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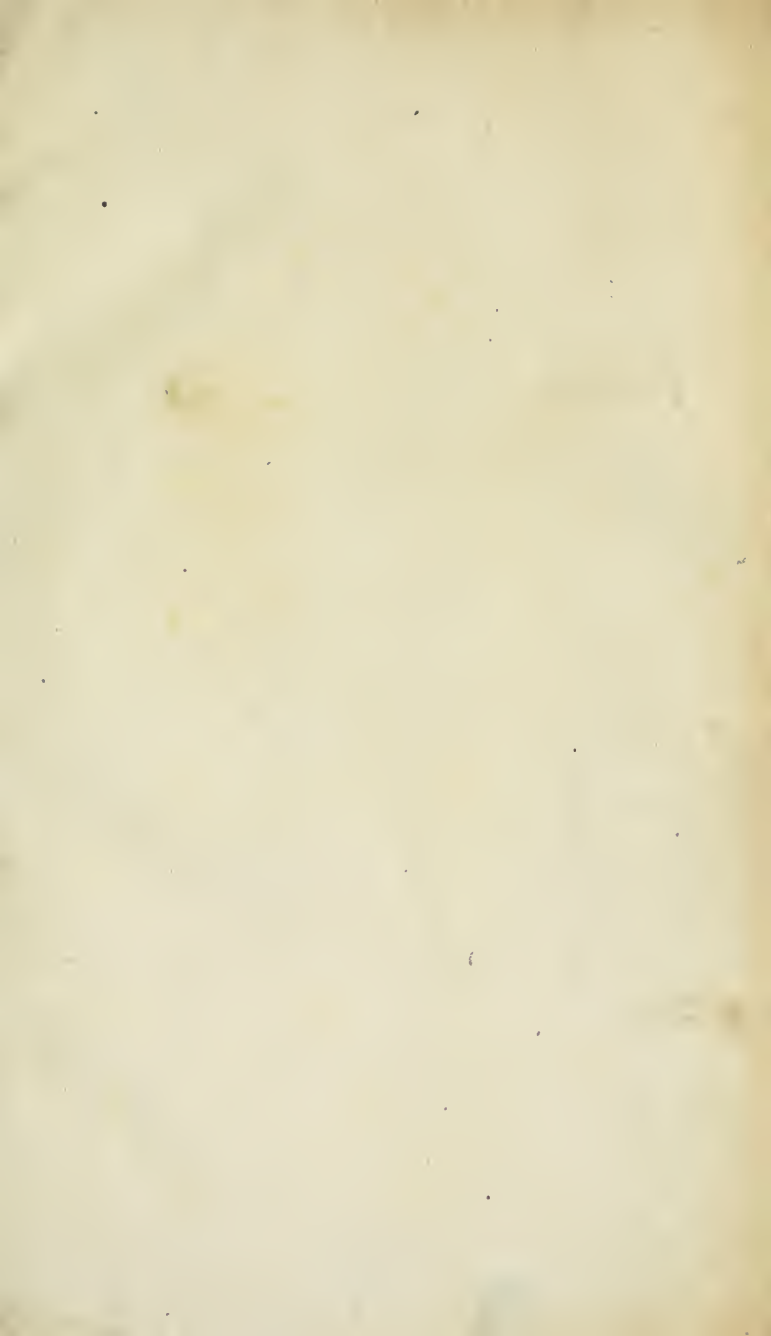
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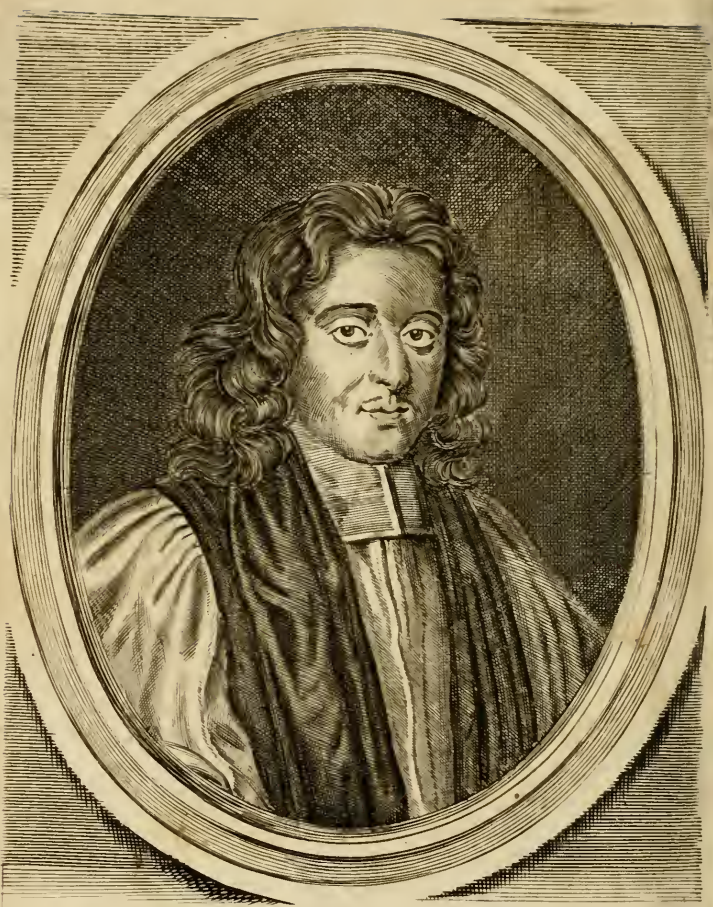
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*Effigies Reverendi admodum veri
Johannis Wilkins nuper Episcopi
Cestriensis.*

Handwritten signature or mark at the top of the page.

T H E

Mathematical and Philosophical

W O R K S

Of the Right Reverend

JOHN WILKINS,

Late Lord Bishop of CHESTER.

C O N T A I N I N G,

- I. The Discovery of a New World : Or, a Discourse tending to prove, that 'tis probable there may be another Habitable World in the Moon. With a Discourse of the Possibility of a Passage thither.
- II. That 'tis probable our Earth is One of the Planets.
- III. *Mercury* : Or, *The Secret and Swift Messenger*. Shewing how a Man may with Privacy and Speed communicate his Thoughts to a Friend at any Distance.
- IV. *Mathematical Magick* : Or the Wonders that may be perform'd by *Mechanical Geometry*.
- V. An Abstract of his Essay towards a *Real Character*, and a *Philosophical Language*.

To which is prefix'd the AUTHOR'S
LIFE, and an Account of his Works.

L O N D O N :

Printed for J. Nicholson, at the King's-Arms in Little Britain ;
A. Bell, at the Cross-Keys in Cornhill; B. Tooke, at the Middle-Temple-Gate in Fleetstreet; and R. Smith under the Piazza's of the Royal-Exchange. M DCC VIII.



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T H E

L I F E of the A U T H O R :
A N D A N
A c c o u n t of his W R I T I N G S .

HE was Son to Walter Wilkins, Citizen and Goldsmith of Oxford; was born at Fawlsly, near Daventry, in Northamptonshire, in the House of the Reverend and well known Mr. John Dod, who wrote upon the Commandments, he being his Grandfather by the Mother's side. He was taught his Latin and Greek by Edward Sylvester, a noted Grecian, who kept a Private School in the Parish of All Saints in Oxford: His Proficiency was such, that at Thirteen Years of Age he entred a Student in New-Inn, in Easter-Term, 1627. He made no long stay there, but was remov'd to Magdalen-Hall, under the Tuition of Mr. John Tombes, and there he took his Degrees in Arts. He afterwards entred into Orders, and was first Chaplain to William Lord Say, and then to Charles Count Palatine of the Rhine, and Prince Elector of the Empire, with whom he continued for some time.

Upon the breaking out of the Civil War, he join'd with the Parliament, and took the Solemn League and Covenant. He was afterwards made Warden of Wadham College by the Committee of Parliament appointed for Reforming the University; and being created Batchelor of Divinity, April 12. 1648. was the Day following put in possession of his Wardenship. Next Year he was created Doctor of Divinity, and about that time took the Engagement then enjoyn'd by the Powers in being.

In 1656. he married Robina, the Widow of Peter French, formerly Canon of Christ-Church, Sister to Oliver, then Lord Protector. In 1659. he was by Richard the Protector made Head of Trinity College in Cambridge, the best Preferment in that University.

After King Charles the III's Restoration, he was ejected from thence, and became Preacher to the Honourable Society of Grays-Inn, and Minister of St. Lawrence Jury, London, in the room of Dr. Ward. About this Time he became a Member of the Royal Society, was chosen one of their Council, and prov'd one of their most Eminent Members, and Chief Benefactors. Soon after this he was made Dean of Rippon, and by the Interest of the late Duke of Buckingham, he was created Bishop of Chester, and consecrated in the Chappel of Ely-House in Holbourn, the 15th of November, 1668. by Dr. Cosin, Bishop of Durham; Dr. Laney, Bishop of Ely; and Dr. Ward, Bishop of Salisbury; on which Occasion Dr. Tillotson, afterwards Archbishop of Canterbury, preach'd an Excellent Sermon.

He was a Person of great Natural Endowments, and by his Indefatigable Study attain'd to an Universal Insight into all, or at least most Parts of Useful Learning. He was a great Mathematician, and very much advanc'd the Study of Astronomy, both while he was Warden of Wadham College in Oxford, and at London, when he was a Member of the Royal Society. He was as well seen in Mechanics and Experimental Philosophy as any Man in his Time, and was a great Promoter of them. In Divinity, which was his main Business, he excelled, and was a very Able Critick; his Talent of Preaching was admirable, and more suited to profit than to please his Hearers; he affected an Apt and Plain Way of Speech, and express'd his Conceptions in a Natural Style. In his Writings he was Judicious and Plain, and valued not Circumstances so much as the Substance. This appear'd evident in whatever Subject he undertook, which he always made easier for those that came after him.

He treated sometimes on Matters that did not properly belong to his Profession; but always with a Design to make Men wiser and better; which was his chief End in promoting Universal Knowledge, and one of the main Reasons for his entring into the Royal Society. His Virtues and Graces were very uncommon; at least as to that Degree of
them

them to which he attain'd : His Prudence was very remarkable, and seldom fail'd him ; but he was so Openhearted and Sincere himself, that he was ready (except he knew some Cause to the contrary) to think other Men to be so too ; by which he was sometimes impos'd on.

His Greatness of Mind was evident to all that knew any thing of him, nor was the Depth of his Judgment less discernible. He never was eager in Pursuit of Dignities ; but was advanc'd to them by his Merit. He contemn'd Riches as much as others admir'd them ; and spent his Ecclesiastical Revenues in the Service of the Church from which he receiv'd them ; and being secur'd against Want, he would often say, That he would be no Richer : And his Conduct made it evident that he was as good as his word.

He was a Stranger to Revenge, and yet not unsensible of Personal Injuries, especially such as reflected on his Good Name, if they proceeded from such as had a good Reputation of their own. The Reproaches of others he despis'd ; but frequently wish'd he had been better understood by the former : He bore it, however, patiently, as his Misfortune ; never requited them with the like measure ; but always mention'd them with Respect, and laid hold on all Opportunities to oblige and do them good.

His Conversation was profitable and pleasant ; and his Discourse was commonly of useful Things ; without occasioning Trouble or Weariness in those that conversed with him. He cultivated that most necessary (but too much neglected) Part of Friendship, To give seasonable Reproof, and wholesome Advice, upon Occasion. This he did with a great deal of Freedom ; but with so much Calmness and Prudence, that it seldom gave Offence.

He was particularly careful of the Reputation of his Friends ; and would suffer no Blot to lye upon the Good Name or Memory of any of them, if he could help it.

His Enemies, who were Strangers to Moderation themselves, made that Virtue in which he excell'd, the chief Subject of their Reproaches, as if he had been a Person of unsteddy

unsteady Principles, and not fixed in Matters of Religion ; this drew severe Censures upon him from Archbishop Sheldon, Bishop Fell, and Archbishop Dolben, &c. without considering that he could not but have a great deal of Charity for Dissenters, by reason of his Education under Mr. John Dod his Grandfather, a truly Pious and Learned Man ; who dissented in many Things from the Church of England long before the Separation which afterwards follow'd upon Archbishop Laud's Severities and new Impositions.

And as his said Grandfather never approv'd of the Extremities on the other Side, but continu'd Loyal to the last, and advis'd others to continue in their Allegiance ; in like manner Doctor Wilkins, (tho' he had Clearness when the Government was dissolv'd, to submit to the Powers then in Being, by which he procur'd an Interest and a Share in the Government of both Universities ;) was always a Friend to those who were Loyal, and continu'd well affected to the Church of England, and protected several of 'em by the Interest he had in the then Government.

After the Restoration he conform'd himself to the Church of England, and stood up for her Government and Liturgy ; but dislik'd Vehemence in little and unnecessary Things, and freely censur'd it as Fanaticism on both sides.

Having thus conform'd to the Church himself, he was very willing to bring over others : In which he was not without Success, especially in his own Diocese ; where the Extremes on both Sides were as remarkable, as in most Parts of the Nation. Being a Person of Extensive Charity himself, he was for an Indulgence and a Comprehension, in order to have brought our Divisions in Matters of Religion to a Conclusion ; which drew upon him the Hatred and Obloquy of those who were for contrary Measures.

His indefatigable Pains in Study brought the Stone upon him ; which prov'd incurable. He had for many days a Prospect of Death ; which he view'd in its Approaches, and gradual Advances upon him : And a few days before his Dissolution, he frequently said, That he found a Sentence

tence of Death within himself. But in the height of his Pain and Apprehensions of Death, he shewed no Dismay or Surprize, nor was ever heard to utter a Word unbecoming a Wise Man, or a true Christian. And thus he concluded his Days with Constancy of Mind, Contempt of the World, and chearful Hopes of a Blessed Eternity, through Faith in our Lord Jesus Christ. He died in the House of his Friend Dr. Tillotson, in Chancery-lane in London, on the 19th of November, 1672. and was buried on the 12th of December following, under the North Wall of the Chancel of the Church of St. Lawrence Jewry, where he had formerly been Minister. His Funeral Sermon was preach'd by Dr. William Lloyd, then Dean of Bangor, (now Lord Bishop of Worcester) at the Guildhall-Chappel in London; by which, those who are Curious may be satisfy'd, that every Part of the Character here given him, may be justify'd to Advantage.

As a further Proof of it, and particularly of his unwearied Endeavours to promote Universal Knowledge, 'tis proper to subjoin a Catalogue of his Works.

1. The first was entitled, The Discovery of a New World; or, A Discourse tending to prove, That ('tis probable) there may be another Habitable World in the Moon. Printed at London in 4to. 1638. and had Four Editions, the last in 1684.

2. Discourse concerning the Possibility of a Passage to the World in the Moon. Printed with the Discovery.

3. Discourse concerning a New Planet; tending to prove, That ('tis probable) our Earth is one of the Planets. London, 1640, in 8vo.

The Author's Name is put to none of the Three; but they were so well known to be his, that Langrenus, in his Map of the Moon, (Dedicated to the King of Spain) calls one of the Spots of his Selenographick Map after his Name.

4. Mercury; or, The Secret Messenger; Shewing how a Man may with Privacy and Speed communicate

cate his Thoughts to his Friend at any Distance. London, 1641. *The Publication of this was occasion'd by the writing of a little thing, call'd Nuncius Inanimatus, by Francis Goodwin.*

5. Mathematical Magick ; or, The Wonders that may be perform'd by Mechanical Geometry. In Two Books. Printed at London, in 1648. and 1680. in 8vo.—

All these Five are entire in this Volume ; Printed from the best Editions Corrected by the Author's own Hand.

6. *Ecclesiastes* ; or, A Discourse of the Gift of Preaching, as it falls under the Rules of Art. London, 1646, 47, 51, 53, and 75. 8vo.

7. Discourse concerning the Beauty of Providence, in all the rugged Passages of it. London, 49. in 120 ; and in 77. the Fifth Edition, in 8vo.

8. Discourse concerning the Gift of Prayer ; shewing what it is ; wherein it consists ; and how far it is attainable by Industry, &c. London, 1653, and 1674. 8vo.

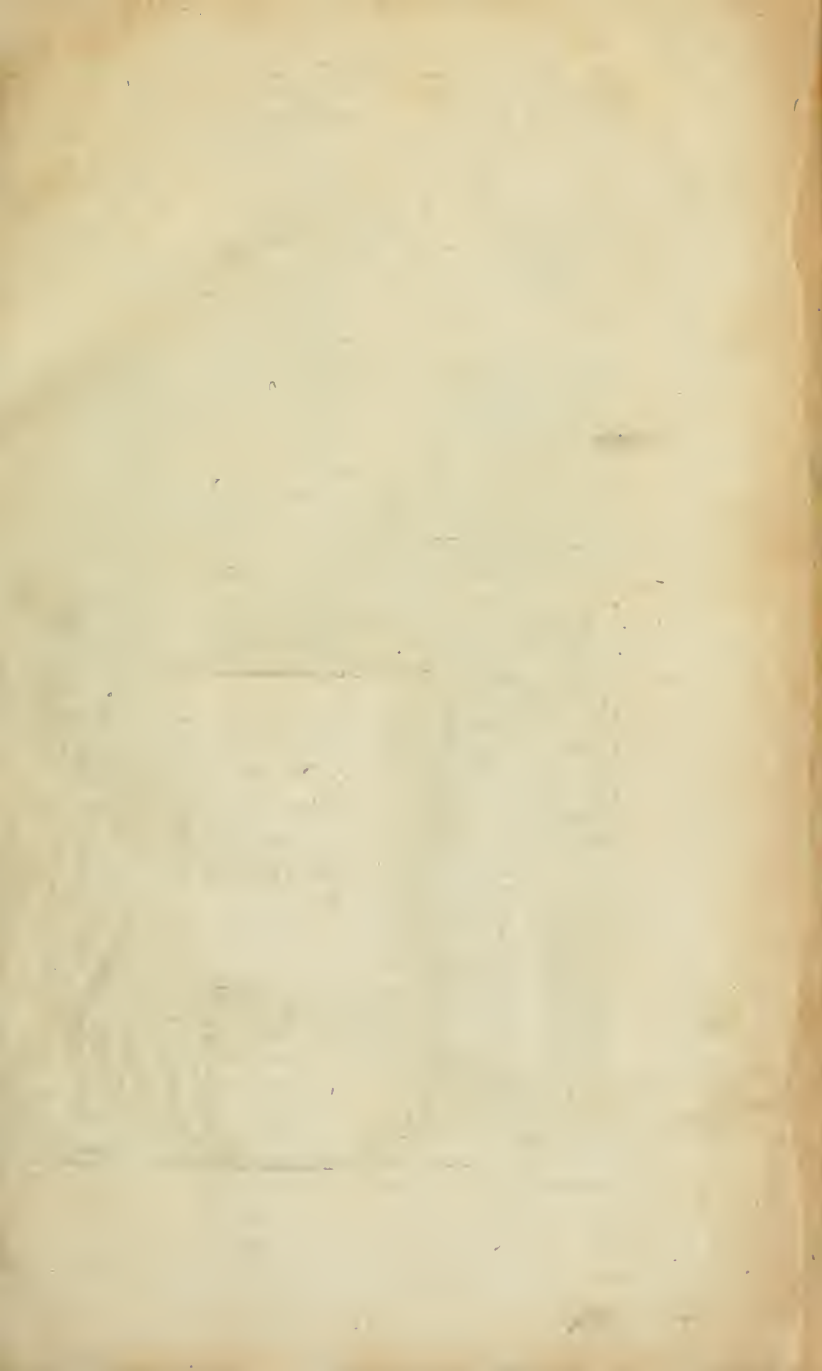
9. Of the Principles and Duties of Natural Religion. Two Books. London, 1675. 8vo. Published by John Tillotson, D. D.

10. Sermons preach'd upon several Occasions. London, 1682. 8vo. They are in number Fifteen, published by Dr. Tillotson.

11. Essay towards a Real Character, and a Philosophical Language. London, 1668. Fol.

An Alphabetical Dictionary : Wherein all *English* Words, according to their various Significations, are either referred to their Places in the Philosophical Tables, or explain'd by such Words as are in those Tables. *This is printed with the Essay.*

This Book is mentioned in the last place, tho' it be not the last in Order of Time ; because the Design being extraordinary and very curious, and printed by Order of the Royal Society, 'twas thought proper to give an Abstract of it at the End of this Volume.





London
 Printed in the year
 of our Lord 1708
 The 5 Edition

N. Copernicus

Galileus Galilei

Quid illi sic?

Uranam et alia

hic eius oculi

A Discourse
 concerning
 A NEW
 World
 &
 Another Planet
 In 2 Books



The FIRST BOOK.

THE
DISCOVERY
OF A
NEW WORLD.
OR,

A Discourse tending to prove, *That* ('tis probable) *there may be another Habitable World in the Moon.*

With a Discourse concerning the Possibility of a Passage thither.

The Fifth Impression; Corrected and Enlarged.

Quid tibi inquis ista proderunt? Si nihil aliud, hoc certè, sciam omnia hic angusta esse. Seneca Præf. ad 1. Lib. Nat. Quæst.

By the Right Reverend Father in God,
JOHN WILKINS, late Lord
Bishop of CHESTER.

L O N D O N :

Printed for *John Nicholson* at the *King's-Arms* in *Little Britain*; *Benj. Tooke* at the *Middle Temple Gate* in *Fleetstreet*; *And. Bell* at the *Cross Keys* and *Bible* in *Cornhill*; and *Ralph Smith* under the *Piazza* of the *Royal-Exchange*. MDCCVII.

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To the Reader.

IF amongst thy Leisure Hours, thou canst spare any for the Perusal of this Discourse, and dost look to find somewhat in it which may serve for thy Information and Benefit; let me then advise thee to come unto it with an equal Mind, not swayed by Prejudice, but indifferently resolved to assent unto that Truth which upon deliberation shall seem most probable unto thy Reason; and then I doubt not, but either thou wilt agree with me in this Assertion, or at least not think it to be as far from Truth, as it is from common Opinion.

Two Cautions there are, which I would willingly admonish thee of in the Beginning :

1. That thou shouldst not here look to find an exact accurate Treatise; since this Discourse was but the Fruit of some lighter Studies, and those too huddled up in a short time; being first thought of and finished in the space of some few Weeks; and therefore you cannot in reason expect that it should be so polish'd, as perhaps the Subject would require, or the Leisure of the Author might have done it.

2. To remember that I promise only probable Arguments for the Proof of this Opinion; and therefore you must not look that every Consequence should be of an undeniable Dependance; or that the Truth of each Argument should be measured by its Necessity. I grant, that some Astronomical Appearances may possibly be solved otherwise than here they are: But the thing I aim at is this; that probably they may so be solved, as I have here set them down. Which, if it be granted (as I think it must) then I doubt not, but the indifferent Reader will find some Satisfaction in the Main Thing that is to be proved.

To the Reader.

Many ancient Philosophers of the better Note, have formerly defended this Assertion which I have here laid down; and it were to be wished, that some of us would more apply our Endeavours unto the Examination of these old Opinions; which, tho' they have for a long time been neglected by others, yet in them may you find many Truths well worthy your Pains and Observation. 'Tis a false Conceit, for us to think that amongst the ancient Variety and Search of Opinions, the best hath still prevailed. Time (saith the Learned Verulam) seems to be of the nature of a River or Stream; which carrieth down to us that which is light, or blown up, but sinketh that which is weighty and solid.

It is my desire, that by the Occasion of this Discourse, I may raise up some more active Spirit to a Search after other hidden and unknown Truths: Since it must needs be a great Impediment unto the Growth of Sciences, for Men still to plod on upon beaten Principles, as to be afraid of entertaining any thing that may seem to contradict them. An Unwillingness to take such things into Examination, is one of those Errors of Learning, in these Times observed by the Judicious Verulam. Questionless there are many secret Truths which the Ancients have passed over, that are yet left to make some of our Age famous for their Discovery.

If by this Occasion I may provoke any Reader to an Attempt of this Nature, I shall think my self happy, and this Work successful.

Farewell.

The Propositions that are proved in this Discourse.

Proposition I.

That the Strangeness of this Opinion is no sufficient Reason why it should be rejected; because other certain Truths have been formerly esteemed ridiculous, and great Absurdities entertained by common Consent. By way of Preface.

Prop. II.

That a Plurality of Worlds does not contradict any Principle of Reason or Faith.

Prop. III.

That the Heavens do not consist of any such pure Matter which can privilege them from the like Change and Corruption, as these Inferior Bodies are liable unto.

Prop. IV.

That the Moon is a Solid, Compacted, Opacous Body.

Prop. V.

That the Moon hath not any Light of her own.

Prop. VI.

That there is a World in the Moon, hath been the direct Opinion of many ancient, with some modern Mathematicians; and may probably be deduced from the Tenents of others.

Prop.

Prop. VII.

That those Spots and brighter Parts, which by our Sight may be distinguished in the Moon, do shew the Difference betwixt the Sea and Land in that other World.

Prop. VIII.

That the Spots represent the Sea, and the brighter Parts the Land.

Prop. IX.

That there are High Mountains, Deep Vallies, and Spacious Plains in the Body of the Moon.

Prop. X.

That there is an Atmo-Sphæra, or an Orb of gross vaporous Air, immediately encompassing the Body of the Moon.

Prop. XI.

That as their World is our Moon, so our World is their Moon.

Prop. XII.

That 'tis probable there may be such Meteors belonging to that World in the Moon, as there are with us.

Prop. XIII.

That 'tis probable there may be Inhabitants in this other World; but of what kind they are, is uncertain.

Prop. XIV.

That 'tis possible for some of our Posterity to find out a Conveyance to this other World; and, if there be Inhabitants there, to have Commerce with them.

The First Book.

That the Moon may be a World.

The first Proposition, by way of Preface.

*That the Strangeness of this Opinion is no sufficient Reason why it should be rejected; because o-
ther certain Truths have been formerly esteem'd
ridiculous, and great Absurdities entertain'd by
common Consent.*

THERE is an Earnestness and Hungering after Novelty, which doth still adhere unto all our Natures; and it is part of that Primitive Image, that wide Extent and infinite Capacity at first created in the Heart of Man. For this, since its Depravation in *Adam*, perceiving it self altogether emptied of any good, doth now catch after every new thing, conceiving that possibly it may find Satisfaction among some of its Fellow Creatures. But our Enemy the Devil (who strives still to pervert our Gifts, and beat us with our own Weapons) hath so contrived it, that any Truth doth now seem distasteful for that very reason, for which Error is entertain'd; Novelty. For let but some upstart Heresie be set abroad, and presently there are some out of a curious Humour; others, as if they watched an occasion of Singularity, will take it up for Canonical, and make it part of their Creed and Profession; whereas solitary Truth cannot any

where find so ready Entertainment ; but the same Novelty which is esteemed the Commendation of Error, and makes that acceptable ; is counted the Fault of Truth, and causes that to be rejected.

How did the incredulous World gaze at *Columbus*, when he promised to discover another Part of the Earth ? And he could not for a long time, by his Confidence or Arguments, induce any of the Christian Princes, either to assent unto his Opinion, or go to the Charges of an Experiment. Now if he, who had such good Grounds for his Assertion, could find no better Entertainment among the wise Sort, and upper End of the World ; 'tis not likely then that this Opinion which I now deliver, shall receive any thing from the Men of these Days ; especially our Vulgar Wits, but Misbelief or Derision.

It hath always been the Unhappiness of new Truths in Philosophy, to be derided by those that are ignorant of the Causes of Things ; and rejected by others, whose Perverseness ties them to the contrary Opinion ; Men whose envious Pride will not allow any new Thing for Truth, which they themselves were not the first Inventors of. So that I may justly expect to be accused of a pragmatistical Ignorance, and bold Ostentation ; especially, since for this Opinion *Xenophanes*, a Man whose Authority was able to add some Credit to his Assertion, could not escape the like Censure from others. For *Natales Comes* speaking of that Philosopher, and this his Opinion, saith thus ; *Nonnulli ne nihil scisse videantur, aliqua nova monstra in Philosophiam introducunt, ut aliquis rei inventores fuisse appareant.* " Some there are
 " who lest they might seem to know nothing, will
 " bring up monstrous Absurdities in Philosophy,
 " that so afterward they may be famed for the In-
 " vention of somewhat." The same Author doth also in another Place accuse *Anaxagoras* of Folly for the

the same Opinion. *Est enim non ignobilis gradus stultitiæ, vel si nescias quid dicas, tamen velle de rebus propositis hanc vel illam partem stabilire.* “ ’Tis none of

“ the worst kinds of Folly, boldly to affirm one

“ side or other, when a Man knows not what to say. If these Men were thus censur’d, I may justly then expect to be derided by most, and to be believed by few or none ; especially since this Opinion seems to carry in it so much Strangeness, and Contradiction to the General Consent of others. But however, I am resolv’d that this shall not be any Discouragement, since I know that it is not common Opinion that can either add or detract from the Truth. For,

1. Other Truths have been formerly esteemed altogether as ridiculous as this can be.

2. Gross Absurdities have been entertained by general Opinion.

I shall give an Instance of each, that so I may the better prepare the Reader to consider Things without a Prejudice ; when he shall see that the common Opposition against this which I affirm, cannot any way derogate from its Truth.

1. Other Truths have been formerly accounted as ridiculous as this. I shall specify that of the *Antipodes*, which have been denied, and laugh at by many wise Men and great Scholars ; such as were *Herodotus*, *Chrysofom*, *Austin*, *Lactantius*, the venerable *Bede*, *Lucretius* the Poet, *Procopius*, and the voluminous *Abulensis*, together with all those Fathers or other Authors who denied the Roundness of the Heavens. *Herodotus* counted it so horrible an Absurdity, that he could not forbear laughing to think of it. Γελῶ ἢ ὄρων γῆς περιόδους γράψαντας, πολλὰς ἡδὲ καὶ ὀδύνας ἰούσας ἐξηγησάμενον δι’ Ὀκειανόν τε βρόντα γράφουσι, πείεζ τιμὴ τε γλῶττῃ ἔβουσαν κυκλο τερεῖα ὡς ἀποτόρνυ. “ I cannot

“ chuse but laugh, (saith he) to see so many Men venture to describe the Earths Compass, “ rela-

Vid. Josef. Acofta. de nat. novi orbis, l. 1. cap. 1.

“relating those things that are without all Sense ;
 “as that the Sea flows about the World, and that the
 “Earth it self is round as an Orb.” But this great
 Ignorance is not so much to be admired in him , as
 in those learned Men of later Times, when all Sci-
 ences began to flourish in the World. Such were
 St. *Chrysoſtom*, who in his 14th *Homily* upon the Epi-
 ſtle to the *Hebrews*, does make a Challenge to any
 Man that ſhall dare to defend that the Heavens are
 round, and not rather as a Tent. Thus likewise St.
Auſtin, who cenſures that Relation of the *Antipodes*
 to be an incredible Fable ; and with him agrees the
 Eloquent *Lactantius*. *Quid illi qui eſſe contrarios veſtigis no-
 ſtris Antipodes putant ? num aliquid loquuntur ? aut eſt quiſpi-
 am tam ineptus, qui credat eſſe homines, quorum veſtigia ſunt
 ſuperiora quam capita ? aut ibi quæ apud nos jacent inverſa
 pendere ? fruges & arbores deorſum verſus creſcere, pluvias &
 nives, & grandinem ſurſum verſus cadere in terram ? & mi-
 ratur aliquis hortos penſiles inter ſeptem miranarrari, quum
 Philoſophi, & agros & maria, & urbes & montes penſiles faci-
 unt, &c.* “What (ſaith he) are they that think there are
 “Antipodes, ſuch as walk with their Feet againſt ours ?
 “do they ſpeak any likelihood ; or is there any one
 “ſo fooliſh as to believe that there are Men whoſe
 “Heels are higher than their Heads ? that things
 “which with us do lie on the Ground, do hang
 “there ? that the Plants and Trees grow down-
 “wards, that the Hail, and Rain, and Snow fall up-
 “wards to the Earth ? and do we admire the hang-
 “ing Orchards amongſt the Seven Wonders, where-
 “as here the Philoſophers have made the Fields and
 “Seas, the Cities and Mountains hanging ?” What
 ſhall we think (ſaith he in *Plut.*) that Men do cling to
 that Place like Worms, or hang by their Claws as Cats ?
 or if we ſuppoſe a Man a little beyond the Center,
 to be digging with a Spade, is it likely (as it muſt be
 according to this Opinion) that the Earth which
 he

*De civit.
 Dei l. 16.
 cap. 9.*

*Inſtitut. l.
 3. c. 24.*

he loosened, should of it self ascend upwards? Or else suppose two Men with their Middles about the Center, the Feet of the one being placed where the Head of the other is, and so two other Men cross them; yet all these Men thus situated, according to this Opinion should stand upright; and many other such gross Consequences would follow (saith he) which a false Imagination is not able to fancy as possible. Upon which Considerations, *Bede* also denies the Being of any Antipodes, *Neque enim Antipodarum ullatenus est Fabulis accommodandus assensus.* "Nor should we any longer assent to the Fable of "Antipodes." So also *Lucretius* the Poet speaking of the same Subject, says,

Sed vanus stolidis hæc omnia finxerit error.

That some idle Fancy feigned these for Fools to believe. Of this Opinion was *Procopius Gazæus*; but he was persuaded to it by another kind of Reason; for he thought that all the Earth under us was sunk in the Water, according to the Saying of the *Psalmist*, *He hath founded the Earth upon the Seas*; and therefore he accounted it not inhabited by any. Nay, *Tostatus*, a Man of later Years and general Learning, doth also confidently deny that there are any such Antipodes, though the Reason which he urges for it be not so absurd as the former; for the *Apostles*, saith he, travelled through the whole habitable World, but they never passed the Equinoctial: And if you answer, that they are said to go through all the Earth, because they went through all the known World; he replies, That this is not sufficient, since Christ would have all Men to be saved, and come to the knowledge of his Truth, and therefore 'tis requisite that they should have travelled thither also, if there had been any Inhabitants; especially since he did expressly command them to go and teach *all Nations*, and preach the Gospel through the *whole World*: And therefore he thinks,

*De ratione
temporum,
Cap. 32.*

*De nat. re-
rum. Lib. 1.*

*Comment.
in 1. Cap.
Gen.*

Psal. 24. 2.

*Comment.
in 1 Genes.*

1 Tim. 2. 4.

Matt. 28. thinks, that as there are no Men, so neither are
 19. there Seas, or Rivers, or any other Conveniency
 for Habitation. 'Tis commonly related of one *Vir-*
Aventinus
Annal. Boi-
orum. lib. 3.
Annal. Ec-
cles. A. D.
 748. *us* says, it was because he thought there was ano-
 ther Habitable World within ours. However, you
 may well enough discern in these Examples, how
 confident many of these great Scholars were in so
 gross an Error; how unlikely, what an incredible
 thing it seemed to them, that there should be any
 Antipodes; and yet now this Truth is as certain and
 plain, as Sense or Demonstration can make it.
 This then which I now deliver, is not to be re-
 jected, though it may seem to contradict the com-
 mon Opinion.

2. Gross Absurdities have been entertained by ge-
 neral Consent. I might instance in many remarka-
 ble Examples, but I will only speak of the supposed
 Labour of the Moon in her Eclipses, because this is
 nearest to the chief Matter in Hand, and was re-
 ceived as a common Opinion amongst many of the
 Ancients; insomuch, that from hence they stiled
 Eclipses by the Name of *πάθη Passions*, or in the
 Phrase of the Poets,

Solis lunæq; labores.

And therefore *Plutarch* speaking of a Lunary Eclipse,
 relates, that at such times 'twas a Custom amongst
 the *Romans*, (the most Civil and Learned People in
 the World) to sound Brass Instruments, and hold
 great Torches toward the Heaven. *Τῶν ἢ Ῥωμαίων (ὡς περ*
ἔστιν ἐρομισμῶρον) χαλκῷ τε πατήροις ἀναχαιμένων τὸ φῶς αὐτῆς καὶ
πυρρῶ πολλὰ θαλοῖς καὶ δακνὶν ἀνεχόντων πρὸς τὸν ἕρανόν. For by
 this means they supposed the Moon was much eased in
 her Labours; and therefore *Ovid* calls such loud In-
 struments, the Auxiliaries or Helps of the Moon,

Cum frustra resonant æra auxiliaria Lunæ.

And

In vita
Paul AE-
mil.

Metam.
Lib. 4.

And therefore the Satyrift too, describing a loud Scold, fays, She was able to make Noife enough to deliver the Labouring Moon.

Una laboranti poterit succurrere Lunæ.

Juven.
Sat. 6.

Now the reason of all this their Ceremony, was, because they feared the World would fall afleep, when one of its Eyes began to wink, and therefore they would do what they could by loud Sounds to rouze it from its Drowfiness, and keep it awake; by bright Torches, to bestow that Light upon it which it began to lose.

Some of them thought hereby to keep the Moon in her Orb, whereas otherwise she would have fallen down upon the Earth, and the World would have lost one of its Lights; for the credulous People believed that Inchanters and Witches could bring the Moon down; which made *Virgil* say,

Cantus & è cælo possunt deducere Lunam.

And those Wizards knowing the times of her Eclipses, would then threaten to shew their Skill, by pulling her out of her Orb. So that when the silly Multitude saw that she began to look red, they presently feared they should lose the Benefit of her Light, and therefore made a great noise that she might not hear the sound of those Charms, which would otherwise bring her down; and this is rendered for a Reason of this Custom by *Pliny* and *Propertius*:

Cantus & è curru lunam deducere tentant,

Et facerent, si non æra repulsa sonent.

Nat. Hist.
Lib. 2. c. 12.

Plutarch gives another Reason of it; and he says, 'tis because they would hasten the Moon out of the dark Shade wherein she was involv'd, that so she might bring away the Souls of those Saints that inhabit within her, which cry out by reason they are then deprived of their wonted Happiness, and cannot hear the Musick of the Spheres; but are forced to behold the Torments and Wailings of those Damned

ed Souls which are represented to them as they are tortured in the Region of the Air. But whether this, or whatèver else was the meaning of this Superstition, yet certainly 'twas a very ridiculous Custom, and bewrayed a great Ignorance of those ancient Times; especially since it was not only received by the Vulgar, such as were Men of less Note and Learning, but believed also by the more Famous and Wiser Sort; such as were those great Poets, *Stesichorus* and *Pindar*: And not only amongst the more sottish Heathens, who might account that Planet to be one of their Gods, but the Primitive Christians also were in this kind guilty; which made *St. Ambrose* so tartly to rebuke those of his time, when he said, *Tum turbatur carminibus Globus Lunæ, quando calicibus turbantur & oculi.* "When your Heads are troubled with Cups, then you think the Moon to be troubled with Charms."

*Turinens.
Episc.*

And for this Reason also did *Maximus* a Bishop, write a Homily against it, wherein he shewed the Absurdity of that foolish Superstition. I remember that *Ludovicus Vives* relates a more ridiculous Story of a People that imprison'd an Ass for drinking up the Moon, whose Image appearing in the Water, was covered with a Cloud as the Ass was drinking; for which the poor Beast was afterward brought to the Bar, to receive a Sentence according to his Deserts; where the grave Senate being set to examine the Matter, one of the Counsel (perhaps wiser than the rest) rises up, and out of his deep Judgment, thinks it not fit that their Town should lose its Moon, but that rather the Ass should be cut up, and that taken out of him; which Sentence being approved by the rest of those Politicians, as the subtlest way for the conclusion of the Matter, was accordingly performed. But whether this Tale were true or no, I will not question; however, there is Absurdity enough in that former Custom of the Ancients, that may

may confirm the Truth to be proved, and plainly declare the Insufficiency of common Opinion to add true Worth or Estimation unto any thing. So that from that which I have said, may be gathered thus much.

1. That a new Truth may seem absurd and impossible, not only to the Vulgar, but to those also who are otherwise wise Men and excellent Scholars: And hence it will follow, that every new thing which seems to oppose common Principles, is not presently to be rejected, but rather to be pry'd into with a diligent Enquiry, since there are many things which are yet hid from us, and reserv'd for future Discovery.

2. That it is not the Commonness of an Opinion that can privilege it for a Truth; the wrong way is sometimes a well-beaten Path, whereas the right way (especially to hidden Truths) may be less trodden and more obscure.

True indeed, the strangeness of this Opinion will detract much from its Credit; but yet we should know that nothing is in it self strange, since every Natural Effect has an equal dependance upon its Cause, and with the like necessity doth follow from it; so that 'tis our Ignorance which makes things appear so: And hence it comes to pass, that many more evident Truths seem incredible, to such who know not the causes of Things. You may as soon persuade some Country Peasants that the Moon is made of Green Cheese, (as we say) as that 'tis bigger than his Cart-wheel, since both seem equally to contradict his sight, and he has not Reason enough to lead him farther than his Senses. Nay, suppose (saith *Plutarch*) a Philosopher should be educated in such a secret Place, where he might not see either Sea or River, and afterwards should be brought out where one might shew him the great Ocean, telling him the Quality of that Water, that it is brackish,

ish, salt, and not potable, and yet there were many vast Creatures of all Forms living in it, which make use of the Water as we do of the Air; questionless he would laugh at all this, as being monstrous Lyes and Fables, without any Colour of Truth. Just so will this Truth which I now deliver appear unto others, because we never dreamt of any such Matter as a World in the Moon; because the State of that Place hath as yet been veiled from our knowledge, therefore we can scarcely assent to any such Matter. Things are very hardly received, which are altogether strange to our Thoughts and our Senses. The Soul may with less difficulty be brought to believe any Absurdity, when as it has formerly been acquainted with some Colours and Probabilities for it; but when a new, and an unheard-of Truth shall come before it, though it have good Grounds and Reasons, yet the Understanding is afraid of it as a Stranger, and dares not admit it into his Belief, without a great deal of Reluctancy and Trial. And besides, things that are not manifested to the Senses, are not assented unto without some Labour of Mind, some Travel and Discourse of the Understanding; and many lazy Souls had rather quietly repose themselves in an easy Error, than take pains to search out the Truth. The strangeness then of this Opinion which I now deliver, will be a great hindrance to its Belief; but this is not to be respected, by reason it cannot be helped. I have stood the longer in the Preface, because that Prejudice which the meer Title of the Book may beget, cannot easily be removed without a great deal of Preparation; and I could not tell otherwise how to rectify the Thoughts of the Reader, for an impartial Survey of the following Discourse.

I must needs confess, though I had often thought with my self that it was possible there might be a World in the Moon, yet it seemed such an uncouth

Opini-

Opinion, that I never durst discover it, for fear of being counted singular and ridiculous ; but afterward, having read *Plutarch, Galileus, Keplar*, with some others, and finding many of mine own Thoughts confirmed by such strong Authority, I then concluded that it was not only possible there might be, but probable that there was another Habitable World in that Planet. In the prosecuting of this Assertion, I shall first endeavour to clear the way from such Doubts as may hinder the speed or ease of farther Progress. And because the Suppositions imply'd in this Opinion, may seem to contradict the Principles of Reason or Faith, it will be requisite that I first remove this Scruple, shewing the Conformity of them to both these, and proving those Truths that may make way for the rest ; which I shall labour to perform in the second, third, fourth, and fifth Chapters, and then proceed to confirm such Propositions which do more directly belong to the main Point in hand.

P R O P. II.

That a Plurality of Worlds doth not contradict any Principle of Reason or Faith.

TIS reported of *Aristotle*, that when he saw the Books of *Moses*, he commended them for such a Majestick Stile as might become a God ; but withal, he censured that manner of Writing to be very unfitting for a Philosopher ; because there was nothing proved in them, but Matters were delivered as if they would rather command than persuade Belief. And 'tis observed, that he sets down nothing himself, but he confirms it by the strongest Reasons that may

be found, there being scarce an Argument of force for any Subject in Philosophy, which may not be picked out of his Writings; and therefore 'tis likely if there were in Reason a necessity of one only World, that he would have found out some such necessary Proof as might confirm it; especially since he labours for it so much in two whole Chapters. But now all the Arguments which he himself urges in this Subject, are very weak, and far enough from having in them any convincing Power. Therefore 'tis likely that a Plurality of Worlds doth not contradict any Principle of Reason. However, I will set down the two chief of his Arguments from his own Works, and from them you may guess the force of the other.

De Caelo
L. I. c. 8, 9.

Ebid.

The First is this: Since every heavy Body doth naturally tend downwards, and every light Body upwards, what a huddling and confusion must there be, if there were two Places for Gravity, and two Places for Lightness? for it is probable that the Earth of that other World would fall down to this Center, and so mutually the Air and Fire here ascend to those Regions in the other; which must needs much derogate from the Providence of Nature, and cause a great Disorder in his Works. But *ratio hæc est minime firma*, (saith Zanchy.) And if you well consider the Nature of Gravity, you will plainly see there is no Ground to fear any such Confusion; for Heaviness is nothing else but such a Quality as causes a Propension in its Subject to tend downwards towards its own Centre: So that for some of that Earth to come hither, would not be said a Fall, but an Ascension, since it is moved from its own Place; and this would be impossible (saith Ruvo) because against Nature, and therefore no more to be feared than the falling of the Heavens.

De operibus Dei,
par. 2 lib. 2.
cap. 2.

De Caelo
L. I. c. 9. q. 1.

If you reply, that then according to this, there must be more Centres of Gravity than one; I answer, 'Tis very probable there are; nor can we well conceive what any piece of the Moon would do, being severed from the rest in the free and open Air, but only return unto it again.

Another Argument he had from his Master Plato, That there is but one World, because there is but one first Mover, God.

Metaphys.
l. 12. c. 8.
Diog. La-
ert. lib. 3.

Infirma etiam est hæc ratio (saith Zanchy); and we may justly deny the Consequence, since a Plurality of Worlds doth not take away the unity of the first Mover, *Ut enim forma substantialis, sic primum efficiens apparentem solummodo multipliciter induit per signatam materiam* (saith a Countryman of ours.) As the substantial Form, so the efficient Cause hath only an appearing Multiplicity from its particular Matter. You may see this Point more largely handled, and these Arguments more fully answered by *Plutarch* in his Book, *Why Oracles are Silent*, and *Jacob Carpentarius* in his Comment on *Alcinous*.

Nic. Hill. de
Philosoph.
Epic. par-
tic. 379

But our Opposites, the Interpreters themselves; (who too often do *jurare in verba magistri*) will grant that there is not any strength in these Consequences; and certainly then such weak Arguments could not convince that wise Philosopher, who in his other Opinions was wont to be swayed by the strength and power of Reason; wherefore I should rather think that he had some by-respect, which made him first assent to this Opinion, and afterwards strive to prove it. Perhaps it was because he feared to displease his Scholar *Alexander*; of whom 'tis related, that he wept to hear a Disputation of another World, since he had not then attained the Monarchy of this; his restless wide Heart would have esteemed this Globe of Earth not big enough for him, if there had been another; which made the Satyrist say of him,

Plutarch.
de tranquill.
anim.

Juvenal.

Æstuat infelix angusto limite mundi.

“ That he did vex himself, and sweat in his Desires,
 “ as being penn’d up in a narrow Room, when he
 “ was confin’d but to one World.” Before, he
 thought to seat himself next the Gods, but now
 when he had done his best, he must be content with
 some equal, or perhaps superior Kings.

It may be, that *Aristotle* was moved to this Opini-
 on, that he might thereby take from *Alexander* the
 occasion of this Fear and Discontent ; or else, per-
 haps, *Aristotle* himself was as loth to hold the Possi-
 bility of a World which he could not discover, as
Alexander was to hear of one which he could not
 conquer. ’Tis likely that some such by-respect mo-
 ved him to this Opinion, since the Arguments he ur-
 ges for it are confess’d by his zealous Followers and
 Commentators, to be very slight and frivolous ; and
 they themselves grant, what I am now to prove,
 that there is not any Evidence in the Light of Natu-
 ral Reason, which can sufficiently manifest that there
 is but one World.

But however, some may object, Would it not be
 inconvenient and dangerous to admit of such Opini-
 ons that do destroy those Principles of *Aristotle*
 which all the World hath so long followed ?

This Question is much contróverted by some of
 the *Romish* Divines : *Campanella* hath writ a Treatise
 in Defence of it, in whom you may see many things
 worth the Reading and Notice.

To it I answer, That this Position in Philosophy
 doth not bring any Inconveniency to the rest, since
 ’tis not *Aristotle*, but Truth, that should be the Rule
 of our Opinions ; and if they be not both found to-
 gether, we may say to him, as he said to his Master

“ Though *Plato* were his Friend, yet he would ra-
 “ ther adhere to Truth than him.

*Apologia
 pro Galili-
 leo.*

*Ethic. l. 1. Plato,
 c. 6.*

I must needs grant, that we are all much beholden to the Industry of the ancient Philosophers, and more especially to *Aristotle*, for the greater part of our Learning; but yet 'tis not Ingratitude to speak against him, when he opposeth Truth; for then many of the Fathers would be very guilty, especially *Justin*, who hath writ a Treatise purposely against him. But suppose this Opinion were false, yet 'tis not against the Faith, and so it may serve for the better Confirmation of that which is true; the Sparks of Error being forc'd out by opposition, as the Sparks of Fire by the striking of the Flint and Steel. But suppose too that it were Heretical, and against the Faith, yet may it be admitted with the same Privilege as *Aristotle*, from whom many more dangerous Opinions have proceeded: As that the World is Eternal; that God cannot have while to look after these inferior Things; that after Death there is no Reward or Punishment, and such like Blasphemies; which strike directly at the Fundamentals of our Religion.

So that it is justly to be wonder'd, why some should be so superstitious in these Days, as to stick closer unto him, than unto Scripture, as if his Philosophy were the only Foundation of all Divine Truths.

Upon these Grounds, both *St. Vincentius* and *Serafinus de Firmo* (as I have seen them quoted) think that *Aristotle* was the Viol of God's Wrath, which was poured out upon the Waters of Wisdom by the third Angel: But for my part, I think the World is much beholden to him for all his Sciences. But yet 'twere a shame for these later Ages, to rest our selves meerly upon the Labours of our Fore fathers, as if they had informed us of all things to be known; and when we are set upon their Shoulders, not to see further than they themselves did. 'Twere a superstitious, a lazy Opinion, to think *Aristotle's* Works the Bounds and Limits of all Human Invention, be-

Rev. 16. 4.

yond which there could be no possibility of reaching. Certainly there are yet many things left to Discovery, and it cannot be any Inconveniency for us to maintain a new Truth, or rectifie an ancient Error.

But the Position (say some) is directly against Scripture; for,

1. *Moses* tells us but of one World, and his History of the Creation had been very imperfect, if God had made another.

2. *St. John* speaking of God's Works, says, he made the World, in the singular Number, and therefore there is but one. 'Tis the Argument of *Aquinas*, and he thinks that none will oppose it, but such who with *Democritus* esteem some blind Chance, and not any wise Providence, to be the Framers of all Things.

3. The Opinion of more Worlds has in ancient Times been accounted a Heresie; and *Baronius* affirms that for this very Reason *Virgilius* was cast out of his Bishoprick, and Excommunicated from the Church.

4. A fourth Argument there is urged by *Aquinas*: If there be more Worlds than one, then they must either be of the same, or of a diverse Nature; but they are not of the same kind; for this were needless, and would argue an Improvidence, since one would have no more perfection than the other: Not of divers kinds; for then one of them could not be called the World or Universe, since it did not contain universal Perfection. I have cited this Argument, because it is so much stood upon by *Julius Cesar la Galla*, one that has purposely writ a Treatise against this Opinion which I now deliver; but the Dilemma is so blunt, that it cannot cut on either side, and the Consequences so weak, that I dare trust them without an Answer: And (by the way) you may see this later Author in that place, where he
endea-

Part 1. Q.
47. Art. 3.

Annal.
Eccles. A. D.
748.

Ibid.

De Phenom.
in arte Lu-
ce.

endeavours to prove a Necessity of one World, doth leave the chief Matter in hand, and take much needless Pains to dispute against *Democritus*, who thought that the World was made by the casual Concourse of *Atoms* in a great *Vacuum*. It should seem that either his Cause or his Skill was weak, or else he would have ventured upon a stronger Adversary. These Arguments which I have set down are the chiefest which I have met with against this Subject; and yet the best of these hath not force enough to endanger the Truth that I have delivered.

Unto the two first it may be answered, that the negative Authority of Scripture is not prevalent in those things which are not the Fundamentals of Religion.

But you'll reply, though it do not necessarily conclude, yet 'tis probable if there had been another World, we should have had some notice of it in Scripture.

I answer, 'tis as probable that the Scripture should have informed us of the Planets, they being very remarkable Parts of the Creation; and yet neither *Moses*, nor *Job*, nor the *Psalms* (the Places most frequent in Astronomical Observations) nor any other Scripture mention any of them but the Sun and Moon. Because the Difference betwixt them and the other Stars, was known only to those who were learned Men, and had Skill in *Astronomy*. As for that Expression in *Job* כוכבי בקר הַבֹּקֶר the Stars of the Morning, it is in the Plural Number, and therefore cannot properly be applied to *Venus*. And for that in *Isaiab* יְהִי לֵיל, 'tis confessed to be a Word of obscure Interpretation, and therefore is but by guess translated in that Sense. It being a true and common Rule, that *Hebræi rei sideralis minime curicfi caelestium nominum penuriâ laborant*. The *Jews* being but little skilled in Astronomy, their Language does want proper Expressions for the Heavenly Bodies; and therefore they

Job 38.7.
Isa. 14. 12.
Fromond.
Vesta t. 3.
cap. 2.
So 2 Reg.
23. 5.
מולות
Which is
interpreted
both
for the
Planets &
for the 11
Signs.

are fain sometimes to attribute the same Name unto divers Constellations.

Now if the Holy Ghost had intended to reveal unto us any natural Secrets, certainly he would never have omitted the mention of the Planets, *Quorum motu nihil est quod de Conditoris sapientiâ testatur evidentius apud eos qui capiunt.* Which do so evidently set forth the Wisdom of the Creator. And therefore you must know that 'tis besides the Scope of the Old Testament or the New, to discover any thing unto us concerning the Secrets of Philosophy. 'Tis not his intent in the New Testament, since we cannot conceive how it might any way belong either to the Historical, Exegetical, or Prophetical Parts of it: Nor is it his intent in the Old Testament, as is well observed by our Country-man Master Wright. *Non Moses aut Prophetarum institutum fuisse videtur Mathematicas aliquas aut Physicas subtilitates promulgare sed ad vulgi captum & loquendi morem, quemadmodum nutrices infantulis solent, sese accommodare.* " 'Tis not the Endeavour of *Moses* " or the Prophets to discover any Mathematical or " Philosophical Subtilties; but rather to accommodate " themselves to Vulgar Capacities, and ordinary " Speech, as Nurses are wont to use their Infants." True indeed, *Moses* is there to handle the History of the Creation. But 'tis certain (saith *Calvin*) that his Purpose is to treat only of the visible Form of the World, and those Parts of it which might be most easily understood by the ignorant and ruder Sort of People, and therefore we are not thence to expect the Discovery of any natural Secret. *Artes reconditas aliunde discat qui volet; hic spiritus Dei omnes simul sine exceptione docere voluit.* As for more hidden Arts, they must be looked for elsewhere; the Holy Ghost did here intend to instruct all without Exception. And therefore 'tis observed, that *Moses* does not anywhere meddle with such Matters as were very hard to be conceived; for being to inform the common Peo-

Keplar. in-
troducet. in
Mart.

In Epist ad
Gilbert.

Calvin in
1. Gen.

50

People as well as others, he does it after a Vulgar Way, as it is commonly noted, declaring the Original chiefly of those things which are obvious to the Sense; and being silent of other things which then could not well be apprehended. And therefore *Pererius* proposing the Question, why the Creation of Plants and Herbs is mentioned, but not of Metals and Minerals?

Com in
1. Gen. 11.

Answers: *Quia istarum rerum generatio est vulgo occulta & ignota*: Because these things are not so commonly known as the other; and he adds, *Moses non omnia, sed manifesta omnibus enarranda suscepit*. *Moses* did not intend to relate unto us the Beginnings of all things, but those only which were most evident unto all Men. And therefore too, *Aquinas* observes, that he writes nothing of the Air; because that being invisible, the People knew not whether there were any such Body or no. And for this very reason *St. Jerom* also thinks that there is nothing exprest concerning the Creation of Angels; because the rude and ignorant Vulgar were not so capable of apprehending their Natures. And yet notwithstanding, these are as remarkable Parts of the Creation, and as fit to be known as another World. And therefore the Holy Ghost too, uses such vulgar Expressions, which set things forth rather as they appear than as they are, as when he calls the Moon *one of the greater Lights*, whereas 'tis the least that we can see in the whole Heavens. So afterwards speaking of the great Rain which drowned the World; he says, The Windows of Heaven were opened, because it seemed to come with that Violence, as if it were poured out from Windows in the Firmament.

Part 1. Q.
68. Art. 3.

Epist. 139.
ad Cypri.
So *Pererius*
in 2 Gen.

Gen. 1. 16.

Gen. 11.
Mal. 3. 10.

Sir Walter
Rawl. c. 7.
Sect. 6.

*Deut. 11.

17.

1 Reg. 3.

55.

Luk. 4. 25.

And in reference to this, a Drowth is described in sundry other * Places by *the Heavens being shut up*. So that the Phrases which the Holy Ghost uses concerning these things, are not to be understood in a literal Sense;

L 2. in Gen.
Psa. 136. 6.

Hexamer
lib. 2.
Item Basil.
Hom 3. in
Genes.
Wild 2. 4.
17. 5.
Ecclus.
43. 3, 4.
Com. in c.
1. Gen.

Sense ; but rather as vulgar Expressions ; and this Rule is set down by St. *Austin*, where speaking concerning that in the *Psalms*, who stretched the earth upon the waters, he notes, that when the Words of Scripture shall seem to contradict common Sense or Experience, there are they to be understood in a qualified Sense, and not according to the Letter. And 'tis observed, that for want of this Rule, some of the Ancients have fasten'd strange Absurdities upon the Words of the Scripture. So St. *Ambrose* esteemed it a Heresy to think that the Sun and Stars were not very hot, as being against the Words of Scripture, *Psalms* 19. 6. where the *Psalmist* says, that there is nothing that is hid from the Heat of the Sun. So others there are that would prove the Heavens not to be round, out of that Place, *Psal.* 104. 2. He stretched out the heavens like a curtain. So *Procopius* also was of Opinion, that the Earth was founded upon the Waters ; nay, he made it part of his Faith, proving it out of *Psal.* 24. 2. He hath founded the earth upon the seas, and established it upon the floods. These and such like Absurdities have followed, when Men look for the Grounds of Philosophy in the Words of Scripture So that, from what hath been said, I may conclude that the Silence of Scripture concerning any other World, is not sufficient Argument to prove that there is none. Thus for the 2 first Arguments.

Unto the third, I may answer, that this very Example is quoted by others, to shew the Ignorance of those Primitive Times, who did sometimes condemn what they did not understand ; and have often censur'd the lawful and undoubted Parts of Mathematicks for Heretical, because they themselves could not perceive a Reason of it. And therefore their Practice in this particular is no sufficient Testimony against us.

But lastly, I answer to all the above-named Objections, that the Term (*World*) may be taken in a double

double Sense, more generally for the whole Universe, as it implies in it the Elementary and Æthereal Bodies, the Stars and the Earth. Secondly, more particularly for an inferior World, consisting of Elements.

Now the main drift of all these Arguments, is to confute a Plurality of Worlds in the first Sense; and if there were any such, it might (perhaps) seem strange, that *Moses* or *St. John* should either not know, or not mention its Creation. And *Virgilius* was condemned for this Opinion, because he held *quod sit alius mundus sub terrâ, aliisque Sol & Luna*, (as *Baronius*) that within our Globe of Earth, there was another World, another Sun and Moon, and so he might seem to exclude this from the Number of the other Creatures.

But now, there is no such danger in this Opinion, which is here delivered; since this World is said to be in the Moon, whose Creation is particularly express'd.

So that in the first Sense, I yield that there is but one World, which is all that the Arguments do prove; but understand it in the second Sense, and so I affirm there may be more, nor do any of the above-named Objections prove the contrary.

Neither can this Opinion derogate from the Divine Wisdom (as *Aquinas* thinks) but rather advance it, shewing a *compendium* of Providence, that could make the same Body a World, and a Moon; a World for Habitation, and a Moon for the use of others, and the Ornament of the whole Frame of Nature. For as the Members of the Body serve not only for the Preservation of themselves, but for the Use and Conveniency of the whole, as the Hand protects the Head as well as saves it self; so is it in the Parts of the Universe, where each one may serve as well for the Conservation of that which is within it, as the Help of others without it.

Cusanus de doct. ignor. l. 2. c. 12.

Comment.
in Gen.
Qu. 19.
Art. 2.

Mersennus a late Jesuit, proposing the Question whether or no the Opinion of more Worlds than one, be heretical and against the Faith? He answers it negatively; because it does not contradict any Express Place of Scripture, or Determination of the Church. And though (saith he) it seems to be a rash Opinion, as being against the Consent of the Fathers; yet if this Controversy be chiefly Philosophical, then their Authorities are not of such Weight. Unto this it may be added, that the Consent of the Fathers is prevalent only in such Points as were first controverted amongst them, and then generally decided one way, and not in such other Particulars as never fell under their Examination and Dispute.

I have now in some measure, shewed that a Plurality of Worlds does not contradict any Principle of Reason or Place of Scripture; and so cleared the first part of that Supposition which is implied in the Opinion.

It may next be enquired, whether 'tis possible there may be a Globe of Elements in that which we call the *Æthereal* Parts of the Universe; for if this (as it is according to the common Opinion) be privileged from any Change or Corruption, it will be in vain then to imagine any Element there; and if we will have another World, we must then seek out some other Place for its Situation. The Third Proposition therefore shall be this.

PROP.

P R O P. III.

That the Heavens do not consist of any such pure Matter, which can privilege them from the like Change and Corruption as these Inferior Bodies are liable unto.

IT hath been often questioned amongst the ancient Fathers and Philosophers, what kind of Matter that should be of which the Heavens are framed. Some think that they consist of a fifth Substance distinct from the four Elements, as *Aristotle* holds, and with him some of the late Schoolmen; whose subtil Brains could not be content to attribute to those vast Glorious Bodies, but common Materials, and therefore they themselves had rather take pains to prefer them to some extraordinary Nature; whereas notwithstanding, all the Arguments they could invent, were not able to convince a Necessity of any such Matter, as is confess'd by their own * side. It were much to be desired, that these Men had not in other Cases, as well as this, multiplied things without Necessity; and, as if there had not been enough to be known in the Secrets of Nature, have spun out new Subjects from their own Brains, to find more Work for future Ages. I shall not mention their Arguments, since 'tis already confess'd, that they are none of them of any necessary Consequence; and besides, you may see them set down in any of the Books *de Cælo*.

But it is the general Consent of the Fathers, and the Opinion of *Lombard*, that the Heavens consist of the same Matter with these Sublunary Bodies. *St. Ambrose* is so confident of it, that he esteems the contrary a Heresie. True indeed, they differ much among themselves, some thinking them to be made of Fire, others of Water, and others of both; But herein they generally

De Cælo
li. 1. cap. 2.

* *Colleg.*
Connimb.
de calo. l. 1.
c. 2. q. 6.
art. 3.

In Hexam.
lib. 4.

generally

generally agree, That they are all framed of some Element or other; which *Dionysius Carthusianus* collects from that Place in *Genesis*, where the Heavens are mentioned in their Creation, as divided only in distance from the Elementary Bodies, and not as being made of any new Matter. To this purpose others cite the Derivation of the Hebrew Word שמים ; quasi אש *ibi* & מים *aquæ* or quasi אש *ignis* & מים *aquæ*. Because they are framed out of these Elements. But concerning this, you may see sundry Discourses more at large in *Ludovicus Molina*, *Eusebius Nurembergius*, with divers others. The Venerable *Bede* thought the Planets to consist of all the four Elements; and 'tis likely that the other Parts of it are of an Aereous Substance, as will be shewed afterward: However, I cannot now stand to recite the Arguments for either; I have only urged these Authorities to countervail *Aristotle* and the Schoolmen, and the better to make way for a Proof of their Corruptibility.

The next thing then to be enquired after, is, Whether they be of a Corruptible Nature; not whether they can be destroyed by God; for this Scripture puts out of doubt.

Nor whether or no in a long time they would wear away and grow worse, for from any such fear they have been lately privileged. But whether they are capable of such Changes and Vicissitudes, as this inferior World is liable unto.

The two chief Opinions concerning this, have both erred in some Extremity, the one side going so far from the other, that they have both gone beyond the right; whilst *Aristotle* hath opposed the Truth as well as the Stoicks.

Some of the Ancients have thought, that the Heavenly Bodies have stood in need of Nourishment from the Elements, by which they were continually fed, and so had divers Alterations by reason of their Food. This is fathered on *Heraclitus*, followed by that great

Natu-

Enarrat in
Genes. art.
10.

In operc. 6.
dierum.
disput. 5.

In lib. de
Mundi
constit.

2Pet. 3. 12.

By Doctor
Haskewill.
Apol. lib. 2.

Naturalist *Pliny*; and in general attributed to all the Stoicks. You may see *Seneca* expressly to this purpose in these Words. *Ex illa plimen'a omnibus animalibus, omnibus satis, omnibus stellis dividuntur, hinc profertur quo sustineantur tot Sidera tam exercitata, tam avida; per diem, noctemque, ut in opera, ita in pastu.* Speaking of the Earth, he says, from thence it is that Nourishment is divided to all the Living Creatures, the Planets and the Stars; hence were sustained so many Constellations, so laborious, so greedy, both Day and Night, as well in their Feeding as Working. Thus also *Lucan* sings,

Plutarch de plac. Philos. l. 2. c. 17. Nat. Hist. l. 2. c. 9. Nat. quest. lib. 2. cap. 5.

Necnon Oceano pasci Phœbumque polumque Credimus.

Unto these, *Ptolomy* also, that Learned *Egyptian*, seemed to agree, when he affirms that the Body of the Moon is moister and cooler than any of the other Planets, by reason of the Earthly Vapours that are exhaled unto it. You see these Ancients thought the Heavens to be so far from this imagined Incorruptibility, that rather like the weakest Bodies they stood in need of some continual Nourishment, without which they could not subsist.

1. Apostol.

But *Aristotle* and his Followers were so far from this, that they thought those Glorious Bodies could not contain in them any such Principles as might make them liable to the least Change or Corruption; and their chief Reason was, because we could not in so long a space discern any Alteration amongst them. But unto this I answer:

De Cælo l. 1. c. 3.

1. Supposing we could not, yet would it not hence follow that there were none, as he himself in effect doth confess in another place; for speaking concerning our Knowledge of the Heavens, he says, 'Tis very imperfect and difficult, by reason of the vast distance of those Bodies from us, and because the Changes which may happen unto them, are not either big enough, or frequent enough to fall within the Apprehension and Observation of our Senses; no wonder then,

De cælo, l. 2. cap. 5.

then, if he himself be deceived in his Assertions concerning these Particulars. But yet, in this he implies, that if a Man were nearer to these Heavenly Bodies, he would be a fitter Judge to decide this Controversie than himself. Now it is our Advantage, that by the help of *Galileus's* Glass, we are advanced nearer unto them, and the Heavens are made more present to us than they were before. However, as it is with us, where there be many Vicissitudes and Successions of Things, though *the Earth abideth for ever*; so likewise may it be amongst the Planets; in which, though there should be divers Alterations, yet they themselves may still continue of the same Quantity and Light.

2. Though we could not by our Senses see such Alterations, yet our Reason might perhaps sufficiently convince us of them. Nor can we well conceive how the Sun should reflect against the Moon, and yet not produce some Alteration of Heat. *Diogenes* the Philosopher was hence persuaded, that those scorching Heats had burnt the Moon into the form of a Pumice-stone.

3. I answer, That there have been some Alterations observed there; witness those Comets which have been seen above the Moon; as also those Spots or Clouds that encompass the Body of the Sun; amongst which, there is a frequent Succession by a Corruption of the old, and a Generation of new. So that tho' *Aristotle's* Consequence were sufficient, when he proved that the Heavens were not Corruptible, because there have not any Changes been discovered in it; yet this by the same Reason must be as prevalent, that the Heavens are Corruptible, because there have been so many Alterations observed there. But of these, together with a farther Confirmation of this Proposition, I shall have occasion to speak afterwards: In the mean space, I will refer the Reader to that Work of *Scheiner*, a late Jesuit, which he Titles his *Rosa Ursina*, where he may see this Point concerning the Corruptibility

bility of the Heavens largely handled, and sufficiently confirmed.

There are some other things, on which I might here take an occasion to enlarge my self; but because they are directly handled by many others, and do not immediately belong to the chief Matter in hand, I shall therefore refer the Reader to their Authors, and omit any large Proof of them my self, as desiring all possible Brevity.

