
By Cotton Mather D. D. And Fellow of the Royal Society.

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TO

Mr. THOMAS HOLLIS,
Merchant in London.

SIR,

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
Dedication.

from 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 faith 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 Bene-

fienced
Dedication.

Licence 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
Dedication.

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,

SIR,

Your Sincere Friend,

and Obedient Servant,

Tho. Bradbury.
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THE
INTRODUCTION.

THE 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 kindled, a Man most effectually shows 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 Priesthood,
The Introduction.

hood, which the Blesledness 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 Superior Way of Thinking and of Living, which the Wise 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, Te Sons of the Mighty, assign 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 teueatur 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 Temp, 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 Iulian, will not be found in it: Quis hab audiat, & non ipso nominum strepitum terreatur, si est ineruditus, qualis est nominum multitudo, & exsisset te aliquem magnum qui habes seire potueris? Nor will there be discernible any Spice of the impertinent Vanity, which La Bruyere hath so well satiriz'd: '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
The Introduction.

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; Ingenuum 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 *sollicits,* 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 annihi-
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 displeasing 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 summ, 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 Centaurs 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 pleaded himself in Him, tho he should affliet him, and even destroy him.' I was going to say, O Mentis aurea Verba bracteata! But the Great Alfred instructs me, that
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 left 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 Structure 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!

Reli
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 enumerate some of them, that He may be glorified in them: And indeed my Essays may pretend unto no more than some of them; for, Theophilus writing, of the Creation, to his Friend Antolycus, might very justly say, That if he should have a Thousand Tongues, and live a Thousand Years, yet he were not able
able to describe the admirable Order of the Creation, ἀρχή ἡ τῶν ἔκτισεν τοῦ ἔντον στίχος τῷ Θεῷ. 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 by his Works, did it afterwards 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 Aegardus; Lectu hic omnibus facilis, et si nunquam legere didicerint, & communis est omnibus, omni-unique oculis expositus.

ESSAY I. Of the LIGHT.

WOULD 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 Second 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 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; φῶς εἰς ἑνεγείρεται ἐν δια- φανεῖ, 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 re-
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 influencing 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 Phenomena by New Modifications of Rays; they depend not on any such Modifications, but on some Congenial 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 vaccu, 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 equa-
The Christian Philosopher.

The 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!

The 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 a 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 satellits 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. Hugens 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,
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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 Merfennus 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 val-de 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 cheer 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: ACCIPE, 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 Melereeticks, 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 Beneficiun: 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, 'Tis no wonder then that

Deum ex Operibus cognoscimus.
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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 Conciones Reales, by those who have best understood them:

Obvia dum pieti 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.

1. 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 haft 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 Prayers 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
The Christian Philosopher.

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 afferts 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,
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 Charit so long in coming?

And, O my Soul, why art thou slow in thy Contemplations 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.

LET 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 Caeli spectam Vertece celso
Terra videretur, si Caeli e Vertece 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 solidi præcep 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-
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 Calum, & totius Natura Decor**, aliud, quam quoddam speculum, in quo summi Oppicitis velucet Magisterium?

The **Pagan Tully**, contemplating, **Caelium admirabilem Ordinem**, *incredibilemque Constantiam*, the admirable Order, and the incredible Constancy of the Heavenly Bodies and their Motions, adds upon it, **Qui vacare Mente purat, ne ipse Mentis express 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. Hugens**, 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 **Immenity**!

The **Number** of the **Stars**! The learned **Arndt** has a good **Thought** upon it: **Si Deus tantam Stellarum Multi-**
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Multitudinem condidit, quis dubitet, illum multo majorem Copiam habere Spirituum Caelestium, fine 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, Acribe 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
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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 Nineteen 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 Praesepe 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.
two. It reappeared 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 Brightness 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 compleated 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. Caffini 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 Ursae 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 surprising 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
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 Asfronts 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 Hebrew 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 Conscientious 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 visitest 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 Dusl, 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 *araign* 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 less; and sometimes there are none at all. Some of them shine, and others that shine, 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.
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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 Caffini, 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.

Caffini 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 surpasse them all. Its Diameter is computed at 822,148 Miles; and so there
there must be 290,971,000,000,000,000 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,
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...sphere, which environss 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 expresseth 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 Fabby Bodies, and their Satellits, who are so various in their Quantities, and their Distanccs, 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. Wcliffe! 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 fLight. 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 Cali, ita CHRISTUS est Ornamentum sua Ecclesia.

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 enlightened, 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 gagged him immediately!

My Pen shall not be served 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 ilorum qui aliis praebuit. And that all Superiors 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 Horror 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. Vicente conclude for us:

Quis Solem per hiberna descendere Signa praecipit? Quis rusticum per aestivas Signa ascendere facit? Quis eum ab Oriente in Occidentem ducit? Quis iterum ab Occidente in Orientem revexit? Hae sunt mirabilia, sed soli Deo possibilia.

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 Anse, 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. Hugens 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 Satellite 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 \textfrac{2}{3} of his Semidiameters.

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

The Third is distant from Saturn eight of his Semidiameters, and makes his Revolution in almost 4 \textfrac{3}{7} 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 \textfrac{1}{2} Days.

Mr. Huygen, who first of all discovered the Fourth, (for which cause 'tis called the Huygenian Satellite, 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 there
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 *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.

*Jupiter*’s Globe, according to *Cassini’s Measures*, must be greater than that of the Earth, by 4460 Times. The Periodical Time of his Revolution about the *Sun*, is Twelve Years, or 4380 Days.

In the Body of *Jupiter*, and overhwhelm his luminous Part, there are observed three great Bells, like the Spots which appear in the *Moon*. These Bells 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 Christian Philosopher.

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 Mo-
tion of the Secondary Planets, is, That it is mixed with
a kind of Coehlesous Direction towards one or other
Pole of its Primary Planet; by which means every Sa-
telit, 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. Mo-
luneux. '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 De-
pendance or Correspondence with each other. This
doth most evidently demonstrate, that they were all
at first put into Motion by one and the same uner-
ring 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 tran-
gress.

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.'
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 Perigeeon; tho' never cornicated 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 everywhere equal to his Night, besides what belongs to Twilight. Mars as well as Jupiter has a perpetual Equinox. Hence there can be but little Variety of Seasons in any one particular Place of these Planets.

Whence the Fascia, or Fillets observed in Mars? There appear certain Swathes, as we may call them, which are posited parallel to his Equator. 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.

VENUS 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 Rhetensis, conclude, that Venus moves about its Axis in about fourteen Hours. Dr. Cheyne says in twenty-three.

ESSAY IX. Of MERCURY.

The Great Hevelius 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. Axout 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.**

<table>
<thead>
<tr>
<th>Planet</th>
<th>Miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury</td>
<td>32,000,000</td>
</tr>
<tr>
<td>Venus</td>
<td>59,000,000</td>
</tr>
<tr>
<td>The Earth</td>
<td>81,000,000</td>
</tr>
<tr>
<td>Mars</td>
<td>123,000,000</td>
</tr>
<tr>
<td>Jupiter</td>
<td>424,000,000</td>
</tr>
<tr>
<td>Saturn</td>
<td>777,000,000</td>
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**The Diameter in English Miles.**

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Mercury</td>
<td>4,240</td>
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<tr>
<td>Venus</td>
<td>7,906</td>
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<td>Mars</td>
<td>4,444</td>
</tr>
<tr>
<td>Jupiter</td>
<td>81,155</td>
</tr>
<tr>
<td>Saturn</td>
<td>67,870</td>
</tr>
<tr>
<td>The Sun</td>
<td>763,460</td>
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**The Time of the Periodick Revolution.**

<table>
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<tr>
<th>Planet</th>
<th>Days</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury</td>
<td>87</td>
<td>23</td>
</tr>
<tr>
<td>Venus</td>
<td>224</td>
<td>17</td>
</tr>
<tr>
<td>The Earth</td>
<td>365</td>
<td>6</td>
</tr>
<tr>
<td>Mars</td>
<td>686</td>
<td>23</td>
</tr>
<tr>
<td>Jupiter</td>
<td>4,332</td>
<td>12</td>
</tr>
<tr>
<td>Saturn</td>
<td>10,759</td>
<td>7</td>
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<tr>
<td></td>
<td></td>
<td>10</td>
</tr>
</tbody>
</table>
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 *Astronomy*, but by an ungodly Life, procures to himself a Condemnation to that *Hell*, which is a State and Place of *Utter Darkness*. Wretched Astronomers!

Who are among the wandering *Stars*, to whom is reserved the Blackness of Darkness 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.
The Christian Philosopher.

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 Perihelia, 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 is sue 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 Cometamantia, generally prevailing, has represent-ed it.

Mr. Cazzini 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 Systena 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 Perigeeon, 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 Phanomena observed by him, which encouraged this Prediction.

