *Ascent* or *Descent* facilitated.

Their *Necks*, how proportioned unto the *Length* of their *Legs*! Indeed, they that must search out their *Food* in the *Waters*, have them longer yet; and they have them so long, that when their *Heads* are extend-  
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ed in flight, they cause a due *Equipoise* and *Libration* of the Body upon the *Wings*.

The Inspection of these Things would compel us to confess the glorious **M A K E R** of them all!

Indeed what *Steno* says on a Description of a particular Subject, (the Myology of the *Eagle*) may be more generally applied; *Non minus arida est Legentibus, quam Inspectantibus jucunda*. For which reason I will not offer the Readers too many Particularities.

The *Nidification* of *Birds*; a thing how full of Curiosity: They find out *secure* Places, and very *proper* ones; where their Young may lie safe and warm, and have their Growth promoted. But then, with what an *artificial Elegancy* are some of their *Nests* prepared? *Human Skill* could hardly imitate it. Among other Curiosities of *Nidification*, I will mention one that is observed in *Pidgeons* of my own Country. They build their *Nests* with little Sticks laid athwart one another, at such distances, that while they are so near together as to prevent the falling through of their *Eggs*, they are yet so far asunder, that the *cool Air* can come at their *Eggs*. And the **REASON** for this *Architecture* of their *Nests*! 'Tis this; their *Bodies* are much *hotter* than those of other *Birds*; and their *Eggs* would be perfectly addled by the *Heat* of their *Bodies* in the Incubation, if the *Nests* were not so built, that the *cool Air* might come at them to temper it.

We have seen the *Nest* of an *Indian Bird* composed of the *Fibres* of certain *Roots*, which were so curiously interwoven, that it could not be beheld without *Astonishment*! These *Nests* they hang on the Ends of the *Twigs* of the *Trees*, over the *Water*, to secure their *Eggs* and *Young* from the Ravage of *Apes*, and other *Beasts*, that else would prey upon them. They are justly enough called *subtle Jacks*.

And what shall we say of the *Flamingo's*? They build their *Nests* in shallow *Ponds*, where there is much *Mud*; which they scrape together into little  
Hillocks,

Hillocks, like *Islands*, appearing out of the Water about a Foot and a half high from the Bottom. They make the Foundation of these Hillocks broad, bringing them up tapering to the Top, where they leave a small hollow Pit, which they lay their *Eggs* in; and when they either lay or hatch their *Eggs*, they stand all the while, not *on* the *Hillock*, but close *by* it, with their *Legs* on the ground, and in the Water, resting themselves on the *Hillock*, and covering the hollow *Nest* upon it with their Bodies. Their *Legs* are very *long*, and building as they do upon the ground, they could neither draw their *Legs* conveniently into their *Nests*, nor *sit* down upon them otherwise than by resting their whole Bodies to the prejudice of their *Eggs* or Young, were it not for this rare Contrivance. [Psal. lxxxiv. 3.]

The *Incubation*, for which this Tribe of *Animals* is remarkable, opens a *new Scene* of Wonders unto us. The *Egg* with its crusty Coat is admirably fitted for it. Here we find one part provided for the *Formation* of the Body before 'tis grown to any considerable Dimensions, another for its *Nourishment* afterwards, till the *Bird* be able to shift for itself.

*Willoughby* confirms that Observation of *Pliny*, *Ipsum Animal ex albo Liquore Ovi incorporatur: Cibus ejus in Luteo est.*

But then the accurate *bracing* of these parts, by which they are kept in their due place, *Mr. Derham* observes, must be a *design'd*, as well as it is a *curious* piece of Workmanship. They are separated by *Membranes*. The *Chalazæ*, (which because formerly thought the *Sperm* of the *Cock*, were called the *Treddles*;) are, as *Harvey* says, *As it were the Poles of this Microcosm, and the Connexions of the Membranes.* But as *Mr. Derham* observes, they serve only to keep one and the same part of the *Yolk* always uppermost, let the *Egg* be turned which way it will. The *Chalazæ*, it seems, are specifically *lighter* than the *Whites* in which they swim;

swim; and being braced unto the Membrane of the *Yolk*, not exactly in the *Axis* of the *Yolk*, but somewhat out of it, it causes one side of the *Yolk* to be heavier than the other: so that the *Yolk* being by the *Chalaza* made buoyant, and kept swimming in the midst of the two *Whites*, is by its own heavy side kept with the same side always uppermost, and probably this *uppermost side* is that on which lies the *Cicatricula*.

It is affirmed, that our *Hens* once in every day of their Incubation *turn* their *Eggs*, without ever turning of one more than once, or leaving any one unturn'd. This is for a Service which they understand not themselves.

The Conveyance of what *Colours* we please to the Fowl that is hatching, by our painting of the *Eggs*, is a Curiosity.

That *Birds* must lay *Eggs*, is a sensible Argument of a *Divine Providence*, designing to preserve them, and secure them, that there might be a greater plenty of them, and that the *Destroyers* might not straiten their Generations. Had they been *viviparous*, if they had brought forth a *great number* at a time, the burden of their Womb would have rendred them so heavy, their *Wings* could not well have served them: or if they had brought forth but *one or two* at a time, they would have been troubled all the Year long with bearing or feeding their Young. The Conveniency consulted in *oviparous* Animals, is one of *Dr. More's* Triumphs over *Atheism*. Of these *Eggs* he makes an *Anidote* against that hellish Poison!

*Dr. Cheyne* will more particularly assure us, *We know* that the *Eggs* of *Animals* are only an *Uterus* for a little *Animal*, furnished with proper *Food*, and fenced from external Injuries: and *we know* likewise that all the Effects of *Incubation* are only to supply a proper degree of *Heat*, which may make the congealed *Fluids* to flow, and more easily pass into the nourishing Channels of  
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the included *Animalcule*. On this occasion he goes on, *We are sure that all the Transformations of Insects and other Animals, are nothing but the Expansion of their Parts, and the breaking of the Membranes that folded them up, by the Augmentation of these Parts; and all the several Figures they put on, are owing to the several Membranes in which they are involved. His Conclusion is what I was wishing for: It is impossible duly to consider these things, without being wrapt into Admiration of the infinite Wisdom of the Divine Architect, and contemning the arrogant Pretences of the World-wrights, and much more the Production of Chance and jostling Atoms.*

As Mr. Derham observes, what a prodigious Instinct is it, that *Birds, and only they, should betake themselves to this way of Generation! How should they be aware that their Eggs contain their Young, and that they have in their power the Production of them? What should move them to betake themselves to their Nests, and there with Delight and Patience abide the due number of Days? And when their Chickens are hatched, how surprizing is their Art, and Care, and Passion, in bringing them on until, and only until, they are able to shift for themselves.*

A Remark of our valuable Ray is worthy to be introduced here. It would be on many accounts inconvenient for *Birds to give suck; and yet no less inconvenient, if not altogether destructive unto the Chicken, upon Exclusion all of a sudden, to make so great a change in its Diet, as to pass from a Liquid unto a harder Food, before the Stomach be consolidated, and by use habituated unto the concocting of it, and its tender and pappy Flesh fitted to be nourished by what shall be strong and solid; and before the Bird be by little and little accustomed to the using of his Bill in the gathering of it up, to which it comes not very readily: therefore there is a large Yolk provided in every Egg, a great part whereof remains after the Chicken is hatched, and is inclosed in its Belly, and*

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by a *Channel* made on purpose, receiv'd by degrees into the *Guts*, and serves instead of *Milk*, to nourish the *Chicken* for a considerable time; which nevertheless in the mean time feeds itself by the *Mouth*, a little at a time, and gradually more and more, as it gets a more perfect Ability.

I will add a Curiosity relating to the *Pidgeons*, which annually visit my own Country in their *Seasons*, in such incredible numbers, that they have commonly been sold for *Two-pence* a dozen; yea, one Man has at one time surprized no less than *two hundred dozen* in his Barn, into which they have come for Food, and by shutting the door, he has had them all. Among these *Pidgeons*, the *Cocks* take care of the *young* ones for one part of the day, and the *Hens* for the other. When they are taken, we generally take but *one Sex* at a time. In the *Crops* of the *Cocks*, we find about the quantity of half a Gill of a Substance like a tender *Cheese-Curd*: the *Hens* have it not. This *Curd* flows naturally into their *Crops*, as *Milk* does into the *Dugs* of other Creatures. The *Hens* could not keep their *young* ones alive when first hatched; but the *Cocks* do fetch up this *thickned Milk*, and throw it into the *Bills* of their *young* ones, which are so nourished with it, that they grow faster, and fly sooner than any other Bird among us. None but the *Cocks* which have *young* ones to care for, have this *Curd* found in their *Crops*. Kill one of those *Cocks*, and all the *young* ones pine away to death in the *Nest*, notwithstanding all that their *Dams* can do for them. See *Sirs*, and be instructed!

*Masculus ipse fovet Fœtus, atque incubat Ovis;  
Conjugii servat fœdera casta sui.*

All Birds lay a *certain number* of *Eggs*, or near that number, and then betake themselves to their *Incubation*: but if their *Eggs* be withdrawn, they will then

then lay more. When they have laid such a number of *Eggs*, as they can conveniently cover, and brood, and hatch, they give over, and begin to *sit*. This is not because they are necessarily *determined* to such a number: For *Hens*, for example, if you let their *Eggs* alone, when they have laid *fourteen* or *fifteen*, they will give over, and begin to *sit*; whereas if you daily take away their *Eggs*, they will go on to lay five times that number! This holds not only in *domestick* Birds; and so, as Mr. Ray observes, it can't be thought the effect of *Cicuration* and *Institution*: But the like was by Dr. Lister observed in *Swallows* too.

But altho almost the whole Tribe of *Birds*, do produce their Young by *Incubation*, there is a marvellous *Deviation* from it in some few Families which do it in a more *novercal* way, and without any trouble at all, only by laying their *Eggs* in the *Sand*, exposed unto the *Heat* of the Sun. This Instinct of the *Ostrich* particularly, *who leaveth her Eggs in the Earth, and warmeth them in the Dust*, is ascribed unto G O D, who supplies the want of Concern in the *Parent-Animal* another way.

It is a surprizing thing, which the observing Ray has mentioned. Such *oviparous* Creatures as are long-lived, have *Eggs* enough at first conceived in them, to serve them for many years laying; probably for as many as they are to live: allowing such a proportion for every year, as will serve one or two *Incubations*. But *Insects* which are to breed but once, lay all their *Eggs* at once, have they ever so many. He says most justly, *Chance cannot govern it*.

The Scarcity of the *voracious* and *pernicious* Birds, and the Plenty of the *mansuete*, and *useful*, and more desirable, is to go among the Matters of our Wonderment!

And so must the *swift Motion* of such whose Food is to be sought in distant Places, and in different Seasons; the *slow Motion* and short Flight of others more *dome-*

*stick*; and the Awkwardness of some to *Flight*, whose *Food* is to be got near at hand, and without much *flying* for it.

It is amazing, *Who feeds the young Ravens when they cry!* — That *Birds* which feed their *Young* in the *Nest*, tho probably they cannot *count the Number* of them, and tho they bring but *one Morsel* of *Meat* at a time, and tho they have not fewer it may be than seven or eight *young* in a *Nest* together, which at the return of their *Dams* do *all at once*, and with equal greediness, hold up their *Heads* and gape, yet they forget not one of them, they feed them all. Our good *Ray* notes well, 'Tis beyond the possibility of a *meer Machine* to perform such a thing as this!

With what an impetuous desire of *sitting* are the *Birds* inspired, while it is called for! After the *Young* are *hatch'd*, for some time they do almost constantly *brood* them under their *Wings*, lest they should suffer by any *Inclemency* of the *Season*; all this while how hard they labour to get them *Food!* *Sparing* it out of their own *Bellies*, almost *pinning* themselves to death rather than that their *Young* should want any thing! With what *Courage* are they inspired in this time, to venture their very *Lives* in defence of them, and even fly in the *Face* of a *Man* that shall molest their *Young*, (as a *Hen* or a *Goose* will do) which they would never do in their own defence! These things are contrary to the *Instinct* of *Self-preservation*, and are eminent *Pieces* of *Self-denial*. Our good *Ray* says well, *They must needs be the Works of Providence for the upholding of the World!* These *Pains* are bestowed upon a thing which takes *no notice* of it, makes *no amends* for it, never acknowledges it with *Thankfulness*; and when the *young* one is grown *old* enough to shift for itself, the *serv'd* is gone! The *old* one takes no further care of it, will beat it indifferently with such as it is not at all related to! The words of *Mr. Robinson* on this *Occasion* are agreeable: 'She does she knows not what, but yet

‘ yet it is what ought to be done by the most exquisite Knowledge; hence it is conclusive, that something else has Knowledge for her, even the Creator and Contriver of all things, who is the omniscient and omnipotent God.’ At the same time how remarkable to see, that Poultry and Partridge, and other Birds, at the first sight know the Birds of Prey, and make a Sign of it with a peculiar Note to their young ones, who thereon hide themselves.

We celebrate the Dove of Archytas, whereof Gellius tells us, *Simulachrum Columbæ à ligno ab Archyta, ratione quadam, disciplinâque mechanica factam, volasse*; the same whom we find celebrated by Horace for a noble Geometrician. This Dove surely had more Geometry in it than the *πλαταγή*, or Childrens Rattle, for which Aristotle celebrates him, as the Inventor of it. We are surprized at what Ramus tells us of the Wooden-Eagle and the Iron-Fly, made by Regiomontanus; the former of which flew forth of the City, met the Emperor a good way off, saluted him, and returned with him; the latter, at a Feast, whereto he invited his Friends, flew out of his Hand, fetch’d a round, and flew back to him again before the astonish’d Beholders. Du Bartas employ’d his Poetry on these Curiosities.

But what! No Honours, no Praises due to that infinite GOD, who hath with so much Art contrived all the Variety of Birds, and accommodated every part of them within and without after so rare a manner, that there is not so much as a Feather misplaced, redundant, or defective! Austin says well, *Deus non solum Angelum & Hominem, sed nec exigui & contemptibilis animantis viscera, nec Avis pennulam, nec Herbæ flosculum, sine suarum partium convenientia dereliquit.*

In the xivth of Deuteronomy there is a Bird called Racham, which signifies Mercy. The Talmudists have a Saying, That when this Bird appears, the Mercy of God and His Messiah is then coming to the World. Verily, in every Bird that flies into our World, there

is a display of the Divine *Goodness*, as well as *Power* and *Wisdom*. I wish that, in the reigning *Dispositions* of *Benignity* and *Compassion* among Mankind, *Racham* were making her Appearance!

Our excellent *Cosmologer* makes his religious Remark upon it, That the *Birds* (and so the *Beasts*) which are *domestick*, or the most *useful*, are the most *prolifick*; there are more *Hens* than *Kites*, more *Geese* than *Swans*. A *Crane*, which is but scurvy Meat, hatches no more than *two Eggs* in a Year; several *Sea-Fowls* but one. The *Pheasant* and *Partridge*, excellent Meat, and easily come at, hatch fifteen or twenty. The more valuable, which lay *fewer* at a time, sit the *finer*, as the *Dove*. Thus, if it were not out of place to observe it here, there are more *Dogs* than *Foxes*; more *Cats* than *Lions*. The *Sheep* feeds and breeds in all Countries much alike.

Of *Wild-Fowl*, those which are the most *useful*, fly not singly, but are *gregarious*, which renders them the more *visible* and *audible* to us, and the more *plentiful* Game. And for our more quiet possession of things that are most *useful*, they are *naturally marked*, when there is occasion for it. *Wild-fowl*, and *Fishes*, and other Creatures, which are not fitted by Nature to be any Man's *Propriety*, have only such distinguishing Marks as belong to the whole *Species*; but of the *domestick*, as *Poultry*, *Horses*, *Dogs* and *Cats*, not only the *Species*, but the *Individuals* have their Marks. The *Sheep*, which are *proprietary*, if not so marked, it is compensated in this, that they do not *straggle*.

¶ 'My Great Saviour has given me this Direction,  
' Matth. vi. 26. *Consider the Fowls of the Air.*'

'But is it possible to *consider* them without continual *Wonders* at the *Divine Workmanship* appearing in them! *Wonders* to be articulated and modulated into endless *Praises* of their Glorious Creator! *Me-thinks* the *sweet Notes* uttered by many *Tribes* of them invite me into a *Consort* with them.'

‘ I know not what well to make of a Relation published a few Years ago, but so well attested, that a pious and worthy Man wrote a large Treatise upon it, entitled, *Vox Corvi!* which affirms, That a Raven perching on the top of a Steeple, and thence turning towards a quarrelsome Neighbourhood, was heard very audibly and articulately to utter these Words, *Look into the third of the Colossians, and the sixteenth*: But this I know, *Ask the Fowls of the Air, and they shall tell thee*. There needs no *Genius* to take a possession of our *Birds*, that we may hear from them the Admonitions of *Piety*, and Exhortations to believe and adore an infinite G O D intelligibly enough proceeding from them.’

‘ It was a celebrated Speech of the Philosopher, *Si Luscinia essem, ut Luscinia canerem*; I can fly much higher than they, and if I praise their Glorious Creator, I shall sing much better than they; *Homo sum, atque ut Homo canam colamque*.’

‘ The Providence of the Glorious G O D, in the Propagation and Sustainment of the *Fowls*, ’tis admirable; it extends to *Ravens*, to *Sparrows*; and shall I imagine myself excluded from the Care of that Providence! Holy Mr. Dod ventur’d upon the Difficulties and Contingences of a married Life, when he saw the Hen with her Chickens provided for. O Unbelief, I command an eternal Silence to thee! Shall the *Birds of Season* bring with them a Condemnation of my Inadvertency, to my fittest Opportunities for the doing and the getting of Good!’

‘ There are the Images of many Virtues in *Birds*, (which have been called *Simulachra Virtutum*) of which I would endeavour an Imitation, and therein glorify the God that speaks to me by them; among these I would especially pitch upon two. Teach me, O *Stork*, how gratefully to treat my Parent; shew me, O *Dove*, how lovingly to treat my Consort.’

Of such Reflections a famous Philosopher says truly, *Rectis animis non poterunt non esse grata, licet perversis ridicula videantur.*

The Man who learns all the Good which the *Birds* may mind him of, and then lives to the G O D, whose *Work* and whose *Voice* he discerns in the *Birds*, this *Man* shall be a *Phoenix*, and the Traditions of the Antients no longer a *Fable*.

### ESSAY XXXI. *Of the FOUR-FOOTED.*

WE proceed to the *Animals* that are perfect, hairy, and walking upon four.

These Quadrupeds are either *hoofed* or *clawed*.

Of the *hoofed* or *ungulate*; some are *whole-hoofed*, whereof 'tis observ'd that none have Horns, nor have the Males any appearance of Breasts: there are four sorts of these.

Others are *cloven-footed*; of these there are two Divisions.

There is the *Bisulcate* Kind, which is also subdivided.

There are the *Ruminant*.

Some of these have *perpetual Horns*.

Whereof there are six of the *Bull-kind*, five of the *Sheep-kind*, eleven of the *Goat-kind*.

Others have *deciduous Horns*; these are the *Deer-kind*, whereof eight sorts have been reckon'd up.

Of those who do not *chew the Cud*, there is only the *Swine-kind*, whereof there are five sorts reckon'd up.

And then there is the Kind whose *Hoof* is cloven into *four Divisions*; we know five of these, but we know no *Rumination* in any of them.

Of the *clawed* or *digitate*; there is one sort whose Claws adhere to one another, cover'd with one common Skin, but with obtuse Nails, that stick out round the margin of the Foot; this is the *Elephant*, who must pass for *anomalous*.

There

There is another sort, which has only two Claws; namely, the *Camels*, which, tho they have no *Horns*, do ruminat, and have the *four Stomachs* of the *horned Ruminants*.

A third sort includes those which the *Greeks* call *Ἀνθρώπινα ποδοσφά*, whose Foot is divided into *many Claws*, with broad Nails on them: this is the *Ape-kind*, whereof there is a great variety; nine or ten Kinds have been described by the Naturalists.

A fourth sort is of those which have *many Claws*, yet they are not cover'd at the end with broad flat Nails, but have them rather like *Talons*, crooked and pointed; these had best be distinguish'd by their *Teeth*.

Some of these have *many cutting Teeth* in each of their Jaws; of these there is a *greater* sort, which either have a *short round Head*, as the *Cat-kind*, whereof there are *seven* sorts; and I hope the *Lion* will not be offended if he be reckon'd among them: or they have a *long Snout*, as the *Dog-kind*, whereof there are thirteen or fourteen sorts; and among these there are Varieties of *Mungrels*, and hebricious Breeds: and there is also a *lesser* sort, which have a long and slender Body, with *short Legs*; these are the *Weasel-kind*, and there are about eight sorts of them.

Others of these have only *two* large remarkable *Teeth* in each of their Jaws; these are the *Hare-kind*, which live mainly on *Plants* and *Fruits*; and there are about half a score sorts of them.

To these Kinds of *Quadrupeds* there must be added several that are *anomalous*.

Some have a *long Snout*, with Feet which are divided into *many Claws*, and are furnish'd with *Teeth*; there are eight or nine sorts of these, whereof the *Hedge-hog* is in the Van.

Others of these are destitute of *Teeth*, and there are two sorts of these.

There are *Quadrupeds* that are *Flyers* too, as the *Bat-kind*, whereof there are different Forms.

There is one very odd Anomale, which has but three Claws on each of his *four Feet*, and has a Name-fake too often among them that go *not upon four*; 'tis the *Ignarvus*, a *Sloth* we call it: he takes eight or nine Minutes to move one of his Feet three or four Inches; and when he has grown fat and plump with eating all the Leaves on a Tree, he will be Skin and Bone before he reach another, which will be five or six Days, tho' it may be very near the former.

There are also viviparous and sanguineous Quadrupeds, breathing with Lungs, but having only one Ventricle in their Hearts; to these we may add the *Tortoise*, whereof there are many Species, tho they be rather *oviparous*.

But then there are some *oviparous* Quadrupeds, which have a long Tail, horizontally stretched out; these are the *Lizard-kind*, and there be fourteen several sorts of them.

The *French Gentleman* who writes *A Demonstration of the Existence of GOD from the Knowledge of Nature*, makes this Remark: 'All the Animals owe their Birth to a certain Male and Female of their Species. All those different Species are preserved much the same in all Ages. We do not find that for three thousand Years past any one has perished or ceased; neither do we find that any one multiplies to such an Excess, as to be a Nufance' or Inconvenience to the rest.'

And now since we are upon the *four-footed*, the Remarkables in their *Legs* and *Feet* may be those which we may agreeably enough begin upon.

The *prone Posture of the Body* in the *Quadrupeds* is not only most beneficial to themselves, but also most advantageous to *Man*; they perform their own Actions the better for that Posture, and they serve *Man* the better, both for *Carriage* and for *Tillage*.

But then it's observable how exactly their *Legs* are made conformable to this Posture.

It invites yet more Observation, how admirably their *Legs* and *Feet* suit the Exercises of every Animal.

The *Elephant*, a Creature of prodigious Weight, has *Legs*, as *Pliny* notes, like *Pillars* rather than *Legs*.

The *Deer*, and the *Hare*, and other Creatures of a singular *Swiftness*, have their *Legs* accordingly slender; but they have therewithal an incredible *Strength* adapted to their *Swiftness*.

Some have their *Feet* made only for *walking* and *running*, but some have them for *swimming* too.

The *Toes* on the *Feet* of the *Otter* are all conjoined with *Membranes*, and in *swimming*, when the *Foot* goes forward in the *Water*, the *Toes* are close; but when backward, they are spread out; whereby they more forcibly strike the *Water*, and are driven forward. The *French Academists* are surprized at the extraordinary Structure in the *Feet* of the *Bever*: their *hindmost* *Feet*, like those of a *Goose*, are more proper to *swim* than to *walk* with; but their *foremost* are like *Hands* rather than *Feet*, and wondrously suit their Occasions.

Some, as the *Moles*, have their *Feet* for *walking*, and for *digging*.

Some, as the *Bats*, for *walking*, and for *flying* too.

In some the *Feet* are more lax and weak, for the plainer Lands; but others have them stiff, and less flexible; their *Joints* hardly discernible, as the *Elks*, and the *Goats*, which are to traverse the *Ice*, or to pass over the dangerous *Precipices* of the *Mountains*.

In some the *Feet* are shod with tough and hard *Hoofs*, (either whole or cleft, as there is most occasion) in others they have only a *callous Skin*.

And here 'tis admirable to see how their *Toes* are supplied, according to their several Conveniences.

The Structure of the *Bones* in *Quadrupeds* would be a mighty large Field for Curiosity and Admiration.

*Galen* remark'd a singular Provision of Nature for the *Strength* of the *Lion*, that his *Bones* are much more *solid* than those of other Animals.

Mr. Ray enquiring how so many Animals do to bear up against the extremest Rigor of the *Cold*, he notes, that the Extremities of their *Toes* are fenced with *Hoofs*, which in a good measure secure them: he adds, the main thing is, that the *Cold* is its own Antidote; for the Air being fully charged and sated with nitrous, or some other sort of Particles, (which are the great Efficients of *Cold*, and no less also the Pabulum for *Fire*) when it is inspired it causes a great Accension in the Blood (as we see the *Fire* burns fiercely in such Weather) as enables it to a vigorous resistance of the *Cold*.

The *defensive Armour* given to some Creatures, with the Skill to use it, how admirable! The *Hedge-hog*, filled with sharp and strong Prickles, has also a Muscle given him on purpose, which enables him to contract himself into a *globular Figure*, and so inclose himself in his Thicket, that his rapacious Enemies cannot lay hold upon him. *Olaus Borrichius* is amazed at the wondrous Fabrick of that Muscle. The *Armadilla*, described by *Marcgrave*, is covered with a strong, hard, scaly Crust or Shell, of a boney Substance, with four transverse Commissures in the middle of the Body, connected by tough Membranes. By a *peculiar Muscle* he brings his Tail to his Head, and so gathers himself into a round Ball, that there is nothing to be seen but his *Armature*: had such a Muscle been given to any Animal covered with soft Hair or Fur, there might have been a pretence to fancy that this was accidental and undesigned; but seeing there is not one Instance of this kind, Mr. Ray very justly says, *It must be great Stupidity to believe it, and Impudence to assert it.*

Let us pass to the *Head*. The Head of *Man* is of one singular Form. In the *Four-footed* the Form of the *Head* is almost as various as the Species, in some square and large, suitable to their Food, Motion, and Abode; in others more small, more sharp, and more slender, still to suit those purposes. How surprizingly

zingly is the *Head* and the *Neck* of the *Swine* adapted for his rooting in the *Earth*! How the *Neck*, *Nose*, *Eyes* and *Ears* of the *Mole*, adapted in the nicest manner to its way of subterraneous living! The strong *Snout* of the *Swine*, such that he may sufficiently thrust it into the *Ground*, where his *Living* lies, without hurting his *Eyes*; and of so sagacious a *Scent*, that we employ them to hunt for us; and even his *wallowing in the Mire*, is a wise *Contrivance* for the *Suffocation* of troublesome *Insects*! The *Mole* so shaped, that our *Doctor More* makes this *Creature* a notable *Ingredient* in the *Composition* of his *Antidote against Aheism*; even his want of a *Tail* is a considerable *Contrivance* for his advantage.