1. The first is this: That there are no solid Orbs. If there be a Habitable World in the Moon, (which I now affirm) it must follow, that her Orb is not solid, as *Aristotle* supposed; and if not hers, why any of the other? I rather think that they are all of a fluid (perhaps aereous) Substance. *St. Ambrose* and *St. Basil* did endeavour to prove this out of that Place in *Isaiab*, where they are compared to Smoak, as they are both quoted by *Rhodiginus*. *Eusebius Nurembergus* doth likewise from that place, confute the Solidity and Incorruptibility of the Heavens, and cites for the same Interpretation the Authority of *Eustachius* of *Antioch*; and *St. Austin*, I am sure, in one Place seems to assent unto this Opinion, though he does often in his other Works contradict it.

Isa. 51. 6.
Ant. lect.
L. 1. c. 4.
Hist. nat.
L. 2. c. 11.
13.

In lib. sup.
Gen. ad lit.

If you esteem the Testimony of the Ancient Fathers, to be of any great Force or Consequence in a Philosophical Dispute, you may see them to this purpose in *Sixtus Senensis*, *Lib. 5. Biblioth. Annot. 14.* The chief Reasons that are commonly urged for the Confirmation of it, are briefly these Three.

1. From the Altitude of divers Comets, which have been observed to be above the Planets; through whose Orbs (if they had been solid) there would not have been any Passage. To these may be added those lesser Planets lately discovered about *Jupiter* and *Saturn*, for which Astronomers had not yet framed any Orbs.

I:

2. From that uncertainty of all Astronomical Observations, which will follow upon the Supposition of such solid Spheres. For then we should never discern any Star, but by a Multitude of Refractions, and so consequently we could not possibly find their true Situations, either in respect of us, or in regard of one another: Since whatever the Eye discerns by a refracted Beam, it apprehends to be in some other Place than wherein it is. But now this would be such an Inconvenience, as would quite subvert the Grounds and whole Art of Astronomy, and therefore is by no Means to be admitted.

Unto this it is commonly answered, That all those Orbs are equally Diaphanous, though not of a continued Quantity. We reply, That supposing they were, yet this cannot hinder them from being the Causes of Refraction, which is produced as well by the Diversity of Superficies, as the different Perspicuity of Bodies. Two Glasses put together, will cause a diverse Refraction from another single one, that is but of equal Thickness and Perspicuity.

3. From the different height of the same Planet at several times. For, if according to the usual *Hypothesis*, there should be such distinct, solid Orbs, then it would be impossible that the Planets should intrench upon one another's Orbs, or that two of them at several times should be above one another, which notwithstanding hath been proved to be so by later Experience. *Tycho* hath observed, that *Venus* is sometimes nearer to us than the *Sun* or *Mercury*, and sometimes farther off than both: Which Appearances *Regiomontanus* himself does acknowledge, and withal, does confess that they cannot be reconciled to the common *Hypothesis*.

But for your better satisfaction herein, I shall refer you to the above-named *Scheiner*, in his *Rosa Ursina*, in whom you may see both Authorities and Reason very largely and distinctly set down for this Opinion. For the better Confirmation of which, he adjoins also

some

some Authentical Epistles of *Fredericus Cæsius Lynceus*, a Noble Prince, written to *Bellarmino*, containing divers Reasons to the same purpose. You may also see the same Truth set down by *Johannes Pena*, in his Preface to *Euclid's Opticks*, and *Christoph. Rothmannus*, both who thought the Firmament to be only Air; and tho' the noble *Tycho* do dispute against them, yet he himself holds, *Quod propius ad veritatis penetralia accedit hæc opinio, quam Aristotelica vulgariter approbata, quæ cælum pluribus realibus atque imperviis orbibus citra rem replevit.*

De stell. 1.
15, 72. l. 1.
c. 9.

“ That this Opinion comes nearer to the Truth, than
“ that common one of *Aristotle*, which hath to no
“ purpose filled the Heavens with such real and im-
“ pervious Orbs.

2. There is no Element of Fire, which must be held with this Opinion here delivered; for if we suppose a World in the Moon, then it will follow, that the Sphere of Fire either is not there, where 'tis usually placed in the Concavity of his Orb, or else that there is no such thing at all; which is most probable, since there are not any such solid Orbs, that by their swift Motion might heat and enkindle the adjoining Air, which is imagined to be the reason of that Element. The Arguments that are commonly urged to this purpose, are these.

1. That which was before alledged concerning the Refractions which will be caused by a different Medium. For if the Matter of the Heavens be of one thickness, and the Element of Fire another, and the upper Region of Air distinct from both these, and the lower Region several from all the rest; there will then be such a Multiplicity of Refractions, as must necessarily destroy the Certainty of all Astronomical Observations. All which Inconveniencies might be avoided, by supposing (as we do) that there is only one Orb of Vaporous Air which encompasses our Earth, all the rest being *Æthereal*, and of the same Perspicuity.

1.

2. The Situation of this Element does no way agree with *Aristotle's* own Principles, or that common Providence of Nature, which we may discern in ordinary Matters. For if the Heavens be without all Elementary Qualities, as is usually supposed, then it would be a very incongruous thing for the Element of Fire to be placed immediately next unto it; since the heat of this is the most powerful and vigorous Quality that is among all the rest: And Nature in her Works, does not join Extremes, but by something of a middle Disposition. So in the very Frame of our Bodies, the Bones which are of a hard Substance, and the Flesh of a soft, are not joined together but by the Intercellion of Membranes and Gristles, such as being of a middle Nature may fitly come betwixt.
3. 'Tis not conceivable for what Use or Benefit there should be any such Element in that place; and certain it is, that Nature does not do any thing in vain.
4. Betwixt two Extreame there can be but one Medium; and therefore between those two opposite Elements of Earth and Water, it may seem more convenient to place only the Air, which shall partake of middle Qualities different from both.
5. Fire does not seem so properly and directly to be opposed to any thing as Ice; and if the one be not an Element, why should the other?

If you object, that the Fire which we commonly use does always tend upwards; I answer, This cannot prove that there is a Natural Place for such an Element, since our Adversaries themselves do grant, that *Culinary* and *Elementary* Fire are of different kinds. The one does burn, thine, and corrupt its Subject; the other disagrees from it in all these Respects. And therefore from the Ascent of the one, we cannot properly infer the Being or Situation of the other.

But for your farther Satisfaction herein, you may peruse *Cardan*, *Johannes Pena*, that Learned *French-*

man the Noble *Tycho*, with divers others who have purposely handled this Proposition.

3. I might add a Third, *viz.* That there is no Musick of the Spheres; for if they be not solid, how can their Motion cause any such Sound as is conceived? I do the rather meddle with this, because *Plutarch* speaks as if a Man might very conveniently hear that Harmony, if he were an Inhabitant in the Moon. But I guess that he said this out of Incogitancy, and did not well consider those necessary Consequences which depend upon his Opinion. However, the World would have no great loss in being depriv'd of this Musick, unless at some times we had the privilege to hear it: Then indeed *Philo the Jew* thinks it would save us the Charges of Diet, and we might live at an easy rate by feeding at the Ear only, and receiving no other Nourishment; and for this very Reason (says he) was *Mojes* enabled to tarry Forty Days and Forty Nights in the Mount without eating any thing, because he there heard the Melody of the Heavens. — *Risum teneatis.* I know this Musick hath had great Patrons, both Sacred and Prophane Authors, such as *Ambrose, Bede, Boetius, Anselm, Plato, Cicero,* and others; but because it is not now, I think, affirmed by any, I shall not therefore bestow either Pains or Time in arguing against it.

De somnit.

It may suffice that I have only named these three last, and for the two more necessary, have referred the Reader to others for satisfaction. I shall in the next place proceed to the Nature of the Moon's Body, to know whether that be capable of any such Conditions, as may make it possible to be inhabited, and what those Qualities are wherein it more nearly agrees with our Earth.

P R O P. IV.

That the Moon is a Solid, Compacted, Opaque Body.

I Shall not need to stand long in the proof of this Proposition, since it is a Truth already agreed on by the general Consent of the most and the best Philosophers.

- I. 1. It is solid, in opposition to fluid, as is the Air ; for how otherwise could it beat back the Light which it receives from the Sun ?

But here it may be question'd, whether or no the Moon bestow her Light upon us by the Reflection of the Sun-beams from the Superficies of her Body, or else by her own Illumination? Some there are who affirm this latter Part. So * *Averroes*, † *Cælius Rhodiginus*, ∴ *Julius Cæsar*, &c. And their Reason is, because this Light is discerned in many Places, whereas those Bodies which give Light by Reflexion, can there only be perceived where the Angle of Reflexion is equal to the Angle of Incidence, and this is only in one Place ; as in a Looking-glass, those Beams which are reflected from it, cannot be perceived in every Place where you may see the Glass, but only there where your Eye is placed on the same Line whereon the Beams are reflected.

But to this I answer, That the Argument will not hold of such Bodies whose Superficies is full of unequal Parts and Gibbosities, as the Moon is. Wherefore it is as well the more probable as the more common Opinion, that her Light proceeds from both these Causes, from Reflexion and Illumination ; nor doth it herein differ from our Earth, since that also hath some Light by Illumination : For how otherwise

* *De celo*
l. 2. com. 49.
† *Art. le-*
tion. l. 20.
c. 4.
De phæ-
nom. Lunæ.
c. 11.

wife would the Parts about us in a Sun-shine Day appear so bright, when as the Rays of Reflexion cannot enter into our Eye ?

For the better illustration of this, we may consider the several ways whereby divers Bodies are enlightned. Either as Water by admitting the Beams into its Substance ; or as Air and Thin Clouds, by transmitting the Rays quite thorough their Bodies ; or as those things that are of an opacous Nature, and smooth Superficies, which reflect the Light only in one place ; or else as those things which are of an opacous Nature, and rugged Superficies, which by a kind of circumfluous Reflection, are at the same time discernible in many Places, as our Earth and the Moon.

2. It is compact, and not a spongy and porous Substance. But this is denied by * *Diogenes*, † *Vitellio*, and † *Reinoldus*, and some others, who held the Moon to be of the same kind of Nature as a Pumice-stone ; and this, say they, is the Reason why in the Sun's Eclipses, there appears within her a Dusky Ruddy Colour, because the Sun-Beams being refracted in passing through the Pores of her Body, must necessarily be represented under such a Colour.

But I reply, if this be the cause of her Redness, then why doth she not appear under the same Form when she is about a Sextile Aspect, and the darkned part of her Body is discernible? for then also do the same Rays pass through her, and therefore in all likelihood should produce the same Effect; and notwithstanding those Beams are then diverted from us, that they cannot enter into our Eyes by a straight Line, yet must the Colour still remain visible in her Body. And besides, according to this Opinion, the Spots would not always be the same, but diverse as the various distance of the Sun requires. Again, if the Sun-beams did pass through her, why then hath she

2.

* *Plut. de
pla. Phil.
l. 2. c. 13.
† Opt. l. 4.
Com.
Purbac.
Theo. p.
164.*

*Soaliger
Exercit.
8o. Sect.*

not a Tail (saith *Scaliger*) as the Comets? Why doth she appear in such an exact Round? and not rather attended with a long Flame, since it is meerly this Penetration of the Sun-beams that is usually attributed to be the cause of Beards in Blazing Stars.

3.
*Plut. de
facie Luna.*

3. It is opacous, not transparent or diaphanous like Chrystal or Glass, as *Empedocles* thought, who held the Moon to be a Globe of pure congealed Air, like Hail enclosed in a Sphere of Fire; for then,

1. Why does she not always appear in the Full? since the Light is dispersed through all her Body?

*Thucid.
Livii.
Plut. de
facie Luna.*

2. How can the Interposition of her Body so darken the Sun, or cause such great Eclipses as have turned Day into Night; that have discover'd the Stars, and frighted the Birds with such a sudden Darknes, that they fell down upon the Earth? as it is related in divers Histories. And therefore *Herodotus* telling of an Eclipse which fell in *Xerxes's* Time, describes it thus: ὁ ἥλιος ἐκλιπὼν τὴν ἐν τῷ ἕργῳ ἔδρην ἀφανὲς ὤ. The Sun leaving his wonted Seat in the Heavens, vanish'd away: All which argues such a great Darknes as could not have been, if her Body had been perspicuous. Yet some there are who interpret all these Relations to be Hyperbolical Expressions; and the noble *Tycho* thinks it naturally impossible that any Eclipse should cause such Darknes, because the Body of the Moon can never totally cover the Sun. However, in this he is singular, all other Astronomers (if I may believe *Keplar*) being on the contrary Opinion, by reason the Diameter of the Moon does for the most part appear bigger to us than the Diameter of the Sun.

*Herodot.
l. 7. c. 37.*

*De phæ-
nom. Luna.
c. 11.*

But here *Julius Cæsar* once more puts in to hinder our Passage. The Moon (saith he) is not altogether opacous, because 'tis still of the same Nature with
the

the Heavens, which are incapable of total Opacity : And his Reason is, because Perspicuity is an inseparable Accident of those purer Bodies ; and this he thinks must necessarily be granted ; for he stops there, and proves no further ; but to this I shall defer an Answer till he hath made up his Argument.

We may frequently see, that her Body does so eclipse the Sun, as our Earth doth the Moon. And besides, the Mountains that are observed there, do cast a dark Shadow behind them, as shall be shewed afterwards. Since then the like Interposition of them both, doth produce the like Effect, they must necessarily be of the like Natures, that is, alike opacous, which is the thing to be shewed ; and this was the Reason (as the Interpreters guess) why *Aristotle* affirmed the Moon to be of the Earth's Nature, because of their Agreement in Opacity ; whereas all the other Elements, save that, are in some measure Perspicuous.

Prop. 9.

In. l. de animalib.

But the greatest Difference which may seem to make our Earth altogether unlike the Moon, is, because the one is a bright Body, and hath Light of its own, and the other a gross dark Body which cannot shine at all. 'Tis requisite therefore that in the next Place I clear this doubt, and shew that the Moon hath no more Light of her own than our Earth.

P R O P. V.

That the Moon hath not any Light of her own.

TWas the Fancy of some of the *Jews*, and more especially of *Rabbi Simeon*, that the Moon was nothing else but a contracted Sun ; and that both those Planets at their first Creation, were equal both in Light and Quantity. For, because God did

To status in 1 Gen. Hyeron. de Sancta fide Hebræo- mast. l. 2. c. 4.

then

then call them both great Lights, therefore they inferred that they must be both equal in Bigness. But a while after (as the Tradition goes) the ambitious Moon put up her Complaint to God against the Sun, shewing that it was not fit there should be Two such great Lights in the Heavens; a Monarchy would best become the Place of Order and Harmony. Upon this, God commanded her to contract her self into a narrower Compass; but she being much discontented hereat, replies, What! because I have spoken that which is Reason and Equity, must I therefore be diminished? This Sentence could not chuse but much trouble her; and for this reason was she in great Distress and Grief for a long Space; but that her Sorrow might be some way pacified, God bid her be of good Cheer, because her Privileges and Charter should be greater than the Sun's; he should appear in the day time only, she both in the Day and Night; but her Melancholy being not satisfied with this, she replied again, That that alas was no Benefit; for in the day time she should be either not seen, or not noted. Wherefore, God to comfort her up, promised, that his People the *Israelites* should celebrate all their Feasts and Holidays by a Computation of her Months; but this being not able to content her, she has looked very melancholy ever since; however, she hath still reserved much Light of her own.

Others there were, that did think the Moon to be a round Globe; the one half of whose Body was of a Bright Substance, the other half being dark; and the divers Conversions of those sides towards our Eyes, caused the Variety of her Appearances. Of this Opinion was *Berosus*; as he is cited by * *Vitruvius*; and † *St. Austin* thought it was probable enough. But this Fancy is almost equally absurd with the former, and both of them sound rather like Fables,

than

* Lib. 9.
Architect.
† Narrat.
Psalm.
item ep.
119.

than Philosophical Truths. You may commonly see how this latter does contradict frequent and easie Experience ; for 'tis observed, that that Spot which is perceived about her middle when she is in the Increase, may be discern'd in the same Place when she is in the Full : Whence it must follow, that the same part which was before darkned, is after enlighten'd, and that the one part is not always dark, and the other light of it self. But enough of this; I would be loth to make an Enemy, that I may afterwards overcome him, or bestow time in proving that which is already granted ; I suppose now, that neither of them hath any Patrons, and therefore need no Confutation.

'Tis agreed upon by all sides, that this Planet receives most of her Light from the Sun ; but the chief Controversy is, whether or no she hath any of her own ? The greater Multitude affirm this. *Cardana* amongst the rest, is very confident of it ; and he thinks that if any of us were in the Moon at the time of her greatest Eclipse, *Lunam aspiceremus non secus ac innumeris cereis splendidissimis accensis, atque in eas oculis defixis cœcutiremus* ; “ We should perceive so great a Brightness of her own, that would blind us with the meer Sight, and when she is enlighten'd by the Sun, then no Eagles Eye (if there were any there) is able to look upon her.” This *Cardan* says, and he doth but say it, without bringing any Proof for its Confirmation. However, I will set down the Arguments that are usually urged for this Opinion, and they are taken either from Scripture or Reason ; from Scripture is urged that Place, *1 Cor. 15.* where it is said, *There is one glory of the Sun, and another glory of the Moon.* *Ulysses Albergettus* urges that in *Matth. 24. 29.* ἡ σελήνη ἔδωκε τὸ φέγγος αὐτῆς. *The Moon shall not give her light* : Therefore (says he) she hath some of her own.

De Subtil.
l. 3.

But

But to these we may easily answer, that the Glory and Light there spoken of, may be said to be hers, though it be derived, as you may see in many other Instances.

The Arguments from Reason are taken either,

1. From that Light which is discerned in her, when there is a total Eclipse of her own Body, or of the Sun.

2. From the Light which is discerned in the darker Part of her Body, when she is but a little distant from the Sun.

1. For when there are any total Eclipses, there appears in her Body a great Redness, and many times Light enough to cause a remarkable Shade, as common Experience doth sufficiently manifest: But this cannot come from the Sun, since at such times either the Earth or her own Body shades her from the Sunbeams; therefore it must proceed from her own Light.

2. Two or three Days after the New Moon, we may perceive Light in her whole Body, whereas the Rays of the Sun reflect but upon a small part of that which is visible; therefore 'tis likely that there is some Light of her own.

In answering to these Objections, I shall first shew, that this Light cannot be her own; and then declare that which is the true Reason of it.

That it is not her own, appears,

1. Because then she would always retain it; but she has been sometimes altogether invisible, when notwithstanding some of the fixed Stars of the fourth or fifth Magnitude might easily have been discerned close by her: As it was in the Year 1620.

2. This may appear likewise from the Variety of it at divers times; for 'tis commonly observed that sometimes 'tis of a brighter, sometimes of a darker Appearance; now redder, and at another time of a

more

more duskish Colour. The Observation of this Variety in divers Eclipses, you may see set down by *Keplar* and many others. But now this could not be, if that Light were her own, that being constantly the same, and without any reason of such an Alteration: So that thus I may argue.

Opt. Astron. c. 7. num. 3.

If there were any Light proper to the Moon, then would that Planet appear brightest when she is eclipsed in her *Perige*, being nearest to the Earth; and so consequently more obscure and duskish when she is in her *Apoge* or farthest from it; the reason is, because the nearer any enlightned Body comes to the Sight, by so much the more strong are the Species, and the better perceived. This Sequel is granted by some of our Adversaries, and they are the very Words of noble *Tycho*; *Si Luna genuino gauderet lumine, utique cum in umbra terræ esset, illud non amitteret, sed èd evidentius exereret; omne enim lumen in tenebris, plus splendet cum alio majore fulgore non præpeditur.* If the Moon had any Light of her own, then would she not lose it in the Earth's Shadow, but rather shine more clearly; since every Light appears greater in the dark, when it is not hinder'd by a more perspicuous Brightness.

De nova stella. l. 1. c. 10.

But now the Event falls out clean contrary, (as Observation doth manifest, and our Opposites themselves do grant) the Moon appearing with a more reddish and clear Light when she is eclipsed, being in her *Apoge* or farthest Distance, and a more blackish Iron Colour when she is in her *Perige* or nearest to us, therefore she hath not any Light of her own. Nor may we think that the Earth's Shadow can cloud the proper Light of the Moon from appearing, or take away any thing from her inherent Brightness; for this were to think a Shadow to be a Body, an Opinion altogether misbecoming a Philosopher, as *Tycho* grants in the fore-cited Place, *Nec umbra terræ corporeum quid est, aut densa aliqua*

Reinold Comment. in Purb. Theor. p. 164.

sub-

Substantia, ut Lunæ lumen obtenebrare possit, atque id visui nostro præripere, sed est quædam privatio luminis solaris, ob interpositum opacum corpus terræ. Nor is the Earth's Shadow any corporeal Thing, or thick Substance, that it can cloud the Moon's Brightness, or take it away from our Sight; but it is a meer Privation of the Sun's Light by reason of the interposition of the Earth's Opacous Body.

3. If she had any Light of her own, then that would in it self be either such a ruddy Brightness as appears in the Eclipses, or else such a Leaden duskish Light, as we see in the darker Parts of her Body, when she is a little past the Conjunction. (That it must be one of these, may follow from the opposite Arguments;) but it is neither of these, therefore she hath none of her own.

1. 'Tis not such a ruddy Light as appears in Eclipses; for then why can we not see the like Redness, when we may discern the obscurer Parts of the Moon?

You will say, perhaps, That then the Nearness of that greater Light takes away that Appearance.

I reply, This cannot be. For then, why does Mars shine with his wonted Redness, when he is near the Moon? Or why cannot her greater Brightness make him appear white, as the other Planets? Nor can there be any Reason given, why that greater Light should represent her Body under a false Colour.

2. 'Tis not such a duskish Leaden Light, as we see in the darker Part of her Body, when she is about a Sextile Aspect distant from the Sun; for then, why does she appear red in the Eclipses; since mere Shade cannot cause such a Variety? For 'tis the Nature of Darkness, by its Opposition, rather to make Things appear of a more white and clear Brightness, than they are in themselves. Or, if it be the Shade, yet those Parts of the Moon are then

then in the Shade of her Body, and therefore in reason should have the like Redness. Since, then, neither of these Lights are hers; it follows, that she hath none of her own. Nor is this a singular Opinion, but it hath had many Learned Patrons: Such was *Macrobius*, who being for this quoted of *Rhodiginus*, he calls him, *Vir reconditissimæ Scientiæ*, a Man who knew more than ordinary Philosophers; thus commending the Opinion in the Credit of the Author. To him assents the Venerable *Bede*, upon whom the Gloss hath this Comparison: As the Looking-Glass represents not any Image within it self, unless it receive some from without; so the Moon hath not any Light, but what is bestowed by the Sun. To these agreed * *Albertus Magnus*, † *Scaliger*, || *Mæslin*, *Keplar*, and more especially ∴ *Mulapertius*; whose Words are more pat to the purpose than others, and therefore I shall set them down as you may find them in his Preface to his Treatise concerning the *Austriaca Sydera*: *Luna, Venus, & Mercurius, terrestres & humidæ sunt Substantiæ; ideoque de suo non lucere, sicut nec Terra.* The Moon, *Venus*, and *Mercury*, (saith he) are of an earthly and moist Substance; and therefore have no more Light of their own, than the Earth hath. Nay, some there are who think, (tho' without ground) that all the other Stars do receive that Light whereby they appear visible to us, from the Sun. So *Ptolomy*, * *Isidore Hisp. lensis*, † *Albertus Magnus*, and || *Bede*: Much more then, must the Moon shine with a borrowed Light.

But enough of this. I have now sufficiently shewed what at the first I promised; That this Light is not proper to the Moon. It remains in the next place, that I tell you the true Reason of it. And here, I think 'tis probable, that the Light which appears in the Moon at the Eclipses, is nothing else but the second Species of the Sun's Rays, which pass

Somm. Scip.
l. 1. c. 20.
Leet. antiq.
l. 1. c. 15.

In lib. de
nat. rer.

* *De 4. Co-*
avis. Q. 4.
Art. 21.

† *Exercit.*
62.

|| *Epitom.*
Astron. l. 4.
p. 2

∴ *Epit. A-*
stron. Cop.
l. 6. part 2.
sect. 2.

* *Origin.*
l. 3. c. 60.
† *De Cælo,*
l. 2.

|| *De rati-*
one temp.
c. 4.

Item Pliu.
l. 2. c. 6.

Hugo de
Sancto Vi-
fore.

Annot. in
Gen. 6.

pass through the Shadow unto her Body : And from a Mixture of this second Light with the Shadow, arises that Redness which at such times appears unto us. I may call it *Lumen Crepusculinum*, the *Aurora* of the Moon, or such a kind of blushing Light that the Sun causes when he is near his Rising, when he bestows some small Light upon the thicker Vapours. Thus we see commonly the Sun being in the Horizon, and the Reflection growing weak, how his Beams make the Waters appear very red.

2 King. 3.

22.

2. *Quæst.*
in hoc cap.

The *Moabites*, in *Jehoram's* time, when they rose early in the Morning, and beheld the Waters afar off, mistook them for Blood. *Et causa hujus est, quia radius solaris in Aurora contrahit quondam rubedinem, propter Vapores combustos manentes circa superficiem terræ, per quos radii transeunt; & ideo cum repercuntur in aqua ad oculos nostros, trahunt secum eundem ruborem, & faciunt apparere locum aquarum, in quo est repercussio, esse rubrum; saith Tostatus.* The Reason is, because of his Rays; which being in the lower Vapours, those do convey an imperfect mixed Light upon the Waters. Thus the Moon being in the Earth's Shadow, and the Sun-beams which are round about it not being able to come directly unto her Body; yet some second Rays there are, which passing through the Shadow, make her appear in that ruddy Colour: So that she must appear brightest, when she is eclipsed, being in her *Apoge* or greatest Distance from us; because then the Cone of the Earth's Shadow is less, and the Refraction is made through a narrower Medium. So on the contrary, she must be represented under a more dark and obscure Form when she is eclipsed, being in her *Perige*, or nearest to the Earth; because then she is involved in a greater Shadow, or bigger part of the Cone; and so the Refraction passing through a greater Medium, the Light must needs

be weaker which doth proceed from it. If you ask now, What the Reason may be of that Light which we discern in the darker Part of the New Moon? I answer; 'Tis reflected from our Earth; which returns as great a Brightness to that Planet, as it receives from it. This I shall have occasion to prove afterward.

I have now done with these Propositions, which were set down to clear the Passage, and confirm the Suppositions implied in the Opinion. I shall in the next place proceed to a more direct Treating of the chief Matter in hand.

P R O P. VI.

That there is a World in the Moon, hath been the direct Opinion of many Ancient, with some Modern Mathematicians; and may probably be deduced from the Tenents of others.

SINCE this Opinion may be suspected of Singularity, I shall therefore first confirm it by sufficient Authority of divers Authois, both ancient and modern; that so I may the better clear it from the Prejudice either of an upstart Fancy, or an obsolete Error. This is by some attributed to *Orpheus*, one of the most ancient *Greek* Poets. Who speaking of the Moon, says thus; ἡ πολλὰ ἕσπευ ἔχει, πολλὰ ἄστρα, πολλὰ μέγαρα. That it hath many Mountains, and Cities, and Houses in it. To him assented *Anaxagoras*, *Democritus*, and *Heraclides*; all who thought it to have firm solid Ground, like to our Earth; containing in it many large Fields, Champion Grounds, and divers Inhabitants.

Of this Opinion likewise was *Xenophanes*, as he is cited for it by *Lactantius*; tho' that Father (perhaps)

*Plat. de
plac. phil.
l. 2. c. 13.*

Ibid. c. 25.

*Diog. La-
ert. l. 2. c.
19.*

*Diog. Inst.
l. 3. c. 13.*

haps) did mistake his Meaning, whilst he relates it thus: *Dixit Xenophanes, intra concavum Lunæ esse aliam terram, & ibi aliud genus hominum, simili modo vivere sicut nos in hac terra, &c.* As if he had conceived the Moon to be a great hollow Body, in the midst of whose Concavity, there should be another Globe of Sea and Land, inhabited by Men, as our Earth is: Whereas, it seems to be more likely by the Relation of others, that this Philosopher's Opinion is to be understood in the same Sense as it is here to be proved. True indeed, the Father condemns this Assertion, as an equal Absurdity to that of *Anaxagoras*, who affirmed the Snow to be black: But no wonder; for in the very next Chapter it is, that he does so much deride the Opinion of those who thought there were *Antipodes*. So that his Ignorance in that particular, may perhaps disable him from being a competent Judge in any other the like Point of Philosophy. Unto these agreed *Pythagoras*, who thought that our Earth was but one of the Planets which moved round about the Sun, (as *Aristotle* relates it of him;) and the *Pythagoreans* in general did affirm that the Moon also was Terrestrial, and that she was inhabited as this lower World: That those living Creatures and Plants which are in her, exceed any of the like kind with us in the same Proportion, as their Days are longer than ours: *Viz.* by Fifteen Times. This *Pythagoras* was esteemed by all, of a most Divine Wit, as appears especially by his Valuation amongst the *Romans*; who being commanded by the Oracle to erect a Statue to the Wisest *Grecian*, the Senate determined *Pythagoras* to be meant; preferring him in their Judgments before the Divine *Socrates*, whom their Gods pronounc'd the Wisest. Some think him a *Jew* by Birth; but most agree that he was much conversant amongst the learned Sort and Priests of that Nation, by whom he was informed of ma-

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De Calo,
l. 2. c. 13.

Plut. ibid.
cap. 30.

Plin. Nat.
Hist. l. 34.
cap. 6.

ny Secrets; and (perhaps) this Opinion which he vented afterwards in Greece, where he was much opposed by Aristotle in some worded Disputations, but never confuted by any solid Reason.

To this Opinion of Pythagoras did Plato also assent, when he considered that there was the like Eclipse made by the Earth; and this, that it had no Light of its own, that it was so full of Spots. And therefore we may often read in him and his Followers, of an *ætherea terra*, and *lunares populi*, an Æthereal Earth, and Inhabiters in the Moon; but afterwards this was mixed with many ridiculous Fancies: For some of them considering the Mysteries implied in the Number Three, concluded that there must necessarily be a Trinity of Worlds, whereof the first is this of ours; the second in the Moon, whose Element of Water is represented by the Sphere of Mercury, the Air by Venus, and the Fire by the Sun. And that the whole Universe might the better end in Earth as it began; they have contrived it, that Mars shall be a Sphere of the Fire, Jupiter of Air, Saturn of Water; and above all these, the Elysian Fields, spacious and pleasant Places appointed for the Habitation of those unspotted Souls, that either never were imprisoned in, or else now have freed themselves from any Commerce with the Body. Scaliger speaking of this Platonick Fancy, *quæ in tres trientes mundum quasi assens dividit*, thinks 'tis Confutation enough, to say, 'tis Plato's. However, for the first part of this Assertion, it was assented unto by many others, and by reason of the Grossness and Inequality of this Planet, 'twas frequently called *quasi terra cœlestis*, as being esteemed the Sediment and more imperfect Part of those purer Bodies; you may see this proved by Plutarch, in that delightful Work which he properly made for the Confirmation of this particular. With him agreed Alcinous and Plotinus, later Writers.

Plat. de
conviviis.
Macrob.
Somn. Scip.
l. 1. c. 11.

Exerc. 62.

De fatie
Lunæ.

Instit. ad
discip. plat.
Gal. Rhod.
dig. l. 1. c. 4.

Thus *Lucian* also in his Discourse of a Journey to the Moon, where though he does speak many things out of Mirth and in a jesting Manner; yet in the Beginning of it he does intimate that it did contain some serious Truths concerning the real Frame of the Universe.

Cusa. de doct. ign. l. 2. cap. 12.

The Cardinal *Cusanus* and *Jornandus Brunus*, held a particular World in every Star; and therefore one of them defining our Earth, he says, it is *stella quædam nobilis, quæ lunam & calorem & influentiam habet aliam, & diversam ab omnibus aliis stellis*; "a noble Star, having a distinct Light, Heat, and Influence from all the rest. Unto this *Nicholas Hill*, a Countryman of ours, was inclined, when he said *Astrea terræ natura probabilis est*: "That 'tis probable the Earth hath a starry Nature.

Philos. Epicur. par. 434.

But the Opinion which I have here delivered, was more directly proved by * *Mæstin*, † *Keplar*, and † *Galiæus*; each of them late Writers, and famous Men for their singular Skill in Astronomy. *Keplar* calls this World by the Name of *Levania*, from the Hebrew Word *לְבָנָה* which signifies the Moon, and our Earth by the Name of *Volva*, a *volvendo*; because it does by reason of its diurnal Revolution appear unto them constantly to turn round; and therefore he stiles those who live in that Hemisphere which is towards us, by the Title of *Subvolvani*, because they enjoy the Sight of this Earth; and the others *Privolvani*, *quia sunt privati conspectu volvæ*, because they are deprived of this Priviledge. But *Fulius Cæsar*, whom I have above quoted, speaking of their Testimony whom I cite for this Opinion, *viz. Keplar* and *Galiæus*, affirms that to his Knowledge they did but jest in those things which they write concerning this; and as for any such World, he assuredly knows they never so much as dreamt of it. But I had rather believe their own words, than his pretended Knowledge.

* *In Thesibus.*

† *Dissertatio cum Nunc*

•• *Nuncius Sydereus. Somn. Astr.*

De Phenom. Lunæ. c. 4.

'Tis true indeed, in some things they do but trifle, but for the main Scope of those Discourses, 'tis as manifest they seriously meant it, as any indifferent Reader may easily discern: As for *Galileus*, 'tis evident that he did set down his own Judgment and Opinion in these Things; otherwise sure *Campsnell* (a Man as well acquainted with his Opinion, and perhaps his Person, as *Cæsar* was) would never have writ an Apology for him. And besides, 'tis very likely if it had been but a Jest, *Galileus* would never have suffered so much for it, as Report saith afterwards he did.

And as for *Keplar*, I will only refer the Reader to his own Words, as they are set down in the Preface to the Fourth Book of his *Epitom*; where his Purpose is to make an Apology for the Strangeness of those Truths that he was there to deliver, amongst which there are divers things to this Purpose concerning the Nature of the Moon. He professes that he did not publish them either out of a Humour of Contradiction, or a Desire of Vain-glory, or in a jesting Way to make himself or others merry, but after a considerate and solemn Manner for the Discovery of the Truth.

Now as for the Knowledge which *Cæsar* pretends to the contrary, you may guess what it was by his strange Confidence in other Assertions, and his Boldness in them may well derogate from his Credit in this. For speaking of *Ptolemy's Hypothesis*, he pronounces this Verdict, *Impossibile est excentricorum & epicyclo-
rum positio, nec aliquis est ex Mathematicis adeo
stultus qui veram illam existimet.* "The Position of
"Excentricks and Epicycles is altogether impossible, nor
"is there any Mathematician such a Fool as to think
"it true" I should guess he could not have Knowledge enough to maintain any other *Hypothesis*, who was so ignorant in Mathematicks as to deny that any good Author held this. For I would fain know

whether there were never any that thought the Heavens to be solid Bodies, and that there were such kinds of Motion as is by those fained Orbs supplied; if so, *Cæsar la Galla* was much mistaken. I think his Assertions are equally true, that *Galileus* and *Keplar* did not hold this; and that there were none which ever held that other. Thus much for the Testimony of those who were directly of this Opinion:

But, in my following Discourse, I shall most insist on the Observation of *Galileus*, the Inventor of that famous Perspective, whereby we may discern the Heavens hard by us; whereby those things which others have formerly guess'd at, are manifested to the Eye, and plainly discovered beyond Exception or Doubt; of which admirable Invention, these latter Ages of the World may justly boast, and for this expect to be celebrated by Posterity. 'Tis related of *Budoxus*, that he wish'd himself burnt with *Phæton*, so he might stand over the Sun to contemplate its Nature; had he lived in these Days, he might have enjoyed his Wish at an easier Rate; and scaling the Heavens by this Glass, might plainly have discerned what he so much desired. *Keplar* considering those strange Discoveries which this Perspective had made, could not chuse but cry out in a *ωροσποπεία* and Rapture of Admiration, *O multiscium & quovis scepro pretiosius perspicillum! an qui te dextrâ tenet, ille non dominus constituatur operum Dei?* And *Johannes Fabricius*, an elegant Writer, speaking of the same Glass, and for this Invention preferring our Age before those former times of greater Ignorance, says thus: *Adeo sumus superiores veteribus, ut quam illi carminis magici pronunciatu demissum representasse putantur, nos non tantum innocenter demittamus, sed etiam familiari quodam intuitu ejus quasi conditionem intueamur.* "So much are we above the Ancients, that whereas they were fain by their Magical Charms to represent the Moon's Approach, we can-

*De macula
in sol obser.*

cannot only bring her lower with a greater Innocence, but may also with a more familiar View behold her Condition." And because you shall have no occasion to question the truth of those Experiments which I shall afterwards urge from it, I will therefore set down the Testimony of an Enemy; and such a Witness hath always been accounted prevalent: You may see it in the above-named *Cæsar la Gallæ*, whose Words are these. *Mercurium caduceum gestantem, cœlestia nunciare, & mortuorum animas ab inferis revocare sapiens finxit antiquitas. Galilæum vero novam Jovis interpretem Telescopio caduceo instructum Sydera aperire, & veterum Philosophorum manes ad superos revocare solers nostra ætas videt & admiratur.* "Wise Antiquity fabled Mercury carrying a Rod in his hand to relate News from Heaven, and call back the Souls of the Dead; but it hath been the Happiness of our industrious Age, to see and admire Galilæus, (the new Ambassador of the Gods) furnished with his Perspective to unfold the Nature of the Stars, and awaken the Ghosts of the ancient Philosophers." So worthily and highly did these Men esteem of this excellent Invention.

De phaenom. cap. 1.

Now if you would know what might be done by this Glass, in the sight of such things as were nearer at hand, the same Author will tell you, when he says, That by it those things which could scarce at all be discerned by the Eye, at the distance of a Mile and a half, might plainly and distinctly be perceived for 16 Italian Miles, and that as they were really in themselves, without any Transposition or Falsifying at all. So that what the ancient Poets were fain to put in a Fable, our more happy Age hath found out in a Truth; and we may discern as far with these Eyes which Galilæus hath bestowed upon us, as *Lyncæus* could with those which the Poets attributed unto him. But if you yet doubt whether all these Observations were true, the same Author may confirm you, when he

Ibid. c. 6.

Cap. 1.

says they were shewed, *Non uni aut alteri, sed quamplurimis, neq; gregarius hominibus, sed præcipuis atq; disciplinatis omnibus, necnon Mathematicis & Opticis præceptis optime instructis sedulâ ac diligenti inspectione.* "Not to one

" or two, but to very many, and those not ordinary

" Men, but to those who were well vers'd in Mathe-

" maticks and Opticks; and that not with a meer

" Glance, but with a sedulous and diligent Inspecti-

" on." And lest any Scruple might remain unan-

swered, or you might think the Men who beheld all

this, though they might be skilful, yet they came

with credulous Minds, and so were more easie to be

deluded: He adds that it was shewed, *Veris qui ad exper-*

imenta hæc contradicendi animo accesserant. "To such

" as were come with a great deal of Prejudice, and

" an intent of Contradiction." Thus you may see

the Certainty of those Experiments which were taken

by this Glass. I have spoken the more concerning it,

because I shall borrow many things in my further Dis-

course, from those Discoveries which were made

by it.

I have now cited such Authors both Ancient and Modern, who have directly maintained the same Opinion. I told you likewise in the Proposition, that it might probably be deduced from the Tenents of others: Such were *Aristarchus, Philolaus, and Copernicus*, with many other later Writers, who assented to their Hypothesis; so *Joach. Rbelicus, David Origanus Lansbergius, Gul. Gilbert*; and, (if I may believe *Campbell*) *Innumeri alii Angli & Galli*; Very many others, both *English and French*, all who affirmed our Earth to be one of the Planets, and the Sun to be the Center of all, about which the Heavenly Bodies did move. And how horrid soever this may seem at the first, yet is it likely enough to be true, nor is there any Maxim or Observation in *Opticks* (saith *Pena*) that can disprove it.

See the
Second
Book.
1. Prop.

*Apologia
pro Galileo.*

Now if our Earth were one of the Planets (as it is according to them) then why may not another of the Planets be an Earth?

Thus have I shewed you the Truth of this Proposition. Before I proceed farther, 'tis requisite that I inform the Reader what Method I shall follow in the proving of this chief Assertion, *That there is a World in the Moon.*

The Order by which I shall be guided, will be that which *Aristotle* uses in his Book *De Mundo* (if that Book were his.)

First, *αὐτὸ ἴσ' ἐν αὐτῇ*, of those chief Parts which are in it; not the Elementary and Æthereal (as he doth there) since this does not belong to the present Question, but of the Sea and Land, &c. Secondly, *αὐτὸ ἀπὸ τοῦ πᾶσιν*, of those things which are Extrinsical to it, as the Seasons, Meteors, and Inhabitants.

P R O P. VII.

That those Spots and brighter Parts, which by our Sight may be distinguished in the Moon, do shew the Difference betwixt the Sea and Land in that other World.

FOR the clear Proof of this Proposition, I shall first reckon up and refute the Opinions of others concerning the Matter and Form of those Spots, and then shew the greater Probability of this present Assertion, and how agreeable it is to that Truth which is most commonly received. As for the Opinions of others concerning these, they have been very many: I will only reckon up those which are common and remarkable.

Some there are that think those Spots do not arise from any Deformity of the Parts, but a Deceit of the Eye,

Eye, which cannot at such a Distance discern an equal Light in that Planet: But these do but only say it, and shew not any Reason for the Proof of their Opinion. Others think that there are some Bodies betwixt the Sun and Moon, which keeping off the Light in some Parts, do by their Shadow produce those Spots which we there discern.

So Bede in
l. de Mund.
conf. 11.

Others would have them to be the Figure of the Seas or Mountains here below, represented there as in a Looking-Glass. But none of those Fancies can be true, because the Spots are still the same, and not varied according to the difference of Places; and besides, *Cardan* thinks it is impossible that any Image should be conveyed so far, as there to be represented unto us at such a distance. But 'tis commonly related of *Pythagoras*, that he by writing what he pleased in a Glass, by the Reflexion of the same Species would make those Letters to appear in the Circle of the Moon, where they should be legible by any other, who might at that time be some Miles distant from him. * *Agrippa* affirms this to be possible, and the way of performing it not unknown to himself, with some others in his time. It may be, that Bishop *Godwin* did by the like Means perform those strange Conclusions, which he professes in his *Nuncius Inanimatus*; where he pretends, that he can inform his Friends of what he pleases, though they be an hundred Miles distant, *forte etiam, vel milliare millesimum*, (they are his own Words) and perhaps a thousand; and all this in a little space, quicker than the Sun can move.

De subtil.
lib. 3.

* *Occulta*
Philos. l. 1.
cap. 6.

Now, what Conveyance there should be for so speedy a Passage, I cannot conceive, unless it be carried with the Light, than which we know not any thing quicker. But of this only by the way. However, whether those Images can be represented so or not, yet certain it is, those Spots are not such Representations. Some think that when God had at first created too much Earth to make a perfect Globe, not know-

know-

knowing well where to bestow the rest, he placed it in the Moon, which ever since hath so darkned it in some Parts: But the Impiety of this is sufficient Confutation, since it so much detracts from the Divine Power and Wisdom.

The * Stoicks held that Planet to be mixed of Fire and Air; and in their Opinion, the Variety of its Composition caused her Spots: Being not ashamed to stile the same Body a Goddess, calling it *Diana*, *Minerva*, &c. and yet affirm it to be an impure Mixture of Flame and Smoak, and fuliginous Air.—But this Planet cannot consist of Fire, saith *Platarch*, because there is not any Fewel to maintain it. And the Poets have therefore fained *Vulcan* to be Lame, because he can no more subsist without Wood or other Fewel, than a Lame Man without a Staff.

Anaxagoras thought all the Stars to be of an Earthly Nature, mixed with some Fire; and as for the Sun, he affirmed it to be nothing else but a fiery Stone: For which latter Opinion, the *Athenians* sentenc'd him to Death; those zealous Idolaters counting it a great Blasphemy to make their God a Stone; whereas notwithstanding, they were so senseless in their Adoration of Idols, as to make a Stone their God. This *Anaxagoras* affirmed the Moon to be more Terrestrial than the other Planets, but of a greater Purity than any thing here below; and the Spots he thought were nothing else but some Cloudy Parts intermingled with the Light which belonged to that Planet; but I have above destroyed the Supposition on which this Fancy is grounded. *Pliny* thinks they arise from some Drossy Stuff, mixed with that Moisture which the Moon attracts unto her self; but he was of their Opinion who thought the Stars were nourished by some Earthly Vapours; which you may commonly see refuted in the *Commentators* on the Books *de Cælo*.

* *Plut. de placit. phil.*
l. 2. c. 25.

Josephus
l. 2. con.
App. August. de Civit. Dei.
l. 18. c. 41.

Nat. Hist.
l. 2. c. 9.

Opt. lib. 9.
Comment.
in Purb.
p. 164.

Ex qua
parte luna
est transpi-
cua non so-
lum secun-
dum super-
ficiem, sed
etiam se-
cundum
substanti-
am, eatenus
clara, ex
qua autem
parte opaca
est, eatenus
obscura vi-
detur. De
Phenom.
cap. 11.

Albert.
mag. de
Coevis.
Q. 4. Art.
21. Colleg.
Con.

De Somnis.

Vitellio and *Reinoldus* affirm the Spots to be the thick-
er Parts of the Moon, into which the Sun cannot in-
fuse much Light; and this (say they) is the Reason
why in the Sun's Eclipses the Spots and brighter Parts
are still in some measure distinguished, because the
Sun-Beams are not able so well to penetrate through
those thicker, as they may through the thinner Parts
of that Planet. Of this Opinion also was *Cæsar la*
Galla, whose Words are these; "The Moon doth
"there appear clearest, where she is transpicuous, not
"only through the Superficies, but the Substance al-
"so; and there she seems spotted, where her Body is
"most opacous." The Ground of this his Assertion
was, because he thought the Moon did receive and
bestow her Light by Illumination-only, and not at all
by Reflexion; but this, together with the supposed
penetration of the Sun-beams, and the perspicuity of
the Moon's Body I have above answered and refuted.

The more common and general Opinion is, that
the Spots are the thinner parts of the Moon, which
are less able to reflect the Beams that they receive
from the Sun, and this is most agreeable to Reason;
for if the Stars are therefore brightest, because they
are thicker and more solid, than their Orbs, then it
will follow, that those Parts of the Moon which
have less Light, have also less thickness. It was the
Providence of Nature (say some) that so contrived
that Planet to have these Spots within it; for since
that is nearest to those Lower Bodies which are so full
of Deformity, 'tis requisite that it should in some
measure agree with them; and as in this Inferior
World, the higher Bodies are the most compleat, so
also in the Heavens, Perfection is ascended unto by
degrees, and the Moon being the lowest, must be
the least pure; and therefore *Philo* the *Jew* inter-
preting *Jacob's* Dream concerning the Ladder, doth
in an Allegory shew how that in the Fabrick of the
World,

World, all things grow perfecter as they grow higher; and this is the Reason (saith he) why the Moon doth not consist of any pure simple Matter, but is mix'd with Air, which shews so darkly within her Body.

But this cannot be a sufficient Reason; for tho' it were true that Nature did frame every thing perfecter as it was higher, yet is it as true that Nature frames every thing fully perfect for that Office to which she intends it. Now had she intended the Moon meerly to reflect the Sun-beams, and give Light, the Spots then had not so much argued her Providence, as her unskilfulness and oversight, as if in the hast of her Work she could not tell how to make that Body exactly fit for that Office to which she intended it.

Scalig. exercit. 62.

'Tis likely then that she had some other end which moved her to produce this Variety; and this, in all probability, was her intent, to make it a fit Body for habitation, with the same Conveniences of Sea and Land, as this Inferior World doth partake of. For since the Moon is such a vast, such a solid and opacous Body, like our Earth (as was above proved) why may it not be probable that those thinner and thicker Parts appearing in her, do shew the difference betwixt the Sea and Land in that other World? And *Galileus* doubts not, but that if our Earth were visible at the same distance, there would be the like appearance of it.

If we consider the Moon as another habitable Earth, then the Appearances of it will be altogether exact and beautiful, and may argue unto us that it is fully accomplish'd for all those Ends to which Providence did appoint it. But consider it barely as a Star or Light, and then there will appear in it much imperfection and deformity, as being of an impure dark Substance, and so unfit for the Office of that Nature.

As for the Form of those Spots, some of the Vulgar think they represent a Man, and the Poets gues's 'tis the Boy *Endymion*, whose Company she loves so well, that she carries him with her: Others will have it only to be the Face of a Man, as the Moon is usually pictured; but *Albertus* thinks rather, that it represents a Lyon with his Tail towards the *East*, and his Head the *West*; and * some others have thought it to be very much like a Fox; and certainly 'tis as much like a Lyon as that in the *Zodiack*, or as *Ursa Major* is like a Bear.

* *Eusebius*
Nieremb.
Hist. Nat.
l. 8. c. 15.

I should gues's that it represents one of these as well as another, and any thing else as well as any of these, since 'tis but a strong Imagination which fancies such Images, as School-Boys usually do in the Marks of a Wall, whereas there is not any such Similitude in the Spots themselves, which rather like our Sea, in respect of the Land, appears under a rugged and confused Figure, and doth not represent any distinct Image: So that both in respect of the Matter and the Form, it may be probable enough that those Spots and brighter Parts may shew the distinction betwixt the Sea and Land in that other World.

P R O P. VIII.

The Spots represent the Sea, and the Brighter Parts the Land.

WHEN I first compared the Nature of our Earth and Water with those Appearances in the Moon, I concluded contrary to the Proposition, that the Brighter Parts represented the Water, and the Spots the Land. Of this Opinion likewise was *Keplar* at the first. But my Second Thoughts, and the reading

Opt. Astro.
c. 6. num.
9. Dissert.
cum nuncio
Gal.

reading of others, have now convinced me (as after he was) of the Truth of that Proposition which I have now set down. Before I come to the confirmation of it, I shall mention those Scruples which at first made me doubt the truth of this Opinion.

1. It may be objected, 'tis probable, if there be any such Sea and Land as ours, that it bears some proportion and similitude with ours: But now this Proposition takes away all likeness betwixt them. For whereas the Superficies of our Earth is but the third part of the whole Surface in the Globe, two parts being overspread with the Water (as *Scaliger* observes) yet here, according to this Opinion, the Sea should be less than the Land, since there is not so much of the Besspotted as there is of the Enlightned Parts; wherefore 'tis probable that there is no such Thing at all, or else that the Brighter Parts are the Sea.

Exercit.
38.

2. The Water, by reason of the smoothness of its Superficies, seems better able to reflect the Sun-beams than the Earth, which in most places is so full of ruggedness, of Grass and Trees, and such like Impediments of Reflexion; and besides, Common Experience shews that the Water shines with a greater and more glorious Brightness than the Earth; therefore it should seem that the Spots are the Earth, and the brighter Parts the Water. But to the first it may be answered.

1. There is no great probability in this Consequence, that because 'tis so with us, therefore it must be so with the Parts of the Moon; for since there is such a difference betwixt them in divers other respects, they may not perhaps agree in this.

2. That Assertion of *Scaliger* is not by all granted for a Truth. *Fromondus* with others think that the Superficies of the Sea and Land, in so much of the World as is already discover'd, is equal and of the same extension.

De Meteoris, l. 5.
c. 1. Art. 1.

3. The

3. The Orb of Thick and Vaporous Air which encompasses the Moon, makes the brighter Parts of that Planet appear bigger than in themselves they are; as I shall shew afterwards.

To the Second it may be answered, That though the Water be of a smooth Superficies, and so may seem most fit to reverberate the Light, yet because 'tis of a perspicuous Nature, therefore the Beams must sink into it, and cannot so strongly and clearly be reflected. *Sicut in speculo ubi plumbum abrasum fuerit,* (saith *Cardan*) as in Looking-Glasses, where part of the Lead is razed off, and nothing left behind to reverberate the Image, the Species must there pass through, and not back again: So it is where the Beams penetrate and sink into the substance of the Body, there cannot be such an immediate and strong Reflexion, as when they are beat back from the Superficies; and therefore the Sun causes a greater heat by far upon the Land, than upon the Water. Now as for that Experiment, where it is said, That the Waters have a greater Brightness than the Land; I answer, 'Tis true only there where they represent the Image of the Sun, or some bright Cloud, and not in other Places; especially if we look upon them at any great distance, as is very plain by common Observation.

And 'tis certain, that from any high Mountain the Land does appear a great deal brighter than any Lake or River.

This may yet be farther illustrated by the Similitude of a Looking-Glass hanging upon a Wall in the Sun shine; where, if the Eye be not placed in the just Line of Reflexion from the Glass, 'tis manifest that the Wall will be of a brighter Appearance than the Glass. True indeed, in the Line of Reflexion, the Light of the Glass is equal almost unto that which comes immediately from the Sun it self; but now this is only in one particular Place, and so is not like
that

that Brightness which we discern in the Moon ; because this does appear equally in several Situations, like that of the Wall, which does seem bright as well from every Place, as from any one. And therefore the roughness of the Wall, or (as it is in the Objection) the ruggedness of our Earth, is so far from being an hindrance of such a Reflexion as there is from the Moon, that it is rather required as a necessary Condition unto it. We may conceive that in every rough Body, there are, as it were, innumerable Superficies, disposed unto an innumerable Diversity of Inclinations. *Ita ut nullus sit locus, ad quem non pertingant pluri- mi radii reflexi a plurimis superficieciculis, per omnem corporis scabri radius luminosus percussus superficiem dispersis.* “ So “ that there is not any Place unto which there are “ not some Beams reflected from these diverse Super- “ ficies, in the several Parts of such a rugged Body.” But yet (as I said before) the Earth does receive a great part of its Light by Illumination, as well as by Reflexion.

Galilæus
System.
Coll. 1.

So that notwithstanding those Doubts, yet this Proposition may remain true, That the Spots may be the Sea, and the brighter Parts the Land. Of this Opinion was *Plutarch*: Unto him assented *Keplar* and *Galilæus*, whose Words are these: *Si quis veterum Pythagoreorum sententiam exuscitare velit, lunam scilicet esse quasi tellurem alteram ejus pars lucidior terrenam superficiem, obscurior vero aqueam magis congruè repræsentet. Mibi autem dubium fuit nunquam terrestris globi à longe inspecti, atque à radiis solaribus perfusi, terream superficiem clario- rem, obscuriorem vero aqueam sese in conspectum daturam.* “ If any Man have a mind to renew the Opinion of “ the *Pythagoreans*, That the Moon is another Earth ; “ then her brighter Parts may fitly represent the “ Earth’s Superficies, and the darker part the Water : “ And for my part, I never doubted but that our “ Earthly Globe being shined upon by the Sun, “ and beheld at a great distance, the Land would “ appear

De facie
Lun.
Dissertatio
Nunc. Syd.

“ appear brightest, and the Sea more obscurely.”
The Reasons may be,

1. That which I urged about the foregoing Chapter ; because the Water is the thinner part, and therefore must give less Light.

Since the Stars and Planets, by reason of their Brightness, are usually concluded to be the thicker Parts of their Orb.

*In lib. de
colorib.*

2. Water is in it self of a blacker Colour (saith *Aristotle*) and therefore more remote from Light than the Earth. Any Part of the Ground being moistned with Rain, does look much more darkly than when it is dry ?

3. 'Tis observed that the Secondary Light of the Moon (which afterwards is proved to proceed from our Earth) is sensibly brighter unto us, for two or three Days before the Conjunction, in the Morning when she appears Eastward, than about the same time after the Conjunction, when she is seen in the *West*. The Reason of which must be this, because that part of the Earth which is opposite to the Moon in the *East*, has more Land in it than Sea. Whereas on the contrary, the Moon when she is in the *West*, is shined upon by that part of our Earth where there is more Sea than Land ; from whence it will follow with good probability, that the Earth does cast a greater Light than the Water.

4. Because Observation tells us, that the Spotted Parts are always smooth and equal, having every where an equality of Light when once they are enlightened by the Sun ; whereas the brighter parts are full of rugged Gibbosities and Mountains, having many Shades in them, as I shall shew more at large afterwards.

That in this Planet there must be Seas, *Campanella* endeavours to prove out of Scripture, interpreting the *Waters above the Firmament*, spoken in *Genesis*, to be meant of the Sea in this World. For (saith he) 'tis

*Apologia
pro Galilaeo.*

not

not likely that there are any such Waters above the Orbs to moderate that Heat which they receive from their swift Motion (as some of the Fathers think). Nor did *Moses* mean the Angels, which may be call'd Spiritual Waters, as *Origen* and *Austin* would have it, for both these are rejected by the General Consent: Nor could he mean any Waters in the Second Region, as most Commentators interpret it. For first there is nothing but Vapours, which though they are afterwards turned into Water, yet while they remain there, they are only the Matter of that Element, which may as well be Fire, or Earth, or Air.

2. Those Vapours are not above the Expansum, but in it. So that he thinks there is no other way to save all, but by making the Planets several Worlds with Sea and Land, with such Rivers and Springs as we have here below: Especially since *Esdra*s speaks of the Springs above the Firmament. But I cannot agree with him in this, nor do I think that any such thing can be proved out of Scripture.

Vide Ieron. Epist. ad Pammachium. Confession. l. 13. c. 32. Retracted lib. 2. Retr. cap. 6.

2 *Esdra*.
4. 7.

Before I proceed to the next Position, I shall first answer some Doubts which might be made against the generality of this Truth, whereby it may seem impossible that there should be either Sea or Land in the Moon: For since she moves so swiftly as Astronomers observe, why then does there nothing fall from her, or why doth she not shake something out by the celerity of her Revolution? I answer, You must know that the inclination of every heavy Body to its proper Center, doth sufficiently tie it unto its place; so that suppose any thing were separated, yet must it necessarily return again. And there is no more danger of their falling into our World, than there is fear of our falling into the Moon.

But yet there are many Fabulous Relations of such Things as have dropped thence. There is a Tale of the *Nemean* Lyon that *Hercules*'slew, which first rushing among the Herds-out of his unknown Den in

Vide Guli. Nubigenf. de rebus Anglica. lib. 1.

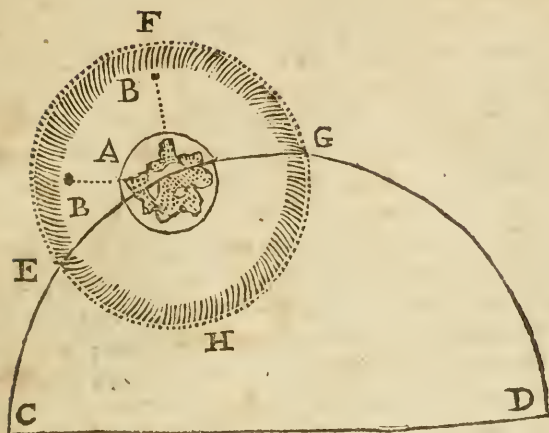
the Mountain of *Cytheron* in *Bœotia*, the Credulous People thought he was sent from their Goddess the Moon. And if a Whirlwind did chance to snatch any thing up, and afterwards rain it down again, the ignorant Multitude were apt to believe that it dropt from Heaven. Thus *Avicenna* relates the Story of a Calf which fell down in a Storm, the Beholders thinking it a Moon-Calf, and that it fell thence. So *Cardan* travelling upon the *Apennine* Mountains, a sudden Blast took off his Hat, which if it had been carried far, he thinks the Peasants, who had perceived it to fall, would have sworn it had rained Hats. After some such manner many of our Prodigies come to pass, and the People are willing to believe any thing which they may relate to others as a very strange and wonderful Event. I doubt not but the *Trojan Palladium*, the *Roman Minerva*, and our Lady's Church at *Loretto*, with many Sacred Relicks preserv'd by the *Papists*, might drop from the Moon as well as any of these.

But it may be again objected, Suppose there were a Bullet shot up in that World, would not the Moon run away from it before it could fall down, since the Motion of her Body (being every Day round our Earth) is far swifter than the other, and so the Bullet must be left behind, and at length fall down to us? To this I answer,

1. If a Bullet could be shot so far till it came to the Circumference of those Things which belong to our Center, then it would fall down to us.

2. Though there were some heavy Body a great Height in that Air, yet would the Motion of that Magnetical Globe to which it did belong, by an attractive Virtue still hold it within its convenient distance, so that whether their Earth moved or stood still, yet would the same Violence cast a Body from it equally far. That I may the plainer express my Meaning, I will set down this Diagram.

Suppose



Suppose this Earth were A, which was to move in the Circle C, D, and let the Bullet be supposed at B, within its proper Verge ; I say, whether this Earth did stand still, or move swiftly towards D, yet the Bullet would still keep at the same distance, by reason of that Magnetick Virtue of the Center (if I may so speak) whereby all Things within its Sphere are attracted with it. So that the violence to the Bullet, being nothing else but that whereby 'tis removed from its Center, therefore an equal Violence can carry a Body from its proper Place but at an equal distance, whether or no this Earth where its Center is, does stand still or move.

The Impartial Reader may find sufficient satisfaction for this and such other Arguments as may be urged against the Motion of that Earth, in the Writings of *Copernicus* and his Followers ; unto whom, for brevity sake, I will refer them.

P R O P. IX.

That there are High Mountains, Deep Vallies,
and Spacious Plains in the Body of the
Moon.

THough there are some who think Mountains to be a deformity to the Earth, as if they were either beat up by the Flood, or else cast up like so many Heaps of Rubbish left at the Creation; yet if well considered, they will be found as much to conduce to the Beauty and Conveniency of the Universe, as any of the other Parts. Nature (saith *Pliny*) purposely framed them for many excellent uses; partly to tame the Violence of greater Rivers, to strengthen certain Joints within the Veins and Bowels of the Earth, to break the Force of the Seas Inundation, and for the safety of the Earth's Inhabitants, whether Beasts or Men. That they make much for the protection of Beasts, the Psalmist testifies; *The highest Hills are a refuge for the Wild Goats, and the Rocks for Conies.* The Kingly Prophet had likewise learned the safety of these by his own experience, when he also was fain to make a Mountain his Refuge from the Fury of his Master *Saul*, who persecuted him in the Wilderness.

True indeed, such Places as these keep their Neighbours poor, as being most barren, but yet they preserve them safe, as being most strong; witness our unconquered *Wales* and *Scotland*, whose greatest Protection hath been the natural Strength of their Country; so fortify'd with Mountains, that these have always been unto them sure Retreats from the Violence and Oppression of others. Wherefore a good Author doth rightly call them Nature's Bulwarks, cast

Nat. Hist.
l. 36. c. 9.

Psal. 104.
v. 18.

up at God Almighty's own Charges, the Scorns and Curbs of Victorious Armies. Which made the *Barbarians* in *Curtius* so confident of their own Safety, when they were once retired to an inaccessible Mountain; that when *Alexander's* Legate had brought them to a Parley, and perswading them to yield, told them of his Master's Victories, what Seas and Wildernesses he had passed; They replied, that all that might be, but could *Alexander* fly too? Over the Seas he might have Ships, and over the Land Horses, but he must have Wings before he could get up thither. Such Safety did those barbarous Nations conceive in the Mountains whereunto they were retired. Certainly then such useful Parts were not the Effect of Man's Sin, or produced by the World's Curse, the Flood; but rather at the first created by the Goodness and Providence of the Almighty.

This Truth is usually concluded from these and the like Arguments.

1. Because the Scripture it self, in the Description of that general Deluge, tells us, it overflowed the highest Mountains.

2. Because *Moses* who writ long after the Flood, does yet give the same Description of Places and Rivers, as they had before; which could not well have been if this had made so strange an Alteration.

3. 'Tis evident that the Trees did stand as before. For otherwise, *Noah* could not so well have concluded, that the Waters were abated, from this Reason, because the Dove brought an Olive Leaf in her Mouth, when she was sent forth the Second Time: Whereas had the Trees been rooted up, she might have taken it the First Time, from one of them as it was floating on the Top of the Waters. Now if the Motion of the Water was not so violent as to subvert the Trees, much less was it able to cast up such vast Heaps as the Mountains.

4. When the Scripture doth set forth unto us the

Power and Immensity of God by the Variety or Usefulness of the Creatures which he hath made ; amongst the rest it doth often mention the Mountains. *Psal.* 104. 8. *item*, 148. 9. *Isa.* 40. 12. And therefore 'tis probable they were created at the first. Unto this I might add that in other Places, Divine Wisdom in shewing of its own Antiquity, saith that he was from the beginning, before the earth or the mountains were brought forth.

Prov. 8.
25.
Psal. 90. 2.

Gen. 1. 1.
cap. 3.

5 If we may trust the Relations of Antiquity, there were many Monuments left undefaced after the Flood.

So that if I intend to prove that the Moon is such a habitable World as this is ; 'tis requisite that I shew it to have the same Conveniences of Habitation as this hath. And here if some *Rabbi* or *Chymick* were to handle the Point, they would first prove it out of Scripture, from that Place in *Moses* his Blessing, where he speaks of the Ancient Mountains and lasting Hills, *Deut.* 33. *הריקרא וגבעות עולם* for having immediately before mentioned those Blessings which should happen unto *Joseph* by the Influence of the Moon, he does presently exegetically iterate them, in blessing him with the chief things of the ancient Mountains and lasting Hills ; you may also see the same Expression used in *Jacob's* Blessing of *Joseph*.

Gen. 49.
26.

But however we may deal *pro* or *con* in Philosophy, yet we must not be too bold with Divine Truths, or bring Scripture to patronize any Fancy of our own ; though, (perhaps) it be a Truth. I am not of their Mind, who think it a good Course to confirm Philosophical Secrets from the Letter of the Scripture, or by abusing some obscure Text in it. Methinks it favours too much of that Melancholly Humor of the *Chymicks*, who, aiming in all their Studies at the making of Gold, do persuade themselves, that the most Learned and Subtile of the Ancient Authors, in all

all their obscure Places do mean some such Sense as may make to their Purpose. And hence it is that they derive such strange Mysteries from the Fables of the Poets ; and can tell you what great Secret it was, that Antiquity did hide under the Fiction of *Jupiter* being turned into a Shower of Gold : Of *Mercury's* being made the Interpreter of the Gods : Of the *Moon's* descending to the Earth for the Love of *Endymion* : With such ridiculous Interpretations of these and the like Fables, which any reasonable considering Man cannot conceive to proceed from any but such as are distracted. No less fantastical in this kind are the *Jewish Rabbies* ; amongst whom, is not any Opinion, whether in Nature or Policy, whether true or false, but some of them, by a Cabalistical Interpretation can father it upon a dark Place of Scripture, or (if need be) upon a Text that is clean contrary. There being not any Absurdity so gross and incredible, for which these Abusers of the Text, will not find out an Argument. Whereas, 'tis the more natural Way, and should be observed in all Controversies, to apply unto every thing the proper Proofs of it ; and when we deal with Philosophical Truths, to keep our selves within the Bounds of Human Reason and Authority.

But this by the way. For the better Proof of this Proposition, I might here cite the Testimony of *Diodorus*, who thought the Moon to be full of rugged Places, *velut terrestribus tumulis superciliosam* ; but he erred much in some Circumstances of this Opinion, especially where he says, there is an Island amongst the *Hyperboreans*, wherein those Hills may to the Eye be plainly discovered ; and for this reason * *Cælius* calls him a fabulous Writer. But you may see more express Authority for the Proof of this in the Opinions of *Anaxagoras* and *Democritus*, who held that this Planet was full of champion Grounds, Mountains and Vallies. And this seemed likewise probable unto *Augustinus Ni-*

* *Leff. aut.*
l. 1. c. 15.

Plut. de
plac. l. 2. c.
25.

De Calo. l.
2. part. 49.

fus,

fus, whose Words are these : *Forſitan non eſt remotum dicere lunæ partes eſſe diverſas, veluti ſunt partes terræ, quarum aliæ ſunt valloſæ, aliæ montosæ, ex quarum differentia effici poteſt facies illa lunæ, nec eſt rationi diſſonum, nam luna eſt corpus imperſectè Sphæricum, cum ſit corpus ab ultimo cælo elongatum, ut ſupra dixit Ariſtoteles.* “Perhaps, it
 “ would not be amiſs to ſay that the Parts of the
 “ Moon were divers, as the Parts of this Earth, where-
 “ of ſome are Vallies, and ſome Mountains; from the
 “ Difference of which, ſome Spots in the Moon may pro-
 “ ceed; nor is this againſt Reason; for that Planet
 “ cannot be perfectly Spherical, ſince ’tis ſo remote a
 “ Body from the firſt Orb, as *Ariſtotele* had ſaid before.”