No Histories of Comets were of service to the Theory of them, until Nicephorus Gregorjas, a Constantinopoli-tan
44 The Christian Philosopher.

Jesuan Astronomer, described the Path of a Comet in 1557.

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. Cheyne 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 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 Ruina.

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. Slave 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, entitled, 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. Flamstead, 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 Satellite, 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 Luniation 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 \( \frac{\Pi}{4} \) 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 Phenomena 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 20.
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-Glafs 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 Zucchi more largely discourse 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
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 spherical, that is to say, having its Diameter at the Equator, longer than its Axis; yet the Excess of the Equatorial 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 Steams of a flagrantaing Ocean. It is evident our Saturn 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.

Huyghens had Glasses in perfection, and wrote since the accurate Maps of the Moon, taken by Hevelius and Riccioli; 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 blest 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 Lunaticks are not the only Instances. Our Husbandmen will multiply the Instances upon us, till they make a Volume, which neither a Columella, 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 Ches-
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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 fitting 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
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 rendered 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 G O D, 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 G O D, and is from a Divine Disposition. Without this, there would be either defolating 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 G O D gives Rain from Heaven, he will give also fruitful Seasons in our Minds, if they be thereby led to due Acknowledgments of him. 'Twill be-speak, 'twill procure, the richest Showers of Blessings upon us. 'How reasonable will it be for us now humbly to acknowledge the Witness, which our G O D gives us of his Power and Goodness! 'To see the Paths of G O D 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

Defiles, 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 Sen-
timents. '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 Nu-

bem variè compostam & temperatam, sed ex Diametro Soli

ipsi, incursente ac incidente, pluvioso tempore; and should

add more than there be Colours in the Rainbow, and

with the modern Corrections of antient Errors, pro-
cceed 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 Knowl-
dedge, that we should be left after all, with the Sub-

ject 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 Ra-

diis Visus & Luix, written before the former Century,
began mathematically to describe how the interior 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 Exterior 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 disperfed, 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 Phenomena 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 antient 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 Caelestum suboriri adspecteris Arcum,
Quo Caelum melius non Meteoron habet:
Illud quidem varios duces & Nube Colores,
Humano generi conspicundus adest.
Hanc ita conspicias, seu veri Pignus amoris,
As olim facti foderis esto Memor.
Quod Deus omnipotens Noah sancto contulit ipse,
Se servaturum viatus Orbis Opus.
Nec perperum submersum Fluminis Unda
Iri Hominem facit fecerat ante quidem.

Engliished:

When you discern the Bow of Heaven to rise,
'The brightest 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 surrounds 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 opake, and inclosed in the other, which is transparent. The same way he accounts for the Parhelia. Only there he apprehends, 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 oversworn with a Flood! So the Sacramental Importance, now instamped by the Will of GOD upon the Rainbow, should be acknowledged with us. It should be considered as a Sign and a Seal of a Covenant, which the Great GOD has
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The Chrifiian Philofophen has made. That He will not have this World, though a finful one, to be drowned any more; nor his Church in the World. Upon the View of the admirable Meteor, how proper this Doxology? Blessed 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 Covenant; and about whose Head there has been the appearance of a Rainbow, in the Visions of his Prophets, betokening our Dependance upon Him for all our Preservations! But then we are not excufed 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 Depredarions whereof, a miserable World is growing horribly combustible. We are to expect,

Affore Tempus
Quo Mare, quo Tellus, correptaque Regia Caeli
Ardent, & Mundi Moles operofa laboret.

ESSAY XIV. Of the Snow.

Of 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. Hook, That very many Parts of the Snow are of a most regular Figure; they are generally so many Rows, or Stars of six Points, being as real, as perfect, as transparent Ice, as any one may fee upon a Vessel of Water: On each of which six Points, there are set other collateral Points, and those always at the fame Angles as are the main Points themselves.

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

Among
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 woolen Confinement, 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 Sanctification, 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, Tremible 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 Coelo;
Hic videt Æterni facra 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 Frytchius's.]

Rumpe Moras, Meteoraque suspice Coeli.
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 Account of Thunder, given by Dr. Hook, is this. The Atmosphere of the Earth abounds with nitrous Particles of a spirituous nature, which are everywhere 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 sulphurous, and noxious, and other combustible Bodies. We see Spirit of Wine, of Turpentine, of Camphire, and almost all other combustible Bodies, will by Heat be raised 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 sulphurous 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 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

\[\text{Fulmina molitur dextra, quo maxima motu}\]
\[\text{Terra remit, fugere Feræ, & mortalia Corda}\]
\[\text{Per Genies humilis stravit Pavor.}\]

And indeed, as the Thunder has in it the Voice of God, [Paganism itself owned it, as being \(\text{Ferrum â€œ\textsuperscript{3}}\)] 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 —-Feriant summos 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 Patience of a Good God to a sinful World? The Desolations of the World, how wonderfully would they be,

* Si quoties peccant Hominis sua Fulmina mittat!

It is no rare thing for the Children of Men to die by a Thunderbolt: A King has been 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 Anima, and used in imitation of God's destroying Men with Lightning; whereby the inward Parts are burnt without any visible Touch upon the outward. This Combustio Anima, a Death by Lightning, has been frequently 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 repaired 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, examines primo quoque Murmure Coeli:

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 having 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 Fælicia Fulmina. Such will they be that make these Impressions upon us.

ESSAY XVII. Of the Air.

The 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 Magnetic Steam 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.
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 Galilaeus, 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 Specific 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 surprising 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 Oyl or Honey, they presently die, and revive no more. Pliny knew not the reason of his own Observation; Oleo illito Insecta omnia examinantur. 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 Fetus in the Womb does receive a measure of Air from the maternal Blood, by the Placentum 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 Walker 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, as lifted 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 Paranymp, 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 Phaenomena, 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 Staticks, 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 AEquilibrium. 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 Meridiana 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 AEquator, 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 Phenomena 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 Ethiopick 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 proposed. 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 AEquilibrium. Hence may be the constant Calms in that part of the Ocean, called The Rains. This Tract being placed in the middle, between the Wetterly 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 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 Tufsoons (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 shocking Stories
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do the Travellers give us of them! How direful Ef-
tects 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 dost on the Wind, and makest it move which
way thou pleasest; who can stand in thy sight, if thou
be angry!

II. 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 fighting the Word of God. And there are Tempeftis,
wherewith the Divine Wrath to be deprefed. 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 A-
gent, that more vehemently agitated its Parts before,
do now ceafe 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 frove of Cor-
puscles, a little a-kin to Nitre, exhaled from the terre-
trial Globe, (of the Figure which Philopoim us 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 Aquarium, 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 foureescore Leagues in length.

The irresistible Force of Congelation!

Congelation seems to be from the Introduction of the Frigorifick Particles, into the Interlices 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, Aqua Copia in Angusto? The Dimen-

sions
ions 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 Diff- pleasure 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 Assauluts 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 Chinenfis, reports of China, Majus in hac Provincia Frigus est, quam illius poscat Poli Altitude. 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...
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 harent; asf ubi Aratro domesfica Tellus nitet, dum loqueris levis Prunina dilabitur. Similiter in Pectoribus Ira confidit; Feras quidem Mentes obsidet, Eruditas praterlabitur.

ESSAY XX. Of the Terraqueous Globe.

The Distance at which our Globe is placed from the Sun, and the Contemplation 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. 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 Satellits, and the Fixed Stars, in any tolerable manner, without admitting the Motion of the Earth; or to account for Co-
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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 Equator: 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 Darkness, if thou see it not!—The Brutish among the People will not be wise.
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The Figure of our Globe is most probably that of an Oblate Spheroid. It swells towards the Equatorial 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 219 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 Territories. 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; that my Service to the Glorious God may be as obedient,
It has been excellently well proposed; *Cum cetera Creatures universa omnibus Viribus, in Hominis Utilitatem commituntur, diffcit hinc Homo, similitur 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. Therefore 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 Creatures cum Deo connectuntur, ne frustra à Deo sint creada.*

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

Two
The Christian Philosopher.

Two Instructions of the pious Egardus will be worth remembrance 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 sanitas 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 superior to that by which they attract.

Being arrived here, we are gotten within a little of the Glorious G O D. 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 exceeding-ly 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
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 specific 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 ex-
ceed 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 Cona-
tus directly contrary to that of Gravity; as in Vegetati-
on the Sprouts directly tend against the Perpendicular.

Dr. Gregory demonstrates, that the antient Astrono-
mers were not ignorant of the heavenly Bodies grav-
tating 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 pla-
ced 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 Gra-
vity, 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 conscienti.