The *Brain* of *Quadrupeds* obliges us to employ ours in a particular *Contemplation* of it; it is larger in us than in them, no doubt for the *Accommodation* of a nobler *Guest*, which we entertain in ours: but an exact *Anatomist* of that *Part*, the famous *Dr. Willis*, has led us more particularly to contemplate the *Situation* of it. In *Man*, to whom *God* has given a *lofty Countenance*, with a *Capacity* to think on *heavenly things*, the *Brain* is placed above the *Cerebellum*, and all the *Sensories*; in *Brutes*, whose *Brain* is incapable of *Speculation*, the *Cerebellum*, whose *Business* it is to minister to the *Actions* and *Functions* of the *Præcordia* (the principal *Office* in those *Creatures*) is above the *Brain*, and the *Eyes* and *Ears* are placed at least equal to it: moreover, in the *Head* of *Man* the *Base* of the *Brain* and *Cerebell* is parallel to the *Horizon*, by which means there is less danger of their jogging or slipping out of their place; but in *Brutes*, whose *Head* hangs down, the *Base* of the *Skull* makes a *right Angle* with the *Horizon*; and yet lest the *Cerebell* should be unsteady, and the frequent *Concussions* thereof should cause disorderly motions of the *Spirits* about the *Præcordia*, there is a sufficient provision made by the *Artifice* of *Nature*, by the *Dura Meninx* closely encompassing

passing of it ; besides which, it has also in some a strong boney *Fence* about it.

The *carotid Arteries* passing thro the Skull of *Quadrupeds*, and their branching into the *Rete mirabile*, and some other such things, are particular Accommodations to their Circumstances, to prevent a too rapid Incurſion of *Blood* into the *Brains* of Creatures that hang down ſo much.

At the great Aperture of the Shell in a *Tortoise*, there is at the top a raiſed Border, to grant a liberty to the *Neck* and *Head*, for the lifting of himſelf upwards ; and this Inflection of the *Neck* is of great uſe to him, for without it he would be unable to turn himſelf when thrown upon his Back. The *French Academists* look'd upon the Contrivance as a ſurprizing one !

The Varieties in the inner and outer *Ear* of *Animals* entertained *Dr. Grew* with obſervable Curioſities. In an *Owl*, that perches *above*, and hearkens after her Prey *below*, it is produced *further* out above than it is below, that ſo the leaſt Sound from that Quarter may be the more<sup>ly</sup> eaſily received ; but in a *Fox* that ſcouts *underneath*, it is for the ſame reaſon produced further out *below*. In a *Polecat*, which hearkens directly forward, it is produced *behind*, for the taking of a forward Sound ; but an *Hare*, which is very quick of hearing, and thinks of nothing but being purſued, has a *boney Tube*, a natural *Otacouſtick*, ſo directed *backward*, as to receive the ſmalleſt and fartheſt Sound that comes behind it ; and in an *Hoſe*, which receives the Sound of the Driver behind, the Paſſage into the Ear is like that of the *Hare*.

It is remarkable that in *Quadrupeds* the *Necks* are commensurate to the *Legs* ; the equality in the length of their *Necks* and their *Legs* is moſt remarkably ſeen in Beaſts that feed conſtantly upon *Grass*. But that which is yet more ſurprizing, is, that in that ſort of Creatures which muſt needs hold their *Heads* down in  
an

an *inclining Posture* for a considerable while together, which would be very painful to the *Muscles*, on each side the Ridge of the *Vertebres* of the *Neck*, Nature hath placed an *ἀπορεύσιμος*, or *nervous Ligament*, very thick and strong, and apt to stretch, and shrink again, as need requires, and void of Sense, extending from the *Head* (to which and the next *Vertebres* of the *Neck* it is fastned at the end) to the middle *Vertebres* of the *Back* (to which it is knit at the other end) for the assisting of them to support the *Head* in that posture; it is by the *Vulgar* called *the Whitleather*.

Indeed this Proportion is not kept in the *Elephant*, he has a *short Neck*, the excessive Weight of his *Head* and his *Teeth* to a *long Neck* would have been unsupportable; but then his *Proboscis*! *Tully* takes notice, *Manus data Elephantis, quia propter Magnitudinem Corporis, difficiles aditus habebant ad Pastum*. He is provided with a *Trunk*, wherewith, as with an *Hand*, he takes up his *Food*, and his *Drink*, and brings it to his *Mouth*; a Member so admirably contrived, that *Mr. Derham* has just occasion to say, 'tis a manifest Instance of the *Creator's Workmanship*.

*Galen* observing the *Necks* of *Animals*, how accommodated to their feeding, is not able to forbear his *Acclamations* of an *Opus Artificis Utilitatis memoris*! He goes on with his *Contemplation*, and adds, as we cannot but also do, *Quo pacto non id etiam est admirandum!*

On the mention of the *Elephant*, we will introduce a particular *Curiosity* relating to him; he has no *Epiglottis*, because there is no danger of any thing falling into his *Lungs* from eating or drinking, seeing there is in him no *Communication* between the *Oesophagus* and the *Passage* into the *Lungs*; the *Passage* to the *Ventricle* is thro the *Tongue*, an *Hole* near the *Root* of it is the beginning of the *Oesophagus*, and the *Passage* of the *Air* into the *Mouth* is quite stopped up; however, he is not sufficiently secured from small *Animals*

mals that may creep in and murder him; a *Mouse* creeping up his *Proboscis*, might get into his *Lungs*, and so stifle him: guess now the reason why an *Elephant* is so afraid of a *Mouse*! To avoid this danger, when he sleeps he keeps his *Proboscis* close to the ground, that nothing but *Air* could get in. Mr. Ray celebrates this as a rare Sagacity!

The *Stomach* of *Quadrupeds*! How adapted to the various Food intended for it! One kind of *Stomach* in the *Carnivorous*, another in the *Herbaceous*!

The peculiar Contrivance on the *Stomach* of the *Camel* deserves our Pause upon it; the words of the *Parisian Anatomists* upon it, are, *At the top of the second of the four Ventracles there are several square Holes, which were the Orifices of about twenty Cavities, made like Sacks, placed between two Membranes, which do compose the Substance of this Ventricle; the view of these Sacks made us think that they might well be the Reservatories, where Pliny saith that Camels do a long time keep the Water, which they drink in great abundance, to supply the want thereof in the dry Desarts.*

In some of the *Quadrupeds* the *Stomach* is fitted for a *Digestion* upon bare *Mastication*; but in others there is a whole Set of *Stomachs*, to digest with the help of *Rumination*. Mr. *Derham* is very sensibly affected with the curious Artifice of Nature, here; but for the whole Business of *Rumination*, the learned *Peyerus* will give you a very affecting Entertainment in his *Merycologia, seu, de Ruminantibus & Ruminacione Commentarius*.

Dr. *Grew* observes, all *carnivorous Animals* have the *smallest Ventracles*, *Flesh* going farthest; those that feed on *Fruits* and *Roots* have them of a middle size; *Sheep* and *Oxen*, which feed on *Grass*, have the *greatest*; yet the *Horse*, tho' *graminivorous*, has comparatively but a little one, for that he is made for *Labour*: the same is to be said of the *Hare*, which is made for *Motion*, for which the most easy *Respiration* and the most free

free play of the *Diaphragm* is requisite, and that could not be if the *Stomach* were very big and cumbersome upon it.

There are *domestick Animals* which look up to me for their *Food*, sometimes for the *Crumbs* that fall from my *Table*; I will consider myself as doing the part of a *Steward* for the Glorious *G O D* in feeding them; it shall be done with an *holy Delight*, and with such an Inference drawn from it as this: *And will not the Glorious G O D graciously and readily grant the Mercy which I look up to Him to bestow upon me!*

The Food of the *Castor* is generally of *dry things*, and such as are hard of digestion; and now there is a wonderful provision made in the *Stomach* of that Creature, by a *digestive Juice*, lodg'd in the curious little Cells of it; the admirable Structure and Order thereof is described by *Blasius* out of *Wepfer*, and then he adds, *Nimirum quia Castoris alimentum ex succum & coctu difficilimum est, sapientissimus & summè admirandus in suis Operibus rerum Conditor, D. O. M. ipsi pulherrimâ istâ & affabrefactâ Structurâ benignissimè prospexit, ut nunquam deesset Fermentum, quod ad solvendum & comminuendum alimentum durum & asperum par foret.*

There is in the *Eye* of *Brutes* a *Periophthalmium*, or nictating Membrane, which the *Eye* of *Man* is a stranger to; the *Royal Academy* at *Paris* have been very curious and punctual in the description of it: their Opinion of it is, that this *Membrane* serves to clean the *Cornea*, and to hinder, that by *drying* it grow not less transparent. *Man* and the *Ape*, which are the only Animals wherein this Membrane is not found, have not wanted this provision for the cleansing of their Eyes, because they have *Hands*, with which they may, by rubbing their *Eyelids*, express the Humidity contain'd in them, which they let out thro the *Ductus Lachrymalis*; as is known by Experience, when the *Light* is darkned, or when the *Eyes* are pained, or  
itching,

itching, these Accidents do cease upon the rubbing of the Eyes.

In the *Heart of Quadrupeds* there is an excellent provision for the living of those Creatures.

The *Foramen Ovale* in some (that which in a *Fetus* makes the *Anastomosis*, by the means whereof the *Blood* goes from the *Cava* into the *Aorta*, without passing thro the Lungs) is an Accession to the Wonders.

This Passage between the *Arteria Venosa* and the *Vena Cava* is kept open in *Amphibious Quadrupeds*; this maintains a degree of Heat and Motion in the Blood, which may be sufficient for them while they are under Water.

The *Epiglottis* in such Creatures is also larger and stiffer than it is in others, that so when they are feeding under Water, the Water may not break in upon their Lungs.

I confess Mr. *Cheselden* is of the Opinion, that it is not the *Foramen Ovale*, but the *Ostium Venarum Coronariarum*, which being very near it, may easily be mistaken for it, that the Anatomists have made their curious Remark upon; however the provision is admirable!

The *Heart* in *Beasts* is near the middle of the whole Body, in *Man* it is nearer the *Head*; this *Aristotle* observes: but Mr. *Lower*, who has been a most curious Anatomist of this Part, gives us a reason for it; the Trajection and the Distribution of the *Blood* wholly depending on the *Systole* of the *Heart*, and so either the *Heart* must have been stronger in *Man*, or the *Head* would have wanted its due Proportion of *Blood*, if it had not been so near to the *Heart*; whereas in *Beasts*, whose *Heads* hang down, the *Blood* goes a plainer way, and often a steep one.

There are also peculiar *Nerves* reaching to the Heart of *Beasts*, besides the sixth Pair, as in *Man*, a Relief provided by Nature, lest their prone *Heads* might fail of imparting Animal Spirits copiously to it.

The

The *Cone* of the *Pericardium* in *Quadrupeds* is loose from the *Diaphragm*, whereas in *Man* it is fastened to it; thus the motion of the *Midriff*, in the necessary Act of *Respiration*, is notably assisted in the posture of both. Dr. *Tyson's* Remark upon it is, *This must needs be the Effect of Wisdom and Design*, and it is plain was intended in *Man* to walk upright, and not upon all four, like the *Quadrupeds*.

In the *Four-footed* there is not that Communication between the *Head* and the *Heart* which there is in a *Man*, especially by the Branches of the *intercostal Pair* of *Nerves*, which are sent from the *cervical Plexus* to the *Heart*, and the *Præcordia*, a thing which Mr. *Derham* cannot behold without calling it a *prodigious Care of Nature*; thus the *Head* and *Heart* of *Man* have a more *intimate Concern* with each other, and a greater and quicker Correspondence, than what is in other *Creatures*: *Brutes* are more simple *Machines*; but in *Man*, by the Commerce of the *cervical Plexus*, the Conceptions of the *Brain* presently affect the *Heart*, and agitate its *Vessels*, and the whole *Appendage* thereof, together with the *Diaphragm*; whence the Alteration in the motion of the *Blood*, the *Pulse*, and *Respiration*: and when any thing affects or alters the *Heart*, the Impressions are not only retorted by the same *Duct* of the *Nerves*, but also the *Blood* itself, with a changed *Course*, flies to the *Brain*, and there agitating the *Animal Spirits* with diverse *Impulses*, produces various Conceptions in the *Mind*. This is Dr. *Willis's* Observation; who adds, that the *Antients* therefore made the *Heart* the *Seat of Wisdom*; and certainly the Works of *Wisdom* and *Virtue* do very much depend upon the Commerce which is between the *Heart* and the *Brain*. This eminent Person dissecting a *Fool*, found, besides the *Smallness* of his *Brain*, the principal difference between him and a *Man* of *Sense* to be, that the *Nervi Intercostalis Plexus*, in hoc *Stulto valde exilis*, & *minorum Nervorum Satellitio sti-*

*patus fuerit.* The want of the *intercatal Commerce* with the *Heart* in Brutes, is truly an admirable thing! MAN, ponder upon this, and say, *Where is God my Maker, who teaches us more than the Beasts of the Earth!*

I cannot here forbear to introduce a good Observation of a Gentleman who writes *Christian Religious Appeal*, which he thus expresses; 'That God should endow us with *Reason*, and make us differ from the *Brutes*, only that we may rule *them*, and not *ourselves*, and put a *golden Nuttack* in our Hands, only to dig *Dunghills*; has not the least Congruity with the *Decorum* observed by Him in all His Works, which are framed in Weight, Number, and Order.'

*Lactantius*, do thou pass a Censure on the Men like the *Brutes* that perish, who do not from the *Beasts* learn the Being and the Glory of a GOD! *Illos qui nullum omnino Deum esse dixerunt, non modo non Philosophos, sed ne Homines quidem fuisse dixerim; qui mutis similimi, ex solo Corpore constiterunt, nihil videntes animo.* [lib. 7. c. 9.]

*Galen* gives us a notable Relation of a *Kid*, which he took alive out of the Belly of the Dam, and brought it up; the *Embrio* presently fell to walking, as if he had heard, says *Galen*, that *Legs* were given him for that purpose; then he smelt into all the things that were set in the Room, and refusing them all, only supped up the *Milk*: after two Months the tender Sprouts of *Shrubs* and *Plants* appeared, and then refusing the rest, he kept to those which are the peculiar Food of *Goats*. But that which to *Galen* appeared most admirable of all, was, that a while after it began to chew the *Cud*; whereupon says he, Θεασάμενοι πάντες ἀνεβόησαν ἐκπλάγυντες ἐπὶ ταῖς τῶν ζώων δυνάμεισι, All that saw cried out with Admiration, being astonished at the natural Faculties of Animals. He complains thereupon that many neglect such Works of Nature, and admire none but *Μόνα τὰ ξεῖα θεάματα*, unusual Spectacles. Mr. Ray notes, One may fill a Volume with Comments on this pleasant Story.

The Sagacity of some *Quadrupeds*, tho' so far short of *Man's*, yet is a matter of Astonishment to *Man*; and *Man's* will be short of *theirs*, if it see not the glorious GOD of Nature operating in it.

Indeed there was Humour enough in *Rorarius*, who upon hearing a learned Man prefer such a Wretch as *Frederick Barberossa*, before that great Emperor *Charles V.* was thereby so provoked, that he wrote his two Books to prove that *Beasts often have more Use of Reason than Men.* The Consequence of the *absurd Reasoning* he found among *Men* was this with him, *Itaque in Mentem mihi venit Animalia Bruta saepe Ratione uti melius Homine.* But the Consequence of his own *absurd Reasoning* will soon be found such as will carry thousands of *Terrors* with it.

It is enough that what of *Reason* appears in the *Brutal Tribes*, is an immediate Effect of the Providence exerted by the all-wise Creator, and applied for the Preservation of His Creatures. O Lord, thou preservest not only *Man*, but *Beast* also!

The Words of the excellent Sir *Richard Blackmore*, in his Essay on the *Immortality of the Soul*, are worthy to be transcribed and pondered on this Occasion. 'I must acknowledge that I look upon the *Souls of Brute* Creatures as *immaterial*, for I cannot conceive how an internal Principle of *sensitive Perception* and *local Motion* can be framed of *Matter*, tho' ever so subtle and refin'd, and modified with the most artful Contrivance; — yet they are plainly of a base and low Nature, and destitute of those *intellectual Faculties* and that *free Choice* that should make them Subjects of *Moral Governm<sup>n</sup>*, enable them to discern the Obligation of *Laws*, and the Distinction of *Virtue* and *Vice*, and understand the Notion of being an *accountable Creature*, and receiving *Rewards* and *Punishments*. — Whether the *Animal Souls* in a State of Separation remain *stupid* and *asleep*, or whether they are *dispersed* thro' the Creation, and employ'd to

‘animate *other Beings*, or return to *one common Element*, whence they were at first deriv’d, is unrevealed; but this is certain, the *Souls of Brutes* are not design’d by the Great Creator for such a Life of *Pleasure and Happiness*, as that of *Human Souls* in a State of *Immortality and Perfection*, for the Enjoyment of which they have no *Dispositions and Capacities*.’

The Opinion of *Descartes*, and *Gassendus*, and *Willis*, and others, That the *Soul of Brutes* is *material*, and the whole Animal a meer *Machine*, is clogg’d with insuperable Difficulties.

Our excellent *Ray* bespeaks a *lower degree of Reason* for them, and his Argument is fetch’d from some of their *Actions*, which, without allowing some *Argumentation* in them, can hardly be accounted for; he singles out the *Dog*, the *Dog* running before his Master, will stop at a divarication of the way, till he see which way his *Master* will take. Again, when the *Dog* has got a *Prey*, which he fears his Master will take from him, he runs away to hide it, and afterwards returns to it. Once more, if a *Dog* be to leap upon a *Table* which he sees too high for him to reach at once, let there be a *Stool* or *Chair* near it, he will first mount that, and so the *Table*, yea, tho the *Stool* stand so that the Creature takes not a *direct Leap* towards the place finally intended; if he were a meer Piece of *Clockwork*, and this Motion caused by the striking of a *Spring*, there can be no reason imagin’d why the *Spring* being set on work, should not carry the *Machine* in a *direct Line* towards the Object that put it in motion, as well when ’tis on an *high Table* as when ’tis on a *low*.

They that have written *de Canum Fidelitate & Sagacitate*, have entertained us with Stories full of Wonders. The Observers have thought themselves obliged sometimes to suspect that the *Dogs* might have a *Spirit of Python* in them. *Camerarius* in his *Horæ Subsestivæ* has collected surprizing, but credible Relations, of such as we may call *reasonable Dogs*.

A well-known King, who dealt much in them, at a famous *Aët* in one of our Universities, very publicly determin'd it, *that they could make Syllogisms*, and so 'tis no longer to be disputed. The Authority is as great as that of *Jacobus Micyllus*, who wrote an *Elegium Canis*, which is thought a very elegant Epigram.

There is a surprizing thing related of the *Sea-Tortoises*, both *Aristotle* and *Pliny* have remark'd it; That when *Tortoises* have been a long time upon the Water, during a Calm, their Shells will be so dried with the *Sun*, that they are easily taken by the Fishermen, because being become too light, they cannot plunge into the Water nimbly enough. The *French Academists* do not refer this easiness to be now taken, merely to the *Lightness* of the Creature's Body, for he could easily let *Air* enough out of the Lungs to render his Body heavier than the Water, upon which he would sink immediately, but to a *Sagacity* of the cautious Animal, which is truly marvellous. The *Tortoise* is always careful to keep himself in his *Equilibrium*, and therefore he dares not let the Air out of his Lungs, to acquire a Weight which would make him to sink immediately; for he fears lest the wetting of his Shell should render it so heavy, that being sunk to the bottom of the Water, he might never afterwards have the power of re-ascending. What *Forefight* here! What a degree of *Argumentation* too!

They that have written *de Solertia Animalium* (as many besides *Plutarch* have done) have reported such Essays and Shadows of *Reason* in many of them as are diverting.

The *Fox* is often catch'd in Tricks, which afford as pleasant Stories as any in that old Volume, *The delectable History of Reynard*. His way to get rid of his *Fleas* is notorious.

What notable *Architects* are our *Beyers*! They lay their *Logs*, and build their *Dams*, and form their *Chambers*, with a marvellous Artifice. A Nation of *Indians*

do sometimes in scarce any thing but their Speech out-man a Nation of *Beyers*.

*Elephants*, what *reasonable*, but what *prodigious* things have been related of them! Things that almost have *Religion* in them. The Story of *Hanno* is an amazing one, *Pierius* is our Author for it. Well may I write of them that have themselves been so susceptible of Discipline as to write whole Sentences; 'tis affirm'd that *Elephants* have done so. *Alsted* spends two whole Pages together, in his concise way, enumerating but the Heads of the *strange things* which this tractable, and almost *rational* Quadruped arrives to!

What a notable, docible, tractable Animal the *Horse*! The *Horse*, of whom the admirable *Buchanan* sings,

— *Equus ad cunctos se accommodat usus.*

Read *Solinus*, and see what Approaches the *Horse* makes to *Reason*! One would question which had most, *Caligula* or *Incitatus*. Dr. *Grew* admires him, as being *swift* and *strong*, above most other Animals, and yet strangely *obedient*; both comely and clean; he breeds no *Vermin* of any sort; his Breath, his Foam, his Excrements and Sweat, all sweet and useful; fitted every way for Service or Pleasure, for the meanest or the greatest Master. There are antient Examples of other *Horses* besides *Bucephalus* and *Lethargus*, that have been honour'd with stately *Funerals* and *Sepulchres* at their *Deaths*, as well as their Masters; yea, tho' the Epitaph of *Adrian* be lost, his *Horse's* is preserved to this day. The *Riders* of *Horses*, who in their *Lives* will submit to no *Bridles*, nor do any *Service* for Him that made them, deserve at their *Deaths* to pass away no better esteem'd than their *Horses*, but will have a worse Fate than they. The Gentleman, who going home with his Head full of the *sickly Fumes* from the *Heaths* of the Evening's Debauch, could not compel his *Horse* to drink an *Health* which at the next Brook he

he proposed to him, had so much *Reason* left him (and a very little might serve) as to make that Reflection, *That the Man in the Saddle was the greater Beast of the two.*

How innumerable are the *Appearances* of Nature, which are above the Powers of *Mechanism*? 'Tis religiously and most reasonably observed by Dr. *Cleyne*, that all these are so many undeniable Proofs for the Being of a GOD; there must be a *Power superior* to those of *Mechanism*, and this must lead us to Him, *who alone does great and marvellous things.*

*How often have I heard this, and how plainly seen it; this Power belongeth to God!*

After all, do we see something in these, and other, and all *Creatures*, that appears *defective* to us? A wise Remark made by the Marquis of *Pianezza* shall be introduced upon it; his remarkable words are these:

'The *limited Perfections*, and the seeming *Irregularities* of the World, rather afford us occasion to acknowledge and glorify the *Providence* of GOD, which not only declares, that all the *Creatures* are too *imperfect* to deserve to be worshipped as *Deities*, but also amidst their *Imperfections* obliges them to confess, as it were with their own Mouths, *one infinitely perfect Deity*; a *Deity* that would not have *Man* fix on them as the Objects of his Love and Admiration, but that from them he should pass on to the Love and Esteem of his only true GOD.'

There is one very surprizing thing, and without acknowledging a Superintendency of a *Divine Providence* there can be no accounting for it. The *Mansuete Creatures* bring forth no more than one or two at a time, the *Beasts of Prey* bring forth as often, and seven, or nine, or eleven at a Litter; and yet! what inexpressible Multitudes of the *Mansuete* have we to serve us! What vast Herds of *Beeves*! What vast Flocks of *Sheep*! Whereas they that live upon *Prey* appear in very little Numbers. How rarely is a *Wolf* met withal,

tho a Price be set upon his Head! What Rarities are *Lions*, and *Tigers*, and *Ounces*! To be caged in the *Tower* for *Spectacles*!

And then the Liberty given us to *butcher* our useful Creatures at our pleasure; 'tis observed by Mr. *Robinson*, that this will be found a *Kindness*, rather than a *Cruelty* to the Creatures; if we kill them for our *Food*, their *Dispatch* is quick, and much less dolorous, than that they should be torn to pieces by such cruel Masters as the *Lion*, and the *Tyger*, and *Bear*, who would not give them time to *die*, but even eat their *Flesh* from their *Bones* *alive*; and if they should live to the tedious Condition and Melancholy of *Old Age*, it would, after many *Tortures*, kill them, and leave their *Carcases* rotting, stinking, and useless upon the ground.

The *short Life* of a *Beast*, compared with the *Life* of *Man*, deserves to have some Remark made upon it; this at least: *Man*, do not lead the *Life* of a *Beast*, if thou wouldst not be condemned and confined to the *short Life* of a *Beast*, nor come under the Execution of that Sentence, *The Days of the Wicked shall be shortened*. There is a way of *living*, by some called *living apace*; it is indeed not *living* at all, but rather *dying apace*; a *beastly* Life ought to be a *shortned* one.

What useful *Instructions* would the Properties of the several *Animals* yield to the *Christian Philosopher*, would he be duly and wisely attentive to them! *Franzius*, and *Simpson*, and others, have cultivated this Theme, not unusefully; 'tis capable of a much more vast Cultivation: *Christian*, hearken to the Voice of the many *Preachers* thou hast about thee, lest thou *mourn at the last*, and say, *I have not obeyed the Voice of my Teachers, nor inclined mine Ear to them that instructed me!*

I remember one Observation of *Seneca*, which a little exemplifies a *moral Remark* on the Properties of some *Four-footed*; *Omnia quæ Naturâ fera ac rabida sunt, consternantur ad Vana. Idem inquietis & stolidis Ingeniis evenit,*

*evenit, rerum suspicione feriuntur.* ----- I thought this worth mentioning, but not because I do not think a *Christian* of a good *Understanding* might easily produce ten thousand more.

The Account which honest *Leguat* gives of the *solitary Bird*, which he and his Companions observed on the Isle of *Rodrigo*, is as admirable as unquestionable; the *Bird* has *Wings*, but so small that it cannot fly with them, they serve to flutter with a mighty noise when they call one another; they never lay but *one Egg*, which is bigger than that of a *Goose*; the *Male* and *Female* sit upon it in their turns, and all the while they are hatching it, or bringing it to provide for itself, (which is divers Months) they will not suffer any other Bird of their own Species to come within two hundred Yards round of the place: but this is very singular, the *Males* will never drive away the approaching *Females*, but call for their own *Females* to do it; the *Female* does the like, and upon the Approach of any other *Males*, call their own *Males* to chase them away. After these *Birds* have raised their *young one*, and left it to itself, 'we have often observed (says my ingenious Traveller) that some days after the *young one* leaves the *Nest*, a Company of thirty or forty brings another *young one* to it, and the new-fledg'd Bird, with its Father and Mother joining with the Band, march to some by-place; we frequently followed them, and found that afterwards the old ones went each their way alone, or in couples, and left the two *young ones* together, which we call'd a *Marriage*.' My religious Traveller does give all possible Assurance for the Truth of this Relation, and adds, *I could not forbear to entertain my Mind with several Reflections on this Occasion. I sent Mankind to learn of the Beasts.*

It is an Observation made by one of the most refin'd Philosophers by whom our Age has been illuminated; 'Most Creatures have some *Quality*, whereby they admonish

‘ admonish us of what is BEST. Of *Neatness*, all  
 ‘ *Birds* which love to be perpetually pruning of them-  
 ‘ selves; and *Cats*, which commonly cover their Ex-  
 ‘ crements, and wipe their *Mouths* after Dinner. Foul  
 ‘ Water will breed the Pip in *Hens*, and Nastiness  
 ‘ Lice and Scabs in *Kine*; and all Creatures, even  
 ‘ *Swine* themselves, which love Dirt, yet thrive best  
 ‘ when kept clean. Of *Forecast*, the *Sitta* and the *Ant*,  
 ‘ which lay up Nuts and other Seeds in their Grana-  
 ‘ ries, that serve them in the Winter. Of *Modesty*,  
 ‘ the *Elephants*, the *Dromedaries*, and the *Deer*, which  
 ‘ always conceal their Venereal Acts. Of *mature*  
 ‘ *Marriage*, all Animals which beget their best Breed  
 ‘ at their full Growth. Of *Conjugal Chastity*, the *Doves*  
 ‘ and *Partridges*, which keep to one Husband and  
 ‘ Wife. Of *Conjugal Love*, the *Rook*, the Male help-  
 ‘ ing the Female to make her Nest, feeding her while  
 ‘ she sits, and often sitting in his turn. Of *Maternal*  
 ‘ *Love*, the domestick *Hen*, gentle by Nature, and un-  
 ‘ armed, yet, in defence of her Chickens, bold and  
 ‘ fierce; and the *Tyger* herself, the fiercest of Beasts,  
 ‘ yet is infinitely fond of her Whelps.’