You may ſee this Truth aſſented unto by *Blancanus* the Jeſuit, and by him confirmed with divers Reaſons. *Keplar* hath obſerved in the Moon’s Eclipſes, that the Diviſion of her enlightned Part from the ſhaded, was made by a crooked unequal Line, of which there cannot be any probable Cauſe conceived, unleſs it did ariſe from the Ruggedneſs of that Planet; for it cannot at all be produc’d from the Shade of any Mountains here upon Earth; becauſe theſe would be ſo leſened before they could reach ſo high in a conical Shadow, that they would not be at all ſenſible unto us (as might eaſily be demonſtrated); nor can it be conceived what reaſon of this Difference there ſhould be in the Sun. Wherefore there being no other Body that hath any thing to do in Eclipſes, we muſt neceſſarily conclude, that it is cauſed by a Variety of parts in the Moon it ſelf; and what can theſe be but its Gibboſities? Now if you ſhould aſk a Reason why there ſhould be ſuch a Multitude of theſe in that Planet, the ſame *Keplar* ſhall jeſt you out an Answer. Suppoſing (ſaith he) that thoſe Inhabitants are bigger than any of us, in the ſame Proportion as their Days are longer than ours, *viz.* by Fifteen Times; it may be, for want of Stone; to erect ſuch vaſt Houſes as were requiſite for their Bodies, they are ſain to dig great and round Hol-
 lows

*De Mundi
 fab. par. 3.
 c. 4.*

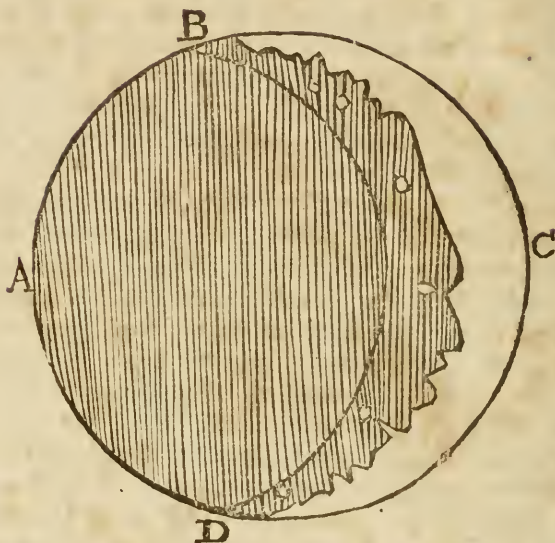
*Aſtron.
 Opt. c. 6.
 num. 9.*

lows in the Earth; where they may both procure Water for their Thirst, and turning about with the Shade, may avoid those great Heats which otherwise they would be liable unto. Or if you will give *Cæsar la Gal-la* leave to guess in the same Manner, he would rather think that those thirsty Nations cast up so many and so great Heaps of Earth in digging of their Wine Cellars; but this only by the Way.

*Rep. appen.
Selenogra.*

I shall next produce the Eye witness of *Galilæus*, on which I most of all depend for the Proof of this Proposition; when he beheld the New Moon through his Perspective, it appeared to him under a rugged and spotted Figure, seeming to have the darker and enlightened Parts divided by a tortuous Line, having some Parcels of Light at a good Distance from the other; and this Difference is so remarkable, that you may easily perceive it through one of those ordinary Perspectives, which are commonly sold amongst us; but for your better apprehending of what I deliver, I will set down the Figure as I find it in *Galilæus*.

*Nunciis
Sydereus.*



Suppose *A B C D* to represent the Appearance of the Moon's Body being in a *Sextile*, you may see some brighter Parts separated at a pretty Distance from the other, which can be nothing else but a Reflection of the Sun-beams upon some parts that are higher than the rest; and those obscure Gibbosities which stand out towards the enlightened Parts, must be such hollow and deep Places whereto the Rays cannot reach. But when the Moon is got farther off from the Sun, and come to that Fulness as this Line *B D* doth represent her under; then do these Parts also receive an equal Light, excepting only that Difference which doth appear betwixt their Sea and Land. And if you do consider how any rugged Body would appear being enlightened, you would easily conceive that it must necessarily seem under some such gibbous unequal Form, as the

the Moon is here represented. Now for the Infallibility of these Appearances, I shall refer the Reader to that which hath been said in the Sixth Proposition.

But *Cæsar la Galla* affirms, that all these Appearances may consist with a plain Superficies, if we suppose the Parts of the Body to be some of them *Diaphanous*, and some *Opacous*; and if you object that the Light which is convey'd to any Diaphanous Part in a plain Superficies, must be by a continued Line; whereas here there appear many brighter Parts among the obscure at some Distance from the rest: To this he answers, it may rise from some secret Conveyances and Channels within her Body, that do consist of a more Diaphanous Matter; which being covered over with an Opacous Superficies, the Light passing through them may break out a great way off; whereas the other Parts betwixt, may still remain dark. Just as the River *Aretheusa* in *Sicily*, which runs under Ground for a great way, and afterwards breaks out again. But, because this is one of the chiefest Fancies, whereby he thinks he hath fully answered the Argument of this Opinion, I will therefore set down his Answer in his own Words, lest the Reader might suspect more in them than I have expressed. *Non est impossibile cæcos ductus diaphani & perspicui corporis, sed opaca superficiei protendi, usque in diaphanam aliquam ex profundo in superficiem emergentem partem, per quos ductus lumen longo postmodum interstitio erumpat, &c.* But I reply, if the Superficies betwixt these two enlightened Parts remain dark because of its Opacity; then would it always be dark, and the Sun could not make it partake of Light more than it could of Perspicuity. But this contradicts all Experience, as you may see in *Galileus*, who affirms that when the Sun comes nearer to his Opposition, then that which is betwixt them both, is enlightened as well as either. Nay, this opposes his own Eye-witness; for he confesses himself that he saw this by the Glass. He had said before, that he came to see those strange
Sights

Sights discovered by *Galilæus* his Glass, with an intent of Contradiction; and you may read that confirmed in the Weakness of this Answer, which rather bewrays an obstinate, than a perswaded Will; for otherwise sure he would never have undertook to have destroyed such certain Proof with so groundless a Fancy.

That Instance of *Galilæus*, would have been a better Evasion, had this Author been acquainted with it; who might then have compared the Moon to that which we call Mother of Pearl, which though it be most exactly polished in the Superficies of it; yet will seem unto the Eye as if there were divers swellings and risings in its several Parts. But yet, this neither would not well have shifted the Experiment of the Perspective. For these rugged Parts do not only appear upon one side of the Moon, but as the Sun does turn about in divers Places, so do they also cast their Shadow. When the Moon is in her Increase, then do they cast their Shadows to the *East*. When she is in the Decrease, and the Sun on the other side of her, then likewise may we discover these brighter parts casting their Shadows *Westward*. Whereas in the full Moon there are none of all these to be seen.

But it may be objected, that 'tis almost impossible, and altogether unlikely, that in the Moon there should be any Mountains so high as those Observations make them. For do but suppose according to the common Principles, that the Moon's Diameter unto the Earth's, is very near to the Proportion of Two to Seven. Suppose withal that the Earth's Diameter contains about 7000 *Italian Miles*, and the Moon's 2000 (as is commonly granted.) Now *Galilæus* hath observed, that some parts have been enlightned, when they were the Twentieth Part of the Diameter distant from the common Term of Illumination. From whence it must necessarily follow, that there may be some Mountains in the Moon so high, that they are able to cast a Shadow

dow a Hundred Miles off. An Opinion that sounds like a Prodigy or a Fiction; wherefore 'tis likely that either those Appearances are caused by somewhat else besides Mountains, or else those are fallible Observations; from whence may follow such improbable, inconceivable Consequences.

But to this I answer;

1. You must consider the height of the Mountains is but very little, if you compare them to the length of their Shadows. Sir *Walter Rawleigh* observe that the Mount *Atbos*, now called *Lacas*, casts its Shadow 300 Furlongs, which is above 37 Miles; and yet that Mount is none of the highest. Nay *Solinus* (whom I should rather believe in this kind) affirms that this Mountain gives his Shadow quite over the Sea, from *Macedon* to the Isle of *Lemnos*, which is 700 Furlongs, or 84 Miles, and yet according to the common reckoning it doth scarce reach 4 Miles upwards in its perpendicular height.

*Hist. l. i.
cap. 7.
sect. 11.*

*Poly. Hist.
c. 21.*

2. I affirm that there are very high Mountains in the Moon. *Keplar* and *Galilæus* think that they are higher than any which are upon our Earth. But I am not of their Opinion in this, because I suppose they go upon a false Ground, whilst they conceive that the highest Mountain upon the Earth is not above a Mile perpendicular.

Whereas 'tis the Common Opinion, and found true enough by observation, that *Olympus*, *Atlas*, *Taurus* and *Emus*, with many others, are much above this height. *Tenariffa* in the *Canary Islands*, is commonly related to be above 8 Miles perpendicular, and about this height (say some) is the Mount *Perjacaca* in *America*. * Sir *Walter Rawleigh* seems to think that the highest of these is near 30 Miles upright: Nay *Aristotle* speaking of *Caucasus* in *Asia*, affirms it to be visible for 560 Miles, as some Interpreters find by computation; from which it will follow, that it was 78 Miles perpendicularly high; as you may see confirmed by

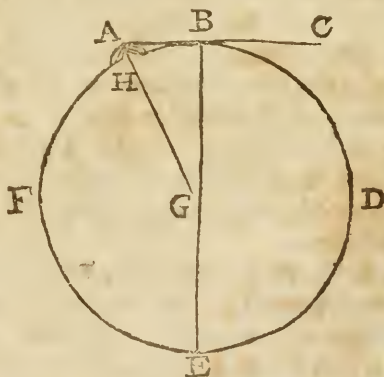
* *Hist. l. i.
c. 7. sect.
11. Meteor.
l. 1. c. 11.*

Jacobs

Comparatio Arist.
cum. Platone, sect. 3.
c. 5.
Exposit. in
loc. Math.
Arist. loc.
148.

Jacobus Mazonius, and out of him in *Blancanus* the Jesuit. But this deviates from the Truth more in excess than the other doth in defect. However, though these in the Moon are not so high as some amongst us; yet certain it is they are of a great height, and some of them at the least four Miles perpendicular. This I shall prove from the observation of *Galileus*, whose Glass can shew to the Senses a Proof beyond exception; and certainly that Man must needs be of a most timorous Faith, who dares not believe his own Eye.

By that Perspective you may plainly discern some enlightened Parts (which are the Mountains) to be distant from the other about the twentieth part of the Diameter. From whence it will follow; that those Mountains must necessarily be at the least four *Italian* Miles in height.



For let B D E F be the Body of the Moon, A B C will be a Ray or Beam of the Sun, which enlightens a Mountain at A, and B is the Point of Contingency; the distance betwixt A and B must be supposed to be the twentieth part of the Diameter, which is an 100 Miles, for so far are some enlightened Parts severed from the common Term of Illumination.

Now

Now the Aggregate of the Quadrate from A B a hundred, and B G 1000 will be 1010000 ; unto which the Quadrate arising from A G must be equal ; according to the 47th Proposition in the First Book of Elements. Therefore the whole Line A G is somewhat more than 104', and the distance betwixt H A must be above 4 Miles, which was the Thing to be proved.

But it may be again objected, If there be such rugged Parts, and so high Mountains, why then cannot we discern them at this distance? Why doth the Moon appear unto us so exactly round, and not rather as a Wheel with Teeth?

I answer, by reason of too great a distance ; for if the whole Body appear to our Eye so little, then those Parts which bear so small a proportion to the whole, will not at all be sensible.

But it may be reply'd, if there were any such remarkable Hills, why does not the Limb of the Moon appear like a Wheel with Teeth, to those who look upon it through the great Perspective, on whose Witness you so much depend? Or what Reason is there that she appears as exactly round through it, as she doth to the bare Eye? Certainly then either there is no such thing as you imagine, or else the Glass fails much in this Discovery.

To this I shall answer out of *Galileus*.

1. You must know, that there is not merely one Rank of Mountains above the edge of the Moon, but divers Orders, one Mountain behind another, and so there is somewhat to hinder those void spaces which otherwise, perhaps, might appear.

Now, where there be many Hills, the Ground seems even to a Man that can see the tops of all. Thus when the Sea rages, and many vast Waves are lifted up, yet all may appear plain enough to one that stands at the Shore. So where there are so many Hills, the
G inequality

inequality will be less remarkable, if it be discerned at a distance.

2. Though there be Mountains in that Part which appears unto us to be the Limb of the Moon, as well as in any other Place, yet the bright Vapours hide their appearance; For there is an Orb of thick vaporous Air that doth immediately compass the Body of the Moon; which though it have not so great opacity, as to terminate the Sight, yet being once enlightned by the Sun, it doth represent the Body of the Moon under a greater Form, and hinders our Sight from a distinct View of her true Circumference. But of this in the next Chapter.

Sonn. Astr.
not. 207.

3. *Keplar* hath observed, That in the Solary Eclipses, when the Rays may pass through this Vaporous Air, there are some Gibbosities to be discerned in the Limb of the Moon.

I have now sufficiently proved, that there are Hills in the Moon; and hence it may seem likely that there is also a World: For since Providence hath some special End in all its Works, certainly then these Mountains were not produced in vain; and what more probable Meaning can we conceive there should be, than to make that Place convenient for habitation.

P R O P. X.

That there is an Atmo-sphæra, or an Orb of Gross, Vaporous Air immediately encompassing the Body of the Moon.

AS that Part of our Air which is nearest to the Earth is of a thicker Substance than the other, by reason 'tis always mixed with some Vapours which
are

are continually exhaled into it: So is it equally requisite, that if there be a World in the Moon, that the Air about that should be alike qualify'd with ours. Now that there is such an Orb of Gross Air, was first of all (for ought I can read) observed by *Meslin*, afterwards assented unto by *Keplar* and *Galilæus*, and since by *Baptista Cittacus*, *Scheiner*, with others, all of them confirming it by the same Arguments; which I shall only cite, and then leave this Proposition.

Vide Euseb. Nicem. de Nat. Hist. l. 2. c. 11.

I. 'Tis not improbable that there should be a Sphere of Grosser Air about the Moon; because 'tis observ'd that there are such kind of Evaporations which proceed from the Sun it self. For there are discovered divers moveable Spots, like Clouds, that do encompass his Body; which those Authors who have been most frequently versed in these kind of Experiments and Studies, do conclude to be nothing else but Evaporations from it. The probability and truth of which Observations may also be inferred from some other Appearances. As,

I. It hath been observed that the Sun hath sometimes for the space of four Days together, appear'd as dull and ruddy almost as the Moon in her Eclipses; infomuch that the Stars have been seen at Mid-day. Nay, he hath been constantly darkned for almost a whole Year, and never shined but with a kind of heavy and dusky Light, so that there was scarce Heat enough to ripen the Fruits. As it was about the Time when *Cæsar* was killed. Which was recorded by some of the Poets. Thus *Virgil*, speaking of the Sun.

So A. D. 1547. April 24. to the 28.

*Ille etiam extincto miseratus Cæsare Romam,
Cum caput obscura nitidum ferrugine texit,
Impiaq; æternam timuerunt sæcula Noctem.*

Virgil, Georg. l. 1.

*He pitying Rome when as Great Cæsar dy'd,
His Head within a Mourning Vail did hide.*

That the Moon may be a World.

And thus the Wicked Guilty World did fright
With doubtful Fears of an Eternal Night.

Ovid likewise speaking of his Death,

Metam. lib.
15.

——— Solis quoque tristis imago
Luida sell. cunctis præbebat lumina terris.

——— The Sun's sad Image then
Did yield a lowering Light to fearful Men.

Now these Appearances could not arise from any lower Vapour: For then, 1. They would not have been so universal as they were, being seen through all Europe: Or else, 2. That Vapour must have covered the Stars as well as the Sun, which yet notwithstanding were then plainly discerned in the Day time. You may see this Argument illustrated in another the like Case, Chap. 12. Hence then it will follow, that this fuliginous Matter, which did thus obscure the Sun, must needs be very near his Body; and if so, then what can we more probably guess it to be than Evaporations from it?

2. 'Tis observed, that in the Sun's total Eclipses, when there is no part of his Body discernible, yet there does not always follow so great a Darkness as might be expected from his total absence. Now 'tis probable that the Reason is, because these thicker Vapours being enlightened by his Beams, do convey some Light unto us, notwithstanding the interposition of the Moon betwixt his Body and our Earth.

3. This likewise is by some guess'd to be the reason of the *crepusculum*, or that Light which we have before the Sun's rising.

Now if there be such Evaporations from the Sun, much more then from the Moon, which does consist of a more gross and impure substance. The other

Arguments

Arguments are taken from several Observations in the Moon her self, and do more directly tend to the proof of this Proposition.

2. 'Tis observed, that so much of the Moon as is enlightened, is always part of a bigger Circle than that which is darker. The frequent Experience of others hath proved this, and an easy Observation may quickly confirm it. But now this cannot proceed from any other Cause so probable as from this Orb of Air; especially when we consider how that Planet shining with a borrowed Light, doth not send forth any such Rays as may make her Appearance bigger than her Body.

3. When the Moon being half enlightened, begins to cover any Star, if the Star be towards the obscurer Part, then may it by the perspective be discerned to be nearer unto the Center of the Moon than the outward Circumference of the enlightened part. But the Moon being in the Full, then does it seem to receive these Stars without its Limb.

4. Though the Moon do sometime appear the first Day of her Change, when so much as appears enlightened cannot be above the 80th part of her diameter, yet then will the Horns seem at least to be of a Finger's breadth in extension; which could not be, unless the Air about it were illuminated.

5. 'Tis observed in the Solary Eclipses, that there is sometimes a great trepidation about the Body of the Moon, from which we may likewise argue an Atmosphæra, since we cannot well conceive what so probable a Cause there should be of such an appearance as this, *Quod radius Solares à vaporibus Lunam ambientibus fuerint intercisi*, that the Sun-beams were broken and refracted by the Vapours that encompassed the Moon.

*Scheiner.
Ros. Urs.
l. 4. part.
2. c. 27.*

6. I may add the like Argument taken from another Observation which will be easily try'd and granted. When the Sun is eclipsed, we discern the Moon as she is in her own natural bigness; but then she ap-

pears somewhat less than when she is in the Full, tho' she be in the same place of her supposed Excentrick and Epicycle ; and therefore *Tycho* hath calculated a Table for the Diameter of the divers New Moons. But now there is no reason so probable to solve this Appearance, as to place an Orb of thicker Air near the Body of that Planet, which may be enlightned by the reflected Beams, and through which the direct Rays may easily penetrate.

But some may object, That this will not consist with that which was before delivered, where I said, that the thinnest parts had least Light.

If this were true, how comes it to pass then that this Air should be as light as any of the other Parts, when as 'tis the thinnest of all?

I answer, If the Light be received by Reflection only, then the thickest Body hath most, because it is best able to beat back the Rays ; but if the Light be received by Illumination (especially if there be an Opaque Body behind, which may double the Beams by reflexion) as it is here, then I deny not but a thin Body may retain much Light ; and perhaps some of those Appearances which we take for Fiery Comets, are nothing else but a Bright Cloud enlightned ; so that probable it is there may be such Air without the Moon : And hence it comes to pass, that the greater Spots are only visible towards her middle Parts, and none near the Circumference ; not but that there are some as well in those Parts as elsewhere, but they are not there perceivable, by reason of those brighter Vapours which hide them.

P R O P. XI.

That as their World is our Moon, so our World is their Moon.

I Have already handled the first thing that I promised, according to the Method which *Aristotle* uses in his Book *De Mundo*; and shew'd you the necessary Parts that belong to this World in the Moon. In the next Place 'tis requisite that I proceed to those things which are extrinsical unto it, as the Seasons, the Meteors, and the Inhabitants.

1. Of the Seasons;

And if there be such a World in the Moon, 'tis requisite then that their Seasons should be some way correspondent unto ours, that they should have Winter and Summer, Night and Day, as we have.

Now that in this Planet there is some Similitude of Winter and Summer, is affirmed by *Aristotle* himself; since there is one Hemisphere that hath always Heat and Light, and the other that hath Darknes and Cold. True indeed, their Days and Years are always of one and the same Length; (unless we make one of their Years to be 19 of ours, in which Space all the Stars do arise after the same Order.) But 'tis so with us also under the Poles, and therefore that great difference is not sufficient to make it altogether unlike ours; nor can we expect that every thing there should be in the same Manner as it is here below, as if Nature had no way but one to bring about her purposes. We have no Reason then to think it necessary that both these Worlds should be altogether alike; but it may suffice if they be correspondent in something only. However, it may be questioned whether it doth not seem to be against the Wisdom of Providence, to make the Night of so great a Length, when they have such a

*Degen. anim.
mg. l. 4. 12.*

Golden
Number.

long time unfit for Work? I answer, no; since 'tis so, and more with us also under the Poles; and besides, the general Length of their Night is somewhat abated in the Bigness of their Moon, which is our Earth. For this returns as great a Light unto that Planet, as it receives from it. But for the better Proof of this, I shall first free the Way from such Opinions as might otherwise hinder the Speed of a clearer Progress.

Plutarch one of the chief Patrons of this World in the Moon, doth directly contradict this Proposition; affirming, that those who live there, may discern our World, as the Dregs and Sediment of all other Creatures; appearing to them through Clouds and foggy Mists, and that altogether devoid of Light, being base and unmoveable; so that they might well imagine the dark Place of Damnation to be here situate, and that they only were the Inhabiters of the World, as being in the midst betwixt Heaven and Hell.

To this I may answer, 'tis probable that *Plutarch* spake this inconsiderately, and without a Reason; which makes him likewise fall into another Absurdity, when he says our Earth would appear immoveable; whereas questionless, though it did not, yet would it seem to move, and theirs to stand still, as the Land doth to a Man in a Ship; according to that of the Poet:

Provehimur portu, terræque, urbesque recedunt.

And I doubt not but that Ingenious Author would easily have recanted, if he had been but acquainted with those Experiences which Men of later Times have found out, for the Confirmation of this Truth.

2. Unto him assents *Macrobius*, whose Words are these; *Terra accepto solis lumine clarescit tantummodo, non relucet.* "The Earth is by the Sun-beams made bright, "but not able to enlighten any thing so far." And his Reason is, because this being of a thick and gross Matter, the Light is terminated in its Superficies, and cannot penetrate into the Substance; whereas the

Moon

*Plut. de
fac. lunæ.*

*Somn. Scip.
l. 1. c. 19.*

Moon doth therefore seem so bright to us, because it receives the Beams within it self. But the Weakness of this Assertion, may be easily manifest by a common Experience; for polished Steel (whose Opacity will not give any Admittance to the Rays) reflects a stronger Heat than Glass, and so consequently a greater Light.

3. 'Tis the general Consent of Philosophers, that the Reflection of the Sun-beams from the Earth doth not reach much above half a Mile high, where they terminate the first Region; so that to affirm they might ascend to the Moon, were to say, there were but one Region of Air, which contradicts the proved and received Opinion.

Unto this it may be answered:

That it is indeed the common Consent, that the Reflexion of the Sun-beams reach only to the second Region; but yet some there are, and those too, Philosophers of good Note, who thought otherwise. Thus Plotinus is cited by Cælius, *Si concipias te in sublime quopiam mundi loco, unde oculus subjiciatur terræ moles aquis circumfusa, & solis syderumque radiis illustrata, non aliam profecto visam iri probabile est, quam qualis modo visatur lunaris globi species.* "If you conceive your self to be
 "in some such high Place, where you might discern
 "the whole Globe of the Earth and Water, when it
 "was enlightned by the Suns Rays, 'tis probable it
 "would then appear to you in the same shape as the
 "Moon doth now unto us." So Paulus Foscarinus. *Terra nihil aliud est quàm altera Luna, vel Stella, talisque nobis appareret, si ex convenienti elongatione eminens conspiceretur, in ipsaque observari possent eadem aspectuum varietates, quæ in Luna apparent.* "The Earth is nothing else
 "but another Moon or Star, and would appear so un-
 "to us if it were beheld at a convenient distance with
 "the same Changes and Varieties as there are in the
 "Moon." Thus also Carolus Malaperthus, whose Words are these: *Terra hæc nostra, si in luna constituti essemus,*
splen-

Ant. lect.
l. 1. c. 4.

In ep. ad
Sebastianum
romum.

Præfat. ad Austriaca Syd. *splendida prorsus quasi non ignobilis planeta, nobis appareret.*
 “If we were placed in the Moon, and from thence
 “beheld this our Earth, it would appear unto us very
 “bright, like one of the nobler Planets.” Unto
Meteor. I. I. c. 2. art. 2. these doth *Fromondus* assent, when he says, *Credo equidem quod si oculus quispiam in orbe lunari foret, globum terræ & aquæ instar ingentis syderis à sole illustrem conspiceret.*
 “I believe that this Globe of Earth and Water would
 “appear like some great Star to any one, who should
 “look upon it from the Moon.” Now this could
 not be, nor could it shine so remarkably, unless the
 Beams of Light were reflected from it. And therefore
 the same *Fromondus* expressly holds, that the first Region
 of Air is there terminated, where the Heat caused by
 Reflexion begins to languish, whereas the Beams them-
 selves do pass a great way further. The chief Argu-
 ment which doth most plainly manifest this Truth, is
 taken from a common Observation which may be easily
 tried.

If you behold the Moon a little before or after the
 Conjunction, when she is in a *Sextile* with the Sun, you
 may discern not only the part which is enlightned, but
 the rest also to have in it a kind of a dusky Light ;
 but if you chuse out such a Situation, where some
 House or Chimney (being some Seventy or Eighty
 Paces distant from you) may hide from your Eye the
 enlightned Horns, you may then discern a greater
 and more remarkable shining in those parts unto which
 the Sun-beams cannot reach ; nay, there is so great
 a Light, that by the Help of a good Perspective you
 may discern its Spots. In so much that *Blancanus* the
Jesuit speaking of it, says, *Hæc experientia ita me aliquando fefellit, ut in hunc fulgorem casu ac repente incidens, existimarim novo quodam miraculo tempore adolescentis lunæ factum esse plenilunium.* “This Experiment did once so de-
 “ceive me, that happening upon the Sight of this
 “Brightness upon a sudden, I thought that by some
 “New Miracle the Moon had been got into her Full
 “a little after her Change. But

But now this Light is not proper to the Moon; it doth not proceed from the Rays of the Sun which doth penetrate her Body, nor is it caused by any other of the Planets and Stars. Therefore it must necessarily follow, that it comes from the Earth. The two first of these I have already proved, and as for the last, it is confidently affirmed by *Cælius*, *Quod si in disquisitionem evocet quis, an lunari syderi lucem fœnerent planetæ item alii, asseverantur astruendum non fœnerare.* "If any should ask whether the other Planets lend any Light to the Moon? I answer, they do not." True indeed, the Noble *Tycho* discussing the Reason of this Light, attributes it to the Planet *Venus*; and I grant that this may convey some Light to the Moon; but that it is not the Cause of this whereof we now discourse, is of it self sufficiently plain; because *Venus* is sometimes over the Moon, when as she cannot convey any Light to that part which is turned from her.

Ant. Lect.
l. 20. c. 5.

Progym. 1.

It doth not proceed from the fixed Stars; for then it would retain the same Light in Eclipses, whereas the Light at such times is more ruddy and dull. Then also the Light of the Moon would not be greater or lesser, according to its distance from the Edge of the Earth's Shadow, since it did at all times equally participate this Light of the Stars.

In brief, this is neither proper to the Moon, nor does it proceed from any Penetration of the Sun's Rays, or the shining of *Venus*, or the other Planets, or the fixed Stars. Now because there' is no other Body in the whole Universe, save the Earth; it remains that this Light must necessarily be caused by that, which with a just Gratitude repays to the Moon such Illumination as it receives from her.

And as loving Friends equally participate of the same Joy and Grief, so do these mutually partake of the same Light from the Sun, and the same Darknels from

from the Eclipses, being also severally helped by one another in their greatest Wants: For when the Moon is in Conjunction with the Sun, and her upper part receives all the Light, then her lower Hemisphere (which would otherwise be altogether dark) is enlightened by the Reflexion of the Sun-beams from the Earth. When these two Planets are in Opposition, then that part of the Earth which could not receive any Light from the Sun-beams, is most enlightened by the Moon, being then in her Full; and as she doth most illuminate the Earth when the Sun-beams cannot, so the grateful Earth returns to her as great (nay greater) Light when she most wants it; so that always that visible part of the Moon which receives nothing from the Sun, is enlightened by the Earth, as is proved by *Galilæus*, with many more Arguments, in that Treatise which he calls *Systema Mundi*. True indeed, when the Moon comes to a *Quartile*, then you can neither discern this Light; nor yet the darker part of her Body; and that for a double Reason;

1. Because the nearer it comes to the Full, the less Light does it receive from the Earth, whose Illumination does always decrease in the same Proportion as the Moon does increase.

2. Because of the Exuberancy of the Light in the other parts. *Quippe illustratum medium speciem recipit v. l. lentiozem*, the clearer Brightness involves the weaker; it being with the Species of Sight, as it is with those of Sound; and as the greater Noise drowns the less, so the brighter Object hides that which is more obscure. But as they do always in their mutual Vicissitudes participate of one anothers Light; so also do they partake of the same Defects and Darknings; for when our Moon is eclipsed, then is their Sun darkned; and when our Sun is eclipsed, then is their Moon deprived of its Light, as you may see affirmed by *Miston*. *Quod si terram nobis ex alto liceret intueri, quemadmodum deficientem lunam ex longinquo spectare possumus, videremus tempore*

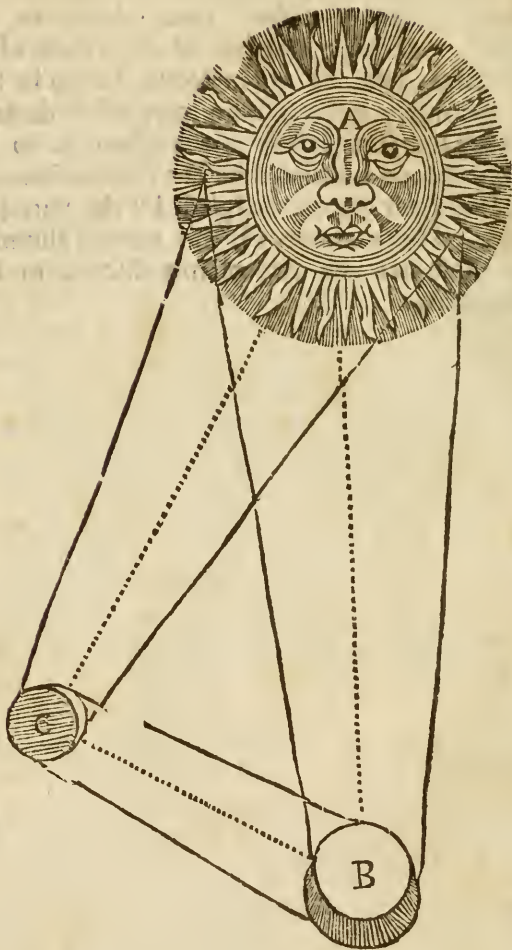
Scal. exerc.
62.

Epit. Astr.
l. 4. part. 2.

tempore

*pore eclipsis solis terræ aliquam partem lumine so-
lis deficere, eodem plane modo sicut ex opposito
luna deficit.* “If we might behold this Globe of Earth
“at the same distance as we do the Moon in her De-
“fect, we might discern some part of it darkned in
“the Sun’s Eclipses, just so as the Moon is. in hers.”
For as our Moon is eclipsed by the Interposition of our
Earth, so is their Moon eclipsed by the Interposition
of theirs. The manner of this mutual Illumination
betwixt these two you may plainly discern in this Fi-
gure following.

Where



Where *A* represents the Sun, *B* the Earth, and *C* the Moon : Now suppose the Moon *C* to be in a *Sextile* of Increase, when there is only one small part of her Body enlightened, then the Earth *B* will have such a part

a part of its visible Hemisphere darkned, as is proportionable to that part of the Moon which is enlightned; and as for so much of the Moon, as the Sun-beams cannot reach unto, it receives Light from a proportionall part of the Earth which shines upon it, as you may plainly perceive by the Figure.

You see then that Agreement and Similitude which there is betwixt our Earth and the Moon. Now the greatest difference which makes them unlike, is this, that the Moon enlightens our Earth round about, whereas our Earth gives Light only to that Hemisphere of the Moon which is visible unto us; as may be certainly gathered from the constant Appearance of the same Spots, which could not thus come to pass, if the Moon had such a diurnal Motion about its own Axis as perhaps our Earth hath. And though some suppose her to move in an Epicycle, yet this doth not so turn her Body round, that we may discern both Hemispheres; for according to that Hypothesis (say they) the Motion of her Eccentric doth turn her Face towards us, as much as the other doth from us.

But now, if any question what they do for a Moon, who live in the upper part of her Body? I answer, The solving of this, is the most uncertain and difficult thing that I know of, concerning this whole Matter. But yet unto me this seems a probable Conjecture.

That the upper Hemisphere of the Moon doth receive a sufficient Light from those Planets about it; and amongst these, *Venus* (it may be) bestows a more especial brightness, since *Galilæus* hath plainly discerned that she suffers the same Increases and Decreases, as the Moon hath; and 'tis probable that this may be perceived there, without the help of a Glass, because they are far nearer it than we. When *Venus* (saith *Keplar*) lies down in the Perige or lower part of her supposed Epicycle, then is she in Conjunction with her Husband the Sun; from whom, after she hath

hath departed for the space of ten Months, she gets *plenum uterum*, and is in the Full.

But you'll reply, Though *Venus* may bestow some Light when she is over the Moon, and in Conjunction, yet being in Opposition, she is not visible to them, and what shall they then do for Light?

I answer; Then they have none; nor doth this make so great a difference betwixt those two Hemispheres, as there is with us betwixt the Places under the Poles and the Line. And besides, 'tis considerable that there are two kind of Planets.

1. Primary; such whose proper Circle do encompass the Body of the Sun, whereof there are six; *Saturn*, *Jupiter*, *Mars*, *Ceres*, or the *Earth*, *Venus*, *Mercury*. As in the Frontispiece.

2. Secondary; such whose proper Circles are not about the Sun, but some of the other primary Planets. Thus are there two about *Saturn*, four about *Jupiter*, and thus likewise does the Moon encompass our *Earth*. Now 'tis probable that these lesser secondary Planets, are not so accommodated with all Conveniencies of Habitation, as the others that are more principal.

But it may seem a very difficult thing to conceive, how so gross and dark a Body as our *Earth*, should yield such a clear Light as proceeds from the Moon; and therefore the Cardinal *de Cusa* (who thinks every Star to be a several World) is of Opinion, that the Light of the Sun is not able to make them appear so bright; but the reason of their shining is, because we behold them at a great distance through their Regions of Fire, which do set a shining Lustre upon those Bodies that of themselves are dark. *Unde si quis esset extra regionem ignis, terra ista in circumferentia suae regionis per medium ignis lucida stella appareret.* " So that if a Man were beyond the Region of Fire, this *Earth* " would appear through that as a bright Star." But if this were the only Reason, then would the Moon

De de F. ig.
l. 2. c. 12.

be freed from such Increases and Decreases, as she is now liable unto.

Keplar thinks that our Earth receives that Light whereby it shines, from the Sun ; but this (saith he) is not such an intended clear Brightness as the Moon is capable of, and therefore he guesses that the Earth there is of a more choaky Soil, like the Isle of *Crete*, and so is better able to reflect a stronger Light ; whereas our Earth must supply this Intention with the quantity of its Body. But this I conceive to be a needless Conjecture, since our Earth (if all things were well consider'd) will be found able enough to reflect as great a Light. For,

1. Consider its Opacity ; if you mark these Sublunary things, you shall perceive that amongst them, those that are most perspicuous, are not so well able to reverberate the Sun-Beams, as the thicker Bodies. The Rays pass singly through a Diaphanous Matter, but in an Opacous Substance they are doubled in their return, and multiplied by Reflexion. Now if the Moon and the other Planets can shine so clearly by beating back the Sun-Beams, why may not the Earth also shine as well, which agrees with them in the cause of this Brightness, their Opacity ?

2. Consider what a clear Light we may discern reflected from the Earth in the midst of Summer ; and withal, conceive how much greater that must be which is under the Line, where the Rays are more directly and strongly reverberated.

3. 'Tis considerable, that though the Moon does in the Night-time seem to be of so clear a Brightness, yet when we look upon it in the Day, it appears like some little whitish Cloud : Not but that at both times, she is of an equal Light in her self. The reason of this Difference is, because in the Night we look upon it through a dark and obscure *Medium*, there being no other enlighten'd Body, whose Brightness may abate from this ; Whereas in the Day-time, the whole Hea-

vens round about it are of an equal Clearness, and so make it to appear with a weaker Light. Now because we cannot see how the enlighten'd Parts of our Earth do look in the Night, therefore in comparing it with the Moon, we must not consider her, as she is beheld through the advantage of a dark *Medium*, but as she seems in the Day-time. Now, in any clear Sun-shine Day, our Earth does appear as bright as the Moon, which at the same time does seem like some dusky Cloud (as any little Observation may easily manifest.) Therefore we need not doubt but that the Earth is as well able to give Light, as the Moon. To this it may be added, that those very Clouds, which in the Day-time seem to be of an equal Light to the Moon, do in the Evening become as dark as our Earth; and as for those of them which are looked upon at any great distance, they are often mistaken for the Mountains.

4. 'Tis considerable, that though the Moon seem to be of so great a Brightness in the Night, by reason of its nearness unto those several Shadows which it casts, yet is it of it self weaker than that part of Twilight, which usually we have for half an Hour after Sun-set, because we cannot till after that time discern any Shadow to be made by it.

5. Consider the great distance at which we behold the Planets, for this must needs add much to their Shining; and therefore *Cusanus* (in the above-cited Place) thinks that if a Man were in the Sun, that Planet would not appear so bright to him, as now it doth to us, because then his Eye could discern but little; whereas here, we may comprehend the Beams as they are contracted in a narrow Body. *Keplar* beholding the Earth from a high Mountain, when it was enlighten'd by the Sun, confesses that it appeared unto him of an incredible Brightness, whereas then he could only see some small parts of it; but how much brighter would it have appeared, if he might
in

in a direct Line behold the whole Globe of Earth and these Rays gathered together? So that if we consider that great Light which the Earth receives from the Sun in the Summer, and then suppose we were in the Moon, where we might see the whole Earth hanging in those vast Spaces, where there is nothing to terminate the Sight, but those Beams which are there contracted into a little compass; I say, if we do well consider this, we may easily conceive that our Earth appears as bright to those other Inhabitants in the Moon, as theirs doth to us.

But here it may be objected, that with us for many Days in the Year, the Heavens are so over-clouded, that we cannot see the Sun at all; and for the most part, in our brightest Days, there are many scattered Clouds which shade the Earth in sundry Places: So that in this respect, it must needs be unlike the Moon, and will not be able to yield so clear, uninterrupted a Light, as it receives from that Planet.

To this I Answer.

1. As for those lesser brighter Clouds, which for the most part are scattered up and down in the clearest Days, these can be no Reason why our Earth should be of a darker Appearance, because these Clouds being near unto the Earth, and so not distinguishable at so great a distance from it; and likewise being illuminated on their back Parts by the Sun that shines upon them, must seem as bright to those in the Moon, as if the Beams were immediately reflected from our Earth.

2. When these Clouds that are interposed, are of any large Extension, or great Opacity, as it is in extraordinary lasting and great Rains, then there must be some discernible Alteration in the Light of our Earth: But yet this does not make it to differ from the Moon, since it is so also with that Planet, as is shewed in the latter part of the next Chapter.

P R O P. XII.

That 'tis probable there may be such Meteors belonging to that World in the Moon, as there are with us.

Plutarch discussing on this Point, affirms that it is not necessary there should be the same Means of Growth and Fructifying in both these Worlds, since Nature might in her Policy find out more ways than one how to bring about the same Effect. But however, he thinks it is probable that the Moon her self sendeth forth warm Winds ; and by the swiftness of her Motion, there should breathe out a sweet and comfortable Air, pleasant Dews, and gentle Moisture, which might serve for Refreshing and Nourishment of the Inhabitants and Plants in that other World.

But since they have all things alike with us, as Sea and Land, and vaporous Air encompassing both ; I should rather therefore think, that Nature there should use the same way of producing Meteors as she doth with us ; and not by a Motion, (as *Plutarch* supposes) because she doth not love to vary from her usual Operations without some extraordinary Impediment, but still keeps her beaten Path, unless she be driven thence.

One Argument whereby I shall manifest this Truth, may be taken from those new Stars which have appeared in divers Ages of the World, and by their Parallax have been discerned to have been above the Moon ; such as was that in *Cassiopeia*, that in *Sagittarius*, with many others betwixt the Planets. *Hipparchus* in his time took especial notice of such as these, and therefore fancied out such Constellations in which to place the Stars, shewing how many there were in every Asterism ; that so afterwards, Posterity might know whether

whether there were any new Star produced, or any old one missing. Now the Nature of these Comets may probably manifest, that in this other World there are other Meteors also; for these in all likelihood, are nothing else but such Evaporations caused by the Sun from the Bodies of the Planets. I shall prove this by shewing the Improbabilities and Inconveniences of any other Opinion.

For the better pursuit of this, 'tis in the first place requisite, that I deal with our chief Adversary, *Cæsar la Galla*, who doth most directly oppose that Truth which is here to be proved. He endeavouring to confirm the Incorruptibility of the Heavens, and being there to satisfy the Argument which is taken from these Comets; He answers it thus: *Aut argumentum desumptum ex paralaxi, non est efficax, aut si est efficax, eorum instrumentorum usum decipere, vel ratione astri, vel medii, vel distantie, aut ergo erat in suprema parte aeris, aut si in cælo, tum forsan factum erat ex reflectione radiorum Saturni & Jovis, qui tunc in conjunctione fuerant.* “*Ei-*”
 “*ther the Argument from the Parallax is not efficaci-*”
 “*ous, or if it be, yet the use of the Instruments*”
 “*might deceive, either in regard of the Star, or the*”
 “*Medium, or the Distance, and so this Comet might*”
 “*be in the upper Regions of the Air; or if it were in*”
 “*the Heavens, there it might be produced by the Re-*”
 “*flexion of the Rays from Saturn and Jupiter, who*”
 “*were then in Conjunction.*” You see what Shifts he is driven to, how he runs up and down to many starting Holes that he may find some Shelter; and instead of the strength of Reason, he answers with a Multitude of Words, thinking (as the Proverb is) that he may use Hail when he hath no Thunder. *Nihil * Epist. 95. turpius (saith * Seneca) dubio & incerto, pedem modo referente, modo producente.* “*What can there be more*”
 “*unseemly in one that should be a fair Disputant,*”
 “*than to be now here, now there, and so uncertain,*”
 “*that one cannot tell where to find him? He thinks*

that there are not Comets in the Heavens, because there may be many other Reasons of such Appearances ; but what, he knows not : Perhaps (he says) that Argument from the Paralax is not sufficient ; or if it be, then there may be some Deceit in the Observation. To this I may safely say, That he may justly be accounted a weak Mathematician, who mistrusts the strength of this Argument ; nor can he know much in Astronomy, who understands not the Paralax, which is a Foundation of that Science : And I am sure that he is a timorous Man, who dares not believe the frequent Experience of his Senses, or trust to a Demonstration.

True indeed, I grant 'tis possible that the Eye, the *Medium*, and the Distance, may all deceive the Beholder ; but I would have him shew which of all these was likely to cause an Error in this Observation ? Meerly to say they might be deceived, is no sufficient Answer ; for by this I might confute the Positions of all Astronomers, and affirm the Stars are hard by us, because 'tis possible they might be deceived in their observing Distance. But I forbear any further Reply : My Opinion is of that Treatise, That either it was set forth purposely to tempt a Confutation, that he might see the Opinion of *Galilæus* confirmed by others ; or else it was Invented with as much haste and negligence as it was Printed, there being in it almost as many Faults as Lines.

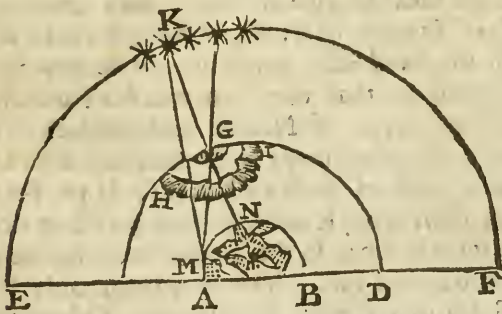
Others think that these are not any new Comets, but some ancient Stars that were there before, which now shine with that unusual Brightness, by reason of the Interposition of such Vapours, which do multiply their Light ; and so the Alteration will be here only, and not in the Heavens. Thus *Aristotle* thought the Appearance of the Milky Way was produced : For he held that there were many little Stars, which by their influence did constantly attract such a Vapour towards that place of Heaven, so that it always appeared

peared white. Now by the same Reason may a brighter Vapour be the cause of these Appearances.

But how probable soever this Opinion may seem, yet if well considered, you shall find it to be altogether absurd and impossible: For,

1. These Stars were never seen there before; and 'tis not likely that a Vapour being hard by us, can so multiply that Light which could not before be at all discerned.

2. This supposed Vapour cannot be either contracted into a narrow compass, or dilated into a broad. 1. It could not be within a little space, for then that Star would not appear with the same multiplied Light to those in other Climates. 2. It cannot be a dilated Vapour, for then other Stars which were discerned through the same Vapour, would seem as big as that. This Argument is the same in effect with that of the Parallax, as you may see in this Figure.



Suppose *AB* to be a Hemisphere of one Earth, *CD* to be the upper part of the highest Region, in which there might be either a contracted Vapour, as *G*, or else a dilated one, as *HI*. Suppose *EF* likewise to represent half the Heavens, wherein was this appear-

ing Comet at K. Now, I say, that a contracted Vapour, as G, could not cause this Appearance, because an Inhabitant at M could not discern the same Star with this brightness, but perhaps another at L, betwixt which the Vapour is directly interposed. Nor could it be caused by a dilated Vapour, as H I, because then all the Stars that were discerned through it, would be perceived with the same brightness.

'Tis necessary therefore that the Cause of this Appearance should be in the Heavens. And this is granted by the most and best Astronomers. But, say some, this doth not argue any Natural Alteration in those purer Bodies, since 'tis probable that the Concourse of many little Vagabond Stars, by the union of their Beams may cause so great a Light. Of this Opinion were *Anaxagoras* and *Zeno* amongst the Ancient, and *Baptista Csfatus*, *Blancanus*, with others amongst our Modern Astronomers. For, say they, when there happens to be a Concourse of some few Stars, then do many other fly unto them from all the parts of Heaven like so many Bees unto their King. But 1. 'Tis not likely that amongst those which we count the fixed Stars, there should be any such uncertain Motions, that they can wander from all parts of the Heavens, as if Nature had neglected them, or forgot to appoint them a determinate Course. 2. If there be such a Conflux of these, as of Bees to their King, then what Reason is there that they do not still tarry with it, that so the Comet may not be dissolv'd? But enough of this. You may commonly see it confuted by many other Arguments. Others there are, who affirm these to be some new created Stars, produced by an extraordinary Supernatural Power. I answer, True indeed, 'tis possible they might be so, but however 'tis not likely they were so, since such Appearances may be solved some other way; wherefore to fly unto a Miracle for such things, were a great injury to Nature, and to derogate from her Skill; an Indignity

Indignity much misbecoming a Man who professes himself to be a Philosopher. *Miraculum* (saith one) *est ignorantiae Asylum*; a Miracle often serves for the Receptacle of a lazy Ignorance; which any Industrious Spirit would be asham'd of; it being but an idle way to shift off the Labour of any further search. But here's the misery of it, we first tye our selves unto *Aristotle's* Principles, and then conclude that nothing could contradict them but a Miracle; whereas 'twould be much better for the Commonwealth of Learning, if we would ground our Principles rather upon the frequent Experiences of our own, than the bare Authrity of others.

Some there are who think that these Comets are nothing else but Exhalations from our Earth, carry'd up into the higher parts of the Heaven. So *Peno*, *Rothmannus* and *Galilæus*. But this is not possible, since by computation 'tis found, that one of them is above 300 times bigger than the whole Globe of Land and Water. Others therefore have thought that they did proceed from the Body of the Sun, and that that Planet only is *Cometarum officina, unde tanquam emissarii & exploratores emitterentur, brevi ad solem redituri*: The Shop or Forge of Comets, from whence they were sent, like so many Spies, that they might in some short space return again. But this cannot be, since if so much Matter had proceeded from him alone, it would have made a sensible diminution in his Body. The Noble *Tycho* therefore thinks that they consist of some such fluider parts of the Heaven, as the Milky Way is framed of, which being condens'd together, yet not attaining to the consistency of a Star, is in some space of time rarify'd again into its wonted Nature. But this is not likely, because the appearance of the Milky Way does not arise from some fluider parts of the Heaven (as he supposes) but from the Light of many lesser Stars which are thereabouts. And therefore it is usually thus described: *Via lactea*

Tycho Progym. l. c. 9.

Fromond. Meteor. l. 2. c. 5. art. 2.

nihil

Item Vestis
tract. 5.
c. 2.

nihil aliud est quam innumerabiles stellarum fixarum greges qui confuso & pallenti lumine tractum illum inalbant. The Milky Way is nothing else but the pale and confused Light of many lesser Stars, whereby some parts of the Heaven are made to appear white.

And beside, what likely cause can we conceive of this condensation, unless there be such Qualities there as there are in our Air, and then why may not the Planets have the like Qualities as our Earth? And if so, then 'tis more probable that they are made by the ordinary way of Nature, as they are with us, and consist of such Exhalations from the Bodies of the Planets, as being very much rarified, may be drawn up through the Orb of Gross Vaporous Air that encompasses them. Nor is this a singular Opinion; but it seem'd most likely to *Camillus Gloriosus*, *Th. Campanella*, *Fromondus*, with some others. But if you ask, whither shall all these Exhalations return? I answer, every one into his own Planet. If it be again objected, that then there will be so many Centers of Gravity; and each several Planet will be a distinct World: I reply, we have not like probability concerning the rest; but yet perhaps all of them are so, except the Sun, though *Cusanus* and some others, think there is one also; and later Times have discovered some lesser Clouds moving round about him. But as for *Saturn*, he hath two Moons on each side. *Jupiter* hath four, that encircle him with their Motion; which are likewise eclipsed by the interposition of his Body, as the Moon is by our Earth. *Venus* is observed to increase and decrease as the Moon. And this perhaps hath been noted by former Ages, as may be guess'd by that Relation of *St. Austin* out of *Varro*. *Mars*, and all the rest, derive their Light from the Sun. Concerning *Mercury*, there hath been little or no observation, because, for the most part, he lies hid under the Sun-beams, and seldom appears by himself. But when he does, yet the Compass of his Body is so little,

De Comet.
l. 5. c. 4.
Apol. pro
Galil.
Meteor. l. 3.
c. 2. Art. 6.

LaFont.
Inst. l. 3.
c. 23.

De Grav.
De l. 21.
c. 8.

tle, and his Light of so clear a brightness, by reason of his nearness to the Sun, that the Perspective cannot make the same discoveries upon him, as from the rest.

So that if you consider their Quantity, their Opacity, or these others Discoveries, you shall find it probable enough, that each of them may be a several World. Especially since every one of them is allotted to a several Orb, and not altogether in one, as the fixed Stars seem to be. But this would be too much for to vent at the first: The chief thing at which I now aim in this Discourse, is to prove that there may be one in the Moon.

It hath been before confirmed, that there was a Sphere of Thick Vaporous Air encompassing the Moon, as the first and second Regions do this Earth. I have now shew'd, that thence such Exhalations may proceed as do produce the Comets: Now from hence it may probably follow, that there may be Wind also and Rain, with such other Meteors as are common amongst us. This consequence is so dependant, that *Fromondus* dares not deny it, though he would (as he confesses himself;) for if the Sun be able to exhale from them such Fumes as may cause Comets, why not then such as may cause Winds, and why not such also as may cause Rain, since I have above shewed, that there is Sea and Land, as with us? Now Rain seems to be more especially requisite for them, since it may allay the Heat and Scorchings of the Sun when he is over their Heads. And Nature hath thus provided for those in *Peru*, with the other Inhabitants under the Line.

De Meteor.
l. 3. c. 2.
Art. 6.

But if there be such great and frequent Alterations in the Heavens, why cannot we discern them?

I answer:

1. There may be such, and we not able to perceive them, because of the weakness of our Eye, and the distance of those Places from us; they are the Words
of

of *Fienus* (as they are quoted by *Fromondus* in the above-cited Place) *Possunt maximæ permutaciones in cælo fieri, etiamsi a nobis non conspiciantur; hoc visus nostri debilitas & immensa cæli distantia faciunt.* And unto him assents *Fromondus* himself, when a little after he says, *Si in sphaeris Planetarum digeremus, plurima forsan cælestium nebularum vellerà toto æthere passim dispersa videremus, quorum species jam evanescit nimia spatii intercapedine.* “ If
 “ we did live in the Spheres of the Planets, we might
 “ there perhaps discern many great Clouds dispersed
 “ through the whole Heavens, which are not now
 “ visible by reason of this great distance.

2. *Mæslin* and *Keplar* affirm, That they have seen

*Dissert. 2.
 cum nunc.
 Galil.
 item Sonn.
 Astron.
 nota ultimi.*

some of these Alterations. The Words of *Mæslin* are these (as I find them cited.) *In eclipsi Lunari vespere Dominicæ Palmarum Anni 1605. In corpore Lunæ versus Boream, nigricans quædam macula conspecta fuit, obscurior cætero toto corpore, quod candentis ferri figuram repræsentabat; dixisset nubila in multam regionem extensa pluvii & tempestuosis imbribus gravida, cujusmodi ab excelsorum montium jugis in humilia convallium loca videre non raro contingit.* “ In that Lunary Eclipse which happened in
 “ the Even of *Palm-Sunday*, in the Year 1605, there
 “ was a certain blackish Spot discerned in the Norther-
 “ ly part of the Moon, being darker than any other
 “ place of her Body, and representing the Colour of
 “ red hot Iron; you might conjecture that it was
 “ some dilated Cloud, being pregnant with Showers;
 “ for thus do such lower Clouds appear from the tops
 “ of high Mountains.

And a little before this Passage, the same Author speaking of that Vaporous Air about the Moon, tells us; *Quod circumflans ille splendor diversis temporibus apparet limpidiôr plus minusve.* That it does at divers times appear of a different clearness, sometimes more, and sometimes less; which he guesses to arise from the Clouds and Vapours that are in it.

Unto this I may add another Testimony of *Bapt. Cifatus*, as he is quoted by *Nierembergius*, grounded upon an Observation taken 23 Years after this of *Mæslin*, and writ to this *Euseb. Nieremberg.* in a Letter by that diligent and judicious Astronomer. The Words of it run thus; *Et quidem in Eclipsi nupera solari quæ fuit ipso die natali Christi, observari clarè in luna soli supposita, quidpiam quod valde probat id ipsum quod Cometæ quoq; & maculæ solares urgent, nempe cælum non esse à tenuitate & variationibus aeris exemptum; nam circa lunam adverti esse sphaeram seu orbem quendam vaporosum, non secus atque circum terram, adeoq; sicut ex terra in aliquam usque sphaeram vapores & exhalationes expirant, ita quoque ex luna.* “In that late Solary Eclipse which happen’d on *Christmas-day*, when the Moon was just under the Sun, I plainly discerned that in her which may clearly confirm what the Comet’s and Sun’s Spots do seem to prove, *viz.* That the Heavens are not so solid, nor freed from those Changes which our Air is liable unto; for about the Moon I perceived such an Orb, or Vaporosus Air as that is which doth encompass our Earth; and as Vapours and Exhalations are raised from our Earth into this Air, so are they also from the Moon.

Histor. nat.
l. 2. c. 11.

You see what probable Grounds, and plain Testimonies I have brought for the confirmation of this Proposition: Many other Things in this behalf might be spoken, which for brevity sake I now omit, and pass unto the next.

PROP.

P R O P. XIII.

That 'tis probable there may be Inhabitants in this other World; but of what kind they are, is uncertain.

I Have already handled the Seasons, and Meteors belonging to this New World: 'Tis requisite that in the next Place I should come unto the third Thing which I promised, and say somewhat of the Inhabitants: Concerning whom there might be many difficult Questions raised; as, whether that Place be more inconvenient for Habitation than our World (as *Keplar* thinks;) whether they are the Seed of *Adam*; whether they are there in a Blessed Estate, or else what means there may be for their Salvation? With many other such uncertain Enquiries, which I shall willingly omit; Leaving it to their Examination who have more Leisure and Learning for the Search of such particulars.

Being for mine one Part content only to set down such Notes belonging unto these, which I have observed in other Writers. *Cum tota illa regio nobis ignota sit, remanent inhabitatores illi ignoti penitus* (saith *Cusanus*;) since we know not the Regions of that Place, we must be altogether ignorant of the Inhabitants. There hath not yet been any such Discovery concerning these, upon which we may build a Certainty, or good Probability: Well may we guess at them, and that too very doubtfully, but we can know nothing; for, if we do hardly guess aright at things which be upon Earth, if with labour we do find the things that are at hand, how then can we search out those things that are in Heaven? What a little is that which we know, in respect of those many Matters contained within this great Universe? This whole Globe of Earth and Water, though it seem to

Deduct. ignorantia.
l. 2. c. 12.

Wisd. 9.
16.

us to be of a large extent, yet it bears not so great a Proportion unto the whole Frame of Nature, as a small Sand doth unto it; and what can such little Creatures as we discern, who are tied to this point of Earth? or what can they in the Moon know of us? *If we understand any thing* (saith *Esdra*) *'tis nothing but that which is upon the earth; and he that dwelleth above in the heavens, may only understand the things that are above in the height of the heavens.*

2 Esd. 4.
21.

So that 'twere a very needless thing for us to search after any particulars; however, we may guess in the general that there are some Inhabitants in that Planet: For why else did Providence furnish that Place with all such Conveniences of Habitation as have been above declared?

But you will say, perhaps, is there not too great and intolerable a heat, since the Sun is in their *Zenith* every Month, and doth tarry there so long before he leaves it?

I answer, 1. This may, perhaps, be remedied (as it is under the Line) by the Frequency of mid-day Showers, which may cloud their Sun, and cool their Earth.

2. The equality of their Nights doth much temper the scorching of the Day; and the extreme Cold that comes from the one, requires some space before it can be dispelled by the other; so that the Heat spending a great while before it can have the Victory, hath not afterwards much time to rage in. Wherefore notwithstanding this doubt, yet that Place may remain habitable. And this was the Opinion of the *Cardinal de Cusa*, when speaking of this Planet, he says, *Hic locus Mundi est habitatio hominum & animalium atque vegetabilium.* "This part of the World is inhabited by Men, and Beasts, and Plants." To him assented *Campagna*; but he cannot determine whether they were Men or rather some other kind of Creatures. If they were Men, then he thinks they could not be infected

De coel.
ign. l. 2.
cap. 12.

with

Ephes. 1.
10.

Col. 1.20.

with *Adam's Sin*; yet perhaps, they had some of their own, which might make them liable to the same misery with us; out of which, it may be, they were delivered by the same means as we, the Death of *Christ*; and thus he thinks that Place of the *Ephesians* may be interpreted, where the Apostle says, *God gathered all things together in Christ, both which are in earth, and which are in the heavens*: So also that of the same Apostle to the *Colossians*, where he says, that it pleased the Father to reconcile all things unto himself by *Christ*, whether they be things in earth, or things in heaven.

But I dare not jest with Divine Truths, or apply these Places according as Fancy directs. As I think this Opinion doth not any where contradict Scripture; so I think likewise, that it cannot be proved from it. Wherefore *Campanella's* second Conjecture may be more probable, that the Inhabitants of that World are not Men as we are; but some other kind of Creatures which bear some Proportion and Likeness to our Natures. Or it may be, they are of a quite different Nature from any thing here below, such as no Imagination can describe; our Understandings being capable only of such things as have entered by our Senses, or else such mixed Natures as may be composed from them. Now, there may be many other Species of Creatures beside those that are already known in the World; there is a great Chasm betwixt the Nature of Men and Angels: It may be the Inhabitants of the Planets are of a middle Nature between both these. 'Tis not improbable that God might create some of all kinds, that so he might more compleatly glorify himself in the Works of his Power and Wisdom.

Cusanus too, thinks they differ from us in many Respects; I will set down his Words as they may be found in the above-cited Place, *Susplicamur in regione solis magis esse solares, claros & illuminatos intellectuales habitatores, spiritualiores etiam quàm in luna, ubi magis lunatici, & in terra magis materiales & crassi, ut illi intellectu-*
alis

alis naturæ solares sint multum in actu & parum in potentia, terrei vero magis in potentia, & parum in actu, lunares in medio fluctuantes. Hoc quidem opinamur ex influentia ignis solis, aquatica simul & aerea lunæ, & gravedine materiali terræ, & consimiliter de aliis stellarum regionibus, suspicantes nullam habitationibus carere, quasi tot sint partes particulares mundiales unius universi, quot sunt stellæ quarum non est numerus, nisi apud eum qui omnia in numero creavit.

“ We may conjecture (saith he) the Inhabitants
 “ of the Sun are like to the Nature of that Planet,
 “ more clear and bright, more intellectual than those
 “ in the Moon where they are nearer to the Nature of
 “ that duller Planet, and those of the Earth being
 “ more gross and material than either; so that these
 “ intellectual Natures in the Sun, are more Form than
 “ Matter, those in the Earth more Matter than Form,
 “ and those in the Moon betwixt both. This we may
 “ guess from the fiery Influence of the Sun, the water-
 “ ry and aereous Influence of the Moon, as also the
 “ material Heaviness of the Earth. In some such
 “ manner likewise is it with the Regions of the other
 “ Stars; for we conjecture that none of them are
 “ without Inhabitants, but that there are so many parti-
 “ cular Worlds and Parts of this one Universe, as
 “ there are Stars, which are innumerable, unless it be
 “ to him who created all things in Number.

For he held that the Stars were not all in one equal Orb as we commonly suppose; but that some were far higher than others, which made them appear less; and that many others were so far above any of these, that they were altogether invisible unto us. An Opinion which (as I conceive) hath not any great Probability for it, nor Certainty against it.

The Priest of *Saturn* relating to *Plutarch* (as he feigns it) the Nature of these *Selenites*, told him they were of divers Dispositions, some desiring to live in the lower Parts of the Moon, where they might look downwards upon us, while others were more surely

mounted aloft, all of them shining like the Rays of the Sun, and as being Victorious, are crowned with Garlands made with the Wings of *Eustathia* or *Constasy*.

It hath been the Opinion amongst some of the Ancients, that their Heavens and *Elysian* Fields were in the Moon, where the Air is most quiet and pure. Thus *Socrates*, thus *Plato*, with his Followers, did esteem this to be the Place where those purer Souls inhabit, who are freed from the Sepulchre, and Contagion of the Body. And by the Fable of *Ceres*, continually wandering in Search of her Daughter *Proserpina*, is meant nothing else but the longing Desire of Men, who live upon *Ceres*, Earth, to attain a Place in *Proserpina*, the Moon or Heaven.

Plutarch also seems to assent unto this; but he thinks moreover, that there are two Places of Happiness answerable to two parts which he fancies to remain of a Man when he is dead, the Soul and the Understanding; the Soul he thinks is made of the Moon; and as our Bodies do so proceed from the Dust of this Earth, that they shall return to it hereafter; so our Souls were generated out of that Planet, and shall be resolved into it again; whereas the Understanding shall ascend unto the Sun, out of which it was made; where it shall possess an Eternity of Well-being, and far greater Happiness than that which is enjoyed in the Moon. So that when a Man dies, if his Soul be much polluted, then must it wander up and down in the middle Region of the Air where Hell is, and there suffer unspeakable Torments for those Sins whereof it is guilty. Whereas the Souls of better Men, when they have in some Space of Time been purged from that Impurity which they did derive from the Body, then do they return into the Moon, where they are possess'd with such Joy, as those Men feel who profess Holy Mysteries; from which Place (saith he) some are sent down to have the Superintendance of Oracles, being dili-

diligent either in the Preservation of the Good, either from, or in, all Perils, and the Prevention or Punishment of all wicked Actions; but if in these Employments they mis-behave themselves, then are they again to be imprisoned in a Body, otherwise they remain in the Moon, till their Souls be resolved into it, and the Understanding being cleared from all Impediments, ascends to the Sun which is its proper place. But this requires a diverse Space of Time, according to the divers Affections of the Soul. As for those who have been retired and honest, addicting themselves to a studious and quiet Life, these are quickly preferred to a higher Happiness. But as for such who have busied themselves in many Broils, or have been vehement in the Prosecution of any Lust, as the ambitious, the amorous, the wrathful Man, these still retain the Glimpses and Dreams of such things as they have performed in their Bodies, which make them either altogether unfit to remain there, where they are, or else keeps them long ere they can put off their Souls. Thus you see *Plutarch's* Opinion concerning the Inhabitants and Neighbours of the Moon, which (according to the Manner of the Academicks) he delivers in a third Person; you see he makes that Planet an inferior kind of Heaven; and though he differs in many Circumstances, yet doth he describe it to be some such Place, as we suppose Paradise to be. You see likewise his Opinion concerning the Place of the Damned Spirits, that it is in the middle Region of the Air; and in neither of these is he singular, but some more late and Orthodox Writers have agreed with him. As for the Place of Hell, many think it may be in the Air, as well as any where else.

True indeed, *St. Austin* affirms that this Place cannot be discovered; but others there are who can shew the Situation of it out of Scripture; some holding it to be in another World without this, because our Sa-

*De Civit.
Dei l. 22.
c. 16.*

Mat. 25.
30.
Eph. 4. 9.

viour calls it $\sigma\kappa\delta\tau\theta\ \epsilon\zeta\omega\tau\tau\epsilon\sigma\sigma\upsilon$, outward Darkness. But the most will have it placed towards the Center of our Earth, because 'tis said, Christ descended into the lower Parts of the Earth: And some of these are so confident that this is its Situation, that they can describe you its Bigness also, and of what Capacity it is. *Francis Ribera* in his Comment on the Revelations, speaking of those Words, where 'tis said, *That the blood went out of the Wine-press, even unto the Horses Bridles, by the space of one thousand and six hundred Furlongs*, interprets them to be meant of Hell, and that that Number expresses the Diameter of its Concavity, which is 200 Italian Miles. But *Lessius* thinks that this Opinion gives them too much room in Hell, and therefore he guesses that 'tis not so wide; for, saith he, the Diameter of one League being cubically multiplied, will make a Sphere capable of 800000 Millions of Damned Bodies, allowing to each six Foot in the square; whereas, says he, tis certain, that there shall not be One hundred thousand Millions in all that shall be Damned. You see the bold Jesuit was careful that every one should have but room enough in Hell; and by the strangeness of the Conjecture, you may guess that he had rather be absurd, than seem either uncharitable or ignorant. I remember there is a Relation in *Pliny*, how that *Dionysiodorus* a Mathematician being dead, did send a Letter from this Place to some of his Friends upon Earth, to certify them what distance there was betwixt the Center and Superficies: He might have done well to have prevented this Controversie, and informed them the utmost Capacity of that Place. However, certain it is, that that Number cannot be known; and probable it is, that the Place is not yet determined, but that Hell is there where there is any Tormented Soul, which may be in the Regions of the Air, as well as in the Center; and therefore perhaps it is, that the Devil is stiled the Prince of the Air. But of this only occasionally, and by

Rev. 14.
20.

De Morib.
div. l. 13.
c. 24.

by reason of *Plutarch's* Opinion concerning those that are round about the Moon. As for the Moon it self, he esteems it to be a lower kind of Heaven; and therefore in another place he calls it a Terrestrial Star, and an Olympian or Cælestial Earth; answerable, as I conceive, to the Paradise of the Schoolmen. And, that Paradise was either in, or near the Moon, is the Opinion of some later Writers, who derived it (in all likelihood) from the Assertion of *Plato*, and perhaps, this of *Plutarch*. *Tostatus* lays this Opinion upon *Isidorus Hispalensis*, and the venerable *Bede*, and *Pererius*, fathers it upon *Strabus* and *Rabanus* his Master. Some would have it to be situated in such a place as could not be discovered; which caused the Penman of *Esdra*s to make it a harder Matter to know the out-goings of Paradise, than to weigh the weight of the Fire, or measure the blasts of Wind, or call again a Day that is past. But notwithstanding this, there be some others, who think that it is on the top of some high Mountain under the Line; and these interpreted the Torrid Zone to be the Flaming Sword whereby Paradise was guarded. 'Tis the Consent of divers others, that Paradise is situated in some high and eminent Place. So *Tostatus*: *Est etiam Paradisus situ altissima, supra omnem terræ altitudinem.* "Paradise is situated in some high place above the Earth." And therefore in his Comment upon the 49th. of *Genesis*, he understands the Blessing of *Jacob* concerning the Everlasting Hills, to be meant of Paradise, and the Blessing it self to be nothing else but a Promise of Christ's Coming, by whose Passion the Gates of Paradise should be opened. Unto him assented *Rupertus*, *Scotus*, and most of the other Schoolmen, as I find them cited by *Pererius*, and out of him in *Sir Walter Rawleigh*. Their Reason was this: Because in probability, this Place was not overflowed by the Flood, since there were no Sinners there, which might draw that Curse upon it. Nay, *Tostatus* thinks that the Body of *Enoch* was kept there; and some of

Cur silent oracula.