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 Mat-
ter, but must of necessity be caused by something which
penetrates the very Substance of all Bodies, and con-
tinually puts forth in them a Force or Power entirely dif-
ferent 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 in 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 
vio late! 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 
vaft System of the World, according to Plato; nor any 
substantial Forms, according to Aristotle; nor any om-
niscent radical Heat, according to Hippocrates; nor any plastick Virtue, according to Scaliger; nor any hy-
larchick 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 unintelli-
gible Beings are derogatory from the Wisdom and Pow-
er 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 Curvature is to be considered as their Angles, when Spheres are considered as Wedges, and the Degrees of Curvature 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. 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 Mvovement 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 into 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 Ebb's 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, vitaque 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 Bobun 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 Thesauru vel uniformum Elementum Aqua, si Deus illud in Sanguinem, ut olim in Egypto, convertet, possemus redimere? The Contemplation may be carried unto the Element that is next above it.'

An excellent Person, who writes Augustissimam Naturæ Scholam, has thus rendred something of it articulately: 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 benedicitem Deum habebas dum bibis. Habetis autem si agnoscas ipsius Majestatem, eamque colis.

Long
The Christian Philosopher.

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."

Appendix.

§. 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 speci-fick 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 Mer-cury.

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 communica-ted in Lines perpendicular to the sides of the contain-ing Vessel. This beautiful and uniform Property of all Fluids necessarily follows from the Sphericity of their constituent Particles.
The Christian Philosopher.

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 Dimensions, their exact Weights, and required Solidities?

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.

The 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 faith well) incredibilis Multitudo, insatiabili Varietate 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 Terra ferre omnes omnia possint.

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 sweetened. 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 Abses, 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 Utse 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 Creilovius 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 rais-
refining of it, makes the lightest and freshest Portions thereof to rise first; which Rarefaction is made (as Dr. Cheyne observes) by the infusion 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 buoy 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 swim 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 Delfs would be so flown with Waters, that it would be impossible to make Addits or Soughs to drain them. Here is, as Olais Magnus expresseth it, Inexhausta pretiosorum Metallorum ubertas.

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

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*
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! — Accusandis sanè med Sententia hic sunt Sophistæ, qui cùm 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 GOD, 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
Rivers?

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 Earth-
quakes usually have these Volcano's, yet without these
fiery Vents their Earthquakes would bring more tremend-
ous 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 Catania, and forced a Pash-
gage 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; Sal 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!
Yeas, 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 G O D! Fear, lest the Pit and the Snare be upon you! Against all other Strokes there may be none 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!

*Chrysostom*
'Chryfostom 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 Deipmophift upon it.

'Indeed, what is the Earth but a Theatre, as has been long since observed? In quo Infinita & Illuftria, Providentia, Bonitatis, Potentia ac Sapientia Divine 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.'

**APPENDIX.**

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

To render us the more fensible 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 Reflex 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 faucily inquisitive, and approach too near the Verge of the Heavens, to eaves-drop the Secrets there.

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

H 4
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, ὤτι ἄν τί τοι ἡμῖν ἔχει, 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 up-on 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 Nor-man. 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 Suspendation 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 Virtue 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 Verti-

ty; 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 hod, it would raise one hundred and forty and four Drams. A smooth Load-

stone, 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 Calesfonia, 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 Ethiopick 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 maztery 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 magnetic Poles, and of the Changes of the Needle's Variations. Who can tell but the final Cause of the Admixture of the magnetic 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 magnetic 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,

'Amisum ne crede Diem; sunt altera nobis
Sydera; sunt Orbes alii; Lumenque videbis
Purium, 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 Grestam 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 Dispen- sations 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 numbered; 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 so
to the least Circleimaginable 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 moven, and in a part quiescent, it will be a curve Line, and no Radius; if it be wholly moven, 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 Imbecility 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 Lapide Numen indee putem. To fall down before a Stone, and say, Thou art a God, would be an Idolatry, 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, 0 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 Reductiorium 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 ascerting the Design, of which our whole Essay is a Prosecution. *Hic præcipiūs & potentissimus Creaturarum omnium Finis est, cum Scala nobis & als frunt, quibus Anima nostra supra Dumeta & Sterquilinia Mundi hujus volitantem, facilius ad Cælem ascendant, & 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 choosing to take our Na-
ure upon him. The Iron is also undistinguish'd, 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 cleans'd, it should not be rusty; nor will our Saviour embrace those who are not so far cleans'd, 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 tuae benà fide spondere; si unicus unicum possideres, Mundi totius te facile Monarchum 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.

Op ERUM Dei Cognitionem (says my dear Arndt) quilibet ex sincero erga Deum amore & gratitudine, sibi acquiervere sudeat, ut sciat, quæ Deus nostri causa creavit. He smiles at the trifling Logicians, who, totam atque inter inanis Subtilitates transfigentes, 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 be-
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 Exuviae 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 Fuller's Earth, how exceedingly useful is the Chalk to us! 'Tis a πολύχρυσον.

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

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 Lapides; tu ne sis Lapis in hac parte, sed ipsorum Vocem audi, & in illis Vocem Dei.

The Wheatsone gives me a particular Admonition, which I have somewhere met with: Multi multa docent alios, quae ipsi præclare 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 Colaptice, such as no Human Skill could arise to!

I 3

Yea,
Yea, in Stones there has been sometimes found so much of an Human Shape, that every thing really in it has been astonish’d at it. Zeiler and Kircher mention some famous Rocks, which do resemble Monks, that all People call them so. Olanus Wormius was Possessor of a large Stone, which had exactly the Head, Face, Neck and Shoulders of a Man. Monconmys 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 forts of Stones found in lesser Masses. Of these there are many who do not exceed the hardnes 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 Osleo-colla, to join and heal our broken Brones.

But then there are others which do exceed Marble in hardnes.

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

[Peblees and Flints are of the Agate-kind.]

Some of these are opake.

Three of the opake have a Body of one Colour.

Here the Wonders of the Nephritick Stone!

Three of the opake 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 perished 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 unsavoury Salt!*

There are three liquid *Bitumens*, six or seven solid. There are about a dozen *metalick 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*
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 curious Writer of natural Theology: We should admire the Munificence of one who would bestow a considerable Quantity of enriching Metals upon us. But then how much cause have we to adore the Munificence of our bountiful GOD, who has enriched 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 effodimur Opes; and so continuing them fit Materials to make Money of.

Among the marvellous Qualities of Gold, its Dutyli ty 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.

\[\text{And}\]
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, ἐν κοσμίω μαλλόν ἐν κοσμότων θαυμάσσεις, 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, faith 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 Plants 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 Quan-
Quantity of this terrestrial Matter, which the Vapours carry up into the Atmosphere, 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 specific 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.
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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 characterfstick Notes, wherein he establishes twenty-five Genders of them. These Plants are to be rather stifled 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 specific 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
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 Muliphi and Mr. Brotherton.

How agreeable the Shade of Plants, let every Man say that fits 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 Degradercy, and stupid as a Beast.

Our Saviour says of the Lilies (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 alat; 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 sustinet, adeo, ut in unica Bacellâ, omnium Membra in exteriori Corporis, nutrimentum continentur, illiusque Vo per totum Corporis 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 befriended 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 morbofo & monstrofo 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 express'd 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. Casius 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 astonisht 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 Trianam Plantam è tantillo 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 homogeneus 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 Shrine, 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 Beau 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 for the Conservation of the Plant, is by my ingenious Derham considered as a loud Invitation to His Praise.

They which dare fliew 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 Tunicks 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 Æschynoména, 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
felves to be swallowed by the Birds, and being fertilized 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 Equilibration there.

An ingenious Observer upon this one Circumstance, cannot forbear this just Reflection: *A visible Argument that the plafick 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 pater, & in omni Vitae parte occurrit*. *Sine illis cautè, sine illis com- K 2*
mode, non vivituri; ac nec vivituri omnino: quacunque ad
victimam necessaria sunt, quacunque ad Delicias factum, e le-
cuprisissimo suo Pene abunde subministrant. Quanto ex iis
Menja innocentior, mundior, salubrior, quam ex Animali-
um Cede & Laniena! Hocno certe Natura Animal carnivoro-
vrum non est; nullis ad Pradum & Rapinam armis insiru-
endum; non Dentibus exercis & ferratis, non Unguis
aduncis. Manus ad Fructus coeligendos, Dentes ad man-
dendos comparati. Non legimus ei ante Divinium Carnes
ad eum concessas. At non victim tantum nobis suppaeditat, fed
& Vestitum, & Medicinam, & Domicilia, aliaque
Ædification, & Navigia, & SuperileAilem, & Focum, &
Obiectamenta Scerumin Animalique. Ex his Naribus Odora-
menta & Suffumignia parantur: Horum Flores inenarrabili
Colorum & Schematum Varietate & Elegantia Oculos exhi-
berunt, & suavissima Odorum quos expirant Fragranciam,
Spiritus recreant. Horum Fructus, Gulæ illecæra Mensas
secundas instruent, & languentem Appetitum excitant. Tu-
ceo Vivorem Oculos Amicum, quem per Prata, Pastua,
Agros, Sylvæ spianantibus objiciunt; & Umbras quas contra
Æstium & Solis Ardores praebent.