The same excellent *Fellow of the ROYAL SOCIETY*  
 carries on his Observation; ‘The most odious or nox-  
 ‘ ious things do serve for Food or Physick, or some  
 ‘ Manufacture, or other good use; neither are they  
 ‘ of less use to *amend our Minds*, by teaching us *Cave*,  
 ‘ and *Diligence*, and more *Wit*: and so much the more,  
 ‘ the worse the things are, we see and should avoid.  
 ‘ *Weasels*, and *Kites*, and other mischievous Animals,  
 ‘ induce us to Watchfulness; *Thistles* and *Moles* to  
 ‘ good Husbandry; *Lice* oblige us to *Cleanliness* in our  
 ‘ Bodies, *Spiders* in our Houses, and the *Moth* in our  
 ‘ *Clothes*: the Deformity and Filthiness of *Swine* makes  
 ‘ them the *Beauty-spot* of the Animal Creation, and  
 ‘ the Emblem of all *Vice*; and the *Obscenity* of *Dogs*  
 ‘ shews how much more beastly it is in *Men*: the *Fox*  
 ‘ teaches us to beware of the *Thief*, and the *Vipers* and  
 ‘ *Scorpions*

‘ *Scorpions* those more noxious Creatures, which carry their Venom in their *Tongues* or their *Tails*.’

I will prosecute this Observation of my Brother, with only observing so much further upon it; that no little part of the *Homage* we owe to the glorious Creator of all these things, is to learn those *Virtues*, and those *decent* and *best* things, whereof, if the Faculties of our Minds be awake, we shall easily perceive His *Creatures* to be the *Monitors*.

In writing these things I cannot but call to mind the expressive Words of *Theodorus Gaza*, in his Preface to *Aristotle’s* Books *de Animalibus*; *In contemplantis Animalium Moribus, Exempla suppetunt omnium Officiorum, & Effigies offeruntur Virtutum summa cum Authoritate Naturæ, omnium Parentis, non simulatæ, non inconstantes, sed verè ingenuæ atque perpetuæ.* He goes on to shew how powerfully the Kindness of the Brutes to those of their own Kind, rebukes the *unbrotherly Carriage* too often found in Mankind; and adds a variety of Admonitions, which, *my Reader*, thou art not unable to discover by thy own Ingenuity.

¶. ‘ One of the most valuable Writers that ever was in the World, brings from the glorious Creator of the *Beasts* this Voice to Man; *Sic utere illis, ut Exempla Virtutum quæ in illis apparent, observes, & omnibus Viribus coneris illa longo intervallo superare, ut ne Bestialem Animam reperiam in tuo Corpore Humano.*’

‘ It would not be a *Fancy* destitute of *Judgment*, if I should set before me the *Tabella Hieroglyphica*, wherewith *Alsted* has obliged us.’

‘ But of all the Tribes that graze in the Field, there is none that I would more chuse for an *Emblem* than the *Sheep*; the clean, patient, innocent Creature, which has nothing belonging to it but what is of a celebrated *Usefulness*. *O thou most honorable Creature, what a Dignity has the Son of God Himself put upon thee!*’

‘ I see so much of GOD in the Circumstances of  
 ‘ the *Brutal Tribes*, as obliges me to *look upwards* in a  
 ‘ way too high for them.’

‘ At the same time, tho I would by no means fall  
 ‘ into *Pythagorean* and *Mahometan* Superstitions, yet I  
 ‘ would abhor to treat any of the *Brutes* with bar-  
 ‘ barous Cruelties, *Immanities* and *Inhumanities*; cruelly  
 ‘ to delight in their *Miseries*, or to be *unmerciful* to  
 ‘ them, is an Offence to God, and what a *righteous*  
 ‘ *Man* would not be guilty of; *unknown Punishments*  
 ‘ may be reserved for it.’

‘ *Great GOD*, if I do not acknowledge Thee, I am con-  
 ‘ demned by the *Ox*, which knows his Owner, and by the  
 ‘ *Ass*, which knows his Master’s Crib!’

Luther seeing the *Cattel* go in the Fields, used this  
 Expression; *Behold, there go our Preachers, our Milk-*  
*bearers, and Wool-bearers, which daily preach to us Faith*  
*towards GOD, that we trust in Him as our loving Father,*  
*who will maintain and nourish us.*

It is very certain our *Dominion* over the *Creatures*  
 is very much impair’d by our Fall from God. Those  
*Creatures* do now either *fly from us*, or *fly at us*, which,  
 if we had been faithful to our God, would not have  
 done so. Honest *Egardus* propounds two *Admonitions*  
 of *Piety* on these Occasions; the one, *Fuga Animalium*  
*à te, moneat te de tua fuga à Deo per peccatum.* The  
 other, *Animalium in te ad ladendum impetus hostilis, mo-*  
*neat te de Odio & Furore Diaboli, & Mundi, adversus te*  
*immani.*

I conclude with an Observation of *Dr. Grew’s*;  
 ‘ As the *Essence* of every thing, and its relation, in be-  
 ‘ ing fitted, beyond any Emendation, for its *Actions*  
 ‘ and *Uses*, evidently proceeds from a Mind of the  
 ‘ *highest Understanding*, so the nature of these *Actions*  
 ‘ and *Uses*, in as much as they are not any way de-  
 ‘ structive or troublesome; no, but each thing tends  
 ‘ apart, and all conspire together to conserve, cherish,  
 ‘ and gratify: this is an Evidence of their proceeding  
 ‘ from

‘ from the *greatest Goodness*. There are many who are  
‘ very *cunning* and *subtile* in the Invention of *Evil*, and  
‘ *Engines* have been fitted, with much Contrivance, for  
‘ the tormenting of Men; how easy had it been for  
‘ the Creator of the Universe to have stock’d it with  
‘ Creatures that should never have moved so much as  
‘ one Limb without *Pain*, or have had the least Sensa-  
‘ tion without a mixture of horrible *Torment*, or have  
‘ entertain’d the least Imagination, but what should  
‘ have had *Horror* in it? But behold, our good God  
‘ has ordered it, that whatever is *natural* is *delightful*,  
‘ and has a tendency to Good; He has employ’d His  
‘ transcendent *Wisdom* and *Power*, that He might  
‘ make way for His *Benignity*.’

*Great G O D, Thou art Good, and Thou dost Good; Oh  
teach me Thy Statutes!* So sings the Poet:

*O Deus, O Mundi solus qui flectis habenas,  
Ut tua nunc Bonitas oculis est obvia cunctis!*

## ESSAY XXXII. Of M A N.

**A**ND now let the *Lord of this lower World* be in-  
troduced, M A N, who is to do the Part of a  
*Priest* for the rest of the Creation, and offer up to God  
the *Praises* which are owing from and for them all.

*In Libro Creaturarum continetur Homo* (as one of the  
School-Divines happens to express it well) *Et est prin-  
cipalior Litera ipsius Libri.*

It was most reasonably done of thee, Father *Austin*,  
to tax the Folly of them who admired the *Wonders* in  
the other Parts of the Creation abroad, *Et relinquunt  
seipfos, nec mirantur*, but see nothing in *themselves* to be  
*wondred* at. It is not for nothing that *Mankind* is in  
the *Gospel* called *every Creature*; he that beholds *Man*,  
may therein behold what is most wonderful in *every  
Creature*.

It is well express'd in a Treatise entitled, *Schola & Scala Naturæ!* 'Nature doth not lead thee towards  
' GOD by a far-fetch'd and winding Compass, but  
' in a short and strait Line. The *Sun* waits upon the  
' *Rain*, the *Rain* upon the *Grass*, the *Grass* serves the  
' *Cattel*, the *Cattel* serve thee, and if thou serve GOD,  
' then thou makest good the highest Link in that gol-  
' den Chain, whereby *Heaven* is joined to *Earth*; then  
' thou standest where thou oughtest to stand, in the  
' uppermost Round of the *Divine Ladder*, next to the  
' most High; then thou approvest thyself to be indeed  
' what thou wert designed by God to be, the High-  
' Priest and Orator of the *Universe*; because thou alone,  
' amongst all the Creatures here below, art endued  
' with Understanding to know Him, and Speech to  
' express thy Knowledge of Him, in thy Praises and  
' Prayers to Him.'

I may now say with honest *Stigelius*,

*Jam vocat ad pulchros nos Fabrica Corporis Artus,  
Quæ mira Authorem monstrat in Arte Deum.*

The BODY of MAN being most obvious to our view, is that which we will first begin with; a Machine of a most astonishing Workmanship and Contrivance! My God, I will praise Thee, for I am strangely and wonderfully made!

' But is it possible for me to consider this BODY as  
' any other than a Temple of GOD! A *Vitruvius*  
' will teach us that the most exquisite and accurate  
' Figure for a Temple will be found in a Conformity to  
' an *Human Body*; indeed an *Human Body* ought for  
' ever to be beheld and employed, as designed for an  
' holy Temple; for me to apply any Part of such a Body  
' to any Action forbidden by God, would be a very  
' criminal Prostitution.'

' By using my Body in and for the Service of God,  
' and by praising the Glorious-One, who has formed  
' every

every Part of my Body, and clothed me with Skin and Flesh, and fenced me with Bones and Sinews, I desire to assure my share in an happy Resurrection of this Body from the Grave, into which it is falling: for tho a Man die, he is to live again; an appointed Time will come, when Thou, O my God, wilt call, and I shall answer thee, and thou wilt have a desire to see the Work of thine Hands revived and restored.'

The erect Posture of Man, the *Os sublime*, how commodious for a rational Creature, who must have Dominion over those which are not so, and must invent and practise things useful and curious! Tully admires the Providence of Nature, as he calls it, adding the reason for it; *Sunt enim è Terra Homines, non ut Incolæ atque Habitatores, sed quasi Spectatores superarum rerum, atque Cœlestium, quarum Spectaculum ad nullum aliud Genus Animantium pertinet.* By this posture Man has the use of his Hands, which, as Galen observes, are, *Organa sapienti Animali convenientia*; and his Eyes, which as they have the glorious Hemisphere of the Heavens above him, so they have the Horizon of three Miles on a perfect Globe about them, when they are six Foot high, and by the Refractions of the Atmosphere they have much more than so: his Head is also sustained, which is heavy, and how painful to be carried in another Posture!

The provision made for this Posture is very surprizing; what Ligaments? especially that of the Pericardium to the Diaphragm, which, as Vesalius and Blancardius note, is peculiar to Man? The Bones, how artificially placed and braced? Most remarkably the Vertebrae of the Back-bone? The Feet, how exquisitely accommodated! For the rare Mechanism whereof, a Cheselden may be consulted; yea, every Writer of Anatomy will offer enough to trample Atheism under foot. To all add the Ministry of the Muscles, which answer all Motions, and yet with easy and ready Touches, keeping the Line of Innixion and the Center of Gravity where

where it ought to be! Yea, all the Parts of the Body so disposed as to *poise* it! All in a nice *Equipoise*! With a prodigious variety of *Muscles* placed throughout the Body for the Service! *Borelli* observes, 'tis 'worthy of Admiration, that in so great a variety of ' *Motions* Nature's Law of *Equilibration* should always ' be observed; so that if it be transgressed or neglect- ' ed, the Body necessarily and immediately tumbles ' down.'

Every thing does conspire to assure us, that the Maker of Man intended Man for such a *Posture*.

The most indigent Condition wherein *Man* is born into the World, but the plentiful Provision which he finds made by a gracious and merciful God for him in the World, this invites *Man* to return to God, and to taste His *Love*, in all the Creatures that accommodate him, and rely upon His *Care* for ever, for the Supply of all his Wants. And, as Mr. *Arndt* expresses it, *Homo Dei Amorem in omnibus rebus eo intimius degustaret, in caducis Creaturis Deum immortalem inveniens disceret, quod immortalis Deus melius possit exhilarare, consolari, corroborare, ac conservare hominem, quam omnes omnino Creatura fluxa & cito peritura.*

A Comparison between the *Macrocosm* and the *Microcosm* would afford a very edifying and acceptable Entertainment to a contemplative Mind; the excellent *Alsted* will therewith entertain the Gentlemen that will visit his *Theologia Naturalis*.

Indeed he that speaks to *MAN*, speaks to every *Creature*; and *Man* is therefore the more concerned, as well as capable to hear every *Creature* speaking to him.

'Tis what calls for a deep Consideration with us, that in the *Body* of *Man* there is nothing deficient, nothing superfluous, an *End* and *Use* for every thing. *Natura non abundat in superfluis, nec deficit in necessariis.* There is no Part that we can well spare, nor any that can say to the rest, *I have no need of you!* The *Belly* and the *Members* cannot quarrel with one another. Even the

the *Paps* in Men, besides their adorning of the *Breast*, and their defending of the *Heart*, sometimes contain *Milk*, as in a *Danish* Family mention'd by *Bartholinus*. A Man mention'd by *Beccone*, upon the Death of his Wife, suckled the Infant himself. He concludes, that since, according to *Malpighius* and others, the *Paps* of Men have the same Vessels with those of Women, 'tis intended that, if need requires, the *Young* should be suckled at them, who, upon a little pulling, soon fetch *Milk* into them.

What should we do with a *Bavarian Poke* under our Chins?

Our pious *Ray* makes this Remark, That if we consider no more than the very *Nails* at our Fingers ends, we must be very *sottish* if we can conceive that any other than an infinitely good and wise God was our Author and Former. And there was an honourable Person who long before him said, *An non videmus in singulis summis Digitis, Artificium Dei? Estne unguis aliquis qui non reddat Testimonium Deum esse Opificem eximium?*

No sign of *Chance* in the whole Structure of our Body. It is remarkable, in Bodies of different Animals there is an *Agreement of the Parts*, as far as their *Occasions* and *Offices* agree; but a *difference* of those where there is a *difference* of these. *Dr. Dowglass* will tell you what *Muscles* are in a *Man* that are not in a *Dog*, what in a *Dog* that are not in a *Man*. The Matter, the Texture, the Figure, the Strength, with the necessary Accoutrements of every Part, how amazingly commodious! How often does the *Ars, Providentia, & Sapientia CONDITORIS*, appear to the Pagan *Galen* upon the Contemplation!

In the *Body* of *Man* the *Lodgment* of the Parts is as admirable as the *Parts* themselves. Where could the *Eye*, the *Ear*, the *Tongue*, be so commodiously placed as in the upper Apartments assigned for them? *Tully* says truly, *Mirifice ad usus necessarios collocati sunt!* And for the other Parts, he notes, *Rectè in illis Corporum par-*

*tibus collocata sunt.* Four of the *five Senses*, how commodiously lodged, near the *Brain*, the common Sensory, and a place well guarded; *Galen* celebrated this wondrously agreeable Situation! And how could the *fifth Sense*, that of the *Touch*, be more agreeably lodged, than with a Dispersion into all Parts of the Body! Where should the *Hand*, the *Feet*, the *Legs* be, but just where they are! Where the *Heart*, the *Sol Microcosmi*, which is to labour about the whole Mass of Blood, but in the *Center* of the Body? Where can the *Viscera* discharge their Offices better, than in the place assigned to them? Where could the *Bones* and the *Muscles* be better disposed of? And what better *Covering* were it possible for the whole Body to have, than the *Skin*; whereof the *Microscopical Views* given by *Cowper* in his *Anatomy*, must give a vast Surprize to us!

What can be more *ornamental*, than that those Members which are *Pairs*, do stand by one another in an *equal Altitude*.

The Provision made in the Body of Man to *save off Evils*, is very admirable. The *Secretions* made by the *Glands*, whereof *Cockburn*, *Keil*, *Moreland*, and others, give us notable Accounts, are such as cannot be considered without some Amazement. How many Parts of the Body stand ready to do what belongs to faithful *Centinels*! The principal and more essential Instruments of Life and Sense, how well *barricado'd* are they? Of how many Parts are we supplied with *Pairs*, to make up a Defect which may happen in any of them? The *Pairs* of *Nerves*, and the Ramifications of the *Veins* and *Arteries* in the fleshy Parts, what *Cases of Disaster* are answered in them? *Mr. Derham* here justly adores the *infinite Contriver*! *Dr. Sloane* justly admires the Contrivance of our *Blood*, which on some Occasions, as soon as any thing destructive to the Constitution of it comes into it, immediately by an *intestine Commotion* endeavours to thrust it forth, and so

'tis not only freed from the new Guest, but sometimes what likewise might long have lain lurking there.

What *Emunctories* has the Body, and what surprizing *Passages*, to carry off Mischiefs, which we foolishly bring upon our selves! And how astonishing the *Methods* and *Efforts* of *Nature* to set all things to rights. *Valsalva* discovered *Passages* into the Region of the *Ear-drum*, which are of mighty use to discharge morbid Matter from the *Head*. *Hippocrates* in his Book *de Alimentis* makes his Remarks upon the *Sagacity* of *Nature*, to find out *Passages* for the discharging of things offensive to the Body; and indeed they who confess no Wonders in it, are *Hippocraticis Vinculis alligandi*. Modern Stories of what *Nature* has done for this, occurring in the *German Ephemerides*, and elsewhere, would scarce be credible, were not the Fidelity of the Relators unreprouchable. *Dr. Grew* bestows his just Remarks upon it, that in most *Wounds*, if kept clean and from the *Air*, the *Flesh* will glue together with a *native Balm* of its own; and that *broken Bones* are cemented with a *Callus*, which they themselves help to make: yea, *Diseases* themselves are not useless, for the *Blood* in a *Fever*, if well govern'd, like *Wine* upon the *fret*, will discharge itself of all heterogeneous Mixtures. But the Philosopher last quoted observes, *Nothing can be more admirable than the many ways Nature hath provided for preventing or curing of Fevers*. Yea, *Mr. Boyle* and others have entertained us with surprizing Relations, how the Senses of *Seeing* and *Hearing* have been restored and strangely quickned by *acute Fevers* befalling those that wanted them.

The *Harmony* and *Sympathy* between the Members of the Body, made by the Commerce of the *Nerves*, and their most curious *Ramifications* thro the whole Body, is, as *Mr. Derham* observes, a most *admirable thing*, and such as greatly sets forth the Wisdom and Benignity of the Great Creator; to see how *God hath so tempered the Body together, that the Members should have*

*the same care one for another, and if one Member suffer, all the Members suffer with it!*

One Instance is by Mr. *Derham* singled out; there is one *Conjugation of the Nerves*, which is branched into the *Ball*, and the *Muscles*, and the *Glands* of the *Eye*; to the *Ear*, to the *Jaws*, and the *Gums*, and the *Teeth*; to the *Muscles* of the *Lips*, to the *Tonsils*, the *Palate*, the *Tongue*, and the Parts of the *Mouth*; to the *Præcordia* too; and lastly, to the *Muscles* of the *Face*, and very particularly those of the *Cheeks*. Hence 'tis that a *gustable* thing, seen or smelt, excites the *Appetite*, and affects the *Glands* and Parts of the *Mouth*. A *shameful* thing seen or heard affects the *Cheeks*. If the *Fancy* be pleased, the *Præcordia* are affected, and the *Muscles* of the *Mouth* and *Face* are put into the *Motions* of *Laughter*. When *Sadness* is caused, it exerts itself upon the *Præcordia*, and the *Glands* of the *Eyes* emit their *Tears*; wherein also, as was long since noted, *Fletus ærumnas levat*, and the *Muscles* of the *Face* put on a *sorrowful Aspect*. Hence also the *torvous Look*, produced by *Anger* and *Hatred*; and a *gay Countenance* accompanies *Love*, and *Hope*, and *Joy*. Finally, hence 'tis that, as *Pliny* notes, the *Face* in *Man* alone is the *Index of all the Passions*.

It is an inexplicable *Sympathy* which there is between the *Diseases* of the *Belly* and those of the *Skin*; whence very stubborn *Diarrhæa's* cured by *Diaphoreticks*.

What a *Sympathy* between the *Fect* and the *Bowels*! The *Priests* walking *barefoot* on the *Pavement* of the *Temple*, were often afflicted, as the *Talmuds* tell us, with *Diseases* in their *Bowels*. The *Physician* of the *Temple* was called a *Bowel-Doctor*. *Belly-achs* occasion'd by walking on a cold *Floor*, are cured by applying *hot Bricks* to the *Soles* of the *Feet*.

A glorious *Providence* of *God* is to be seen in three remarkable *Dissimilitudes* between *Men* and *Men*, *Faces*, *Voices*, and *Writings*.

First,

First, Such is the variety of Lineaments in the *Faces* of Men, that tho *Valerius Maximus*, and some others, gives us Examples of Men that have been very like one another, yet there are no *two Faces* in all things alike. Had Nature been a blind Architect (as our curious *Ray* well observes) the *Faces* of several Men might have been as like as *Eggs* laid by the same Hen, or *Bullets* cast in one Mould. It was one of *Pliny's* Wonders, *In Facie Vultuque nostro, cum sint decem aut paulo plura membra, nullas duas in tot milibus Hominum indiscretas Effigies existere.* Now, as my modern and better *Pliny* proceeds upon it, 'should there be an indiscernible Similitude between *divers Men*, what Confusion and Disturbance would necessarily follow? What *Uncertainty* in all Conveyances, Bargains and Contracts? What *Frauds* and *Cheats*, and suborning of *Witnesses*? What a Subversion of all *Trade* and *Commerce*? What Hazard in all *judicial Proceedings*? In Assaults and Batteries, in Murders and Assassinations, in Thefts and Robberies, what *Security* would there be to Malefactors? How many other Inconveniencies?'

Secondly, The *Voices* of Men differ too; not only *divers Countries* pronounce in ways peculiar to themselves, but in the same Country how many *Dialects*? *Britain* as well as *Greece* exemplifies this variety; thus *Gileadites* can discover *Ephraimites*. *A-Lapide* tells us how the *Flemings* discover a *Frenchman*; and *Fuller*, what way they took in *England* long since to discover a *Dutchman*: yea, some have demonstrated that *Voices* do distinguish *Individuals* as much as *Faces*, and in some Cases more; for this way the Discovery is made in the *Dark*, and by the *Blind* also.

Thirdly, *Dr. Cockburn* shall supply us with one *Dissimilitude* more: 'To no other Cause than the wise Providence of God can be referr'd the no less strange variety of *Hand-writings*.. Common Experience shews, that tho *Hundreds* and *Thousands* were taught by

‘ one Master, and one and the same Form of Writing,  
 ‘ yet they all *write differently*; there is something *pe-*  
 ‘ *culiar* in every one’s *Writing*, which distinguishes it;  
 ‘ some indeed can counterfeit another’s Character and  
 ‘ Subscription, but the Instances are rare, nor is it  
 ‘ done without Pains and Trouble: nay, the most  
 ‘ Expert and Skilful cannot *write much* so exactly like,  
 ‘ that it cannot be known whether it be genuine or  
 ‘ counterfeit; and if the Providence of God did not  
 ‘ so order it, what Cheats and Forgeries too would  
 ‘ be daily committed, which would run all into Con-  
 ‘ fusion? The diversity of *Hand-writing* is of mighty  
 ‘ great Use to the Peace of the World; and what is  
 ‘ so very useful is not the Effect of any Human Con-  
 ‘ cert; Men did not of themselves agree to it, they  
 ‘ are only carried to it by the secret Providence of  
 ‘ God.’

*My God, let me never do any thing that may be to the  
 Damage of that which thou proclaimest thyself so very tender  
 of! HUMAN SOCIETY, Mankind associated.*

The *Variety* of the *Parts* whereof the Body is com-  
 posed cannot but oblige our Admiration, cannot but  
 compel our admiring Souls to acknowledge our glo-  
 rious Maker!

The *Bones* in a Skeleton are two hundred and  
 forty-five, besides the *Ossa Sesamoidæa*, which are for-  
 ty-eight.

The *Muscles* of the Body are four hundred and  
 forty-six.

The *Nerves* which come immediately out of the  
 Skull, from the *Medulla oblongata*, are ten Pair.

The *Nerves* which come out between the *Vertebra*  
 are thirty Pair.

The *Scarf-skin* examin’d with a Microscope, ap-  
 pears made up of Lays of exceeding small *Scales*, which  
 cover one another more or less, according to the dif-  
 ferent Thickness of the *Scarf-skin* in the several Parts  
 of the Body; but in the Lips they only in a manner  
 touch

touch one another. *Leuenhoeck* reckons that in one *cuticular Scale* there may be five hundred *excretory Channels*, and that one Grain of *Sand* will cover two hundred and fifty Scales; wherefore one Grain of *Sand* will cover one hundred and twenty-five thousand *Orifices*, thro which we are *daily perspiring*. What a prodigious number of *Glands* must there now be on the Surface of the whole Body! Into every one of these *Glands* there enters an *Artery*, a *Vein*, and a *Nerve*. How many *Organs* now in all the Body!

Look upon thy *Skin*, O Man, and say, *Great God*, how wondrously hast thou clothed me!

*Daily perspiring*, I said. The Sum of all the Particles that are strained thro the *cuticular Glands*, is reckon'd by *Sanctorius* to amount to about *fifty Ounces* in a day; so that supposing a Man's Body to weigh *one hundred and sixty Pounds*, in *fifty one Days* a Quantity equal to the whole Body is perspired. The *Medicina Statica* will multiply the Calls to us to glorify the God who so upholds our Souls in Life.

But then the *multitude* of *Intentions* which our Creator has in the Formation of our several Parts, and the *Qualifications* they require to fit them for their various Uses, this also calls for our Wonders. *Dr. Wilkins* takes notice of it, that according to *Galen* there are in an Human Body above six hundred several *Muscles*, and there are no less than ten several Intentions to be observed in each of these; about the *Muscles* alone there are at least six thousand several Ends or Aims to be attended to. They reckon the *Bones* to be two hundred and eighty-four, the distinct Intentions of each of these are no fewer than forty; the whole Number of Scopes for the *Bones* arise to an hundred thousand: thus it is in proportion with all the other Parts, the *Skin*, *Ligaments*, *Vessels*, *Glandules*, *Humours*, but more peculiarly with the several Members of the Body, which do in regard of the *multitude* of Intentions or Qualifications required to

them, very much exceed the *homogeneous* Parts; a failing in any one of these would cause an Irregularity in the Body, and in many of them, as the Doctor notes, it would be such as would be very notorious. *My Friend*, contemplate the Figures of *Spigelius*, and *Bidloe*, and *Lyserus*, if thou canst without Astonishment! Who can behold a Machine composed of so many Parts, to the right Form, and Order, and Motion whereof there are such an infinite number of Intentions required, without crying out, *Who can be compared to the Lord!*

The *variety of Offices* which sometimes *one Part* performs, will here come into Consideration. Thus the *Tongue*, it serves not only for *tasting*, but also for the *Mastication* and the *Deglutition* of our Food; and then for the Formation of our Words in *speaking*, the use of it is admirable! The *Diaphragm*, with the Muscles of the *Abdomen*, are of use, not only in *Respiration*, but also for the compression of the *Intestines*, that the *Chyle* may be forced into the *Lacteal Veins*, and out of them into the *Thoracick Channel*; and no doubt the comminution of the *Meat* in the *Stomach* is likewise hereby assisted. The *muscular Contraction* of the *Heart*, in the *Pulse* of it, serves not only for the *Circulation* of the *Blood*, but also for the more perfect *Mixture* of it, by which it is preserved in its due *Crisis* and *Fluidity*, and it incorporates the *Chyle* and other Juices it receives with it.