Sir W.
Raw. l. v.
c. 3. sect. 7.
In *Genes.*

2 *Esdra*. 4. 7.

In *Genes.*

Comment.
in 2. *Gen.*
v. 8.
L. 1. c. 3.
sect. 6, 7.

the Fathers, as *Tertullian* and *Austin*, have affirmed, That the Blessed Souls were reserved in that Place till the Day of Judgment; and therefore 'tis likely that it was not overflowed by the Flood. It were easie to produce the unanimous Consent of the Fathers, to prove that Paradise is yet really existent. Any diligent Peruser of them, may easily observe how they do generally interpret the Paradise whereto *St. Paul* was wrapt, and that wherein our Saviour promised the Thief should be with him, to be locally the same from whence our first Parents were banished. Now there cannot be any Place on Earth designed where this should be; and therefore it is not altogether improbable that it was in this other World.

2 Cor. 12. 4.
Luke 23.
43.

And besides, since all Men should have went Naked if *Adam* had not fell, 'tis requisite therefore that it should be situated in some such Place where it might be privileged from the Extremities of Heat and Cold. But now this could not be (they thought) so conveniently in any lower, as it might in some higher Air: For these and such like Considerations, have so many affirmed that Paradise was in a high elevated Place: Which some have conceived could be no where but in the Moon: For it could not be in the top of any Mountain; nor can we think of any other Body separated from this Earth, which can be a more convenient Place for Habitation than this Planet; therefore they concluded that it was there.

It could not be on the top of any Mountain:

Gen. 7. 19.

1. Because we have express Scripture, that the highest of them was overflowed.

2. Because it must be of a greater Extension, and not some small Patch of Ground, since 'tis likely all Men should have lived there, if *Adam* had not fell. But for a satisfaction of the Arguments, together with a farther Discourse of Paradise, I shall refer you to those who have written purposely upon this Subject. Being content for my own part to have spoken so much

much of it, as may conduce to shew the Opinion of others concerning the Inhabitants of the Moon; I dare not my self affirm any thing of these *Selenities*, because I know not any Ground whereon to build any probable Opinion. But I think that future Ages will discover more; and our Posterity, perhaps, may invent some Means for our better Acquaintance with these Inhabitants.

P R O P. XIV.

That 'tis possible for some of our Posterity, to find out a Conveyance to this other World; and if there be Inhabitants there, to have Commerce with them.

ALL that hath been said concerning the People of the new World, is but Conjectural, and full of Uncertainties; nor can we ever look for any evident or more probable Discoveries in this kind, unless there be some hopes of inventing Means for our Conveyance thither. The possibility of which, shall be the Subject of our Enquiry in this last Proposition.

And, if we do but consider by what Steps and Leisure, all Arts do usually rise to their growth, we shall have no cause to doubt why this also may not hereafter be found out amongst other Secrets. It hath constantly yet been the Method of Providence, not presently to shew us all, but to lead us on by degrees, from the knowledge of one thing to another.

'Twas a great while e'er the Planets were distinguished from the fixed Stars; and some time after that, e'er the Morning and Evening Star were found to be the same; and in greater space (I doubt not) but this also, and other as excellent Mysteries will be discovered. Time, who hath always been the Father of

Nat. Qu.
l. 7. c. 25.

new Truths, and hath revealed unto us many things which our Ancestors were ignorant of, will also manifest to our Posterity that which we now desire, but cannot know. *Veniet tempus* (saith Seneca) *quò ista quæ nunc latent, in lucem dies extrahet, & longioris ævi diligentia.* Time will come, when the Endeavours of After-Ages shall bring such things to Light, as now lie hid in Obscurity. Arts are not yet come to their Solstice; but the Industry of future Times, assisted with the Labours of their Forefathers, may reach that height which we could not attain to. *Veniet tempus quo posteri nostri nos tam aperta nescisse mirentur.* As we now wonder at the Blindness of our Ancestors, who were not able to discern such things as seem plain and obvious unto us; so will our Posterity admire our Ignorance, in as perspicuous Matters.

In the first Ages of the World, the Inlanders thought themselves either to be the only Dwellers upon Earth, or else if there were any other, they could not possibly conceive how they might have any Commerce with them, being severed by the deep and broad Sea. But After-times found out the Invention of Ships; in which notwithstanding, none but some bold daring Men durst venture, according to that of the Tragedian.

Sen. Med.
act. 1.
Vide Hora.
Od. 3.
Juvenal.
sat. 12.
Claud. præf.
ad 1. lib. de
rap. Proser.

*Audax nimium qui freta primus
Rate tam fragili perfida rupit.*

*Too bold was he, who in a Ship so frail,
First ventur'd on the treacherous Waves to Sail:*

And yet now, how easie a thing is this even to a timorous and cowardly Nature? And questionless, the Invention of some other Means for our Conveyance to the Moon, cannot seem more incredible to us, than this did at first to them; and therefore we have no just reason to be discouraged in our hopes of the like Success.

Yea,

Yea, but (you will say) there can be no Sailing thither, unless that were true which the Poet does but feign , That she made her Bed in the Sea. We have not now any *Drake*, or *Columbus*, to undertake this Voyage, or any *Dædalus* to invent a Conveyance through the Air.

I answer, Though we have not, yet why may not succeeding Times raise up some Spirits as eminent for new Attempts , and strange Inventions, as any that were before them ? 'Tis the Opinion of *Keplar*, That as soon as the Art of Flying is found out, some of their Nation will make one of the first Colonies that shall transplant into that other World. I suppose his appropriating this Preheminence to his own Countrey-men, may arise from an over-partial affection to them. But yet thus far I agree with him, That whenever that Art is invented, or any other, whereby a Man may be convey'd some twenty Miles high, or thereabouts, then 'tis not altogether improbable that some or other may be successful in this Attempt.

*Disserta.
cum Num.
Syder.*

For the better clearing of which I shall first lay down, and then answer those Doubts that may make it seem utterly impossible.

These are chiefly Three.

The First, taken from the natural heaviness of a Man's Body, whereby it is made unfit for the Motion of Ascent, together with the vast distance of that Place from us.

2. From the extreme Coldness of the Æthereal Air.

3. The extreme Thinness of it.

Both which must needs make it impassible, though it were but as many single Miles thither as it is thousands.

For the first. Though it were supposed that a Man could fly, yet we may well think he would be very slow in it , since he hath so heavy a Body, and
such

such a one too, as Nature did not principally intend for that kind of Motion. 'Tis usually observed, that amongst the variety of Birds, those which do most converse upon the Earth, and are swiftest in their running, as a Pheasant, Partridge, &c. together with all Domestical Fowl, are less able for flight than others which are for the most part upon the Wing, as a Swallow, Swift, &c. And therefore we may well think, that Man being not naturally endowed with any such Condition as may enable him for this Motion; and being necessarily tied to a more especial Residence on the Earth, must needs be slower than any Fowl, or less able to hold out. Thus it is also in Swimming; which Art though it be grown to a good eminence, yet he that is best skilled in it, is not able either for continuance, or swiftness to equal a Fish; because he is not naturally appointed to it. So that though a Man could fly, yet he would be so slow in it, and so quickly weary, that he could never think to reach so great a Journey as it is to the Moon.

But suppose withal that he could fly as fast and long as the swiftest Bird, yet it cannot possibly be conceived how he should ever be able to pass through so vast a distance as there is betwixt the Moon and our Earth. For this Planet, according to the common Grounds, is usually granted to be at the least 52 Semidiameters of the Earth from us; reckoning for each Semidiameter 3456 *English* Miles, of which the whole Space will be about 179712.

So that though a Man could constantly keep on in his Journey thither by a strait Line, though he could fly a Thousand Miles in a Day, yet he would not arrive thither under 180 Days, or half a Year.

And how were it possible for any to tarry so long without Diet or Sleep?

I. For Diet. I suppose there could be no trusting to that Fancy of *Philo the Jew* (mentioned before,) who

who thinks that the Musick of the Spheres should supply the strength of Food.

Nor can we well conceive how a Man should be able to carry so much Luggage with him, as might serve for his *Viaticum* in so tedious a Journey.

2. But if he could, yet he must have some time to rest and sleep in. And I believe he shall scarce find any Lodgings by the way. No Inns to entertain Passengers, nor any Castles in the Air (unless they be enchanted ones) to receive Poor Pilgrims, or Errant Knights. And so consequently he cannot have any possible hopes of reaching thither.

Notwithstanding all which Doubts, I shall lay down this Position.

That supposing a Man could fly, or by any other means raise himself twenty Miles upwards, or thereabouts, it were possible for him to come unto the Moon.

As for those Arguments of the first kind, that seem to overthrow the truth of this, they proceed upon a wrong ground, whilst they suppose that a condensed Body, in any place of the Air, would always retain in it a strong Inclination of tending downwards towards the Center of this Earth. Whereas 'tis more probable, that if it were but somewhat above this Orb of Vaporous Air, it might there rest immovable, and would not have in it any propension to this Motion of Descent.

For the better illustration of this, you must know, that the heaviness of a Body, or (as *Aristotle* defines it) the proneness of it to'tend down unto some Center, is not any absolute Quality intrinsical unto it, as if where-ever the Body did retain its Essence, it must also retain this Quality: Or as if Nature had implanted in every condensed Body *Appetitionem centri, & fugam extremitatis*. Such a Love to the Center, and Hatred to the Extremities. Because one of these being

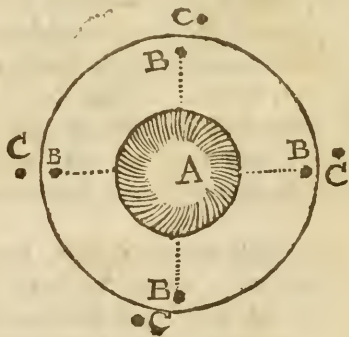
De celo,
lib. 4. c. 1.

less than a Quantity, and the other no more, cannot have any Power of attraction or depulsion in them. According to that common Principle, *Quantitatis nulla est efficacia.*

A magnetical Natural Attraction. So Keplar, *Sonn. Astron. N. 66. Coper. l. 1. cap. 26. Foscarin in epist. ad Sebast. Farnesum.* But now the true nature of Gravity is this. 'Tis such a respective mutual desire of union, whereby condensed Bodies, when they come within the Sphere of their own Vigour, do naturally apply themselves one to another by attraction or coition. But being both without the reach of either's Virtue, they then cease to move, and though they have general aptitude, yet they have not any present inclination or proneness to one another. And so consequently cannot be styl'd heavy.

The meaning of this will be more clearly illustrated by a Similitude. As any light Body (suppose the Sun) does send forth its Beams in an Orbicular Form; so likewise any Magnetical Body, for instance a Round Loadstone does cast abroad his Magnetical Vigour in a Sphere. Thus.

Gilbert. de Magnet. l. 2. cap. 7.



Where suppose the inward Circle at *A* to represent the Loadstone, and the outward one betwixt *B, C*, the Orb that does determinate its Virtue.

Now

Now any other Body that is like affected coming within this Sphere, as *B*, will presently descend towards the Center of it, and in that respect may be styled heavy. But place it without this Sphere as *C*, and then the desire of union ceaseth, and so consequently the Motion also.

To apply then what hath been said. This great Globe of Earth and Water hath been proved by many Observations, to participate of Magnetical Properties. And as the Loadstone does cast forth its own Vigour round about its Body, in a Magnetical Compass, so likewise does our Earth. The difference is, that it is another kind of Affection which causes the Union betwixt the Iron and Loadstone, from that which makes Bodies move unto the Earth. The former is some kind of nearness and similitude in their Natures, for which Philosophy, as yet, has not found a particular Name. The latter does arise from that peculiar Quality whereby the Earth is properly distinguish'd from the other Elements, which is its Condensity. Of which the more any thing does participate, by so much the stronger will be the desire of union to it. So Gold and other Metals which are most close in their Composition, are likewise most swift in their Motion of Descent.

And though this may seem to be contradicted by the instance of Metals which are of the same weight, when they are melted, and when they are hard: As also of Water, which does not differ in respect of Gravity, when it is frozen, and when it is fluid: Yet we must know that Metals are not rarify'd by melting, but mollify'd. And so too for Frozen Waters, they are not properly condensed, but congealed into a harder Substance, the Parts being not contracted closer together, but still possessing the same Extension. But yet (I say) 'tis very probable that there is such a Sphere about the Earth, which does terminate its Power of attracting other things unto it. So that suppose
a Body

a Body to be placed within the Limits of this Sphere, and then it must needs tend downwards towards the Center of it. But on the contrary, if it be beyond this Compass, then there can be no such mutual attraction; and so consequently it must rest immovable from any such Motion.

For the farther confirmation of this, I shall propose two Pertinent Observations.

The first taken in the presence of many Physicians, and related by an Eminent Man in that Profession, *Hieron. Fracastorius*. There being divers Needles provided of several kinds, like those in a Mariner's Chart; they found that there was an attractive Power not only in the Magnet, but that Iron also, and Steel, and Silver did each of them draw its own Metal. Whence he concludes, *Omne trahit quod sibi simile est*. And as these peculiar Likenesses have such a mutual efficacy, so 'tis probable that this more general Qualification of Condensity may be the cause why things so affected desire union to the Earth. And though 'tis likely that this would appear betwixt two lesser Condensed Bodies, (as suppose two Pieces of Earth) if they were both placed at liberty in the Æthereal Air, yet being near the Earth, the stronger Species of this great Globe does, as it were, drown the less.

'Tis a common Experiment, that such a Lump of Ore or Stone, as being on the Ground, cannot be moved by less than Six Men, being in the bottom of a deep Mine, may be stirred by two. The Reason is, because then 'tis compassed with attractive Beams, there being many above it as well as below it. Whence we may probably infer (saith the Learned *Verulam*), "That the Nature of Gravity does work but weakly also far from the Earth; because the Appete of Union in Dense Bodies must be more dull in respect of distance." As we may also conclude from the Motion of Birds; which rise from the Ground but heavily, though with much Labour; whereas being

Lib. de Sympath. & Antip. c. 7.

Vid. Bapt. Masul. exer. Acad. de attract. exer. 4.

Nat. Hist. Gent. I. exper. 33.

ing on high, they can keep themselves up, and soar about by the meer extension of their Wings. Now the Reason of this difference, is not (as some falsely conceive) the depth of Air under them. For a Bird is not heavier when there is but a Foot of Air under him, than when there is a Furlong. As appears by a Ship in the Water, (an Instance of the same nature) which does not sink deeper, and so consequently is not heavier, when it has but five Fathom depth, than when it has fifty. But the true Reason is, the weakness of the Desire of Union in Dense Bodies at a distance.

So that from hence, there might be just occasion to tax *Aristotle* and his Followers, for teaching that Heaviness is an absolute Quality of it self, and really distinct from Condensity: Whereas it is only a Modification of it, or rather another Name given to a condensed Body in reference to its Motion.

For if it were absolute, then it should always be inherent in its Subject, and not have its Essence depend upon the Bodies being here or there. But it is not so. For,

1. Nothing is heavy in its proper Place, according to his own Principle, *Nihil grave est in suo loco*. And then,

2. Nothing is heavy, which is so far distant from that proper Orb to which it does belong, that it is not within the reach of its Virtue. As was before confirmed.

But unto this it may be objected; though a Body being so placed, be not heavy *in actu secundo*; yet it is *in actu primo*: Because it retains in it an inward Proneness to movedownwards, being once severed from its proper Place. And this were Reason enough why the Quality of Heaviness should have an absolute Being.

I answer, this Distinction is only applicable to such natural Powers as can suspend their Acts; and will

not hold in Elementary Qualities, whose very Essence does necessarily require an Exercise of the second Act, as you may easily discern by an Induction of all the rest. I cannot say, that Body has in it the Quality of Heat, Coldness, Driness, Moisture, Hardness, Softness, &c. which for the present has not the second Act of these Qualities. And if you mean by the Essence of them, a Power unto them: Why, there is not any natural Body but has a Power to them all.

From that which hath been said concerning the Nature of Gravity, it will follow, That if a Man were above the Sphere of this Magnetical Virtue which proceeds from the Earth, he might there stand as firmly in the open Air, as he can now upon the Ground: And not only so, but he may also move with a far greater Swiftmess, than any living Creatures here below; because then he is without all Gravity, being not attracted any way; and so consequently will not be liable to such Impediments as may in the least manner resist that kind of Motion which he shall apply himself unto.

If you yet enquire, how we may conceive it possible, that a condensed Body should not be heavy in such a Place?

I answer, by the same Reason as a Body is not heavy in its proper Place. Of this I will set down two Instances.

1. When a Man is in the Bottom of a deep River, though he have over him a Multitude of heavy Waters, yet he is not burden'd with the Weight of them. And though another Body, that should be but of an equal Gravity with these Waters, when they are taken out, would be heavy enough to press him to Death; yet notwithstanding whilst they are in the Channel, they do not in the least manner crush him with their Load. The Reason is, because they are both in their right Places; and 'tis proper for the Man, being the

more condensed Body, to be lower than the Waters. Or rather thus, Because the Body of the Man does more nearly agree with the Earth, in this Affection, which is the Ground of its Attraction, and therefore doth that more strongly attract it, than the Waters that are over it. Now, as in such a Case, a Body may lose the Operation of its Gravity, which is, to move, or to press downwards: So may it likewise, when it is so far out of its Place, that this attractive Power cannot reach unto it.

'Tis a pretty Notion to this Purpose, mentioned by * *Albertus de Saxonia*, and out of him by † *Francis Mendoca*; That the Air is in some part of it Navigable. And that upon this Statick Principle, any Brass or Iron Vessel (suppose a Kettle) whose Substance is much heavier than that of the Water; yet being filled with the lighter Air, it will swim upon it, and not sink. So suppose a Cup, or Wooden Vessel, upon the outward Borders of this Elementary Air, the Cavity of it being filled with Fire, or rather Æthereal Air, it must necessarily upon the same Ground remain swimming there, and of it self can no more fall, than an empty Ship can sink.

* *Phys. l. 3. Q. art. 2. 6.*
 † *Viridar. l. 4. prob. 47. Vid. Arch. l. de insidentibus humida.*

2. 'Tis commonly granted, that if there were a Hole quite through the Centre of the Earth, though any heavy Body (as suppose a Millstone) were let fall into it; yet when it came unto the Place of the Centre, it would there rest immoveable in the Air. Now, as in this Case, its own Condensity cannot hinder, but that it may rest in the open Air, when there is no other Place to which it should be attracted; so neither could it be any Impediment unto it, if it were placed without the Sphere of the Earth's Magnetical Vigor, where there should be no Attraction at all.

From hence then (I say) you may conceive, that if a Man were beyond this Sphere, he might there stand as firmly in the open Air, as now upon the Earth. And if he might stand there, why might he

not also go there? And if so; then there is a Possibility likewise of having other Conveniences for Traveling.

And here 'tis considerable, that since our Bodies will then be devoid of Gravity, and other Impediments of Motion; we shall not at all spend our selves in any Labour, and so consequently not much need the Reparation of Diet: But may perhaps live altogether without it, as those Creatures have done, who by reason of their Sleeping for many Days together, have not spent any Spirits, and so not wanted any Food: Which is commonly related of Serpents, Crocodiles, Bears, Cuckoes, Swallows, and such like. To this purpose, * *Mendoca* reckons up divers strange Relations. As that of *Epimenides*, who is storied to have slept 75 Years. And another of a Rustick in *Germany*, who being accidentally covered with a Hay-rick slept there for all Autumn, and the Winter following, without any Nourishment.

* *Viridar.*
l. 4. prob.
24.

Or, if this will not serve; yet why may not a Papist fast so long, as well as *Ignatius* or *Xaverius*? Or if there be such a strange Efficacy in the Bread of the Eucharist, as their miraculous Relations do attribute to it: Why then, that may serve well enough, for their *Viaticum*.

* *Deficie*
in Luna.
† *Nat.Hist.*
l. 7. c. 2.

Or, if we must needs feed upon something else, why may not Smells nourish us? * *Plutarch* and † *Pliny* and divers other Ancients, tell us of a Nation in *India* that lived only upon pleasing Odors. And 'tis the common Opinion of Physicians, that these do strangely both strengthen and repair the Spirits. Hence was it that *Democritus* was able for divers Days together, to feed himself with the meer Smell of hot Bread.

Diog.Laer.
l. 1. c. 9.

Or if it be necessary that our Stomachs must receive the Food: Why then 'tis not impossible that the Purity of the Æthereal Air, being not mixed with any improper Vapours, may be so agreeable to our Bodies,

as

as to yield us sufficient Nourishment ; according to that of the Poet :

————— *Vescitur aurâ*

Virgil.

Ætherea —————

'Twas an old *Platonick* Principle, that there is in some part of the World such a Place where Men might be plentifully nourished by the Air they breathe : Which cannot more properly be assigned to any one particular, than to the *Æthereal* Air above this.

I know 'tis the common Opinion, that no *Element* can prove *Aliment*, because 'tis not proportionate to the Bodies of living Creatures which are compounded: But,

Arist. de Sens. c. 5.

1. This *Æthereal* Air is not an *Element* ; and tho' it be purer, yet 'tis perhaps of a greater Agreeableness to Man's Nature and Constitution.

2. If we consult Experience and the credible Relations of others, we shall find it probable enough that many things receive Nourishment from meet Elements.

First, for the Earth ; * *Aristotle* and † *Pliny*, those two great Naturalists, tell us of some Creatures, that are fed only with this. And it was the Curse of the Serpent, *Gen. 3. 14.* *Upon thy belly shalt thou go, and dust shalt thou eat all the days of thy life.*

The earth,

* *Hist. Animal. l. 8.*

cap. 5.

† *Hist. l. 10.*

cap. 72.

The Water.

∴ *De Animal. l. 7.*

* *De Pisc. l. 1. c. 12.*

So likewise for the Water. ∴ *Albertus Magnus* speaks of a Man who lived Seven Weeks together by the meer Drinking of Water. * *Rondoletius* (to whose Diligence these later Times are much beholden for sundry Observations concerning the Nature of Aquatils ;) affirms that his Wife did keep a Fish in a Glass of Water, without any other Food for three Years : In which Space it was constantly augmented, till at first it could not come out of the Place at which it was put in, and at length was too big for the Glass it self, though that were of a large Capacity. *Cardan* tells us of some Worms, that are bred and nourished by the Snow; from which being once separated, they die.

Subtil. l. 9.

The Air.

Thus also is it with the Air, which we may well conceive does chiefly concur to the nourishing of all Vegetables. For if their Food were all sucked out from the Earth, there must needs be then some sensible Decay in the Ground by them; especially since they do every Year renew their Leaves and Fruits: Which being so many, and so often, could not be produced without Abundance of Nourishment. To this purpose is the Experiment of Trees cut down which will of themselves put forth Sprouts. As also that of Onions, and the Semper-vive, which will strangely shoot

forth, and grow as they hang in the open Air. Thus likewise is it with some sensible Creatures; the *Camelion* (saith * *Pliny* and † *Solinus*) meerly nourished by this: And so are the Birds of Paradise, treated of by many ∴, which reside constantly in the Air, Nature having not bestowed upon them any Legs, and therefore they are never seen upon the Ground but being dead. If you ask how they multiply? 'Tis answered, they lay their Eggs on the Backs of one another, upon which they sit till their young Ones be fledg'd.

* *Rhondoletius* from the History of *Hermolaus Barbarus*, tells us of a Priest (of whom one of the Popes had the Custody) that lived Forty Years upon meer Air. As also of a Maid in *France*, and another in *Germany*, that for divers Years together did feed on nothing but this: Nay, he affirms that he himself had seen one, who lived till ten Years of Age without any other Nourishment. You may find most of these, and some other Examples to this purpose, gathered together by *Mendoca Viridar. Lib. 4. Prob. 23, 24.* Now, if this Elementary Air, which is mixed with such improper Vapours, may accidentally nourish some Persons; perhaps then, that pure Æthereal Air may of it self be more natural to our Tempers.

But if none of these Conjectures may satisfy; yet there may haply be some possible Means for the Conveyance of other Food, as shall be shewed afterwards.

Again,

* *Hist. l. 8.**cap. 33.**Polyhistor.**cap. 53.*† *Lop. hist.**Ind. Occid.**cap. 96.**Maiolus.**Colloq. 3.*

∴ 'Tis

likely

that these

Birds do

chiefly re-

side in the

Æthereal

Air, wher

they are

nourished

and up-

held.

* *De Piscibus, l. 1.**cap. 13.*

Again, seeing we do not then spend our selves in any Labour, we shall not, it may be, need the Refreshment of Sleep. But if we do, we cannot desire a softer Bed than the Air, where we may repose our selves firmly and safely as in our Chambers.

But here you may ask, whether there be any means for us to know, how far this Sphere of the Earth's Virtue does extend it self?

I answer, 'tis probable that it does not reach much farther than that Orb of thick vaporous Air, that encompasseth the Earth; because 'tis likely the Sun may exhale some earthly Vapours, near unto the utmost Bounds of the Sphere allotted to them.

Now there are divers ways used by Astronomers, to take the Altitude of this vaporous Air. As,

1. By observing the Height of that Air which causeth the *Crepusculum*, or Twilight; for the finding of which, the Ancients used this Means: As soon as ever they could discern the Air in the *East* to be altered with the least Light, they would by the Situation of the Stars find out how many Degrees the Sun was below the *Horizon*, which was usually about Eighteen. From whence they would easily conclude, how high that Air must be above us, which the Sun could shine upon, when he was 18 Degrees below us. And from this Observation, it was concluded to be about 52 Miles high.

*Vitel. l. 10
Theo. 7.*

But in this Conclusion, the Ancients were much deceived, because they proceeded upon a wrong ground, whilst they supposed that the Shining of the Sun's direct Rays upon the Air, was the only Reason of the *Crepusculum*; whereas 'tis certain that there are many other things which may also concur to the causing of it. As,

*Keplar. Ep
Coper. l. 1
part 3.*

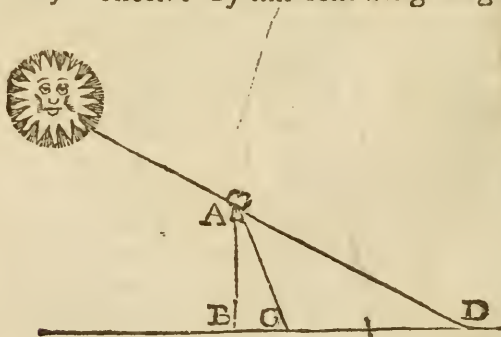
1. Some bright Clouds below the *Horizon*, which being illuminated by the Sun, may be the Means of conveying some Light to our Air, before the direct Rays can touch it.

2. The often Refraction of the Rays, which suffer a frequent Repercussion from the Cavity of this Sphere, may likewise yield us some Light.

3. And so may the Orb of enlightned Air compassing the Sun, part of which must rise before his Body.

2. The second way whereby we may more surely find the Altitude of this grosser Air, is by taking the Heighth of the highest Cloud: Which may be done, 1. Either as they use to measure the Altitude of things that cannot be approached unto, *viz.* by two Stations, when two Persons shall at the same time, in several Places, observe the Declination of any Cloud from the vertical Point. Or, 2. which is the more easie way, when a Man shall chuse such a Station, where he may at some distance discern the Place on which the Cloud does cast its Shadow, and withal does observe, how much both the Cloud and the Sun decline from the vertical Point. From which he may easily conclude the true Altitude of it, as you may more plainly conceive by this following Diagram.

Stevinus.
Geog. l. 3.
prop. 3.



Where AB is a perpendicular from the Cloud, C the Station of him that measures, D the Place where the Shadow of the Cloud does fall.

The Instrument being directed from the Station *C*, to the Cloud at *A*, the Perpendicular will shew the Angle *B A C*. Then letting the Sun shine through the Sights of your Instrument, the Perpendicular of it will give the Angle *B A D*. Afterwards having measured the Distance *C D* by Paces, you may according to the common Rules, find the Height *B A*.

Pitisc. Trigon.

But if without making the Observation, you would know of what Altitude the highest of these are found by Observation; * *Cardan* answers, not above two Miles; † *Keplar* not above 16000 Paces or thereabouts.

* *Subt. l. 17.*
† *Epit. Cop. l. 1. p. 3.*

3. Another way to find the Height of this vaporous Air, is, by knowing the Difference of Altitude which it causeth in refracting the Beams of any Star near the *Horizon*. And from this Observation also, it is usually concluded to be about two or three Miles high.

But now you must not conceive, as if the Orb of Magnetical Vigor were bounded in an exact Superficies, or as if it did equally hold out just to such a determinate Line, and no farther. But, as it hath been said of the first Region, which is there terminated where the Heat of Reflexion does begin to languish; so likewise is it probable, that this Magnetical Vigor does remit of its Degrees proportionally to its Distance from the Earth, which is the Cause of it: And therefore though the thicker Clouds may be elevated no higher, yet this Orb may be continued in weaker Degrees a little beyond them. We will suppose it (which in all likelihood is the most) to be about twenty Miles high. So that you see the former Thesis remains probable; that if a Man could but fly, or by any other Means get twenty Miles upwards, it were possible for him to reach unto the Moon.

But it may be again objected; Though all this were true; though there were such an Orb of Air which did terminate the Earth's Vigor: And though the Heaviness of our Bodies could not hinder our Pas-

sage,

sage through the vast Spaces of the Æthereal Air; yet those two other Impediments may seem to deny the Possibility of any such Voyage.

1. The extream *Coldness* of that Air. If some of our higher Mountains for this reason be not habitable, much more then will those Places be so, which are farther from any cause of Heat.

2. The extream thinness of it, which may make it unfit for Expiration. For, if in some Mountains (as *Aristotle* tells us of *Olympus*, and out of him * *St. Austin*) the Air be so thin, that Men cannot draw their Breath, unless it were through some moistned Spunges; much more then must that Air be thin, which is more remotely situated from the Causes of Impurity and Mixture. And then beside, the Refraction that is made by the vaporous Air encompassing our Earth, may sufficiently prove that there is a great difference betwixt the Æthereal Air and this, in respect of Rarity.

To the first of these I answer, That though the second Region be naturally endowed with so much Coldness, as may make it fit for the production of Meteors; yet it will not hence follow, that all that Air above it which is not appointed for the like purpose, should partake of the same Condition: But it may seem more probable, that this Æthereal Air is freed from having any Quality in the Extreams. And this may be confirmed from those common Arguments, which are usually brought to prove the Warmness of the third Region; as you may see in * *Fromundus*, and others who treat of that Subject.

'Tis the Assertion of *Perertus*, that the second Region is not cold merely for this Reason, because it is distant from the ordinary Causes of Heat, but because it was actually made so at the first, for the condensing of the Clouds, and the production of other Meteors that were there to be generated; which (as I conceive) might be sufficiently confirmed from that

Order

* *In Gen.
ad literam.
l. 3. cap. 2.*

* *Meteor.
lib. 1. ca. 2.
art. 1.*

*Comment.
in Gen 1. 8.*

Order of the Creation observed by *Moses*, who tells us that the Waters above the Firmament (by which, in the greatest probability, we are to understand the Clouds in the second Region) were made the second Day, *Gen.* 1. 7, 8. whereas the Sun it self (whose Reflection is the cause of Heat) was not created till the fourth Day, *ver.* 16, 19.

To the other Objection I answer, That though the Air in the second Region (where by reason of its Coldness there are many thick Vapours) do cause a great Refraction; yet 'tis probable that the Air which is next the Earth, is sometimes, and in some places, of a far greater thinness; nay, as thin as the Æthereal Air it self; since sometimes there is such a special heat of the Sun, as may rarifie it in an eminent degree: And in some dry places, there are no gross impure Exhalations to mix with it.

But here it may be objected: If the Air in the second Region were more condensed and heavy than this wherein we breathe, then that must necessarily tend downwards, and possess the lower place.

To this some answer, That the hanging of the Clouds in the open Air, is no less than a Miracle. They are the words of *Pliny*: *Quid mirabilis aquis in caelo stantibus?* What more wonderful thing is there, than that the Waters should stand in the Heavens? Others prove this from the Derivation of the word *מים* from *מאש* *stupescere* and *מים* *aquæ*; because the Waters do hang there after such a stupendious inconceivable Manner: Which seems likewise to be favoured by Scripture, where 'tis mentioned as a great Argument of God's Omnipotency, that he holds up the Clouds from falling. *He binds up the Waters in his thick Clouds, and the Cloud is not rent under them.*

Hist. 1. 35
cap. 1.

Job 26. 8.

But that which unto me seems full Satisfaction against this Doubt, is this Consideration; That the natural Vigour whereby the Earth does attract dense Bodies unto it, is less efficacious at a distance; and there-

therefore a Body of less Density, which is near unto it, as suppose this thin Air wherein we breathe, may naturally be lower in its Situation, than another of a greater Condensity that is farther off; as suppose the Clouds in the second Region. And though the one be absolutely, and in it self more fit for this Motion of Descent; yet by reason of its distance, the Earth's Magnetical Vertue cannot so powerfully work upon it.

As for that Relation of *Aristotle*, if it were true, yet it does not prove this Air to be altogether impassible, since moistned Sponges might help us against its thinness: But 'tis more likely that he took it upon trust, as he did some other Relations concerning the height of the Mountains, wherein 'tis evident that he was grossly mistaken: As where he tells us of *Caucasus*, that it casts its Shadow 560 Miles. And this Relation being of the same Nature, we cannot safely trust unto him for the truth of it.

If it be here enquired, what Means there may be conjectured, for our ascending beyond the Sphere of the Earth's Magnetical Vigour.

I answer. 1. 'Tis not perhaps impossible that a Man may be able to Fly, by the application of Wings to his own Body: As Angels are pictured, as *Mercury* and *Dædalus* are feigned, and as hath been attempted by divers; particularly by a *Turk* in *Constantinople*, as *Busbequius* relates.

2. If there be such a great *Ruck* in *Madagascar*, as * *Mircus Polus* the *Venetian* mentions, the Feathers in whose Wings are twelve Foot long, which can swoop up a Horse and his Rider, or an Elephant, as our Kites do a Mouse; why then 'tis but teaching one of these to carry a Man, and he may ride up thither, as *Ganymede* does upon an Eagle.

3. Or if neither of these Ways will serve: Yet I do seriously, and upon good Grounds affirm it possible to make a Flying-Chariot; in which a Man may sit,

Meteor.
l. 1. c. 11.

Mr. Burton.
Melanch.
pa. 2. sect. 2.
mem. 3.
* *Lib.* 3. c.
40.

fit, and give such a Motion unto it, as shall convey him through the Air. And this perhaps might be made large enough to carry divers Men at the same time, together with Food for their *Viaticum*, and Commodities for Traffick. It is not the bigness of any thing in this kind, that can hinder its Motion, if the motive Faculty be answerable thereunto. We see a great Ship swims as well as a small Cork, and an Eagle flies in the Air as well as a little Gnat.

This Engine may be contrived from the same Principles by which *Archytas* made a Wooden Dove, and *Regiomontanus* a Wooden Eagle.

I conceive it were no difficult Matter (if a Man had leisure) to shew more particularly the Means of Composing it.

The perfecting of such an Invention, would be of such excellent Use, that it were enough, not only to make a Man Famous, but the Age also wherein he lives. For besides the strange Discoveries that it might occasion in this other World, it would be also of inconceivable Advantage for Travelling, above any other Conveyance that is now in use.

So that notwithstanding all these seeming Impossibilities, 'tis likely enough, that there may be a Means invented of Journying to the Moon ; and how happy shall they be, that are first successful in this Attempt ?

——— *Felicesq; animæ, quas nubila supra,
Et turpes fumos, plenumq; vaporibus orbem,
Inseruit cælo sancti scintilla Promethei.*

Having thus finished this Discourse, I chanced upon a late Fancy to this purpose, under the feigned Name of *Domingo Gonsales*, written by a late Reverend and Learned Bishop : In which (besides sundry Particulars wherein this latter Chapter did unwittingly agree with it) there is delivered a very pleasant and

and well-contrived Fancy concerning a Voyage to this other World.

He supposeth that there is a natural and usual Passage for many Creatures betwixt our Earth and this Planet. Thus he says, those great Multitudes of Locusts, wherewith divers Countries have been destroyed, do proceed from thence. And if we peruse the Authors who treat of them, we shall find that many times they fly in numberless Troops, or Swarms, and for sundry Days together before they fall, are seen over those Places in great high Clouds, such as coming nearer, are of extension enough to obscure the Day, and hinder the Light of the Sun. From which, together with divers other such Relations, he concludes that 'tis not altogether improbable they should proceed from the Moon. Thus likewise he supposeth the Swallows, Cuckoes, Nightingales, with divers other Fowl, which are with us only half the Year, to fly up thither, when they go from us. Amongst which kind, there is a Wild-Swan in the *East-Indies*, which at certain Seasons of the Year do constantly take their Flight thither. Now this Bird being of great strength, able to continue for a long Flight, as also going usually in Flocks, like our Wild-Geese; he supposeth that many of them together, might be taught to carry the weight of a Man; especially if an Engine were so contrived (as he thinks it might) that each of them should bear an equal share in the Burden. So that by this means 'tis easily conceivable, how once every Year a Man might finish such a Voyage; going along with these Birds at the beginning of Winter, and again returning with them at the Spring.

And here, one that had a strong Fancy, were better able to set forth the great Benefit and Pleasure to be had by such a Journey. And that whether you consider the strangeness of the Persons, Language,
Arts,

Arts, Policy, Religion of those Inhabitants, together with the new Traffick that might be brought thence. In brief, do but consider the Pleasure and Profit of those later Discoveries in *America*, and we must needs conclude this to be inconceivably beyond it.

But such Imaginations as these, I shall leave to the Fancy of the Reader.

————— ———— *Sic itur ad astra.*
Reptet bumi quicumq; velit—————

Cælo restat iter, cælo tentabimus ire.

T H E

The SECOND BOOK.

A

DISCOURSE

Concerning A

NEW PLANET.

Tending to prove, *That* ('tis probable)
our Earth is one of the Planets.

Digna res est Contemplatione, ut sciamus in quo rerum statu scimus: Pigerimam sortiti, an velocissimam sedem: Circa nos Deus omnia, an nos agat. Sen. Nat. Quæst. Lib. 7. Cap. 2.

The Fifth Impression.

By the Right Reverend Father in God,
J O H N W I L K I N S, late Lord
Bishop of **C H E S T E R**.

L O N D O N :

Printed for *John Nicholson* at the *King's-Arms* in
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Piazza of the *Royal-Exchange*. M D C C V I I.



To the READER.

NOT to trouble you with an *Invective* against those multitudes of Pamphlets which are every Day press'd into the World ; or an *Apology* , why this was publish'd amongst the rest (the usual Matter for such kind of Epistles :) Let me in brief premonish you something concerning the

Chief Scope }
 And } of this following Discourse.
 Manner }

1. 'Tis not the *Purpose* of it to set down an Exact Treatise of this kind of *Astronomy*, but rather to remove those Common Prejudices which usually deter Men from taking any Argument, tending this way, into their Considerations. For we may observe, that in those Points which are cry'd down by the more General Opinion, Men do for the most part rest themselves in the Superficial Knowledge of Things, as they seem at their first Appearances, thinking they can say enough to any Paradox, against which they can urge the most Obvious and Easy Objections; and therefore seldom or never search into the depth of these Points, or enter into any Serious Impartial Examination of those Grounds on which they are bottomed. Which as it must needs be a great hindrance to the Proficiency of all kind of Learning, so more especially is it in this Particular. We might discern a greater Comeliness and Order in this great Fabrick of the World, and more easily understand the Appearances in *Astronomy*, if we could with Indifferency attend to what might be said for that Opinion of *Copernicus*, which is here defended,

2. *For the Manner.* It is not maintained with such Heat and Religion, as if every one that reads it were presently bound to yield up his Assent: But as it is in other Wars where *Victory* cannot be had, Men must be content with Peace: So likewise is it in this, and should be in all other Philosophical Contentions. If there be nothing able to convince and satisfy the Indifferent Reader, he may still enjoy his own Opinion. All Men have not the same way of apprehending things; but according to the Variety of their Temper, Custom, and Abilities, their Understandings are severally fashioned to different Assents: Which had it been but well consider'd by some of our Hot

* *Fromond.* * Adversaries, they would not have shewed more *Vio-*
Al. Ross. *lence* in opposing the *Persons* against whom they write, than *Strength* in confuting the *Cause*.

'Tis an Excellent Rule to be observed in all Disputes, That Men should give *Soft Words* and *Hard Arguments*; that they would not so much strive to *vex*, as to *convince* an Enemy. If this were but diligently practis'd in all Cases, and on all sides, we might in a good measure be freed from those Vexations in the search of Truth, which the Wise *Solomon*, by his own Experience did so much complain of, *Ecclesiastes* I. 18. *In much Wisdom there is much Grief; and he that increaseth Knowledge, increaseth Sorrow.*

To conclude: Though there should be nothing in this Discourse conducible to your Information and Benefit; yet it may serve in the *Perusal*, as it did in the *Composure*, for the Recreation of such Leisure Hours as may conveniently be spared from more weighty Employments.

Farewell.

T H E
P R O P O S I T I O N S

That are insisted on in this D I S C O U R S E.

P R O P. I.

THAT the seeming Novelty and Singularity of this Opinion can be no sufficient Reason to prove it erroneous.

P R O P. II.

That the Places of Scripture which seem to intimate the Diurnal Motion of the Sun or Heavens, are fairly capable of another Interpretation.

P R O P. III.

That the Holy Ghost in many Places of Scripture does plainly conform his Expressions to the Error of our Conceits, and does not speak of sundry Things as they are in themselves, but as they appear unto us.

P R O P. IV.

That divers Learned Men have fallen into great Absurdities, whilst they have looked for the Grounds of Philosophy from the Words of Scripture,

The CONTENTS.

PROP. V.

That the Words of Scripture in their Proper and Strict Construction, do not any where affirm the Immobility of the Earth.

PROP. VI.

That there is not any Argument from the Words of Scripture, Principles of Nature, or Observations in Astronomy, which can sufficiently evidence the Earth to be in the Center of the Universe.

PROP. VII.

'Tis probable that the Sun is in the Centre of the World.

PROP. VIII.

That there is not any sufficient Reason to prove the Earth incapable of those Motions which Copernicus ascribes unto it.

PROP. IX.

That it is more probable the Earth does move, than the Heavens.

PROP. X.

That this Hypothesis is exactly agreeable to Common Appearances.

THAT

That the Earth may be a Planet;

P R O P. I.

That the Seeming Novelty and Singularity of this Opinion, can be no sufficient Reason to prove it erroneous.

IN the search of Theological Truths, it is the safest Method, first of all to look unto Divine Authority; because that carries with it as clear an Evidence to our Faith, as any thing else can be to our Reason. But on the contrary, in the examination of Philosophical Points, it were a preposterous Course to begin at the Testimony and Opinion of others, and then afterwards to descend unto the Reasons that may be drawn from the Nature and Essence of the things themselves: Because these Inartificial Arguments (as the Logicians call them) do not carry with them any clear and convincing Evidence; and therefore should come after those that are of more necessary dependance, as serving rather to confirm, than resolve the Judgment.

But yet, so it is, that in those Points which are besides the Common Opinion, Men are carried away at the first by the general Cry, and seldom or never come so far, as to examine the Reasons that may be urged for them. And therefore, since it is the Purpose of this Discourse, to remove those Prejudices which may hinder our Judgment in the like Case, 'tis requisite that in the first place there be some satisfacti-

on given to those Arguments that may be taken from the Authority of others.

Which Arguments are insisted on by our Adversaries with much Heat and Violence.

What (say they) shall an upstart Novelty thrust out such a Truth as hath passed by Successive Tradition through all Ages of the World; and hath been generally entertain'd, not only in the Opinion of the Vulgar, but also of the greatest Philosophers, and most Learned Men? * Shall we think that amongst the multitude of those who in several Times have been eminent for New Inventions, and Strange Discoveries, there was none able to find out such a Secret as this, besides some Fabelous *Pythagoreans*, and of late *Copernicus*? Is it probable that the World should last for above Five Thousand Years together, and yet the Inhabitants of it be so dull and stupid, as to be unacquainted with its Motion? Nay, shall we think that these Excellent Men whom the Holy Ghost made use of in the Penning of Scripture, who were extraordinarily inspired with Supernatural Truths, should notwithstanding be so grossly ignorant of so common a Matter as this? Can we believe, if there were any such thing, that *Joshua*, and *Job*, and *David*, and *Solomon*, &c. should know nothing of it? Certainly it must needs argue a strong Affectation of Singularity, for a Man to take up any groundless Fancy against such Ancient and General Authority.

I answer: As we should not be so fondly conceiv'd of our selves, and the extraordinary Abilities of these present Ages, as to think every thing that is ancient to be obsolete: Or, as if it must needs be with Opinions as it is with Cloaths, where the Newest is for the most part best. So neither should we be so superstitiously devoted to Antiquity, as to take up every thing for Canonical, which drops from the Pen of a Father; or was approved by the Consent of the Ancients

* *Alex. Ross de Terra motu, contra Lansb. l. 1. sect. 1. cap. 10.*

ents. 'Tis an Excellent Saying, * *Δεῖ ἐλευθέρου ἕν τῆ γνώμῃ τὸν μέλλοντα φιλοσοφεῖν.* It behoves ever. one in the search of Truth, always to preserve a Philosophical Liberty; not to be so enslav'd to the Opinion of any Man, as to think whatever he says to be infallible. We must labour to find out what things are in themselves, by our own Experience, and a thorough Examination of their Natures, not what another says of them. And if in such an Impartial Enquiry, we chance to light upon a New Way, and that which is besides the Common Road, this is neither our Fault, nor our Unhappiness.

Not our Fault, because it did not arise from Singularity or Affectation. Not our Unhappiness, because it is rather a Privilege to be the first in finding out such Truths as are not discernible to every Common Eye. If Novelty should always be rejected, neither would Arts have arrived to that Perfection wherein now we enjoy them, nor could we ever hope for any future Reformation: Though all Truth be in it self eternal, yet in respect of Mens Opinions, there is scarce any so ancient but had a beginning, and was once counted a Novelty; and if for this Reason it had been condemned as an Error, what a general Darkness and Ignorance would then have been in the World, in comparison of that Light which now abounds; according to that of the Poet:

* *Quod si tam Antiquis Novitas inuisa fuisset,
Quam nobis, quid nunc esse vetus aut quid haberet,
Quod legeret tereretque viritim publicus usus?*

* Horat.
lib. 2. ep. 1.

*If our Forefathers had but hated thus,
All that were new; what had been old to us?
Or, how might any thing confirm'd be,
For publick use by its Antiquity?*

But for more full satisfaction of all those Scruples that may arise from the seeming Novelty or Singularity of this Opinion, I shall propose these following Considerations.

Consid. 1.

Suppose it were a Novelty, yet 'tis in Philosophy, and that is made up of nothing else; but receives addition from every Day's Experiment. True indeed, for Divinity we have an Infallible Rule that does plainly inform us of all necessary Truths; and therefore the Primitive Times are of greater Authority, because they were nearer to those Holy Men who were the Penmen of Scripture. But now for Philosophy, there is no such Reason: Whatever the Schoolmen may talk, yet *Aristotle's* Works are not necessarily true, and he himself hath by sufficient Arguments proved himself to be liable unto Error. Now in this Case, if we should speak properly, Antiquity does consist in the Old Age of the World, not in the Youth of it. In such Learning as may be increased by fresh Experiments and new Discoveries; 'tis we are the Fathers, and of more Authority than former Ages; because we have the advantage of more Time than they had, and Truth (we say) is the Daughter of Time. However, there is nothing in this Opinion so magisterially proposed, but the Reader may use his own liberty; and if all the Reasons considered together do not seem convincing unto him, he may freely reject it.

In those Natural Points which carry with them any Doubt or Obscurity, it is the safest way to suspend our Assents; and though we may dispute *pro* or *con*, yet not to settle our Opinion on either Side.

Consid. 2.

In weighing the Authority of others, 'tis not their Multitude that should prevail, or their Skill in some things that should make them of credit in every thing; but we should examine what particular insight and experience they had in those Things for which they are cited. Now 'tis plain, that Common People judge
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by their Senses, and therefore their Voices are altogether unfit to decide any Philosophical Doubt, which cannot well be examined or explained without Discourse and Reason. And as for the Ancient Fathers, though they were Men very eminent for their Holy Lives, and extraordinary Skill in Divinity, yet they were most of them very ignorant in that part of Learning which concerns this Opinion; as appears by many of their gross Mistakes in this kind; as that concerning the *Antipodes*, &c. And therefore it is not their Opinion neither, in this Business, that to an indifferent Seeker of Truth will be of any strong Authority.

But against this it is * objected, That the Instance of the *Antipodes* does not argue any special Ignorance in these Learned Men; or that they had less skill in such Human Arts than others; since *Aristotle* himself, and *Pliny*, did deny this as well as they.

* *Alex.*
Ross. l. 1.
sect. c. 8.

I answer :

1. If they did, yet this does make more to the present purpose : For if such great Scholars, who were so eminent for their Knowledge in Natural Things, might yet notwithstanding be grossly mistaken in such Matters as are now evident and certain, why then we have no Reason to depend upon their Assertions or Authorities, as if they were infallible.

2. Though these great Naturalists, for want of some Experience, were mistaken in that Opinion, whilst they thought no Place was habitable but the Temperate Zones : Yet it cannot be from hence infer'd that they denied the possibility of *Antipodes*; since these are such Inhabitants as live opposite unto us in the other Temperate Zone : And 'twere an absurd thing to imagine that those who liv'd in different Zones, can be *Antipodes* to one another; and argues that a Man did not understand, or else had forgotten that Common Distinction in *Geography*, wherein the Relation of the World's Inhabitants unto one another are reckoned

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up under these three Heads ; *Antaci, Periaci, and Antipodes.* But to let this pass : 'Tis certain, that some of the Fathers did deny the Being of any such, upon other more absurd Grounds. Now if such as *Chrysoftom, Lactantius, &c.* who were noted for great Scholars and such too as flourished in these later times, when all human Learning was more generally profess'd, should notwithstanding be so much mistaken in so obvious a Matter: Why then may we not think that those Primitive Saints, who were the Penmen of Scripture, and eminent above others in their Time for Holiness and Knowledge ; might yet be utterly ignorant of many Philosophical Truths, which are commonly known in these Days? 'Tis probable, that the Holy Ghost did inform them only with the Knowledge of those things whereof they were to be the Penmen, and that they were not better skilled in Points of Philosophy than others. There were indeed some of them who were supernaturally endowed with human Learning ; yet this was, because they might thereby be fitted for some particular Ends, which all the rest were not appointed unto : Thus *Solomon* was strangely gifted with all kind of Knowledge, in a great measure ; because he was to teach us by his own Experience the extream Vanity of it, that we might not so settle our Desires upon it, as if it were able to yield us Contentment. So too the Apostles were extraordinarily inspired with the Knowledge of Languages, because they were to Preach unto all Nations. But it will not hence follow, that therefore the other Holy Penmen were greater Scholars than others. 'Tis likely that *Job* had as much human Learning as most of them, because his Book is more especially remarkable for lofty Expressions, and Discourses of Nature ; and yet 'tis not likely that he was acquainted with all those Mysteries which later Ages have discovered ; because when God would convince him of his own Folly and Ignorance, he proposes to him such Questions, as being altogether unanswerable ;

swerable; which notwithstanding, any ordinary Philosopher in these Days might have resolved. As you may see at large in the thirty eighth Chapter of that Book.

The Occasion was this: *Job* having * before desired * *Cap. 13. 3.* that he might dispute with the Almighty concerning the Uprightness of his own Ways, and the Unreasonableness of those Afflictions which he underwent, does at length obtain his Desire in this kind; and God vouchsafes in this thirty eighth Chapter, to argue the Case with him. Where he does shew *Job* how unfit he was to judge of the Ways of Providence, in disposing of Blessings and Afflictions; when as he was so ignorant in ordinary Matters, being not able to discern the Reason of natural and common Events. As * why * *V. 8, 10, 11.* the Sea should be so bounded from overflowing the Land? What is the † Breadth of the Earth? What is the * Reason of the Snow or Hail? What was the † Cause of the Rain or Dew, of Ice and Frost, and the like. By which Questions, it seems, *Job* was so utterly puzzled, that he is fain afterwards to humble himself in this Acknowledgment: * *I have uttered that I understood not, things too wonderful for me, which I knew not. Wherefore I abhor my self, and repent in dust and ashes.* * *Cap. 42. ver. 3, 6.*

So that 'tis likely these holy Men had not these human Arts by any special Inspiration, but by Instruction and Study, and other ordinary Means; and therefore *Moses* his Skill in this kind is called the Learning of the *Egyptians*. Now, because in those times all Sciences were taught only in a rude and imperfect Manner; therefore 'tis likely that they also had but a dark and confused Apprehension of Things, and were liable to the common Errors. And for this Reason is it, why * *Tostatus* (speaking of *Joshua's* bidding the Moon stand still as well as the Sun) says, *Quod forte erat imperitus circa Astrorum doctrinam, sentiens ut vulgares sentiunt*: That perhaps he was unskilful in Astronomy, having the same gross Conceit of the Heavens, as the
Vul-

† *Ver. 18.** *Ver. 22.*† *Ver. 28, 29.** *Cap. 42. ver. 3, 6.**Act. 7. 22.** *Josh. c. 10. Quest. 19.*

Vulgar had. From all which it may be inferred, that the Ignorance of such good Men and great Scholars concerning these Philosophical Points, can be no sufficient Reason, why after Examination we should deny them, or doubt of their Truth.

Confid. 3.

'Tis considerable, that in the Rudiments and first Beginnings of Astronomy, and so in several Ages after, this Opinion hath found many Patrons, and those too Men of eminent Note and Learning. Such was more especially *Pythagoras*, who was generally and highly esteemed for his Divine Wit, and rare Inventions; under whose mysterious Sayings, there be many excellent Truths to be discovered.

* *Alex. Ros.*
l. 2. Sect. 2.
c. 10.

But against his Testimony, it is again* objected; If *Pythagoras* were of this Opinion, yet his Authority should not be of any Credit, because he was the Author of many other monstrous Absurdities.

To this I answer; If a Man's Error in some particulars should take away his Credit for every thing else, this would abolish the Force of all human Authority; for *humanum est errare*. Secondly, 'tis probable that many of *Pythagoras's* Sayings which seem so absurd, are not to be understood according to their Letter, but in a mystical Sense.

2. But he objects again, That *Pythagoras* was not of this Opinion; and that for two Reasons; First, because no ancient Author that he had read ascribes it unto him. Secondly, it is contradictory to his other Opinions, concerning the Harmony that was made by the Motion of the Heavens; which could not consist with this other of the Earth's Motion.

To the first I answer; The Objector could not chuse but know that this Assertion is by many ancient Authors ascribed to that Sect whereof *Pythagoras* was the Chief. He might have seen it expressly in * *Aristotle* him-

* *De Calc.*
l. 2. c. 13.

self. *Οἱ δὲ Πυθαγόρειοι λέγουσι ὅτι μὴ τὸ μέτω πῦρ ἐστὶν, τὴν τε γῆν ἐν τῇ ἀστρον ἐστὶν κύβητος φερομένη περὶ μέσσην, νόματα τε καὶ ἰμέγαν ποιεῖν.*

In which the Philosopher does compendiously reckon up the three chief Particulars implied in the Opinion of the *Pythagoreans*. First, the Sun's being in the Centre of the World. Secondly, the Earth's Annual Motion about it, as being one of the Planets. Thirdly, its diurnal Revolution, whereby it caused Day and Night.

To his Second Reason I answer; First, that *Pythagoras* thought the Earth to be one of the Planets (as appears by *Aristotle's* Testimony concerning him;) and to move amongst the rest. So that his Opinion concerning the Motion of the Heavens, is not inconsistent with that of the Earth. Secondly, but as for the Celestial Harmony, he might perhaps under this Mystical Expression, according to his usual Custom, shadow forth unto us that mutual Proportion and Harmonical Consent, which he did conceive in the several Bigness, Distance, Motions of the Orbs. So that notwithstanding these Objections, it is evident that *Pythagoras* was of this Opinion, and that his Authority may add somewhat for the Confirmation of it. Unto him assented * *Aristarchus Samius*, who flourished about 280 Years before the Birth of our Saviour; and was by reason of this Opinion, arraigned for Prophaneness and Sacrilege by the *Arecpagites*; because he had blasphemed the Deity of *Vesta*, affirming the Earth to move. To them agreed *Philolaus*, *Heraclides*, *Pontius*, *Nicetas*, *Syracusanus*, *Ephantus*, *Lucippus*, and *Plato* himself (as some think.) So likewise *Numa Pompilius*, as *Plutarch* relates it in his Life; who in reference to this Opinion, built the Temple of *Vesta* round, like the Universe; in the middle of it was placed the perpetual Vestal Fire; by which he did represent the Sun in the Centre of the World. All these Men were in their several Times of special Note, as well for their extraordinary Learning, as for this Opinion.

* *Archimedes de aræne numero.*

A. *Confid.*

'Tis considerable, that since this Science of Astronomy hath been raised to any Perfection, there have been many of the best Skill in it, that have assented unto that Assertion which is here defended. Amongst whom was the Cardinal *Cusanus*, but more especially *Copernicus*, who was a Man very exact and diligent in these Studies for above Thirty Years together, from the Year 1500 to 1530, and upwards; and since him, most of the best Astronomers have been of this side. So that now there is scarce any of Note and Skill, who are not *Copernicus* his Followers; and if we should go to most Voices, this Opinion would carry it from any other. It would be too tedious to reckon up the Names of those that may be cited for it; I will only mention some of the chief: Such were *Joachimus Rheticus*, an elegant Writer; *Christopherus Rothman*; *Meslin*, a Man very eminent for his singular Skill in this Science; who though at the first he were a Follower of *Ptolemy*, yet upon his second and more exact Thoughts, he concluded *Copernicus* to be in the right; and that the usual *Hypothesis*, * *præscriptione potius quam ratione valet*, does prevail more by Prescription than Reason. So likewise *Erasmus Reinoldus*, who was the Man that calculated the Prutenical Tables from *Copernicus* his Observations, and did intend to write a Commentary upon his other Works, but that he was taken our of this Life before he could finish those Resolutions. Unto these also I might add the Names of *Gilbert*, *Keplar*, *Galilaus*, with sundry others, who have much beautified and confirmed this *Hypothesis*, with their new Inventions. Nay I may safely affirm, that amongst the Variety of those Opinions that are in Astronomy, there are more (of those which have skill in it) that are of this Opinion, not only than any other side, but than all the rest put together. So that now it is a greater Argument of Singularity to oppose it.

De doct. ignor. l. 2. cap. 12.

* *Præf. ad Narrat. Rhetici.*

Ibid.

'Tis probable, that many other of the Ancients would have assented unto this Opinion, if they had been acquainted with those Experiments which later Times have found out for the Confirmation of it : And therefore * *Rheticus* and † *Keplar* do so often with that *Aristotle* were now alive again. Questionless, he was so rational and ingenious a Man, (not half so obstinate as many of his Followers) that upon such Probabilities as these, he would quickly have renounced his own Principles, and have come over to this side : For in one place, having proposed some Questions about the Heavens, which were not easie to be resolved, he sets down this Rule ; That in Difficulties, a Man may take a liberty to speak that which seems most likely to him ; and in such Cases, an aptness to guess at some Resolution, for the satisfying of our Philosophical Thirst, does deserve rather to be stiled by the Name of Modesty, than Boldness. And in another place, he refers the Reader to the different Opinions of Astronomers, advising him to examine their several Tenents, as well *Eudoxus* as *Calippus* ; and to entertain that (not which is most ancient, but) which is most exact and agreeable to Reason. And as for *Ptolomy*, 'tis his Counsel, that we should endeavour to frame such Suppositions of the Heavens, as might be more simple, being void of all Superfluities : And he confesses, that his *Hyporbesis* had many Implications in it, together with sundry intricate and unlikely Turnings ; and therefore in the same place, he seems to admonish us, that we should not be too confident the Heavens were really in the same Form wherein Astronomers did suppose them. So that 'tis likely, 'twas his chief intent to propose unto us such a Frame of the Celestial Bodies, from which we might, in some measure, conceive of their different Appearances ; and according to which, we might be able to calculate their Motions. But now 'tis *Copernicus* his endeavour, to propound unto us the true natural Causes

5 *Confid.** *In Narratione.*† *Myss. Cosmog. c. 1. Item pref. ad 4. l. Astr. Copern.**De Gall. l. 2. c. 12.**Met. lib. 12. cap. 8.**Alm. l. 13. cap. 2.*

ses of these several Motions and Appearances : It was the intent of the one, to settle the Imagination ; and of the other, to satisfy the Judgment. So that we have no reason to doubt of his Assent unto this Opinion, if he had but clearly understood all the Grounds of it.

'Tis reported of *Clavius*, that when lying upon his Death-Bed, he heard the first News of those Discoveries which were made by *Galilæus's* Glass, he brake forth into these Words : *Videre Astronomos, quo pacto constituendi sunt orbis Cælestes, ut hæc Phænomena salvari possint* ; That it did behove Astronomers to consider of some other *Hypothesis*, beside that of *Ptolomy*, whereby they might solve all those new Appearances. Intimating that this old one, which formerly he had defended, would not now serve the turn : And doubtless, if he had been informed how congruous all these might have been unto the Opinion of *Copernicus*, he would quickly have turned on that side. 'Tis considerable, that amongst the Followers of *Copernicus*, there are scarce any who were not formerly against him ; and such, as at first had been thoroughly seasoned with the Principles of *Aristotle* ; in which, for the most part, they have no less skill than those who are so violent in the defence of them. Whereas on the contrary, there are very few to be found amongst the Followers of *Aristotle* and *Ptolomy*, that have read any thing in *Copernicus*, or do fully understand the Grounds of his Opinion ; and I think, not any, who having been once settled with any strong Assent on this side, that have afterwards revolted from it. Now if we do but seriously weigh with our selves, that so many ingenious, considering Men, should reject that Opinion which they were nursed up in, and which is generally approved as the Truth ; and that for the embracing of such a *Paradox* as is condemned in Schools, and commonly cryed down, as being absurd and ridiculous : I say, if a Man do but well consider all this, he must
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needs conclude, that there is some strong Evidence for it to be found out by Examination; and that in all probability, this is the righter side.

'Tis probable, that most of those Authors who have opposed this Opinion, since it hath been confirmed by new Discoveries, were stirred up thereunto by some of these Three insufficient Grounds.

7 *Confid.*

1. An over-sound and partial Conceit of their proper Inventions. Every Man is naturally more affected to his own Brood, than to that of which another is the Author; though perhaps it may be more agreeable to Reason. 'Tis very difficult for any one, in the search of Truth, to find in himself such an Indifferency, as that his Judgment is not at all swayed by an over-weaning Affection unto that which is proper unto himself. And this perhaps might be the first Reason that moved the noble *Tycho* with so much heat to oppose *Copernicus*, that so he might the better make way for the spreading of that *Hypothesis* which was of his own Invention. To this I might likewise refer that Opinion of *Origanus* and *Mr. Carpenter*, who attribute to the Earth only a Diurnal Revolution. It does more especially concern those Men that are *Leaders* of several Sides, to beat down any that should oppose them.

2. A servile and superstitious fear of Derogating from the Authority of the Ancients, or opposing that Meaning of Scripture-Phrases, wherein the supposed Infallible Church hath for a long time understood them. 'Tis made part of the new Creed, set forth by *Pius* the Fourth, 1564. That no Man should assent unto any Interpretation of Scripture, which is not approved of by the Authority of the Fathers. And this is the reason why the Jesuits, who are otherwise the greatest Affectors of those Opinions which seem to be new and subtil, do yet forbear to say any thing in defence of this; but rather take all Occasions to inveigh against it. * One of them does expressly condemn it for a Heresie. And since him, it hath been

* *Serrarius*
Commen. in
Jos. cap. 10.
Quest. 14.
So Lipsius
Physiol. l. 2.

* Ann.
Dom. 1616.
item 1633.

called in by * two Sessions of the Cardinals, as being an Opinion both absurd and dangerous. And therefore likewise do they punish it, by casting the Defenders of it into the Pope's truest Purgatory, the Inquisition : But yet neither these Councils, nor any (that I know of) since them, have proceeded to such a peremptory Censure of it, as to conclude it a Heresie ; fearing perhaps, lest a more exact Examination, and the Discovery of future Times, finding it to be an undeniable Truth, it might redound to the prejudice of their Church, and its Infallibility. And therefore he that is most bitter against it, in the heat and violence of Opposition, will not call it a Heresie : The worst that he dares say of it, is, That it is *opinio temeraria quæ altero saltem pede intravit hæresios limen* : A rash Opinion, and bordering upon Heresie. Though unto this likewise he was incited by the eagerness of Disputation, and a desire of Victory ; for it seems many eminent Men of that Church before him, were a great deal more mild and moderate in their Censures of it.

Paul the Third was not so much offended at *Copernicus*, when he Dedicated his Work unto him.

The Cardinal of *Cusa* does expressly maintain this Opinion.

Schonbergius, the Cardinal of *Capua*, did with much Importunity and great Approbation, beg of *Copernicus* the Commentaries that he writ in this kind : And it seems the Fathers of the Council of *Trent*, were not such confident Defenders of *Ptolomy's Hypothesis* against *Copernicus*, as many now are. For, speaking of those intricate Subtilties which the Fancies of Men had framed to maintain the Practice of the Church, they compared them to Astronomers, who, say they, do feign *Excentricks* and *Epicicles*, and such Engines of Orbs, to save the *Phænomena* ; though they know there are no such things. But now, because this Opinion of *Copernicus* in later Times hath been so strictly forbidden and punished, it will concern those of that Religion,

Fromondus
Antarist.
cap. 6.

Religion, to take heed of meddling in the defence of it, but rather to submit the liberty of their Reason unto the Command of their Superiors, and (which is very absurd) even in Natural Questions, not to assent unto any thing but what Authority shall allow of.

3. A judging of things by Sense rather than by Discourse and Reason: A tying of the Meaning of Scripture to the Letter of it, and from thence concluding Philosophical Points, together with an ignorance of all those Grounds and Probabilities in *Astronomy*, upon which this Opinion is bottomed. And this, in all likelihood, is the Reason why some Men, who in other things perhaps are able Scholars, do write so vehemently against it; and why the Common People in general do cry it down, as being absurd and ridiculous. Under this Head I might refer the Opposition of Mr. Fuller, Al. Ross. &c.

But now, no Prejudice that may arise from the bare Authority of such Enemies as these, will be liable to sway the Judgment of an indifferent considering Man; and I doubt not but that he who will throughly weigh with himself these Particulars that are here propounded, may find some satisfaction for these Arguments, which are taken from the seeming Novelty and Singularity of this Opinion.

P R O P. II.

That there is not any Place in Scriptures, from which (being rightly understood) we may infer the Diurnal Motion of the Sun or Heavens.

IT were happy for us, if we could exempt Scripture from Philosophical Controversies: If we could be content to let it be perfect for that end unto which it was intended, for a Rule of our Faith and Obedience; and not stretch it also to be a Judge of such Natural Truths as are to be found out by our own Industry and Experience: Though the Holy Ghost could easily have given us a full Resolution of all such Particulars; yet he hath left this Travel to the Sons of Men to be exercised therewith: *Mundum reliquit disputationibus hominum*: That being busied for the most part in an Inquisition after the Creatures, we might find the less leisure to wait upon our Lusts, or serve our more sinful Inclinations.

But however, because our Adversaries generally do so much insult in those Arguments that may be drawn from hence; and more especially, because *Pineda* doth for this Reason with so many bitter and empty Reproaches, revile our Learned Countryman, *Dr. Gilbert*; in that renewing of this Opinion, he omitted an Answer to the Scripture Expressions: Therefore 'tis requisite, that in the prosecution of this Discourse, we should lay down such satisfaction as may clear all Doubts that may be taken thence: Especially since the Prejudice that may arise from the misapprehension of those Scripture Phrases, may much disable the Reader from looking on any other Argument with an equal and indifferent Mind.

*Eccles. 3.
10, 11.*

*Comment.
in Eccles.
c. 1. v. 4.*

The Places that seem to oppose this, are of two kinds. First, Such as imply a Motion in the Heavens ; Or, Secondly, such as seem to express a Rest and Im-mobility in the Earth.

Those of the first kind seem to bear in them the clearest Evidence, and therefore are more insisted on by our Adversaries. They may be referred unto these Three Heads.