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 befal
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; Mafts, Sails,
Cordage, for their Vessels; add, Medicines for their Dif-
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 numbered. *Hernandes* will assure us, *Planta has unica, quicquid Vivere potest necessarium facile preparare potest, si effe rebus humannis 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 whole 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 *Banda-Cingatensium*, 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 Basin, 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 Reservoir 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 Hemorrhages; 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,
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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 Ærummarum Vita humana plurimarum divinitat concesso. And, In Sanitatem Gentium proculubio 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 favorite 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 Solarvel, 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

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Customs
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 Nepenshe, 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 quacunque Regione a Deo creaturar, quaeles Hominibus & Animalibus ibidem natis maxime conveniant.

Yea, Seleander 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.

Bonaventinus has written a Book, on purpose to shew that every Country has every thing serving to its Occasions,
cations, and particularly Remedies for all the Diftem-
pers which it may be afflicted with.

Can we be any other than charmed with the Good-

ness appearing in it, when we see the Plants every
where starting out of the Earth, and hear their cour-
teous 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 Rhodo-
logia! 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, writ-
ten 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 Nature Curiosi 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 Thea, 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 Diftem-
pers. Then go to Waldschmidt, and you'll find it al-
so to brighten the Intellectuals. When Profe has done
its part, our Tate will bring in Verse to celebrate the
sovereign Virtues of it.
At last it shall be the very θεα of the Poet.

Whilst T E A, our Sorrows safely to beguile,
Sobriety and Mirth does reconcile:
For to this Nestar we the Blessing owe,
To grow more wise as we more cheerful 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 lark naked, like a Monkey, grinning at the rest; a fourth fondly kisses 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 remembrance 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
The Christian Philosopher.

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 Odorefoque 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.

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 devotional Studies, tho he says, Nullos fe 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 depoimus, & nostra Creatura facta sumus. Facite vos nunc aliquid simile. And again, *Dum in hac miserrima Vita estis, nolite de Corpore esse solitiis; nostri memores estote, quas Creator bonissime coloratis Vestibus induit, quotannis per tot Millennios, jam inde ab exordio Mundi.* And once more, *Ecce vires nostre, non nobis ipsis, sed vobis deserviunt. Non nostro Bono floremus, sed vestro.*

A famous *German Doctor of Philosophy* declares, that he found it impossible for him to look upon the Vegetable World without those Acclamations, *Psalm cxviii. 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, *Seias, O homo, hanc Liquoris mei Sustitatem, qua Cor tuum recreo, a Creatore meo esse.* Our *Bread* so calls upon us, *Vis ista, qua famem sublevo, a Creatore meo, & vestro mihi obtigit. It is a Saying of* *Austin*’s, *Deum Creaturas singulas guttula Divina sue Bonitatis aspersisse, ut per illas homini bene sit.*

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 *fruiful Seasons,* to engage our Love and Obedience. *Quae sanè Beneficia aliud nihil sunt, quam tot manus*
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 tendering 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 Herba & Flusculi Opificis sui Omnipotentiam & Sapientiam commendant Odore, Pulchritudine, & Colorum varia Pictura: Aves Cantu & Modulatione; Arbores Fruibtibus; Mare Piscibus; omnes Creaturae laudant Deum, dum illius mandata exequuntur. 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 Arisfote*Etiena. 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 paruit atque nullis, quaæ Ratiœ, 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 *Aneuraphida* 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 *aquatic,* 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 *aquatic* 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 *Teßanæskaidécapoda,* or fourteen-footed ones; particularly the three sorts of *Afeli.* 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 Μελαμοχθενα, 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 Rea-
son, as well as those that have; both which are ne-
ceSSary to the Subsistence of the Universe? May not
we hence easily argue, that surely this was done in-
tentionally 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. Gordon adds to the Assurances which all the In-
quisitive 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 Erucas'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 num-
ber 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 Li-
quor that is to be considered in this Case. It was like-
wise 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 Hermaphrodites; but such Worms as become Flies are not so, rather they are of no Sex, but are Nesfs full of Animals.

The Spontaneous Generation of Insects has at last been so confused by Redi, and Malpighi, and Squummerdam, 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 frame or in two different Individuals. And there are very few who have considered the Matter, but what own that every Animal proceeds from a praë-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 GOD, 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 Noife; 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 Mensem continuata) 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 Footless 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 moistened 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 sown asunder, no doubt they grew of a Toad-Spawn, 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 places,
ces, and make towards them; and tho they seem to
flow, yet it has been found that in a little time they
will march a considerable way to find out a conve-
nient Harbour. Here Mr. Ray makes a Pause of Re-
ligion; 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 Sturtishness, and provoke them to Cleanliness.
God himself hates Uncleanliness, and turns away from
it, [Deut. xxiii. 12, 13, 14.] But if God requires,
and is pleased 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 ad-
mirable! Their great necessity for accurate Vision is,
in the reticulated Cornea of their Eyes, admirably pro-
vided 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 ministring
to it.
Spiders are mostly oägonocular; some, as Mr. Wil-
loughby thought, senocular. Flies are multocular, having
as many Eyes as there are Perforations in their Cornea.
The greatest part of the Head of that predatious In-
fest, the Dragon-Fly, is possessed 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 Antennæ, by which they not only
cleanse their Eyes, but also guard them; their Eyes be-
ing fitted mostly to see distant Objeûts, these Feelers
obviate the Inconvenience of their too rashly running
their Heads against Objects that may be very near to
them.
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 clash on Glas, 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?
The Christian Philosopher.

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 folded 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 Animalculas, and such as cannot be seen without our Microscopes.

When Galen had admired the Skill, quod declarant Opifices cum in Corperibus parvis aliquid insculpant, in- fianced 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 arque Sapientia; and is amazed that Ars tanta in tam aljectis Animalibus appa rent.

Among
Among the celebrated Pieces of Human Art, there was the Cup that Oswald Nerlinger made of a Pepper-corn, 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 Leuenhoekian 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 GOD, we are amazed!

The Jews have a foolish Notion, tho' advance'd by a Rabbi Solomon, (upon the Egyptian Plague of Lice) Quod Diaboli non dominatur super Creaturam, quae 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 Nymphæ, 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 Torpitude, 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 Zodi Politikà, or 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, Pennae breviores, Crura recta, Ingressus celior, in Fronte macula quodam Diademate candicans, multum etiam Nitore a vulgo differunt. This majestical 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.

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Rege incolumi Mens omnibus una est;
Amisso rupere fidem.

Ille operum custos; illum admirantur; & omnes
Circumstant fremitu denso, stipantque frequentes,
Et sese attollunt humeris, & Corpora bello
Objequant, 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 unpleasant 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, nisi per Calum licuit, Otio perit Dies.*

Another of these Providers is the **A N T**, 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 Tenderness, the Diligence, the Forecast of this little Animal, for the Safety of their young ones! A σταυρός, that filled Squammerdam with an unspreakable Pleasure at the view thereof; *Non sine Juvenitate 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.
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 foremolt 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 *Contrainvance*. *Johnston* makes it an *Article* of his *Thaumatography*, and says very truly, *Vix allius Urbis artificiosior Struttra*. 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 *Offspring*.

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 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 Whimsey 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. Maffett 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 hales 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, Hisse ipse vidi Oculis. Yea, Dr. Lyster affirms true Caterpillars to have been vomited from thence. And Mr. Jesop 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, Verzasa has found them (without a Metaphor) in the Brains of Men; probably they were laid in the Lamina 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 Fierors the Blood has been found strangely vermiculated, as Kircher and several others have upon Examination reported; [so one Worm kills another!] Vermious 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 Ichneum. no carry in Maggats, which they take from the Leaves of Trees, which
which they sagaciously put up close into their Nets. 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 Nets, 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, & Lucerna; 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 ruffling 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-Infest, with a stiff fetacious Tail, terrifies 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 Excrecence, 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 Virulence in the Juice or Egg of the Animal.
Animal reposited on the Vegetable; which Malpighi, in his Description of the Fly bred in Oaken-Galls, has notably confirm'd to us. Erunt Plantarum Tumores, morbosæ Excrecentiae, vi deposti Ovi à turbata Plantarum compage, & vititato humorum Motu excitatae, quibus inclusa Ova & Animalcula, velut in Utero foventur & augentur; donec manifestatis firmatisque propriis partibus, quasi exoriantur novam exoptantia avium.

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 Locusls, 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 *Aridophagi*, 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 apprehending 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 assaulits me, it shall humble 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-
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 episcopal 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 know-est 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 Confort 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 numbered. 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 pur-
fue 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 lessned; 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 REPTILS.