Even *Pain* itself, however afflictive it be, yet is of *Use* to us; it quickens us to seek for *Help*, and makes us careful to avoid what may be for our *Hurt*; it is, as Mr. Ray calls it, a *πολύχρηστον* in the Government of the World.

The mention of *Pain* leads one to think on *Sleep*; *Sleep*, a thing so necessary to repair the great Expence of Spirits we make in the day-time, thro the constant exercise of our *Senses* and motion of our *Muscles*. 'Tis a little surprizing, that tho we lie long on one side,

we have no sense of *Pain* during our *Sleep*, no, nor when we awake. One would think the whole Weight of the *Body* pressing the *Side* on which we lie, should be very burdensome and uneasy, and create a grievous *Pain* to us; and if we lie *long awake* we really find it so. Our ingenious *Ray* supposes that our *Ease* in this case may be owing to an *Inflation of the Muscles*, whereby they become soft, and yet renitent, like so many *Pillows*, dissipating the force of the *Pressure*, and so the feeling of the *Pain*. Hence when we rest in our *Clothes* we loose our *Garters*, our *Buckles*, and other *Ligatures*, to give the *Spirits* a free *Passage*, else these *Parts* will be *pained*, which when we are awake are not so. The reason of this *Ἀναλγησία*, during and after a long *Sleep* on one side, is by *Dr. Lyster* and by *Dr. Jones* attributed to the *Relaxation* of the *Nerves* and *Muscles* in the time of *Sleep*; or *Pain* while we lie awake, is owing to the *Tension* of them.

*O merciful God, thou makest my Bed for me!*

Let more particular *Parts* of our *Body* come into *Consideration* with us; 'tis impossible for them to do so without coming into *Admiration* too!

The *Head* ought certainly to be first considered. The *Head*, because it must contain a large *Brain*, is made of a most capacious *Figure*, as near as may be to a *Spherical*.

What an infinite number of *Glands* in the *cortical* part, and of beginning *Nerves* in the *medullar* part; an hundred whereof exceed not one *single Hair*.

Upon the *Head* grows the *Hair*, which is of great use, not only to quench the *Stroke* of a *Blow* at the *Skull*, but also to cherish the *Brain*; it serves also to disburthen the *Brain* of a superfluous *Moisture*, wherewith it abounds. *Marchetti* finds that *Baldness* comes from the *Dryness* of the *Brain*, and the shrinking of it from the *Skull*; he found an *empty Space* between the *Brain* and the *Skull* in the *Bald*. The *Hair* is likewise a graceful *Ornament*, else, as *Mr. Ray* observes, the  
present

present Age would not bestow so much Money upon Periwigs.

How commodiously are the *Nerves*, wherewith four of the *Senses* are served, as well as all the *superiour Parts*, all sent out the shortest and safest ways, thro proper Holes in the *Head*. And those that serve the *Inferiour*, carried down in a *Bony Channel*. And as *Dr. Cheyne* remarks, it is very remarkable, that the *Veins* do not pass out at the same Holes the *Arteries* enter; for if they did, then upon any violent Motion of the Blood, or any greater Quantity thereof than ordinary, lodged in the *Arteries*, their *Dilatation* and *Pulsation* would compress the *Veins* against the *Bony Sides* of their Passage, and so occasion a *Stagnation* and *Extravasation* of the Blood in the *Brain*, to the Destruction of the whole *Machine*, which by these different *Entries* and *Exits* of these Vessels is prevented.

The *Brain*, the *cortical* Parts thereof, serve to make the *Animal Spirits*; that is, to separate them from the Blood: The *Medullary* Parts to receive them, and convey them from thence into the *Nerves*.

The inner *Meninx*, by its *Constriction*, upon occasion, causes a more vigorous Efflux of the Spirits, and thereby the better Irradiation of the *Organs* of Motion and Sense. By the frequent Repetition of this *Constriction* all the day, being tired, as all other *Muscles* are by continual Action, it is anon relaxed, or suspended from Action. Hereupon, the Efflux of the Spirits into the said *Organs*, being made more slowly, we fall asleep.

A great Philosopher observes and affirms, that the Clearness of our *Fancy* depends on the *regular Structure* of the *Brain*; by which it is fitted for the receiving and compounding of all Impressions with the more Regularity. In *Fools* the *Brain* is deformed. The Deformity is not easily noted in other People: But, no doubt, a smaller Difference than can be imagined, may

may alter the Symmetry of the Brain, and so the Perspicuity of the Fancy.

*Gracious God! how much ought I to adore the Goodness of thy superintending Providence, which gave my Brain that Conformation, that enables me now to see and write thy Praises.*

The Head has wonderful things to show: But can any thing in the World be shown so curious and marvellous as the EYE! Our excellent Ray says truly, *Not the least Curiosity can be added to it.* What Rhetorick what Poetry can sufficiently celebrate the Glories of this admirable Organ! *How perverted the Eye, which is not ever unto the Lord, the glorious Maker of it!* There was much Discourse all over Europe a while ago, concerning a Child, in whose Right Eye there were very apparent and legible, those Latin Capitals, *DEUS MEUS*; and in whose Left Eye, those Hebrew Letters, *אֲדֹנָי*, My Lord. This we may justly say, No rational Beholder can look upon the Eye, without seeing Reason in the wondrous Workmanship thereof, to make this Confession, *The Maker of this Organ is forever to be adored, as MY God and MY Lord.*

The Place of the Eye, even in the Head, how agreeable! 'Tis here not only near to the Brain, but also advantaged for the better View of Objects, and better defended and secured. How unhappy were the People, if there were any such as Pliny tells of, *Oculis Pectori affixis*, and *Oculos in humeris habentes*; from whom our famous Romancer Mandeville, doubtless, took hints for some of his Fables. Galen would satisfy us, if we wanted any Satisfaction, that the Eye in the Hand would have had many inconvenient Circumstances.

The spherical Form of the Eye, how commodious! To lodge the Humours, and also take in the Objects, and likewise to befriend the Motions! The Parts of the Eye being made convex, especially the *chrystaline*, which is of a lenticular Figure, convex on both sides; by

by the Refractions there made, there is a direction of many Rays coming from one point in the Object, namely, as many as the Pupil can receive, to one point answerable in the bottom of the Eye, without which the Sense would be obscure and confused. The difference between a Picture that is received on a *white Paper* in a *dark Room*, thro an open or empty Hole, and the same received thro an Hole furnished with an exactly polished lenticular Chrystal, is brought by Mr. Ray to illustrate this.

The *Membranes* and *Humours* of the *Eye* are all purely *transparent*, purely *pellucid*; thus none of the Rays let in are suffocated before they reach the bottom of the *Eye*, nor are they *sophisticated* with the Tincture of any *Colour*, by which that Colour might be refunded on the Object, and the Soul deceived.

The *uveous Coat* or *Iris* of the *Eye* has a musculous Power, and can contract or dilate the Pupil; the former is to preserve the *Eye* from Injury, by too lucid an Object that may be too near to it; the latter is to apprehend a remoter Object, or one placed in a fainter Light: all, as 'tis justly said by *Scheiner*, *Tam miro Artificio, quam munifica Natura largitate*. There are some Animals which can so close the *Pupil* as to admit of, one may say, one single Ray of *Light*, and by throwing all open again they can take in the faintest Rays; 'tis an incomparable provision for them who must watch for their *Prey* in the *Night*. These have also another astonishing provision for their business, which is a *Radiation of the Eyes*, from the shining of the *Retina* about the *Optick Nerve*. Man has not this provision, because he has no occasion; and yet there have been Instances of some whose *Iris* has had the Faculty so to dart out Rays of *Light*, that they could see in the Dark. *Willis* and *Briggs* mention divers Instances; and *Pliny* tells us, 'twas reported of *Tiberius Caesar*, that *Expergestus noctu paulisper, haud alio modo quam luce clara, contueretur omnia*.

The *uveous Coat* and the inside of the *Choroides* are wonderfully blackened; this is, that the Rays may be suppressed there, and not so reflected backwards as to confound the Sight: if any be reflected by the *retiform Coat*, they are soon choak'd in the black inside of the *Uvea*; were they to and fro reflected, there could be no distinct Vision; as the *Light* admitted into a dark Room would obliterate the Species, which before were seen upon white Paper, by the *Light* let in thro' an Orifice in the Wall; Dr. Briggs adds this reason for it, *Quod Rarii in Visione superflui, qui ab Objectis lateralibus proveniunt, hoc ritu absorbeantur.*

Dr. Grew makes a just Exclamation: What more wonderful than to see *two Humours* of equal Use to true Vision, bred so near together as to be contained within one common Coat, and yet one of them as clear as Chrystal, the other as black as Ink!

Since the Rays from an Object nearer to us, or farther from us, don't meet just in the same distance behind the *chrystalline Humour*, therefore the *ciliary Processes*, or the Ligaments observed in the inside of the *sclerotick Tunicles* of the Eye, do serve instead of a Muscle, by their contraction, to alter the Figure of the Eye, and make it broader; and consequently draw the *Retina* nearer to the *chrystalline Humour*, and by the relaxation thereof suffer it to return to its natural distance, according to the Exigency of the Object, in respect of distance more or less. Dr. Grew ascribes to the *Ligamentum Ciliare* a power of making the *Chrystalline* more convex, as well as of moving it either to or from the *Retina*; and indeed by the Laws of *Opticks* there must be something of this necessary to distinct Vision.

The *chrystalline Humour*, when dried, appears manifestly to be made up of many very thin *spherical Scales*, lying one upon another; *Leuenhoeck* reckons there may be two thousand of them in one *Chrystalline*, from the outermost to the Center: every one of these wonderful

ful Scales is made up of one single Fibre, or the finest Thread imaginable, wound in a stupendous manner this way and that way, so as to run several Courses, and meet in as many Centers, and yet not in any one place to interfere or cross one another. Some ingenious Men have question'd this, but Mr. *Derham* silences them with, *It is what I myself have seen, and can shew to any body with the help of a good Microscope.*

*Peter Herigon* has observed a remarkable thing about the Insertion of the *Optick Nerve* into the Bulb of the *Eye*. The Situation of it is not just behind the *Eye*, but on *one side*, lest that part of the Image which falls upon the Hole of the *Optick Nerve* should want its Picture. But Mr. *Ray* will rather have the reason to be, because if the *Optick Axis* fall upon such a Center, as it would were the *Nerve* seated just behind the *Eye*, this great Inconvenience would follow, that the middle point of every Object we view'd would be invisible, or there would a dark Spot appear in the midst of it. Behold, a Situation of a *Nerve*, which any one would at first have thought inconvenient, now evidently found to be assign'd by a most admirable Wisdom!

And then, what a wise Contrivance, particularly about the motion of the *Eye*, in uniting into one that Pair which are called *the motory Nerves*? Each of these do send their Branches in each Muscle of each *Eye*; this would cause a *Distortien* of the *Eyes*: but being united near their Insertion, they cause *both Eyes* to have but *one motion*; when one *Eye* is moved this or that way, the other is turned the same way with it. But what shall we say concerning this? There is a decussation of the *Rays* in the *Pupil* of the *Eye*, the Image of the Object in the *Retina*, or bottom of the *Eye*, is *inverted*; whence does it come to pass that it appears not so, but in its *natural Posture*? Why the *visual Rays* coming in straight Lines by those Points of the Sensory, or the *Retina*, which they touch, affect the common Sense or Soul, according to their direction;

tion; they signify to it, that the several Parts of the Object, from whence they proceed, lie in strait Lines (Point for Point) drawn thro the *Pupil*, to the several Points of the *Sensory*, where they terminate, and which they press upon: Whereupon the Soul must needs conceive the Object in its true Posture. The *Nerves* are naturally made, for to inform the Soul, not only of the external Objects, which do press thereupon, but also of their *Situation*. Hence the Objects will appear double, if the *Eyes* be distorted. This is *Des Cartes's* way of accounting for this Mystery: *Notitia illius ex nulla Imagine pendet, nec ex ulla Actione ab objectis veniente, sed ex solo situ exiguarum partium cerebri, è quibus Nervi expullulant.* Mr. *Molyneux* contents himself with this Account: *The Eye is only the Organ or Instrument, it is the Soul that sees by means of the EYE. To enquire how the Soul perceives the Object erect, by an inverted Image, is to enquire into the Soul's Faculties.*

Even the *aqueous Humour* is not an useles one: It sustains the *Uvea Tunica*, which else would fall flat upon the *Chrystalline*.

Because the *outermost Coat* of the *Eye* might chance to be wounded or pricked, and this fluid Humour be let out, there is therefore a Provision made, speedily to repair it, by the help of certain *Water-Pipes*, or *Lymphaducts*, inserted into the Bulb of the *Eye*, proceeding from *Glandules* designed by Nature to separate this Water from the Blood for that Use. *Antonius Nuck* found, that if the *Eye* of an Animal be pricked, and the *aqueous Humour* squeezed out, in the space of ten hours the Humour and Sight would be restored unto the *Eye*, at least if the Creature be kept in the Dark. *Verzascha* gives divers Examples, both antient and modern, of *Sight* strangely recovered, by the Reparation of the *aqueous Humour*, after it had been let out at very dangerous Wounds.

It is remarkable, that the *horny Coat* of the *Eye* does not lie in the same Superficies with the *White* of the *Eye*; but it rises up, as it were on *Hillock*, above its *Convexity*, and is of an *Hyperbolic* or *Parabolic* Figure. Tho' the *Eye* seems to be perfectly round, in reality it is not so; but the *Iris* thereof is protuberant above the *White*: and the Reason is, because if the *Cornea Tunica*, or *ChrySTALLINE Humour*, had been concentric to the *Sclerodes*, the *Eye* could not have admitted a whole Hemisphere at one View; and as by *Sheiner* noted upon it, *Sic Animalis Incolumitati in multis rebus minus cautum esset.*

*Dr. More* has now a Remark, That the *Eye* being thus perfect, the Reason of Man would easily have rested here, and admired the Contrivance. Being able to move himself every way, he might have thought himself every way sufficiently provided for. But, behold! An Addition to this Perfection! There are *Muscles* also added unto the *Eyes*! For we have occasion, particularly in *reading*, to move our *Eyes*, without moving our *Head*. The *Organ* is therefore furnished with no less than *six Muscles*, to move it upwards, downwards, to the right, to the left, obliquely, and round about.

And now, for the Security of this wonderful *Organ*, the *Eyes* are sunk in a convenient Valley, where, as *Tully* says, *Latent utiliter*; and they are encompassed round with Eminencies, as within a Rampart: *Excelsis undique partibus sepiuntur.* This defends them from the Strokes of any flat or broad Bodies. Above stand the *Eye-brows*, to keep off any thing from running down upon them, says the same Orator, *Superiora Superciliis obducta, sudorem à Capite & Fronte defluentem repellunt*; the *Eye-lids* then fence them from sudden and lesser Stripes: whereas the *Fishes*, who have no occasion for a Defensative against Dust and Motes, are destitute of *Eye-lids*! The *nititating Membrane* is an abundant Provision for all their Occasions! These

*Eye-lids,*

*Eye-lids*, also round the Edges, are fortified with *Bristles*, like *Palisadoes*, to keep off the Incurfions of troublefome Infefts. 'Tis remarkable, that thefe Hairs grow to a *determinate*, but a moft *commodious* Length, and need no *cutting*, as many other Hairs of the Body do; and that their Points do ftand out of the way, bending *upwards* in the upper Lid, in the lower *downwards*. But then *Sleep* is neceffary for us. This would be difturbed, if the *Windows* were always open to the Light. Here are *Curtains* then to be drawn, for the keeping of it out. Yet more: The outward Coat of the *Eye* muft be kept *pellucid*. This would anon dry and fhrink, and lofe its *Diaphaneity*, if the *Eyes* were always open. The *Eye-lids* are therefore fo contrived, as often to wink. Thus they varnifh the *Eyes* with their *Moifture* over again: They have *Glandules*, on purpofe to feparate an Humour for that ufe, and withal wipe off whatever *Duft* or *Filth* may ftick to them. And left the Sight fhould be hinder'd, they do it, with what *Celerity*! *Cicero* adds, they are *Molliffimæ tactu, ne læderent Aciem*: And I will add, *Man*, who is a *fociable Creature*, and fhould exhibit *focial Affections* by fome *visible Tokens*, is here furnifhed with *Tears* for that purpofe, beyond any other Animal.

*My God, let me ever employ them, on the juft Occafions for them.*

It is a *Paflage* which drops from the Pen of a *Perfon of Quality*, in a *Treatife*, entitled, *A View of the Soul*: 'It does not feem wonderful to behold a *Diffillation* from the *Eyes*, 'tis to be found in *Beaft*, as well as in *Man*, upon an *offenfive Touch* thereof: But when there is no fuch *Cauſe* to be alledged, to have the *Body*, as it were, *melted* on a fudden, fend forth its *Streams* thro that unufual *Channel*, makes it feem to me no lefs than the quick and violent *Agitation* of ſome *Divine Flame*, thawing all the *vital Parts*, and drawing the *Moifture* thro the chief and cleareft

‘ Organ of the Body, the *Eye*, and not to be caused  
 ‘ by any thing, which is part of itself.’

This brings to my mind an antient Problem: *Cur Deus Oculos fetus instrumentum esse valuit.* And the Answer to it, *Ut quò sordes peccatorum hauriuntur, eodem per lacrymas diluantur.*

And then the *Ball* of the *Eye* has the exterior Coat made so thick, so tough, so strong, that it is a very hard matter for to make a Rupture in it. But because the *Eye* must be exposed at all Seasons, and in all Weathers, there is provided for it an hot Bed of *Fat*, which fills up the Interstices of the Muscles; nor is it so sensible of Cold, as other Parts of our Body. 'Tis a strange thing, which the *French* Academists found by Experience! The *Aqueous Humour* of the *Eye* will not freeze. Admirable! It has the Fluidity and Perspicuity of common Water, nothing singular to be discovered in the Taste or Smell of it. Of what *Ethereal Nature* must we imagine it?

Shall we, on this occasion, look back on the *Eyes* of other *Animals*, and compare ours with theirs? The *Chrystalline Humour*, in the *Eyes* of the *Fishes*, is much nearer to a *Sphere*, than that of *Land-Animals*. 'Tis because the Light has a different *Refraction* in the *Water*, from what it has in the *Air*: That *Convexity*, which would unite the Rays of Light in the *Air*, will not in the *Water*. In those *Animals*, that gather their Food from the Ground, the *Pupil* is *Oval* or *Elliptical*, the greater *Diameter* going *transversely* from Side to Side. In those that seek their Food on higher Places, the greater *Diameter* is the *Perpendicular*. These two Figures are wonderfully fitted unto their different Necessities. Those *Animals*, that have no Motion of their *Neck*, have a Cluster of *Semispherical Eye-balls*, which send in the Pictures of Objects all round about them; and they that seek their Food in the dark, have a *Retina* coloured *white*, which reflects the Light, and enables them to see best, when they have least of it.

An acute Philosopher says justly, 'These are wonderful and surprizing Instances of *Forefight* and *Counsel*, in the Being who framed those *Organs*.'

But why don't we see double with our two Eyes? *Galen*, and others after him, took this to be from a Coalition, or Decussation of the *Optick Nerves*. I pass by the Assertion of the *Bartholines*, that they are united, not by any Interfection, *sed per totam Substantiæ Confusionem*. *Dr. Gibson* says there is the closest *Conjunction*, but no *Confusion* of the *Fibres*. Others apprehend only a *Sympathy* between the *Optick Nerves*. *Mr. Briggs* thinks that the *Optick Nerves* of each Eye consist of *homologous Fibres*, and that these *Fibrillæ* have the same Tension and other Circumstances in both Eyes; and so when an Image is painted on the same corresponding and sympathizing Parts of the *Retina*, the same Effects are produced, the same Notice or Information is carried to the *Thalamus Nervorum Opticorum*, and so imported and imparted to the Soul, that is to judge of all. Our great *Sir Isaac Newton* says, *Are not the Species of Objects seen with both Eyes, united where the Optick Nerves meet, before they come into the Brain, the Fibres on the right side of both Nerves uniting there?* *Monsieur Tawvry*, in his *Rational Anatomy*, thinks this Answer to be enough: 'When we see the same Body with two *Organs*, we judge it to be one, because we see it still in *one place*, and refer it to *one place*; for every Point of the seen Object is directed upon *one place*, by the perpendicular Rays of each of the two Cones; this is what we call *the Direction of the Optick Axis*. 'Tis a natural Consequence from this Explication, that certain Distortions of the Eye will make the Object appear double, because we then direct the same Point of the Object to two different places.'

We might go on and resume our Enquiry, Why Objects which are *inverted* in the bottom of the Eye do not appear so, but in a direct Position? *Tawvry*

thinks it enough to say, 'We do not judge of the Situation of the Bodies by the *Part* which is affected in the *Eye*, but by the *Manner* in which it is affected; the Soul judges of the Object by the *Manner* in which the *Organ* is affected.'

To conclude our Observations of the *Eye*; Mr. *Derham* very justly says, *None less than GOD could contrive, order, and provide an Organ as magnificent and curious as the Sense is useful.* And *Sturmius* had reason enough to say, he was fully persuaded, that no Man who survey'd the *Eye* could abandon himself to any *speculative Atheism*. And *Cheyne* passes a most equal Sentence, when he says, *He certainly deserves not to enjoy the Blessings of his Eyesight, whose Mind is so depraved as not to acknowledge the Bounty and Wisdom of the Author of his Nature, in the ravishing and astonishing Structure of this noble Organ!*

'Good God! How unreasonable am I, if the Eyes made by Him should not be ever to the Lord!

'An envious Eye is an abused one; an haughty Eye is a distorted one; an unchaste Eye, how ignominiously misapplied! It has Dirt thrown into it. Gracious God, let not my Eyes be Port-holes of Wickedness. Let no Death get into my Soul by those Windows.'

'A pitiful Eye a bountiful Eye, and the Eye on the Book that will feed it well, how much to be wish'd for! And an Eye upon a CHRIST at His Table, evidently set forth as crucified before it.'

'Tis an odd Question in *Tympius*, Why the Eyes are the last things quickned, and the first that are decayed? It is answered, *Ut quo magis est ipsorum Periculum, eo minus sit nocendi Spatium.*

The EAR is what falls next under our Consideration; double, not only to provide against the Loss of one, but also for the more commodious hearing.

'Tis astonishing to see the Sagacity of some deaf Persons, who come to understand things that are spoken, only by seeing the motion of the Lips in the Speaker;

ker; but the Instances of this are so rare, that they abate nothing of our Obligations to our glorious Maker for bestowing the noble Sense of *Hearing* upon us.

The Situation of the *Ear* is where it may give the most *speedy Information*, and where it will *occasion* and also *encounter* the least Annoyance.

The *outward Ear* is most nicely adjusted to the peculiar Circumstances of every Animal. Dr. *Grew* celebrates the marvellous *Varieties* in the *Ears* of several Animals for the reception of Sound, according to their several Exigences. And Mr. *Derham* challenges our Confession of a *notable Prospect of the Handy-work of God even in so inconsiderable a Part as this*. In *Man* the Form of it is of all the most agreeable to the *erect Posture* of his Body. 'Tis pity the most eminent of our modern *Anatomists* cannot yet agree whether it has any *Muscles* belonging to it.

What a surprizing Spectacle the *Helix*, which in its tortuous Cavities collects the *sonorous Undulations*, and gives them a gentle *Circulation*, with some *Refraction*, and conveys them to the *Concha*, that large and round Cell at the entrance of the *Ear*! Then to bridle the Evagation of the *Sound* when arrived thus far, but at the same time avoid any Confusion thereof by *Repercussions*, what a curious provision is there made by those little Protuberances called the *Tragus* and the *Antitragus* of the *outward Ear*, softer than the *Helix*, and blunting the Sound without repelling it! Monsieur *Dionis* observes, they that have this *Ear* cut off have *but a confused way of hearing*.

That the Substance of the *outward Ear* should be *cartilaginous*; this is an admirable Contrivance of the most wise Creator. Dr. *Gibson* observes, if it had been *Bone*, it would have been troublesome, and might by many Accidents have been broken off; if it had been *Flesh*, it would have been subject to Contusion, yea, we may add, it would not then have remained so well expanded, nor have so kindly received *Sounds*, but

have absorbed them, and retarded them; whereas now the Sounds have their agreeable *Vibrations*, as in well-built Arches, and the *Whispering-places*, whereof the World has had many famous ones.

How artfully tunnell'd the *auditory Passage*! But then, because the Passage must be always open, therefore to prevent the invasion of *noxious things*, which love to retreat into every little Hole, behold, the Passage secured with a bitter and nauseous Excrement, afforded from *Glands* appointed for that purpose! Where the *Meatus auditorius* is long enough to afford harbour to any Insects, there this *Ear-wax* is constantly to be found; but *Birds*, whose Ears are cover'd with Feathers, and where the *Tympanum* lies but a little way within the Skull, have none of it. *Schelhammer* confutes the old Anatomists, who make this *Ear-wax* an Excrement of the *Brain*, and justly says, *Nil absurdius!* Dr. Drake has given us an handsome Cut of the *Glandulæ Ceruminosæ*. *Pliny* ascribes a great medical Virtue to the *Ear-wax*, the *Sordes ex Auribus*, as curing the *Bites of Men*, (which he says, *inter asperimos numerantur*) and of *Scorpions* and *Serpents*. And Mr. *Derham* asserts he had found it a good *Balsam* in his own Experience.

The Notion of an *innate Air* in the *Ear*, is by *Schelhammer* found but a Fancy; the Passage into the *inner Ear* from the *Throat* confutes it: but in this Passage there is a wise provision, as he notes, that no *Air* might pass in thither but what shall be changed and warmed, and so rendred harmless: *Imo fortassis non facile alius, nisi ex Pulmonibus.*

The Passage from the *Ear* to the *Palate* (the *Tuba Eustachiana*) accurately described by *Valsalva*; this is to give way to the *inner Air* upon every motion of the *Membrana Tympani*, the *Malleus*, the *Incus*, and the *Stapes*; and if this be shut up, *Deafness* ensues.

And then the *Os Petrosum*, that *Bone* which contains the rest, this has a remarkable Texture and Hardness  
above

above the other Bones of the Body, and so it serves not only as a very substantial *Guard* to the Sensory, but also, as *Dr. Vieussens* observes, to oppose the Impulses of the *athereal Matter*, that there be no loss of Sound, and no confusion in it, but that the *auditory Nerves* may have it regularly convey'd to them.