1. All those Scriptures where there is any mention made of the rising or setting of the Sun or Stars.

2. That Story in *Joshua*, where the Sun standing still is reckoned for a Miracle.

3. That other Wonder in the Days of *Hezekiah*, when the Sun went back Ten Degrees in the Dial of *Abaz*. All which Places do seem to conclude, That the Diurnal Motion is caused by the Heavens.

To this I answer in general;

That the Holy Ghost in these Scripture Expressions, is pleased to accommodate himself unto the Conceit of the Vulgar, and the usual Opinion : Whereas, if in the more proper Phrase it had been said, That the Earth did rise and set ; or, that the Earth stood still, &c. the People who had been unacquainted with that Secret in Philosophy, would not have understood the Meaning of it ; and therefore it was convenient that they should be spoken unto in their own Language.

Ay, but you will reply, It should seem more likely, if there had been any such thing, that the Holy Ghost should use the truest Expressions : For then he would at the same time have informed them of the Thing, and reformed them in an Error : Since his Authority alone had been sufficient to have rectified the Mistake.

I Answer :

1. Though it were, yet 'tis beside the chief Scope of those Places, to instruct us in any Philosophical Points, as hath been proved in the former Book ; especially when these Things are neither necessary in themselves, nor do necessarily induce to a more full understanding of that which is the main business of those Scriptures. But now the People might better conceive the Meaning of the Holy Ghost, when he does conform himself unto their Capacities and Opinions, than when he talks exactly of Things in such a proper Phrase as is beyond their reach : And therefore 'tis said in *Isaiab*, *I am the Lord which teacheth thee utilia, profitable Things* : Where the Gloss has it, *non subtilia*, not such Curiosities of Nature as are not easily apprehended.

2. 'Tis not only besides that which is the chief purpose of those Places, but it might happen also to be somewhat opposite unto it. For Men being naturally unapt to believe any thing that seems contrary to their Senses, might upon this begin to question the Authority of that Book which affirmed it, or at least to retch Scripture some wrong way, to force it to some other Sense, which might be more agreeable to their own False Imagination. † *Tertullian* tells us of some Hereticks, who when they were plainly confuted out of any Scripture, would presently accuse those Texts or Books to be fallible, and of no Authority ; and rather yield Scripture to be erroneous, than forgo those Tenets for which they thought there was so good Reason. So likewise might it have been in these Points which seem to bear in them so much Contradiction to the Senses and Common Opinion : And therefore 'tis Excellent Advice set down by St. † *Austin*. *Quod nihil credere de re obscurâ temere debemus, ne forte quod postea veritas patefecerit, quamvis libris sanctis sive testamenti veteris, sive novi, nullo modo esse possit adversam, tamen propter amorem nostri erroris oderimus :*

That

Praescript.

17.

In Genes.
lit. l. 2.
fine.

That we should not hastily settle our Opinions concerning any obscure Matter, lest afterwards, the Truth being discover'd, (which however it may seem, cannot be repugnant to any thing in Scripture) we should hate that, out of love to the Error that we have before entertained. A little reading may inform us how those Texts have been abused to strange and unmeant Allegories, which have mentioned any natural Truth in such a manner as was not agreeable to Mens Conceits. And besides, if the Holy Ghost had propounded unto us any Secrets in Philosophy, we should have been apt to be so busied about them, as to neglect other Matters of greater importance. And therefore *St. Austin* proposing the Question, What should be the Reason, why the Scripture does not clearly set down any thing concerning the Nature, Figure, Magnitude and Motion of the Heavenly Orbs; he answers it thus: The Holy Ghost being to deliver more necessary Truths, would not insert these, lest Men according to the Pravity of their Dispositions, should neglect the more weighty Matters, and bestow their Thoughts about the speculative natural Points, which were less needful. So that it might seem more convenient that the Scripture should not meddle with the revealing of these unlikely Secrets, especially when it is to deliver unto us many other Mysteries of greater necessity, which seem to be directly opposite to our Sense and Reason. And therefore, I say, the Holy Ghost might purposely omit the treating of these Philosophical Secrets, till Time and future Discovery might with leisure settle them in the Opinion of others: As he is pleased in other Things of a higher kind, to apply himself unto the Infirmary of our Apprehensions, by being represented, as if he were a Human Nature, with the Parts and Passions of a Man. So in these Things likewise, that he might descend to our Capacities, does he vouchsafe to conform his Expressions unto the Error and Mistake of our Judgments.

Ibid. cap. 9.

But before we come to a further Illustration, let us a little examine those particular Scriptures which are commonly urged to prove the Motion of the Sun or Heavens. These (as was said) might be distributed under these Three Heads.

* *Psal.* 19.
5, 6.

I. Those Places which mention the rising or setting of the Sun; as that in the * *Psalms*, *The Sun like a Bridegroom cometh out of his Chamber, and rejoiceth as a Giant to run his Race: His going forth is from the end of Heaven, and his circuit unto the end of it, and there is nothing hid from the heat thereof.* And that in *Ecclesiastes*, *The Sun ariseth, and the Sun goeth down, &c.*

Eccles. I. 5.

In which Scriptures we may observe divers Phrases that are evidently spoken in reference to the appearance of Things, and the False Opinion of the Vulgar. And therefore 'tis not altogether unlikely, That this, which they seem to affirm concerning the Motion of the Heavens, should also be understood in the same Sense.

The Sun like a Bridgroom cometh out of his Chamber; Alluding perhaps unto the Conceit of Ignorant People: As if it took rest all the while it was absent from us, and came out of its Chamber when it arose.

And rejoiceth as a Giant to run his Race; because in the Morning it appears bigger than at other Times; and therefore in reference to this Appearance, may then be compared unto a *Giant*.

His going forth is from the end of Heaven, and his Circuit unto the ends of it. Alluding again unto the Opinion of the Vulgar: Who not apprehending the Roundness of the Heavens, do conceive it to have two Ends, one where the Sun riseth, the other where it setteth.

And there is nothing hid from the Heat thereof; speaking still in reference to the common Mistake, as if the Sun were actually hot in it self; and as if the Heat of the Weather were not generated by reflection,
but

but did immediately proceed from the Body of the Sun.

So likewise, for that in *Ecclesiastes*, where 'tis said, *The Sun riseth, and the Sun goeth down, &c.* which Phrases being properly understood, do import that he is sometimes in a higher place than at others: Whereas, in a Circumference, there is no Place higher or lower, each part being at the same distance from the Centre, which is the Bottom. But now understand the Phrase in reference to the Sun's appearance, and then we grant that he does seem sometimes to rise, and sometimes to go down, because in reference to the *Horizon*, (which Common People apprehend to be the Bottom, and in the utmost Bounds of it to join with the Heavens,) the Sun does appear in the Morning to rise up from it, and in the Evening to go down unto it. Now, I say, because the Holy Ghost, in the manner of these Expressions, does so plainly allude unto Vulgar Errors, and the False Appearance of Things; therefore 'tis not without probability, that he should be interpreted in the same Sense, when he seems to imply a Motion in the Sun or Heavens.

2. The Second Place was that Relation in *Joshua*; where 'tis mention'd as a Miracle, That the Sun did stand still. And *Joshua* said, *Sun stand thou still upon Gibeon, and thou Moon in the Valley of Ajalon. So the Sun stood still in the midst of Heaven, and hastened not to go down about a whole Day. And there was no Day like that, before it, or after it.* In which Place likewise there are divers Phrases wherein the Holy Ghost does not express Things according to their true Nature, and as they are in themselves; but according to their Appearances, and as they are conceived in Common Opinion. As,

Jos. 10. 12.
14. Galile-
us main-
tains the
Literal
Sense of
this Place,
towards
the end of
that Trea-
tise, which
he calls,
Nov. An-
tig. pat.
doctrina.

1. When he says, *Sun stand thou still upon Gibeon, or over Gibeon.* Now the whole Earth being so little in comparison to the Body of the Sun, and but as a Point,
 in

in respect of that Orb wherein the Sun is supposed to move ; and *Gibeon* being, as it were, but a Point of this Globe of Earth ; therefore the Words cannot be understood properly , but according to appearance. 'Tis probable that *Joshua* was then at *Azecha*, a little East from *Gibeon*, and the Sun being somewhat beyond the Meridian, did seem unto him as he was in that Place, to be over against *Gibeon* ; and in reference to this Appearance, and Vulgar Conceit, does he command it to stand still upon that Place.

2. And so secondly for that other Expression ; *And thou Moon in the Valley of Ajalon.* This Planet was now a little East from the Sun, it being about three or four Days old (as † Commentators guess.) *Ajalon* was three Miles from *Gibeon* Eastward , and *Joshua* commanded the Moon to stand still there ; because unto him it did then seem to be over-against that Valley ; whereas, 'tis certain, if he had been there himself, it would still have seemed to be as much distant from him. Just as men commonly speak in shewing another the Stars : We point to a Star over such a Chimney, or such a Tree, because to us it appears so ; whereas the Star in it self is not sensibly more over them, than it is over us. So that in this Phrase likewise the Holy Ghost doth conform himself unto the appearance of things, and our grosser Conceit.

3. *And the Sun stood still in the midst of Heaven.* Now to speak properly, and as the Thing is in it self, Heaven has no midst but the Centre ; and therefore this also must be interpreted in reference to the Opinion of the Vulgar ; and by the midst of Heaven, we are to understand such a Place as was not very near to either of the Ends, the East or West.

4. *And there was no Day like that, before it, or after it :* Which Words are not to be understood absolutely, for there are always longer Days under the Poles ; but in respect to the Opinion of the Vulgar ; that is, there was never any Day so long which these ignorant People knew of.

3. As

To stat. in
locum,
Quest. 16,
17.
Arius Mon-
tanus in
locum.

† To stat. ib.
Quest. 18.
Serrarius
in Josh. 10.
Quest. 21.
22.

3. As for this last Place concerning the Sun's returning Ten Degrees in the Dial of *Abaz*: I think it may probably be affirmed, That it is to be understood only concerning the Shadow: Which though it do necessarily happen in all Horizontal Dials, for any Latitude betwixt the Tropicks: And so consequently in all declining Dials, the Elevation of whose Pole is less than the Sun's greatest Declination; as *Clavius de Morol. cap. 21.* observes: Yet the Circumstances of this Relation in Scripture, make the Event to differ from that other which is common and natural: Which against its Nature did seem to go backwards, when as the Sun it self was not in the least manner altered from its usual Course. Of this Opinion were *Abarbinel, Arius Montanus, Burgensis, Vacabias Sanctius, &c.*

2King.20.

11.

IIsa. 38. 8.

The Reasons for it may be these;

1. The Miracle is proposed only concerning the Shadow; *Wilt thou that the Shadow shall ascend or return by Ten Degrees*: There being not in the Offer of this Wonder, any the least mention made concerning the Sun's going backwards.

2. 'Tis likely we should have had some Intimation concerning the extraordinary Length of the Day, as it is in that of *Joshua*; but in this Relation, the chief Matter that the Story takes notice of, is the Alteration of the Shadow.

3. Had it been by the supposed return of the Sun's Body, this had been a greater Miracle than those which were performed upon more solemn Occasions; it had been more wonderful than its seeming Rest in *Joshua's* Time; than the supernatural Eclipse at our Saviour's Death, when the Moon was in the Full. And then it is not likely, that the Holy Ghost in relating of this Miracle, should chiefly insist in expressing how the Shadow returned, and that only in the Dial of *Abaz*.

4. This Sign did not appear in the Sun it self; because in the 2. *Chron. 32 31.* 'tis said, *That the Ambas-*

bas-

bassadors of the King of Babylon did come unto Hezekiah, to enquire of the wonder that was done in the Land; and therefore it seems the Miracle did not consist in any Change of the Heavens.

5. If it had been in the Sun, it would have been as well discerned in other parts of the World, as in the Land of *Judea*. And then,

1. What need the King of *Babylon* send thither to enquire after it? If you reply, because it was occasioned by *Hezekiah's* Recovery; I answer, 'tis not likely that the Heathens would ever believe so great a Miracle should be wrought merely for a Sign of one Man's Recovery from a Disease: But would rather be apt to think that it was done for some more remarkable Purpose, and that by some of their own Gods, unto whom they attributed a far greater Power than unto any other. 'Tis more probable, they might hear some flying Rumor of a Miracle that was seen in *Judea*: Which because it happened only in *Hezekiah's* House and Dial, and that too upon his Recovery from a dangerous Sickness, they might be more apt to believe that it was a Sign of it.

2. Why have we no mention made of it in the Writings of the Ancients? It is no way likely, that so great a Miracle as this was (if it were in the Sun) should have been passed over in Silence; especially, since it happened in those later times, when there were many Heathen Writers that flourished in the World; *Hesiod, Archilochus, Symonides*; and not long after, *Homer*, with divers others; and yet none of them have the least mention of any such Prodigy. We have many Relations of Matters that were less observable, which were done about that time; the History of *Numa Pompilius, Gyges*; the Fight betwixt the three Brethren, with divers such Stories. And 'tis scarce credible, that this should have been omitted amongst the rest.

Nay, we have (as many guess) some Hints from Prophane Antiquity, of the Miracle wrought by *Joshua*. Unto which, 'tis thought the Ancients did allude in the Fable of *Phaeton* ; when the Sun was so irregular in his Course, that he burnt some part of the World. And questionless then, this which happened in later times, would not have been so wholly forgotten. 'Tis an Argument urged by **Origen*, That the Eclipse at our Saviour's Passion was not universal, because no Prophane Author of those times mentions it. Which Consequence is the very same with that which is urged in this other case ; but by the way, his Antecedent was false, since † *Tertullian* affirms, That it was recorded amongst the *Roman* Annals.

* *Treat.*
35. in *Mat.*

† *Apologet.*
c. 21.

Now as for that Story in *Herodotus*, where after he had related the Flight of *Senacherib*, he tells us, how the Sun did Four Times in the Space of 10340 Years invert his Course, and rise in the *West* ; which would seem so unto other Nations, if he had only returned, as many conclude, from this Scripture: As for this Story, (*Isay*) it cannot well be urged as pertinent to the present Business, because it seems to have Reference unto times that never were.

Lib. 2.

So that all these things being well considered, we shall find it more probable, that this Miracle doth consist in the Return of the Shadow.

If you object, That the Scripture does expressly say, *the Sun it self returned ten degrees* ; I answer, 'tis a frequent Manner of Speech in Scripture, to put the Cause for the Effect ; as that in *Jonas*, where 'tis said, That *the Sun did beat upon the head of Jonas* ; that is, the Beams of the Sun. So that of the Psalmist, *The Sun shall not smite thee by day*, that is, the Heat which proceeds from the Sun's Reflection. In the same Sense may the Phrase be understood in this Place ; and the Sun may be said to return back, because the Light, which is the Effect of it, did seem to do so ; or rather,

Isa. 38. 8.

Jonah 4. 8.
Psal. 121.
6.

ther, because the Shadow, which is the Effect of that did change its Course.

This later Scripture then, will not at all make to the present Purpose: As for those of the two former kinds, I have already answered, That they are spoken in reference to the Appearance of Things, and vulgar Opinion. For the further Illustration of which, I shall endeavour to confirm these two Particulars.

1. That the Holy Ghost in many other Places of Scripture, does accommodate his Expressions unto the Error of our Conceits: And does not speak of divers Things as they are in themselves, but as they appear unto us. Therefore 'tis not unlikely, that these Phrases also may be liable unto the same Interpretation.

2. That divers Men have fallen into great Absurdities, whilst they have looked for the Grounds of Philosophy from the Words of Scripture; and therefore it may be dangerous in this Point also, to adhere so closely unto the Letter of the Text.

P R O P. III.

That the Holy Ghost, in many Places of Scripture, does plainly conform his Expressions unto the Errors of our Conceits; and does not speak of divers Things as they are in themselves, but as they appear unto us.

THERE is not any particular by which Philosophy hath been more endamaged, than the ignorant Superstition of some Men: Who in stating the Controversies of it, do so closely adhere unto the meer Words of Scripture. *Quam plurima occurrunt in libris sacris ad naturam pertinentia, &c.* They are the Words of † Vallesius. "There are sundry Things in Holy

† Proam.
ad Phil.
Sacros.

“ Writ concerning natural Points, which most Men
 “ think are not so to be understood, as if the Holy
 “ Ghost did intend to unfold unto us any thing in that
 “ kind : But referring all to the Salvation of our
 “ Souls, does speak of other Matters according to
 “ common Opinion. ” And a little after, *Ego, divi-*

na hæc eloquia, &c. “ I for my part am persuaded,
 “ that these Divine Treatises were not written by the
 “ Holy and Inspired Penmen, for the Interpretation
 “ of Philosophy, because God left such things to be
 “ found out by Men’s Labour and Industry. But yet
 “ whatsoever is in them concerning Nature is most
 “ true : As proceeding from the God of Nature, from
 “ whom nothing could be hid. ” And questionless, all
 those things which the Scripture does deliver concern-

ing any natural Point, cannot be but certain and infal-
 lible, being understood in that Sense, wherein they
 were first intended ; but now that it does speak
 sometimes according to common Opinion, rather than
 the true Nature of the things themselves, was intima-
 ted before ; wherefore (by the way) * *Fromondus* his
 Triumph upon the latter Part of this Quotation, is but
 vain, and to no purpose. ’Tis a good Rule set down
 by a learned † *Commentator*, to be observed in the
 Interpretation of Scripture : *Scriptura Sacra sæpe non tam*
ad veritatem ipsam, quam ad hominum opinionem, sermonem
accommodat ; that it does many times accommodate its
 Expressions, not so much to the Truth it self, as to
 Men’s Opinions. And in this Sense is that Speech of
Gregory concerning Images and Pictures, attributed by
 * *Calvin* unto the History of the Creation ; *viz. Li-*
brum esse ideotarum, that it is a Book for the simpler and
 ignorant People. For it being written to inform them,
 as well as others, ’tis requisite that it should use the
 most plain and easie Expressions. To this purpose
 likewise is that of † *Merjennus*, *Mille sunt Scriptura loca,*
 &c. “ There are very many Places of Scripture,
 “ which are not to be interpreted according to the Let-

* *Vest.*

Traët. 3.

c. 2.

† *Sanctius*
in Isa. 13.

5. Item in
Zachar.

l. 9. n. 45.

* *Comment.*
in Gen. c. 1.

† *In Gen. c.*
1. v. 10.
art. 6.

“ ter ;

Vid. Hiero.
in Jer. 28.
Aquinas in
Job. 26. 7.

“ter; and that for this Reason, because God would
“apply himself unto our Capacity and Sense: *Prefer-*
tum in eis, quæ ad res naturales, oculisque subjectas perti-
ment; more especially in those things which concern
Nature; and are subject to our Eyes. And therefore
in the very same Place, though he be eager enough a-
gainst *Copernicus*, yet he concludes that Opinion not to
be a Heresy; because (saith he) those Scriptures
which seem to oppose it, are not so evident, but that
they may be capable of another Interpretation: Inti-
mating, that it was not unlikely they should be under-
stood in reference to outward Appearance and com-
mon Opinion: And that this manner of Speech is
frequently used in many other Places of Scripture,
may be easily manifest from these following Exam-
ples.

Thus though the Moon may be proved by infallible
Observation, to be less than any of the visible Stars;
yet because of its Appearance, and vulgar Opinion,
therefore doth the Scripture in comparison to them,
call it one of the great Lights. Of which Place,
saith *Calvin*, *Moses populariter scripsit, nos potius respexit*
quam Sydera. *Moses* did not so much regard the Na-
ture of the thing, as our Capacity; and therefore
uses a popular Phrase: So as ordinary People without
the Help of Arts and Learning, might easily under-
stand him; and in another Place, *Non fuit Spiritus*
Sancti concilium Astrologiam docere: “It was not the
“purpose of the Holy Ghost to teach us Astronomy:
“But being to propound a Doctrine that concerns
“the most rude and simple People, he does (both by
“*Moses* and the Prophets) conform himself unto their
“Phrases and Conceits: Lest any should think to ex-
“cuse his own Ignorance with the Pretence of Diffi-
“culty: As Men commonly do in those things which
“are delivered after a learned and sublime Manner.”

Gen. 1. 16.
Psal. 136,
7.

Comment.
in Psal.
136.

† De oper.
Dii, par. 2.
l. 6. c. 1.

Thus *Zanchy* † likewise, *Moses majorem rationem habuit*
nostri humanique judicii, &c. “When *Moses* calls the
“Moon

“ Moon a great Light, he had a more especial Reference to Men’s Opinions of it, than to to the Truth of the thing it self; because he was to deal with such, who do usually judge rather by their Sense than by their Reason.” Nor will that Distinction of *Fromondus* and others avoid this Interpretation, when he tells us of *magnum Materiale*, which refers to the Bulk and Quantity of the Body; and *magnum Formale*, which imports the Greatness of its Light. For we grant, that it is really unto us a greater Light than any of the Stars, or than all of them together: Yet there is not one of them, but is in its self a bigger Light than this: And therefore when we say this Speech is to be understood according to its Appearance, we do not oppose this to Reality: But ’tis implied, that this Reality is not absolute, and in the Nature of the thing it self; but only relative, and in reference to us. I may say a Candle is a bigger Light than a Star, or the Moon, because it is really so to me. However any one will think this to be spoken, only in relation to its Appearance, and not to be understood as if the thing were so in it self. But (by the way) it does concern *Fromondus* to maintain the Scripture’s Authority, in revealing of natural Secrets; because, from thence it is that he fetches the chief Argument for that strange Assertion of his, concerning the Heaviness of the Wind; Where *Job* says, that *God makes the weight for the wind*. Thus likewise, because the common People usually think the Rain to proceed from some Waters in the *Expansum*, therefore doth *Moses* in reference to this erroneous Conceit, tell us of Waters above the Firmament, and the Windows of Heaven: Of which saith *Calvin*, *Nimis serviliter literæ se astringunt, &c.* “Such Men too servilely tie themselves unto the Letter of the Text, who hence conclude, that there is a Sea in the Heavens: When as we know that *Moses* and the Prophets, to accommodate themselves unto the Capacity of ruder People,

De Meteor.
L. 4. c. 2.
art. 3.

Job 28. 25.

Comment.
in *Psa.* 148.

4.

“ do use a vulgar Expression ; and therefore it would
 “ be a preposterous Course, to reduce their Phrases un-
 “ to the exact Rules of Philosophy.” Let me add,
 that from this Mistake, 'tis likely did arise that ground-
 less Observation of the ancient *Jews*, who would not
 admit any to read the beginning of *Genesis*, till he
 was arrived to Thirty Years of Age. The true Rea-
 son of which was this : Not because that Book was
 harder than any other, but because *Moses* conforming
 his Expression to vulgar Conceits, and they examining
 of them by more exact Rules of Philosophy, were
 fain to force upon them many strange Allegories, and
 unnatural Mysteries.

Thus also, because for the most part we conceive
 the Stars to be innumerable, therefore doth the Holy
 Ghost often speak of them in reference to this Opini-
 on. So *Jeremy*, *As the Host of Heaven cannot be num-
 bred, neither the Sand of the Sea measured, so will I multi-
 ply the Seed of David.* So likewise, when God would
 comfort *Abraham* with the Promise of a numberless Po-
 sterity, he bids him look up to Heaven, and tells him,
 that his Seed should be like those Stars for Number ;
 which, saith * *Clavius*, *Intelligendum est secundum com-
 munem sententiam vulgi, existimantis infinitam esse multitu-
 dinem stellarum, dum eas nocte serena confuse intuetur,* is to
 be understood according to the common Opinion of
 the Vulgar, who think the Stars to be of an infinite
 Multitude, whilst they behold them all (as they seem
 confused) in a clear Night. And though many of our
 Divines do commonly interpret this Speech to be a
Hyperbole ; yet being well considered, we shall find that
Abraham's Posterity, in some few Generations, were
 far more than there are visible Stars in the Firmament ;
 and of such only does God speak, because he bids
Abraham look up to the Heavens.

Now all these, even unto six Differences of Magni-
 tude, are reckoned to be but 1022. True indeed, at
 the first viewing of the Heavens, it may seem an in-
 credible

credible thing that they should be of no greater a Number ; but the reason of this is, because they appear scattered and confused, so that the Eye cannot place them in any such order, as to reckon them up, or take any distinct Survey of them. Now 'tis a known Truth, *Quod fortius operatur pluralitas partium, ubi ordo abest ; nam inducit similitudinem infiniti, & impedit comprehensionem ;* That a plurality of Parts without Order, has a more strong Operation, because it has a kind of seeming Infinity, and so hinders Comprehension. And then besides, there are more Appearances of Stars many times, than there are Bodies of them : For the Eye, by reason of its weakness and disability to discern any thing at so great a distance ; as also, because of those Beams which proceed from such remote Bodies in a twinkling and wavering manner, and so mix and confound themselves at their entrance into that Organ ; it must needs receive more Representations than there are true Bodies. But now, if a Man do but leisurely and distinctly compare the Stars of the Heaven with those of this Number that are noted in a Cœlestial Globe, he shall scarce find any in the Sky which are not marked with the Globe ; nay, he may observe many in the Globe, which he can scarce at all discern in the Heavens.

Now this Number of the Stars is commonly distributed into 48 Constellations ; in each of which, though we should suppose Ten thousand Stars, (which can scarce be conceived) yet would not all this Number equal that of the Children of Israel. Nay, 'tis the Assertion of *Clavius*, that *Abraham's* Posterity in some few Generations were far more than there could be Stars in the Firmament, though they stuck so close that they touched one another. And he proves it thus : A great Circle in the Firmament does contain the Diameter of a Star of the first Magnitude 14960 times. In the Diameter of the Firmament, there are contained 4760 Diameters of such a Star :

Sir Fr. Bac.
Table of
Colours,
Num. 5.

In prim. ca.
Sphæra.

Now if we multiply this Circumference by this Diameter, the Product will be 71209600, which is the full Number of Stars, that the eighth Sphere (according to *Ptolemy's* Grounds) would contain, if they stood so close that they touched one another.

Num. 1. 46.

The Children of *Israel* were reckoned at their going out of *Egypt* 603550, of such as were One and Twenty Years old and upwards, and were able to go to War; besides Children, and Women, and Youths, and old Men, and the *Levites*; which in probability, did always treble the other Number. Now if they were so many at one time, we may well conceive that in all those several Generations, both before and since, the Number was much augmented; and long before this time, did far exceed this supposed Multitude of the Stars. From all which, we may infer, That the Scripture-Expressions in this kind, are to be understood according to Appearance and common Opinion.

Another Place usually cited for the same purpose, to shew that the Holy Ghost does not speak exactly concerning Natural Secrets, is that in the *Kings* and *Chronicles*, which relates unto us the Measure of *Solomon's* Brazen Sea, whose Diameter was ten Cubits, and its Circumference thirty; whereas to speak Geometrically, the more exact proportion betwixt the Diameter and the Circumference, is not as Ten to Thirty, but rather as Seven to Twenty two.

1 King. 7.

23.

2 Chr. 4. 2.

But against this 'tis * objected by our Adversaries, *1. This* Sea was not perfectly round, but rather inclining to a Semicircular Form, as † *Josephus* affirms.

† *Antiq.*

Jud. lib. 8.

cap. 2.

I reply: If it were so, yet this is so much from helping the Matter, that it makes it much worse; for then the Disproportion will be far greater.

But *Secondly*, Scripture, which is to be believed before *Josephus*, does tell us in express Terms, that it was round all about, *1 Kings 7. 23.*

2. The Proportion of the Diameter to the Circumference, is not exactly the same as Seven to Two and twenty, but rather less. I answer, though it be, yet 'tis nearer unto that, than any other Number.

Ross. *ibid.*

3. The Scripture does but according to its usual Custom, suppress the less Number, and mention only that which is bigger and more full. So in some * Places, *Abraham's* Posterity is said to remain in the Land of *Egypt* for Four hundred Years; when as notwithstanding, † other Scriptures tell us, that they tarried there thirty Years longer. Thus likewise in one * Place, the Number of *Jacob's* House who came into *Egypt*, is reckoned to be Seventy; whereas ∴ elsewhere, they are said to be Seventy five.

Ibid.

* *Gen.* 15.
13. *Acts* 7.
6.

† *Exod.* 12.
41.
Gal. 3. 17.
* *Gen.* 46.
27.
∴ *Acts* 7.

I answer: All this is so far from destroying the force of the present Argument, that it does rather confirm it, and more clearly evidence unto us, that the Scripture does not only, not speak exactly in these subtle and more secret Points of Philosophy; but also, in the ordinary obvious numbring of things, does conform unto common Custom, and often use the round Number for the whole.

4ⁱ

4. 'Tis yet objected by * another Adversary, That we have no reason to expect the Holy Ghost should reveal unto us this Secret in Nature; because neither *Archimedes*, nor any other, had then found it out. I reply, and why then should we think that the Scripture must needs inform us of the Earth's Motion; when as neither *Pythagoras*, nor *Copernicus*, nor any else, had then discovered it?

* *Fromond.*
Vesta. 4.
tract. 3. c. 2.

5. In taking the compass of this Vessel, they measured somewhat below the Brim, where it was narrower than at the Top, and so the Circumference there might be exactly but Thirty Cubits; whereof its Diameter was Ten.

Ibid.

I answer: 'Tis evident this is a meer Shift, there being not the least Ground for it in the Text. And then besides, why might not we affirm, That the Dia-

meter was measured from that place, as well as the Circumference? since 'tis very probable that the Holy Ghost did speak *ad idem*, and not tell us the breadth of one place, and the compass of another. So that all our Adversaries Evasions cannot well avoid the force of the Argument that is taken from this Scripture.

Again, common People usually conceive the Earth to be such a Plain, as in its utmost Parts is terminated by the Heavens, so that if a Man were in the farthest Coasts of it, he might touch the Sky. And hence also, they think that the Reason why some Countries are hotter than others, is, because they lie nearer unto the Sun. Nay, *Strabo* tells us of some Philosophers too, who in this Point have grossly erred; affirming, that there was a Place towards the utmost Coasts of *Lusitania*, where a Man might hear the noise that the Sun made, as he quenched his Beams in his descent to the Ocean; which, though it be an absurd Mistake, yet we may note, that the Holy Ghost in the Expression of these things, is pleased to conform himself unto such kind of vulgar and false Conceits; and therefore often speaks of the * *ends of Heaven*, and the † *ends of the World*. In this sense, they that come from any far Country, are said to come from the *end of Heaven*, *Isaiah* 13. 5. And in another Place, *From the side of the Heavens*, *Deut.* 4. 32. All which Phrases do plainly allude unto the Error of vulgar Capacities (saith *Sanctilius*) which hereby is better instructed, than it would be by more proper Expressions.

Thus likewise, because ignorant People cannot well apprehend how so great a Weight as the Sea and Land should hang alone in the open Air, without being founded upon some *Basis* to uphold it; therefore in this respect also does Scripture apply it self unto their Conceits, where it often mentions the *Foundations of the Earth*. Which Phrase, in the Letter of it, does manifestly allude unto Men's Imaginations in this kind.

Thus

* *Psa.* 19. 6.

Mat. 24.

31.
† *Pf.* 22. 27,
&c.

Comment.
in Isa. 13.

5.

Job 38. 4.

Psa. 102.

25.

Thus also the Common People usually conceive the Earth to be upon the Water ; because, when they have travelled any way as far as they can, they are at length stopped by the Sea. Therefore doth Scripture in reference to this, affirm, That *God stretched the Earth upon the Waters, founded the Earth upon the Seas, and established it upon the Floods.* Of which Places saith Calvin, *Non disputat Philosophicè David, de terræ situ ; sed populariter loquens, ad rudium captum se accommodat :* 'Twas not *David's* intent to speak Philosophically concerning the Earth's Situation ; but rather by using a popular Phrase, to accommodate his Speech unto the Capacities of the ruder People.

Psal. 136.
6.
Psal. 24. 2.

In this sense likewise, are we to understand all those Places of Scripture, wherein the Coasts of Heaven are denominated from the Relations of Before, Behind, the right Hand, or the left. Which do not imply, saith *Scaliger*, any absolute difference in such Places, but are spoken meerly in reference to Men's Estimations, and the common Opinion of those People for whom the Scriptures were first penned. Thus because it was the Opinion of the *Jewish* Rabbies, that Man was created with his Face to the East, therefore the *Hebrew* word *קדמ* signifies *Ante*, or the East ; *אחור* *Post*, or the West ; *ימין* *Dextra*, or the South, *שמאל* *Sinistra*, or the North. You may see all of them put together in that Place of *Job* : *Behold I go forward,* and he is not there, and backward, but I cannot perceive him ; on the left hand, where he doth work, but I cannot behold him. He hideth himself on the right hand, that I cannot see him. Which Expressions, are by some Interpreters referred unto the Four Coasts of Heaven, according to the common use of those Original Words. From hence it is, that many of the Ancients have concluded Hell to be in the North, which is signified by the Left Hand : Unto which side our Saviour tells us, that the Goats shall be divided. Which Opinion likewise seems to be favoured by that Place in *Job*,

Subtil. Exercit. 67.

Job 23. 8, 9.

Mat. 25.

33.

Job 36.
6, 7.

where 'tis said, *Hell is naked before God, and destruction hath no covering.* And presently 'tis added, *He stretched out the North over the empty place.*

Upon these grounds, *St. Jerom* interprets that Speech of the Preacher, *Eccles. 11. 3.* *If the tree falls towards the South, or towards the North, in the place where the tree falleth, there shall it be.* Concerning those who shall go either to Heaven or Hell. And in this Sense also do some expound that of *Zachary, 14. 4.* Where 'tis said, *That the mount of Olives shall cleave in the midst; half of it shall remove towards the North, and half of it towards the South.* By which is intimated, that amongst those *Gentiles* who shall take upon them the Profession of Christ, there are two Sorts; some that go to the North, that is, to Hell; and others to the South, that is to Heaven. And therefore it is (say they) that God so * often threatens Evil out of the North; and upon this ground it is (saith † *Besoldus*) that there is no Religion that worships that way. We read of the *Mabometans*, that they adore towards the South; the *Jews* towards the West; Christians towards the East, but none to the North.

But of this only by the way. However, certain it is that the Holy Ghost does frequently in Scripture set forth the several Coasts of Heaven, by those relative Terms of Right Hand and Left Hand, &c. which Expressions do not denote any real intrinsical Difference betwixt those Places, but are rather fitted for the Apprehension of those Men, from whose Fancy it is that they have such Denominations. And though *Aristotle* concludes these several Positions to be natural unto the Heavens; yet his Authority in this particular is not available, because he delivers it upon a wrong ground, supposing the Orbs to be living Creatures, and assisted with Intelligences. We may observe, that the meaning of these Coasts by the Relations of Right Hand and Left Hand, &c. is so far from having any ground in the Nature of those several Places, that these

* *Jer. 1.*
14, 25.
Item cap.
4. 6. 6. 1.
† *L de nat.*
pop. c. 4.

De Cal.
1. 2. c. 2.

these Relations are not only variously applied unto them by divers Religions (as was said before,) but also by divers Arts and Professions. Thus because Astronomers make their Observations toward the South parts of the *Horizon*, where there be most Stars that rise and set; therefore do they account the *West* to be at their Right Hand, and the *East* at their Left. The *Cosmographers* in taking the Latitude of Places, and reckoning their several Climates must look towards the *North Pole*; and therefore in their Phrase, by the Right Hand is meant the *East*; and by the Left Hand, the *West*: And thus (saith *Plutarch*, are * we to understand these Exprssions in *Pythagoras*, *Plato*, *Aristotle*. The Poets count the *South* to be towards the Left, and the *North* the Right Hand. Thus † *Lucan* speaking of the *Arabians* coming unto *Theffaly*, says:

Ignotum vobis Arabes venistis in orbem:
Umbras mirati nemorum, non ire sinistras.

The *Augurs* taking their Observations at the *East*, count the *South* to be at their Right Hand, and the *North* their Left: So that these Denominations have not any real ground in the Nature of the things, but are imposed upon them by the Scripture Phrase, in Reference to the Account and Opinion of the *Jews*.

Thus also, because heretofore it was generally received, that the Heart was the principal Seat of the Faculties; therefore doth the Spirit apply himself unto this common Tenent; and in many Places, attributes Wisdom and Understanding to the Heart. Whereas, to speak properly, the Reason and discursive Faculties have their principal Residence in the Head (saith *Galen* and *Hypocrates*, together with the Generality of our later Physicians,) because they are hindered in their Operations by the Distempers of that part, and recovered by Medicines applied unto it.

So likewise are we to understand those other Places: *Isa.* 59. 5. where some Translations read it, *Ova Aspidum ruperunt*, they have broken the Vipers Eggs; al-

* *De plac. Philos. l. 2. cap. 10.*
 † *Lib. 3.*

D. Hakwel, Apol. l. 1. c. 1. Sect. 2.

Prov. 8. 5. 10. 8. Eccles. 1. 13, 16, 17. & 8. 5.

luding to that common but fabulous Story of the Viper, who breaks his Passage through the Bowels of the Female. So *Pfal.* 58. 4, 5. where the Prophet speaks of the deaf Adder, *that stops her Ears against the voice of the Charmer.* Both which Relations (if we may believe many Naturalists) are as false as they are common; and yet because they were entertained with the general Opinion of those Days, therefore doth the Holy Ghost vouchsafe to allude unto them in Holy Writ. 'Tis a plain mistake of *Fromondus*, when in Answer to these Places, he is fain to say, that they are used proverbially only, and do not positively conclude any thing. For when *David* writes these Words, that they are *like the deaf Adder which stoppeth her ears,* &c. this Affirmation is manifestly implied, That the deaf Adder does stop her Ears against the Voice of the Charmer: Which because it is not true in the Letter of it, (as was said before) therefore 'tis very probable that it should be interpreted in the same Sense wherein here it is cited.

Vesta Trac.
3. cap. 3.

In reference to this also, we are to conceive of those other Expressions; *Cold cometh out of the North*; *Job.* 37. 9. and again, *Fair weather comes out of the North,* *Ver.* 22. So *Ver.* 17. *Thy garments are quieted when he warmeth the Earth by the South Wind.* And *Prov.* 25. 23. *The North Wind driveth away rain.* Which Phrases do not contain in them any absolute general Truth, but can so far only be verified, as they referred to several Climates: And though unto us who live on this side of the Line, the *North Wind* be coldest and driest; and on the contrary, the *South Wind* moist and warm, by Reason that in one in these Places there is a stronger Heat of the Sun to exhale moist Vapours, than in the other; yet it is clean otherwise with the Inhabitants beyond the other Tropick; for there the *North Wind* is the hottest, and moist, and the *South* the coldest and dry: So that with them, these Scriptures cannot properly be affirmed, that *cold or that fair weather cometh*
out

out of the North; but rather on the contrary. All which notwithstanding, does not in the least manner derogate from the Truth of these Speeches, or the Omniscience of the Speaker, but do rather shew the Wisdom and Goodness of the Blessed Spirit, in vouchsafing thus to conform his Language unto the Capacity of those People unto whom these Speeches were first directed: In the same sense are we to understand all those places where *the Lights of Heaven* are said to be darkned, and *the Constellations not to give their light*, *Isa.* 13. 10. Not as if they were absolutely in themselves deprived of their Light, and did not shine at all; but because of their Appearance to us; and therefore in another Place answerable to these, God says, *he will cover the Heavens*, and so make the Stars thereof dark, *Ezek.* 37. 2. Which argues, that they themselves were not deprived of this Light (as those other Speeches seem to imply) but we.

Joel 2. 31.
Item c. 3.
15.

In reference to this likewise are we to conceive of those other Expressions, that *the Moon shall blush, and the Sun be ashamed*, *Isa.* 24. 23. That *they shall be turned into Blood*, *Matth.* 24. 29. Not that these things shall be so in themselves (saith St. *Jerom.*) but because they shall appear so unto us. Thus also *Mark* 13. 25. *The Stars shall fall from Heaven*; that is, they shall be so wholly covered from our Sight, as if they were quite fallen from their wonted Places. Or if this be understood of their real Fall, as it may seem probable by that Place in the *Revelations*, 6. 13. *And the Stars of Heaven fell unto the Earth, even as a Fig-Tree casteth her untimely Figs, when she is shaken by a mighty Wind*: Then is it to be interpreted not of them that are truly Stars, but them that appear so: Alluding unto the Opinion of the unskilful Vulgar (saith * *Sanctius*) that think the Meteors to be Stars. And † *Mersennus* speaking of the same Scripture, says, *Hoc de veris Stellis minime volunt Interpretes intelligi, sed de Cometis & aliis ignitis Meteoris*: Interpreters do by no means understand this of true Stars,

Comment.
in Joel, c. 3.

* *Comment.*
in Isa. c.
13. 5.

† *Comment.*
in Gen. c. 3.
v. 10. ar. 6.

Stars, but of the Comets and other fiery Meteors: Though the falling of these be a natural Event, yet may it be accounted a strange Prodigy, as well as an Earthquake, and the darkning of the Sun and Moon, which are mentioned in the Verse before.

In reference to this, doth the Scripture speak of some common natural Effects, as if their true Causes were altogether inscrutable, and not to be found out, because they were generally so esteemed by the Vulgar.

* Job. 3. 8.

† Jer. 10.

13.

Item c. 51.

16.

∴ וַיִּשְׁמַע

† Job. 37.

10.

† Jo. 26.

14.

∴ Psal. 29.

3, 4. &c.

Eccles. 1. 7.

Job, 9. 9.

Item 38.

31.

Vide Fro-

mond. Met.

l. 3. c. 1.

art. 1.

Thus of the Wind it is * said, *That none know whence it cometh, nor whither it goeth.* In another † Place God is said to bring it out of his treasures; and ∴ elsewhere it is called the * breath of God; and so likewise of the Thunder: Concerning which, † Job proposes this Question, *The Thunder of his Power who can understand?* and therefore too ∴ David does so often stile it, *the voice of God.* All which Places seem to imply, that the Cause of these things was not to be discovered, which yet later Philosophers pretend to know: So that according to their Construction, these Phrases are to be understood in relation unto their Ignorance unto whom these Speeches were immediately directed.

For this Reason is it; Why, though there be in Nature many other Causes of Springs and Rivers than the Sea, yet Solomon (who was a great Philosopher, and perhaps not ignorant of them) does mention only this; because most obvious, and easily apprehended by the Vulgar. Unto all these Scriptures, I might add that in Amos 5. 8. which speaks of the Constellation commonly called the Seven Stars; whereas later Discoveries have found that there are but Six of them discernable to the bare Eye, as appears by Galileus his Glass: The Seventh of them being but a deceit of the Eye, arising from their too great nearness; and if a Man try in a clear Night to number them distinctly, he shall find that there will sometimes appear but Six, and sometimes more.

True indeed, the Original Word of this Scripture

כִּימָה, does not necessarily imply any such Number in its Signification, but yet our *English* Translation renders it the Seven Stars; and if it had been expressly so in the Original too, it might have spoken true enough, because they are usually esteemed of that Number. And when it had been said, *He made the Seven Stars and Orion*, we might have easily understood the Words thus: He made those Constellations that are commonly known unto us under such Names.

From all these Scriptures 'tis clearly manifest, that it is a frequent Custom for the Holy Ghost to speak of natural Things, rather according to their Appearance and common Opinion, than the Truth it self. Now it is very plain, and our Enemies themselves do grant it, that if the World had been framed according to the System of *Copernicus*, *futurum esset ut vulgus, de Solis motu & Terra statu proinde ut nunc loqueretur*. The vulgar Phrase would have been the same as now it is, when it speaks of the Sun's Motion, and the Earth's standing still.

*Fromond.
Ant. c. 6.*

Wherefore 'tis not improbable, that such kind of Scripture-Expressions are to be understood only in relation to outward Appearances, and Vulgar Opinion.

P R O P. IV.

That divers Learned Men have fallen into great Absurdities, whilst they have looked for the Sects of Philosophy from the Words of Scripture.

IT has been an Ancient and common Opinion amongst the *Jews*, that the Law of *Moses* did contain in it, not only those things which concern our Religion and Obedience, but every Secret also that

*Schickard.
Bechin. Ha-
penn. Disp.
5. Num. 8.*

that may possibly be known in any Art or Science; so that there is not a Demonstration in Geometry, or Rule in Arithmetick; not a Myſtery in any Trade, but it may be found out in the *Pentateuch*. Hence it was (ſay they) that *Solomon* had all his Wiſdom and Policy: Hence it was that he did fetch his Knowledge concerning the Nature of Vegetables, from the Cedar of *Lebanon*, to the Hyſop that grows upon the Wall. Nay from hence, they thought a Man might learn the Art of Miracles, to remove a Mountain, or recover the Dead. So ſtrangely have the learned Sort of that Nation been befooled, ſince their own Curſe hath lighted upon them.

Not much unlike this fooliſh Superſtition of theirs, is that Cuſtom of many Artiſts amongſt us; who upon the Invention of any new Secret, will preſently find out ſome obſcure Text or other to father it upon; as if the Holy Ghofit muſt needs take notice of every particular which their partial Fancies did over-value.

Nor are they altogether guiltleſs of this Fault, who look for any Secrets of Nature from the Words of Scripture; or will examine all its Expreſſions by the exact Rules of Philoſophy.

Unto what ſtrange Abſurdities this False Imagination of the Learned *Jews* hath expoſed them, may be manifeſt by a great multitude of Examples. I will mention only ſome few of them. Hence it is that they prove the Shin-Bone of *Og* the Giant to be above three Leagues long; or (which is a more modeſt Relation) that *Mofes* being fourteen Cubits in ſtature, having a Spear ten Ells in length, and leaping up ten Cubits, could touch this Giant but on the Ankle. All which they can confirm unto you by a Cabaliſtical Interpretation of this Story, as it is ſet down in Scripture. Hence it is that they tell us of all thoſe ſtrange Beaſts which ſhall be ſeen at the coming of the Meſſias: As firſt, the Ox, which *Job* calls *Behemoth*,

*Schickard.
ib. Disp. 6.
num. 2.*

*Buxtor. Sy-
nag. Judæ.
c. 36.*

moth,

moth, that every Day devours the Grass on a thousand Mountains, as you may see it in the * *Psal.*, where *David* mentions the Cattel, or ברמות upon a Thousand Hills. If you ask how this Beast does to find Pasture enough, they answer, that he remains constantly in one place, and where there is as much Grass grows up in the Night, as was eaten in the Day.

* *Psal.* 50.
10.

They tell us also of a Bird, which was of that quantity, that having upon a time cast an Egg out of her Nest, there were beaten down by the fall of it Three hundred of the tallest Cedars, and no less than Threescore Villages drowned. As also of a Frog as big as a Town capable of Sixty Houses; which Frog, notwithstanding his greatness, was devoured by a Serpent, and that Serpent by a Crow; which Crow, as she was flying up to a Tree, eclipsed the Sun, and darkened the World; by which you may guess what a pretty Twig that Tree was. If you would know the Proper Name of this Bird, you may find it in *Psal.* 50. 11. where it is called ין, or in our Translation, the Fowl of the Mountains. It seems it was somewhat of kin to that other Bird they tell us of, whose Legs were so long, that they reached unto the bottom of that Sea, where there had been an Axe-Head falling for Seven Years together, before it could come to the bottom.

Vide Pa-
rap. Chald.

Many other Relations there are, which contain such horrible Absurdities, that a Man cannot well conceive how they should proceed from Reasonable Creatures. And all this arising from that wrong Principle of theirs, That Scripture did exactly contain in it all kind of Truths; and that every Meaning was true, which by the Letter of it, or by Cabalistical Interpretations might be found out.

Now as it hath been with them, so likewise hath it happened in proportion unto others, who by a Superstitious adverting unto the bare Words of Scripture, have

have exposed themselves unto many strange Errors. Thus * *St. Basil*, holds, That next to the Sun, the Moon is bigger than any of the Stars, because *Moses* does call them only two great Lights.

Thus others maintain, That there are Waters properly so called, above the Starry Firmament, because of those Vulgar Expressions in Scripture, which in their Literal Sense do mention them. Of this Opinion were many of the Ancients, *Philo*, *Josephus*, and since them the Fathers; (a) *Justin Martyr*, (b) *Theodoret*, (c) *Austin*, (d) *Ambrose*, (e) *Basil*, and almost all the rest. Since them sundry other Learned Men, as *Beda*, *Strabo*, *Damascent*, *Iho. Aquinas*, &c. If you ask for what purpose they were placed here, *Justin Martyr* tells us, for these two ends: First, to cool the Heat that might otherwise arise from the Motion of the Solid Orbs; and hence it is, say they, that *Saturn* is colder than any of the other Planets, because though he move faster, yet he is nearer to these Waters. Secondly, to press and keep down the Heavens, lest the frequency and violence of Winds might break and scatter them afunder: Which Opinion, together with both its Reasons, are now accounted absurd and ridiculous.

(f) *St. Austin* concludes the visible Stars to be innumerable, because Scripture Phrases seem to imply as much.

That the Heavens are not round, was the Opinion of (g) *Justin Martyr*, (h) *Ambrose*, (i) *Cbrysoftom*, (k) *Theodoret*, (l) *Theophylact*, doubted of by *St. Austin* (m), and divers others. Nay, *St. Cbrysoftom* was so confident of it, that he proposes the Question in a triumphant manner: (k) *In c. 8. Heb.* Πῶς εἰσιν οἱ σφαιροὶ εἰς τὴν ἑσπερὴν εἶδ' ἀποφανόμενοι. Where are those Men that can prove the Heavens to have a Spherical Form? The Reason of which was this, Because 'tis said in one Scripture, *That God stretched forth the Heavens as a Curtain*, *Psal. 104. 2. and spreadeth them as a Tent to dwell in*, *Isa. 40. 22.* And so in that Place of

* *Enarr. st.*
in Gen.

(a) *Respons.*
ad ques. 93.
Orthod.
(b) *Que. II.*
sup. Gen.
(c) *De Civ.*
Dei lib. II.
cap. ult.
(d) *Hexam.*
l. 2. c. 2.
(e) *Homil. 3.*
in Gen.

(f) *De Civ.*
Dei, l. 16.
c. 23.
(g) *Respons.*
ad ques. 93.
(h) *Hexam.*
l. 1 c. 6.
(i) *Homil.*
14. in Ep.
ad Hebr.
(k) *In c. 8.*
Hebr.
(l) *In id. c.*
(m) *In Gen.*
ad lit. l. 1.
c. 9. Item.
l. 2. c. 6.

the Epistle to the Hebrews, 8. 2. they are called, a Tent or Tabernacle: Which because it is not spherical, therefore they conclude also, that the Heavens are not of that Form; whereas now, the contrary is as evident as Demonstration can make a Thing. And therefore, * St. Jerom in his time, speaking of the same Error, gives it this plain Censure: *Est in Ecclesia stultiloquium, si quis Cælum putet fornicis modo curvatum, Esauis quem non intelligit sermone deceptus.* 'Tis foolish speaking in the Church, if any through misapprehension of those Words in *Isaiab*, shall affirm the Heavens not to be round.

* Lib. 3.
Comment.
in Galat.
c. 5.

That the Seas not overflowing the Land is a Miracle, was the Opinion of (a) *Basil*, (b) *Chryostom*, (c) *Theodorat*, (d) *Ambrose*, (e) *Naxianzen*, and since them, (f) *Aquinas*, (g) *Luther*, *Calvin*, *Martorate*, with sundry others: Which they proved from these Scripture Expressions: That in *Job* 38. 8, 11. *Who hath shut up the Sea with Doors, when it brake forth, as if it had issued out of the Womb; when I did break up for it my decreed Place; and set Bars, and Doors, and said, Hyberio shalt thou come, and no further, and here shall the Pride of thy Waves be staid.* So likewise, *Prov.* 8. 29. *God gave to the Sea his Decree, that the Waters should not pass his Commandment.* And *Jerem.* 5. 22. *I have placed the Sand for a Bound of the Sea by a perpetual Decree, that they cannot pass it; and though the Waves thereof toss themselves, yet can they not prevail; though they roar, yet can they not pass over, that they turn not again to cover the Earth.* In all which Places, say they, 'tis imply'd, that the Water of it self, were it not withheld from its own natural Inclination by a more special Power of God, would overflow the Land.

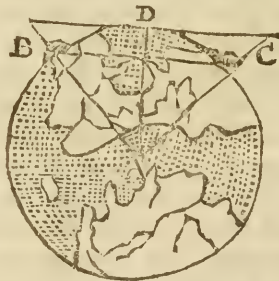
(a) Homil.
4. Hexam.
(b) Com-
men. in Job.
(c) In Psal.
103.
(d) Hexam.
l. 3. c. 2, 3.
(e) Orat. 34
(f) Aquinas
part 1.
quest. 69.
art. 1.
(g) Com-
men.
in Psal. 24.
Item in
Psal. 136.
6.

Others infer the same Conclusion from that in *Ecclesiastes*, where the Rivers are said to come from the Sea, which they could not do, unless that were higher. I answer: They should as well consider the latter part of that Scripture, which says, that the Rivers return

to that place from whence they came, and then the force of this Consequence will vanish. To this purpose some urge that Speech of our Saviour, where he bids *Simeon* to launch forth into the Deep; the *Latin* Word is, *in altum*; from whence they gather, that the Sea is higher than the Land. But this favours so much of Monkish Ignorance, that it deserves rather to be laughed at, than to be answered.

Luke 5, 4.
Ἐἰς τὸ βῆ-
θος.

But now if we consider the true Properties of this Element, according to the Rules of Philosophy, we shall find, that its not overflowing the Land is so far from being a Miracle, that it is a necessary Consequence of its Nature; and 'twould rather be a Miracle, if it should be otherwise, as it was in the General Deluge. The Reason is, because the Water of it self must necessarily descend to the lowest place; which it cannot do, unless it be collected in a Spherical Form, as you may plainly discern in this Figure.



Where the Sea at *D*, may seem to be higher than a Mountain at *B*, or *C*, because the rising of it in the midst, does so intercept our Sight from either of those Places, that we cannot look in a Strait Line, from the one to the other. So that it may seem to be no less than a Miracle, by which the Sea (being a heavy Body) was withheld from flowing down to those lower Places of *B*, or *C*. But now, if you consider that
the

the ascending of a Body is its Motion from the Centre, and descent is its approaching unto it; you shall find, that for the Sea to move from *D*, to *B* or *C*, is a Motion of Ascent, which is contrary to its Nature, because the Mountains at *B*, or *C*, are farther off from the Centre, than the Sea at *D*; the Lines *AB*, and *AC*, being longer than the other *AD*. So that for the Sea to keep always in its Channel, is but agreeable to its Nature, as being a heavy Body. But the meaning of those Scriptures is, to set forth the Power and Wisdom of God; who hath appointed these Channels for it, and beset it with such strong Banks to withstand the fury of its Waves. Or if these Men do so much rely in Natural Points, upon the bare Words of Scripture, they might easily be confuted from those other Places, where God is said to have founded the Earth upon the Seas, and establish'd it upon the Floods. From the Literal Interpretation of which, many of the Ancients have fallen into another Error; affirming the Water to be in the lower place; and as a *Basis*, whereon the weight of the Earth was born up. Of this Opinion were * *Clemens Alexandrinus*, † *Orat. Ibanasius*, * *Hilary*, * *Eusebius*, and others. So that it seems, if a Man should resolutely adhere to the bare Words of the Scripture, he might find Contradiction in it; of which the Natural Meaning is altogether incapable. † *St. Jerom* tells us of some who would prove Stars to have Understanding, from that place in *Isaiab*, 45, 12. *My Hands have stretched out the Heavens, and all their Host have I commanded.* Now (say they) none but Intelligent Creatures are capable of Precepts; and therefore the Stars must needs have Rational Souls. Of this Opinion was † *Philo the Jew*: Nay, many of the Rabbies conclude, that they do every Hour sing Praises unto God with an audible real Voice; because of that in *Job* 38. 7. which speaks of the *Morning Stars singing together*. And *Psal* 19. 3, 4. where 'tis said of the Heavens, That

* *Recog.* 8.† *Orat.**cont. Idolos.** *In Psal.*

136. 6.

* *In Psal.*

24.

† *Comment.**in Isa. l. 13.*† *Deplant.*
*Nec.**Testatus in*
*Job. c. 101**quest. 13.*

14.

there is no Speech nor Language where their Voice is not heard; and their Words are gone to the ends of the World. And whereas we translate that Place in the Tenth of *Joshua*, concerning the standing still of the Heavens; the original Word, $\square\Gamma$ does properly signify Silence, and according to their Opinion, *Joshua* did only bid them hold their peace. From such grounds 'tis likely did * *Origen* fetch his Opinion, that the Stars should be saved. I might set down many other the like Instances, were it not for being already weary of raking into the Errors of Antiquity, or uncovering the Nakedness of our Forefathers. That Excuse of † *Acosta* may justly serve to mitigate the Mistakes of these Ancient Divines: *Facile condemnandum est patribus, si cum cognoscendo colendoque Creatori toti vacarent, de Creaturâ minus apè aliqua ex parte opinati sunt.* Those Good Men were so wholly busied about the Knowledge and Worship of the Creator, that they had not leisure enough for an Exact Search into the Essence of the Creatures. However, these Examples that have been already cited, may sufficiently manifest how frequently others have been deceived, in concluding the Points of Philosophy from the Expressions of Scripture. And therefore 'tis not certain, but that in the present Case also, it may be insufficient for such a manner of Arguing.

* *Tom. I.*
in Johan.

† *De nat.*
novi orbis,
l. I. c. 2.

P R O P. V.

That the Scripture, in it Proper Construction, does not any where affirm the Immobility of the Earth.

THE same Answer which was insisted on before, concerning the Conformity of Scripture Expressions to Mens Capacity and Common Opinion, may well

well enough satisfy all those other Arguments, which seem thence to affirm the Earth's Settledness and Im-mobility ; since this is as well agreeable to outward appearance and vulgar apprehension as the other. But now for more full satisfaction, I shall set down the Particular Places that are urged for it ; which being thoroughly examined, we may plainly discern that none of them, in their proper Meaning, will serve to infer any such Conclusion.

One of these Sayings is that of the Preacher, *Eccles. i. 4.* *One Generation cometh, and another passeth, but the Earth endureth for ever* ; where the Original Word is, *וַיָּוָד*, and the Vulgar, *Stat* ; from whence our * Adver-saries conclude that it is immovable.

I answer : The Meaning of the Word, as it is here apply'd, is *permanent* ; or as we translate it, *endureth*. For it is not the purpose of this Place to deny all kind of Motion to the whole Earth, but that of Ge-neration and Corruption, to which other things in it are liable. And though *Pineda*, and others keep a great deal of impertinent stir about this Scripture, yet they grant this to be the natural Meaning of it : Which you may more clearly discern, if you consider the chief Scope of this Book ; wherein the Preacher's In-tent is, to shew the extraordinary Vanity of all Earth-ly Contentments, *ver. 2.* the utter Unprofitableness of all a Man's Labour, *ver. 3.* and this he illustrates by the shortness and uncertainty of his Life, in which re-spect he is below many of his Fellow Creatures, as may be manifested from these four Compari-sons.

1. From the Earth, which though it seem to be but as the Sediment of the World, as the Rubbish of the Creation ; yet is this better than Man in re-spect of his lastingness ; for *one Generation passeth away, and another cometh ; but the Earth that abideth for ever, v. 4.*

* *Vallesius*
Sacra Phil.
c. 62.
Fuller, Mis-
cell. l. 1. c.
15. Pineda
Comment. 1
in locum. 1

2. From the Sun; who though he seem frequently to go down, yet he constantly seems to rise again, and shines with the same Glory, *v. 5. But Man dieth, and wasteth away, yea, Man giveth up the Ghost, and where is he? he lieth down, and riseth not till the Heavens be no more.*

3. From the Wind, the Common Emblem of Uncertainty; yet it is more constant than Man, for that *knows its Circuits, and whirleth about continually, v. 6. Whereas our Life passeth away as doth the Wind, but returneth not again.*

4. From the Sea; though it be as uncertain as the Moon, by whom 'tis governed, yet is it more durable than Man and his Happiness. For though the Rivers run into it, and from it, yet is it still of the same quantity that it was at the beginning, *v. 7. But Man grows worser as he grows older, and still nearer to a decay. So that in this respect he is much inferior to many other of his Fellow Creatures.*

From whence it is manifest, that this Constancy, or Standing of the Earth is not opposed to its Local Motion, but to the changing or passing away of divers Men in their several Generations. And therefore rance to conclude the Earth's Immobility were as weak and ridiculous as if one should argue thus: One Miller goes, and another comes, but the Mill remains still; *ergo*, the Mill hath no Motion.

Or thus: One Pilate goes, and another comes, but the Ship remains still; *ergo*, the Ship doth not stir.

* R. Moses tells us, how that many of the Jews did from this place conclude, that Solomon thought the Earth to be Eternal, because he saith it abideth *עליון* for ever; and questionless, if we examine it impartially, we shall find that the Phrase seems more to favour this Absurdity, than that which our Adversaries would collect from hence, that it is without Motion.

But Mr. *Fuller* urging this Text against *Copernicus* ; tells us, if any should interpret these Phrases concerning the Earth's standing still, *v.* 4. and the Sun's Motion, *v.* 5. in reference only to Appearance, and Common Opinion ; he must necessarily also understand those two other Verses which mention the Motion of the Wind and Rivers in the same Sense. As if he should say ; Because some things appear otherwise than they are, therefore every thing is otherwise than it appears: Or, Because Scripture speaks of some Natural Things, as they are esteem'd according to Man's False Conceit, therefore 'tis necessary that every Natural Thing mention'd in Scripture must be interpreted in the like Sense : Or, because in one place we read of the Ends of a Staff, *1 Kings* 8. 8. and in many other places of the Ends of the Earth, and the Ends of Heaven ; therefore the Earth and Heavens have as properly Ends as a Staff. 'Tis the very same Consequence of that in the Objection. Because in this place of *Ecclesiastes* we read with the Rest of the Earth, and the Motion of the Sun ; therefore these Phrases must needs be understood in the same proper Construction as those afterwards, where Motion was attributed to the Wind and Rivers. Which Inference you see is so weak, that the Objector need not triumph so much in its strength as he doth.

Another Proof like unto this is taken from *St. Peter*, *Epist.* 2. *cap.* 3. *ver.* 5. where he speaks of the Earth standing out of the Water, and in the Water, $\gamma\tilde{\iota}\sigma\sigma\omega\epsilon\sigma\tilde{\omega}\delta\tau\omega$, and therefore the Earth is immovable.

I answer : 'Tis evident that the Word here is equivalent with *suit* ; and the Scope of the Apostle is to shew, that God made all the Earth, both that which was above the Water, and that which was under it. So that from this Expression, to collect the Rest and Immobility of the Earth, would be such an Argument as this other. Such a Man made that part of a Mill-Wheel, or a Ship, which stands below the Water, and

that part which stands above the Water; therefore those Things are immovable.

To such vain and idle Consequences does the Heat of Opposition drive our Adversaries.

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* 1 Chron. 16. 30.
Psal. 93. 1.
Item 96.
10.
A Third Argument stronger than either of the former, they conceive may be collected from those *Scriptures; where 'tis said, *The World is established, that it cannot be moved.*

To which I answer: These Places speak of the World in general, and not particularly of our Earth; and therefore may as well prove the Immobility of the Heavens, they being the greatest part of the World; in comparison to which, our Earth is but as an insensible point.

If you reply, that the Word in these Places is to be understood by a *Synechdecbe*, as being meant only of this Habitable World, the Earth:

I answer: First, this is only said, not proved: Secondly, *David* but a little before seems to make a difference between the World and the Earth, *Psal. 90. 2.* where he says, *Before thou hadst formed the Earth and the World.* But Thirdly, in another Place there is the same Original Word apply'd expressly to the Heavens; and which is yet more, the same Place does likewise mention this supposed Settledness of the Earth, *Prov. 3. 19.* *The Lord by Wisdom hath founded the Earth; and by Understanding hath he established the Heavens.* So that these Places can no more prove an Immobility in the Earth than in the Heavens.

If you yet reply, That by the Heavens there is meant the Seat of the Blessed, which does not move with the rest:

I answer: Though by such an Evasion a Man might possibly avoid the force of this Place; yet, First, 'tis but a groundless shift, because then that Verse will not contain a full enumeration of the Parts in the World, as may seem more agreeable to the Intention of it; but only shew, that God created this Earth where we live,

live, and the Heaven of Heavens. So that the Heaven of the Stars and Planets shall be shifted out from the number of the other Creatures. Secondly, there is another place which cannot be so avoided, *Psal.* 89. 37. where the Psalmist uses this Expression, יָסֵד It shall be established as the Moon. So *Psal.* 8. 4. The Moon and the Stars, אֲשֶׁר בְּנוֹתָיִךְ which thou hast established. Thus likewise, *Prov.* 8. 27. when he established the Heavens: And in the next Verse, our English Translation reads it, when he established the Clouds. And yet our Adversaries will affirm the Moon, and Stars, and Clouds to be subject unto Natural Motions: Why then should the very same Expressions be counted as sufficient Arguments to take it away from the Earth?

If it be replied, That by establishing the Heavens, is meant only the holding of them up, that they do not fall down to us (as *Lorinus* explains that in the Eighth Psalm, and quotes *Euthymius* for the same Interpretation ;) *fundandi verbum significat decidere non posse, aut dimoveri a loco ubi collocata sunt.* I answer, why may not we as well interpret the Words thus of the Earth ; so that by establishing of it, is meant only the keeping of it up in the vast Places of the open Air, without falling to any other Place.

Lorinus
Comment.
in *Psal.* 8.

From hence it is plain, That these Scriptures are to be understood of such an Immobility in the Earth, as may likewise agree with the Heavens: The same Original Word being so promiscuously applied to both.

Ay, but (you will say) there are some other Places which do more peculiarly apply this Settledness and Establishment to the Earth. So *Psal.* 119. 90. Thy faithfulness is unto all generations: Thou hast established the Earth, and it abideth. Thus likewise, *Psal.* 104. 5. Who laid the foundations of the Earth, that it should not be removed for ever. The latter of which, being well weighed in its Original (saith Mr. Fuller) does in three

Miscel. L.I.
Em- cap. 15.

Emphatical Words strongly conclude the Earth's Im-mobility.

As First, when he says יָסַד *fundavit*, he hath found-ed it; wherein it is implied, that it does not change his Place. To which may be added all those Texts, which so frequently speak of the foundations of the Earth; as also that Expression of the Psalmist, where he mentions the Pillars of the Earth, *Psal. 75. 3.*

The Second Word is $\text{בָּסַס$ translated *Basis*; and by the Septuagint, $\epsilon\pi\iota\tau\omega\ \alpha\sigma\phi\alpha\lambda\epsilon\iota\omega\ \alpha\upsilon\tau\omicron\upsilon\varsigma$; that is, he hath founded it upon its own Firmness; and therefore it is altogether without Motion.

The Third Expression is בַּל-תִּטַּשׁ from the Root טַשׁ which signifies, *declinare*; implying, that it could not wag with the least kind of Declination.

To these I answer severally:

First, for the word, יָסַד *fundavit*, it cannot be under-stood properly, as if the natural Frame of the Earth, like other artificial Buildings, did need any Bottom to uphold it; for *he hangeth the earth upon no-thing*, *Job 26. 7.* But it is a Metaphor, and signifies God's placing or situating this Globe of Land and Water. As David tells us of the Pillars of the earth; so Job mentions Pillars of the Heavens, *Job 26. 11.* And yet that will not prove them to be immoveable.

True indeed, we read often concerning the Founda-tions of the Earth: But so we do likewise of the Ends, Sides, and Corners of the Earth; and yet these Scriptures will not prove it to be of a long or square Form. Besides, we read also of the Foundati-ons of Heaven, מוֹסְדוֹת 2 Sam. 22. 8. And yet we must not hence infer, that they are without all Motion: As also of the planting of the Heavens, *Isa. 51. 6.* which may as well prove them to be immoveable, as that which follows in the same Verse concerning the Foundations of the Earth.

Which Phrase (if I have observed right) in several Places of Scripture, is to be understood according to these three Interpretations.

1. It is taken sometimes for the lower Parts of the Earth, as appears by that Place, 2 Sam. 22. 16. *The channels of the Sea appeared, the foundations of the World were discovered.* So Psal. 18. 15.

2. Sometimes for the Beginning and first Creation of it. *Isa. 40. 2. Hath it not been told you from the beginning, have ye not understood from the foundations of the Earth? And in many other Places, Before the Foundations of the World was laid; that is, before the first Creation.* Joh. 17. 24. Ephe. 1. 4.