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 Earthworm, Dr. Willis makes this Remark: Lumbricus terrestris, licet vile & contemptibile habeatur, Organa Vitalia, necnon
And the spiral Motion of it is admired as well as described by Dr. T.'son.

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. Lyfier 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 Con- trivances.

The Magnitude whereto some Serpents have grown, is prodigious. Bochart will astonish you with a Collection of Relations found in Antiquity concerning Ser- pents, and particularly Dragons, of a most enormous Magnitude. Gesner too will quote us Authors for

M 4
some so big, that the little Book I am now writing
will afford no room for them.

Yea, Suetonius affirms, that one was exposed by Au-
gustus, which was no less than fifty Cubits long. Dio
comes up with him, and affirms, that in Heruria 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 af-
ffirms, that in Caeso-Syria there had been one which
was an hundred Foot long, and so thick, that a cou-
ple of Men on horseback, on each side of him, could
not see one another. Yea, one that was an hun-
dred 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 Meta-
plor, I would say, I have known where to find a greater
than all of these! But,

*Te 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 Obje&ion
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 Liquor, but quickly changed, and shot out in-
to Crystals, of an incredible Tenacity and Sharpness, with
something like to Knots here and there, from which they
seemed 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
thele
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 Treadle fetch’d
d out of a Viper; the Viper’s Flesh cures Leprosies, and
obliterate 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 pur-
pose I have often taken it, and given it: it invigorates
the Blood into a mighty Circulation, when fatal Sup-
pressions are upon it; it is highly alexipharmick, and
cures Quarten-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 bit-
ten, come off immediately, as if it had been under a
Putrefaction.

The very Steam of the Serpents in the famous La
Grotta deli Serpi, at Saffa in Italy, celebrated by Wor-
mius 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 Rept-
tils, and other pernicious Creatures.’

There is a strange Story related and asserted by
Franzius, That Anno Christi 1564, vast Armies of Ser-
pents 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, articu-
lately cried out, Nolite hoc facere, quia non nostro Arbi-
trio,
trio, sed a Deo luc misfit 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 Maypla 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 useless 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 pleased with rolling themselves, like Swine, in the Dirt; and others cannot be pleased except they be soundly dubb'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 sigh, 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 pleased 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.
The Christian Philosopher.

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 purposed 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 flung 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? Quamodo 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
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 Natura ual, & in Mari esse, praterque multa quae nusquam alibi.

Mr. Willoughby says Aristotle's Division of the Fishes is the best, [better than Rondelerius's] into three Kinds, the cetaceous, 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 equipoherent 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
The Christian Philosopher.

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, a nomine 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 mayest 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 aquatic 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 suckling 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 Balaena 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 chieflly 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, de-
scribe 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 pafs for a Plinyism; and so what Bajil in his Hexa-
emeron reports of Whales equal in bignefs to the great-
est Mountains, let the Censure of Brierwood pafs upon
it, as an intolerable Hyperbole: We will write more fo-
ber things. Passing by what Ælian affirms of the
Whale being five times beyond the largest Elephant,
we find Rondeletius ascribing 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 com-
ing 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 Timmouth-Haven, in
the Year 1532, which was ninety Foot in length, and
the breadth of his Mouth fix Yards and an half, and
his Belly of such a compass, that one flanding on the
Fifh, and flipping 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 enu-
merated, 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 fort 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 virtue 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 proposeth 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 ἄγονεσιν ἀπὸ τὰ ἴχθυα, 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 straight; 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 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 mere 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 dres'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 progress. 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 wondered 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 waft 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 pendem, quam reliquii omnes Musculi ejusdem Avis 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 Mud-suckers 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 Piscina stagna, mergentibus se pullis, Natura duce.

There is a considerable Observation of Aristotle, \(\text{Ἀμφιδέραν \ ϊδείτε} \). 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 fit, 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 Structuraæ, by which means it may continue half an Hour under Water without any danger of choaking.

Read Blasius and Coter, and admire the Tongue of the Wood-pecker, especially the sharp, horned, bearded Point, and the gley Matter at the end of it, the better to stab and flick 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 of
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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 Man-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 grope 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 Carcasses 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 viscid

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; muscular, with a Strength agreeable, where Grain must undergo a Communion!

The Gizzard has a Faculty of grinding; to which purpose the Bird swallows rough Stones, which when grown smooth, it throws up again as useless. 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 Communion 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-
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 MAKER of them all!

Indeed what Stew s says on a Description of a particular Subject, (the Myology of the Eagle) may be more generally applied; Non minus arida est Legemibus, quam Inspectamibus 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 Jakes.

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.

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.

W illoughby confirms that Observation of Pliny, Ipsum Animal ex albo Liquore Ovi corporatur: 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 Antidote 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, furnish'd 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 the
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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 justling 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
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 thickened 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!

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

Masculus ipse foveat Fatus, atque incubat Ovis;
Conjugii servat fiedera casta sui.
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 fit. 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 fit; whereas if you daily take away their Eggs, they will go on to lay five times that number! This holds not only in domestic Birds; and so, as Mr. Ray observes, it can’t be thought the effect of Curation 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 GOD, 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 mansuet, 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 domestic.
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 mere 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 pining 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 Care 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 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 Constructor 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 Columbaè ligno ab Archyta, ratione quadam, disciplinâque mechanica factam, volasse; the fame whom we find celebrated by Horace for a noble Geometrician. This Dove surely had more Geometry in it than the ἄλατον, 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 Herba 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, Rachel 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 prolific; there are more Hens than Kites, more Geese than Swans. A Crane, which is but sparrow 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, fit the oftner, 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.

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! My Great Saviour has given me this Direction, that the sweet Notes uttered by many Tribes of them invite me into a Comfort 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 *GOD* intelligibly enough proceeding from them.'

'It was a celebrated Speech of the Philosopher, *Sic Luscinia esset, ut Luscinia caneret;* 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 *Provvidence* of the Glorious *GOD,* in the Propagation and Sustentation of the *Fowls,* 'tis admirable; it extends to *Ravens,* to *Sparrows,* and I shall imagine myself excluded from the Care of that *Provvidence!* 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, 
Reellis 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 GOD, 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 Ruminination 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 pafs for anomalous.
There is another fort, which has only two Claws; namely, the Camels, which, tho' they have no Horns, do ruminate, and have the four Stomachs of the hooved Ruminants.

A third fort includes those which the Greeks call *Aρτερωμόρφα*, 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 fort 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 distinguished by their Teeth.

Some of these have many cutting Teeth in each of their Jaws; of these there is a greater fort, 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 fort, 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-bog 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
There is one very odd Anomale, which has but three Claws on each of his four Feet, and has a Name-take too often among them that go not upon four; 'tis the Ignarus, 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 Nuisance 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 observably 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 fated with nitrous, or some other sort of Particles, (which are the great Efficient 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 Commisures 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 surpri-
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 Atheism; 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 Senses; in Brutes, whose Brain is incapable of Speculation, the Cerebellum, whose Business it is to minister to the Actions and Functions of the Pracordia (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 flipping 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 left the Cerebell should be unsteady, and the frequent Concussions thereof should cause disorderly motions of the Spirits about the Pracordia, 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 bony 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 Inflexion 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 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 pursu'd, has a bony Tube, a natural Otacoustick, so directed backward, as to receive the smallest and farthest Sound that comes behind it; and in an Horse, 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 ᾀντονύγιον, 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 Probofis! Tully takes notice, Manus data Elephantis, quia propter Magnitudinem Corporis, difficiles aditus habeant ad Pafium. 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 Praise upon it; the words of the Parisian Anatomists upon it, are, At the top of the second of the four Ventricles 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 Reservoirs, where Pliny faith that Camels do a long time keep the Water, which they drink in great abundance, to supply the want thereof in the dry Deserts.

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 Ruminatid. Mr. Derham is very sensibly affected with the curious Artifice of Nature here; but for the whole Business of Ruminatid, the learned Peyerus will give you a very affecting Entertainment in his Merycologia, seu, de Ruminantibus & Ruminatidn Commentarium.

Dr. Grew observes, all carnivorous Animals have the smallest Ventricles, 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 domestic 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 GOD 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 GOD graciously and readily grant the Mercy which I look up to Him to bestow upon me!

The Food of the Cæstor 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, Nimium quid Cæstori alimentum ex succum & coha difficilimum est, sapientissimus & summe admirandus in suis Operibus rerum Conditor, D. O. M. ipsi pulcherrimâ istâ & affabrefactâ Structurâ benignissimè prospexit, ut nunquam decet Fermentum, quod ad solvendum & comminuendum alimentum durum & asperum par forat.

There is in the Eye of Brutes a Periopthalmium, 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 Fœtus 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 Corono-riarum, 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 Trajectio 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, left their prone Heads might fail of imparting Animal Spirits copiously to it.
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 Intercofialis Plexus, in hoc Stulto valde exilis, & minorum Nervorum Satellitio sit-

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The want of the intercostal 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 expresseth; '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 Mattock 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.'