The *Membrana Tympani*, as long ago as *Hippocrates's* Time, had some notice taken of it, whether it has any disengaged part, by which it is not fastned to the *boney Circle*, in which it is enchased, as *Monsieur Dicnis* affirms, is disputed. *Mr. Derham* could not find it. But then *Dr. Vieussens* discover'd a further inner Membrane, *Tenuissimæ raræque admodum Texturæ*, whereof the Uses are to keep the Gate of the *Labyrinth*, lest the *thick Air* abroad hurt the *pure Air* within, and that a due Heat may be preserved in the Basis of the *Labyrinth*.

But now the astonishing *four little Bones*, and *three little Muscles* about them, to move them, and adjust the whole Compages to the several Purposes of *Hearing*, and for all manner of *Sounds*!

These were wholly unknown to the antient Anatomists. *Jacobus Carpenfis* was he by whom the *Malleus* and the *Incus* were first of all discovered; the Gentleman who was indeed the first Restorer of the *Anatomick Art*, which *Vesalius* afterwards carried on. The *Stapes* was found out by *Johannes ab Ingrassia*, a learned *Sicilian*. The fourth was what *Francis Sylvius* first lit upon.

In *Man*, and in the *Four-footed*, they are *four*, curiously inarticulated with one another, with an external and internal Muscle, to draw or work them in extending or in relaxing of the Drum. In *Fowls* *Dr. Moulen* could never find any more than *one Bone* and a *Cartilage*, making a Joint with it, that was easily moveable.

It is a probable Thought of *Robault*, That for us to give *Attention*, is nothing else but for us, by ex-

tending or relaxing the *Tympanum* of the *Ear*, to put it into that position, *in qua tremulum aeris externi motum excipere possit*, wherein it shall be most sensible of the motion of the *external Air*. The Benefit which *deaf Persons* receive by *loud Noises*, enabling to hear what shall be spoken to them in the midst thereof, helps to clear this Matter. *Dr. Willis* tells of one who hired a *Servant* who was a *Drummer*, on purpose that his *deaf Wife* might hear his *Discourses*, which, while the *Drum* was beating, she was able to do.

In *Birds* the *auditory Nerve* is affected from the impression made on the *Membrane*, only by the inter-mediation of the *Columella*; but in *Man* it is done by the intervention of the *four little Bones*, with the *Muscles* acting upon them, his *Hearing* being to be adjusted to all kinds of *Sounds* or *Impressions* made upon the *Membrana Tympani*; the *Impressions* are thus made upon the *auditory Nerve*, they first act upon the *Membrane* and the *Malleus*, the *Malleus* upon the *Incus*, the *Incus* upon the *Os orbiculare* and *Stapes*, and the *Stapes* upon the *auditory Nerve*, the *Base* of the *Stapes* not only covering the *Fenestra ovalis*, wherein the *auditory Nerve* lies, but also having a part of the *auditory Nerve* spread upon it. Our valuable *Derham*, upon a diligent Examination, found this to be the *Process of Hearing*.

How will the *Wonders* grow upon us, if we pass now to the *Labyrinth*! And there survey the wonderful Structure of the *Vestibulum* and the *Cochlea*, and yet more particularly the *semicircular Canals*! These last are three, and of three different Sizes. *Valsalva* thinks, that as a part of the *auditory Nerve* is lodg'd in these Canals, thus they are of *three Sizes*, the better to suit all the variety of *Tones*; and tho there be some difference as to the *Length* and *Size* of the Canals in different *Persons*, yet lest there should be *Discord* in the *auditory Organs* of one and the same *Man*, those *Canals* have always in the same *Man* a most exact *Conformity* to one another.

Shall we take notice of one Curiosity more! There is one of the *auditory Nerves*, whose Branches do spread partly to the Muscles of the *Ear*, partly to the *Eye*, partly to the *Tongue* and Instruments of *Speech*, and insculcated with the *Nerves*, to go to the *Heart* and *Breast*; by means hereof there is an useful and wondrous *Consent* between these Parts of the Body. It is natural for most Animals, upon the hearing of any uncouth Sound, presently to erect their *Ears*, and prepare them for the catching of every *Sound*, and therewithal open their *Eyes*, to stand as faithful Centinels upon the Watch, and be ready with the *Mouth* to call out, or utter, according to the Dictates of the present Occasion; when surprized with any frightful Noise, they give a Shriek immediately.

Dr. *Willis* observes another great Use of this *nervous Commerce* between the *Ear* and the *Mouth*; *Usum alium insigniorem præstat*: that is, that the *Voice* may correspond with the *Hearing*, and be a kind of *Echo* to it; that what is *heard* with one of the two *Nerves*, may be readily expressed with the *Voice*, by the help of the other.

SOUND is the Object of this admirable Sense; the intricate nature of it has puzzled the best of Naturalists.

How many *sounding Instruments* have yet been contrived by the Wit of Man, whereby *Sounds* have been augmented, and conveyed, and rendred serviceable!

The biggest Bell in *Europe* is reckon'd to be at *Erfurt* in *Germany*, which may be heard, they say, *four and twenty Miles*.

It is reported that *Alexander* the Great had a *Tube*, which might be heard an hundred *Stadia*, whereof the Figure is preserved in the *Vatican*. It is a little strange that no one should hit upon the like Invention, till *Athanasius Kircher*, in our Days, and soon after him Sir *Samuel Moreland*, whose *Tuba Stentorophonica* was publish'd in 1672.

*Carves* have out-done *Tubes* for bellowing. *Olaus Magnus* describes a *Cave* in *Finland*, into which if a *Dog* or any other *Animal* be cast, it sends forth so dreadful a *Sound* as to knock down every one that is near it; and they have therefore guarded it with high *Walls* to prevent such a *Mischief*. *Peter Martyr* informs us of a *Cave* in *Hispaniola*, which with a small *Weight* cast into it, will with its hideous noise at five *Miles* distance endanger *Deafness*. *Kircher* in his *Phonurgia* finds a *Pit* in the *Cucumber Mountains* of *Switzerland*, that sends out a fearful *Noise*, and *Wind* accompanying of it; and a *Well* in that *Country*, a noise in which is equal to that of a great *Gun*.

*Olaus Magnus* mentioning the vast high *Mountains* of *Augermannia*, tells, that the *Waves* of the *Sea* striking at the bottom thereof, make such a terrible noise, as not only to deafen the *Mariners*, but also to sicken them, and even to fright them out of their *Wits*, if they dare approach them. *Habent Bases illorum Montium in Fluctuum ingressu & egressu tortuosas rimas, sive scissuras, satis stupendo Naturæ Opificio fabricatas, in quibus longa Voragine formidabilis ille sonitus, quasi subterraneum tonitru generatur.*

The prodigious *Cataract* of *Niagara*, whereof *Hennepin* has given some relation, produces a *Noise* which perhaps nothing on *Earth* has equall'd; a *Noise* which it might well nigh deafen one to think upon.

What is the *Matter* of *Sound*? The *Atmosphere* in gross? Or the *ethereal part* of it? Or some soniferous *Je-ne-sçay-quoy* *Particles* of *Bodies*?

That the *Air* is the *Medium* of *Sound*, is manifest from *Experiment*. In an *unexhausted Receiver* a small *Bell* may be heard at the distance of several *Paces*; but when it is exhausted, it can scarce be heard at the nearest distance: if the *Air* be compressed, a *Sound* will be louder, proportionably to the *Compression*, or the *Quantity* of *Air* crowded in; the *Experiment* succeeds, not only in *forced Rarefactions* and *Condensa-*

tions of the Air, but also in such as are *natural*. The Story of the *Pistols* discharged by *Frædlichius* on the *Carpathean Mountains*, related by *Varenius*, gives an Instance how the *Sound* was diminished, by the rarity of the Air, at the great Ascent up to the Atmosphere; but how magnified by the *Polyphonisms*, or the Repercussions of the Rocks and Caverns, and other *phonocaptick Objects* in the Mount below!

The *Water* also is capable of transmitting a *Sound*; the *Sound* of a *Bell* struck under *Water* is heard, tho as much more dull, and not so loud: Judges in *musical Notes* pronounce it about a *fourth* deeper.

*Divers* at the bottom of the *Sea* can hear *Noises* made above, but confusedly; those above cannot hear the *Divers* below at all.

*Dr. Hearn* tells of *Guns* fired at *Stockholm*, which were heard an hundred and fourscore *English Miles*. In the *Dutch War*, *Guns* were heard above two hundred *Miles*. If we go more Southward, *Guns* at *Florence* are heard at *Leghorn*, which is sixty-five *Miles*. When the *French* bombarded *Genoa*, they were heard at *Leghorn*, which is ninety *Miles*. In the *Insurrection* at *Messina* they were heard at *Syracuse*, which is an hundred *Miles*. This inclines *Mr. Derham* to think that *Sounds* fly near as far in the Southern as in the Northern Regions, tho the *Mercury* in the *Barometer* does rise higher without the *Tropicks* than within the *Tropicks*; and the more Northerly, still the higher, which may increase the *Sounds*.

Celebrated Authors differ about the Velocity of *Sounds*. *Mr. Derham* has by nice Experiments determined, that there is a small difference in *Sounds* before the *Wind* and against it, and this a little abated or augmented, according to the Strength of the *Wind*; but nothing else in the World will affect it: and there is one motion to all kinds of *Sounds*, whether loud or low; and they all fly equal Spaces in equal Times; and lastly, the Mean of their Flight is at the rate of a Mile

Mile in  $9\frac{1}{4}$  half Seconds, or 1142 Feet in one *Second* of Time.

The Power of *musical Sounds* over the *Spirits of Men*, yea, and over their *Bodies* too, is very surprizing. What could the famous *Timothy* the Musician do upon *Alexander*? What another upon *Ericus*? *Athanasius Kircher* in his *Phonurgia*, and *Isaac Vossius* writing *de Poematum Cantu & Rythmi Viribus*, report strange things of the Power which *Musick* has over the Affections.

The *German Ephemerides* mentions those, who at some Notes of *Musick* are unable to hold their *Water*. *Morhoff* tells us of those who would break *Romer Glasses* with their *Voice*. Great Sea-Commanders have observed, that their *wounded Men*, with broken Limbs, undergo much Pain at the Enemies Discharges. 'Tis well known that *Seats* will sometimes tremble at the Sound of *Organs*.

The Force of *Musick* on Persons poisoned with the *Tarantula*, is altogether astonishing!

*Ismenias* the *Theban*, by playing on the *Flute* or *Harp*, cured the *Sciatica*. In the late *French History* of the *Academy of Sciences*, there is a Man cured of a *Fever* and *Frenzy* by proper *Tunes* play'd to him.

But after all, who but a God infinitely wise could contrive such a *fine Body*, so susceptible of every Impression that the Sense of *Hearing* has occasion for; and thus empower Animals to express their *Sense of things* to one another?

Mr. *Derham* thus justly concludes his Discourse on the Sense of *Hearing*; 'Who can survey all this admirable Work, and not as readily own it to be the Work of an omnipotent and infinitely wise and good God, as the most *artful Melodies* we hear, are the Voice or Performances of a living Creature!'

Great God, let me ever use my *Ear* to learn what thou wouldst have me to know, and shut my *Ear* upon those things, wherewith to be unacquainted is a learned Ignorance!

'May I have the Happiness of that Experience, Faith comes by hearing.'

I will add one Remark : Many have been born destitute of *Seeing* ; many born destitute of *Hearing* ; exposed unto many Inconveniences by the want of the *Sense* whereof they were destitute ; however capable of being provided for. I could never learn, that any Child of Man was born destitute of *both Senses* ; one destitute of both could not be in any Capacity of being provided for. *My God, I behold thy Compassion, and I adore it !*

What a Provision has our Glorious Creator made for our Smelling ? The Apertures of our *Nostrils*, which are cartilaginous, and accommodated with proper and curious *Muscles*, have, as our *Derham* notes, *all the Signatures of Accuracy*. And long before him, *Tully* ; *Nares, eò quod omnis odor ad superiora fertur, recte sursum sunt, & quod Cibi & Potionis Judicium magnum earum est, non sine causâ vicinitatem Oris secutæ sunt*. Here the *olfactory Nerves* receive the odoriferous Effluvia of Bodies ; and because the odorant Particles are drawn in by Breathing, the upper part of the Nose is barricadoed with *Laminae*, which fence out noxious Bodies from entering the breathing Passages ; (for which purpose the *Vibrisci*, or Hairs placed at the entrance of the *Nostrils*, are a notable Contrivance) and they receive also the Divarications of the *olfactory Nerves*, which are here spread very thick, and thus meet the *Scents* which enter by the *Breath*, and strike upon them. The more accurate the Sense of *Smelling* is in any Animal, the longer these *Laminae* are, and the more in Number, folded and crouded with the more nervous Filaments, to detain and fetter the *odorous Particles*. There are Animals, the chief *Acts* of whose Lives are performed by the Ministry of this wonderful Sense, and these have certain *Points of Provision*, which are not in *Man* ; but, I will not say, are wanting in him : For he has enough ; and he has utterly lost all *Sagacity*, if he be not sensible of *enough*, to oblige his Praises of the God that made him.

Out *Tasting* is as well provided for.

For the Causes of *Tastes*, and their Diversities, Dr. *Grew* will give us a more accurate Account than *Theophrastus*.

Concerning the *Organ* of *Tasting*, we will not recite the various Opinions of *Baubin*, and *Bartholin*, and *Laurentius*, and our *Wharton*. Our *Willis* determines, *Præcipuum & fere solum gustatus Organon est Lingua*. Our *Derham* inclines to that of *Malpighi*, that since the outward Covering of the *Tongue* is perforated, and under this there lie the *Papillary Parts*, whereof Mr. *Cowper* has given us Cuts full of Elegancy, the Taste probably lies in these: *Occurrunt Papillaria Corpora, probabilius est in his ultimò, ex subintrante sapido Humore, Titillationem & Mordicationem quandam fieri, quæ Gustum efficiat.*

There are *Nerves* curiously divaricated about the *Tongue* and *Mouth*, to receive the Impressions of every *Gust*, and these *Nerves* guarded with a firm and proper Tegument, which defends them from Harms, but so perforated in the *Papillary Eminences*, that the *Tastes* of all things are freely admitted there.

Admirable the Situation of the *Taste* with the *Smell*, for the Discharge of their Offices, at the first Entrance into the way to the grand Receptacle of our Nourishment: that they may therefore judge what is nourishing, and what unfavoury and pernicious.

The *Taste*: *Qui sentire eorum quibus vescimur genera debet*; as *Tully* long since observed, *Habitat in ea parte Oris, qua esculentis, & poculeatis iter Natura patefecit.*

Our most wise Creator has established a great Consent between the *Eye*, and the *Nose*, and the *Tongue*, by ordering the Branches of the same *Nerves* to each of those three Parts. Hereby there is all the Guard that can be against Food that may hurt us; it is to undergo the Scrutiny of *three Senses*, before it goes into the *Stomach*.

But if the other Senses have their peculiar Seats, there is one, to wit, *Feeling*, that is dispersed thro' the whole Body, both without and within. Every Part needs to be sensible of what may be for its own Safety, and therefore our most wise Creator has admirably lodged the Sense of *Feeling* in every part. It was Tully's Remark, *Toto Corpore æqualibiter fusus est, ut omnes Ictus, omnesque nimios & Frigoris & Caloris impulsus sentire possimus.* Pliny adds, *Tactus sensus omnibus est, etiam quibus nullus alius.*

The Organ of this wonderful Sense, is the *Nerves*; which are, in a most curious, astonishing, incomparable manner, scattered throughout the whole Body.

Malpighi, upon many Observations, has determin'd, that as *Tasting* is performed by the *Papillæ* in the *Tongue*, so *Feeling* is performed by the like *Papillæ* under the *Skin*. That these *Papillæ Pyramidales*, thrusting their Heads up to terminate in the outer *Skin*, are those by which we *feel*; he speaks of an *Animus abundè certior redditus*. Our diligent Cowper has confirmed this, and given us elegant Cuts of these *Papillæ*, from the Informations of the Microscope.

Dr. Cheyne observes, the apt proportioning of that Sense, our *Feeling*, unto the Actions and Impulses of the Bodies among which we live, is wonderful! Had the Sense been ten times as exquisite as it is, we should have been in perpetual Torment. Had it been many times duller and more callous than it is, we should have lost many of our most agreeable Delights, and we should have had our tenderest Parts consumed without Knowledge or Concern. This nice Adjustment!

We were but now pretty near the *Teeth*; of these the Numbers are *thirty two*. But, Oh! how many more the *Wonders*! Galen observes, we commend the Skill and Sense of him that shall well marshal a Company of *thirty two*: and shall we not admire him who hath so admirably disposed these *thirty two*?

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We will here single out eight or nine things, that are very remarkable: The *Teeth* continue to *grow* in their Length as long as we live, as appears by the unsightly Length of a *Tooth*, when the opposite happens to be pulled out. Thus Providence repairs the waste that is daily made of the *Teeth*, by the frequent Attrition in Mastication. That part of the *Teeth*, which is above the Gums, is not invested with the sensible Membrane, called *Periostrum*, with which the other Bones are covered; but then the *Teeth* are of a *closer* and *harder* Substance than the rest of the Bones, that they may not be so soon worn down by grinding the Food. For the *nourishing* of these necessary Bones, the Glorious Creator has wonderously contrived an *unseen Cavity* in each side of the *Jaw-Bone*, in which are lodged an *Artery*, a *Vein*, and a *Nerve*, which thro' lesser Gutters do send their *Twigs* to each particular *Tooth*. But because *Infants* are to feed a considerable while upon *Milk*, and lest their *Teeth* should hurt the tender *Nipples* of the *Nurse*, Nature defers the Production of them for many Months; whereas divers Animals, which must *seek betimes* a Food that needs Mastication, are born with them. The different Figure of the *Teeth*, how surprizing! The *Foreteeth*, called *Incisores*, broad, with a thin and sharp Edge, to cut off a Morsel from any solid Food. The *Eye-Teeth*, called *Canini*, stronger, deeper, and more able to tear the resisting sort of Aliments. The *Jaw-Teeth*, called *Molares*, flat, broad, uneven, accommodated with little Knobs, to hold, and grind, and mix the Aliments.

Because the Operations, to be performed by the *Teeth*, sometimes require a considerable Strength, what strong *Muscles* is the lower Jaw provided withal! And every *Tooth* is placed in a strong, a close, a deep Socket; and the *Teeth* are furnished with *Holdfasts*, that are suitable to the stress, which in their different Offices they may be put unto. The *Fore-teeth* and  
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the *Eye-teeth* have usually but *one Root*, which, in the latter, is very long; but the *Grinders*, that must manage hard Bodies, have *three Roots*, and in the upper Jaw often *four*, because these are pendulous, and the Jaw something softer. How convenient the Situation of the *Teeth*! The *Grinders*, nearest the Center of their Motion, because the greatest Force is required in them; the *Cutters*, where they may readily cut off what is to be transmitted to the *Grinders*. Finally, the *Jaw*, that is furnished with *Grinders*, has an oblique or transverse Motion, which is necessary for the Comminution of the Meat: But this Motion is not in the Jaw of Animals, which have not such *Teeth* belonging to them.

‘*Temperance in Feeding*, is one special Article of the Homage we owe to the Glorious One, who has, in our *Teeth*, so display’d his admirable Workmanship!’

And we are now not far from the *Tongue*, the *Uses* whereof are, how various! how marvellous! and the *Texture* how much to be wonder’d at! You were in the right of it, *Vesalius*, when you told us, *That no Mortal had ever yet thorowly consider’d all the Wonders of it.*

This is the main Organ of *Tasting*; it helps also in the *Mastication*, and the *Deglutition* of the Food.

Here the *Spittle* has its Vent; which, tho commonly taken for an *Excrement*, is indeed an *Humour* wonderfully serviceable; because a great part of our Food is dry, there are provided several *Glandules*, to separate this Juice from the Blood, and no less than four pair of *Channels* to convey it into the Mouth, which are lately found out, and called the *Ductus Salivales*; and through which the *Saliva* continually distilling, serves to macerate our Food, and, by tempering of it, render it fit for chewing and swallowing. And hereby also the *Concoction* in the Stomach is not a little promoted.

But the grand *Glory* of the *Tongue*, is, that it is the main Instrument of *speaking*; and *therewith* we *blefs* God, *even our Father!* This is a Faculty peculiar to *Man*: It was never known that a *Beast* could attain to any thing of it. A *Bird* indeed has been taught now and then a few words, and with no little difficulty; but then he *understands not* the meaning of his few words, nor does he use them for Signs of things conceived by him: The most that can be pretended, is, that a *Parrot* being used unto such or such Enjoyments or Afflictions, at the Prolation of certain words, may express his Passions by the noise of these words. The *Jewish* Rabbins were not so very absurd in defining a *Man*, *Animal loquens*, a Creature that speaks. By the way, 'you that are *Stammerers* ought exceedingly to humble yourselves before the Holy God, under his Rebuke upon you, in an *Organ*, which, well employed, would be your *Glory*. Our Saviour, seeing a *Man* that had an *Impediment* in his *Speech*, he *sighed* upon it; no doubt it grieved him to see a *Man* so *marked* by the Displeasure of God, in a most sensible Wound upon so distinguishing a Faculty. *My Friends*, learn to *speak deliberately*. This Expedient alone would help you wonderfully: For in *Singing* there is no *Stammering*. Speak but *little*, don't affect a *Loquacity*; a Folly *your Tribe* are often subject to! tho'tis more burdensome and ungrateful in *them*, than in other People. What *little* you speak, let it be very *wise*, very *good*; such as may bespeak some respectful Regard for what you say. Then be not altogether discouraged under your Calamity: A *MOSES*, a *PAUL*, and a *BOYLE*, will make a noble *Triumvirate* of Companions for you, under your uneasy Infirmity.' I go on: The necessity of the *Tongue* for *Speech* will remain generally to be asserted, notwithstanding the Tricks of the *Ventriloqui*, taking advantage of the Duplication of the *Mediastinum*, to form various Voices; and notwith-

notwithstanding the rare Instance reported by *Roland*, in his *Aglossostomographia, sive Descriptio Oris sine Lingua, quod perfectè loquitur, & reliquas suas functiones naturaliter exercet.*

What the Emperor *Justinian* himself asserts in his Rescripts; [*Vidimus venerabiles Viros, qui abscissis radicibus Linguis;*] that he himself saw *venerable Men*, who when their *Tongues* were cut out, at the very *Root*, yet continued plainly speaking the *Truth* of *Christianity* against the *Arians*; a *Fact* whereof many *Witnesses* are subpœna'd by *Cujacius*: it looks miraculous!

*My God, thou hast made Man's Mouth! Make thou the Speech of mine what it ought to be. A pure Language! I have said, I will take heed, that I do not sin with my Tongue. Assist me to keep such a Resolution, and abhor all rotten or faulty Communication. I resolve my Mouth shall speak the Praise of the Lord: Oh that my Tongue may be like choice Silver, for the good Use and Worth of what is thereby articulated, and as a Tree of Life, in all my Conversation!*

If we pass down from the *Mouth*, we are quickly entertained with a *Wind-Pipe*, which is all made up of *Wonder*! A continual *Respiration* is necessary for the *Support* of our *Lives*; it is therefore made with *annulary Cartilages*, to keep it constantly open, and that the *Sides* of it may not flag and fall together. And lest, when we swallow, our *Meat* or *Drink* should fall in to do mischief there, it hath a strong *Valve*, an *Epiglottis*, to cover it when we swallow. For the more convenient bending of our *Necks*, it is not made of one *continued Cartilage*, but of many *annular* ones, which are joined by strong *Membranes*; and these *Membranes* are *muscular*, compounded of *strait* and *circular Fibres*, for the more effectual *Contraction* of the *Wind-pipe*, in any violent *Breathing* or *Coughing*. And that the *Asperity* of the *Cartilages* may not hurt the *Gullet*, which is of a *tender* and *skinny Substance*,

or hinder our swallowing of our Food, these annulary Gristles are not entire Circles; but where the *Wind-pipe* touches the *Gullet*, there the Circles are fitted up with only a soft Membrane, which may easily give way to the Dilatation of the *Gullet*. But now to proclaim a plain Design in this Conformation, as soon as the *Wind-pipe* enters the *Lungs*, its *Cartilages* are no longer deficient, but perfect Circles; it was no longer necessary they should be deficient, it was more convenient they should be perfect. And then, to finish the Collection which our excellent Ray has made (for I have him now before me) of these Curiosities; for the various Modulation of the *Voice*, the upper end of the *Wind-pipe*, is endued with several *Cartilages* and *Muscles*, to contract or dilate it, as we would have our *Voice* flat or sharp; and the whole is continually moistened, with a glutinous Humour issuing out of the small *Glandules*, that are upon its inner Coat: so 'tis fenced, that neither the *Air* fetched in, nor the *Breath* going out, may hurt it; yet it is of so quick a Sense, that it is provoked easily to cast out, by coughing, whatever may be offensive to it.

*Caspar Bartholin* has further observed, that where the *Gullet* perforates the *Midriff*, the carneous Fibres of that muscular Part are inflected and arcuate, as a *Sphincter* embracing it, and closing it fast; which is a sensible Providence, lest, in the perpetual Motion of the said *Midriff*, the upper Orifice of the *Stomach* should gape and cast out the Food as fast as it received it.

*Dr. Grew* observes, that the Variation of the *Wind-pipe* is observable in every Creature, according as it is necessary for that of the *Voice*; and the Rings of the *Wind-pipe* are fitted for the Modulation of the *Voice*.

The Faculty of the *Glottis*, in so exquisitely contracting, or dilating of itself, as to form all Notes, is, as *Mr. Derham* says, prodigious! For, as *Dr. Keil* notes, if you suppose the greatest Distance of the two sides

of the *Glottis*, to be one *tenth part* of an *Inch*, in sounding *twelve Notes*, to which the *Voice* easily reaches, the *Line* must be divided into *twelve Parts*, each of which gives the *Aperture* that is requisite for such a *Note* with a certain *Strength*. But if we consider the *Subdivision of Notes*, into which the *Voice* can run, the *Motion* of the *Sides* of the *Glottis* will be still vastly nicer. A *Voice* can divide a *Note*, at least into an *hundred Parts*, which a *just Ear* can perceive; but then it follows, that the different *Apertures* of the *Glottis* actually divide the *tenth Part* of an *Inch* into *twelve hundred Parts*, and a *good Ear* will be sensible of the *Alteration*. But because each side of the *Glottis* moves just equally, therefore the *Divisions* are double, the *Sides* of the *Glottis*, by their *Motion*, do actually divide one *tenth part* of an *Inch*, we must say, into *two thousand and four hundred Parts*.

My God, I desire that never any evil Word may have my leave to go thro so curious a Passage, and that the Dispositions of my Mind may not be so vicious and odious, as to render so elegant a Passage, the vent of an open Sepulchre. 'Tis fit that nothing but Confessions of God, and Kindnesses to Men, should have such an exquisite Passage found for them.'