3. Sometimes it signifies the Magistrates and chief Governors of the Earth. So, many interpret that Place in *Micah*, where 'tis said, 6. 2. *Hear O ye mountains the Lord's controversy, and ye strong foundations of the Earth.* So Psal. 82. 5. *The foundations of the Earth are out of course; and in Sam. 2. 8. They are called Pillars. For the Pillars of the Earth are the Lords, and he hath set the World upon them.* Hence it is, that the Hebrews derive their Word for Master, or Lord, from a Root which signifies a Basis or Bottom. ארן, *ab* ארן. And the Greek Word for King, does in its Primitives import as much as the Foundation of the People, βασις, *quasi* ἐκείνης τῆς λαῶ. But now, none of all the several Interpretations of this Phrase, will in the least manner conduce to the Confirmation of the present Argument. Etimol. mag.

As for the Second Word, מְנוּחָה *Basis ejus*: I answer, the proper Signification of it, is *locus dispositus, sedes, or statio*, an appointed Seat or Station; and according to this Sense, is it most frequently used in Scripture. And therefore, the Heavens are sometimes called מְנוּחָה the Seat of God's Habitation. And for this Reason likewise, do *Aquila* and *Symmachus* translate it by the Word ἐδρα, a Seat or appointed Situation, which may as well be attributed to the Heavens.

The Third Expression is בל תנוט, that it should not be moved, from the Primitive נוט, which does not signify barely to move, but *declinare, or vacillare*, to decline or slip aside from its usual Course. Thus is it used

used by *David*, *Psal.* 17. 5. where he prays, *Hold up my goings in thy paths, בַּר נַמְטוּ בַּעֲמִי* That my footsteps slide not: He does not mean that his Feet should not move. So *Psal.* 121. 3. He will not suffer thy foot to be moved. Thus likewise, *Psal.* 16. 8. Because the Lord is at my right hand, I shall not be moved. Which last Place is translated in the New Testament by the Greek Word *σαλδῶ*, which signifies *fluctuate*, or *wacillare*, to be shaken by such an uncertain Motion as the Waves of the Sea. Now as *David's* Feet may have their usual Motion, and yet in this Sense be said not to move, that is, not to decline or slip aside; so neither can the same Phrase applied to the Earth, prove it to be immoveable.

Act. 2. 25.

Comment.
in Job.

Nor do I see any Reason, why that of *Didacus Asturica* may not be truly affirmed, That we may prove the natural Motion of the Earth, from that Place in *Job* 9. 6. *Qui commovet terram e loco suo*, as well as its Rest and Immobility from these.

From all which, it is very evident, that each of these Expressions, concerning the founding or establishing both of Heaven or Earth, were not intended to shew the Unmoveableness of either; but rather, to manifest the Power and Wisdom of Providence, who had so settled these Parts of the World in their proper Situations, that no natural Cause could displace them, or make them decline from their appointed Course. As for such who do utterly dislike all new Interpretation of Scripture, even in such Matters as do meerly concern Opinion, and are not fundamental, I would only propose unto them a Speech of *St. Hierom*, concerning some that were of the same Mind in his Time. *Cum novas semper expetant voluptates, & gulæ eorum vicina Marianon sufficiant, cur in solo studio Scripturarum, veteri sapore contenti sunt.*

Thus have I in some measure cleared the chief Arguments from Scripture, against this Opinion. For which notwithstanding, I have not thence cited any;

be-

because I conceive the Holy Writ, being chiefly intended to inform us of such things as concern our Faith and Obedience, we cannot thence take any proper Proof for the Confirmation of Natural Secrets.

P R O P. VI.

That there is not any Argument from the Words of Scripture, Principles of Nature, or Observations in Astronomy, which can sufficiently evidence the Earth to be in the Centre of the Universe.

OUR Adversaries do much insult in the strength of those Arguments which they conceive do unanswerably conclude the Earth to be in the Centre of the World. Whereas, if they were but impartially considered, they would be found altogether insufficient for any such Conclusion, as shall be clearly manifested in this following Chapter.

The Arguments which they urge in the Proof of this, are of Three sorts; Either such as are taken,

1. From Expressions of Scripture.
2. From Principles of Natural Philosophy.
3. From common Appearances in Astronomy.

Those of the first kind are chiefly Two: The first is grounded on that common Scripture-Phrase, which speaks of the Sun, as being above us. So *Solomon* often mentioning human Affairs, calls them, *the works which are done under the Sun*. From whence it appears, that the Earth is below it, and therefore nearer to the Centre of the *Universe*, than the Sun. *Eccles. 1. 14, &c.*

I answer: Though the Sun in comparison to the absolute Frame of the World, be in the midst; yet this does not hinder, but that in respect to our Earth, he may be truly said to be above it; because we usually measure

measure the height or lowness of every thing, by its being further off, or nearer unto this Centre of our Earth. From which, since the Sun is so remote, it may properly be affirmed that we are under it, though notwithstanding that be in the Centre of the World.

A second Argument of the same kind, is urged by *Frömondus*.

Antar. c.
12. item
Vesta.
tract. 5.
c. 2.

'Tis requisite, that Hell (which is in the Center of the Earth) should be most remotely situated from the Seat of the Blessed. But now this Heaven, which is the Seat of the Blessed, is Concentrical to the Starry Sphere: And therefore it will follow, that our Earth must be in the midst of this Sphere; and so consequently in the Center of the World.

I answer: This Argument is grounded upon these Uncertainties;

1. That Hell must needs be situated in the Center of our Earth.

2. That the Heaven of the Blessed must needs be Concentrical to that of the Stars.

3. That Places must be as far distant in Situation as in Use.

Which because they are taken for granted, without any Proof, and are in themselves but weak and doubtful; therefore the Conclusion (which always follows the worse part) cannot be strong, and so will not need any other Answer.

The second sort of Arguments taken from Natural Philosophy, are principally these Three.

Arg. 1.

1. First, from the Vileness of our Earth, because it consists of a more sordid and base Matter than any other part of the World; and therefore must be situated in the Center, which is the worst place, and at the greatest distance from those purer incorruptible Bodies, the Heavens.

I answer: This Argument does suppose such Propositions for Grounds, which are not yet proved, and therefore not to be granted. As, 1. That

1. That Bodies must be as far distant in Places, as in Nobility.

2. That the Earth is of a more ignoble Substance than any of the other Planets, consisting of a more base and vile Matter.

3. That the Center is the worst Place.

All which are (if not evidently false) yet very uncertain.

2. From the Nature of the Center, which is the place of Rest, and such as in all Circular Motions is its self immovable, and therefore will be the fittest Situation for the Earth; which by reason of its heaviness, is naturally unfit for Motion. *Arg. 2.*

I answer: This Argument likewise is grounded upon these Two false Foundations; As,

1. That the whole Frame of Nature does move round, excepting only the Earth.

2. That the whole Earth, considered as whole, and in its proper Place, is heavy, or more unfit for a Natural Motion, than any of the other Planets.

Which are so far from being such general Grounds from which Controversies should be discussed, that they are the very thing in Question betwixt us and our Adversaries.

3. From the Nature of all heavy Bodies, which is to fall towards the lowest Place. From whence they conclude, that our Earth must be in the Center. *Arg. 3.*

I answer: This may prove it to be a Center of Gravity, but not of Distance, or that it is in the midst of the World. Yea, (but say our Adversaries) *Aristotle* for this urges a Demonstration, which must needs be infallible. Thus the Motion of light Bodies does apparently tend upward towards the Circumference of the World: But now the Motion of heavy Bodies is directly contrary to the ascent of the other; wherefore it will necessarily follow, that these do all of them tend unto the Center of the World.

I answer: Though *Aristotle* were a Master in the Art of *Syllogisms*, and he from whom we received the Rules of Disputation; yet in this Particular, 't's very plain that he was deceived with a Fallacy, whilst his Argument does suppose that which it does pretend to prove.

That light Bodies do ascend unto some Circumference which is higher and above the Earth, is plain and undeniable. But that this Circumference is the same with that of the World, or Concentrical unto it, cannot be reasonably affirmed, unless he suppose the Earth to be in the Center of the *Universe*, which is the thing to be proved.

I would fain know from what Grounds our Adversaries can prove, that the Descent of heavy Bodies is to the Center; or the Ascent of light Bodies, to the Circumference of the World. The utmost Experience we can have in this kind, does but extend to those things that are upon our Earth, or in the Air above it. And alas! what is this unto the vast Frame of the whole *Universe*, but *punctulum*, such an insensible Point, which does not bear so great a proportion to the whole, as a small Sand does unto the Earth. Wherefore it were a senseless thing, from our Experience of so little a part, to pronounce any thing infallibly concerning the Situation of the whole. The Arguments from *Astronomy*, are chiefly these Four; each of which are boasted of to be unanswerable.

Arg. (1.)

1. The *Horizon* does every where divide all the great Circles of a Sphere into two equal Parts; so there is always half the Equinoctial above it, and half below. Thus likewise, there will constantly be six Signs of the *Zodiack* above the *Horizon*, and other six below it. And besides, the Circles of the Heaven and Earth, are each way proportionable to one another; as Fifteen *German* Miles on the Earth, are every where agreeable to one Degree in the Heavens; and one Hour in the Earth, is correspondent to Fifteen Degrees in

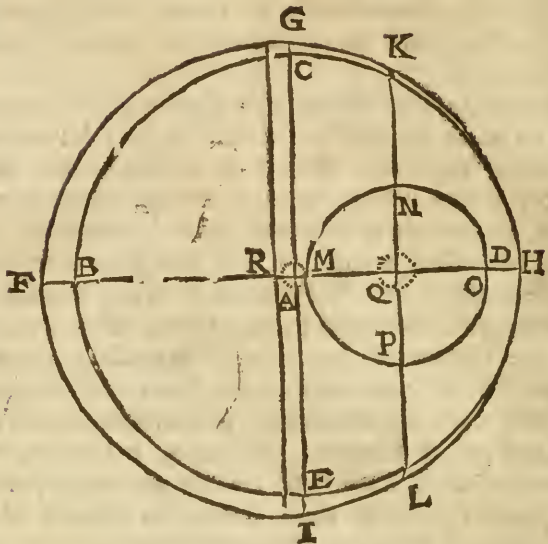
The Equator. From whence it may be inferred, that the Earth must necessarily be situated in the midst of these Circles; and so consequently, in the Center of the World.

I answer: This Argument does rightly prove the Earth to be in the midst of these Circles; but we cannot hence conclude, that it is in the Center of the World: From which, though it were never so much distant, yet would it still remain in the midst of those Circles, because it is the Eye that imagines them to be described about it. Wherefore it were a weak and preposterous Collection, to argue thus, That the Earth is in the Center of the World, because in the midst of those Circles; or because the Parts and Degrees of the Earth, are answerable in proportion to the Parts and Degrees in Heaven. Whereas, it follows rather on the contrary, That these Circles are equally distant and proportional in their Parts, in respect of the Earth, because it is our Eye that describes them about the Center of it.

So that though a far greater part of the World did appear at one time than at another, yet in respect of those Circles which our Eye describes about the Earth, all that we could see at once, would seem to be but a perfect Hemisphere; as may be manifested by this following Figure.

P

Where



Where if we suppose *A* to be our Earth, *BCDE* one of the great Circles which we fancy about it, *FGHI* the Orb of fixed Stars, *R* the Center of them: Now though the Ark *GFI* be bigger than the other *GHI*, yet notwithstanding, to the Eye on the Earth *A*, one will appear a Semicircle as well as the other; because the Imagination does transfer all those Stars into the lesser Circle *BCDE*, which it does fancy to be described above that Center. Nay, tho' there were a habitable Earth at a far greater distance from the Center of the World, even in the place of *Jupiter*, as suppose at *Q*; yet then also would there be the same Appearance. For though the Ark *KFL* in the Starry Heaven, were twice as big as the other *KHL*, yet notwithstanding at the Earth *Q* they would both appear but as equal Hemispheres, being transferred into that other Circle *MNOP*, which is part of the Sphere that the Eye describes to it self about that Earth.

From

From whence we may plainly discern, That though the Earth be never so far distant from the Center of the World, yet the Parts and Degrees of that imaginary Sphere about it, will always be proportional to the Parts and Degrees of the Earth.

Arg. (2.)

Vid. Corp. Geog. l. 1. c. 5.

2. Another Demonstration like unto this former, frequently urged to the same purpose, is this. If the Earth be out of the Center of the World, then must it be situated in one of these Three Positions: Either in the *Equator*, but out of the *Axis*; or 2^{dly}, in the *Axis*, but out of the *Equator*; or 3^{dly}, besides both of them. But it is not placed according to any of these Situations, therefore must it needs be in the Center.

1. 'Tis not in the *Equator*, and beside the *Axis*: For then, 1st, there will be no *Equinox* at all in some Places, when the Days and Nights shall be of an equal length; 2^{dly}, the Afternoons and Forenoons will not be of the same length; because, then our Meridian Line must divide the *Hemisphere* into unequal Parts.

2. 'Tis not in the *Axis*, but out of the *Equator*; for then, first, the *Equinox* would not happen when the Sun was in the middle Line betwixt the two *Solstices*, but in some other Parallel, which might be nearer to one of them, according as the Earth did approach to one *Tropick* more than another. Secondly, there would not be such a proportion between the increase and decrease of Days and Nights, as now there is.

3. 'Tis not besides both of them: For then, all these Inconveniencies, and sundry others must with the same necessity of Consequence be inferred. From whence it will follow, That the Earth must be situated there where the *Axis* and *Equator* meet, which is in the Center of the World.

To this we grant, that the Earth must needs be placed both in the *Axis* and *Equator*; and so consequently, in the Center of that Sphere which we imagine about it. But yet this will not prove, that it is in the

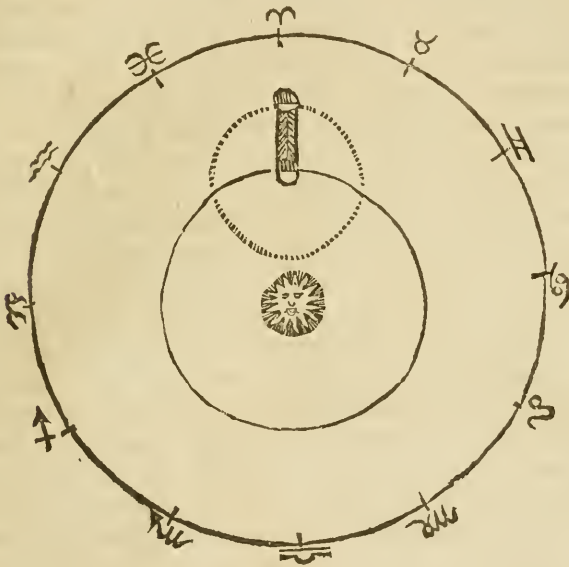
midst of the *Universe* : For let our Adversaries suppose it to be as far distant from that, as they conceive the Sun to be ; yet may it still be situated in the very Concourse of these two Lines ; because the *Axis* of the World is nothing else, but that imaginary Line which passes through the Poles of our Earth, to the Poles of the World. And so likewise the *Equator* is nothing else but a great Circle in the midst of the Earth, betwixt both the Poles, which by Imagination is continued even to the fixed Stars. Thus also, we may affirm the Earth to be in the Plane of the *Zodiack*, if by its Annual Motion it did describe that imaginary Circle : And in the Plane of the *Equator*, if by its Diurnal Motion about its own *Axis*, it did make several Parallels, the midst of which should be the *Equator*. From whence it appears, that these two former Arguments proceed from one and the same Mistake ; whilst our Adversaries suppose the Circumference and Center of the Sphere, to be the same with that of the World.

Arg. 3.

Another Demonstration of the same kind, is taken from the Eclipses of the Sun and Moon ; which would not always happen when these two Luminaries are Diametrically opposed, but sometimes when they are less distant than a Semicircle, if it were so that the Earth were not in the Center.

Answer : This Argument, if well considered, will be found most directly to infer this Conclusion ; That in all Eclipses, the Earth is in such a strait Line (betwixt the two Luminaries) whose Extremities do point unto opposite parts of the *Zodiack*. Now, tho' our Adversaries should suppose (as *Copernicus* does) the Earth to be situated in that which they would have to be the Sun's Orb ; yet would there not be any Eclipse, but when the Sun and Moon were Diametrically opposite, and our Earth betwixt them ; as may clearly be manifested by this Figure, where you see the two Luminaries in opposite Signs : And according as any
part

part of our Earth is situated by its Diurnal Revolution, so will every Eclipse be either visible, or not visible unto it.



The last and chief Argument, is taken from the appearance of the Stars; which in every Horizon, at each Hour of the Night, and at all times of the Year, seem of an equal bigness. Now this could not be, if our Earth were sometimes nearer unto them by 2000000 German Miles, which is granted to be the Diameter of that Orb wherein the Earth is supposed to move.

*Arg. 4.
Arist. Mete.
celo. lib. 2.
c. 14.*

I answer: This Consequence will not hold, if we affirm the Earth's Orb not to be big enough for the making of any sensible difference in the appearance of the fixed Stars.

Yea, but (you will say) 'tis beyond Conceit, and without all Reason, to think the fixed Stars of so vast a distance from us, that our approaching nearer unto

*Copern. 1. 1.
cap. 5, 6.*

them by 2000000 German Miles, cannot make any difference in the seeming Quantity of their Bodies.

I reply : There is no certain way to find out the exact distance of the Starry Firmament ; but we are fain to conclude of it by Conjectures, according as several Reasons and Observations seem most likely unto the Fancies of divers Men. Now that this Opinion of *Copernicus* does not make it too big, may be discerned from these following Considerations.

The Words *Great* and *Little*, are relative Terms, and do import a Comparison to something else : So that where the Firmament, (as it is according to *Copernicus*) is said to be too big, 'tis likely that this Word is to be understood in reference to some other thing of the same kind, the least of which is the Moon's Orb. But now if its being so much bigger than this, may be a sufficient Reason why it should be thought too great, then it seems that every thing which exceeds another of the same kind in such a proportion, may be concluded to be of too big a Quantity ; and so consequently, we may affirm that there is no such thing in the World. And hence it will follow, that Whales and Elephants are meer *Chimæras*, and Poetical Fictions, because they do so much exceed many other Living Creatures. If all this eighth Sphere, (saith *Galilæus*) as great as it is, were a light Body, and placed so far from us that it appeared but as one of the lesser Stars, we should then esteem it but little ; and therefore we have no reason now to thrust it out from being amongst the Works of Nature, by reason of its too great Immensity. 'Tis a frequent Speech of our Adversaries, *Tycho*, *Fromondus*, and others, in excuse of that incredible Swiftnes which they imagine in their *primum mobile*, That 'twas requisite the Motion of the Heavens should have a kind of Infinity in it, the better to manifest the Infiniteness of the Creator. And why may not we as well affirm this concerning the Bigness of the Heavens ? *Difficilius est accidens præ-*

ter modulum subjecti intendere, quam subjectum sine accidente augere (saith Kepler.) His Meaning is, that 'tis less absurd to imagine the eighth Sphere of so vast a bigness, as long as it is without Motion, or at least has but a very slow one; than to attribute unto it such an incredible Celerity, as is altogether disproportionable to its Bigness.

2. 'Tis the Acknowledgment of *Clavius*, and might easily be demonstrated, That if the Center were fastened upon the Pole of the World, the Orb wherein he supposes the Sun to move would not be able to reach so far in the eighth Sphere (being considered according to *Ptolomy's Hypothesis*) as to touch the Pole-Star; which notwithstanding (saith he) is so near the Pole it self, that we can scarce discern it to move: Nay, that Circle which the Pole-Star makes about the Pole, is above Four times bigger than the Orb of the Sun. So that according to the Opinion of our Adversaries, though our Earth were at that distance from the Center, as they suppose the Sun to be, yet would not this *Eccentricity* make it nearer to any one part of the Firmament, than the Pole-Star is to the Pole; which according to his Confession, is scarce sensible. And therefore according to their Opinion, it would cause very little difference in the appearance of those Stars, the biggest of which does not seem to be of above five Seconds in its Diameter.

3. 'Tis considerable, That the Spheres of *Saturn*, *Jupiter*, *Mars*, are, according to the general Opinion, of very great Extension; and yet each of them is appointed only to carry about its particular Planet, which are but very little in comparison of the fixed Stars. Now if for the Situation of these fixed Stars, there should be allotted a proportionable part of the World, 'tis certain that their Orb must be far bigger than it is commonly supposed, and very near to this Opinion of *Copernicus*.

*Comment.
in Spher.
cap. 1.*

4. We usually judge the bigness of the higher Orbs by their different Motions: As because *Saturn* finishes his Course in Thirty Years, and *Jupiter* in Twelve, therefore we attribute unto those Orbs such a different proportion in their Bigness. Now if by this Rule we would find out the Quantity of the eighth Sphere, we shall discern it to be far nearer unto that Bigness which *Copernicus* supposeth it to have, than that which *Ptolemy*, *Tycho*, and others ordinarily ascribe unto it: For the Starry Heaven (say they) does not finish his Course under 26000 Years; whereas *Saturn*, which is next unto it, does compass his Orb in Thirty Years. From whence it will probably follow, that there is a very great distance betwixt these in place, because they have such different Terms of their Revolutions.

But against this Answer unto the last Argument, our Adversaries thus reply:

Fromond. V. sic. 157. 5. cap. 1. 1. If the fixed Stars are so far distant from us, that our approaching nearer unto them by 1000000 German Miles, does not make any sensible difference in their appearance; then *Galleus's* Perspective could not make them seem of a bigger Form than they do to the bare Eye, which yet is contrary to common Experience.

Ibid. 2. From hence it may be inferred, That the least fixed Star is bigger than all this Orb wherein we suppose the Earth to move; because there is none of them but are of a sensible Bigness in respect of the Firmament, whereas this it seems is not.

Ibid. 3. Since God did at first create the Stars for the use of all Nations that are under the whole Heavens, Deut. 4. 19. it might have argued some Improvidence in him, if he had made them of such vast Magnitudes; whereas they might as well bestow their Light and Influences, and so consequently be as serviceable to that end for which they were appointed, if they had been made with less Bodies, and placed nearer unto us. And 'tis a common Maxim, that Nature in all her Operations, does

does avoid Superfluities, and use the most compendious Way.

I answer :

1. To the First, whether the Perspective do make the fixed Stars appear bigger than they do to the bare Eye, cannot certainly be concluded, unless we had such an exact Glass, by which we might try the Experiment. But if in this kind we will trust the Authority of others, * *Keplar* tells us from the Experience of skilful Men, that the better the Perspective is, by so much the less will the fixed Stars appear through it, being but as meer Points, from which the Beams of Light do disperse themselves like Hairs. And 'tis commonly affirmed by others, that the Dog-star, which seems to be the biggest Star amongst those of the first Magnitude, does yet appear through this Glass but as a little Point no bigger than the fiftieth Part of *Jupiter*. Hence it is, that though the common Opinion hold the Stars of the first Magnitude to be two Minutes in their Diameter, and *Tycho* three; yet † *Galilæus*, who hath been most versed in the Experiments of his own Perspective concludes them to be but five Seconds.

* *Astron.*
Copern. lib.
4. par. 1.

† *Systems.*
mundi,
Coll. 3.

2. To the Second : First we affirm, the fixed Stars to be of a vast Magnitude. But however, this Argument does not induce any Necessity that we should conceive them so big as the Earth's Orb. For it might easily be proved, that though a Star of the Sixth Magnitude were but equal in Diameter unto the Sun (which is far enough from the Greatness of the Earth's Orb;) yet the starry Heav'n would be at such a distance from us, that the Earth's Annual Motion could not cause any Difference in its Appearance.

Suppose the Diameter of the Sun to be about half a Degree, as our Adversaries grant; whereas a Star of the Sixth Magnitude is 50 Thirds, which is comprehended in that of the Sun 2160 Times. Now if the Sun were removed so far from us, that its Diameter would seem but as one of that number whereof it now

Vid. Gal.
Ibid.

con-

contains 2160 ; then must his Distance from us, be 2160 times greater than now it is : Which is all one, as if we should say, that a Star of the Sixth Magnitude is severed from us by so many Semidiameters of the Earth's Orb. But now according to common Consent, the Distance of the Earth from the Sun, does contain 128 Semidiameters of the Earth, and (as was said before) this supposed Distance of the fixed Stars does comprehend 2160 Semidiameters of the Earth's Orb. From whence it is manifest, that the Semidiameter of the Earth, in comparison to its Distance from the Sun, will be almost doubly bigger than the Semidiameter of the Earth's Orb, in comparison to this Distance of the Stars. But now, the Semidiameter of the Earth, does make very little difference in the Appearance of the Sun, because we see common Observations upon the Surface of it, are as exactly true to the Sense, as if they were made from the Centre of it. Wherefore, that Difference which would be made in these fixed Stars, by the Annual Course of the Earth, must needs be much more unobservable, or rather altogether insensible.

2. The Consequence of this Argument is grounded upon this false Supposition, That every Body must necessarily be of an equal Extension to that Distance from whence there does not appear any sensible difference in its Quantity. So that when I see a Bird flying such a height in the Air, that my being nearer unto it, or farther from it, by Ten or Twenty Foot, does not make it seem unto my Eyes either bigger or less ; then I may conclude, that the Bird must needs be either Ten or Twenty Foot thick : Or when I see the Body of a Tree that may be half a Mile from me, and perceive that my approaching nearer to it by 30 or 40 Paces, does not sensibly make any different Appearance, I may then infer, that the Tree is Forty Paces thick ; with many the like absurd Consequences,

that

that would follow from that Foundation upon which this Argument is bottomed.

To the Third I answer: 'Tis too much Presumption, to conclude that to be Superfluous, the Usefulness of which we do not understand. There be many secret ends in these great Works of Providence, which human Wisdom cannot reach unto; and as *Solomon* speaks of those things that are under the Sun, so may we also of those things that are above it; *That no man can find out the Works of God; for though a man labour to seek it out, yea further, Though a wise man think to know it, yet shall he not be able to find it.* He that hath most insight into the Works of Nature, is not able to give a satisfying Reason, why the Planets or Stars should be placed just at this particular Distance from the Earth, and no nearer or farther. And besides, this Argument might as well be urged against the *Hypothesis* of *Ptolomy* or *Tycho*, since the Stars, for ought we know, might have been as serviceable to us, if they had been placed far nearer, than either of those Authors suppose them. Again, were there any force in such a Consequence, it would as well conclude a great Improvidence of Nature, in making such a Multitude of those lesser Stars, which have lately been discovered by the Perspective. For to what purpose should so many Lights be created for the Use of Man, since his Eyes were not able to discern them? So that our Disability to comprehend all those ends which might be aimed at in the Works of Nature, can be no sufficient Argument to prove their Superfluity. Though Scripture do tell us that these things were made for our Use, yet it does not tell us, that this is their only end. 'Tis not impossible, but that there may be elsewhere some other Inhabitants, by whom these lesser Stars may be more plainly discerned. And (as was said before) why may not we affirm that of the Bigness, which our Adversaries do concerning the Motion of the

Ecclef. 8.
17.

Hea-

Heavens? That God, to shew his own Immensity, did put a kind of Infinity in the Creature.

Lib. I.
Sect. 2. c. 1.

There is yet another Argument to this purpose, urged by *Al. Ross.* which was not referred to any of the former kind, because I could scarcely believe I did rightly understand it; since he puts it in the Front of his other Arguments, as being of Strength and Subtilty enough to be a Leader unto all the rest; and yet in the most likely Sense of it, 'tis so extremely simple to be pressed in a Controversy, that every Fresh-Man would laugh at it. The Words of it are these: *Quod minimum est in circulo debet esse centrum illius; at terra longe minor est Sole, & Æquinoctialis terrestris est omnium in Cælo circulus minimus; ergo, &c.*

By the same reason, it would rather follow, that the *Moon* or *Mercury* were in the Centre, since both these are less than the Earth. And then, whereas he says that the *Æquinoctial* of the Earth is the least Circle in the Heavens, 'tis neither true nor pertinent, and would make one suspect, that he who should urge such an Argument, did scarce understand any thing in Astronomy.

There are many other Objections like unto this, not worth the citing: The chief of all have been already answered; by which you may discern, that there is not any such great Necessity as our Adversaries pretend, why the Earth should be situated in the midst of the Universe.

P R O P. VII.

'Tis probable that the Sun is in the Centre of the World.

THE chief Reasons for the Confirmation of this Truth, are implied in the Conveniences of this
Hypo-

Hypothesis above any other; whereby we may resolve the Motions and Appearances of the Heavens into more easie and natural Causes.

Hence will the Frame of Nature be freed from that Deformity which it has according to the System of *Tycho*; who though he make the Sun to be in the midst of the Planets, yet without any good Reason denies it to be in the midst of the fixed Stars; as if the Planets, which are such eminent parts of the World, should be appointed to move about a distinct Centre of their own, which was beside that of the Universe.

Hence likewise are we freed from many of those Inconveniencies in the *Hypothesis* of *Ptolemy*, who supposed in the Heavens, *Epicycles* and *Eccentricks*, and other Orbs, which he calls the Deferents of the *Apo-ge* and *Perige*. As if Nature in framing this great Engine of the World, had been put unto such hard shifts, that she was fain to make use of Wheels and Screws, and other the like artificial Instruments of Motion.

There be sundry other particulars, whereby this Opinion concerning the Sun's being in the Centre, may be strongly evidenced; which because they relate unto several Motions also, cannot therefore properly be insisted on in this Place. You may easily enough discern them, by considering the whole Frame of the Heavens, as they are according to the System of *Copernicus*; wherein all those probable Resolutions that are given for divers Appearances amongst the Planets, do mainly depend upon this Supposition, that the Sun is in the Centre. Which Arguments (were there no other) might be abundantly enough for the Confirmation of it. But for the greater Plenty, there are likewise these Probabilities considerable.

1. It may seem agreeable to Reason, that the Light which is diffused in several spots through the Circumference of the World, should be more eminently contained, and (as it were) contracted in the Center of it, which can only be by placing the Sun there.

* *In prim.*
c. *Spher.*

2. 'Tis an Argument of * *Clavius*, and frequently urged by our Adversaries, That the most Natural situation of the Sun's Body was in the midst, betwixt the other Planets; and that for this Reason, because from thence he might more conveniently distribute amongst them both his Light and Heat. The force of which may more properly be apply'd to prove him in the Center.

3. 'Tis probable that the Planetary Orbs (which are special parts of the *Universe*) do move about the Center of the World, rather than about any other Center which is remote from it. But now 'tis evident that the Planets *Saturn*, *Jupiter*, *Mars*, *Venus*, *Mercury*, do by their Motion encompass the Body of the Sun. 'Tis likely therefore that this is situated in the midst of the World.

As for the three upper Planets, 'tis found by Observation, that they are always nearest to the Earth when in opposition to the Sun, and farthest from us when in conjunction with it; which difference is so eminent, that *Mars* in his *Perige* does appear sixty times bigger than when he is in the *Apoge*, and at the greatest distance.

Now, that the Revolution of *Venus* and *Mercury* also is about the Sun, may from hence be evidenced: First, because they are never at any great distance from him. Secondly, because they are seen sometimes above, and sometimes below him. Thirdly, because *Venus*, according to her different situation, does change her Appearance as the Moon.

4. There is yet another Argument, which † *Aristotle* himself does repeat from *Pythagoras*. The most excellent Body shou'd have the best place; but the Sun is the most excellent Body, and the Center is the best place; therefore 'tis likely the Sun is in the Center. In the Frame of Nature (which is supposed to be of an Orbicular Form) there are but two places of any eminency, the Circumference and the Centre. The Circumference being of so wide a Capacity, cannot so fitly be the peculiar Seat of a Body, that is so little in respect of it: And besides, that which is the most Excellent part of the World, should be equally preserved in it self, and shared in its Virtues by all the other parts, which can only be done by its being placed in the midst of them. This is intimated unto us in that frequent Speech of *Plato*, that the Soul of the World does reside in the innermost place of it: And that in * *Macrobius*, who often compares the Sun in the World to the Heart in a Living Creature.

† *De Cælo.*
l. 2. c. 13.

* *Saturnal.*
l. 1. c. 17,
&c.

Unto this *Aristotle* answers by a distinction: There is *medium magnitudinis*, so the Centre is the middle of a Sphere, And there is *medium naturæ*, or *informaticnis*, which is not always the same with the other; for in this Sense the Heart is the Middle of a Man; because from thence (saith he) as from the Centre, the Vital Spirits are conveyed to all the Members: And yet we know that it is not the Centre of Magnitude, or at an equal distance from all the other parts.

And besides, the Middle is the worst place, because most circumscribed, since that is more excellent which does limit any thing, than that which is bounded by it. For this Reason is it, that *Matter* is amongst those Things which are terminated, and *Form*, that which does circumscribe.

But against this Answer of *Aristotle*, it is again replied:

I. Though

Keplar,
Astr. Co-
perm. l. 4.
part. 2.

1. Though it be true, that in Living Creatures the best and chiefest part is not placed always just in the middl, yet this may be, because they are not of an Orbicular Form, as the World is.

2. Though that which bounds another Thing be more excellent than that which is terminated by it, yet this does not prove the Center to be the worst place, because that is one of the Terms or Limits of a Round Body, as well as the Circumference.

There are likewise other Arguments to this purpose, much insisted on by eminent Astronomers, taken from that Harmonical Proportion which there may be betwixt the severall distance and bigness of the Orbs, if we suppose the Sun to be in the Centre.

Mæstin.
præ. ad
Narrat.
Rhetici,
Keplar,
mysterium
Cosmogra-
phicum.

For according to this (say they) we may conceive an Excellent Harmony both in the number and the distance of the Planets: (And if God made all other things *numero & mensurâ*, much more then those greater Works, the Heavens); for then the Five Mathematical Bodies, so much spoken of by * *Euclid*, will bear in them a proportion answerable to the severall distances of the Planets from one another.

* Lib. 13.
prop. 14,
15, &c.

Thus a *Cube* will measure the distance betwixt *Saturn* and *Jupiter*; a *Pyramis* or *Tetraëdron*, the distance betwixt *Jupiter* and *Mars*; a *Dodecaëdron*, the distance betwixt *Mars* and the *Earth*; an *Icosaëdron*, the distance betwixt the *Earth* and *Venus*; and an *Octaëdron*, the distance betwixt *Venus* and *Mercury*; that is, if we conceive a *Circumference* described immediately without the *Cube*, and another within it, the distance between these two will shew what proportional distance there is betwixt the Orb of *Saturn*, and that of *Jupiter*. Thus also if you conceive a *Circumference* described on the outside of a *Pyramis* or *Tetraëdron*, and another within it, this will shew such a proportional distance as there is betwixt the Orb of *Mars* from that of *Jupiter*. And so of the rest.

Now if any ask why there are but six Planetary Orbs? *Keplar* answers: *Quia non oportet plures quàm quinque proportiones esse, totidem nempe quot regularia sunt in Mathesi corpora. Sex autem termini consummant hunc proportionum numerum.* Because there are but five Proportions, so many as there are Regular Bodies in Mathematicks, each of whose Sides and Angles are equal to one another. But now there are six Terms required to consummate this number of Proportions; and so consequently, there can be but six primary Planets.

Thus likewise by placing the Sun in the Center, we may conceive such a proportion betwixt the Bodies of the Planets, as will be answerable unto their several Spheres: Then *Mercury*, which has the least Orb, will have the least Body; *Venus* bigger than that, but less than any of the other; our *Earth* bigger than *Venus*, but less than the rest; *Mars* bigger than the *Earth*, but less than *Jupiter*; *Jupiter* bigger than *Mars*, and less than *Saturn*, *Saturn* being the highest, should also be the biggest. All which Harmony would be disturbed by putting in the Sun amongst them; and therefore it may be more convenient for him to sit still in the Center.

There are sundry other Arguments in this kind to be found out, by a Consideration of this whole *Hypothesis*: He that does rightly understand it, may therein easily discern many strong Probabilities, why the Sun should be in the midst of the World, rather than in any other Position.

P R O P. VIII.

That there is not any sufficient Reason to prove the Earth incapable of those Motions which Copernicus ascribes unto it.

THE two chief Motions in the World, which are more especially remarkable above the rest, are the *Diurnal*, and *Annual*.

The *Diurnal*, which makes the difference betwixt Night and Day, is caused by the Revolution of our Earth upon its own *Axis*, in the space of four and twenty Hours.

The *Annual*, which makes the difference betwixt Winter and Summer, is likewise caused by the Earth, when being carried through the *Ecliptick* in its own Orb, it finishes its Course in a Year.

The first is usually stiled, *Motus revolutionis*: The second, *Motus circumlationis*: There is likewise a third, which *Copernicus* calls, *Motus inclinationis*: But this being thoroughly considered, cannot properly be stiled a Motion, but rather an Immutability, it being that whereby the *Axis* of the Earth does always keep parallel to it self, from which situation it is not his annual Course that does make it in the least manner to decline.

As for the Difficulties which concern the Second of these, they have been already handled in the Sixth Proposition, where the Earth's *Eccentricity* was maintained.

So that the chief business of this Chapter, is to defend the Earth's Diurnal Motion, against the Objections of our Adversaries. Sundry of which Objections, to speak (as the truth is) do bear in them a great shew of probability, and such too (as it seems) was very efficacious; since *Aristotle* and *Ptolomy*, &c. Men
of

of Excellent Parts and Deep Judgments, did ground upon them, as being of infallible and necessary consequence.

I shall reckon them up severally, and set down such Answers unto each, as may yield some satisfaction to every indifferent seeker of Truth.

I. First then, 'tis objected from our Senses ; If the Earth did move, we should perceive it. The Western Mountains would then appear to ascend towards the Stars, rather than the Stars to descend below them.

I answer : The Sight judges of Motion according as any thing does desert the Plain whereon it self is seated ; which Plain every where keeping the same situation and distance, in respect of the Eye, does therefore seem immovable unto it , and the Motion will appear in those Stars and parts of the Heaven , through which the Vertical Line does pass.

The Reason of such Deceit may be this : Motion being not a proper Object of the Sight, nor belonging to any other peculiar Sense , must therefore be judged of by the *Sensus communis*, which is liable to mistake in this respect ; because it apprehends the Eye it self to rest immovable, whilst it does not feel any Effects of this Motion in the Body ; As it is when a Man is carried in a Ship ; so that Sense is but an ill Judge of Natural Secrets. 'Tis a good Rule of *Plato*, *Ἐπὶ τὸν νῆον, ἀφορᾶν δεῖ φιλόσοφον καὶ μὴ εἰς τὴν ὄψιν* : A Philosopher must not be carried away by the bare Appearance of things to Sight, but must examine them by Reason. If this were a good Consequence, The Earth does not move, because it does not appear so to us, we might then as well argue , That it does move when we go upon the Water, according to the Verse :

Provebimur portu, terræque, verbefque recedunt.

Or if fuch Arguments would hold, it were an eafy matter to prove the Sun and Moon not fo big as a Hat, or the fixed Stars as a Candle.

*Al. Roff.
l. 1. fect. 1.
c. 1.*

Yea, but if the Motion of the Heavens be only apparent, and not real, then the Motion of the Clouds will be fo too, fince the Eye may be as well deceived in the one as the other.

I answer: 'Tis all one, as if he fhould infer that the Senfe was miftaken in every thing, becaufe it was fo in one thing: And this would be an excellent Argument to prove that Opinion of *Anaxagoras*, that the Snow was black.

The Reason why that Motion which is caufed by the Earth does appear as if it were in the Heavens, is, becaufe the *Sensus communis* in judging of it, does conceive the Eye to be it felf immovable (as was faid before) there being no Senfe that does difcern the Effects of any Motion in the Body; and therefore it does conclude every thing to move, which it does perceive to change its diftance from it: So that the Clouds do not feem to move fometimes, when as notwithstanding they are every where carried about with our Earth, by fuch a fwift Revolution; yet this can be no hindrance at all, why we may not judge aright of their other particular Motions, for which there is not the fame Reason. Tho' to a Man in a Ship, the Trees and Banks may feem to move, yet it would be but a weak Argument, to conclude from hence, that therefore fuch a one could not tell whether his Friend does really flir, whom he fees to walk up and down in the Ship: Or that he might as well be deceived in judging the Oars to move when they do not.

Ibid.

'Tis again reply'd by the fame Objector, That it is not credible the Eye fhould be miftaken in judging of the Stars and Heavens; becaufe thofe being light Bodies,

Bodies, are the primary and proper Objects of that Sense.

Answer: The Deceit here is not concerning the Light or Colour of those Bodies, but concerning their Motion; which is neither the primary nor proper Object of the Eye, but reckoned amongst the *Objecta Communia*.

2. Another Common Argument against this Motion, is taken from the Danger that would thence arise, unto all high Buildings, which by this would quickly be ruined, and scattered abroad.

Answer: This Motion is supposed to be natural; and those Things which are according to Nature, have contrary effects to other Matters, which are by force and violence. Now it belongs unto Things of this latter kind to be inconsistent and hurtful; whereas those of the first kind must be regular, and tending to conservation. The Motion of the Earth is always equal and like it self; not by starts and fits. If a Glass of Beer may stand firmly enough in a Ship, when it moves swiftly upon a smooth Stream, much less then will the Motion of the Earth, which is more natural, and so consequently more equal, cause any danger unto those Buildings that are erected upon it. And therefore to suspect any such Event, would be like the Fear of *Lactantius*, who would not acknowledge the being of any *Antipodes*, lest then he might be forced to grant that they should fall down unto the Heavens. We have equal Reason to be afraid of high Buildings, if the whole World above us were whirled about with such a mad Celerity as our Adversaries suppose; for then there would be but small hopes that this little point of Earth should escape from the rest.

Copern. l. 1. c. 8.

Gilbert de Magn. l. 6. c. 5.

But supposing (saith * *Rosse*) that this Motion were natural to the Earth, yet it is not natural to Towns and Buildings, for these are artificial.

* *Lib. 1. sect. 1. c. 3.*

To which I answer: Ha, ha, he.

3. Another Argument to this purpose is taken from the rest and quietness of the Air about us; which could not be, if there were any such swift Motion of the Earth. If a Man riding upon a fleet Horse, do perceive the Air to beat against his Face, as if there were a Wind, what a vehement Tempest should we continually feel from the *East*, if the Earth were turned about with such a swift Revolution as is supposed.

Unto this 'tis usually answered, That the Air also is carried along with the same Motion of the Earth: For if the Concavity of the Moon's Orb, which is of so smooth and glabrous a Superficies, may (according to our Adversaries) drive along with it the greatest part of this Elementary World, all the Regions of Fire, and all the vast upper Regions of Air, and (as some will have it) the two lower Regions, together with the Sea likewise; for from hence (saith *Alex. Resse*, l. 1. sect. 1. c. 3.) is it, that betwixt the *Tropicks* there is a constant Eastern Wind, and a continual flowing of the Sea Westward: I say, if the Motion of the Heavens, which are smooth Bodies, may be able to carry with it so great a part of the Elementary World: Or if the rugged parts of the Moon's Body be able to carry with it so great a part of the Air, as *Fromondus* (*Ant. c. 16.*) affirms; much more then may our Earth, which is a rugged Mountainous Body, be able to turn about so little a part of the World, as that Vaporous Air next unto it.



Suppose the inward Circle to represent the Earth; and the outward the Thicker Air, which encompasses it. Now it is easily conceivable, that the Revolution of so great a Body as this Globe of Earth, may turn about by its meer Motion (if there were nothing else) so little a part of the adjoining Air, as is here represented: And yet,

1. The Disproportion betwixt the Thickness of the Earth, and this Orb of Air, is far greater than could be express'd in the Figure, being but as twenty Miles; which is at most the thickness of this Air, unto 3456 Miles, which is the Semidiameter of our Earth, and so is but as an insensible number in respect of this other.

2. Besides the meer Motion of the Earth, which in probability (being such a rugged Body) might be enough to carry so little a part of the Air along with it; there is also (as we suppose) a Magnetical Vigor which proceeds from it, whereby 'tis more able to make all Things that are near unto it, to observe the same Revolution.

*Li. I. sect.
I. cap. 5.

But if it be so (saith * *Alex. Ross.*) that not only the Man, but the *Medium* also, and the Object be moved: This must needs be such a great hindrance to the sight, that the Eye cannot judge exactly of any thing. For, suppose the Man alone to be in a Motion, he could not see so well as when he is still; but now if not only he, but his Spectacles and Book were all moved, he would not be able to discern any thing distinctly.

Syst. mun-
di, Colloq. 2.

I answer: The Consequence were pertinent, if all these were several Motions; but if the Subject and *Medium*, and Object, were all carried with one and the same equal Motion, (as it is here supposed) this could be no Impediment to the Act of Seeing, but it would be all one with the rest; because by this Means, they are not severed from one another, and therefore the *Species* are not disturbed. 'Tis an excellent Saying of *Galileus*, and may serve for the Resolution of many such Doubts as these: *Motus eatenus tanquam motus operatur, quatenus relationem habet ad eas res quæ ipso distinguuntur, in ijs vero rebus, quæ totæ æqualiter de eo participant, nihil operatur, & ita se habet ac si nullus esset.* If a Man be within some Room of a Ship, he may read altogether as easily when the Ship moves, as when it stands still.

4. Another Argument against this Circular Motion of the Earth, is grounded upon that common Principle amongst the *Aristotelians*: *Unius corporis simplicis unus tantum est motus.* One kind of Body has but one kind of Motion. But now the Earth and Water has a Motion of Descent; the Air a Motion of Ascent; and therefore none of them can have any Circular Motion natural unto them.

I answer: First, These right Motions of Elementary Bodies belong only to the Parts of them, and that too when they are out of their proper places; so that the whole to which they belong, may notwithstanding this, have another Motion of its own. But

Secondly,

Secondly, this Saying which *Aristotle* calls a Principle, will not consist with other evident Experiments of Nature. Thus, though a Loadstone, in respect of its Matter and Condensity, naturally tends downward; yet this does not hinder, but that in respect of some other Qualities, as its desire of Union and Coition to another Loadstone, it may also naturally move upwards. From whence it will follow, that the same Elementary Body may have divers Natural Motions.

5. The Gravity and Magnitude of this Earthy Globe do make it altogether unfit for so swift a Motion.

I answer: First, Heaviness can only be applied unto those Bodies which are out of their proper Places, or unto such parts as are severed from the whole to which they belong. And therefore the Globe of Earth, (considered as whole, and in its right place) cannot truly be called heavy. I deny not, but that there is in it, and so likewise in the other Planets, an Ineptitude to Motion, by reason of the Matter and Condensity of their Bodies: And so likewise there is as truly (though not according to the same Degrees) in the least particle of a Material condensed Substance: So that this cannot reasonably be pretended as a just Impediment, why the Earth should be incapable of such a Motion. Secondly, and though this Globe be of so vast a Magnitude, yet as Nature bestows upon other Creatures (for Instance, an Eagle and a Fly) Spirits, and motive Powers, proportionable to their several Bodies; so likewise may she endow the Earth with a Motive Faculty answerable to its Greatness. Or if this may make the Earth incapable of so swift a Motion as is supposed, much more then will the Heavens be disabled for that greater Swiftness which is imagined in them. I might add, the Globe of the Sun and *Jupiter* are observed to move about their own Centers; and therefore the Earth, which is far less than either of them, is not, by reason of its too
great

great Magnitude, made unfit for such a Revolution. Thirdly : As for the swiftness of the Earth's Course, it does not exceed (all Circumstances well considered) the Celerity of some other Motions, with which we are acquainted ; as that of the Clouds, when driven by a Tempestuous Wind ; that of a Bullet shot from a Cannon, which in the space of a Minute does fly 4 Miles : Or as another hath observed, in the second Scruple of an Hour it may pass the Fifteenth part of a German Mile. Than which, there is not any Point in the Earth's Equinoctial that moves faster : And though a Bullet be much slower in moving a greater distance, yet for so little a space, while the force of the Powder is most fresh and powerful, it does equal the swiftness of the Earth. And yet,

1. A Bullet or Cloud is carried in its whole Body, being fain to break its way through the Air round about it : But now the Earth, (in respect of this first Motion) does remain still in the same Situation, and move only about its own Center.

2. The Motion of a Bullet is violent, and against its Nature, which does strongly incline it to move downwards : Whereas the Earth, being considered as whole, and in its proper place, is not heavy, nor does it contain any Repugnancy to a Circular Motion.

6. The chief Argument on which our Adversaries do most insist, is this. If there were such a Motion of the Earth as is supposed, then those Bodies which are severed from it in the Air, would be forsaken by it. The Clouds would seem to rise and set as the Stars : The Birds would be carried away from their Nests : No heavy Body could fall perpendicular : An Arrow or Bullet being shot from East to West by the same violence, will not be carried an equal distance from us, but we should by the Revolution of our Earth, overtake that which was shot to the East, before it could fall. If a Man leaping up, should abide in the Air but one second Scruple of an Hour, or the

Sixtieth

Meslin praefat. ad Narrat. Rhet. Fromond. Vesta. tract. 1. cap. 3.

Arist. de Caelo, lib. 2. cap. 13.

Sixtieth part of a Minute, the Earth in that space would withdraw it self from him almost a quarter of a Mile. All these, and many other such strange Inferences, which are directly contrary to Sense and Experience, would follow from this Motion of the Earth.

There are Three several Ways most frequently used for the Resolving of these kind of Doubts.

1. From those Magnetical Qualities, which all Elementary Bodies do partake of.
2. From the like Motion of other things, within the Room of a Sailing Ship.
3. From the like Participation of Motion in the open Parts of a Ship.

1. For those *Magnetical* Properties, with which all these Bodies are endowed. For the better understanding of this, you must know, That besides those common Elementary Qualities of Heat, Coldness, Dryness, Moisture, &c. which arise from the Predominancy of several Elements, there are likewise other Qualities (not so well known to the Ancients) which we call *Magnetical*, of which every Particle in the Terrestrial Globe does necessarily participate: And whether it be joined to this Globe by Continuity or Contiguity, or whether it be severed from it, as the Clouds in the second Region, a Bird, or Bullet in the Air; yet does it still retain its Magnetical Qualities, together with all those Operations that proceed from them.

Now from these Properties, do we suppose the Circular Motion of the Earth to arise.

If you ask what Probabilities there are, to prove that the Earth is endowed with any such Affections; I answer: 'Tis likely, that the lower Parts of this Globe do not consist of such a soft fructifying Earth, as there is in the Surface, (because there can be no such use for it, as here, and Nature does nothing in vain,) but rather of some hard rocky Substance; since

since we may well conceive, that these lower Parts are pressed close together by the weight of all those heavy Bodies above them. Now 'tis probable, that this rocky Substance is a Loadstone, rather than a *Jaspis*, *Adamant*, *Marble*, or any other; because Experience teacheth us, that the Earth and Loadstone do agree together in so many Properties. Suppose a Man were to judge the Matter of divers Bodies, each of which should be wrapt up in some Covering from his Eye, so that he might only examine them by some other outward Signs: If in this Examination he should find any particular Body which had all the Properties that are peculiar to a Loadstone, he should in reason conclude it to be of that Nature, rather than any other. Now there is altogether as much reason why we should infer, that the inward Parts of the Earth do consist of a Magnetical Substance. The Agreement of these two you may see largely set forth in the Treatise of *D. Gilbert*. I will instance only in one Example; which of it self may sufficiently evidence, that the Globe of Earth does partake of the like Affections with the Loadstone. In the Mariners Needle you may observe the Magnetical Motions of *Direction*, *Variation*, *Declination*; the two last of which are found to be different, according to the Variety of Places. Now this Difference cannot proceed from the Needle it self, because that is the same every where. Nor can we well conceive how it should be caused by the Heavens; for then the Variation would not be always alike in the same place, but diverse, according to those several Parts of the Heaven, which at several times should happen to be over it: And therefore it must necessarily proceed from the Earth, which being it self endowed with Magnetical Affections, does diversly dispose the Motions of the Needle, according to the difference of that Disponent Virtue which is in its several Parts.

Now to apply this unto the particular Instances of the Objection ; We say, though some parts of this great Magnet, the Earth, may according to their Matter be severed from the whole ; yet are they always joined to it by a Communion of the same Magnetical Qualities ; and do no less observe these kind of Motions, when they are separated from the whole, than if they were united to it. Nor need this seem incredible, that a heavy Bullet, in such a swift violent Course, should be able to observe this Magnetical Revolution of the whole Earth ; when as we see that those great Bodies of *Saturn, Jupiter, &c.* hanging in the vast Spaces of the Æthereal Air, do so constantly and regularly move on, in their appointed Courses. Though we could not shew any Similitude of this Motion in these Inferior Bodies, with which we are acquainted ; yet we must know, there may be many things which agree to the whole Frame, that are not discernible in the divers parts of it. 'Tis natural unto the Sea to ebb and flow ; but yet there is not this Motion in every Drop or Bucket of Water. So if we consider every part of our Bodies severally, the Humours, Bones, Flesh, &c. they are all of them apt to tend downwards, as being of a condensed Matter ; but yet consider them according to the whole Frame, and then the Blood or Humours may naturally ascend upwards to the Head, as well as descend to any of the lower Parts. Thus the whole Earth may move round, though the several parts of it have not any such particular Revolution of their own. Thus likewise, tho' each condensed Body being considered by it self, may seem to have only a Motion of Descent ; yet in reference to that whole Frame of which it is a part, it may also partake of another Motion that may be natural unto it.

But some may here object ; Though the Earth were endowed with such Magnetical Affections, yet what Probability is there that it should have such a Revolution ?

tion? I answer; 'Tis observed of those other Magnetical Bodies of *Saturn*, *Jupiter*, and the Sun, that they are carried about their own Centers; and therefore 'tis not improbable, but that it may be so with the Earth also; which if any deny, he must shew a Reason why in this respect they should be unlike.

Yea, but though the Earth did move round, what ground is there to affirm that those Bodies which are severed from it, as a Bullet, or the Clouds, should follow it in the same Course?

I answer; Those Spots which are discovered about the Sun, and are thought to be Clouds or Evaporations from his Body, are observed to be carried about according to his Revolution. Thus the Moon is turned round by our Earth; the Four lesser Planets by the Body of *Jupiter*. Nay, thus all the Planets in their several Orbs, are moved about by the Revolution of the Sun, upon its own Axis, saith *Keplar*;) and therefore much more may an Arrow or Bullet be carried round by the Magnetical Motion of our Earth.

The Second Way, whereby some answer unto the Instances of this Argument, is, by shewing the like Motions of other things within some Room of a sailing Ship. Thus Experience teaches (say they) that a Candle, as also the Fumes that come from it, will always keep the same Situation in the swiftest Motion of a Ship, as if it did rest immoveably, and the Flame will not more especially bend one way, or have any troubled Fluctuation; but burn as strait and quietly, as if it did stand still. Again, it has been found (say those that have been versed in these kind of Experiments,) that the same force will cast a Body but at an equal Distance, whether or no the Body do move with, or against the Motion of the Ship. As also that any Weight being let fall, will descend in as true a Perpendicular, as if the Ship did stand still. If a Man leaping up, do tarry in the Air one second Minute of an Hour; yet the Ship will not in its greatest

Swift-

Swiftness (as it should according to the Calculation of our Adversaries) be carried from him at least fifteen Foot. If we suppose a Man to jump in such a Ship, he will not be able to pass farther, when he jumps against the Motion of it, than when he jumps with it. All which Particulars may argue, that these things are carried along together, by the common Motion of the Ship. Now if Bodies may be thus jointly moved by such a Preternatural Motion, much more then will they accompany the Earth in its diurnal Revolution, which we suppose to be Natural unto them, and as a Law imposed by God in their first Creation.

If the Flame of a Candle, or the Smoak that comes from it, (things that are so easily moveable) are notwithstanding carried so equally, and without any Disturbance, by the Motion of a Ship; then also the Clouds in the Air, and all other light Bodies, may well enough be turned about by the Revolution of our Earth.

If an equal Force will cast an heavy Body but at an equal Distance, whether or no it move with, or against the Motion of the Ship; then may we easily conceive, that an Arrow or Bullet being shot with the same Violence, will pass but the same Space on the Earth, whether or no it be shot towards the *East* or *West*.

If a heavy Body, while the Ship does move, will fall down in a strait Line, then it is not the Revolution of our Earth that can hinder a Perpendicular Descent.

If a Man leaping up in a Ship, may abide in the Air one second Scruple of an Hour, and yet this Ship in its greatest Swiftness not withdraw it self fifteen Foot; then will not the Earth in that Space go from him almost a quarter of a Mile.

But against this 'tis objected, That the Earth has the Similitude of an open Ship, and not of any Room that is close. And though it be true, that when the
Roof

Fromondus
Vest. Tract.
2. cap. 2.

Roof and the Walls do all move together, the Air which is included betwixt them, must be carried along by the same Motion; yet it is not so with the Earth, because that hath not any such Walls or Roof, wherein it may contain and carry along with it the *Medium*. And therefore Experience will rather argue against this supposed Revolution. Thus 'tis observed, that a Stone being let fall from the Mast of a Ship that moves swiftly, will not descend to the same Point, as if the Ship did stand still. From whence it will follow, that if our Earth had such a circular Motion, then any heavy Body being let fall from some high Tower, or other steep Place, would not descend unto that Point of Earth which was directly under it at the Beginning.

To this we answer; That the Air which moves along with our Earth, is as well limited in certain Bounds, as that which is included in a Room. If you ask where these Bounds are terminated; I answer, neither by the utmost parts of the World, nor yet by the Concavity of the Moon's Orb (as *Fromondus* would have us affirm;) but by the Sphere of vaporous Air that encompasses our Earth; or which is all one, by the Orb of Magnetical Vigor, which proceeds from it. And besides, 'tis considerable that all Earthly Bodies are not only contained within these Limits, as things are in a close Room, but also as parts in that whole to which they belong.

2. Though the carrying along of the *Medium* may solve the Motion of light Bodies in a Ship, as the Flame of a Candle, Smoak, or the like; yet this cannot concur to that which hath been said of heavy Bodies, as a Man leaping up, a Bullet descending, &c. since it is not the Motion of the meer Air that is able to make these partake of the same Motion with the Ship. Unto that Argument which he urges from the Experiment of a Stone falling in an open Ship, we answer:

1. Though

1. Though the Instance of a Ship may serve as a Proof for this Opinion, it being an Argument *a minori ad majus*, from an accidental Motion to a natural; yet it will not serve against it. For though it were not thus in accidental Motions; yet this would not hinder but that it might be so in those that are supposed to be proper and natural.

2. As for that Experiment it self, 'tis but a groundless Imagination, and was never yet confirmed by any particular Experience; because 'tis certain the Event would be clean otherwise, as shall be proved in the Third Way of Answering.

3. The Third and Last Way of clearing the Doubts in the sixth Argument, is by shewing the like Participation of Motion, in those things that are in the open Parts of a Ship. To which purpose *Galilæus* urges this Experiment: If any one should let fall a Stone from an high Mast, he would find *lapidem in eundem semper Navis locum decidere, seu consistat illa, seu quantacunque velocitate moveatur*: That the Stone would always descend unto the very same Place, whether or no the Ship did move or stand still. The reason of which is, because the Motion of the Ship is likewise impressed in the Stone: Which Impression is not equally prevalent in a light Body, as a Feather, or Wool, because the Air which has power over them, is not carried along by the same Motion of the Ship. Thus likewise will it be in this other Experiment: If a Man upon a running Horse should in his swiftest Course let fall a Bullet or Stone, these heavy Bodies, besides their own Descent, would also participate that transverse Motion of the Horse. For as those things that are thrown from us, do continue their Motion when they are out of the Hand in the open Air; so likewise must it be when the force is conferred by that Motion which the Arm has from the Horse. While a Man is riding, his Arm is also carried by the same Swiftness

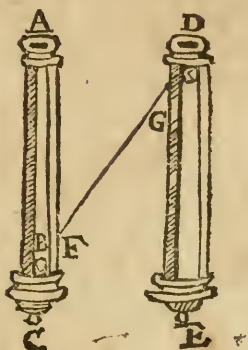
*Syst. Mund.
Colloq. 2.*

of the Horse ; therefore, if he should only open his Hand and let fall any thing, it would not descend in a strait Line, but must necessarily be driven forward, by reason of that Force impressed in it by the Swiftness of the Horse, which is also communicated to the Arm ; it being all one in Effect, whether or no the Arm be moved by a particular Motion of its own, as it is in casting of things from us ; or by the common Motion of the Body, as it is in dropping of any thing from us, either when we are on the Top of some sailing Ship, as in the *Former* ; or on some running Horse, as in this *Latter* Instance.

What hath been said concerning the Motion of Descent, is likewise applicable, both to that which is *upward*, and that which is *transversal*. So that when 'tis objected, if the Earth did move, then a Bullet that were shot up perpendicularly would be forsaken by it, and not descend to the Place from whence it arose : We answer, that the Cannon which is upon the Earth, together with the Bullet in it, do partake of the same circular Motion with the Earth ; and this perhaps our Adversaries will grant, whilst we suppose the Bullet to remain still in the Cannon ; all the Difficulty will be to shew how it must necessarily observe the same Motion, when it is shot out into the open Air. For the better Explication of this, you may note this following Figure.

Gall. Syst.
Colloq. 2.

Where



Where we suppose AC to be a Cannon perpendicularly, erected with a Bullet in it at B , which if it were immoveable, we grant that the Bullet being discharged, must ascend in a just Perpendicular. But now conceive this Cannon to move along with the Earth, then in that Space of Time while the Bullet by the Force of the Powder is ascending to the Top of the Bore, the Cannon will be transferred to the Situation DE ; so that the Bullet must be moved according to the Line FG , which is not directly upright, but somewhat declining. Now the Motion of the Bullet in the Air, must necessarily be conformed unto that Direction that is impressed in it by the Cannon from whence it is shot, and so consequently it must be continued according to the Line FG , and therefore will always keep perpendicularly over the Point from which it did ascend.

If you reply, that the Motion of the Bullet in the Cannon must needs be so swift, that the Earth cannot carry the Cannon from C to E , in the same Space of Time wherein the Bullet does move from B to A . I answer; 'tis not material whether the Earth be of a greater or lesser Swiftness than the Bullet, because the Declination must always be proportionable to the Motion of the Earth; and if we suppose this to be slower than the Bullet, then the Declination of the Line FG , will be so much the less.

This Truth may yet farther be illustrated by the Practice of those Fowlers, who use to kill Birds as they are flying: Concerning which Art, 'tis commonly thought that these Men direct their Aims to some certain Space in the Air, just before the Birds, where they conceive the Bullet will meet with them in their Flight; whereas the Truth is, they proceed in this case, the very same way, as if the Birds did stand still, by a direct aiming at their Bodies, and following of their Flight by the Motion of the Piece, till at length, having got a perfect Aim, they discharge, and do hit altogether as surely, as if the Birds were sitting upon a Tree. From whence we may observe, that the Motion of the Piece, as in our aiming it is made to follow the Birds in their Flight (though it be but slow,) yet is communicated to the Bullet in the Air.

But here it may seem very difficult to give any reason according to those Grounds concerning the Flight of Birds; which being animated, have a Liberty to fly here or there, to tarry for a good Space of Time in the open Air, and so 'tis not easie to conceive what means there is, by which they should participate of the Earth's diurnal Revolution.

To this *Galileus* answers, that the motion of the Air, as it does turn about the Clouds, so doth it also carry with it the Birds, together with such other like things that are in it. For if some violent Wind be able to drive with such Swiftnes a full laden Ship, to throw down Towers, to turn up Trees, and the like; much more then may the diurnal Motion of the Air, (which does so far exceed in Swiftnes the most tempestuous Wind) be able to carry with it the Bodies of Birds.

Ob. But if all things be turned about by this Revolution, then it should seem there is no such thing as a right motion, whether of Ascent, or Descent in a strait Line.

I answer;

I answer ; The moving of heavy or light Bodies, may be considered in a double Relation.

Sor^o

1. According to the Space wherein they move, and we grant their Motions not to be simple, but mixed of a direct and circular.

2. According to the Body or *Medium* wherein they move, and then they may properly be said to have right Motions, because they pass through the *Medium* in a strait Line ; and therefore it is, that unto us they seem directly to ascend or descend. *Aristotle* himself would not deny, but that Fire may ascend in a strait Line unto its Sphere ; and yet participate also of that circular Motion which he supposes to be communicated from the Heaven, unto the upper part of the Air, and its own Region. So likewise must it be for the Descent of any thing. Suppose a Ship in its swiftest Motion, and a Man in it, having some Vessel filled with Water, should let fall into it a little Ball of Wax, or some other matter which may be slow in its sinking, so that in one Minute it should scarce descend the Space of a Cubit, though the Ship (it may be) in the same time may pass at least a hundred Cubits ; yet would this still seem unto the Eye to descend in a strait Line ; and the other Motion which is communicated unto it by the Ship, would not at all be discernible in it. And though in this Case, the Motion were in it self composed of a circular and direct ; yet in respect of us it would appear, and so might be stiled, exactly strait.

Now if it be thus in those which are generally granted to be preternatural Motions ; we need not doubt then the possibility of the like effect in that Motion which we conceive to be proper and natural, both to the Earth, and the things that belong unto it.

There is yet another Objection to this purpose urged by * *Malapertius*, a late Jesuit ; who, though he do with much eagerness press this Argument concern-

Austriaca
Syder. part.
2. prop. 25

ing a Bullet or Stone, against the Opinion of *Copernicus*; yet he grants that it might easily be resolved, if the Defenders of it would affirm that the Air did move round with the Earth. But this, says he, they dare not avouch; for then the Comets would always seem to stand still, being carried about with the Revolution of this Air; and then they could not rise or set, as Experience shews they do.

To this it may be answered, That most Comets are above that Sphere of Air which is turned round with our Earth, as is manifest by their height. The Motion that appears in them, is caused by the Revolution of our Earth, whereby we are turned from them.

As for those which are within the Orb of our Air, these do seem to stand still. Such a one was that mentioned by † *Josephus*, which did constantly hang over *Jerusalem*; and that likewise which appeared a-boat the time of *Agrippa's* Death, and for many Days together did hang over the City of *Rome*. Wherefore ∴ *Seneca* does well distinguish out of *Epigenes*, betwixt two sorts of Comets; the one being low, and such as seem immovable; the other higher, and such as did constantly observe their Risings and Settings, as the Stars.

I have done with all the Arguments of any Note or Difficulty, that are urged against this Diurnal Motion of the Earth. Many other Cavils there are, not worth the naming, which discover themselves to be rather the Objections of a captious, than a doubtful Mind. Amongst which, I might justly pass over those that are set down by *Alex. Rosse*. But because this Author does proceed in his whole Discourse with so much Scorn and Triumph, it will not be amiss therefore to examine what infallible Evidence there is in those Arguments upon which he grounds his Boastings.

We have in one Chapter no less than these Nine.

† *De bello
Judaico, l.
7. cap. 12.
Dion. l. 54.*

∴ *Nat. Qu.
lib. 7. cap. 6.*

*Lib. 1. sect.
2. cap. 6.*

1. If the Earth did move, then would it be hotter than the Water, because Motion does produce Heat : And for this Reason likewise, the Water would be so hot and rarified, that it could not be congealed ; since that also does partake of the same Motion with the Earth. *Arg. 1.*

2. The Air which is next the Earth, would be purer, as being rarified with Motion. *Arg. 2.*

3. If the Earth did move the Air, it would cause some Sound ; but this is no more audible, than *Pythagoras's* Harmony of the Heavens. *Arg. 3.*

4. 'Twould have been in vain for Nature to have endowed the Heavens with all Conditions requisite for Motion, if they had been to stand still. As first, they have a round Figure. Secondly, they have neither Gravity nor Levity. Thirdly, they are Incorruptible. Fourthly, they have no Contrary. *Arg. 4.*

5. All Similary Parts are of the same Nature with the whole : But each part of the Earth does rest in its place ; therefore also doth the whole. *Arg. 5.*

6. The Sun in the World is as the Heart in a Man's Body ; but the Motion of the Heart ceasing, none of the Members do stir : Therefore also if the Sun should stand still, the other Parts of the World would be without Motion. *Arg. 6.*

7. The Sun and Heavens do work upon these Inferior Bodies by their Light and Motion. So the Moon does operate upon the Sea. *Arg. 7.*

8. The Earth is the Foundation of Buildings, and therefore must be firm and stable. *Arg. 8.*

9. 'Tis the constant Opinion of Divines, That the Heavens shall rest after the Day of Judgment ; which they prove from *Isa. 6. 20. Thy Sun shall no more go down, neither shall thy Moon withdraw it self.* So likewise, *Rev. 10. 6.* The Angel swears that there shall be time no longer ; and therefore the Heavens must rest, since by their Motion it is that Time is measured. And *St. Paul* says, *Rom. 8. 20. That all the Creatures*

are subject to Vanity. Now this can be no other in the Heavens, than the Vanity of Motion, which the Wise Man speaks of, *Eccles. i. 4. The Sun riseth, and the Sun goeth down, &c.*

To these it may be Answered :

Ad. 1. & 2.

In the first you may note a manifest Contradiction, when he will have the Earth to be hotter than the Water, by reason of this Motion ; when as notwithstanding, he acknowledges the Water to move along with it : And therefore too in the next Line, he infers that the Water, because of that Heat and Rarefaction which it receives from this Motion with the Earth, must be incapable of so much Cold, as to be congealed into Ice.