Laëntanius, 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 similibi, ex solo Corpore confiterunt, 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 melted 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, Θείας ἀνήθους ἐκπαθηγάλης ἔπι τοις τῶν ζώων διαμυμεσί. 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 Μίνα τα ἐξελθη θεία, unusual Spectacles. Mr. Ray notes, One may fill a Volume with Comments on this pleasant Story.
The Christian Philosopher.

The Sagacity of some Quadrupeds, tho' so far short of Man's, yet is a matter of Amazishment 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 Rovarius, 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 sepe 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 subtile 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 Government, 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, 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 mere 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 flop 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 mere 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 Horae Subsecrve 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 Academy in one of our Universities, very publickly 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 Mycilus, who wrote an Elogium 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 left 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 Forethought here! What a degree of Argumentation too!

They that have written de Solertia Animalium (as many besides Plutarch have done) have reported such Epistles 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 Beavers! 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 Bevers.

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
Disipline 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; fit-
ted every way for Service or Pleasure, for the meanest
or the greatest Master. There are ancient 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
Healths 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. Cheyne, that all these are so many undeniable Proofs for the Being of a G O D; 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 wife 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 G O D, 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 G O D.'

There is one very surprizing thing, and without acknowledging a Superintendency of a Divine Providence there can be no accounting for it. The Manufuete 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 Manufuete 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,
to a Price be set upon his Head! What Rarities are Lions, and Tygers, 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 shortened 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! Franzinus, 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, left 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 qua Nature sfera ac rabidn sunt, consternantur ad Vana. Idem inquietis & solidis Ingeniis evenit,
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 so-
litary 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 ap-
proaching 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 chace 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 fol-
lowed 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 Mar-
riage.’ 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 Re-
flexions 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 themselves; and Cats, which commonly cover their Excrements, and wipe their Mouths after Dinner. Foul
Water will breed the Pip in Hens, and Naftinesse.
Lice and Scabs in Kine; and all Creatures, even
Swine themselves, which love Dirt, yet thrive best
when kept clean. Of Forecaft, the Sitta and the Ant,
which lay up Nuts and other Seeds in their Granaries, 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 Chafity, the Doves
and Partridges, which keep to one Husband and
Wife. Of Conjugal Love, the Rock, the Male helping
the Female to make her Neft, feeding her while
she sits, and often sitting in his turn. Of Maternal
Love, the domellick Hen, gentle by Nature, and unarmed, 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 noxious 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 Care,
and Diligence, and more Wit: and so much the more,
the worse the things are, we see and should avoid.
Wesfels, and Kites, and other mischievous Animals, induce us to Watchfulness; Thiftles and Moles to
good Husbandry; Lice oblige us to Cleanliness in our Bodies, Spiders in our Houfes, and the Moth in our
Clothes: the Deformity and Filthinesse 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 beaftly 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 Cre-
ator of all these things, is to learn those Virtues, and
those decent and honest 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 contemplandis Ani-
malium Moribus, Exempla suppetunt omnium Officiorum,
& Effigies offeruntur Virtutum summã cum Authoritate
Naturœ, omnium Parentis, non simulata, non inconstantes,
seh vere ingenua atque perpetua. 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 Ad-
monitions, 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 Ex-
empla Virtutum qua in illis apparent, observes, & om-
nibus Viribus conersis 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 Em-
bler than the Sheep; the clean, patient, innocent
Creature, which has nothing belonging to it but
what is of a celebrated Usefulness. O thou most hono-
rable Creature, what a Dignity has the Son of God Him-
sel 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 barbarous 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 condemned 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 iadendum impetus hostilis, moneat 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 being fitted, beyond any Emendation, for its Actions andUses, 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 destructive 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 Sensation 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 GOD, Thou art Good, and Thou dost Good; Oh teach me Thy Statutes! So sings the Poet:

O Deus, O Mundi solus qui seestis habenas,
Ut tua nunc Bonitas oculis est obvia cunctis!

ESSAY XXXII. Of MAN.

AND now let the Lord of this lower World be introduced, MAN, 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) & est principalior 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, & relinquunt seipso, nec mirantur, but see nothing in themselves to be wondered 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 Natura! ‘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 golden 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, Qua 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 sublīme, 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 Tērra Hominis, non ut Incola atque Habitatores, sed quasi Spectatores superarum rerum, atque Civitātem, quārum Spectaculum ad nūllum aliud Genus Animalium pertinet. By this posture Man has the use of his Hands, which, as Galen observeth, are, Organā 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 surprising; what Ligaments? especially that of the Pericardium to the Diaphragm, which, as Vesalius and Blan-cardius 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 neglected, the Body necessarily and immediately tumbles down.'

Every thing does conspire to allure 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 posset 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 Bartholomius. 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 fingulis 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 coliciati sunt! And for the other Parts, he notes, Reœ in illis Corporum partibus Q
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 slake 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 fleshly Parts, what Cases of Disaster are answered in them? Mr. Durham 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 Gueft, but sometimes what likewise might long have lain lurking there.

What 

*Epistories* 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 morbidick 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 unproachable. Dr. Grew beflowd 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.
The Christian Philosopher.

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 Pra-
cordia 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 Laugh-
ter. 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 arumna
levat, and the Muscles of the Face put on a sorrowful
Aspect. Hence also the toruous 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 be-
tween the Diseases of the Belly and those of the Skin;
whence very stubborn Diarrhae's cured by Diapho-
reticks.

What a Sympathy between the Feet 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 millibus 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 Assaulsts and Batteries, in Murders and Assassinations, in Thefts and Robberies, what Security would there be to Malefactors? How many other Inconveniences?’

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 Dif-similitude 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
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one Master, and one and the same Form of Writing, yet they all write differently; there is something peculiar 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 Confusion? 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 Concert; 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 proclaindest thyself so very tender of! Hum an Society, Mankind associated.

The Variety of the Parts whereof the Body is composed cannot but oblige our Admiration, cannot but compel our admiring Souls to acknowledge our glorious Maker!

The Bones in a Skeleton are two hundred and forty-five, besides the Osja Sesamoidae, which are forty-eight.

The Muscles of the Body are four hundred and forty-six.

The Nerves which come immediately out of the Skull, from the Medulla oblongava, are ten Pair.

The Nerves which come out between the Vertebrae are thirty Pair.

The Scarf-skin examin'd with a Microscope, appears made up of Lays of exceeding small Scales, which cover one another more or less, according to the different 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. Leuwenhoek 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, Glands, 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,
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 Læstal Veins, and out of them into the Thoracic Channel; and no doubt the communication 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 Craft and Fluidity, and it incorporates the Chyle and other Juices it receives with it.

Even Pain itself, however afflicting 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 παρέχων 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 retentive, like so many Pillows, dissipating the force of the Pressure, and to 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 Anaemia, 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, where-with 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 Peri-
wigs.

How commodiously are the Nerves, therewith four
of the Senses are served, as well as all the superior
Parts, all sent out the shortest and safest ways, thro
proper Holes in the Head. And those that serve the
Inferior, 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
erent; 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 De-
struction of the whole Machine, which by these differ-
ent 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 Meminx, by its Constriction, upon oc-
casion, causes a more vigorous Efflux of the Spirits, and
thereby the better Irradiation of the Organs of Mo-
tion and Sense. By the frequent Repetition of this
Constriction all the day, being tired, as all other Mus-
cles 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 alter the Symmetry of the Brain, and so the Per-
spicuity of the Fancy.

Gracious God! how much ought I to adore the Goodness of thy superintending Providence, which gave my Brain that Confirmation, 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 mar-
vellous 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, יִבְנֵי, 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 for ever to be adored, as MY God and MY Lord.

The Place of the Eye, even in the Head, how a-
greeable! "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 Circum-
stances.

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 crystalline, which is of a lenticular Figure, convex on both sides;
by the Refraotions 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 Chryftal, 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 sophificated 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 mino Ar-tificio, quam munifca Nature 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 Cesar, that Expergefactus 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 through an Orifice in the Wall; Dr. Briggs adds this reason for it, \textit{Quod Radii in Visione superfici, qui ab Objectis lateralis 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 Chryftal, 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 chryftalline 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 chryftalline 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 Chryftalline 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 chryftalline 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 Chryftalline, from the outermost to the Center: every one of these wonder-
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 si-
ences them with, It is what I myself have seen, and can shew to any body with the help of a good Microscope.