We cannot leave these Parts, without considering *Respiration*. A Faculty of such importance to *Life*, that in the sacred Oracles, and indeed in our common Phrase also, *Breath* and *Life* are so concomitant, as to be equivalent: *Lord, thou takest away their Breath, and they die.*

The Uses of *Respiration* were but indifferently assigned, until *Malpighi's Discoveries*. *Willis*, and *Mayow*, and others, do mention Uses thereof that are not contemptible; but our *Thurston* rejects the Opinion of their being the *principal*, and thinks, 'tis principally to move, or pass the *Blood*, from the right to the left Ventricle of the Heart. Experiments made, by divers ingenious Men, on strangled Animals, have

demonstrated his Opinion: For which cause the learned *Etmuller* also espoused it, who having reckoned up no less than *thirteen* Uses of *Respiration*, which are of great consequence, but conduce rather to the *Well-being*, than the *Being* of the living Creature, he concludes with a *fourteenth*, as the chief of all, which is, *For the passing of the Blood thro the Lungs, that is thrown into them by the Heart.* Anon comes *Dr. Drake*, and he not only establishes this Notion of *Respiration*, but also carries it further, and makes it the true Cause of the *Diastrale* of the Heart; which neither *Borelli*, nor *Lower*, nor *Cowper*, much less any before those eminent Persons, have well accounted for. *Dr. Lower* has proved, that the *Heart* is a *Muscle*. The Motion of all *Muscles* does consist in *Constriction*. This accounts for the *Systole*: but the *Heart* has no *Antagonist Muscle*. What shall we now do for the *Diastrale*? Great Wits have been puzzled here. But now *Dr. Drake* makes the weight of the incumbent *Atmosphere* to be the true *Antagonist* for all the *Muscles*; which serve both for the *Constriction* of the Heart, and for ordinary *Respiration*.

*Dr. Cheyne* adds yet one Use more for this great Faculty and Action; that is, to form the *Elastick Globules*, of which the *Blood* does principally consist, and without which there would be a general Obstruction in all the *capillary Arteries*.

*Dr. Wainwright* observes, the *Air* can't remain in the *Lungs*, without being much heated, and thereby having the Spring of it unbent, and so become specifically lighter than the external *Air*: For which reason it will, by a known Principle in *Mechanicks*, give place to it, and rise to such an height, as till it meet with *Air* of its own Weight, and there it will remain. But then the Sides of the *Blood-Vessels*, which by the Inflation of the *Lungs* were drawn asunder, now, when the *Lungs* are crowded on an Heap, will be forced together, and so the *Blood* contained in them will be broken into innumerable Parts, exceeding small,

small, and thereby rendered the fitter to pass the several *Strainers* of the Body.

*Great God! thou hast in thy Hand my Breath and all my ways; I resolve to serve thee as long as I breathe; I resolve to look on thy Service as the end for which thou dost continue my Breath; I resolve to employ my Breath in thy Service to the last: I will praise thee as well as I can to and in my last Breath; and when I have no Breath, I shall do it better.*

Behold now the *Lungs*, a most surprizing Piece of Workmanship! Consult the Description of them given by *Malpighi*, who first of all discovered their *Vesiculae*; and by *Willis*, who, writing after him, has proceeded upon it yet more accurately, and by *Cowper* in his admirable Tables. Then stand and admire the *Work of God*. You can do no otherwise! We will not meddle with the Controversy between *Etmuller* and *Willis*, whether the *Vesiculae* of the *Lungs* have any muscular Fibres, or no. We will content ourselves with *Galen's* Conclusion upon the Parts ministring to *Respiration*, that *admirabilem Sapientiam testantur*.

While the *Fœtus* is yet in the *Womb* (as *Dr. Keil* observes) the *Vesicles* of the *Lungs* lying flat upon one another, compress all the *capillary Blood-Vessels*, which are spread upon them. As soon as we are born, the *Air*, by its Gravity and Elasticity, rushes into the empty Branches of the *Trachea Arteria*, and blows up the *Vessels* into Spheres: by which means the Compression being taken off from the *Blood-Vessels*, and they equally expanded with the *Lungs*, all the *Blood* has a free Passage thro the *Pulmonary Artery*. But when the *Air* is thrust out again, by a Contraction of the Cavity of the *Thorax*, it being a fluid Body, compresses the *Vesicles* and *Blood-Vessels* upon them, every where equally. By this Compression, the red Globules of the *Blood*, which thro their languid Motion, in the *Veins*, were grown too big to circulate in the fine *capillary Vessels*, are broken, and again divided in the

*Serum*, and the *Blood* is made fit for Nutrition and Secretion. This Pressure of the *Air* on the *Blood-Vessels*, Dr. Keil says, is equal to an hundred pound weight. It is also probable, he thinks, that Particles of the *Air* must enter the *Blood-Vessels*, and mix with the *Blood* in the *Lungs*.

The Divine Workmanship about the HEART, who, that has any *Heart*, can forbear admiring of it, with most sensible Acknowledgments! This is that admirable Bowel, which with its incessant Motion distributes the *Blood*, the Vehicle of Life, throughout the whole Body. From this *Fountain of Life and Heat*, there are *Conduit-Pipes* even to the least, yea, and most remote Parts of the Body. 'Tis the Machine, which receives the *Blood* from the *Veins*, and forces it out by the *Arteries*, thro the whole Body. The force with which the *Heart* squeezes out the *Blood* into the *Arteries*, is, in Borelli's Reckoning, equal to the force of three thousand Pound weight. For this important Use it is most exquisitely contrived. Being a *muscular* Part, the Sides of it are composed of two Orders of *Fibres*, running circularly or spirally from the Base to Tip, contrarily the one to the other; and so being drawn contrary ways, do violently constringe and straiten the *Ventricles*, and strongly force out the *Blood*. And then the Vessels, we call *Arteries*, which carry from the *Heart* to the several Parts, have their *Valves*, which open *outwards* like Trap-doors, and give the *Blood* a free Passage out of the *Heart*, but will not suffer any Return of it thither; and the *Veins*, which bring it back from the several Members to the *Heart*, have their *Valves*, or Trap-doors, which open *inwards*, and give way for the running of the *Blood* into the *Heart*, but prevent its running that way back again. Moreover, the *Arteries* consist of a *Quadruple Coat*, the third of which is made up of annular, or orbicular, carneous *Fibres*, to a good Thickness, and is of a *muscular* Nature, (which was first observed by

Dr.

Dr. *Wilis*) and this, after every Pulse of the *Heart*, serves to contract the Vessel successively with incredible Celerity, so by a kind of *peristaltick Motion*, forcibly and very swiftly impelling the *Blood* onwards to the *capillary Extremities*, and thro the *Muscles*; wherefore the Pulse of the *Arteries* is not caused only by the Pulsation of the *Heart*, which drives the *Blood* thro them after the manner of a *Wave*, as many would have it; but also by the *Coats* of the *Arteries* themselves, as it has been confirmed by the Experiments of many modern Physicians, yea, and of *Galen* also. We may add one thing more, that the *Heart* and the *Brain* do notably enable one another to work; for the *Brain* cannot live unless it receive continual Supplies of *Blood* from the *Heart*, much less can it perform its Functions of preparing and of dispensing the *Animal Spirits*; nor can the *Heart* afford a *Pulse*, unless it receive *Spirits* or something descending from the *Brain* by the *Nerves*: do but cut asunder the *Nerves* that go from the *Brain* to the *Heart*, the *Motion* thereof ceaseth immediately.

For the *Motion* of the *Heart*, Monsieur *Tauvry* lies to a *subtile Matter* managing the *Fibres* of it, but seems to acknowledge it a *Matter* which no *Mortal* has traced yet to *Satisfaction*. In fine, the *Heart* is a compound *Muscle*, and each *Ventricle* of it will (as Dr. *Keil* observes) contain an *Ounce* of *Blood*. We may well suppose the *Heart* throws into the *Aorta* an *Ounce* of *Blood* every time it contracts; the *Heart* contracts four thousand times in one *Hour*, sometimes more, sometimes less; hence there passes thro the *Heart* every *Hour* four thousand *Ounces* of *Blood*, that is to say, three hundred and fifty *Pound*. Now the whole *Mass* of *Blood* is no more than twenty-five *Pound*, so that a *Quantity* of *Blood* equal to the whole *Mass* passes thro the *Heart* fourteen times in one *Hour*, which is about once in every four *Minutes*; not the *whole Mass* itself: we don't suppose that the *Blood* which goes to the *Extremities*,  
can

can return to the *Heart* as soon as the *Blood* which goes only to the *Kidneys* or the *Liver*.

‘ Without making any fanciful Excursions upon  
‘ *Metaphors* drawn from the *Figure* and *Office* of the  
‘ *Heart*, I am sure ’tis infinitely reasonable that I  
‘ should behold this *Bowel* with a most hearty and  
‘ lively Sense of my Obligations to give thee my *Heart*,  
‘ O my God, and love thee with all my *Heart* !’

The *Stomach* has in it how many things that are truly admirable ! The greatest Philosophers have cried out, ‘ How great a Comprehension of Nature did it require to make a *Menstruum* that should corrode all sorts of *Flesh* coming into the *Stomach*, and yet not the *Stomach* itself, which is also *Flesh* !’ ’Tis membranous, and capable of being dilated or contracted, according to the Quantity of Meat contained in it ; the Situation of it under the *Liver*, accommodates with an *Heat*, that carries on the *Concoction* ; when it has gone thro with the *Concoction*, it can shrink itself, and cast out the Food. But, *Concoction*, how performed ? Inform us, Dr. Drake ! — There is in Bodies a *Principle of Dissolution*, which upon the Extinction of their vital and vegetative Faculty, begins to exert itself towards the *Destruction* of the Subject. This *Principle of Corruption* is, perhaps, the same that in a State of *Circulation* and *Vegetation* was the *Principle of Life*, but now being denied that Passage which it had before, it makes its way *irregularly*, and so destroys the Continuity of the *Solids*, in which it is included, and introduces that Change in the whole Mass which is called *Corruption*. This *active Principle* is a sort of Air, which is mixed in a considerable Quantity with all sorts of *Fluids* ; this (tho its natural and essential Motion be expansive or *quaquaversum*) when it is introduced into Bodies, has two kinds of motion, one *expansive*, by which it communicates that *intestine Motion* which all Juices have, and by which the containing Parts are gradually extended, and have their  
Growth ;

Growth; but the other *progressive*, and indeed *circulatory*, which is occasioned by the Renitency of solid Parts, and obliges its taking that Course which is most open and free. This *Motion* being stopt, the *expansive* still remains, and continues to act, till by degrees it hath so far overcome the Resistance of the including Bodies, as to bring itself into an equal degree of *Expansion* with the *external Air*, which cannot be done without a *Destruction* on the Texture and Continuity, or specifick degree of Cohætion of the *Solids*; and this is called a *State of Corruption*. This *destructive Quality* of the *Air* in Bodies may be promoted, either by *weakening* the Tone of them, and the Cohætion of the Parts, and so facilitating the Work of the *Air*, as it is done when *Fruit* is bruised; or by intending the *expansive Force* of the *Air* itself with *Heat*, or other co-operating Circumstances. The former is done in *Mastications*, the latter is done by the *Heat* of the *Stomach*, which forcibly rarefying the *Air*, enables it to rend the including Bodies to pieces the sooner, and so to let loose the Fluids, and perhaps likewise produce a Comminution upon several parts of the *Solids*, so as to make them sustainable in the *Liquor*; which latter is the Operation that compleats the *Digestion in the Stomach*. In *stewing*, tho the *Heat* be unspeakably short of what is in *roasting* and in *boiling*, the Operation is of all the quickest, because it is performed in a pretty close Vessel, and full, by which means the *Succussions* are more often repeated, and more strongly reverberated. The Operation of the *Stomach* is mightily resembled by the *Digestor* of Monsieur *Papin*; in this the *Meat* is put, together with so much *Water* as exactly fills the *Engine*, the Lid is then skrewed on so close as to admit of no external *Air*, and with two or three lighted *Charcoal*, or the *Flame* of a *Lamp*, it is reduced into a perfect *Pulp*, or indeed a *Liquor*, in a very few Minutes, in six, or eight, or ten, or twelve, or sixteen, according to the Toughness of the Matter

to be digested, or the Augmentation of this little Fire ; this way even the *hardest Bones* are presently dissolved. Thus the *Stomach* naturally closes on the Aliments, which descend to it ; it strictly embraces them when it is full ; by keeping out extraneous *Air*, it fortifies and invigorates the *Succussions* of that which is contained in the Aliments, and this is enabled hereby to break and resolve the Bodies which included it, into Particles that may be small enough to enter the *Lacteals*. When all the *Chyme* and *Chyle* is pressed out, the *Stomach*, which follows the motion of its Contents, is again by means of its *muscular Coat* reduced into a State of Contraction, and the inner is brought thereby to lie in Folds, and by means of the *Peristaltick Motion* rubbing lightly upon one another, produce that Sense of a *Vellication* which we call *Hunger* : this being felt first in the upper Orifice, which is first evacuated, begins first therefore to prompt us to replenishing ; but as by degrees the remainder of the Contents are expelled, this Friction of the Membranes upon each other, spreads gradually over the whole *Stomach*, and renders our *Hunger* more impatient.

*Great God, I bless thee for all my Food. My gracious Feeder, I bless thee that I have not known the terrible Famine. I will take no Food without looking up to thee for thy Blessing, by which alone I live !*

The *Intestines* ; these receive the *Chyle*, from the *Pylorus* ; these further digest it, prepare it, separate it : these by their peristaltick Motion drive it into the *Lacteals* ; but the excrementitious Parts they send off elsewhere, from whence there is no regress, unless upon a Relaxation or Laceration befalling the Valve of the *Colon*. Can you behold the Structure of the *Intestines*, as reported by *Kerkringius*, by *Glisson*, by *Willis*, and *Peyer*, and others, without Astonishment !

The *Intestines*, 'tis wonderful, they are six times as long as the *Body* to which they appertain ; and now that they should keep their *Tone*, and their *Site*, and hold

hold on doing their *Office*, and give an undisturb'd Passage to what every day passes thro them, and this for some Scores of Years together, 'tis impossible for me to consider it without falling down before the glorious God, and making that Acclamation, *What hast thou done in me, O thou Preserver of Men! How much do I depend upon thee for my Preservation from grievous Diseases!*

The *Liver* does admirable things, in continually separating the *Choler* from the *Blood*, and emptying it into the *Intestines*, where it is useful, not only to provoke *Dejection*, but also to attenuate the *Chyle*, and render it so subtil and fluid, that it may enter at the *Orifices* of the *Lacteals*.

The *Bladder* is an admirable Vessel! The Substance is *membranous*, and extremely dilateable, for the receiving and containing of the *Urine*, till a convenient opportunity of emptying it; it hath also Shuts for the Ends of the *Ureters*, which are so artificially and marvellously contrived, as to give the *Urine* a free entrance, but stop all passage backward: the *Wind* itself cannot be transmitted thro the Shuts, tho never so strongly forced upon them!

In the *Kidneys*, how admirable the innumerable *Siphons*, the little and curious *Tubes*, conveying the urinous Particles into the *Ureters*! discovered first by *Bellini*, afterwards illustrated by *Malpighi*.

*Leuenhoeck* has discovered Vessels in an Human Body, the *Diameters* whereof are more than *seventy-nine thousand* times less than an *Inch*; and, as *Dr. Wainwright* observes, at least so small must be the *Diameters* of the *Lacteals*. My God, how exquisite, how curious are thy Works! But then how much do I depend upon thee to keep all the Vessels of my Body, doing their *Office* in their order!

— That so fine an Engine is not ruin'd a thousand times in a day, but holds on in its motion for *twenty-five thousand five hundred and sixty-seven Days!*

All the *Glands* of the Body, each of them an admirable *Congeries* of many *Vessels*, in a stupendous Variety, curled, complicated, circumgyrated, and marvellously woven into one another; these give the *Blood* an opportunity to stop a little, and separate thro the Pores of the *capillary Vessels* into the *secretory* ones, which after all exonerate into one common *Ductus*. Read *Wharton*, and *Bartholin*, and *Bilsius*, and others; but prepare always for a Field of *Wonders*, equal to any in the *Field of Zoan!* — But then consider too the Variety of *Humours* that are separated by the *Glands*; all different in Colour, in Taste, in Smell, and in other Qualities.

The *Bones*, how admirable in their Circumstances! The *Back-bone* is contrived with an Artifice truly astonishing! It is divided into many *Vertebres*, for the commodious *bending*; one entire and rigid *Bone* of that length would have been often in danger of snapping; it is *tapering*, in the form of a *Pillar*, the lower *Vertebres* being the broadest and largest, the superior in order lesser and lesser, that so the Trunk of the Body may have the greater Stability: but the several *Vertebres* are so elegantly compacted and united, that they are as firm and strong as if they were but one single *Bone*; they are all perforated in the middle, with a large Hole for the *Spinal Marrow* (that wondrous *Pith!*) to pass along, and each of them hath an Hole on each of their sides, to transmit the *Nerves* to the *Muscles* of the Body, and thereby convey both Sense and Motion. By the close Connection of the *Vertebres*, the *Back-bone* is formed so as to admit of no great Flexure and Recess from a right Line; it also admits no *angular*, nor any but a moderate *circular* bending, lest the *Spinal Marrow* should be compressed, and so the Passage of the Spirits to and fro meet with some Obstruction.

Dr. *Grew* observes, that in *Trees* there is a new Ring added every Year out of the Bark to the Wood; so

too in *Animals*, while they grow, there is a new *Periostium* added from time to time out of the *muscular Membranes* to the *Bones*: *The sweet Harmony with the vast Variety in the Works of God!*

Admirable the Provision that is made for the more easy and expedite Motions of the *Bones* in their Articulations: a twofold *Liquor* is prepared, by the Inunction whereof their *Heads* or *Ends* enjoy some Lubrication; first, there is an *oily* one, furnish'd by the *Marrow*; and then there is a *mucilaginous* one, furnished by certain *Glandules*, that are seated in their Articulations; both of these together make up the most proper *Mixture* for this purpose that can possibly be thought upon; both of the Ingredients are *lubricating*. But more than this, from their Composition they mutually improve one another; the *Mucilage* adds to the smoothing Efficacy of the *Oil*, and the *Oil* preserves the *Mucilage* from Inspissation, and from contracting the Consistency of a Jelly. Hereby the *Motion* of the *Bones* is facilitated; for if they were dry, they would not readily obey the Pulls of the *motory Muscles*, which we find in the *Wheels* of our *Clocks*; the ends of the *Bones* are hereby also kept from an inconvenient *Incalescency*, which, if they were dry, being so hard, a swift and long *Motion* would necessarily give to them; and thus the *Wheels* of our *Coaches* must be besmeared with a *Mixture* of *Grease* and *Tar* (an Imitation of *ours!*) that they may not be set on fire. What a *slothful World* must we have had, and how confined to *Deliberation*, if this Care had not been taken of our *Bones!* And finally, a great *Mischief* is now prevented, the *Ends* of our *Bones* are not *worn down*, by a grievous *Attrition* in their motion rubbing against one another; 'tis indeed a strange thing that this proves a sufficient *Preservative* to prevent the *Consumption* of the *Bones*, when we see the tops of *Teeth*, which are harder, worn off by *Mastication*, and brought so low, that the very *Nerve* lies bare, and for meer *Pain* they  
can

can be used no more. The ingenious Mr. *Havers*, who makes these Remarks in his *Osteology*, makes this Conclusion : *Here we cannot avoid the notice of the visible Footsteps of an infinite Reason, and we can never sufficiently admire the Wisdom and Providence of our great Creator !*

We may add, wonderful the *Construction* of the *Bones*, that are to support the *Body*, or bear heavy *Burdens*, or be employed in difficult *Exercises* ; they are made *hollow*, this wonderfully accommodates them for both *Lightness* and *Stiffness* ; an *hollow* *Body* is more inflexible than a *solid* one, of the same *Substance* and *Weight* : but the *Ribs*, which do not carry *Loads*, nor do any thing wherein so much *Strength* is required, but are only to fence the *Breast*, these have no *Cavity* in them, and these, towards the fore part of them, are broad and thin, so that they may give way, without much danger of any *Fracture* ; and when they are bent, they do by their *elastick* *Property* again return to their *Figure* : and yet the *Hollow* of the *Bones* is not useless, but it contains the *Marrow*, which supplies an *Oil*, for the *Maintaining* and *Inunction* of the *Bones*, and of the *Ligaments*, and facilitating their *Motion*, and to secure them from *Disruption*, to which they would by any sudden *Contortions* be otherwise obnoxious. The mention of the *Ribs* will bring on one *Observation* more ; That altho the *Breast* is encompassed with *Ribs*, the *Belly* is left free ; this is, that it may give way to the motion of the *Midriff* in *Respiration*, and to the necessary reception of our *Food*, and to the convenient bending of our *Body*. The *Females* also find the *Benefit* of it in the time of their *Pregnancy*. *Great God, all my Bones must say, who is like to thee ! I bless thee for that thou dost not chasten the multitude of my Bones with strong Pain !*

It cannot be without *Admiration* looked upon, that all the *Bones*, and all the *Muscles*, and all the *Vessels* of the *Body*, should be so contrived, so adapted and compacted, for their several *Motions* and *Uses* ! All according

according to the strictest Rules of the *Mathematicks*! If you attempt an Innovation or Alteration, you *mar* all instead of *mending* any thing. In the *Muscles* alone there is more *Geometry* than in all the artificial Engines in the World; the greatest Mathematicians have not found a nobler Subject for their Disquisitions and Contemplations than *de Motu Animalium*. The Essays of *Croon*, and *Steno*, and *Borelli*, on that Subject, have been very curious.

Dr. *Grew* observes, that no less than forty or fifty *Muscles*, besides many other subservient Parts, go to execute that one *Act of Laughing*; certainly then *laughing for nothing* may be indicted for an *Act of Folly*! He goes on with his Observation, That in some Cases we cannot execute *one single Thought* without such a Retinue. Suppose one sitting in a Room has a *Thought* of looking at something out of a Window, that one *Thought* has immediately seventy or eighty *Muscles* put into motion to wait upon it; so that, says the Doctor, *there is not a Monarch upon Earth served with such Majesty as every Man is within the Territory of his own Body*: But then how reasonable is it, O Man, for thee to serve the Maker of all these! *Glorious God, I will do it with all my Muscles, with all my Powers!*

Dr. *Grew* has a further Observation; What can be more admirable, than for the Principles of the *Fibres* of a *Tendon* to be so mixed as to make it a soft Body, fit both to receive and impart the Species of *Sense*, and to be easily nourished and moved, and yet with such a *Softness* to have the *Strength* of *Iron*!

Those *Muscles* which appear as contemptible as any of the Body, even the *Muscles of the Belly*, tho' *Galen*, and other Anatomists after him, have contented themselves with reckoning four or five *Uses* of them, they are indeed more than can be reckoned. Dr. *Grew* has employed almost a large Page in the Enumeration.

'Tis admirable that under our *Skin* there should be such an unknown variety of *Parts*, and so very variously mingled,

mingled, all so pack'd that there is no *unnecessary Vacuity* in the whole Body, yet so far from clashing with and hindring of one another, that they do all in the most friendly manner *conspire* to assist one another, and concur in the general Design, which is the Preservation of the whole. Behold, *Arguments* (as our pious *Ray* well notes hereupon) of *infinite Wisdom and Counsel*! He must be worse than mad, that can find in his Heart to imagine all not provided by a most wise and intelligent Cause!

Every Part is clothed, joined, corroborated by *Membranes*, which are capable of a prodigious Extension; those of the *Peritonæum* are a particular Instance of that, out of which alone, in *hydropical Persons*, there have been drawn forty Gallons of Water, by a *Paracentesis*. The undoubted Authorities of *Tulpius*, and *Blasius*, and other Physicians, oblige us to believe surprising things of this Importance.

It is notable, that all our Organs are involved in *Coats*, one or more, consisting of tough or muscular *Fibres*, intended not only to *protect* them, as has been commonly thought, but also by a due Constriction to assist them in *straining* off their several Contents.

These Parts which at first appear to be of no more use than to fill up empty Spaces, will upon Examination be found exceeding serviceable. The *Fat* serves to cherish the Body, and keep it warm; yea, will maintain it for some time, when *Food* is wanting, and be as a sulphurous *Pabulum*, to preserve the *Heat* of the *Blood*. By what Vessels the *Fat* comes to be separated from the *Blood*, is a Point of curious Enquiry; the collection of it more on some certain Parts (as the *Caul* and the *Reins*) than on others, appears to be for the cherishing of those Parts with *Warmth*; the *Caul* is like an Apron of *Woollen Cloth* to the lower Belly. The *Gladiator*, whose *Caul* was cut out by *Galen*, felt so much *Cold*, that he was forced constantly to keep his Belly covered with *Wool*. The *Intestines* containing  
much

much Food, there to undergo its last Concoction, and Vessels of Blood not flowing thither, need such a Covering to defend them; doubtless a constant Heat is required about the Reins, for the Separation of the Urine from the Blood: for we see if the Blood be chilled, the Secretion of the Urine will be sensibly stopt, and the Serum cast upon the Glandules of the Mouth and Throat.

Monfieur Bernoulli, in a curious Meditation about muscular Motion, has observed another thing, that must not be pretermitted; that in muscular Motion the Expence of Animal Spirits is not in proportion to the Labour which the Animal is at: and so a Man reduc'd to hard Labour, is not reduc'd to the necessity of having twice or four times as much Victuals as one that is under no such necessity of working. Now the Spirits are the most precious things in all the Animal Body, we live by them; so needful and useful a Substance was to be saved by all the Means that were possible. And behold, as Dr. Cheyne expresses it, *we see the wise Author of Nature has taken wonderful Care that no Expences should be made that could be avoided.*

It has been observed by some, that to provide Matter for the generation of Spirits in Man, a vast Quantity of Blood is prepared, far exceeding what is found in other Animals. The Blood for the Body of Man bears the Proportion to his Weight, of one to ten; in other Animals 'tis but one to twenty. And for the fetching of Spirits out of this Matter, there is the Laboratory of the Brain, which in a Man is twice as much as in a Beast four times as big.

It is Dr. Cheyne's Proposition, That the Strength of Animals is in a triplicate Proportion to the Quantity of Blood running in the Vessels.

The Lympha of the Blood is a marvellous thing; a Liquor separated in the Membranes and Glandules, which is the Medium whereby the serous and fibrous Parts of the Blood are united, and the Bones and mem-

*branous* Parts of the Body are nourished. But how marvellous the *Lymphatick Vessels*, which convey this *exquisite Liquor*! They disappear when the *Animal* dies; their number is unaccountable: they were first of all discovered by *Thomas Bartholin* and *Olaus Rudbeck*, in the Years 1650 and 1651. *Pecker* made a progress in the discovery of them; and their Valves were demonstrated by *Frederick Ruysch*, which permit this transparent Liquor to pass thro them towards the *Heart*, but are like shut *Floodgates* upon the returning; they rise in all Parts of the Body. The *Glands* that separate the *Lympha* are of the smallest kind, and scarce visible by the finest *Microscopes*; but the *Lymphaducts* unite with one another, and grow larger as they approach the *Heart*; and yet they do not, like the *Veins*, open into one common Channel. — The whole Contrivance of these *fine Vessels*, who can behold without Amazement!

About the *Blood*, this is admirable; the Branches which go off at any small distance from the Trunk of an *Artery*, unite their Channels into one Trunk again, whose Branches likewise communicate with one another, and with others; whence it comes to pass (as *Dr. Keil* observes) that when any small *Artery* is obstructed, the Blood is brought by the communicating Branches to the Parts below the Obstruction, which must otherwise have been deprived of their Nourishment. And in the *Veins* there is the like Provision, that so justly surprizes us in the *Arteries*.

The *Viscidty* of the *Blood* is increased by the *Heat* in a *Fever*; if we apply a much less degree of *Heat* than will boil Water, it will turn the *Serum* into a *Jelly*; the *Heat* of the *Skin*, where the *Pulse* will beat sixty Strokes in a Minute, is to the *Heat* of boiling Water as 16 to 52; boiling Water is but little more than three times as hot as the *Blood* of an healthy Man. If the *Heat* of the *Blood* increase in proportion to the Beat of the *Pulse* (as it must, if it beat with the same Strength

Strength it did) a Man whose Pulse beats 195 Strokes in a Minute, would be as hot as *boiling Water*; now 120 Strokes is common. Behold whence the *Siziness* of the Blood in inflammatory Distempers!