But unto that which may be conceived to be his Meaning in this and the next Argument ; I answer : If he had fully understood this Opinion which he opposes, he would easily have apprehended that it could not be prejudiced by either of these Consequences. For we suppose that not only this Globe of Earth and Water, but also all the vaporous Air which environs it, are carried along by the same Motion. And therefore, though what he says concerning the Heat ; which would be produced by such a Motion, were true, yet it would not be pertinent, since our Earth and Water, and the Air next unto them, are not by this means severed from one another, and so do not come within the compass of this Argument.

If any reply, That this will notwithstanding hold true concerning the upper part of the Air, where there is such a Separation of one Body from another ; and so consequently, an answerable Heat. I answer,

1. 'Tis not generally granted, That Motion in all kind of Bodies does produce Heat ; some restrain it only to solid Bodies, affirming, That in those which are fluid, it is rather the cause of Coldness. This is the reason, say they, why running Waters are ever to our sense the coolest ; and why, amongst those Winds which

which proceed from the same Coasts of Heaven, about the same time of the Year, the strongest always is the coldest? If you object, that running Waters are not so soon frozen as others, they answer; This is not because they are thereby heated, but because unto Congelation it is requisite that a Body should settle and rest, as well as be cold.

2. If we should grant a moderate heat in those parts of the Air, we have not any Experiment to the contrary, nor would it prejudice the present Opinion, or common Principles.

As the sound of this Motion is not more heard than the Harmony of the Heavens; so neither is there any Reason why this Motion should cause a sound, more than the supposed Motion of the Heavens, which is likewise thought to be continued unto the Air hard by us.

Ad. 3.

This will prove the Earth to move as well as the Heavens: For that has, first, a round Figure, as is generally granted. Secondly, being considered as whole, and in its proper place, it is not heavy, as was proved before. And as for the two other Conditions, neither are they true of the Heavens, nor if they were, would they at all conduce to their Motion.

Ad. 4.

1. This Argument would prove that the Sea did not Ebb and Flow, because there is not the same kind of Motion in every Drop of Water; or that the whole Earth is not Spherical, because every little piece of it is not of the same Form.

Ad. 5.

This is rather an Illustration than a Proof; or if it do prove any thing, it may serve as well for that purpose unto which it is afterward applied, where the Motion of every Planet is supposed to depend upon the Revolution of the Sun.

Ad. 6.

That the Sun and Planets do work upon the Earth by their own real daily Motion, is the thing in Question; and therefore must not be taken for a common Ground.

Ad. 7.

We

Ad. 8. We grant that the Earth is firm and stable from all such Motions whereby it is joggled or uncertainly shaken.

Ad. 9. 1. For the Authority of those Divines, which he urges for the Interpretation of these Scriptures; this will be but a weak Argument against that Opinion which is already granted to be a Paradox.

2. The Scriptures themselves, in their right meaning, will not at all conduce to the present purpose.

As for that in *Isaiab*, if we consult the Coherence, we shall find that the Scope of the Prophet is to set forth the Glory of the Church Triumphant. Wherein he says there shall not be any need of the Sun or Moon, but God's Presence shall supply them both: *For the Lord shall be unto thee an everlasting Light, and thy God thy Glory, ver. 19.* and as for this Sun and Moon, it shall not go down, or withdraw it self, but he shall be an *everlasting Light*: without Intermission. So that 'tis evident he speaks of that Light which shall hereafter be instead of the Sun and Moon.

Vid. Revel.
21.23.item
6.22.ver.5.

Gen. c 1 l.
2. quest. 6.

As for that in the *Revelations*, we yield that *time shall cease*; but to say that this depends upon the Cessation of the Heavens, is to beg the Question, and to suppose that which is to be proved; *viz.* That Time is measured by the motion of the Heavens, and not of the Earth. *Perrerus* (from whom this last Argument was borrowed without Acknowledgment) might have told him in the very same place, that Time does not absolutely and universally depend upon the Motion of the Heavens, *sed in motu & successione, cujuscumque durationis*, but in any such Succession, by which Duration may be measured.

As for that in the *Romans*, we say, That there are other Vanities to which the Heavenly Bodies are subject: As first, unto many Changes and Alterations; witness those Comets which at several times have been discerned amongst them; and then likewise to

that

that general Corruption, in which all the Creatures shall be involved at the last Day. *When they shall pass away with a great noise, and the Elements shall melt with fervent Heat.* 2 Pet. 3. 10, 12.

Thus you see, there is not any such invincible strength in these Arguments, as might cause the Author of them to triumph before-hand with any great Noise of Victory.

Another Objection like unto these is taken from the Etymology of several Words. Thus the Heavens are called *Æthera, ab ætèrè*, because they are always in motion, and the Earth *Vesta, qui vi stat*, because of its Immobility.

To which I answer: 'Twere no difficult matter to find such Proofs for this Opinion, as well as against it.

Thus we may say that the Hebrew Word ארץ is derived from צרר *quia currit*; and *Terra, non quod terratur, sed quod perenni cursu omnia terat*, saith *Calceagniss*. However, though we suppose the Etymology to be never so true and genuine, yet it can at the best but shew what the more common Opinion was of those Times when such Names were first imposed.

But suppose all this were so, That the Earth had such a diurnal Revolution; yet how is it conceivable that it should at the same time have two distinct Motions? Ob.

I answer: This may easily be apprehended, if you consider how both these Motions do tend the same way from West to East. Thus a Bowl being turned out of the Hand, has two Motions in the Air; one, whereby it is carried round; the other, whereby it is cast forward. Sol.

From what hath been delivered in this Chapter, the indifferent Reader may gather some Satisfaction for those Arguments which are usually urged against this Diurnal Motion of the Earth.

P R O P. IX.

That it is more probable the Earth does move, than the Sun or Heavens.

AMongst those many Arguments that may be urged for the Confirmation of this Truth, I shall set down only these Five.

1. If we suppose the Earth to be the cause of this Motion, then will those vast and glorious Bodies of the Heavens be freed from that inconceivable, unnatural swiftness, which must otherwise be attributed unto them.

*Vid. Mesl.
Epit. Astr.
l. 1. in fine.*

*De Prop.
l. 5. prop.
58.*

For if the Diurnal Revolution be in the Heavens, then it will follow according to the common *Hypothesis*, that each Star in the *Equator* must in every Hour move at the least 4529538 German Miles. So that according to the Observation of *Cardan*, who tells us that the Pulse of a well-tempered Man does beat 4000 times in an Hour; one of these Stars in that space, whilst the Pulse beats once, must pass 1132 German Miles (saith *Alphraganus*;) Or according to *Tycho*, 732 German Miles. But these Numbers seem to be somewhat of the least, and therefore many others do much enlarge them, affirming that every Star in the *Equator*, in one beating of the Pulse, must move 2528 of these Miles.

*Comment.
in prim.
cap. Sphae-
ra.*

'Tis the Assertion of *Clavius*, That though the distance of the Orbs, and so consequently their swiftness, seem to be altogether incredible; yet it is rather far greater in it self than Astronomers usually suppose it; and yet, saith he, according to the common Grounds, every Star in the *Equator* must move 42398437½ Miles in an Hour. And though a Man should constantly travel 40 Miles a Day, yet he would not be able to go so far as a Star does in one Hour,

under

under 2904 Years : Or if we will suppose an Arrow to be of the same swiftness, then must it compass this great Globe of Earth and Water 1884 times in an Hour. And a Bird that could but fly as fast, might go round the World seven times in that space, whilst one could say, *Ave Maria, gratia plena, Dominus tecum.*

Which though it be a pretty round pace, yet you must conceive that all this is spoken only of the eighth Sphere ; and so being compared to the swiftness of the *Primum Mobile*, is but a slow and heavy Motion.

For (saith the same Author) the thicknes of each Orb is equal to the distance of its Concave Superficies from the Center of the Earth. Thus the Orb of the Moon does contain as much space in its thicknes, as there is betwixt the nearest parts of that and the Center. Thus also the eighth Sphere is as thick as that whole space betwixt the Center of the Earth and its own Concave Superficies. So likewise must it be in those Three other Orbs, which he supposes to be above the Starry Heaven. Now if we proportion their swiftness according to this difference in their bigness, you may then conceive (if you can) what a kind of Celerity that must be, by which the *Primum Mobile* will be whirled about.

Tycho makes the distance of the Stars to be much less, and their Motion slower ; and yet he is fain to confess, that it is *omni cogitatione celerior.*

Clavius likewise speaking concerning the Swiftness of the Starry Orb, does acknowledge, *Quod velocitas ejus captum humani ingenij excedit.* What then could he think of the *Primum Mobile* ?

Dr. Gilbert being it seems astonish'd at the consideration of this strange Swiftness, says of it, that it is *motus supra omnes cogitationes, somnia, fabulas & licentias poeticas insuperabilis, ineffabilis, incomprehensibilis.* A Man may more easily conceive the possibility of any Fable or Fiction, how Beasts and Trees might talk together,

De magnet.
l. 6. c. 3.

gether, than how any Material Body should be moved with such a Swiftnefs.

Not but that 'tis possible for God to turn them about with a far greater Velocity. Nay 'tis possible for Art to contrive a Motion, which shall be equally slow in that proportion as this is swift. But however, the Question here is not what can be done, but what is most likely to be done according to the usual Course of Nature. 'Tis the part of a Philosopher, in the Resolution of Natural Events, not to fly unto the Absolute Power of God, and tell us what he can do, but what according to the usual way of Providence, is most likely to be done, to find out such Causes of Things, as may seem most easy and probable to our Reason.

If you ask what repugnancy there is in the Heavens, unto so great a swiftnefs: We answer, Their being such vast material condensed Substances, with which this inconceivable Motion cannot agree.

Since Motion and Magnitude are two such Geometrical Things, as bear a mutual proportion to one another; therefore it may seem convenient, that slowness should be more agreeable to a great Body, and swiftnefs to a lesser: And so it should be more consonant to the Principles of Nature, that the Earth, which is of a lesser quantity, should be appointed to such a motion as is somewhat proportionable to its bigness, than that the Heavens that are of such a vast magnitude, should be whirled about with such an incredible swiftnefs, which does as far exceed the proportion of their bigness, as their bigness does exceed this Earth, that is but a Point or Centre to them. 'Tis not likely that Nature in these constant and great Works, should so much deviate from that usual Harmony and Proportion which she observes in lesser Matters. If this Globe of Earth only were appointed to move every Day round the Orb of the fixed Stars, though it be but a little Body, and so more capable of a swift motion;

tion ; yet that swiftness would be so extremely disproportionate unto it, that we could not with Reason conceive it possible, according to the usual course of Nature. But now that the Heavens themselves, of such strange bigness, with so many Stars, which do so far exceed the magnitude of our Earth, should be able to turn about with the same celerity : Oh ! 'tis altogether beyond the Fancy of a Poet or a Madman.

For Answer unto this Argument, our Adversaries tell us, That there is not in the Heavens any repugnancy to so swift a motion ; and that whether we consider the nature of those Bodies ; or, secondly, the swiftness of this motion.

1. For the Nature of those Bodies, either $\left\{ \begin{array}{l} \text{Qualities.} \\ \text{Quantity.} \end{array} \right.$
their

1. There is not in them the Qualities of Lightness or Heaviness, or any the least Contrariety that may make them reluctant to one another.

2. Their Magnitude will help them in their swiftness : For the greater any Body is, the quicker will it be in its motion, and that not only when it is moved by an inward Principle, as a Millstone will descend faster than a little Pibble ; but also when its motion does proceed from some External Agent ; as the Wind will drive a great Cloud, or a heavy Ship, when it is not able to stir a little Stone. *Roff. l. 1. sect. 1. c. 1.*

2. As for the swiftness of this Motion, the possibility of it may be illustrated by other Particulars in Nature : As,

1. The Sound of a Cannon, in a little time is carried for twenty Miles distance. *Idem. l. 2. sect. 1. c. 1.*

2. Though a Star be situated so remotely from us, yet the Eye discerns it in a moment, which is not without some motion, either of the Species of the Star or the Rays of the Eye. Thus also the Light does in an instant pass from one side of the Heaven to another. *Idem, l. 1. sect. 1. c. 2.*

3. If

3. If the force of Powder be able to carry a Bullet with so great a swiftness, we need not doubt then, but that the Heavens are capable of such a celerity as is usually attributed unto them.

Unto these it may be answered :

1. Where they say that the Heavenly Bodies are without all gravity, we grant it, in the same sense as our Earth also, being considered as whole, and in its proper place, may be deny'd to be heavy : Since this Quality in the exactest Sense, can only be ascribed unto such parts as are severed from the whole to which they belong. But however, since the Heavens or Stars are of a material Substance, 'tis impossible but there should be in them some ineptitude to motion ; because Matter is of it self a dull and sluggish thing ; and by so much the more, as it is kept close and condensed together. And though the Followers of *Ptolomy* do with much confidence deny the Heavens to be capable of any reluctancy to Motion, yet it were easy to prove the contrary out of their own Principles. 'Tis not conceivable how the upper Sphere should move the nether, unless their Superficies were full of rugged parts (which they deny) : Or else one of the Orbs must lean upon the other with its weight, and so make it partake of its own Motion. And besides, they tell us, that the farther any Sphere is distant from the *primum mobile*, the less is it hindered by that in its proper Course, and the sooner does it finish its own Revolution. From whence it will easily follow, that these Bodies have resistency from one another.

I have often wondred why amongst the Enchanted Buildings of the Poets, they have not feigned any Castle to be made of the same Materials with the Solid Orbs, since in such a Fabrick there would have been these Eminent Conveniences.

1. It must needs be very pleasant, by reason of its perspicuity, because it is more diaphanous than the Air it self, and so the Walls of it could not hinder the Prospect any way.

2. Be-

2. Being so solid and impenetrable, it must needs be excellent against all violence of Weathers, as also against the Assaults of the Enemy, who should not be able to break it with the most furious Batteries of the Ram, or pierce it with any Cannon Shot.

3. Being void of all Heaviness, a Man may carry it up and down with him, as a Snail does his House; and so whether he follow the Enemy, or fly from him, he has still this Advantage, that he may take his Castle and Defence along with him.

But then again, there are on the other side as many Inconveniencies. For,

1. Its Perspecuity would make it so open, that a man should not be able to retire himself into any private part of it. And then,

2. Being so extremely solid, as well as invisible, a man should be still in danger of knocking his Head against every Wall and Pillar; unless it were also intangible, as some of the *Peripateticks* affirm.

3. Its being without all Gravity, would bring this Inconvenience, that every little Puff of Wind would blow it up and down; since some of the same Sect are not ashamed to say, that the Heavens are so utterly devoid of Heaviness, that if but a little Fly should juggle against the vast Frame of the Cœlestial Spheres, he would move them out of their Places.

A strong Fancy, that could be at leisure, might make excellent Sport with this Astronomical Fiction.

So that this first Evasion of our Adversaries will not shelter them from the force of that Argument, which is taken from the incredible swiftness of the Heavens.

2. Whereas they tell us in the second place, that a bigger Body, as a Millstone, will naturally descend swifter than a less, as a Pibble. I answer: This is not because such a great Body is in it self more easily

movable, but because the bigger any thing is which is out of its own Place, the stronger will be its natural desire of returning thither, and so consequently, the quicker its Motion. But now those Bodies that move circularly, are always in their proper Situations, and so the same Reason is not applicable unto them. And then, whereas 'tis said, that Magnitude does always add to the swiftness of a violent Motion (as Wind will move a great Ship sooner than a little Stone:) We answer: This is not because a Ship is more easily movable in it self than a little Stone: For I suppose the Objector will not think he can throw the one as far as the other; but because these little Bodies are not so liable to that kind of violence from whence their Motion does proceed.

As for those Instances which are cited to illustrate the possibility of this swiftness in the Heavens, we answer: The passage of a Sound is but very slow in comparison to the motion of the Heavens. And then besides, the swiftness of the Species of Sound or Sight which are Accidents, are not fit to infer the like Celerity in a Material Substance: And so likewise for the Light, which * *Aristotle* himself, and with him the generality of Philosophers, do for this very Reason prove not to be a Body, because it moves with such swiftness, of which (it seems) they thought a Body to be incapable. Nay, the † Objector himself in another place, speaking of Light in reference to a Substance, does say: *Lumen est accidens, sic species rei visæ, & alia est ratio substantiarum, alia accidentium.*

To that of a Bullet, we answer: He might as well have illustrated the Swiftness of a Bullet, which will pass 4 or 5 Miles in 2 Minutes, by the motion of a Hand in a Watch, which passes 2 or 3 Inches in 12 Hours; there being a greater disproportion betwixt the motion of the Heavens, and the swiftness of a Bullet, than there is 'twixt the swiftness of a Bullet, and the Motion of a Hand in a Watch.

Another

* *De Ani-*
ma. l. 2.
c. 7.

† *Ross. l. 2.*
sect. 1. c. 4.

Another Argument to this purpose may be taken from the chief End of the Diurnal and Annual Motions, which is to distinguish betwixt Night and Day, Winter and Summer; and so consequently, to serve for the Commodities and Seasons of the habitable World. Wherefore it may seem more agreeable to the Wisdom of Providence, for to make the Earth as well the Efficient, as the final Cause of this Motion; especially since Nature in her other Operations does never use any tedious difficult Means to perform that which may as well be accomplished by shorter and easier Ways. But now, the Appearances would be the same, in respect of us, if only this little Point of Earth were made the Subject of these Motions, as if the vast Frame of the World, with all those Stars of such Number and Bigness were moved about it. 'Tis a common Maxim, *Μίσην εἰχὴ τὴν φύσιν ἐργάζεσθαι.* Nature does nothing in vain, but in all her Courses does take the most compendious Way. 'Tis not therefore (I say) likely, that the whole Fabrick of the Heavens, which do so much exceed our Earth in Magnitude and Perfection, should be put to undergo so great and constant a Work in the Service of our Earth, which might more easily save all that Labour by the Circumvolution of its own Body; especially, since the Heavens do not by this Motion attain any farther Perfection for themselves, but are made thus serviceable to this little Ball of Earth. So that in this Case it may seem to argue as much Improvidence in Nature to employ them in this Motion, as it would in a * Mother, who in warm-

Galen.

* Lansberg.

† Kepler.

∴ Galil.

that so he might easily take a view of them.

We allow every Watchmaker so much Wisdom as not to put any Motion in his Instrument, which is superfluous, or may be supplied an easier way : And shall we not think that Nature has as much Providence as every ordinary Mechanick ? Or can we imagine that She should appoint those numerous and vast Bodies, the Stars, to compass us with such a swift and restless Motion, so full of Confusion and Uncertainties, when as all this might as well be done by the Revolution of this little Ball of Earth ?

Arg. 3.

Amongst the several parts of the World, there are Six Planets which are generally granted to move. As for the Sun and the Earth, and the fixed Stars, it is yet in question, which of them are naturally endowed with the same Condition. Now common Reason will dictate unto us, that Motion is most agreeable to that which in Kind and Properties is most near to those Bodies that undoubtedly are moved. But now there is one eminent Qualification, wherein the Earth does agree with the Planets ; whereas the Sun, together with the fixed Stars, do in the same respect differ from them : And that is Light, which all the Planets, and so too the Earth, are fain to borrow elsewhere, whilst the Sun and the Stars have it of their own. From whence it may be probably concluded, that the Earth is rather the Subject of this Motion than the other. To this it may be added, that the Sun and Stars seem to be of a more excellent Nature than the other parts of the World ; and therefore should in reason be endowed with the best Qualifications. But now Motion is not so noble a Condition as Rest. That is but a kind of wearisome and servile thing ; whereas, this is usually ascribed to God himself : Of whom 'tis said :

* *Immotus stabilisque manens dans cuncta moveri.*

† Aristotle tells us, 'tis very agreeable to Reason that the Time appointed for the Revolution of each Orb, should be proportionable to its Bigness. But now this

can

* Boet. de
Consol.

Phil. l. 3.

Arg. 4.

† De Calo,

l. 2. c. 10.

can only be by making the Earth a Planet, and the Subject of the Annual and Diurnal Motions. Wherefore 'tis probable, that this does rather move than the Heavens.

According to the common *Hypothesis*, the *Primum Mobile* will move round in a Day. *Saturn* in Thirty Years. *Jupiter* in Twelve. *Mars* in Two. The *Sun*, *Venus*, and *Mercury*, which have several Orbs, yet will agree in their Revolutions, being each of them about a Year in finishing their Courses: Whereas by making the Earth a Planet, there will be a just Proportion betwixt the Bigness of the Orbs, and the time of their Motions: For then, next to the Sun or Centre, there will be the Sphere of *Mercury*; which as it is but narrow in its Diameter, so likewise is it quick in its Motion, running its Course in 88 Days. *Venus*, that is next unto it, in 224 Days. The Earth in 365 Days, or a Year. *Mars*, in 687 Days. *Jupiter*, in 4332 Days. *Saturn*, in 10759 Days. Thus likewise is it with those *Medicean Stars* that encompass *Jupiter*. That which is lowest amongst them, finishes his Course in two and twenty Hours; the next in three Days and a half; the third, in seven Days; and the farthest in seventeen Days. Now as it is (according to *Aristotle's* Confession) more likely that Nature should observe such a due Proportion betwixt the Heavenly Orbs; so is it more probable, that the Earth should move, rather than the Heavens.

This may likewise be confirmed from the Appearance of Comets: Concerning which, there are three things commonly granted, or if they were not, might be easily proved: Namely,

1. That there are divers Comets in the Air, betwixt the Moon and our Earth.
2. That many of these Comets do seem to rise and set as the Stars.
3. That this appearing Motion is not properly their own, but communicated unto them from somewhat else.

Arg. 5.

But now, this Motion of theirs cannot be caused by the Heavens; and therefore it must necessarily proceed from the Revolution of our Earth.

That the Moon's Orb cannot carry along with it the greater part of the Air, wherein these Comets are placed, might easily be proved from the common Grounds. For the concave Superficies of that Sphere is usually supposed to be exactly terse and smooth; so that the meer touch of it cannot turn about the whole Element of Fire, with a Motion that is not natural unto it. Nor could this Elementary Fire which they imagine to be of a more rarified and subtle Nature, communicate the same Motion to the thicker Air, and that to the Waters (as some affirm:) For by what Means could that smooth Orb take hold of the adjoining Air? To this *Sarsius* answers, that there are great Gibbosities, and mountainous Inequalities, in the Concavity of the lowest Sphere, and by these is it enabled to carry along with it the Fire and Air. But * *Fromondus* tells him, *Fictitia ista & ad fugam reperta sunt*. And yet his own Conjecture is scarce so good, when he affirms, that this Motion of the Æthereal Air, as also of that Elementary Air hard by us, is caused by that Ruggedness which there is in the Bodies of the Planets; of which Opinion we may with as good Reason say as he says to *Sarsius*, *Fictitia ista & ad fugam reperta*: These Things are meer Fictions invented for Shifts, and without any probable ground.

* *Antar.*
cap. 16.

But now this Appearance of the Comets may easily be resolved, if we suppose the Earth to move. For then, though they did still remain in their wonted Places; yet this, by its diurnal Revolution successively withdrawing it self from them, they will appear to rise and set. And therefore, according to this common natural Experiment, it is more probable that the Earth should move, than the Heavens.

Another Argument urged by some to prove that this Globe of Earth is easily moveable, is taken from
the

the Opinion of those who affirm that the Access of any Weight unto a new Place, as suppose an Army, does make the Earth poise it self afresh, and change the Centre of Gravity that it had before: But this is not generally granted; and therefore not to be insisted on as a common ground.

*Vid. Vasy.
l. 1. diff. 2.
cap. 8. 16.*

To this purpose likewise is that inference of *Lansbergius*, who from *Archimedes* his saying, that he could move the Earth, if he knew where to stand and fasten his Instrument; concludes, that the Earth is easily moveable; whereas 'twas the Intent of *Archimedes* in that Speech, to shew the infinite Power of Engines: There being no Weight so great, but that an Instrument might be invented to move it.

Before we finish this Chapter, 'tis requisite that we enquire what kind of Faculty that is from which these Motions that *Copernicus* ascribes unto the Earth, does proceed: Whether or no it be some Animal Power, that does assist (as *Aristotle*) or inform (as *Keplar* thinks,) or else some other natural motive Quality which is intrinsic unto it.

We may observe, That when the proper genuine Cause of any Motion is not obvious, Men are very prone to attribute unto that which they discern to be the most frequent Original of it in other things, Life. Thus the *Stoicks* affirm, the Soul of the Water to be the Cause of the ebbing and flowing of the Sea. Thus others think the Wind to proceed from the Life of the Air, whereby it is able to move it self several Ways, as other living Creatures. And upon the same grounds do the *Platonicks*, *Stoicks*, and some of the *Peripateticks*, affirm the Heavens to be animated. From hence likewise it is, that so many do maintain *Aristotle* his Opinion concerning *Intelligences*: Which some of his Followers, the Schoolmen, do confirm out of Scripture. From that Place in *Mt. 24. 29.* where 'tis said, *The Powers of the Heavens shall be shaken.* In which words, by *Powers* (say they) are meant the Angels, by whose Power it is, that the Heavens are moved.

*Sen. Nat.
Quest. 1. 5.
cap. 5, 6.*

And so likewise in that, *Job* 9. 13. where the Vulgar has it, *Sub quo curvantur, qui portant orbem*; that is, the Intelligences. Which Text might serve altogether as well, to prove the Fable of *Atlas* and *Hercules*. Thus *Cajetan* concludes from that Place in the *Psalms* 136. 5. where 'tis said, *God by Wisdom made the Heavens*; or according to the Vulgar, *Qui fecit Caelos intellectu*, That the Heavens are moved by an intelligent Soul.

If we consider the Original of this Opinion, we shall find it to proceed from that Mistake of *Aristotle*, who thought the Heavens to be Eternal; and therefore to require such a moving Cause, as being of an Immaterial Substance, might be exempted from all that Weariness and Inconstancy which other things are liable unto.

But now this Ground of his is evidently false, since 'tis certain, That the Heavens had a beginning, and shall have an end. However, the employing of Angels in these Motions of the World, is both superfluous, and very improbable.

1. Because a natural Power, intrinsic to those Bodies, will serve the turn as well. And as for other Operations, which are to be constant and regular, Nature does commonly make use of some inward Principle.

2. The Intelligences being immaterial, cannot immediately work upon a Body; nor does any one tell us what Instruments they should make use of in this Business. They have not any Hands to take hold of the Heavens, or turn them about. And that Opinion of *Aquinas*, *Durand*, *Soncinas*, with other Schoolmen, seems to be without all Reason; who make the Faculty whereby the Angels move the Orbs, to be the very same with their Understandings and Will: So that if an Angel do but meerly suspend the Act of willing their Motion, they must necessarily stand still: And on the contrary, his only willing them to move, shall be enough to carry them about in their several Courses: Since it were then a needless thing for Providence to have appointed Angels unto this Business,
which

which might have been done as well by the only Will of God. And besides, how are the Orbs capable of perceiving this Will in the Intelligences? Or if they were, yet what Motive Faculty have they of themselves, which can enable them to obey it?

Now as it would be with the Heavens, so likewise is it with the Earth, which may be turned about in its' Diurnal Revolution, without the help of Intelligences, by some motive Power of its own, that may be Intrinsical unto it.

If it be yet enquired, what cause there is of its Annual Motion: I answer; 'Tis easily conceivable, how the same Principle may serve for both these, since they tend the same way from West to East.

However, that Opinion of *Keplar* is not very improbable, That all the Primary Planets are moved round by the Sun, which once in Twenty five or Twenty six Days, does observe a Revolution about its own Axis, and so carry along the Planets that encompass it; which Planets are therefore slower or swifter, according to their distances from him. If you ask by what means the Sun can produce such a Motion? He answers; By sending forth a kind of Magnetick Virtue in strait Lines, from each Part of its Body; of which there is always a constant Succession: So that as soon as one Beam of this Vigour has passed a Planet, there is another presently takes hold of it, like the Teeth of a Wheel.

But how can any Virtue hold out to such a distance? He answers: First, as Light and Heat, together with those other secret Influences which work upon Minerals in the Bowels of the Earth; so likewise may the Sun send forth a Magnetick, Motive Virtue, whose Power may be continued to the farthest Planets. Secondly, if the Moon, according to common Philosophy, may move the Sea, why then may not the Sun move this Globe of Earth?

In such *Queries* as these, we can conclude only from
Con-

Conjectures: That Speech of the Wise Man, *Eccles. 3. 11.* being more especially verified of *Astronomical Questions* concerning the Frame of the whole *Universe*, *That no Man can find out the Works of God, from the beginning to the end.* Though we may discern divers things in the World, which may argue the infinite Wisdom and Power of the Author, yet there will be always some Particulars left for our Dispute and Enquiry, and we shall never be able with all our Industry, to attain a perfect Comprehension of the Creatures, or to find them wholly out, *from the beginning to the end.*

Vallef. Sacr.
Philos. c. 64.

The Providence of God having thus contrived it, that so Man might look for another Life after this, when all his Longing and Thirst shall be fully satisfied. For since no natural Appetite is in vain, it must necessarily follow, that there is a possibility of attaining so much Knowledge as shall be commensurate unto these Desires; which because it is not to be had in this World, it will behove us then to expect and provide for another.

P R O P. X.

That this Hypothesis is exactly agreeable to common Appearances.

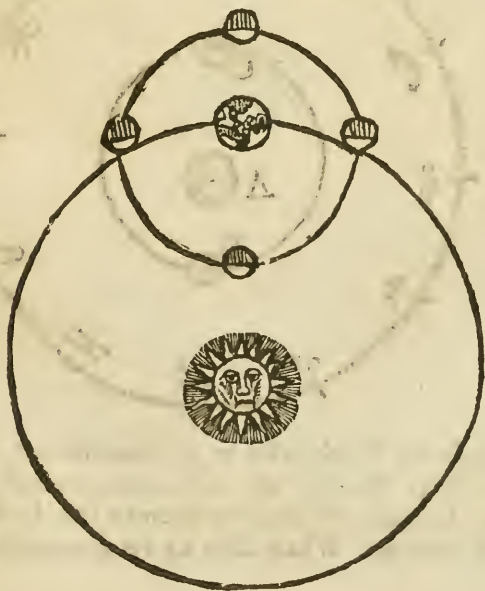
IT hath been already proved, that the Earth is capable of such a Situation and Motion as this Opinion supposes it to have. It remains, that in the last Place we shew how agreeable this would be unto those ordinary Seasons of Days, Months, Years, and all other Appearances in the Heavens.

1. As for the difference betwixt Days and Nights; 'tis evident, That this may be as well caused by the Revolution of the Earth, as the Motion of the Sun; since the Heavenly Bodies must needs seem after the same manner to rise and set, whether or no they themselves
by

by their own Motion, do pass by our *Horizon* and *Vertical Point* ; or whether our *Horizon* and *Vertical Point*, by the Revolution of our Earth, do pass by them. According to that of * *Aristotle*, ἐάν διαφύγει κινεῖν τὴν ὄψιν ἢ τὸ ὁρώμενον, there will not appear any difference, whether or no the Eye be moved from the Object, or the Object from the Eye. And therefore I cannot chuse but wonder that a Man of any Reason or Sense, should make choice of no better an Argument to conclude his Book withal, than that which we read at the latter end of *Al. Rosse*, where he infers, That the Earth does not move, because then the Shadow in a Sun-Dial would not be altered.

* *De Caelo,*
lib. 2. cap. 8.

2. As for the difference of Months, we say, That the diverse Illumination of the Moon, the different bigness of her Body, her remaining for a longer or shorter time in the Earth's Shadow, when she is Eclipsed, &c. may well enough be solved by supposing her to move above our Earth, in an Eccentrical Epicycle. Thus,



In which kind of *Hypothesis*, there will be a double difference of Motion; the one caused by the different Situations of the Moon's Body, in its own Eccentric; the other by the different Situations of the Moon's Orb, in the Earth's Eccentric: Which is so exactly answerable to the Motions and Appearances of this Planet, that from hence *Lansbergius* draws an Argument for this System of the Heavens, which in the strength of his Confidence he calls, *Demonstrationem ὁμολογουμένην, cui nulla ratione potest contradici.*

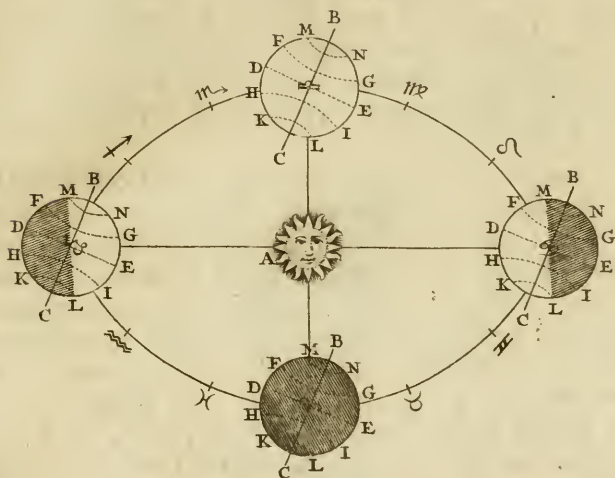
4. As for the difference betwixt Winter and Summer; betwixt the number and length of Days, which appertain to each of those Seasons; the seeming Motion of the Sun from one Sign to another in the *Zodiac*: All this may easily be solved, by supposing the Earth to move in an Eccentric Orb about the Sun. Thus,



Suppose the Earth to be at C, then the Sun at A will seem to be in the Sign ♋, and at the greatest distance from us, because the Earth is then in the farthest part of its *Eccentric*. When after by its Annual Motion it hath

hath passed successively by the Signs ♈ ♉ ♊ ♋ ♌ , at length it comes to the other *Solstice* at *B*, where the Sun will appear in ♋ , and seem biggest, as being in its *Perige*, because our Earth is then in the nearest part of its *Eccentric*.

As for all other Appearances of the Sun which concern the Annual Motion, you may see by the following Figure, that they are exactly agreeable to this *Hypotesis*.



Where you have the Earth described about the Sun at *A*, in the Four chief Points of the *Zodiack*; namely, the two *Equinoctials* at ♊ and ♋ , and the *Solstices* at ♈ and ♉ . Through all which Points the Earth does pass in his Annual Motion from West to East.

The *Axus* upon which our Earth does move, is represented by the Line *BC*, which *Axus* does always decline from that of the *Ecliptick*, about 23 Degrees, 30 Minutes. The Points *BC* are imagined to be the Poles, *B* the North-Pole, and *C* the South.

Now if we suppose this Earth to turn about its own *Axus* by a Diurnal Motion, then every Point of it will

will describe a parallel Circle, which will be either bigger or lesser, according to its distance from the Poles. The chief of them are the *Equinoctial* *D, E*. The two *Tropicks*, *F, G*; and *H, I*, the two *Polar* Circles. *M, N*, the *Arctick*, and *K, L*, the *Antarctick*; of which the *Equinoctial* only is a great Circle, and therefore will always be equally divided by the Line of Illumination *M, L*, whereas the other Parallels are thereby distributed into unequal parts. Amongst which parts, the Diurnal Arches of those that are towards *B*, the North Pole, are bigger than the Nocturnal, when our Earth is in νs and the Sun appears in \odot : Infomuch, that the whole *Arctick* Circle is enlightned, and there is Day for half a Year together under that Pole.

Now when the Earth proceeds to the other *Solstice* at $\overline{\odot}$, and the Sun appears in νs , then that *Hemisphere* must be involved in Darknes, which did before partake of Light. And those Parallels towards the North and South Poles will still be divided by the same Inequality. But those bigger parts which were before enlightned, will now be darkned, & *vice versa*. As when the Earth was in *N*, the *Arctick* Circle *M, N*, was wholly enlightned, and the *Antarctick*, *K, L*, altogether in the dark. So now, when it is in *A*, the *Antarctick* *K, L*, will be wholly in the Light, and the other *M, N*, altogether obscured. Whereas the Sun before was vertical to the Inhabitants at the *Tropick* *F, G*; so now is he in the same Situation to those that live under the other *Tropicks*, *H, I*. And whereas before the Pole did incline 23 Degrees 30 Minutes towards the Sun, so now does it decline as much from him. The whole difference will amount to 47 Degrees, which is the distance of one *Tropick* from the other.

But now in the two other Figures, when the Earth is in either of the *Equinoctials* $\nu \text{ or } \text{m}$, the Circle of Illumination will pass thro' both the Poles, and therefore

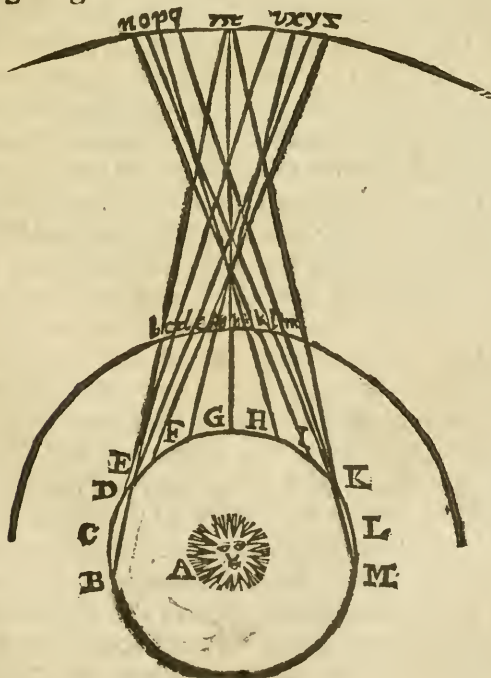
must

must divide all the Parallels into equal Parts. From whence it will follow, that the Day and Night must then be equal in all places of the World.

As the Earth is here represented in Σ , it turns only the enlightned part towards us : As it is in Ψ we see its Nocturnal Hemisphere.

So that according to this Hypothesis, we may easily and exactly reconcile every Appearance concerning the difference betwixt Days and Nights, Winter and Summer, together with all those other Varieties which depend upon them.

If you would know how the Planets (according to the System of the Heavens) will appear Direct, Stationary, Retrograde; and yet still move regularly about their own Centers, you may plainly discern it by this following Diagram.



Where

Where suppose the Sun to be at *A*, the Circle (*B*, *G*, *M*,) to be the Orb of the Earth's Motion, and that above it noted with the same Letters, to be the Sphere of *Jupiter*; and the uppermost of all, to be a part of the *Zodiack* in the Starry Heaven.

Now if you conceive the Letters *A B C D E F G H I K L M*, and *b c d e f g b i k l m*, to divide the Earth's Orb and that of *Jupiter*, into several parts, proportionable to the slowness or swiftness of their different Motions (*Jupiter* finishing his Course in 12 Years, and the Earth in one) then supposing the Earth to be at the Point (*B*) and *Jupiter* likewise in his Orb to be situated at (*b*), he will appear unto us to be in the *Zodiack* at the Point (*r*). But afterwards both of them moving forwards to the Letter (*C c*) *Jupiter* will seem to be in the *Zodiack* at (*v*), as having passed directly forward according to the Order of the Signs. And so likewise each of them being transferred to the places (*D d*) (*E e*) *Jupiter* will still appear *Direct*, and to have moved in the *Zodiack* unto the Points (*yz*). But now when the Earth comes to be more immediately interposed betwixt this Planet and the Sun; as when both of them are at the Letter (*F f*) then will *Jupiter* be discerned in the *Zodiack* at (*x*). So that all the while the Earth was passing the Arch (*E F*) *Jupiter* did still remain betwixt the Points (*z*) and (*x*), and therefore must seem unto us as if he were *Stationary*; but afterwards both of them being carried to (*G g*), then *Jupiter* will appear at (*s*), as if by a hasty motion he had returned from his former Course the space (*xs*). Both of them passig to (*H h*), this Planet will still seem to be swiftly *Retrograde*, and appear in the Point at (*p*), but when they come to the Points (*I i*), *Jupiter* will then seem to be slower in this motion, and to have only passed the Space (*pn*). Both of them being transferred to (*K k*), *Jupiter* will then appear in the *Zodiack* at (*o*) as being again *Direct*, going forward according to the order of the Signs, and while the Earth did pass the Arch

(IK) *Jupiter* then remain'd between the Points (*no*), and so consequently did again seem to be *Stationary*. Both of them coming to (*Ll*), and thence to (*Mm*), *Jupiter* will still appear *Direct*, and to have gone forward in the *Zodiack* from (*q*) to (*t*). So that all the space wherein *Jupiter* is *retrograde*, is represented by the Arch (*nz*). In which space he himself moves in his own Orb, the Arch (*ei*), and so the Earth in its Orb, a proportional space (*EI*).

As it hath been said of this Planet, so likewise is it applicable to the other, *Saturn*, *Mars*, *Venus*, *Mercury*; all which are thus made to appear *direct*, *stationary*, and *retrograde*, by the motion of our Earth, without the help of those *Epicycles* and *Excentricks*, and such unnecessary Wheel-work, wherewith *Ptolomy* hath filled the Heavens. Insomuch, that here **Fromondus* is fain to confess, *Nullo Argumento in speciem probabiliori, motum terræ annum a Copernicanis astrui, quam illo stationis, directionis, regressionis Planetarum*. There is not any more probable Argument to prove the annual motion of the Earth, than its agreeableness to the *station*, *direction*, and *regression* of the Planets.

* *Antarist.*
c. 18. *Vest.*
tract. 4.
c. 3.

Lastly, That *Copernicus's* System of the Heavens is very answerable to the exactest Observations, may be manifest from this following Description of it.

¶

Suppose



Suppose the Sun to be situated at *A*: Now because *Mercury* is found by experience to be always very near the Sun, so that he does for the most part lye hid under his Rays; as also because this Planet hath a more lively vigorous Light than any of the other; therefore we may infer, that his Orb is placed next unto the Sun, as that at *B*.

As for *Venus*, 'tis observ'd, That she does always keep at a set distance from the Sun, never going from him above 40 Degrees, or thereabouts; that her Body appears thro' the Perspective to be forty times bigger at one time than at another; that when she seems biggest and nearest unto us, we then discern her as being perfectly round. Therefore doth this Planet also move in a Circle that encompasses the Sun. Which Circle does not contain the Earth within it; because then *Venus* would sometimes be in *opposition* to the Sun; whereas

'tis generally granted, that she never yet came so far as to be in a *Sextile*.

Nor is this Circle below the Sun (as *Ptolomy* supposeth) because then this Planet, in † both its Conjunctions, would appear horned, which she does not. † *Matutina*
Vesperina.

Nor is it above the Sun, because then she would always appear in the Full, and never horned.

From whence it will follow, that this Orb must necessarily be betwixt the Earth and the Sun, as that at C.

As for *Mars*, 'tis observ'd, that he does appear sixty times bigger when he is near us, than at his greatest distance; that he is sometimes in opposition to the Sun. From whence we may conclude that his Orb does contain our Earth within it. 'Tis observed also, that he does constantly appear in the Full, and never Horned: From whence likewise it is manifest, that the Sun is comprehended within its Orb, as it is in that which is represented by the Circle E.

And because the like Appearances are observ'd in *Jupiter* and *Saturn* (tho' in less Degrees) therefore we may with good Reason conceive them to be in the Heavens, after some such manner as they are here set down in the Figure, by the Circles F. G.

As for the Moon, because she is sometimes in opposition to the Sun, therefore must her Orb comprehend in it the Earth; because she appears dark in her Conjunction, and sometimes eclipses the Sun; therefore that must necessarily be without her Orb, as it is in that *Epicycle* at H. In the Center of which, the Earth must necessarily be situated, according to all those Appearances mention'd before. So that the Orb of its annual motion will be represented by the Circle D.

All which Appearances cannot so well be reconciled by *Ptolomy*, *Tycho*, *Origanus*, or by any other *Hypothesis*, as by this of *Copernicus*. But the application of these to the several Planets, together with sundry other Particulars, concerning the *Theoretical* part of *Astronomy*, you may see more fully set down by those who have pur-

posely handled this Subject, *Copernicus, Rheticus, Galileus*; but more especially *Keplar*: Unto whom I do acknowledge myself indebted for sundry Particulars in this Discourse.

I have done with that which was the chief Purpose of the present Treatise; namely, the removal of those Common Prejudices that Men usually entertain against this Opinion. It remains, that by way of Conclusion, I endeavour to stir up others unto these kind of Studies, which by most Men are so much neglected.

'Tis the most rational way, in the prosecution of several Objects, to proportion our Love and Endeavour after every thing, according to the excellency and desirableness of it. But now amongst all Earthly Contentments, there is nothing either better in it self, or more convenient for us, than this kind of Learning; and that, whether you consider it according to its *General Nature*, as a *Science*; or according to its more *Special Nature*, as *such a Science*.

1. Consider it as a *Science*. Certain it is, that amongst the variety of Objects, those are more eligible which conduce unto the Welfare of that which is our best part, our Souls. 'Tis not so much the pleasing of our Senses, or the increasing of our Fortunes, that does deserve our Industry, as the Information of our Judgments, the Improvement of our Knowledge. Whatever the World may think, yet it is not a vast Estate, a Noble Birth, an Eminent Place, that can add any thing to our true real Worth; but it must be the degrees of that which makes us *Men*, that must make us *better Men*, the Endowments of our Soul, the Enlargement of our Reason. Were it not for the Contemplation of Philosophy, the Heathen * *Seneca* would not so much as thank the Gods for his Being: *Nisi ad haec admitterer non fuit opere pretium nasci. Detrahe hoc inestimabile bonum non est vita tanti, ut sudem, ut aestuem.* Take but away this Benefit, and he would not think Life worth the sweating for. So much Happiness could he discern in the Studies of Nature. And therefore as a *Science* in general, it may very well deserve our Love and Industry.

2. Consider it as such a particular *Science*, *Astronomy*: the Word signifies the Law of the Stars; and the *Hebrews* (who do not ordinarily admit of Composition) call it in two Words, *חוקי שמים* *Calorum Statuta*, or the *Ordinances of Heaven*; because they are governed in their Courses by a certain Rule, as the *Psalmist* speaks in the 148th *Psal.* v. 6. *God has given them a Law which shall not be broken.*

Now this of all other *Natural Sciences* may best of all challenge our Industry; and that, whether you consider it,

1. Absolutely, as it is in it self: Or,
2. As it stands in reference to us.

1. As it is in it self. The Excellency of any *Science* may be judged of (saith the Philosopher) first, by the Excellency of the Object. Secondly, by the Certainty of its Demonstrations.

* *Præf. ad*
l. 1. *Nat.*
Quest.

Job 38.33.
Jer. 33.25.

1. For the *Object*. It is no less than the whole World (since our Earth also is one of the Planets) more especially those vast and glorious Bodies of the Heavens. So that in this respect it far exceeds all those barren, empty Speculations about *Materia prima*, and *Universale*, and such like Cobwebs of Learning; in the study of which so many do misplace their younger Years. And for the same Reason likewise is it to be preferr'd before all those other *Sciences*, whose Subjects are not either of so wide an Extent, or so excellent a Nature.

2. For the *Demonstrations* of *Astronomy*, they are as infallible as Truth it self; and for this Reason also does it excel all other Knowledge, which does more depend upon Conjectures and Uncertainty. They are only those who want Skill in the Principles of this *Science*, that mistrust the Conclusions of it. Since therefore in these respects, it is one of the most Excellent *Sciences* in Nature, it may best deserve the Industry of Man, who is one of the best Works of Nature. Other Creatures were made with their Heads and Eyes turned downwards: Would you know why Man was not created so too? why it was, that he might be an *Astronomer*.

Os homini sublime dedit, Celumq; tueri

Jussit, & erectos ad Sydera tollere vultus.

God gave to Man an Upright Face, that he Might view the Stars, and learn *Astronomy*.

2. Consider it in reference to us; and so it is,

1. Most Useful.

2. Most Pleasant.

1. Most Useful, and that in sundry respects. It proves a *God* and a *Providence*, and incites our Hearts to a greater Admiration and Fear of his Omnipotency. *We may understand by the Heavens, how much mightier he is that made them; for by the Greatness and Beauty of the Creatures, proportionably the Maker of them is seen,* saith the Book of *Wisdom*, 13. 4, 5. It was hence that *Aristotle* did fetch his Chief Argument to prove a *Primus Motor*. 'Twas the consideration of these Things that first led Men to the Knowledge and Worship of God (saith * *Tully*). *Hæc nos primum ad Deorum cultum, tum ad modestiam, magnitudinemq; animi erudit.* And therefore when God by the Prophet would convince the People of his Deity, he bids them *lift up their Eyes on high, and behold who hath created those things; that bringeth out their Host by number, that calleth them all by their Names, &c.* Isa. 40. 26. Which occasion'd that Saying of *Lactantius*; *Tanta rerum magnitudo, tanta dispositio, tanta in servandis ordinibus, temporibusq; constantia; non potuit aut olim sine provido artifice oriri, aut constare tot sæculis sine incola potente, aut perpetuum gubernari sine perito & sciente rectore, quod ratio ipsa declarat.* Such a great Order and Constancy amongst those vast Bodies, could not at first be made but by a Wise Providence, nor since preserved without a Powerful Inhabitant, nor so perpetually governed without a skilful Guide. True

* *Tuscul.* 1.

Item. Plut.

deplacit.

Phil. l. 1.

c. 6.

Instit. l. 2.

c. 5.

True indeed, an ordinary View and common Apprehension of these Celestial Bodies, must needs manifest the Excellency and Omnipotency of their Maker; but yet a more accurate and diligent Enquiry into their Natures, will raise our Understandings unto a nearer Knowledge, and a greater Admiration of the Deity: As it is in those inferior things, where the meer outside of a Man, the Comeliness and Majesty of his Countenance, may be some Argument from whence to infer the Excellency of his Creator. But yet the subtle Anatomist, who searches more deeply into this wonderful Structure, may see a clear Evidence for this in the Consideration of the inward Fabrick, the Muscles, Nerves, Membranes, together with all those secret Contrivances in the Frame of this little World. Thus also is it in the great *Universe*, where the common Apprehension of Things is not at all considerable, in comparison to those other Discoveries, which may be found out by a more exact Enquiry.

As this Knowledge may conduce to the proving of a God, and making Men Religious; so likewise may it serve to confirm unto us the Truth of the Holy Scriptures: Since the Sacred Story, in the order of its Narrations, does so exactly agree with the Conversions of Heaven, and *Logistical Astronomy*.

Psal. 8, 3, 6.

It may also stir us up to behave our selves answerably unto the Noble and Divine Nature of our Souls. *When I consider the Heaven, the Works of thy Fingers, the Moon and the Stars which thou hast ordained, what is Man, that thou art so mindful of him? as to create such vast Glorious Bodies for his Service.*

* *Sen. Nat.*

Quaest. l. 1.

Nonne o

terrena ani-

malia con-

sideratis,

quibus prae-

sidere vide-

amini?

Nam si in-

ter marces

videres nu-

num ali-

quam, jus

sibi ac pote-

statem prae

ceteris vin-

dicentem,

quanto mo-

vereris cha-

chinno, &c.

Boetius de

Consol. l. 2.

Again, when I consider with my self the strange Immensity and Bigness of this great *Universe*, in comparison to which, this Earth of ours is but as an undiscernible Point: When I consider that I carry a Soul about me, of far greater Worth than all this, and Desires that are of a wider Extent, and more unbounded Capacity than this whole Frame of Nature; then, methinks, it must needs argue a Degenerateness and Poverty of Spirit, to busy my Faculties about so ignoble, narrow a Subject as any of these Earthly things. What a Folly is it in Men to have such high Conceits of themselves, for some small Possessions which they have in the World above others; to keep so great a Bustle about so poor a Matter? * *Hoc est punctum quod inter tot gentes ferro & igni dividitur.* 'Tis but a little Point which with so much ado is distributed unto so many Nations by Fire and Sword. What great Matter is it to be Monarch of a small part of a Point? Might not the Ants as well divide a little Mole-hill into divers Provinces, and keep as great a stir in disposing of their Government? *Punctum est illud in quo navigatis, in quo bellatis, in quo regna desponitis.* All this place wherein we War, and Travel, and dispose of Kingdoms, is but a Point far less than any of those small Stars, that at this distance are scarce discernible. Which when the Soul does seriously meditate upon, it will begin to despise the narrowness of its

its present Habitation, and think of providing for it self a Mansion in those wider Spaces above ; such as may be more agreeable to the Nobleness and Divinity of its Nature.

Why should any one Dream of propagating his Name, or spreading his Report through the World ? When although he had more Glory than Ambition can hope for, yet as long as all this Habitable Earth is but an inconsiderable Point, what great Matter can there be in that Fame which is included within such strait contracted Limits ?

Boetius
Ibid.

*Quicumq; solam mente præcipiti petit
Summumq; credit gloriam,
Late patentes ætheris cernat plagas,
Arcumq; terrarum situm.
Breve replere non valentis ambitum,
Pudebit aucti nominis.*

- “ He that to Honour only seeks to mount,
- “ And that his chiefest End doth count ;
- “ Let him behold the largeness of the Skies,
- “ And on the strait Earth cast his Eyes ;
- “ He will despise the Glory of his Name,
- “ Which cannot fill so small a Frame.

Why should any one be taken up in the Admiration of these lower Outfides , these Earthly Glories ? *Respicite Cæli spatium, firmitudinem, celeritatem, & aliquando desinite vilia mirari.* He that rightly understands the Nature of the Heavens, will scarce esteem any other thing worth his Notice, much less his Wonder. Idem lib.3.

Now when we lay all this together, That he who hath most in the World, hath almost nothing of it : That the Earth it self, in comparison to the Universe is but an inconsiderable Point ; and yet that this whole Universe does not bear so great a proportion to the Soul of Man, as the Earth does unto that. I say, when a Man in some retired Thoughts shall lay all this together, it must needs stir up his Spirits to a contempt of these Earthly Things, and make him place his Love and Endeavour upon those Comforts that may be more answerable to the Excellency of his Nature.

Without this Science, what Traffick could we have with Foreign Nations ? What would become of that mutual Commerce, whereby the World is now made but as one Commonwealth.

*Vosque mediis in aquis Stellæ, pelagoque timendo.
Decretum monstratis iter, totique dedistis,
Legibus inventis hominum, commercia mundo.*

’Tis you Bright Stars, that in the fearful Sea,
Do guide the Pilot through his purpos’d Way.
’Tis your Direction that doth Commerce give,
With all those Men that thro’ the World do live.

2. As this Science is ’tnus profitable in these and many other respects ; so likewise is it equally pleasant. The Eye (saith the Philosopher) is the Sense of Pleasure, and there are no De-
lights

lights so pure and immaterial as those which enter through that Organ. Now to the Understanding, which is the Eye of the Soul, there cannot be any fairer Prospect, than to view the whole Frame of Nature, the Fabrick of this great *Universe*, to discern that Order and Comeliness which there is in the *Magnitude, Situation, Motion* of the several Parts that belong unto it; to see the true Cause of that constant Variety and Alteration which there is in the different Seasons of the Year. All which must needs enter into a Man's Thoughts with a great deal of Sweetness and Complacency. And therefore it was that *Julius Cæsar* in the Broils and Tumult of the Camp, made choice of this Delight :

Wis. 7. 18,
19.

Lucan. 10.

— Media inter prælia semper,
Stellarum, Cælique plagis, superisque vacavit.

He always leisure found amidst his Wars,
To mark the Coasts of Heav'n, and learn the Stars.

And for this reason likewise did *Seneca*, amidst the continual Noise and Bustle of the Court, betake himself to this Recreation.

O quam juvabat, quo nihil majus, parens
Natura genuit, operis immensi artifex,
Cælum intueri Solis, & currus sacros
Mundique motus, Solis alternas vices,
Orbemque Phæbes, astra quem cingunt vaga
Lateque fulgens Ætheris magni decus.

O what a Pleasure was it to survey
Nature's chief Work, the Heavens; where we may
View the alternate Courses of the Sun,
The Sacred Chariots, how the World does run:
The Moon's bright Orb, when She's attended by
Those scatter'd Stars, whose Light adorns the Sky.

And certainly those eminent Men who have this way bestowed a great Part of their Employment, such as were *Ptolomy*, *Julius Cæsar*, *Alphonsus King of Spain*, the Noble *Tycho*, &c. have not only by this Means pitched upon that which for the present was a more solid kind of Pleasure and Contentment; but also a surer way to propagate their Memories unto future Ages. Those great costly Pyramids which were built to perpetuate the Memory of their Founders, shall sooner perish and moulder away into their Primitive Dust, than the Names of such Worthies shall be forgotten. The Monuments of Learning are more durable than the Monuments of Wealth or Power.

All which Encouragements may be abundantly enough to stir any considering Man, to bestow some part of his Time in the Study and Inquisition of these Truths.

Fælices animæ, quibus hæc cognoscere primum,
Inque domos superas scandere cura fuit.

Mercury :

Mercury :
OR THE
SECRET and SWIFT
Messenger.

S H E W I N G,

How a Man may with *Privacy* and
Speed communicate his *Thoughts* to a
Friend at any Distance.

The Third Edition.

By the Right Reverend Father in God,
J O H N W I L K I N S, late Lord
Bishop of **C H E S T E R**.

L O N D O N :

Printed for *John Nicholson* at the *King's-Arms* in
Little Britain; *Benj. Tooke* at the *Middle Temple*
Gate in *Fleetstreet*; *And. Bell* at the *Cross Keys* and
Bible in *Cornhill*; and *Ralph Smith* under the
Piazza of the *Royal-Exchange*. MDCCVII.

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To the Right Honourable
G E O R G E,
Lord *Berkley*, Baron of *Berkley*,
Mobray, *Segrave*, and *Bruce*,
and Knight of the Noble Order
of the *Bath*.

My Lord,

I Do here once more present your Lordship with the Fruit of my leisure Studies, as a Testimony of my Readiness to serve you in those sacred Matters, to which I devote my more serious Hours. I should not have presumed to this Dedication, had I not been encouraged by that generousness and sweetness of Disposition, which does so eminently adorn your Lordship's Place and Abilities.

If your Lordship please to excuse this Boldness, and to vouchsafe this Pamphlet a shelter under your favourable Patronage, you shall thereby encourage me in those higher Studies, which may be more agreeable to that Relation wherem I stand, as being

Your Lordship's Servant and Chaplain,

J. W.

T O

To the R E A D E R.

THat which first occasion'd this Discourse, was the reading of a little Pamphlet, stiled, *Nuntius Inanimatus*, commonly ascribed to a late Reverend Bishop; wherein he affirms, That there are certain Ways to discourse with a Friend, though he were in a close Dungeon, in a besieged City, or a Hundred Miles off.

Which Promises, at the first Perusal, did rather raise my Wonder than Belief, having before that time observed nothing that might give any Satisfaction in these Particulars. And I should have esteemed them altogether Fabulous, had it not been for the Credit of their reputed Author.

After this, I did collect all such Notes to this Purpose, as I met with in the Course of my other Studies.

From whence when I had received full Satisfaction, I did for mine own farther Delight compose them into this Method.

I have already attained mine own Ends, both in the Delight of Composing this, and the Occasion of Publishing it: And therefore need not either fear the Censure of others, or beg their Favour. I could never yet discern, that any Reader hath shewed the more Charity for the Author's bespeaking it. Farewell.

J. W.

T O

To M E R C U R Y the Elder :

On the most Learned Mercury the Younger.

REST Maja's Son, sometimes Interpreter
Of gods, and to us Men their Messenger :
Take not such Pains as thou hast done of old,
To teach Men Hieroglyphicks, and to unfold
Egyptian hidden Characters, and how
Men writ in dark Obscurity : For now
Trithemius and Selenus both are grown
Such Cryptographers, as they scarce will own
Thee for their Master ; and Decipherers know
Such secret Ways to write, thou ne'er didst show.
These are but Artists which thou didst inspire ;
But now thou of a Mercury art Sire
Of thine own Name, a Post with whom the Wind,
Should it contend, would be left far behind.
Whose Message, as thy Metal, strikes the Gold
Quite through a Wedge of Silver uncontrol'd ;
And in a moment's space doth pass as far
As from the Artick to th' Antartick Star.
So proving what is said of Influence,
May now be said of his Intelligence,
They neither of them having such a Quality
As a relation to Locality :
No Places distance hindring their Commerce,
Who freely traffick through the Universe ;
And in a minute can a Voyage make
Over the Ocean's universal Lake.
This Son of thine, could any Words or Praise,
His Learning, Worth, or Reputation raise,

*We should be Suitors to him to bestow
Encomiums on Himself, which We do owe
Unto his Worth, and use that Eloquence,
Which as his own, must claim Prebeminence :
For thee, 'tis Glory enough thou hast a Son
Of Art, that hath thy self in Art outdone.*

Sir Francis Kinaston, Knt.

To the Unknown Author.

OF Old, who to the common Good apply'd
Or Mind or Means, for it were Deifi'd :
But chiefly such who new Inventions found ;
Bacchus for Wine, Ceres that till'd the Ground.
I know no reason Time should breed such odds,
(*W* have warrant for't) Men now may be stil'd gods.
By hiding who thou art, seek not to miss
The Glory due to such a Work as this ;
But set thy Name, that thou may'st have the Praise,
Lest to the Unknown God we Altars raise.

Anthony Aucher, Esq;.

To my Friend the Author.

TO praise thy Work, were to anticipate
Thy Reader's Judgment, and to injure Fate ;
Injustice to thy self ; for real Worth
Needs not Arts Flattery to set it forth.
Some chuse selected Wits to write as Friends,
Whose Verses, when the Work fails, make amends.
So as the Buyer has his Pennyworth,
Though what the Author write prove spumy Froth.

*Thou, of a Humour cross to that, hast chose
A Friend or two, whose Verse hops like rough Prose ;
From whose inexpert Vein thou canst not look
For Lines that may enhance the Price o'rb' Book.
Let it commend it self, all we intend
Is but to shew the World thou art our Friend.*

Richard Hatton, *Esq;*

To the Reader.

Readers, this Author has not long ago
Found out another World to this below ;
Though that alone might merit great Renown,
Yet in this Book he goes beyond the Moon:
Beyond the MOON indeed, for here you see
That he from thence hath fetch'd down Mercury ;
One that doth tell us Things both strange and new,
And yet believ'e't they're not more strange than true.
I'm loth to tell thee what rare Things they be,
Read thou the Book, and then thou'lt tell them me.

Tob. Worlrich, *J. C. Doct.*

To his Honoured Friend J. W. on his
Learned Tract,
The Secret and Swift Messenger.

Inimitable Sir, we here discern
Maxims the Stagirite himself might learn.
Were Plato now alive he'd yield to you,
Confessing something might be Known anew.
Fresh Heresies (New-nothings) still appear
As Almanacks, the Births of every Year.

*This Dutchman writes a Comment ; that Translates ;
A third Transcribes ; Your Pen alone Creates
New necessary Sciences : This Art
Lay undiscover'd as the World's Fifth Part.
But Secresy's now publish'd ; You reveal
By Demonstration how we may conceal.*

*Our Legates are but Men, and often may
Great State-Affairs unwillingly betray ;
Caught by some sifting Spies, or tell-tale Wine,
Which dig up Secrets in the deepest Mine.
Sometimes, like Fire pent in, they outward break,
And 'cause they should be silent, therefore speak.*

*Nor are King's Writings safe : To guard their Fame,
Like Scævola they wish their Hand i'th' Flame.
Ink turns to Blood ; they oft participate
By Wax and Quill sad Icarus his Fate.
Hence Noblemens bad Writing proves a Plot ;
Their Letters are but Lines, their Names a Knot.*

*But now they shall no more Seal their own Fall ;
No Letters prove Killing, or Capital.
Things pass unknown, and each Ambassador's
Strict as the Breast of Sacred Confessors :
Such as the Inquisition cannot see ;
Such as are forc'd neither by Rack, nor Fee.
Swift Secrecy descends to Human Powers ;
That which was Pluto's Helmet, now is Ours.
We shall not henceforth be in pay for Air,
Transported Words being dear as precious Ware ;
Our Thoughts will now arrive before they're stale ;
They shall no more wait on the Carriers Ale
And Hostess, two Land-Remoraes, which bind
All to a Tortoise pace, though Words be Wind.
This Bock's a better Ark ; we brook no stay,
Mugre the deepest Flood, or foulest Way.
Commerce of Goods and Souls we owe to Two,
(Whose Fames shall now be Twins) Noah and You.
Each Bird is turn'd a Parrot, and we see
Esop's Beasts made more eloquent by thee.*

Woovers again may wing their fetter'd Love,
By Noah's trusty Messenger the Dove.
Torches which us'd only to help our Sight,
(Like Heavenly Fires) do give our Reason Light.
Deaths Harbingers, Arrows, and Bullets prove
Like Cupid's Darts, Ambassadors of Love.
Then your Diviner Hieroglyphicks tell,
How we may Landskips read, and Pictures spell.
You teach how Clouds inform, how Smoaks advise ;
Thus Saints with Incense talk to Deities.
Thus by dumb Creatures we instructed are,
As the Wise Men were tutor'd by a Star.

Since we, true Serpents like, do little wrong
With any other Member but the Tongue ;
You tell us how we may by Gestures talk ;
How Feet are made to speak, as well as walk ;
How Eyes discourse, how mystick Nods contrive ;
Making our Knowledge too, Intuitive.
A Bell no noise but Rhetorick affords ;
Our Musick Notes are Speeches, Sounds are Words.
Without a Trope there's Language in a Flow'r,
Conceits are smelt without a Metaphor.
Dark Subtleties we now shall soon define,
Each Organ's turn'd the Sense of Discipline.
'Tis to your Care we owe that we may send
Business unknown to any but our Friend.
That which is English Friendship to my Brother,
May be thought Greek or Nonsense to another.
We now may Homer's Iliads confine,
Not in a Nut shell, but a Point, or Line.
Which Art though't seem to exceed Faith, yet who
Tries it will find both Truth and Reason too.
'Tis not like Jugglers Tricks, absurd, when shown ;
But more and more admir'd, the more 'tis known.
Writing's an Act of Emanation,
And Thoughts speed quick and far as Day doth run.

Richard West. C. C. Ox.

THE

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M E R C U R Y,

T H E

Secret and Swift Messenger.

C H A P. I.

*The Dependance of this Knowledge in Nature.
The Authors that have treated of it. Its Relation to the Art of Grammar.*

EVery rational Creature, being of an imperfect and dependent Happiness, is therefore naturally endowed with an Ability to communicate its own Thoughts and Intentions; that so by mutual Services. it might the better promote it self in the Prosecution of its own Well-being.

And because there is so vast a Difference betwixt a Spirit and a Body, therefore hath the Wisdom of Providence contrived a distinct Way and Means, whereby they are each of them enabled to Discourse, according to the Variety of their several Natures.

The Angels or Spiritual Substances, *Per insinuationem specierum*, (as the Schoolmen speak.) By insinuating of the Species, or an unveiling of their own Natures in the Knowledge of such Particulars as they would discover to another. And since they are of an *Homogeneous* and *immaterial* Essence, therefore

*Aquinas
part 1.
Quæst. 107.
Zanch. de
Operibus
Dei, part
1. l. 3. c. 19.*

fore

fore do they hear, and know, and speak, not with several parts, but with their whole Substance. And tho' the Apostle mentions the *Tongue of Angels*, yet that is only *Per concessionem, & ex hypothesi*.

But now, *Men* that have *Organical Bodies*, cannot communicate their Thoughts so easie and immediate a way. And therefore have need of some Corporeal Instruments, both for the *Receiving* and *Conveying* of Knowledge. Unto both which Functions, Nature hath designed several Parts. Amongst the rest, the Ear is chiefly the Sense of Discipline or *Learning*, and the Tongue the Instrument of *Teaching*. The Communion betwixt both these, is by Speech or Language, which was but one at first, but hath since been confounded into several kinds. And Experience now shews, that a Man is equally disposed for the Learning of all, according as Education shall direct him. Which would not be, if (as some fondly conceive) any one of them were Natural unto us. For *Intus existens prohibet alienum*.

Or suppose that a Man could be brought up to the Speaking of another Tongue, yet this would not hinder, but that he should still retain his Knowledge of that which was Natural. For if those which are gotten by Art do not hinder one another, much less would they be any impediment to that which is from Nature. And according to this it will follow, that most men should be of a double Language, which is evidently false. Whence likewise you may guess at the Absurdity of their Enquiries, who have sought to find out the Primitive Tongue, by bringing up Infants in such silent solitary Places, where they might not hear the Speech of others.

Languages are so far Natural unto us, as other Arts and Sciences. A Man is born without any of them, but yet capable of all.

Now, because *Words* are only for those that are present both in *Time* and *Place*; therefore to these there

x Cor. 13.
2.

Vallesius
Sac. Phil.
cap. 3.