Peter Herigom has observed a remarkable thing about the Intersion of the Optick Nerve into the Bulb of the Eye. The Situation of it is not just behind the Eye, but on one side, left 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 Distortion of the Eyes: but being united near their Interstion, 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 Piture? Why the visual Rays coming in strait Lines by those Points of the Sensory, or the Retina, which they touch, affect the common Sense or Soul, according to their dire-

ction;
tion; they signify to it, that the several Parts of
the Object, from whence they proceed, lie in strict
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 My-
stery: Notitia illius ex nulla Imagine pendet, nec ex ulla
Actione ab objectis veniente; sed ex solo fitu exiguarum
partium cerebri, e quibus Nervi expullant. Mr. Mo-
lyneux 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 useless 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, speedi-
ly to repair it, by the help of certain Water-Pipes, or
Lymphaducts, inserted into the Bulb of the Eye, pro-
ceeding from Glandules designed by Nature to sepa-
rate this Water from the Blood for that Use. Anso-
nius 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 Hyperbolical or Parabolical 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 concentrical 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 effet.

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: Excelcis undique partibus sepiantur. 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 Reteititating 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 Incursions of troublesome Insects. 'Tis remarkable, that these Hairs grow to a determinate, but a most commodious Length, and need no cutting, as many other Hairs of the Body do; and that their Points do stand out of the way, bending upwards in the upper Lid, in the lower downwards. But then Sleep is necessary for us. This would be disturbed, 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 must be kept pellucid. This would anon dry and shrink, and lose its Diaphaneity, if the Eyes were always open. The Eye-lids are therefore so contrived, as often to wink. Thus they varnish the Eyes with their Moisture over again: They have Glandules, on purpose to separate an Humour for that use, and withal wipe off whatever Dust or Filth may flick to them. And lest the Sight should be hinder'd, they do it, with what Celerity! Cicero adds, they are Mollissima tætu, ne laderent Aciem: And I will add, Man, who is a sociable Creature, and should exhibit Social Affections by some visible Tokens, is here furnished with Tears for that purpose, beyond any other Animal.

My God, let me ever employ them, on the just Occasions for them.

It is a Passage which drops from the Pen of a Person of Quality, in a Treatise, entitled, A View of the Soul: 'It does not seem wonderful to behold a Distillation from the Eyes, 'tis to be found in Beast, as well as in Man, upon an offensive Touch thereof: But when there is no such Cause to be alleged, to have the Body, as it were, melted on a sudden, send forth its Streams thro that unusual Channel, makes it seem to me no less than the quick and violent Agitation of some Divine Flame, thawing all the vital Parts, and drawing the Moisture thro the chief and clearest Organ.
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' 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 fletus instrumentum esse valuit. And the Answer to it, Ut quò fordes peccatorum haeriantur, eodem per lachrymas 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 Chryflalline 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 Spherical 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 won-
derful and surprizing Instances of Foresight and Coun-
 sel, 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 Decuslation of the Optick Nerves. I pass by the Assertion of the Bartholines, that they are united, not by any Intersection, sed per totam Substan-
tiae Confusioinem. 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 Fibrillae 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 In-
formation is carried to the Thalamus Nervorum Optico-
um, 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 Tauvry, 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, be-
cause 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? Tauvry thinks
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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 Sturmuns 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 wished 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 fit 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;
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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 Evagination 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

R 3 have
have absorbed them, and retarded them; whereas
now the Sounds have their agreeable Volutions, 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, there-
fore to prevent the invasion of noxious things, which
love to retreat into every little Hole, behold, the Pas-
sage 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 constant-
ly 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. Schel-
hammer 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 Glandulae Ceruminosae. Pliny ascribes a great
medical Virtue to the Ear-wax, the Serdes ex Auribus,
as curing the Bites of Men, (which he says, inter asper-
rimos numerantur) and of Scorpions and Serpents. And
Mr. Derham ascerts he had found it a good Balsam in
his own Experience.

The Notion of an innate Air in the Ear, is by Schel-
hammer 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 fa-
eile 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 aethereal 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, Tenusissa raraque admodum Textura, whereof the Uses are to keep the Gate of the Labyrinth, left 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 Rohault, That for us to give Attention, is nothing else but for us, by extending
tending or relaxing the Tymanum of the Ear, to put it into that position, *in qua tremulum aeris externi motum exciperre posset*, 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 intermedation 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 left 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 insculptured 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 praestat: 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 rendered 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.
Caves 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 Pho-

murgia finds a Pit in the Cimmer 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 ficken them, and even to fright them out of their Wits, if they dare approach them. Habent Bases illerum Monti- tum in Fluétium ingressu & egressu tortuosas rimas, se- 
siiuras, satis stupendo Natura Opificio fabricatas, in qui-bus longa Voragine formidabilis ille sonitus, quasi subterra-
neum tonitru generatur.

The prodigious Cataract of Niagara, whereof Hennepin has given some relation, produces a Noise which perhaps nothing on Earth has equal’d; a Noise which it might well nigh deafen one to think upon.

What is the Matter of Sound? The Atmosphere in gros? Or the ethereal part of it? Or some soniferous Je-ne-şay-quo'y 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 crouded in; the Experiment succeeds, not only in forced Rarefactions and Conden-
tions of the Air, but also in such as are natural. The
Story of the Pistols discharged by Fradlichius on the
Carpathian 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 Reper-
cussions of the Rocks and Caverns, and other phonocap-
 tick 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 hun-
dred Miles. If we go more Southward, Guns at Flo-
rence 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 Insurrec-
tion 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 deter-
mined, 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 \(\frac{9}{4}\) half Seconds, or \(11\frac{1}{4}\) 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 Phomurgia, and Isaac Vossius writing de Poematum Cantu & Rythmi Vivibus, 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 would'st 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, ed quod omnis odor ad superiora fertur, recte sursum sunt, & quod Cibi & Potionis Judicium magnum earum est, non sine cause vicinitatem Oris secutae 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 barricaded 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 crowded 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 loft all Sagacity, if he be not sensible of enough, to oblige his Praises of the God that made him.
The Christian Philosopher.

Our 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 Bauhin, and Bartholin, and Laurentius, and our Wharton. Our Willis determines, Præcipium & fere folum 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: Occurrent Papillavia Corpora, probabilius est in his ultrimo, ex subintrante sapido Humore, Titillationem & Mordicationem quandam fieri, qua 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 unfavourable and pernicious.

The Taste: Qui sentire eorum quibus vestibur genera debet; as Tully long since observed, Habitat in ca parte Oris, qua esculentis, & poccularis 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 equalibiter fusus est, ut omnes Ictus, omnesque nimios & Frigoris & Caloris appulsus sentire possumus. 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 Papilla in the Tongue, so Feeling is performed by the like Papilla under the Skin. That these Papilla 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 Papilla, 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? We
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 Periostium, 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 through 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 Holiefsafts, that are suitable to the stress, which in their different Offices they may be put unto. The Fore-teeth and
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 Commination 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 Duæus 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 Composition 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 bless 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 Rebuff 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 Infirmitv.' I go on: The necessity of the Tongue for Speech will remain generally to be ascertained, notwithstanding the Tricks of the Ventriloqui, taking advantage of the Duplicature of the Media-fimum, to form various Voices; and notwith-
notwithstanding the rare Instance reported by Roland, in his Aglosoftomagaphia, five Descriptio Oris sive Lingua, quod perfecte 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 subpoena'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 annular Cartilages, to keep it constantly open, and that the Sides of it may not flag and fall together. And left, 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 annular Cylinders 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 inlected and arcuate, as a Sphincter embracing it, and closing it fast; which is a sensible Providence, left, 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. Grow 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
of the Glottis, to be one tenth part of an Inch, in founding 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 conduct 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 Diafsole 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 Syfsole: but the Heart has no Antagonist Muscle. What shall we now do for the Diafsole? 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 Elafick 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 Vesicula; 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 Esmuller and Willis, whether the Vesicula of the Lungs have any muscular Fibres, or no. We will content ourselves with Galen’s Conclusion upon the Parts ministering to Respiration, that admirabilem Sapientiam testantur.

While the Foetus 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,
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 contringe 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. Willis) and this, after every Pulse of the Heart, serves to contract the Vessels 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 afunder the Nerves that go from the Brain to the Heart, the Motion thereof ceaseth immediately.

For the Motion of the Heart, Monsieur Tauvry flies 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 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 quaquaversal 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 stop’d, 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 specific degree of Cohesion 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 Cohesion 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 Communion upon several parts of the Solids, so as to make them sustaineable 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 Vessal, and full, by which means the Successions 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 Successions 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 subtile and fluid, that it may enter at the Orifices of the Latheals.

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 marvelously 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 Bel-lini, 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 Latheals. 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!
The Christian Philosopher.