‘Why should I sinfully *over-heat* my *Blood*? But since my Life depends on the good Constitution of this *red Liquor*, which is yet so easily depraved, so easily disturbed, so easily overturned; O God of my Life, I wonder that I live! I desire to live as a dying Man! But I live, because thou art the God of my Life!’

But at last the *Instrument* all this while employed in writing these things, that *ὄργανον ὄργάνων*, demands of me that it be not forgotten; the HAND, the HAND, whereof I need no *Cicero* to be my Monitor, *Quam aptas, quamque multarum Artium Ministras, MANUS, Natura homini dedit!* It is divided into four Fingers, bending forwards, and one stronger than any of them that bends backwards, to join with them; 'tis fitted thus to *lay hold* on Objects of any shape, or size, or quantity; and sometimes *one Finger* alone can discharge many Offices: the *Fingers* are strengthened with several *Bones*, jointed for motion, furnished with *Muscles* and *Tendons*, to bend them circularly forwards; how convenient this for the holding and griping of any Object! The *Fingers* also have their *Muscles*, to extend and open the *Hand*, and move them to the right and left; and thus the *whole Hand* may be employed, as all of a piece.

But then how notable is it, how wonderful! That the *Tendons* bending the *middle Joint* of the *Fingers* are so *perforated*, as to give passage to the *Tendons* of the *Muscles* which draw the uppermost Joints, and all bound close down to the *Bone* with strong *Fillets*, like so many Bow-strings, lest they should start up, and hinder the *Hand* in its Operations: finally, the *Ends* of the *Fingers* are fortified with *Nails*, which indeed *adorn* them as well as *defend* them; yea, and have their further Uses too, if what *Camillus* writes in his *Trea-*

rife upon the forming of *Judicia Medica* from the Inspection of the *Nails*, may be relied upon: and how thin the *Skin*, and how exquisite the *Sense* at our *Fingers-ends*, by which we may judge of what we have there to be handled! We know who considered this Question, and how long ago; *Num eam omnino Constitutionem habeat Manus, quã meliorem aliam habere non potuit?*

The *Uses* of this *astonishing Instrument* cannot be reckoned up; a whole *Book* written by it, might be easily filled with an Enumeration of its *Uses*. *Aristotle* says well, They do ill who complain that Man is worse dealt with than other Creatures, who are born with *natural Weapons* to defend themselves, and offend their Enemies; an *Hand*, with *Reason* to use it, abundantly supplies the *Uses* of all those *natural Weapons*; 'tis an *Horn*, an *Hoof*, a *Claw*, a *Tush*, and all! *Dr. Grew* says very truly, *Never was there made an Instrument so curious!* The sixteen several general *Motions* of it are the *Elements of Operation*, as the *Letters* are of *Speech*; how infinitely to be diversified! What shall we call this but the *Handy-work of our God!*

*Galen* having described the Parts of the *Fingers*, and their *Motion*, cries out, *Considera hic mirabilem CREATORIS Sapientiam!*

'When I apply my *Hand* to any *Action* which could not be done without it, I have my *Mind* invited to such a *Thought* upon it; *Great God, I bless thee for arming me with so curious and so adapted an Instrument!* *May I never ungratefully put forth my Hand to an evil Action.'*

'Such a *Thought* often rolling in my *Mind*, and ruling of my *Hand*, would be a better *Token for Good* to me, than the most promising *Lines* of any silly *Chiromancy*.'

*Voluntary Motion* should not be left unconsidered; whereof *Dr. Cheyne* observes, the only *Conception* we can form, is, that the *Mind*, like a skilful *Musician*,  
strikes

strikes on that *Nerve* which conveys *Animal Spirits* to the *Muscle* that is to be contracted, and adds a greater force than the *natural* to the *nervous Juice*, whereby it opens its passage into the *Vesicles*, of which the *muscular Fibres* consist; but this *Action* of the *Mind* or *Will* on these *Animal Spirits*, is altogether *unaccountable* from the *Laws of Motion*. *My God, in thee I move!* *The astonishing Power of Spontaneous Motion is what thou hast given me! Oh! may I never employ it in any Acts of Rebellion against Him that gave it.*

Certainly Men may do well also to consider, whether the very *Configurations* of several *Parts*, may not afford good and great *Admonitions of Morality* to them. I need not explain my self, when I offer an *Hint* I have somewhere met withal: *Ponder, O Man, what Parts of thy Body have Bridles of Nature upon them!*

Some *Consideration* is also due to the *astonishing Strength* with which the *Bones* of Men have been sometimes endued. The *Strength* for which a *Samson* has been so famous, was indeed owing to a *Possession* and *Assistance* of a *Spirit* entering into him from above; but the *ordinary Strength* of our *Nerves*, exerted in *moving* and *lifting*, is truly admirable; the *Force* of the *nervous Fluid!* And the *Ability* of the *little Fibres*, to sustain what it puts them on! And there are now and then, since the *Days of Milo the Ox-carrier*, *Examples of Strength*, which will yet more *strongly* call for our growing *Admiration*; it would swell my *Essay* so big, that it would require a *Man* of such *Strength* to carry it, if on this and other *Occasions* I should insert all that has occurred to our purpose, in *Valerius Maximus*, in *Cælius Rhodiginus*, in *Zuinger*, in *Camerarius*, in *Hakewell*, in *Wanly*, and in other *Collectors*; however, a touch or two may not be unacceptable.

The *Tyrant Maximus* would with his *Hands* draw *loaden Carts* and *Wains*, break the *Bones* of *Horses*, and cleave *Trees* asunder. *Marius*, who of a *Cutler* became an *Emperor*, could with his fourth *Finger* stop a *Cart*

that was drawn with Horses, and force it backwards; and a *Fillip* of his Finger (which they also report of *Tiberius*) would knock a Man down like a Blow of an *Hammer*. One *Salvius*, mentioned by *Pliny*, having an *hundred-Pounds* weight at his *Feet*, and as many in his *Hands*, with twice as much on his *Shoulders*, could go up a pair of *Stairs*. *George Castriot* with his massy *Scimeter* did amazing Executions, he cut the *Turks* to pieces, *Barletius* affirms, three thousand of them with his own *Hands*, and scorn'd ever to throw away more than *one Blow* upon an *Object*; he could cleave *Helmet* and *Harness*, as if they were but *Straw* before him, *Cardan* saw one dancing with two in his *Arms*, two on his *Shoulders*, and one hanging about his *Neck*. A *Baron of Mindelheim* would with his middle *Finger* do things that surpass *Imagination*; he would shove a *Cannon* where he pleased; he would break *Horse-shoes* with his *Hands* like *Potsherds*; (which is a *Circumstance* they also relate of *Pocova*, a *Polish Gentleman*.) Little *Venetianello* would with his *Hands* wreath great *Pins of Iron*, as if they were softened with the *Fire*, and carry on his *Shoulders* an erect *Beam* of twenty foot long and a foot thick, and shift it without the use of *Hands* from one *Shoulder* to another. A *Provost* at *Misna* would make nothing with his bare *Hands* to fetch a *Pipe of Wine* out of a *Cellar*, and lay it on a *Cart*. *Mayolus* affirms he saw a *Man* who took a *Pillar* of *Marble* three foot long, and one foot in diameter, which he cast up very high into the *Air*, and received it again in his *Arms*, and play'd with it as a little *Ball*; and another who would break a *Cable* as big as a *Man's Arm*, as easily as if it were a *Thread of Twine*. *Froisard*, a faithful *Historian*, tells of a *Man* who would make nothing to carry a great *Ass*, with all his *Lead*, upon his *Back*. The *Stories* we have of the mighty *Burdens* carried by some of our *Cornish Men*, related by *Mr. Carew*, and others, are truly wonderful,

Can we now do any other than fall down before the glorious G O D, who has given such *Strength* to the Children of Men, as if their *Strength* were the *Strength* of Stones, or their *Flesh* were Brass; (and yet, when God pleases, *crush'd* before the Moth!) with the antient Adoration, O Lord God of Hosts, who is a strong God like to thee!

I conclude with the pathetic Words of an outlandish Doctor of Philosophy; *O Deus, si totius Corporis mei Membra verterentur in Linguas, Nominis tui magnificentiam enarrare non possem.*

But in M A N, must that have the *last* Consideration, the *State* whereof, alas, is that which too commonly is the *last* considered! The S O U L, which has mustered the many *Thoughts* wherewith our *Christian Philosopher* has fill'd his Pages, must now be thought upon. But oh! How much is the *Father of Spirits* to be herewith acknowledged and glorified! Even the Pagan Orator shall be our Monitor; *Jam vero Animum ipsum, Mentemque Hominis, Rationem, Consilium, Prudentiam, qui non Divina Cura perfecta esse perspicit, is his ipsis Rebus mihi videtur carere.*

'Tis high time for us now to take the S O U L of Man into our Contemplation. The S O U L, whereof *Juvenal*,

*Sensum à cœlesti demissum traximus arce,  
Cujus egent prona, & terram spectantia. ———*

The S O U L, whereof *Claudian*,

*—— Hæc sola manet, bustoque superstes  
Evolat. ——*

And if our *Philosophy* terminate in *Theology*, the surprizing Words of a Pagan Physician will be proper to be introduced on the Occasion: O *Galen*, we Professors of *Christianity* will be thy surprized Hearers, while thou

thou speakest at this rate to us: *Si quis nulli Sectæ ad-  
dictus, sed libera sententia rerum Considerationem inierit,  
conspicatus in tantâ Carnium & Succorum coluviæ tantam  
Mentem habitare, — (omnia enim declarant Opificis Sapi-  
entiam,) — perfectissimæ Theologiæ verum principium con-  
stituet; quæ Theologia multo est major atque præstantior to-  
ta Medicina.* [De usu Part. lib. 17. c. 1.] Wonderful  
Words from a Pagan Physician!

The stupendous Faculties of the SOUL!

The *Wisdom*, with which a SOUL may perform  
wonderful things. 'Tis the *Wisdom* that God puts into  
the Heart of a Solomon.

The Performances of that reaching *Philosophy*,  
which we have seen sagacious Minds endued withal,  
they have been amazing ones!

The Performances of the *Politician*, have sometimes  
been as amazing as those of the *Philosopher*.

Men of a *Great Soul*, what astonishing things have  
they arrived unto!

And yet, I will venture to say, the *Love of GOD*  
in the Soul, or a *Principle of Grace* infused into it, is a  
*Divine Workmanship*, that is more noble than all its o-  
ther Faculties, and will unspeakably enoble them all.

I have read, in the *Asceticks*, of a Servant of God, a  
Passage of this Importance: 'I am not unable to write  
' in *seven Languages*; I feast myself with the Sweets  
' of all the *Sciences*, which the more polite part of  
' Mankind ordinarily pretend unto. I am entertained  
' with all kinds of *Histories*, antient and modern. I  
' am no Stranger to the *Curiosities*, which by all sorts  
' of Learning are brought to the Curious. Never-  
' theless, it appears unto me more valuable than all of  
' this, it appears more delectable, it is a thing of a  
' superiour Character, with a true *Spirit of Charity*,  
' to relieve a poor, mean, miserable Neighbour;  
' much more to do any extensive Service for the Re-  
' drefs of those *Epidemical Miseries*, under which Man-  
' kind

' kind in general is languishing, and to advance the Kingdom of God in the World.'

REASON, what is it, but a Faculty formed by GOD, in the Mind of Man, enabling him to discern certain *Maxims of Truth*, which God himself has established, and to make true *Inferences* from them! In all the Dictates of Reason, there is the *Voice of God*. Whenever any *reasonable thing* is offered, I have GOD speaking to me. Behold a Method in which a Man, (who will shew himself a Man, and hearken to Reason) may fill his Life with *Acts of Obedience* to GOD! Whatever I see to be Reason, I will comply with it, from this Consideration, 'tis what GOD calls me to! Reason extends to Points of *Morality*, with as much Evidence as to those of *Mathematicks*. 'Tis as evident, that GOD, my Maker, is to be glorified; and, that I am to do as I would be done unto; as it is, that three and four makes seven; or, that a Square is double to a Triangle, of equal Base and Height. May the Fear of GOD for ever preserve me from doing any thing, whereof I may say, it seems to me unreasonable.

The prodigious Learning, wherewith some great Literators have been enriched! *Ideas*, like the Sands on the Sea-shore, for the vast variety of them! There have been Men of so extensive a Genius, that they have been worthy to have a Celebration of their Obsequies, in as many Languages as were those of *Peireskius*: A Collection whereof, entitled *Panglossia*, had in it no fewer than forty Languages.

We see sometimes a much richer Soul than that of *Tostatus*; of whom yet *Bellarmino* says,

*Hic stupor est mundi, qui scibile discutit omne.*

What a Character could *Vives* give of his *Budæus*? *Casaubon* reports of *Joseph Scaliger*, There is nothing that any Man could desire to learn, but that he was able to teach: He had read nothing, (and yet what had he not read?)

read?) but what he did readily remember. *Salmafius* gives a Report, little short of this, concerning *Casaubon*. *Voetius* and *Vossius*, how do they celebrate the vast Erudition of our *Usher*! Others will or may do as much for theirs. *Bochart* is rarely mentioned without the Epithet of *the incomparable*. *Grotius* was no little Man, *Selden* was not much smaller than he, both concluding their Lives with Testimonies to the Preference of *real Piety*, before all their Skill in *Languages* and *Sciences*.

My dear *Witfius*, lately dead, must for ever live in the Catalogue of *wonderful Men*; and Mr. *Baxter* too!

Of these two, and of some others, what *Amberachius* writes of *Zuinger*, may be the consummate Elogy; *Cujus magna fuit Doctrina, sed exigua, si cum Pietate conferatur*. Such was he, of whom I am going to repeat what I have heretofore asserted; had I Learning enough to manage a Cause of that nature, I should be ready to maintain, that there never was known under the Cope of Heaven a more learned Man than the incomparable *ALSTEDIUS*; he has written on every one of the Subjects in the whole *Circle of Learning* as accurately and as exquisitely as those Men who have spent all their Lives in cultivating but any one of the Subjects. The reason why many of his Composesures are no more esteemed, is the *Pleonasm* of their Worth, and their deserving so much Esteem. To hear some silly and flashy Men, with a scornful Sneer, talk as if they had sufficiently done his Business, by a foolish Pun, of *Al's-tedious*, is to see the ungrateful and exalted Folly of the World; for *Conciseness* is one of his peculiar Excellencies: they might more justly call him any thing than *tedious*.

The early Attainments and Atchievements of some, have been the just Admiration of the World. Mr. *Baillet* has drawn up a curious List of *illustrious Youths*.

When

When I see such *Men*, and their *Works*, I must for ever look off, and look up to the glorious God, and acknowledge, *Great God, thou art the Father of these Lights!* These had nothing but what they received from thee! And if such Perfections may be found in frail and weak *Men*, what, Oh! what are the Excellencies of the infinite God, before whom all these *Men* are but as the Drop of the Bucket, and the light Dust of the Balance! But when I consider how far the sinful Children of *Men* may come to have the Chambers of their Souls filled with precious things, it leads me to think, *What is that MAN, who is more than a meer MAN! That MAN who is the Son of God! O God, the Heavens do praise thy Wonder!* BOOKS which have in them vast Amazements of most valuable Treasures, cannot well be laid out of our Hands without such Thoughts as these.

But what shall we say when we see the vast Performances and Capacities of some SOULS, from which the want of Bodily Senses would have prohibited all our Expectations of any thing that should be considerable. *My God, I know that thou canst do every thing; all Souls are thine, and thou canst make them do what thou pleasest!*

The Jews tell us of a Professor in their Academy of Sora, who was called Sagi Nabor, or Joseph of great Light; he was blind, but it seems he had a Soul full of Knowledge.

We have had eminent Preachers who were blind Men, and educated for and serviceable in the Evangelical Ministry; Mr. Cheesman of East-garston was one, who lost his Eyes by the Small-Pox before he was four Years old: thus Mr. Francis Tailor, and Mr. Homer Jackson.

But then that they should prove Writers too, learned, acute, polite Writers!

The Books of Mr. *John Troughton* are valuable things; his *Lutherus Redivivus* could be writ by none but a *Seer*, and an *Eagle-ey'd* one.

But if many *blind Men* have done learnedly, thou, Mr. *William Jameson*, hast excelled them all! That miraculous Man, a Professor of History in the famous University of *Glasgow*, tho blind from his Nativity, has published a variety of Books, and these in the *Latin* as well as the *English* Tongue, and full of *Quotation*, full of *Criticism*, full of accurate and exquisite Explanations on the nicest Controversies: when I read such things, I cannot but see, and say, *the Finger of God!*

That one Faculty of the Soul, the MEMORY, how amazing the Powers of it, how stupendous the Performances! The Account *Seneca* gives of himself, if half of it be true! ——— *Nam & duo milia Nominum recitata, quo ordine erant dicta, reddebam.* Of his very dear Companion, as he calls *Latro Porcius*, he affirms, that he retained in his Memory all the Declamations he had ever spoken, and never had his Memory failing him so much as in one single word. *Pliny* will give us more Examples of what the Memory of Man has done; a *Cyrus*, who could call all the Soldiers in his Army by Name; a *Mithridates*, who could speak to twenty-two several Nations in their own Languages; a *Carneades*, who *Quæ quis exegerat in Volumina in Bibliothecis, Legentis modo representavit.* Such was the Memory of Dr. *John Rainolds*, that he was called a *living Library*, and a *third University.* *Lipsius* had all *Tacitus* exactly in his Memory, and *Suarez* had all *Austin.* *Homer's Iliads* have thirty-one thousand six hundred and seventy Verses, his *Odysses* no less; and yet the younger *Scaliger* committed all *Homer* to his Memory in one and twenty Days. The Memory of our famous *Jewel* would perform Wonders, he would readily and exactly repeat any thing he had written, after once reading of it, and would have done it if the Auditors had been shouting, or fighting, and given him the greatest Occasions of  
Con-

Confusions; even Scores of barbarous Words, after once reading, he would repeat forwards and backwards, without hesitation. *Zuinger* mentions many strange Examples of a strong Memory, among which that of *Christopher Longolius* is very memorable; scarce any Length of Time was able to dislodge any thing he had once lodged in his *Memory*! But then how unaccountable the Instances of a *Læsa Memoria*, reported by *Zuinger*, and *Forestus*, and *Schenkius*, and others, especially when an *Apoplexy* has left a Man Memory enough to write Volumes, but unable to read a Syllable! The various *Inclinations* of the SOUL are a most admirably wise Provision of our good God, that the *Business of the World* may be all transacted, and with Satisfaction:

*Diversis gaudet Natura ministris.*

We find *Homer* sometimes admiring this Variety; and *Horace* entertains us with a *Sunt quos Curriculo*,— which might have been extended to a Volume; for as one says, ‘there may be found a *Sunt quos* for every thing under the Sun.

Tho *Solomon* declares truly, that much Study is a Weariness to the Flesh, yet with what Affiduity do many apply themselves to it, and how delightfully! There have been other hard Students besides *Cato*, of whom *Tully* says, *Erat in eo inexhausta aviditas legendi, nec satiari poterat.*

The *Jews* have done well to place this among their *Beracoth*; *Deus facit ut unicuique suum Opificium placeat.* The blessed God is to be acknowledged in it! There is an Instance which *Dr. Edwards* has pitch'd upon: Would a Gentleman brought up a Scholar, and one very nice, neat, and curious, visit sick Persons whenever they call him, and leave his own Bed that he may give his Visits to them in theirs, and enter into Rooms that are filled with the most ungrateful Steam and Stench,

Stench, and all his Days converse with Excrements, continue situated *inter Stercus & Urinam*? One would think this were a Degradation to the *Velvet Cap* and *Scarlet Robe*; to go in Silk and Plush to the most squalid and nasty Chambers, looks a little strange; to suck in the Air of a Room which the Breath of the Diseased has infected, for this to be done by Persons of an honourable Character, and for them to undergo patiently and cheerfully more servile things than what are undergone in the basest and most servile Callings!

But, —

‘Behold, I have created the Smith, who blows the Coals  
‘in the Fire! so saith our God: and he is to be seen  
‘in the disposition to profess every honest Trade for ne-  
‘cessary Uses! When I behold any Man cheerfully fol-  
‘lowing the Business of his Calling, I would upon the  
‘Invitation say, *Glorious God, it is well that thou hast so*  
‘*disposed the Mind of this my Neighbour!*’

They who have written *de Morbis Artificum*, have mentioned no Case more deplorable than this, *for a Man to be sick of his Calling.*

Our Great GOD is to be seen, confessed, adored, in that admirable *Variety* of Matters which the *Invention* of Man has reach’d to! And the admirable *Sagacity* that prosecutes them! When such inventive Wits as *Helmont* and *Wallis* have taught the *Deaf* and the *Dumb* to read and speak, methoughts I have seen that *Sagacity* notably exemplified.

‘Glorious GOD, my Soul with all possible Pro-  
‘stration before thee receives thy faithful Sayings,  
‘wherein thou hast instructed me: Every good Gift  
‘comes down from the Father of Lights! And the Lord  
‘giveth Wisdom! Not only of the four Children that  
‘had it, but of all that have ever had any thing of it,  
‘it must be own’d God gave them Knowledge and Skill  
‘in all Learning and Wisdom: If a *Bazaleel* have it, O  
‘Spirit of God, thou art He who givest him Knowledge  
‘in all manner of Workmanship.’

But

But then there is another thing wherein the Superintendence of the Glorious Creator and Governor of the World is most conspicuous; and that is, the *Progress* which the *Invention* of Man has made: things of greater use were sooner invented, things of a lesser use later, every thing in the *Time* wherein our Great God has had his excellent Purposes to be served with it; things equally plain with such as have been formerly discovered, and as much desired, have been lock'd up from Human Understanding, till the God, in whose hand are our *Times*, is pleased wisely to make them understood by the Children of Men. 'Tis not from your *firtuitous Concourse of Atoms*, ye foolish *Epicureans*! Why must *Printing* be withheld from the Service of Mankind till the Year 1430, when the *First-born* of printed Books was by the Hand of *Laurence Kestier* midwifed into the World, and the Skill immediately improved by *Faust* and *Schoeffer*? Why must Mankind have no *Telescopes* till the Year 1609, when one whom *Syrtrurus* would suspect almost an *Angel* in the Shape of a *Dutchman*, instructed *Lippersein* at *Middleburgh* to proceed upon them? To mention a Subject which my *Christian Philosopher* has very much liv'd upon, What is the Anatomy of *Mundinus*, if compared to our modern? (tho *Cardan*, and other learned Men, have so much cried it up with their Elogies and Commentaries.) *Bagliwi* says truly, 'tis as far short of it as a Flea is of an Elephant. We will pass to another Instance: The *Romans* had not so much as a *Sun-dial* till the second *Punick* War, and when they had one, they had no more than that one, in the *Forum*, above an hundred Years, tho *Pliny* says it never went right in all this time. Our King *Alfred* had no better shift than this for measuring his Hours, the burning of a Candle, marked into twelve parts, for which a *Lanthorn* was needful to secure it from the Winds of the *Windows*, for *Glazing* was not yet in fashion. *Dr. Grew* observes, the first Conceit which tended to a *Watch*, was a *Draw-well*; first, People found the drawing of

Water with a *Hand-cord* and a *Pitcher* troublesome, so they thought of a *Draught-wheel*; by and by they conceived such a Movement applicable to a *Spit*, if the motion of the Weight could be made slow enough, this was done by adding more *Wheels* and a *Flyer*, which made a *Jack*: by and by Men began to see, that if the motion were yet slower, it would serve to *measure Time* also, then instead of a *Flyer* they put a *Balance*, and thus made a *Clock*; this being so useful, Men considered how it might be made portable, by something answerable to a *Weight*, and so instead of that they put the *Spring* and the *Fuse-wheel*, which make a *Watch*. Here is the Pedigree of the noble Engine. But to what an astonishing Perfection is *Clock-work* and *Watch-work* now arrived! We will hardly allow a Gentleman of such Antiquity as *Boethius* to be the Inventor of the *Clock-work*, that hath been so mightily improved; no, *Regiomontanus*, thou shalt have the Honour of being the Instrument employed by God for the rare Invention, not more than between two and three hundred Years ago. The curious Performances of *Clock-work* cannot be related without our finding a Surprize of Pleasure in the Relations; how many *Motions* produced! How many *Designs* answer'd! The Gentleman who writes *The Artificial Clock-maker*, has with his Calculations made provision for a marvellous variety of them. What *Heylin* in his *Cosmography* reports of the Clock at *Lunden* in *Denmark*, what *Gaffarel* in his *unheard-of Curiosities* reports that he himself saw in a Clock at *Ligorn*, and the Clock which every day diverts the Spectators at *Harlem*, are notable Instances among many others. The *Repeating-Clocks* are now common on thousands of Tables, but how curious! At length Mr. *Huygens* has invented the way of applying *Pendulums* to *Watch-work*. If *Galileo* entertained a Thought of such a thing, yet he never brought it to Perfection. We must not let Mr. *Huygens* be robb'd of his Claim, either by *Becher*, or the Academy *Del Cimento*. The first that was made in *England* was in

the Year 1662. The Uses of these *Pendulum-Watches* cannot be sufficiently celebrated.

But useful indeed will be these *Measurers of Time*, if they teach and help us to be the more wise *Redeemers* of it.

It was thought, that he, who when Patents for *Monopolies* were granting in *France*, begg'd for one to demand a *Shilling* from every Man who wore a *Watch*, but had no care how he spent his *Time*, ask'd for what would have afforded a *Revenue* too rich for a Subject!

If the *Mathematicks*, which have in the two last Centuries had such wonderful Improvements, do for two hundred Years more improve in proportion to the former, who can tell what Mankind may come to! We may believe, without having *Seneca* our Author for it, *Multa venientis ævi populus ignota nobis sciet.*

The Union between the *SOUL* and the *BODY* is altogether inexplicable, the *Soul* not having any *Surface* to touch the *Body*, and the *Body* not having any *Sentiment* as the *Soul*. The Union of the *Soul* and *Body* does consist, as *Monsieur Taurvy* expresses it, in the Conformity of our *Thoughts* to our *Corporeal* Actions; but, says he, for the *Explication* of this Conformity, we must have recourse to a *superior Power*. Truly, *Sirs*, do what you can, you must quickly come to that!

Our *nervous Parts* are very sensible. *Objects* do affect our *Senses*, and make Impressions on them; the *Senses* receiving such Impressions, the Modifications of the *Organs* produced by them terminate in the *Brain*; if they do not so, the *Soul* is unconcerned in them; but there is a *Law* given to the *Soul* by the glorious *God*, who forms the *Spirit* of Man within him, that in their doing so there shall be such and such *Thoughts* produced in the *Soul*.

‘O my *Soul*, what a wondrous Being art thou! How capable of astonishing *Improvements*! How worthy to be cultivated with the best *Improvements*! How worthy to have all possible Endeavours used for thy Recovery from the *Depravations* which thy *Fall* from *God*

‘ has brought upon thee ! How worthy to be kept with  
 ‘ all Diligence from every thing that will bring any  
 ‘ more Wounds upon thee ! What *reason* is there that  
 ‘ thou shouldst be filled with the Love of God, and  
 ‘ acted by the Faith of thy only Saviour ! And if the  
 ‘ Image of the glorious God, which has been impaired  
 ‘ by *Satanick* Impressions on thee, be revived and re-  
 ‘ stored in thee, what marvellous, and even eternal  
 ‘ Felicities, art thou sure of arriving to !’

But, O MAN, wilt thou stop here, and know nothing *above thy self*? Among the ancient Jews there was a sort of *natural Philosophers*, who are by the Rab-  
*bins* called *הַבְּקֵר הַקָּמִי*, *Sapientes Inquisitionis*, or *Sapientes Scrutationis*, from their enquiring after *natural Causes*; perhaps our Apostle may mean these, when he says, 1 Cor. 1. 20. *Where is the Enquirer of this World?* Jerome’s Version favours it. Now of these Gentlemen it is reported, that they denied the Existence of *superior Intelligences*; our *Christian Philosopher* will not be guilty of such a Stupidity.

We are now soaring into the *invisible World*, a World of *intellectual Beings*, but invisible to such Eyes as ours. I do here in the first place most religiously affirm, that even *my Senses* have been convinced of such a World, by as clear, plain, full *Proofs* as ever any Man’s have had of what is most obvious in the *sensible World*; *Proofs* which I am ready to offer in the most convenient Season. But then, *how glorious art thou, O God, in thy innumerable Company of the holy Angels, and in thy Government over those also that have made themselves evil ones!* All the Wonders we have hitherto seen in the *visible Creation*, what are they, compared to those that are out of sight, those that are found among the *Angels that excel in Powers*, the Hosts of the infinite  
 G O D, the *Ministers which do His Pleasure!*

There is a *Scale of Nature*, wherein we pass regularly and proportionably from a *Stone* to a *Man*, the *Faculties of the Creatures in their various Classes* growing still brighter and brighter, and more capacious,  
 till

till we arrive to those noble ones which are found in the *Soul* of M A N ; and yet M A N is, as one well expresses it, *but the Equator of the Universe.*

It is a just View which Dr. Grew had of *the World*, when he came to this Determination : ‘ As there are  
‘ several Orders of *animated Body* before we come to  
‘ *Intellect*, so it must needs be that there are several  
‘ Orders of *imbodied Intellect* before we come to *pure*  
‘ *Mind.*’

It is likely that the Transition from *Human* to *perfect MIND* is made by a *gradual Ascent* ; there may be *Angels* whose Faculties may be as much superior to *ours*, as *ours* may be to those of a *Snail* or a *Worm*.

By and by we may arrive to *Minds* divested of all *Body*, excellent *Minds*, which may enjoy the Knowledge of Things by a more *immediate Intuition*, as well as without any Inclination to any *moral Evil*.

The highest Perfection that any *created Mind* can arise to, is that in the *Soul* of our admirable Saviour, which is indeed *embodied* ; but it is the *Soul* of the *Man* who is personally united to the SON of GOD.

Anon we see an infinite GOD ; but *canst thou by searching find out GOD ? Canst thou find out the Almighty to Perfection ?*

It is a good Thought, and well expressed of an honest Writer on *the Knowledge of God from the Works of Creation*. ‘ It is true there are some *Footsteps* of a *Deity*  
‘ in all the Works of Nature, but we should ascend  
‘ by these *Footsteps* as by a *Footstool* to the *God* of the  
‘ World, as *Solomon* by several Steps ascended to his  
‘ *Throne*, and by the *Scale of Nature* ascend to the  
‘ *God of Nature.*’

This is what we shall now, tho in a more *summary* way, a little more distinctly proceed to.

No *Dominion over the Creatures* can be more acceptably, more delightfully exercised with me than this ; for me to *employ them* as often as I please in *leading me to GOD*, and so in serving that which I propose as the chief END for which I *live*, and *move*, and have my

*Being*; which is, to glorify G O D, and acknowledge Him. When the *Creatures* were brought to our *Protoplast*, to see what he would call them, he did not exercise a more desirable *Dominion* over them, in giving what *Name* he pleased to each of them, than I shall do in having them all brought to me, that I may read the *Name* of God, so far as it is to be seen in them, and be assisted in my *Acknowledgments* of the Glorious-ONE.

¶. Hear now the *Conclusion* of the *Matter*. To enkindle the *Dispositions* and the *Resolutions* of P I E T Y in my Brethren, is the *Intention* of all my E S S A Y S, and must be the *Conclusion* of them.

*Atheism* is now for ever chased and hissed out of the World, every thing in the World concurs to a Sentence of *Banishment* upon it. Fly, thou *Monster*, and hide, and let not the darkest *Recesses* of *Africa* itself be able to cherish thee; never dare to shew thyself in a *World* where every thing stands ready to overwhelm thee! A B E I N G that must be superior to *Matter*, even the *Creator* and *Governor* of all *Matter*, is every where so conspicuous, that there can be nothing more monstrous than to deny the *God* that is above. No *System* of *Atheism* has ever yet been offered among the *Children* of *Men*, but what may presently be convinced of such *Inconsistencies*, that a *Man* must ridiculously believe nothing certain before he can imagine them; it must be a *System* of *Things* which cannot stand together! A *Bundle* of *Contradictions* to themselves, and to all *common Sense*. I doubt it has been an *inconsiderate* thing to pay so much of a *Compliment* to *Atheism*, as to bestow solemn *Treatises* full of learned *Arguments* for the *Refutation* of a *delirious Phrenzy*, which ought rather to be put out of countenance with the most *contemptuous Indignation*. And I fear such *Writers* as have been at the pains to put the *Objections* of *Atheism* into the most plausible *Terms*, that they may have the honour of laying a *Devil* when they have raised him, have therein done too *unadvisedly*. However, to so much notice of the raving *Atheist* we may condescend while we go along, as to tell him, that  
for

for a Man to question the *Being* of a *G O D*, who requires from us an *Homage of Affection*, and *Wonderment*, and *Obedience* to Himself, and a perpetual *Concern* for the *Welfare* of the *Human Society*, for which He has in our *Formation* evidently *suit*ed us, would be an *exalted Folly*, which undergoes especially two *Condemnations*; it is first condemned by this, that every *Part* of the *Universe* is continually *pouring in* something for the *confuting* of it; there is not a *Corner* of the whole *World* but what supplies a *Stone* towards the *Inflition* of such a *Death* upon the *Blasphemy* as justly belongs to it: and it has also this *condemning* of it, that *Men* would soon become *Canibals* to one another by embracing it; *Men* being utterly destitute of any *Principle* to keep them *honest in the Dark*, there would be no *Integrity* left in the *World*, but they would be as the *Fishes of the Sea* to one another, and worse than the *creeping Things*, that have no *Ruler* over them. Indeed from every thing in the *World* there is this *Voice* more audible than the loudest *Thunder* to us; *God hath spoken*, and these two things have I heard! First, *Believe and adore a glorious G O D*, who has made all these *Things*, and know thou that He will bring thee into *Judgment*! And then be careful to do nothing but what shall be for the *Good* of the *Community* which the glorious *G O D* has made thee a *Member* of. Were what *God hath spoken* duly regarded, and were these two things duly complied with, the *World* would be soon revived into a desirable *Garden of God*, and *Mankind* would be fetch'd up into very comfortable *Circumstances*; till then the *World* continues in a wretched *Condition*, full of *doleful Creatures*, with *wild Beasts* crying in its *desolate Houses*, *Dragons* in its most *pleasant Palaces*. And now declare, *O every thing that is reasonable*, declare and pronounce upon it whether it be possible that *Maxims* absolutely *necessary* to the *Subsistence* and *Happiness* of *Mankind*, can be *Falsities*? There is no possibility for this, that *Cheats* and *Lyes* must be so *necessary*, that the *Ends* which alone are worthy of a glorious *G O D*, cannot be attain'd without having *them* imposed upon us!

Having dispatch'd the *Atheist*, with bestowing on him *not many* Thoughts, yet *more* than could be deserved by such an *Idiot*; I will proceed now to propose two general Strokes of *Piety*, which will appear to a *Christian Philosopher* as unexceptionable as any Proposals that ever were made to him.

First, the Works of the glorious God exhibited to our View, 'tis most certain they do *bespeak*, and they should *excite* our *Acknowledgments of His Glories* appearing in them: the Great GOD is infinitely *gratified* in beholding the Displays of His own infinite *Power*, and *Wisdom*, and *Goodness*, in the Works which He has made; but it is also a most acceptable Gratification to Him, when such of His Works as are the *rational Beholders* of themselves, and of the rest, shall with devout Minds *acknowledge* His Perfections, which they see shining there. Never does one endued with *Reason* do any thing more evidently *reasonable*, than when he makes every thing that occurs to him in the vast Fabrick of the World, an *Incentive* to some agreeable Efforts and Salleys of *Religion*. What can any Man living object against the *Piety* of a Mind awaken'd by the sight of God in His Works, to such Thoughts as these: *Verily, there is a glorious GOD! Verily, the GOD who does these things is worthy to be feared, worthy to be loved, worthy to be relied on! Verily, all possible Obedience is due to such a GOD, and most abominable, most inexcusable is the Wickedness of all Rebellion against Him!* A Mind kept under the Impression of such Thoughts as these, is an *holy* and a *noble* Mind, a *Temple of God*, a *Temple filled with the Glory of God*. There is nothing but what will afford an *Occasion* for the *Thoughts*; the oftner a Man improves the *Occasion*, the more does he *glorify GOD*, and answer the *chief End of Man*; and why should he not *seek occasion* for it, by visiting for this purpose the several *Classes* of the Creatures (for *Discipulus in hac Scholâ erit Peripateticus*) as he may have opportunity for so generous an Exercise! But since the horrid Evil of all *Sin* is to be inferred from this; *it is*

a Rebellion against the Laws of the glorious G O D, who is the Maker and the Ruler of all Worlds; and it is a disturbance of the good Order wherein the glorious Maker and Ruler of all Things has placed them all; how much ought a quickned Horror of Sin to accompany this Contemplation, and produce this most agreeable Resolution, *My God, I will for ever fear to offend thy glorious Majesty!* Nor is this all the Improvement which we are to make of what we see in the Works of God; in our improving of them, we are to accept of the Rebuke which they give to our Presumption, in pretending to criticize upon the dark things which occur in the Dispensations of His Providence; there is not any one of all the Creatures but what has those fine things in the Texture of it, which have never yet been reached by our Searches, and we are as much at a loss about the Intent as about the Texture of them; as yet we know not what the glorious God intends in His forming of those Creatures, nor what He has to do in them, and with them; He therein proclaims this Expectation, *Surely they will fear me, and receive Instruction.* And the Point wherein we are now instructed is this: 'What! Shall I be so vain as to be dissatisfied because I do not understand what is done by the glorious G O D in the Works of His Providence!' *O my Soul, hast thou not known, hast thou not heard concerning the everlasting God, the Lord, the Creator of the Ends of the Earth, that there is no searching of His Understanding?*

And then, secondly, the CHRIST of God must not be forgotten, who is the Lord of all. *I am not ashamed of the Gospel of CHRIST,* of which I will affirm constantly, that if the Philosopher do not call it in, he paganizes, and leaves the finest and brightest Part of his Work unfinished. Let Colerus persuade us if he can, that in the Time of John Frederick the Elector of Saxony there was dug up a Stone, on which there was a Representation of our crucified Saviour; but I cannot forbear saying, there is not a Stone any where which would not look black upon me, and speak my Condemnation,

nation, if my *Philosophy* should be so *vain* as to make me lay aside my Thoughts of my *enthroned Saviour*. Let *Lambecius*, if he please, employ his Learning upon the Name of our Saviour CHRIST, found in Letters naturally engraven at the bottom of a large *Agate-Cup*, which is to be seen among the Emperor's Curiosities; I have never drank in that *Cup*, however I can more easily believe it than I can the *Crucifixus ex Radice Crambres enatus*, or the *Imago Virginis cum Filiolo in Minerâ Ferri expressa*, and several more such things, which the Publishers of the *German Ephemerides* have mingled with their better Entertainments: but I will assert, that a glorious CHRIST is more to be considered in the *Works of Nature* than the *Philosopher* is generally aware of; and my *CHRISTIAN Philosopher* has not fully done his Part, till He who is the *First-born of every Creature* be come into Consideration with him. *Alsted* mentions a *Siclus Judæo-Christianus*, which had on one side the Name of JESUS, with the Face of our Saviour, and on the other the Words that signify the *King Messiah comes with Peace, and God becomes a Man*; and *Leusden* says he had a couple of these Coins in his possession. I have nothing to say on the behalf of the *Zeal* in those *Christianized Jews*, who probably were the Authors of these Coins, a *Zeal* that boil'd into so needless an Expression of an Homage, that indeed cannot be too much expressed in the *instituted ways* of it to a Redeemer, whose *Kingdom is not of this World*: but this I will say, *all the Creatures in this World are part of His Kingdom*; there are no *Creatures* but what are His *Medals*, on every one of them the Name of JESUS is to be found inscribed. Celebrate, O *Danhaver*, thy *Granatilia*, the *Peruvian Plant*, on which a strong *Imagination* finds a Representation of the *Instruments* employed in the *Sufferings* of our Saviour, and especially the *bloody Sweat* of His Agonies; were the Representation as really and lively made as has been imagined, I would subscribe to the Epigram upon it, which concludes:

*Flos hic ita formâ vincit omnes Flosculos,  
Ut totus optet esse Spectator Oculus.*

But I will, with the Exercise of the most *solid Reason*; by every part of the World, as well as the *Vegetables*, be led to my Saviour.

A *View of the Creation* is to be taken, with suitable Acknowledgments of the glorious CHRIST, in whom the *eternal Son of God* has personally united Himself to ONE of His *Creatures*, and becomes on his account propitious to *all the rest*; our *Piety* indeed will not be *Christianity* if HE be left unthought upon.

This is HE, of whom we are instructed, Col. 1. 16, 17. *All things were created by Him, and for Him; and He is before all things, and by Him all things consist.* It is no contemptible Thought wherewith *De Sabunde* has entertained us: *Productio Mundi à Deo facta de Nihilo, arguit aliam productionem, summam, occultam, & æternam in Deo, quæ est de sua propria Natura, in qua producitur Deus de Deo, & per quam ostenditur summa Trinitas in Deo.* And certainly he that as a *Father* does produce a *Son*, but as an *Artist* only produce an *House*, has a Value for the *Son* which he has not for the *House*; yea, we may say, if GOD had not first, and from Eternity, been a *Father* to our *Saviour*, He would never have exerted Himself as an *Artist* in that *Fabrick*, which He has built by the *Might of His Power*, and for the *Honour of His Majesty*!

The Great Sir *Francis Bacon* has a notable Passage in his *Confession of Faith*: *I believe that God is so holy, as that it is impossible for Him to be pleased in any Creature, tho the Work of his own Hands, without beholding of the same in the Face of a Mediator; — without which it was impossible for Him to have descended to any Work of Creation, but He should have enjoyed the blessed and individual Society of three Persons in the Godhead for ever; but out of His eternal and infinite Goodness and Love purposing to become a Creature, and communicate with His Creatures, He*  
ordained

ordained in His eternal Counsel that one Person of the God-head should be united to one Nature, and to one particular of His Creatures; that so in the Person of the Mediator the true Ladder might be fixed, whereby God might descend to His Creatures, and His Creatures ascend to Him.

It was an high Flight of Origen, who urges, that our High-Priest's having tasted of Death, *ὑπὲρ πάντων*, FOR ALL, is to be extended even to the very Stars, which would otherwise have been impure in the sight of God; and thus are ALL THINGS restored to the Kingdom of the Father. Our Apostle Paul in a famous Passage to the Colossians [i. 19, 20.] may seem highly to favour this Flight. One says upon it, 'If this be so, we need not break the Glasses of Galilæo, the Spots may be washed out of the Sun, and total Nature sanctified to God that made it.'

Yea, the sacred Scriptures plainly and often invite us to a Conception, which Dr. Goodwin has chosen to deliver in such Terms as these: 'The Son of God personally and actually existing as the Son of God with God, afore the World or any Creature was made, He undertaking and covenanting with God to become a Man, yea, that Man which He hath now taken up into one Person with Himself, as well for this End, as for other Ends more glorious; God did in the Fore-knowledge of that, and in the Assurance of that Covenant of His, proceed to the creating of all things which He hath made; and without the Intuition of this, or having this in His Eye, He would not have made any thing which He hath made.'

O CHRISTIAN, lift up now thine Eyes, and look from the place where thou art to all Points of the Compass, and concerning whatever thou seest, allow that all these things were formed for the Sake of that Glorious-One, who is now God manifest in the Flesh of our JESUS; 'tis on His Account that the eternal God-head has the Delight in all these things, which preserves them in their Being, and grants them the Help, in the obtaining whereof they continue to this day.

But were they not all made *by the Hand*, as well as *for the Sake* of that Glorious-ONE? They were verily so. O my JESUS, it was that Son of God who now dwells in thee, in and by whom the Godhead exerted the Power, which could be exerted by none but an all-powerful GOD, in the creating of the World! He is that WORD of GOD by whom all things were made, and without whom was not any thing made that was made.

This is not all that we have to think upon; we see an incomparable *Wisdom* of GOD in His *Creatures*; one cannot but presently infer, *What an incomprehensible Wisdom then in the Methods and Affairs of that Redemption, whereof the glorious GOD has laid the Plan in our JESUS!* Things which the *Angels desire to look into*. But, O *evangelized Mind*, go on, mount up, soar higher, think at this rate; *the infinite Wisdom which formed all these things is peculiarly seated in the Son of God; He is that reflexive Wisdom of the eternal Father, and that Image of the invisible God, by whom all things were created; in Him there is after a peculiar manner the original Idea and Archetype of every thing that offers the infinite Wisdom of God to our Admiration. Wherever we see the Wisdom of God admirably shining before us, we are invited to such a Thought as this; this Glory is originally to be found in thee, O our Immanuel!* 'Tis in Him *transcendently*. But then 'tis impossible to stop without adding, *How glorious, how wondrous, how lovely art thou, O our Saviour!*

Nor may we lay aside a grateful Sense of this, that as the Son of God is *the Upholder of all Things in all Worlds*, thus, that it is owing to his potent *Intercession* that the *Sin of Man* has made no more havock on this *our World*. This *our World* has been by the *Sin of Man* so perverted from the *true Ends* of it, and rendred full of such loathsome and hateful Regions, and such *Scelerata Castra*, that the *Revenues of God* would have long since rendred it as a *fiery Oven*, if our blessed JESUS had not *interceded* for it: O my Saviour, *what would have become of me, and of all that comforts me, if thy Interposition had not preserved us!*

We will add one thing more: Tho the one GOD in His *three Subsistences* be the *Governor* as well as the *Creator* of the World, and so the *Son* of God ever had what we call the *natural Government* of the World, yet upon the *Fall* of Mankind there is a *mediatory Kingdom* that becomes expedient, that so *guilty Man*, and that which was *lost*, may be brought to God; and the singular Honour of this *mediatory Kingdom* is more *immediately* and most *agreeably* assign'd to the *Son of God*, who assumes the Man JESUS into His own Person, and has *all Power in Heaven and Earth* given to Him; all things are now commanded and ordered by the *Son of God* in the *Man upon the Throne*, and this *to the Glory of the Father*, by whom the *mediatory Kingdom* is erected, and so conferred. This *peculiar Kingdom* thus managed by the *Son of God* in our JESUS, will cease when the illustrious Ends of it are all accomplished, and then the *Son of God* no longer having such a *distinct Kingdom* of His own, shall return to those eternal Circumstances, wherein He shall reign with the *Father* and the *Holy Spirit*, one God, blessed for ever. In the mean time, what Creatures can we behold without being obliged to some such Doxology as this; *O Son of God, incarnate and enthroned in my JESUS, this is part of thy Dominion! What a great King art thou, and what a Name hast thou above every Name, and how vastly extended is thy Dominion! Dominion and Fear is with thee, and there is no Number of thine Armies! All the Inhabitants of the Earth, and their most puissant Emperors, are to be reputed as nothing before thee!*

But then at last I am losing myself in such Thoughts as these: *Who can tell what Uses* our Saviour will put all these *Creatures* to at the *Restitution of all things*, when He comes to rescue them from the *Vanity* which as yet captivates them and incumbers them; and His raised People in the *new Heavens* will make their Visits to a *new Earth*, which they shall find flourishing in *Paradisick Regularities*? *Lord, what thou meanest in them, I know not now, but I shall know hereafter!* I go on, *Who*  
can

can tell how sweetly our Saviour may feast His chosen People in the Future State, with Exhibitions of all these Creatures, in their various Natures, and their curious Beauties to them? Lord, I hope for an eternally progressive Knowledge, from the Lamb of God successively leading me to the Fountains of it!

I recover out of my more conjectural Prognostications, with resolving what may at present yield to a serious Mind a Satisfaction, to which this World knows none superior: When in a way of occasional Reflection I employ the Creatures as my Teachers, I will by the Truths wherein those ready Monitors instruct me, be led to my glorious JESUS; I will consider the Truths as they are in JESUS, and count my Asceticks deficient, till I have some Thoughts of HIM and of His Glories awakened in me. To conclude, It is a good Passage which a little Treatise entitled, *Theologia Ruris*, or, *The Book of Nature*, breaks off withal, and I might make it my Conclusion: 'If we mind Heaven whilst we live here upon Earth, this Earth will serve to conduct us to Heaven, thro the Merits and Mediation of the Son of God, who was made the Son of Man, and came thence on purpose into this lower World to convey us up thither.'

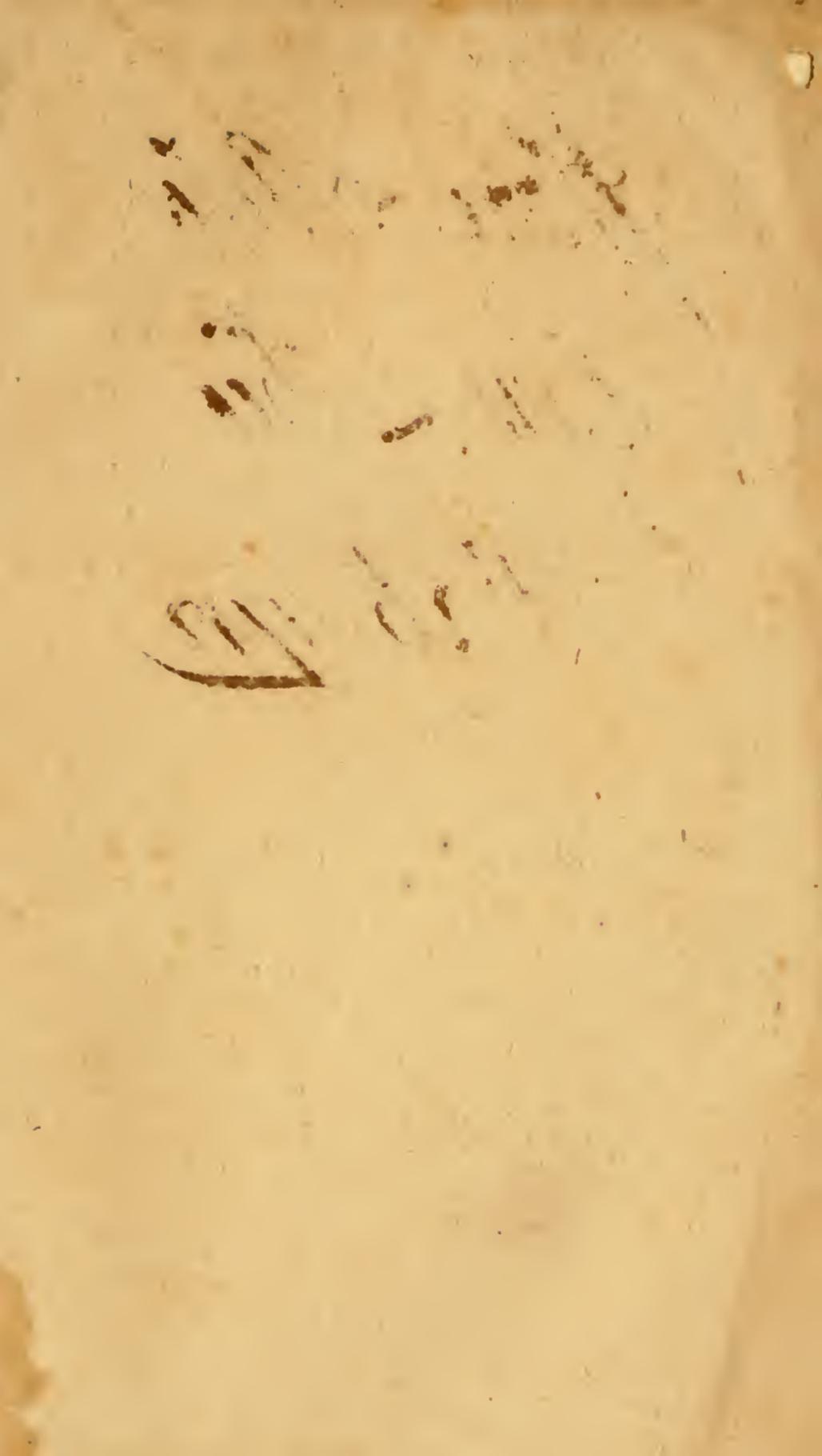
I will finish with a Speculation, which my most valuable Dr. Cheyne has a little more largely prosecuted and cultivated.

All intelligent compound Beings have their whole Entertainment in these three Principles, the DESIRE, the OBJECT, and the SENSATION arising from the Congruity between them; this Analogy is preserved full and clear thro the Spiritual World, yea, and thro the material also; so universal and perpetual an Analogy can arise from nothing but its Pattern and Archetype in the infinite God or Maker; and could we carry it up to the Source of it, we should find the TRINITY of Persons in the eternal GODHEAD admirably exhibited to us. In the GODHEAD we may first apprehend a Desire, an infinitely active, ardent,

ardent, powerful *Thought*, proposing of *Satisfaction*; let this represent GOD the FATHER: but it is not possible for any Object but God Himself to *satisfy Himself*, and fill His *Desire* of Happiness; therefore HE Himself *reflected* in upon Himself, and contemplating His own infinite Perfections, even the *Brightness of His Glory*, and the *express Image of His Person*, must answer this glorious Intention; and this may represent to us GOD the SON. Upon this Contemplation, wherein GOD Himself does behold, and possess, and enjoy Himself, there cannot but arise a *Love*, a *Joy*, an *Acquiescence* of God Himself within Himself, and worthy of a God; this may shadow out to us the third and the last of the Principles in this *mysterious Ternary*, that is to say, the Holy SPIRIT. Tho' these *three Relations* of the Godhead in itself, when derived analogically down to Creatures, may appear but *Modifications* of a *real Subsistence*, yet in the supreme Infinitude of the Divine Nature, they must be infinitely *real* and *living* Principles. Those which are but *Relations*, when transferred to *created Beings*, are glorious *Relatives* in the infinite God. And in this View of the Holy Trinity, low as it is, it is impossible the SON should be without the FATHER, or the FATHER without the SON, or both without the Holy SPIRIT; it is impossible the SON should not be necessarily and eternally begotten of the FATHER, or that the Holy SPIRIT should not necessarily and eternally proceed both from Him and from the SON. Thus from what occurs throughout the whole Creation, *Reason* forms an imperfect Idea of this incomprehensible Mystery.

But it is time to stop here, and indeed how can we go any further!

F I N I S.



Samuel Miller

Esq. Libr.

Oct. 26. 1742