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 Bifius, and others; but prepare always for a Field of Wonders, equal to any in the Field of Zoon! — 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
too in Animals, while they grow, there is a new Periosteum 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 Lubrification; 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 Insipidation, 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 Incalescence, 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 Mischiefs 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 useles, 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
cording 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 Eslays 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 Peritoneum are a particular Instance of that, out of which alone, in hydroplical 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 Woolen 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 stopped, 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 Expense of Animal Spirits is not in proportion to the Labour which the Animal is at: and so a Man reduced to hard Labour, is not reduced 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 Expenses 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 membranous
branous Parts of the Body are nourished. But how
marvellous the Lymphatic 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 Olau Rudbeck,
in the Years 1650 and 1651. Pecker made a progress
in the discovery of them; and their Valves were de-
monstrated 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 ap-
proach the Heart; and yet they do not, like the Veins,
open into one common Channel. — The whole Con-
trivance 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 ano-
ther, and with others; whence it comes to pass (as
Dr. Keil observes) that when any small Artery is ob-
structed, the Blood is brought by the communicating
Branches to the Parts below the Obstruction, which
must otherwise have been deprived of their Nourish-
ment. And in the Veins there is the like Provision,
that so justly surprizes us in the Arteries.

The Viscidity 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 Ὠγίανος Ὠγίανος, 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, M A N U S, 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, left 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 Treas-
tise 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, quâ 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 *Tisb*, 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 CR E-ATORIS 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 Chirromancy.*

*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 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 somewher 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 CaIius Rhodiginus, in Zuinger, in Camerarius, in Hake-well, in Wanly, and in other Collectors; however, a touch or two may not be unacceptable.

The Tyrant Maximus would with his Hands draw loaded Carts and Wains, break the Bones of Horfes, and cleave Trees asunder. Marius, who of a Culler became an Emperor, could with his fourth Finger stop a Cart that
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 mafty 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 Potsherd; (which is a Circumstance they also relate of Pozova, a Polish Gentleman.) Little Venetianello would with his Hands wrest 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 As, 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 GOD, 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 pathetical Words of an outlandish Doctor of Philosophy; O Deus, si totius Corporis mei Membra verterentur in Linguas, Nominis tui magnificientiam enarrare non possem.

But in MAN, must that have the last Consideration, the State whereof, alas, is that which too commonly is the last considered! The SOUL, 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 Curae perfecta esse perspicuit, is his ipsis Rebus mihi videtur careere.

'Tis high time for us now to take the SOUL of Man into our Contemplation. The SOUL, whereof Juvenal,

Sensum à caelestii demissum traximus arce,  
Cujus egent prona, & terram spectantia.

The SOUL, whereof Claudian,

Hec 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
The Christian Philosopher.

thou speakest at this rate to us: Si quis nulli Secte addicteus, sed libera sentimentia rerum Considerationem inierit, conspicatus in tantâ Carnium & Succorv colievie tantam Memem habitare, — (omnia enim declarant Opificis Sapientiam,) — perfecissima Theologia verum principium consistet; qua Theologia multo est major atque praestantior tota Medicina. [De usu Part. lib. 17. c. I.] 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 other Faculties, and will unspeakably enable them all.

I have read, in the AEscticks, 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. Nevertheless, 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 Redress of those Epidemical Miseries, under which Man-
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 Bellarmine says,

Hic stupor est mundi, qui scibile discutit omne.

What a Character could Vives give of his Budaus? 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?)
but what he did readily remember. Salmasius gives a Report, little short of this, concerning Casaubon. Voetius and Vossius, how do they celebrate the vast Erudition of our Uher! Others will or may do as much for theirs. Bechard 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 Testimonials to the Preference of real Piety, before all their Skill in Languages and Sciences.

My dear Witius, lately dead, must for ever live in the Catalogue of wonderful Men; and Mr. Baxter too!

Of these two, and of some others, what Amberashius 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 AL STE DIUS; 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 Compositions 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 All's-tedious, is to see the ungrateful and exalted Folly of the World; for Concifeness is one of his peculiar Excellencies: they might more justly call him any thing than tedious.

The early Attainments and Achievements of some, have been the just Admiration of the World. Mr. Baillet has drawn up a curious List of illustrious Youths.
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 Nahor, 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-eyed 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 millia Nominum recitata, quo ordine erant dicta, redebam.* 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 *Quae 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 *Odysse* no less; and yet the younger Scaliger committed all *Homer* to his *Memory* in one and twenty Days. The *Memory* of our famous Jewell 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 Lasta Memoria, reported by Zuinger, and Foreftus, 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 \textit{inter Stercus} \& \textit{Urinam}? One would think this were a Degradation to the \textit{Velvet Cap} and \textit{Scarlet Robe}; to go in Silk and Plush to the most squa-lid and nasty Chambers, looks a little strange; to fuck 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 faith our God: and he is to be seen in the disposition to profess every honest Trade for necessary Uses! When I behold any Man cheerfully following 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 \textit{de Morbis Artificum}, have mentioned no Case more deplorable than this, for a Man to be sick of his Calling.

Our Great \textit{G O D} 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 \textit{G O D}, my Soul with all possible Prostration 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 Bazekeel have it, O Spirit of God, thou art He who givest him Knowledge in all manner of Workmanship.'
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 fortuitous 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 Ketier mid-
wifed 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 Syrturus 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 mo-
dern? (tho Cardan, and other learned Men, have so much cried it up with their Elogies and Comment-
taries.) Baglivi says truly, 'tis as far short of it as a Flea is of an Elephant. We will pass to another In-
fstance: The Romans had not so much as a Sun-dial till the second Punic 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 Win-
dows, 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 Ligurn, 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
The Year 1662. The Uses of these Pendulum-Watches cannot be sufficiently celebrated.

But useful indeed will be these Measures 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 aevi 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 Taurey 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! Why 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 restored 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 fort of natural Philosophers, who are by the Rab-bins called סוריניש Inquisitionis, or Sapiences Scrutionis, 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 super- rior 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 MAN; and yet MAN 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 imbedded Intellect before we come to pure Mind.'

It is likely that the Transition from Human to perfect M I N D 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 S O N of G O D.

Anon we see an infinite G O D; but canst thou by searching find out G O D? 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 G O D, and so in serving that which I propose as the chief E N D for which I live, and move, and have my Being;
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-O N E.

II. 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 show thyself in a World where every thing stands ready to overwhelm thee! A BEING 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 T r a t i f s 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 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 suited 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 Inflation 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 delecful 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 GOD, 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 genera 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 inexusable 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 oftener 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 Clusses of the Creatures (for Discipulus in hoc Schola 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 God, 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 Rebuffe which they give to our Pretension, 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 God 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 Lambeius, 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 drunk 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 Mineral 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 Judeo-Chrisitianus, which had on one side the Name 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 Leufden 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 Danhauser, thy Granatilla, 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 livery made as has been imagined, I would subcribe 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. i. 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 a Deo facta de Nililo, arguit aliam productionem, summam, occultam, & aternam in Deo, qua 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 Godhead 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, ζητεί παραγερμόνοι, 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 Galilee, 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 Godhead 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
But were they not all made by the Hand, as well as for the Sake of that Glorious-O N E? They were verily so. O my J E S U S, 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 G O D, in the creating of the World! He is that W o r d of G O D 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 W i s d o m of G O D in His Creatures; one cannot but presently infer, W h a t an incomprehensible W i s d o m then in the Methods and Affairs of that Redemption, whereof the glorious G O D has laid the Plan in our J E S U S! Things which the Angels desire to look into. But, O evangelized Mind, go on, mount up, soar higher, think at this rate; t h e i n f i n i t e W i s d o m which formed all these things is peculiarly seated in the Son of God; He is that r e f l e x i v e W i s d o m of the eternal Father, and that I m a g e of the invisible God, by whom all things were created; in H i m there is after a peculiar manner the original I d e a and A r c h e t y p e of every thing that offers the infinite W i s d o m of God to our Admiration. Wherever we see the W i s d o m of God admirably shining before us, we are invited to such a Thought as this; t h i s G l o r y is originally to be found in thee, O our I m m a n u e l! 'Tis in H i m t r a n s c e n d e n t l y. But then 'tis impossible to stop without adding, H o w g l o r i o u s, h o w w o n d e r f u s, h o w l o v e l y a r t t h o u, O our Saviour!

Nor may we lay aside a grateful Sense of this, that as the S o n of God is the Upholder of all Things in all Worlds, thus, that it is owing to his potent I n t e r c e s s i o n that the S i n of M a n has made no more havock on this o u r W o r l d. This o u r W o r l d has been by the S i n of M a n so p e r v e r t e d from the t r u e E n d s of it, and rendered full of such loathsome and hateful Regions, and such S c e l e r a t a C a f r a, that the Revenges of God would have long since rendred it as a f i e r y O v e n, if our b l e s s e d J E S U S had not interceded for it: O my Saviour, what would have become of me, and of all that comforts me, if thy I n t e r p o s i t i o n 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 Restoration 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 Paradisack Regularities? Lord, what thou meanest in them. I know not now, but I shall know hereafter! I go on, Who can
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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 Reflexion 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 preferred 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 posses, 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!

FINIS.
Jane Smith
Eius Libri
Oct 26. 1742