Cæl. Rhod.
Ant. lect.
l. 2. g. c. 14.

there hath been added. the Invention of *Letters* and Writing, which are such a Representation of our Words (tho' more permanent) as our Words are of our Thoughts. By these we may discourse with them that are remote from us, not only by the Distance of many Miles, but also of many Ages. *Hujus usu scimus maxime constare humanitatem vitæ, memoriam, ac hominum immortalitatem*, saith *Pliny*. *Quid hoc magnificentius? Quid æque mirandum? in quod ne mortis quidem avida rapacitas jus ullum habeat*, saith *Rhodiginus*. This being the chiefest Means both for the promoting of Human Society, and the perpetuating our Names unto following Times.

Nat. Hist.
l. 14. c. 11.
Antiq. leſt.
l. 4. c. 3.

How strange a thing this Art of Writing did seem at its first Invention, we may guess by the late discovered *Americans*, who were amazed to see Men converse with Books, and could scarce make themselves believe that a Paper should speak; especially, when after all their Attention and listning to any Writing (as their Custom was) they could never perceive any Words or Sound to proceed from it.

There is a pretty Relation to this Purpose, concerning an *Indian Slave*; who being sent by his Master with a Basket of Figs and a Letter, did by the Way eat up a great Part of his Carriage, conveying the Remainder unto the Person to whom he was directed; who when he had read the Letter, and not finding the Quantity of Figs answerable to what was spoken of, he accuses the Slave of eating them, telling him what the Letter said against him. But the *Indian* (notwithstanding this Proof) did confidently abjure the Fact, cursing the Paper, as being a false and lying Witness. After this, being sent again with the like Carriage, and a Letter expressing the just Number of Figs that were to be delivered, he did again, according to his former Practice, devour a great Part of them by the Way; but before

Herman-
nus Hugo
de Orig.
Scribendi
Præf.

he

he meddled with any, (to prevent all following Accusations) he first took the Letter, and hid that under a great Stone, assuring himself, that if it did not see him eat the Figs, it could never tell of him; but being now more strongly accused than before, he confesses the Fault, admiring the Divinity of the Paper, and for the future does promise his best Fidelity in every Employment.

Such strange Conceits did those wilder Nations entertain, concerning this excellent Invention. And doubtless it must needs argue a vast Ability both of Wit and Memory in that Man who did first confine all those different Sounds of Voice, (which seem to be almost of infinite Variety) within the Bounds of those few Letters in the Alphabet.

Cic. l. 3. de Nat. Deor. Polyd. Vir. de Inven- tor. l. 1. c. 6. Vossius de Gramma- tica, l. 1. c. 9. Natal. Comes My- sho. l. 5. c. 5.

The first Inventor of this was thought to be the *Egyptian Mercury*, who is therefore stiled the *Messenger* of the Gods. To which purpose the Poets have furnished him with Wings for *Swiftness* and dispatch in his Errands. And because the Planet of that Name was thought to observe a more various and obscure Revolution than any of the rest, therefore likewise did they attribute unto him such *Secret* and subtle Motions, as might make him a trusty and private Messenger, and so the fitter for that Preference to which for this Invention they had advanced him.

There is yet another way of Discoursing, by Signs and Gestures; and though it be not so common in *Practice* as either of the other, yet in *Nature* perhaps it is before them both, since Infants are able this way to express themselves, before they have the Benefit of Speech.

But now, because none of these ways in ordinary Use, are either so *Secret* or *Swift* as some Exigencies would require; therefore many of the Ancients have busied themselves in a further Enquiry, how both these Deficiencies may be remedied; as conceiving

ceiving that such a Discovery would be of excellent Use, especially for some Occasions that are incident to *Statesmen* and *Soldiers*.

That the Ignorance of *Secret* and *Swift* Conveyances, hath often proved Fatal, not only to the Ruin of particular Persons, but also of whole Armies and Kingdoms, may easily appear to any one that is but little versed in Story. And therefore the redressing of these may be a Subject worth our Enquiry.

Amongst the Ancients that have most laboured in these Particulars, † *Aneas*, *Cleomenes*, and *Democritus*, (as they are cited by * *Polybius*) were for their Inventions of this kind, more remarkably eminent. And that ∴ Author himself hath given us such an exact Relation of the Knowledge of Antiquity in these things, that 'tis a wonder these following Ages should either take no more notice, or make no more use of it. Besides these, there is also *Julius Africanus*, and *Philo Mechanicus*, two Ancient Grecians, who have likewise treated of this Subject.

The Military Significations in use amongst the *Romans*, are handled by † *Vegetius* and * *Frontinus*.

Their Notes of Secrefy, and Abbreviation in Writing, are largely set down by * *Valerius Probus*, and *Pet. Diaconus*. There is likewise a Volume of these set forth by *Janus Gruterus*, which for their first Invention are commonly ascribed unto *Cicero* and * *Seneca*.

In latter times these particulars have been more fully handled by the Abbot ^a *Trithemius*, ^b *Theodorus Bibliander*, ^c *Baptista Porta*. *Cardan. Subtil. l. 17. de Var. C. 12. 6.* ^d *Isaac Casaubon*, ^e *Johannes Walchius*, ^f *Gustavus Selenus*, ^h *Gerardus Vossius*, ⁱ *Hermannus Hugo*, and divers others in particular Languages.

† *Polioretica.*
* *Hist. l. 10.*

∴ *Polybius, ib. juxta finem.*

† *De re milit. l. 3. c. 5.*
* *De Strat.*

* *L. de notis antiquis.*

* *The Father.*

^a *L. de Polygraph. item de Stenograph.*

^b *Tract. de ratione*

commun. linguarum. ^c *Lib. de Zyperis.* ^d *Notis in Aenea Polyoretica.* ^e *Fab. 2. de Cryptog.* ^h *de Gram. L. 1. c. 40.* ⁱ *L. de Or. Scrib. de Augm. Scientiar. l. 6. c. 1.*

Amongst

The Secret and Swift Messenger.

Amongst the rest, our *English Aristotle*, the Learned *Verulam*, in that Work truly stiled the *Advancement of Learning*, hath briefly contracted the whole Substance of what may be said in this Subject. Where he refers it to the Art of *Grammar*, noting it as a deficient Part. And in reference to this is it handled by most of those Authors who have treated of it.

That Art, in its true Latitude comprehending a Treaty, concerning all the Ways of Discourse, whether by Speech, or by Writing, or by Gesture, together with the several Circumstances pertaining to them. And so this Subject belongs to the *Mint* of Knowledge; Expressions being currant for Conceits, as Money is for Valuations.

Now as it will concern a Man that deals in Traffick, to understand the several kinds of Money, and that it may be framed of other Materials besides Silver and Gold: So likewise does it behove them who profess the Knowledge of Nature or Reason, rightly to apprehend the several Ways whereby they may be expressed.

So that besides the Usefulness of this Subject for some special Occasions, it doth also belong unto one of the Liberal Arts.

From which Considerations we may infer, that these particulars are not so trivial, as perhaps otherways they would seem; and that there is sufficient motive to excite any Industrious Spirit unto a further Search after them.

In this following Discourse I shall enquire,

1. Concerning the *Secrecy* of Means, whereby to communicate our Thoughts;
2. Concerning their *Swiftness*, or quick passing at any great Distance.
3. How they may be both joined together in the Conveyance of any Message.

In the Prosecution of which, I shall also mention

(besides the true Discoveries) most of those other ways, whether *Magical*, or *Fabulous*, that are received upon common Tradition.

C H A P. II.

The Conditions requisite to Secresy: The use of it in the Matter of Speech, either

By { *Fables of the Heathen.*
Parables of Scripture.

TO the Exactness of Secresy in any way of Discourse, there are these two Qualifications requisite.

1. That it be difficult to be unfolded, if it should be doubted of, or examined.

2. That it be (if possible) altogether devoid of Suspicion; for so far as it is liable to this, it may be said to come short in the very Nature of Secresy; siece what is once suspected, is exposed to the Danger of Examination, and in a ready way to be discover'd; but if not, yet a man is more likely to be disappointed in his Intentions, when his Proceedings are mistrusted.

Both these Conditions together are to be found but in few of the following Instances; only they are here specified, to shew what a Man should aim at, in the Inventions of this Nature.

The Art of secret Information in the General, as it includes all significatory Signs, may be stiled *Cryptomeneses*, or private Intimations.

The particular Ways of Discoursing, were before intimated to be threefold.

1. By Speaking.

B b

2. By

2. By Writing.
3. By Signs or Gestures.

According to which Variety, there are also different Ways of Secresy.

1. *Cryptologia.*
2. *Cryptographia.*
3. *Semæologia.*

Cryptologia, or the Secresy of Speaking, may consist either,

1. In the Matter.
2. In the Words.

1. In the *Matter* : When the thing we would utter is so concealed under the Expression of some other Matter, that it is not of obvious Conceit. To which purpose are the *Metaphors*, *Allegories*, and divers other Tropes of Oratory ; which, so far as they concern the Ornament of Speech, do properly belong to *Rhetorick* ; but as they may be applied for the Secresy of Speech, so are they reducible unto this Part of *Grammar*.

To this likewise appertains all that *enigmatical Learning*, unto which not only the Learned Heathen, but their Gods also were so much devoted, as appears by the strange and frequent Ambiguities of the *Oracles* and *Sybils*. And those were counted the most profound Philosophers amongst them, who were best able for the Invention of such affected Obscurities.

Fables.

Of this kind also were all those mysterious *Fables*, under which the Ancients did veil the Secrets of their *Religion* and *Philosophy*, counting it a Prophanè Thing to prostitute the hidden Matters of either, unto *Vulgar Apprehension*. *Quia sciunt inimicam esse naturæ, apertam nudamque expositionem sui ; quæ, sicut vulgaribus hominum sensibus, intellectum sui, vario rerum tegmine operimentoque subtraxit, ita à prudentibus arcana sua voluit per fabulosa tractari*, saith *Macrobius*. The Gods and Nature would not themselves have hidden

In *Somn.*
Scip. Lib. I.
Cap. 2.

so

so many things from us, if they had intended them for common Understandings, or that others should treat of them after an easy and perspicuous Way: Hence was it that the Learned Men of former times were so generally inclined to involve all their Learning, in obscure and mysterious Expressions. Thus did the *Egyptian* Priests, the *Pythagoreans*, *Platonicks*, and almost all other Sects and Professions.

And to this general Custom of those Ages (we may guess) the Holy Ghost does allude, in the frequent *Parables* both of the Old and New Testament. *Parabola est sermo similitudinarius, qui aliud dicit, aliud significat*, saith *Aquinas*. It is such a Speech of Similitude, as says one thing and means another. The Disciples do directly oppose it to plain speaking, *Behold now speakest thou plainly, and no Parables.*

Parables.

Commen. in
Isai. 14.

John 16.
29.

And elsewhere 'tis intimated, that our Saviour did use that Manner of Teaching for the *Secresy* of it: That those proud and perverse Auditors, who would not apply themselves to the Obedience of his Doctrine, might not so much as understand it. *To whom it is not given to know the mysteries of the Kingdom of God, to them all things are done in Parables, that seeing they may see and not perceive, and hearing they may hear and not understand.*

Mat. 13.
10, 11.
Mark 4.
11, 12.

The Art of these was so to imply a secret Argument, that the Adversary might unawares be brought over to an Acknowledgement and Confession of the thing we would have. Thus did *Nathan* unexpectedly discover to *David*, the Cruelty and Injustice of his Proceedings in the Case of *Uriah*. Thus did another Prophet make *Ahab* condemn himself, for suffering the King of *Syria* to escape. And by this means did our Saviour in the Parable of the Vineyard, and the unjust Husbandman, force the unbelieving *Jews* to a secret Acknowledgment of those Judgments they had themselves deserved.

Glos. Phil.
l. 2. par. 1.
Traet. 2.
Seet. 5.
2 Sam. 12.

1 Kings
20. 39.
Mat. 21.
31.

Of this Nature was that Argument of an ancient *Orator*, who when the Enemies had proposed Peace, upon this Condition, that the City should banish their Teachers and Philosophers, he steps up and tells the People a Tale, of certain Wars betwixt the Wolves and the Sheep, and that the Wolves promised to make a League, if the Sheep would put away their Mastiff-Dogs. By this means better instructing them of the Danger and Madness there would be, in yeilding to such a Condition.

The *Jewish* Doctors do generally in their *Talmud*, and all their other Writings, accustom themselves to a Parabolical Way of Teaching; and 'tis observed, that many of those horrid Fables that are fathered upon them, do arise from a Misapprehension of them in this particular: Whilst others interpret that according to the *Letter*, which they intended only for the *Moral*. As that which one *Rabby* relates, concerning a Lyon in the Forest of *Elay*, that at the distance of Four hundred Leagues, did with his Roaring shake down the Walls of *Rome*, and make the Women Abortive. Wherein he did not affirm the Existence of any such Monster, but only intimate the Terribleness and Power of the Divine Majesty. But this by the way.

By this Art many Men are able in their ordinary Discourses, so secretly to convey their Counsels, or Reproofs, that none shall understand them, but those whom they concern. And this way of teaching hath a great Advantage above any other, by reason it hath much more Power in exciting the Fancy and Affections. Plain Arguments and Moral Precepts barely proposed, are more flat in their Operation, not so lively and perswasive, as when they steal into a Man's Assent, under the Covert of a Parable.

To be expert in this particular, is not in every Man's Power; like Poetry, it requires such a Natural

tural Faculty as cannot be taught. But so far as it falls under the Rules and Directions of Art, it belongs to the Precepts of *Oratory*.

In the General 'tis to be observed, That in these Cases a Man must be very careful to make Choice of such a Subject, as may bear in it some proper Analogy and Resemblance to the chief Business. And he must before-hand in his Thoughts, so aptly contrive the several Parts of the Similitude, that they may fitly answer unto those particular Passages which are of greatest Consequence.

C H A P. III.

Concerning that Secresy of Speech, which consists in the Words, Either

By inventing new ones, { *Canting.*
as in { *Conjuring.*

Or by a changing } *Inversion.*
of the known } *Transmutation.*
Language, whe- } *Diminution.*
ther } *Augmentation.*

THe secret Ways of Speaking, which consist in the Matter of Discourse, have been already handled. Those that are in the Words are Two-fold. Either,

1. By inventing new Words of our own, which shall signifie upon compact.
2. Or by such an Alteration of any known Language, that in Pronunciation it shall seem as obscure, as if it were altogether barbarous.

To the first kind we may refer the *Canting* of Beggars; who though they retain the common Particles,

cles, yet have imposed new Names upon all such Matters as may happen to be of greatest Consequence and Secresy.

And of this Nature the Charms of Witches, and Language of Magicians seem to be. Though of these it may well be doubted, whether they have any Signification at all. And if they have, whether any understand them, but the Devil himself. 'Tis probable he did invent such horrid and barbarous Sounds, that by them he might more easily delude the weak Imaginations of his credulous Disciples. *Martinus de Arles*, an Archdeacon in *Navar*, speaking of a Conjuring-book, that was found in a Parish under his Visitation, repeats out of it these Forms of Discoursing with the Devil. *Conjuro te per ælim, per ælion, per seboan, per adonay, per allelujah, per tanti, per archabulon, &c.* And a little after, *Sitis allegati & constricti per ista sancta nomina Dei, Hir, ælli, habet, sat, mi, filisgæ, adrotiagundi, tat, chamiteram, &c.* And in another Place, *Coriscion, Matatron, Caladafon, Ozcozo, Yofiel, &c.*

*Traçt. de
superstitio-
nibus.*

In which Forms the common Particles and Words of usual Sense, are plainly set down in ordinary *Latin*; but many of the other, which seem to have the greatest Efficacy, are of such secret Sense, as I think no Linguist can discover.

The Inventions of this kind do not fall under any particular Rule or Maxim, but may be equally Infinite to the Variety of articulate Sounds.

The second Way of Secresy in Speech, is by an Alteration of any known Language, which is far more easie, and may prove of as much Use for the Privacy of it, as the other. This may be performed Four Ways.

I. By *Inversion*, when either the *Letters* or *Syllables* are spelled backwards.

Mitto tibi METULAS caneros imitare legendo, where the Word *SALUTE M* is expressed by an Inver-

*Porta de
furi. lit. l.
1. cap. 5.
Selenus de
Cryptogra-
phia, l. 2.
cap. 1.*

Inversion of the Letters. Or as in this other Example, *Stisno estad, veca biti*, which by an Inversion of the Syllables, is *Hostis adest, cave tibi*.

2. By *Transmutation*, or a mutual changing of one Letter for another in Pronunciation; answerable to that Form of Writing, mentioned in the Seventh Chapter. And tho this may seem of great Difficulty, yet Use and Experience will make it easie.

3. By *Contracting* some Words, and leaving Part of them out; pronouncing them after some such Way as they were wont to be both Written and Printed in ancient Copies. Thus $\bar{a} \bar{a}$ stands for *anima*, *Ar's* for *Aristoteles*. But this can be but of small Use in the *English* Tongue, because that does consist most of *Monosyllables*.

4. By *Augmenting* Words with the Addition of other Letters. Of which kind is that secret Way of Discoursing in ordinary Use, by doubling the Vowels that make the Syllables and interposing G. or any other Consonant, K. P. T. R. &c. or other Syllable s, as *Porta lib. 1. cap.*

5. *de furtiv. liter. notis*. Thus if I would say, *Our Plot is discovered*, it must be pronounced thus, *Ongour plogot igis digiscogovegereged*. Which does not seem so obscure in Writing, as it will in Speech and Pronunciation. And it is so easie to be learnt, that I have known little Children, almost as soon as they could speak, discourse to one another as fast this Way, as they could in their plainest *English*.

But all these latter kinds of Secresy in Speech, have this grand Inconvenience in them, that they are not without Suspicion.

There are some other Ways of Speaking by inarticulate Sounds, which I shall mention afterwards.

Chap. 17.
18.

C H A P. IV.

Concerning the Secret Conveyances of any written Message in Use amongst the Ancients.

Either by $\left\{ \begin{array}{l} \text{Land.} \\ \text{Water.} \\ \text{The open Air.} \end{array} \right.$

THe Secrefy of any written Message $\left\{ \begin{array}{l} \text{Conveyance.} \\ \text{Writing.} \end{array} \right.$ may confift either in the

1. In the *Conveyance*, when a Letter is fo clofely concealed in the Carriage of it, as to delude the Search and Suspicion of the Adverfary. Of which kind the Ancient Historians do furnifh us with divers Relations, reducible in the General unto thefe three Heads. Thofe that are

1. By Land.
2. By Water.
3. Through the open Air.

1. *By Land.*

1. The fecret Conveyances by Land, may be of numberlefs variety; but thofe ancient Inventions of this Nature, which to my Remembrance are moft obvious and remarkable, are thefe.

That of *Harpagus the Mede* (mentioned by *Herodotus* and *Justin*) who when he would exhort *Cyrus* to a Conſpiracy againſt the King his Uncle, (and not daring to commit any ſuch Message to the ordinary Way of Conveyance, eſpecially ſince the King's Jealouſy had ſtopped up all Paſſages with Spies and Watchmen) he puts his Letters into the Belly of a Hare, which, together with certain Hunters Nets, he delivered unto a truſty Servant, who under this Diſguiſe of a Huntsman, got an unſuſpected Paſſage to *Cyrus*. And *Aſtyages* himſelf was
by

Herod. l. 1. cap. 123.
Justin. l. 1.

by this Conspiracy bereaved of that Kingdom which was then the greatest Monarchy in the World.

To this Purpose likewise is that of *Demaratus* King of *Sparta*, who being banished from his own Country, and received in the *Persian* Court, when he there understood of *Zerxes* his Design and Preparation for a War with *Greece*, he used these means for the Discovery of it unto his Countrey-men. Having writ an Epistle in a * Tablet of Wood, he covered over the Letters with Wax, and then committed it unto a trusty Servant, to be delivered unto the Magistrates of *Lacedæmon*; who, when they had received it, were for a long time in a perplexed Consultation what it should mean; they did see nothing written, and yet could not conceive but that it should import some weighty Secret; till at length the King's Sister did accidentally discover the Writing under the Wax: By which means the *Grecians* were so well provided for the following War, as to give a Defeat to the greatest and most numerous Army that is mentioned in History.

Justin. l. 2.
See the like related of *Harmucar. Ib. l. 21.*

* Such as formerly they were wont to write upon, whence the Phrase *Rasa Tabula*, and *littera a litura*.

Isaac. Casp. Notis in Æneæ Poëtor. c. 31.

De Bello Judaic. l. 3. c. 8.

Herm. Hugo de Orig. Scrib. c. 15. Solemn. de Cryptographia, l. 8 c. 7.

The Fathers of the Council of *Ephesus*, when *Nestorius* was condemned, being strictly debarred from all ordinary Ways of Conveyances, were fain to send unto *Constantinople* by one in the Disguise of a Beggar.

Some Messengers have been sent away in Coffins as being dead: Some others in the Disguise of Brute Creatures, as those whom *Josephus* mentions in the Siege of *Jotapata*, who crept out of the City by Night like Dogs.

Others have conveyed Letters to their imprisoned Friends, by putting them into the Food they were to receive, which is related of *Polycrita*. *Laurentius Medices* involving his Epistles in a Piece of Bread, did send them by a certain Nobleman in the Form of a Beggar. There is another Relation of one, who rolled up his Letters in a Wax-candle, bidding the Messenger tell the Party that was to receive it, that

the Candle would give him Light for his Business. There is yet a stranger Conveyance spoken of in *Aeneas*, by Writing on Leaves, and afterwards with these Leaves covering over some sore or putrid Ulcer, where the Enemy would never suspect any secret Message.

Others have carried Epistles inscribed upon their own Flesh, which is reckoned amongst those secret Conveyances mentioned by *Ovid*.

Caveat hoc custos, pro charta, conscia tergum

Præbeat, inque suo corpore verba ferat.

But amongst all the ancient Practices in this kind, there is none for the Strangeness, to be compared unto that of *Hystiaus*, mentioned by *Herodotus*, and out of him in *Aulus Gellius*; who whilst he resided with *Darius* in *Persia*, being desirous to send unto *Aristagoras* in *Greece*, about revolting from the *Persian* Government, (concerning which they had before conferred together) but not knowing well how at that Distance to convey so dangerous a Business with sufficient Secresy, he at length contrived it after this Manner: He chose one of his Household-Servants that was troubled with sore Eyes, pretending that for his Recovery his Hair must be shaved, and his Head scarified; in the Performance of which *Hystiaus* took occasion to Imprint his secret Intentions on his Servant's Head; and keeping him close at Home till his Hair was grown, he then told him, That for his perfect Recovery, he must travel into *Greece* unto *Aristagoras*, who by shaving his Hair the second Time, would certainly restore him. By which Relation you may see what strange Shifts the Ancients were put unto, for want of Skill in this Subject that is here discoursed of.

'Tis reported of some Fugitive *Jews* at the Siege of *Jrusalem*, who more securely to carry away their Gold, did first melt it into Bullets, and then swallow it down, venting it afterwards amongst their other

Excre-

Poliorcee.
c. 31.

De Arte
Amand.

Herod. l. 5.
c. 35.
Notæ Ar-
ti. l. 17. c.
10.

Joseph. de
Bello juda.
l. 6. c. 15.

Excrements. Now if a Man had but his Faculty, who could write *Homer's Iliads* in so small a Volume as might be contained in a Nut-shell; it were an easie Matter for him, by this Trick of the *Jews*, securely to convey a whole Pacquet of Letters.

*Solin. Poly-
hist. c. 6.*

2. When all the Land-Passages have been stopped up, then have the Ancients used other secret Conveyances by Water; writing their Intentions on thin Plates of Lead, and fastning them to the Arms or Thighs of some expert Swimmer. * *Frontinus* re-

2. By Wa-
ter.

lates, that when *Lucullus* would inform a Besieged City of his coming to succour them, he put his Letters into two Bladders, betwixt which a common Soldier in the Disguise of a Sea-monster, was ap-

* *De Stra-
tag. l. 3. c.
13.*

pointed to swim into the City. There have been likewise more exquisite Inventions to pass under the Water, either by a Man's Self, or in a Boat, wherein he might also carry Provision, only having a long Trunk or Pipe, with a Tunnel at the Top of it, to let down fresh Air. But for the Prevention of all such Conveyances, the Ancients were wont in their strictest Sieges, to cross the Rivers with strong * Nets, to fasten Stakes in several Parts of the Channel with sharp Irons, as the Blades of Swords, sticking upon them.

* *Plin. l.
10. c. 37.*

3. Hence was it that there have been other means attempted through the open Air, either by using Birds, as Pigeons and Swallows instead of Messengers, of which I shall treat more particularly in the sixteenth Chapter. Or else by fastning a Writing to an Arrow, or the Weight that is cast from a Sling.

3. Thro'
the open
Air.

Somewhat of this Nature, was that Intimation agreed upon betwixt *David* and *Jonathan*, though that Invention does somewhat favour of the Ancient Simplicity and Rudeness. It was a more exact Invention mentioned by *Herodotus* concerning *Artabazus* and *Timoxenus*, who when they could not come together, were wont to inform one another of any

1 Sam. 20.

*Urania's
l. 8. c. 128.*

Thing

Thing that concerned their Affairs, by fastning a Letter unto an Arrow, and directing it unto some appointed Place, where it might be received.

Polyænus,
l. 2.
See *Plu-*
tarch in
Cimon.

Thus also *Cleonimus* King of *Lacedæmon*, in the Siege of the City *Trezenæ*, enjoyned the Soldiers to shoot several Arrows into the Town, with Notes fastned unto them having this Inscription, "Ἡκω τὴν κλιῖν ἐλευθερώσω. I come that I may restore this Place to its Liberty. Upon which the credulous and discontented Inhabitants were very willing to let him enter.

When *Cicero* was so streightly Besieged by the *Gauls*, that the Soldiers were almost ready to yield; *Cæsar* being desirous to encourage him with the News of some other Forces that were to come unto his Aid, did shoot an Arrow into the City, with these Words fastned unto it, *Cæsar Ciceroni fiduciam optat, expecta auxiliam.* By which means the Soldiers were persuaded to hold out so long, till these new Succours did arrive and break up the Siege.

The same thing might also be done more securely, by rolling up a Note within the Head of an Arrow, and then Shooting of it to a Confederates Tent, or to any other appointed Place.

Poliarctet.
l. 4. c.
Dialog. 2.
mention-
ed also by
Heliodor.
Hist. Æ-
thio. l. 9.

To this purpose is that which *Lypsins* relates out of *Appian*, concerning an ancient Custom for the Besieged to write their Minds briefly in a little Piece of Lead, which they could with a Sling cast a great Distance, and exactly hit any such particular Place as should be agreed upon, where the Confederate might receive it, and by the same means return an Answer.

Of this Nature likewise are those kind of Bullets, lately invented in these *German Wars*, in which they can shoot, not only Letters, Corn, and the like, but (which is the strangest) Powder also into a besieged City.

But amongst all other possible Conveyances thro' the Air, Imagination it self cannot conceive any one more useful, than the Invention of a flying Chariot, which I have mentioned elsewhere. Since by this means a Man may have as free a Passage as a Bird, which is not hindered, either by the highest Walls, or the deepest Rivers and Trenches, or the most watchful Centinels. But of this perhaps I may have occasion to treat more largely in some other Discourse.

World in
the Moon,
chap. 14.

C H A P. V.

Of that Secresy which consists in the Materials of Writing, whether the Paper or Ink.

THE several Inventions of the Ancients, for the private *Conveyance* of any written Message, were the Subject of the last Chapter.

The Secresy of *Writing* may consist,

Either in { The Materials,
Or,
The Form.

1. The *Materials* of Writing, are, the Paper and Ink, (or that which is instead of them) both which may be so privately ordered, that the inscribed Sense shall not be discoverable, without certain Helps and Directions.

*Selenus de
Cryptogra.
l. 8. c. 1. 4.*

1. The chief Contrivance of Secresy by the Paper in Use amongst the Ancients, was, the *Lacedemonian Scytale*; the Manner of which was thus: There were provided two round Staves, of an equal Length and Size, the Magistrates always retaining one of them at Home, and the other being carry'd abroad by the General, at his going forth to War. When there was any secret Business to be writ by it, their manner was, to wrap a narrow Thong of Parchment about one of these Staves,
by

*1. The Pa-
per.*

by a Serpentine Revolution, so that the Edges of it might meet close together; upon both which Edges they inscribed their Epistle; whereas, the Parchment being taken off, there appear'd nothing but Pieces of Letters on the Sides of it, which could not be joined together into the right Sense, without the true *Scytale*. Thus is it briefly and fully described by *Ausonius*.

*Vel Lacedemoniam Scytalen imitare libelli,
Segmina Pergamei, tereti, circumdata ligno,
Perpetuo inscribens versu, deinde solutus,
Non respondentes sparsa dabit ordine formas.*

*Ausonius
ad Pauli-
num.*

*In Vita Ly-
sandri.*

You may read in *Plutarch*, how by this means *Pharnabaz* did deceive *Lysander*.

Exerc. 327.

'Tis true, indeed, that this Way was not of such inextricable Secresy, but that a little Examination might have easily discover'd it, (as *Scaliger* truly observes); however, in those Ages, which were less versed in these Kinds of Experiments, it seem'd much more secret than now it does unto us; and in these Times, there are such other means of private Discoursing, which even *Scaliger's* Eyes (as good as they were) could not discover. And therefore it was too inconsiderate and magisterial a Sentence of him, from thence to conclude all this kind of Learning to be vain and useles, serving only for Imposture, and to perplex the Enquirer.

*Vossius de
Arte Gram.
l. 1. c. 40.*

*Veget. de re
milit. l. 3.*

'Tis certain, that some Occasions may require the exactest Privacy; and 'tis as certain, that there may be some Ways of Secresy, which it were Madness for a Man to think he could unfold. *Furori simile esse videtur, sibi aliquem persuadere, iam circumspectum hominem esse posse, ut se à furtivo quodam scripto, abditaq; machinatione tueri possit: Nam astans quilibet, vel procul distans loquitur, & factum nunciat, ut non solum à nemine percipiatur, sed ne sic quidem significare quippiam posse existimet, faith Vegetius.* And *Baptista Porta*, who had a strange and incredible Ability in discover-
vering

*Proam. l. 3.
de furtivis
notis.*

Vering of Secret Writings, yet doth ingeniously confess, *Multa esse posse furtiva scripta, quæ se interpretaturum quenquam polliceri, furorem ac delirium plane existimarem.*

So that tho' the Ancient Inventions of this Kind were too easily discoverable, yet *Scaliger* had no Reason to conclude this to be a needless Art, or that therefore he could unfold any other way that might be invented. But this by the by.

2. The other Material of Writing, is, the Ink, or that Liquor which is used instead of it; by which Means also there are fundry Ways of Secresy, commonly mentioned in *Natural Magick*.

2. The Ink.

Porca Magia, l. 16. Wecker. de Secret. l. 14. Joach. Fortius Experient.

Thus, if a Man write with Salt *Armoniack* dissolved in Water, the Letters will not appear legible, till the Paper be held by the Fire: This others affirm to be true also in the Juice of Onions, Lemons, with divers the like Acid and Corroding Moistures.

Cardan. Subt. l. 17. Item devarietate, l. 12. c. 61. Ibid.

And on the contrary, those Letters that are written with dissolved Allum, will not be discernable, till the Paper be dipped in Water.

There are some other Juices, that do not appear, till the Paper be held betwixt a Candle and the Eye.

That which is written with the Water of putrify'd Willow, or the distilled Juice of Glowworms, will not be visible but in the Dark; as *Porta* affirms from his own Experience.

Bibliander de Ratione com. linguarum. De furtiv. lit. l. 1. c. 15.

There is also a Secret Way of Writing with two several Inks, both of them alike in Colour, but the one being of that Nature, that it will easily be rubbed or washed off, and the other not.

A Man may likewise write secretly with a raw Egg, the Letters of which being thoroughly dried, let the whole Paper be blacked over with Ink, that it may appear without any Inscription; and when this Ink is also well dried, if you do afterwards gently scrape it over with a Knife, it will fall off

from

from those Places, where before the Words were written.

Those Letters that were described with Milk, or Urine, or Fat, or any other glutinous Moisture, will not be legible, unless Dust be first scatter'd upon them; which, by adhering to those Places, will discover the Writing. This Way is mentioned by Ovid :

*De Arte
Amandi.*

*Tuta quoq; est, fallitq; oculos è lacte recenti
Litera, carbonis pulvere tange, leges.*

And 'tis thought that *Attalus* made use of this Device, the better to excite the Courage of his Soldiers. Being before the Battel to sacrifice to the gods for Success, as he pulled out the Entrails of the Beast, he described upon them these words, *Regis Victoria*, which he had before written backward in his hand with some gummy Juice. The Entrails being turned up and down by the Priest, to find out their signification, the Letters did by that means gather so much Dust as to appear legible. By which *Omen* the Soldiers were so strangely heighten'd in their Hopes and Valour, that they won the Day.

*Gust. Selenus de
Cryptographia, l. 8.
c. 3.*

Unto these Experiments of Secresy in the *Materials* of Writing, some add those other ways of expressing any private Intimation, by drawing a String through the holes of a little Tablet or Board; these holes should be of the same number with the Letters, unto which by Compact they should be severally applied. The order of the Threads passing through them, may serve to express any Words, and so consequently any Sense we would discover.

To this purpose likewise is that other way of secret Information, by divers Knots tied upon a String, according to certain Distances, by which a Man may as distinctly, and yet as *Secretly*, express his Meaning, as by any other way of Discourse. For who would mistrust any private News or Treachery to lye hid in a Thread, wherein there was nothing to be

When it is taken off, and sent to a Confederate, he may easily understand its intention, by applying it to his own Tablet, which must be answerable unto this. The Instrument may be made much longer than is here expressed: But if the Matter to be revealed should happen to be more than the Tablet would bear, then may it be supplied either by another String, or else by beginning again with that part of the same String wherein the last Letter was terminated.

There may be divers other Inventions of this kind, but I have not observed any more remarkable than those which are already mention'd.

C H A P. VI.

Secret Writing with the common Letters, by changing of their Places.

THAT Secresy which does consist in the Form of Writing, is when the Words or Letters are so framed by Compact, that they are not of ordinary signification. The Inventions of this kind may, both for their Pleasure and Benefit, justly challenge a place amongst our other Studies.

St. *Austin* speaking of such human Inventions as are to be embraced or avoided, and rejecting all Magical Institutions and Commerce with the Devil, he adjoins, *Ea verò quæ homines cum hominibus habent, assumenda, & maxime literarum figuræ, &c. Ex eo genere sunt etiam notæ, quas qui didicerunt, proprie notarii appellantur. Utilia sunt ista, nec discuntur illicite, nec superstitiosè implicant, nec luxu enervant, si tantum occupent, ut majoribus rebus, quibus inservire debent, non sint impedimento.*

Selenus de Cryptographia, l. 2. c. 5.

Ars notarum occultandi inter artes Subtilitate

præstantes annumeranda est.

Cardan. Subtil.

l. 17.

De Doctrin. Christiana,

l. 2. c. 26.

This way of Secret Writing may be contrived, either,

- 1. By the common Letters.
- 2. Or by some invented Notes and Characters instead of them.

Both these being distinguishable into those kinds that contain either,

- 1. Equal.
- 2. Or more.
- 3. Or fewer Signs than are naturally required to the true framing of the Word.

The particulars of these may be altered to such great Variety as cannot be reckoned, and therefore I shall specify those only which seem most remarkable, either for their Antiquity or Usefulness.

The Way of Secret Writing by equal Letters, is, either by Changing of

- 1. Their Places, or
- 2. Their Powers.

1. By altering of the Places ;

Either of the $\left\{ \begin{array}{l} \text{Lines.} \\ \text{Letters.} \\ \text{Both.} \end{array} \right.$

1. A Man may obscure the Sense, by perplexing the Order of the *Lines*. If they be written, not only from the Left Hand to the Right, but also from the Right Hand to the Left, as in the *Eastern* Languages ; or from the Top to the Bottom, and so upward again, as is commonly related to be usual amongst the Inhabitants of *Taprobana* in the *South* Sea, with those in *China* and *Japan*: According to this following Example.

1. By transposing the Lines.

Diodor. Sic. Biblioth. 1. 2. Herman. Hugo de Orig. Scrib. c. 8.

e r f d l e e l l t
 i e t o o f w i i h
 l f u u h h s n t e
 p h o t o a v c s p
 p a h t t l t r h e
 u n t h e l s e t s
 f d i e l n g a o t
 y f w f b o n f d i
 d p e i a t o e c l
 e e g e e b m a n e

In the Reading of which, if you begin at the first Letter towards the Right Hand, and so downwards, and then upwards again, you may find these Words expressed:

The Pestilence doth still increase amongst us; we shall not be able to hold out the Siege, without fresh and speedy Supply.

2. By transposing the Letters.

2. A Man may obscure the Sense of his Writing, by transposing each *Letter*, according to some unusual Order. As, suppose the first Letter should be at the latter End of the Line, the second at the Beginning, or the like.

3. By transposing both the Lines and Letters.

3. The Meaning of any written Message may be concealed, by altering the Order both of the *Letters* and the *Lines* together. As if a Man should write each Letter in two several Lines, thus:

T e o l i r a e l m s f m f e s p l v o w e u t e l
 h f u d e f r a l o t a i h d, u p y s r e m s y i d

The Souldiers are almost famished; Supply us, or we must yield.

* Or as many more as the length of the Epistle shall require.

This way may be yet further obscured, by placing them in * four Lines, and after any discontinued Order. As, suppose that the first Letter be in the Beginning

Beginning of the first Line, the second in the Beginning of the fourth Line, the third in the End of the first, the fourth in the End of the fourth, the fifth in the Beginning of the second Line, the sixth in the Beginning of the third, the seventh in the End of the second, the eighth in the End of the third; and so of the rest: As in this Example.

W m r p i t a h h s c t e i n p k e
 h a t h f o n o i h k f t o e n i l
 a n o e r r o c g t t t h m n v r l
 e a u o m h t e i n l e n e t t e f

Which in its Resolution is this:

We shall make an Irruption upon the Enemy from the North, at Ten of the Clock this Night.

This way will yet seem more obscure, if each Line be sever'd into such Words as may seem barbarous. *Walchius, Fab. 9.*

All these Kinds may be varied unto divers other more intricate Transpositions, according as a Man's Fancy or Occasion shall lead him.

C H A P. VII.

Concerning Secret Writing with equal Letters, by changing their Powers. The Use of this amongst the Jews and Romans. The Key-Character.

AS a written Message may be concealed by changing the Places of the Letters, so likewise by changing of their Powers, putting one of them for another, as suppose L for A, and A for L, or the like: Answerable to that Kind of Cabalism in the Jewish Learning, which the Rabies call צירוף, *Schickard in Bebbinath. Hapernus. Disp. l. 4. Glassius Philolog. l. 2. part 1. tract 2.*

The Secret and Swift Messenger.

or *Combinatio*; when the Letters of the Alphabet are severally transposed, and taken one for another, after any known Order. Of which there be as many Kinds, as there may be several Combinations of the Letters: But amongst the rest, they observe two of more frequent Use. The first is stiled from the four first Correspondent Letters א ל ג ט *Albam*; in which they are thus opposite to one another.

א ב ג ד ה ו ז ח ט י כ
ל מ נ ס ע פ צ ק ר ש ת

The other is from the same Reason called *Athbash*, wherein the Letters are thus mutually opposed:

א ב ג ד ה ו ז ח ט י כ
ח ש ר ק צ פ ע ס נ מ ל

Both these Kinds of Secret Writing, the *Jewish* Doctors think to be frequently used by the Sacred Penmen of Holy Writ; amongst whom, the Prophet *Isaiab* and *Jeremiab* are observed to be of more especial Note for their Skill in Cabalisms.

By the first of these Combinations, called *Albam*, that Place of *Isaiab* 7. 6. is usually interpreted; where there is a Person mentioned, under the unknown Name of *טבאל* *Tabeal*, whom the Prophet affirms to aspire unto the Crown of *Judah*; meaning, by a secret Transmutation of the Letters, *רמליאב* *Remaliab* the King of *Israhel*, whom he was loth more expressly to nominate: And therefore he veils it by this kind of Secresy, instead of ר writing the Letter above it ט; for מ, the Correspondent Letter ב; and so ל for א, and א for ל. Which being joined together, do make *טבאל*, instead of *רמלא*.

By the second of these Combinations, called *Arb-
bash*, is that Place, *Jerem.* 51. 1. translated; where
by the Original *ל ק ל* *Cor insurgentium contra me*,
is meant *כשׁוׁי* the *Chaldeans*; and therefore both
the *Targum*, and the *Septuagint* do unanimously tran-
slate it so; as if in their Version of it, they had
chiefly respect unto this kind of Cabalism. So
likewise in 41 Verse of the same Chapter, by the
feigned Name of *שׁוׁשׁ*, is meant *שׁוׁשׁ*.

*Item c. 25.
v. 26. fide
Hieron.
com. in eun-
dem locum.*

This way of Secret Writing hath been also in use
amongst the *Ancient Romans*: Thus *Suetonius* relates
of *Julius Cæsar*, when he would convey any pri-
vate Business, he did usually write it, *per quartam Ele-
mentorum Literam*; that is, D for A, E for B, and
so of the rest, after this Order.

*Sueton. in
vita ejus.
A. Gellius
Noct. Ar-
tic. 1. 17.
c. 9.*

d e f g h i k l m n o p q r s t u w x y z a b c
a b c d e f g h i k l m n o p q r s t u w x y z

Hasten unto me.
Ldwxhq yqxr ph.

And the same Author reports of *Octavius Augus-
tus*, that in the writing of his Secrets, he did *se-
cundum Elementum proprii loco substituere*, set down the
second Letter for the first, as B for A, C for B, and
for A a Double x x.

But now, because such an Epistle might be easily
unfolded, being altogether written by the same
way; therefore this kind of Secresy hath, by later
Invention, been further obscured, by writing each
several Word, or Line, or Letter, by a diverse Al-
phabet.

For the Performance of this, two Friends must
before-hand, by Compact, agree upon some cer-
tain Form of Words, that may be instead of a Key,
serving both to close, and to unlock the Writing;

which Words would be less discoverable, if they be barbarous, and of no Signification.

But for the easier apprehending of this, I shall explain it in an Example.

Suppose the Key agreed upon, were only this one Word *Prudentia*.

Having first framed several Alphabets, according to each of its Letters, thus:

A	b	c	d	e	f	g	h	i	k	l	m	n	o	p	q	r	s	t	u	w	x	y	z	
P	q	r	s	t	u	v	w	x	y	z	a	b	c	d	e	f	g	h	i	k	l	m	n	o
R	s	t	u	w	x	y	z	a	b	c	d	e	f	g	h	i	k	l	m	n	o	p	q	
U	w	x	y	z	a	b	c	d	e	f	g	h	i	k	l	m	n	o	p	q	r	s	t	
D	e	f	g	h	i	k	l	m	n	o	p	q	r	s	t	u	w	x	y	z	a	b	c	
E	f	g	h	i	k	l	m	n	o	p	q	r	s	t	u	w	x	y	z	a	b	c	d	
N	o	p	q	r	s	t	u	w	x	y	z	a	b	c	d	e	f	g	h	i	k	l	m	
T	u	w	x	y	z	a	b	c	d	e	f	g	h	i	k	l	m	n	o	p	q	r	s	
I	k	l	m	n	o	p	q	r	s	t	u	w	x	y	z	a	b	c	d	e	f	g	h	
A	b	c	d	e	f	g	h	i	k	l	m	n	o	p	q	r	s	t	u	w	x	y	z	

I may write each Line, or Word, or Letter, according as the Order of these Alphabets shall direct. As in these,

1. In the Lines.

Ixt hdkasytgh bkiycn
 xfi nrel fx matlmrck;
 npkks pn, im oczs qdff
 uhyrox xr xlh hqmpmh.

2. In the Words.

Ixt kfmicuwik gpoths
 nu aery bs oiwnotem;
 bdytg vs, dg lzwq qdff
 uhyrox ys gur ygcfcy.

3. In the Letters.

Izz wshemitin in pzgcwy
 vfm zean xf kaxxznebr
 skgkoc hm, xr izzb awet
 rtm iox gh cht whmqwy.

Which Examples being unfolded, do each of them express this inward Meaning :

*The Souldiers mutiny
 for want of Victuals ;
 Supply us, or they will
 Revolt to the Enemy.*

These Ways may be yet further obscured, if the first Alphabet, (according to which the rest are described) be contrived after any mixed Order. As, suppose instead of the ordinary A b c, &c. there be written these Letters, after this manner.

R z k m p s e b l a u f t c y g w h x o q i n d.

And then will they be liable to all those other Differences of Secresy, that are usually invented by the *Wheel Character*, which you may see largely described by *Porta*.

There may be divers other Ways to this purpose, but by these you may sufficiently discern the Nature of the rest.

C H A P. V.

Of Secret Writing by more Letters than are requisite to the intended meaning.

THE different kinds of Secresy by equal Letters have been already handled. The next particular

cular to be discussed, is concerning the Ways of hiding any private Sense under *more Letters* than are required to the Words of it.

Of which kind there may be divers particulars, some of them in Use amongst the Ancients.

1. A Writing may be so contrived, that only one Letter in a Verse shall be significant. As it was in those remarkable *Acrosticks* made by a *Sybil* concerning our Saviour; where the Letters at the Beginning of each Verse, being put together, made up these Words, *Ἰησὺς Χριστὸς Θεοῦ υἱὸς αὐτῆς*. *Jesus Christ the Son of God, a Saviour.*

The Translation of these you may see in St. *Augustin de Civit. Dei*, lib. 18. cap. 23. And the Original are mentioned by *Ludovicus Vives*, in his Notes upon that Place.

According unto this doth *Plautus* contrive the Names of his Comedies in the first Letters of their Arguments. But this Way is so ordinary in Practice, that it needs not any further Explication.

2. The inward Sense hath likewise been conveyed by some single Letters of several Words in the same Verse. As in that common Distich.

*Mitto tibi caput Veneris, ventremque Dianæ
Latronisque caput, posteriora canE.*

3. Sometimes one Letter in each Word was only significant. By which Way of Secret Expression, the Holy Ghost (say the *Rabbies*) hath purposely involved many sacred Mysteries in Scripture. When these significant Letters were at the Beginning of each Word, the *Cabalists* in their Learning, called such an implicit Writing ראשי תיבות *Capita Dictionum*. When they were at the latter End, then was it stiled סופי תיבות *Fines dictionum*. Both being reckoned as Species of that *Cabalism* which they called נטריוקון *Notaricon*, imposed by some later *Rabbies* from the *Latin* Word *Notarius*.

Of the first Sort, is that Collection from those eminent Words, *Gen. 49. 10.* יבֵּן שִׁלְהוֹהֵינוּ *Shilo shall come, and in him, &c.* where the Capital Letters make up the Word ישו *Jesu.*

The Capital Letters.

So *Psal. 72. 17.* וַיְהַבְרַכְבּוּ שְׁמוֹ יְיָוִה *His name shall continue, and in him shall be blessed, &c.* which Place does expressly treat concerning the *Messias* his Name, and therefore seems unto the *Jews*, to be of strong Consequence for the Proof of Christianity. For so much is that Nation befooled in their absurd Dotage upon these trivial literal Collections, that a Reason of this Nature is of greater force unto them, than the most evident solid Demonstration that may be urged. *Ludovicus Carret*, a famous *Jew*, Physician to the *French King*, being himself converted, and writing an Epistle to this Purpose, unto those of his own Nation, he does chiefly insist upon the Arguments of this kind, as being in his Opinion of greatest Efficacy to prove the Truth of Christian Religion.

Lib. Visorum Divinorum.

Of the other Sort is that Passage, *Gen. 1. 1.* בְּרֵאשִׁית אֱלֹהִים אָמַר *where the final Letters make up the Word אמת or Truth.* Which kind of *Cabalism* is six Times repeated in the History of the Creation. As if *Moses* by such an artificial Contrivance of the Letters at the Beginning of his Writings, did purposely commend unto our Belief his following Books. Unto this *David* is thought to allude, *Psal. 119. 160.* The beginning of thy word is אמת *Truth.* Of this Nature likewise is that Observation from *Exod. 3. 13.* לֵי מָה שְׁמוֹ מָה *When they shall say unto me, what is his name, &c.* Where the final Letters answer יהוה *Jehovah.*

The final Letters.

It were an easie matter for a Man that had Leisure and Patience for such Enquiries, to find out sundry Arguments of this kind for any Purpose.

4. There is another way of hiding any secret Sense under an ordinary Epistle, by having a Plate with certain Holes in it, through which (being

*Cardande subtil. l. 17. Porta de furt. l. 2. c. 18.

Such as
Printers
use when
they are to
insert di-
verse red
Letters a-
mongst
the black.

ing laid upon the Paper) a Man may write those Letters or Words, that serve to express the inward Sense; the other Spaces being afterwards filled up with such other Words, as in their Conjunction to these former, shall contain some common unsuspected Business.

5. There is also another intricate Way to this Purpose, much insisted on by *Tritemius*, *Porta*, and *Sylenus*. When each usual Word or Form of an Epistle, is varied to as many Differences as there are Letters, unto which they must all of them be severally assigned. But these two latter Inventions (tho' they be of great Secresy, yet) because they require so much Labour and Trouble in the Writer, I shall therefore pass them over without any further Enlargement.

CH A P. IX.

Of concealing any written Sense under Barbarous Words, and such as shall not seem to be of any Signification. How all the Letters may be expressed by any Five, Three, or Two of them. Of Writing with a double Alphabet. How from these two last Ways together, there may be contrived the best kind of Secret Writing.

ALL the Ways of Secresy by *more Letters*, already specified, do make the Writing appear under some other Sense, than what is intended, and so consequently are more free from Suspicion: There are likewise some other Inventions to express any inward Sense by barbarous Words, wherein only the first, and middle, and last Letters shall be significant. As in this Example.

Fildy,

Fildy, fagodur wyndeeldrare discogure rantibrad.

Which in its resolution is no more than this :

Fly for we are discovered.

To this Purpose likewise is that other Way of expressing the whole Alphabet by any five, or three, or two of the Letters repeated. And though such a Writing, to ordinary Appearance, will seem of no Signification at all, and so may seem of less Use ; yet because a right Apprehension of these Ways may conduce to the Explication of some other particulars that follow, it will not be amiss therefore to set them down more distinctly.

All the Letters may be expressed by any five of them doubled. Suppose A B C D E.

A B C D E F G H I K L M N
aa ab ac ad ae ba bb bc bd be ca cb cc

O P Q R S T V W X Y Z. &
cd ce da db dc dd de ea eb ec ed ee

According to which, these Words, *I am betrayed,* may be thus described.

Bd aacb abaedddbaeceaead.

Three Letters being transposed through three Places, do give sufficient Difference, whereby to express the whole Alphabet.

A B C D E F G H I
aaa aab aac baa bba bbb bbc caa cca

K L M N O P Q R S
ccb ccc aba abb abc aca acb acc bca

T V W X Y Z &
cbv bcc bab cba cbb cbc bac

Hasten unto me,

Caa aaa bca bcb bba abb bcc abb bcb abc aba
bba.

The whole Alphabet expressed by any 2 Letters in five Places.

Two Letters of the Alphabet being transposed through five Places, will yield thirty two Differences, and so will more than serve for the Four and twenty Letters; unto which they may be thus applied.

A. B. C. D. E. F. G.
aaaaa. aaaab. aaaba. aaabb. aabaa. aabab. aabba.

H. I. K. L. M. N. O.
aabbb. abaaa. abaab. ababa. abaab. abbaa. abbab.

P. Q. R. S. T. V. W.
abbba. abbbb. baaaa. baaab. baaba. baabb. babaa.

X. Y. Z.
babab. babba. babbb.

aababababababba aaaaababaaaaaababba.

f l y a w a y.

Writing by a double Alphabet.

There is yet another Way of Secresy by more Letters than are naturally required to the inward Sense; if we write with a double Alphabet, wherein each Letter shall in the Fashion of it, bear some such small Distinction from the other of the same kind, as is usual in common mixed Writing. *For Example.*

The first Alphabet.

Aa. Bb. Cc. Dd. Ee. Ff. Gg. Hh
 Ii. Kk. Ll. Mm. Nn. Oo. Pp. Qq.
 Rr. Ss. Tt. Vv. Ww. Xx. Yy. Zz.

the second Alphabet.

Aa. Bb. Cc. Dd. Ee. Ff. Gg. Hh
 Ii. Kk. Ll. Mm. Nn. Oo. Pp. Qq.
 Rr. Ss. Tt. Vv. Ww. Xx. Yy. Zz.

1. Write an Epistle of an ordinary Matter, or (if it be needful) contrary to what you intend. Let the Body of it consist chiefly of the first Alphabet, only inserting (as you have occasion) such Letters of the second, as may express that inward meaning which you would reveal to a Confederate.

For Example, from those that are Besieged.

We prosper still in our af-
 faires. and shall (without
 having any further help)
 endure the siege.

In which Clause, the Letters of the second Alphabet are only significant, expressing this inward Sense.

*We perish with hunger
help us.*

But because the Differences betwixt these two Alphabets may seem more easily discoverable, since they are both generally of the same kind, the Letters of the second being all of them more round and full than the other; therefore for their better Secrecy in this particular, it were safer to mix them both by Compact, that they might not in themselves be distinguishable.

Now if this kind of Writing be mixed with the latter Way of Secrecy, by two Letters transposed through five Places, we may then write *omnia per omnia*, which (as a learned Man speaks) is the highest Degree of this Cyphering.

For supposing each Letter of the first Alphabet to be instead of the Letter A, and those of the other for B, we may easily inscribe any secret Sense in any ordinary Letter, only by a quintuple Proportion of the Writing infolding to the Writing infolded. As for Example.

The best
way of
secret
writing.
Bacon.
Augment.
scient. l. 6.
c. 8.

All things do happen according to our desires, the particulars you shall understand when wee meete at the appointed time and place of which you must not faile by any means The success of our affairs dos much depend vpon the meeting that wee have agreed vpon.

The involved meaning of which Clause is this :

Fly, for we are discovered, I am forced to write this.

If you suppose each Letter of the first Alphabet to be instead of A, and those of the second for B, then will the former Clause be equivalent to this following Description.

Aabab	ababa	babba	aabab	abbab	baaaa	babaa
F	l	y	f	o	r	w
aabaa	aabaa	aaaaa	baaaa	aabaa	aaabb	abaaa
e	e	a	r	e	d	i
baaab	aaaba	abbab	baabb	aabaa	baaaa	aabaa
f	c	o	v	e	r	c
aaabb	abaaa	aaaaa	ababb	aabab	abbab	baaaa
d,	l	a	m	f	o	r
aaaba	aabaa	aaabb	baaba	abbab	babaa	baaaa
c	e	d	t	o	w	r
abaaa	baaba	aabaa	baaba	aabbb	abaaa	baaab.
i	t	e	t	h	i	s.

This Way of Secresy may be serviceable for such Occasions as these. Suppose a Man were taken Captive, he may by this means discover to his Friends the Secrets of the Enemies Camp, under the outward Form of a Letter persuading them to yield. Or, suppose such a Man were forced by his own Hand-writing to betray his Cause and Party, though the Words of it in common Appearance may express what the Enemy does desire; yet the involved meaning, (which shall be legible only to his Confederates) may contain any thing else which he has a Mind to discover to them: As in the former Example.

But now if there be a threefold Alphabet, (as is easie to contrive) then the inward Writing will bear unto the outward but a triple Proportion, which will be much more convenient for enlarging of the private Intimations.

And this Way of Writing is justly to be preferred before any of the other, as containing in it more eminently, all those Conditions that are desirable in such kind of Inventions. As,

1. 'Tis not very laborious either to write or read.
2. 'Tis very difficult to be decyphered by the Enemy.
3. 'Tis void of Suspicion.

But by the way, 'tis to be generally observed, that the mixture of divers kinds of secret Writing together (as suppose this with the Key-character) will make the inward Sense to be much more intricate and perplexed.

C H A P. X.

Of Writing any Secret Sense by fewer Letters than are required to the Words of it. The Use of this amongst the Jews and Romans.

AS the Sense may be obscured by writing it with more Letters than are required to the Words of it, so likewise by fewer. Abbreviations have been anciently used in all the Learned Languages, especially in common Forms, and Phrases of frequent Use. Sometimes by contracting Words, when some Parts of them did stand for the whole. So in the *Hebrew*, וכו' for וכו' et totum illud, which is all one with our *et cetera*, &c. כרו' for כרו' *Secundum dicere*, equivalent to our *viz.* or *v. g. verbi gratia.* So likewise in the *Greek*, X̄ς̄ for X̄ς̄ος, and ᾱ⊕ for ᾱνδρ̄ωνος. And in the *Latin*, d̄us for Dominus; āa for Anima, and the like. But these were rather for the Speed of Writing, than the Secresy.

*Buxtorf de
Abbreviat.
in ievitio.*

Sometimes Words were expressed only by their first Letters. Thus did the *Jews* write all their Memorials, and common Forms, which are largely handled by *Buxtorf*. Hence was it, that their Captain *Judas* had his Name of *Maccaby*; for being to fight a-

Ibid.

gainst *Antiochus*, he gave that saying for his Watchword, *Exod. 15.* מִי כָמוֹךָ בְּאֱלֹהִים יְהוָה. *Who is like unto thee (O Lord) amongst the Gods?* inscribing in his Ensigns the Capital Letters of it, מַכַּבִּי *Maccabi*. Whereupon after the Victory, the Soldiers stiled their Captain by that Name.

'Tis observed by the *Rabbies*, that many grand Mysteries are this Way implied in the Words of Scripture. Thus, where it is said, *Psal. 3.* רַבִּים מִנִּי יִשְׂרָאֵל *Many rise up against me*, 'tis interpreted from the several Letters, *Resh* the Romans, *Beth* the Babylonians, *Fod* the *Fonians* or *Grecians*, *Mem* the *Medes*. Answerable unto which, that Place in *Gen. 49. 10.* (speaking of *Sibilo*, unto whom יְקִוּת the gathering of the People shall be) is by another *Rabby* applied to the *Jews*, *Christians*, *Heathens*, and *Turks*.

Upon these Grounds likewise, is that Argument to prove the Trinity, from the first Verse of *Genesis*. בְּרֵאשִׁית בָּרָא אֱלֹהִים אֱלֹהִים *Elohim*, being of the Plural Number, is thought to be that Divine Name which denoteth the Persons of the Deity; which Persons are more particularly intimated in the Letters of the Verb בָּרָא, that answers unto it: בְּ *Beth* being put for בֶּן the Son, רֶשֶׁת *Resh* for רוּחַ the Holy Ghost, אֵלֶף *Aleph* for אָב the Father. And if you will believe the *Jews*, the Holy Spirit hath purposely involved in the Words of Scripture, every Secret that belongs to any Art or Science, under such Cabalisms as these. And if a Man were but expert in unfolding of them, it were easie for him to get as much Knowledge as *Adam* had in his Innocency, or Human Nature is capable of.

This kind of mysterious Interpretations from particular Letters, do seem to be somewhat favoured, by God's Addition of the Letter וּ unto the Name of *Abraham* and *Sara*, upon the renewing of his Covenant with them; which in all likelihood was not without some secret Mystery. That being the chief Letter

of the *Tetragrammaton*, might perhaps intimate that amongst their other Posterity, with the Promise of which he had then Blessed them, they should also be the Parents of the *Messias*, who was *Jehovah*.

This likewise others have confirmed from the Example of Christ, who calls himself *Alpha* and *Omega*, Rev. i. 8.

Vide Tertul. l. de præscr. c. 50.

But though such Conjectures may be allowable in some particulars, yet to make all Scriptures capable of the like Secrets, does give such a Latitude to Men's roving and corrupt Fancies, as must needs occasion many wild and strange Absurdities. And therefore *Irenæus* does fitly observe, that from such idle Collections as these, many Heresies of the *Valentini-ans* and *Gnosticks* had their first Beginnings.

Iren. l. i. c. 13.

As this Way of short Writing by the first Letters, was of ancient Use amongst the *Jews*, so likewise amongst the *Romans*, which appears from many of their Contractions yet remaining, as *S. P. D. Salu-tem plurimam dicit. S. Pq. R. Senatus populusque Romanus. C. R. Civis Romanus. U. C. Urbs condita.* And the like.

These single Letters were called *Syglæ*, per *Syncopen*, from the obsolete Word *Sigillæ*, whence *Sigillatim*. They were usually inscribed in their Coins, Statues, Arms, Monuments, and Publick Records. You may see them largely treated of by *Valerius Probus*, where he affirms the Study of them to be very necessary for one that would understand the Roman Affairs. *His enim exprimebant nomina Curiarum, Tribuum, Comitiorum, Sacerdotiorum, Potestatum, Magistratum, Præfecturarum, Sacrorum ludorum, Rerum Urbanarum, Rerum militarium, Collegiorum, Decuriarum, Fastorum, Numerorum, Mensurarum, Juris civilis, & similibus.*

Lib. de liter. anti-quis. As it is set forth by Jacobus Mazochius.

They were first used by their Notaries, at Senates and other Publick Assemblies, and from thence re-

tained in their Statutes and Civil Laws : Whence *Manilius* makes it the Note of a good Lawyer.

— *Qui legum tabulas & condita jura
Noverit, atque notis levebus pendentia verba.*

*Ifidor.
Bibliand.
de ratione
com. ling.
Pet. Crinit.
Honest.*

Thus (saith *Ifidor*) (A) inverfed V did formerly stand for *Pupilla*, and M inverfed W for *Mulier*. By these Letters D. E. R. I. C. P. is signified, *De ea re ita censuerunt Patres.*

*Disc. 1 6.c.
8.*

* From the
Greek, *αδ-
λαδινδλετ.*

When the Judges were to inscribe their several Opinions on a little Stone or *Tessera*, to be cast into the Urn ; by the Note A, they did absolve, by *K condemn ; by N. L. *Non liquet*, they did intimate that they could not tell what to make of the Business, and did therefore suspend their Judgments.

*Lib. 1. Cod.
Tit. 17. leg.
1, 2.*

But because of those many Ambiguities which this contracted Way of Writing was liable unto, and the great Inconveniencies that might happen thereupon in the Misinterpretation of Laws ; therefore the Emperor *Justinian* did afterward severely forbid any further Use of them, as it were, calling in all those Law-Books that were so written. *Neque enim licentiam aperimus ex tali codice in judicium aliquid recitari.*

The chief Purpose of these Ancient Abbreviations amongst the *Romans*, was properly for their Speed. But it is easie to apprehend how by Compact they may be contrived also for Secresy.

CHAP. XI.

Of Writing by invented Characters.

The Distinction of these into $\left\{ \begin{array}{l} \text{Letters.} \\ \text{Words.} \\ \text{Notions.} \end{array} \right.$
such as signifie, either

The General Rules of unfolding and obscuring any Letter-characters. How to express any Sense, either by Points, or Lines, or Figures.

BESIDES the Ways of secret Writing by the common Letters, there may likewise be divers others by invented Notes.

The Difference of Characters, whereby several Languages are express'd, is part of the second general Curse in the Confusion of Tongues; for as before there was but one Way of Speaking, so also but one Way of Writing. And as now, not only Nations, but particular Men, may discover their Thoughts by any different articulate Sounds, so likewise by any written Signs.

These invented Characters in the General, are distinguishable into such as signifie, either

1. Letters.
2. Words.
3. Things, and Notions.

First, concerning those that signify Letters: To which kind some Learned Men refer the *Hebrew* Character that is now in use; affirming, that *Ezra* first invented it, thereby the better to conceal the Secrets of their Law, and that they might not have so much as their Manner of Writing common with the *Samaritans* and other Schismaticks.

The Letter-character.
Hieronym. pref. ad l. Regum. Joseph Scal. notis ad Euseb.

'Twere but needless to set down any Particulars of this kind, since it is so easy for any ordinary Man to invent or vary them at Pleasure.

The Rules that are usually prescribed for the unfolding of such Characters, are briefly these.

1. Endeavour to distinguish betwixt the Vowels and Consonants. The Vowels may be known by their Frequency, there being no Word without some of them. If there be any single Character in *English*, it must be one of these three Vowels, *a, i, o.*

2. Search after the several Powers of the Letters: For the understanding of this, you must mark which of them are most common, and which more seldom used. (This the Printers in any Language can easily inform you of, who do accordingly provide their Sets of Letters.) Which of them may be doubled, and which not, as *H, Q, X, Y.* And then, for the Number of Vowels or Consonants in the Beginning, Middle, or End of Words, a Man must provide several Tables, whence he may readily guess at any Word, from the Number and Nature of the Letters that make it: As, what Words consist only of Vowels; what have one Vowel, and one Consonant; whether the Vowel be first, as in these Words, *Am, an, as, if, in, is, it, of, on, or, us;* or last, as in these Words, *Be, he, me, by, dy, ly, my, ty, do, to, so, &c.* And so for all other Words, according to their several Quantities and Natures.

These Tables must be various, according to the Difference of Languages. There are divers the like Rules to be observed, which are too tedious to recite; you may see them largely handled by *Baptista Porta,* and *Gustavus Selenus.*

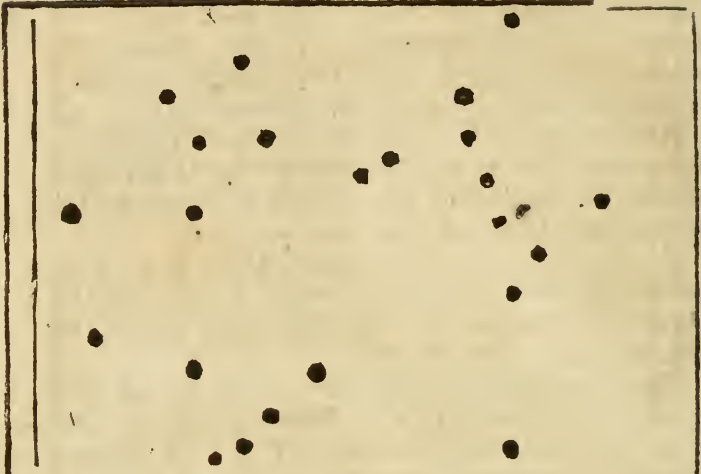
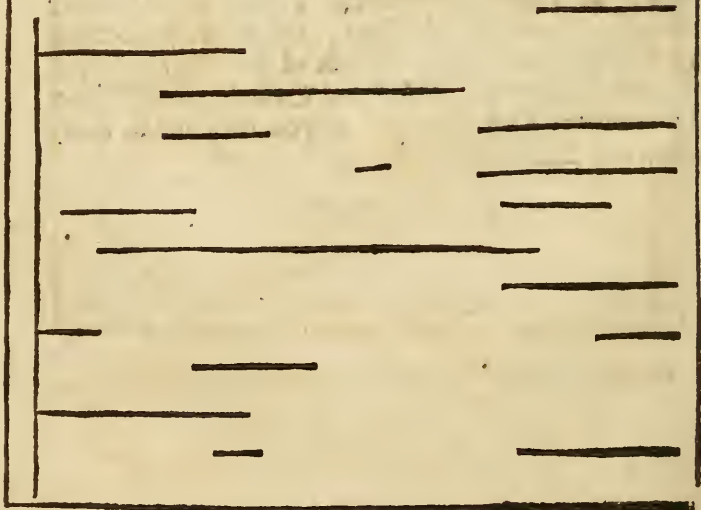
The common Rules of unfolding being once known, a Man may the better tell how to delude them; either by leaving out those Letters that are of less Use, as *H, K, Q, X, Y*; and putting other Characters instead of them, that shall signify the Vowels: So that the Number of this invented Alphabet will be perfect; and the Vowels, by reason of their double Character, less distinguishable. Or a Man may likewise delude the Rules of Discovery, by writing continually, without any Distinction betwixt the Words, or with a false Distinction, or by inserting *Nulls* and *Non-significants*, &c.

In these cases Orthography is not to be regarded.

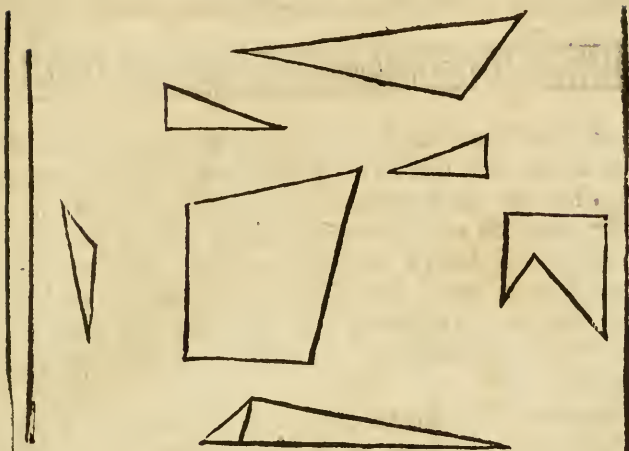
These Characters are besides liable to all those other Ways whereby the common Letters may be obscured, whether by changing their *Places*, or their *Powers*.

The Particulars of this kind, may be of such great Variety, as cannot be distinctly recited: But it is the grand Inconvenience of all these Ways of Secresy by invented Characters, that they are not without Suspicion.

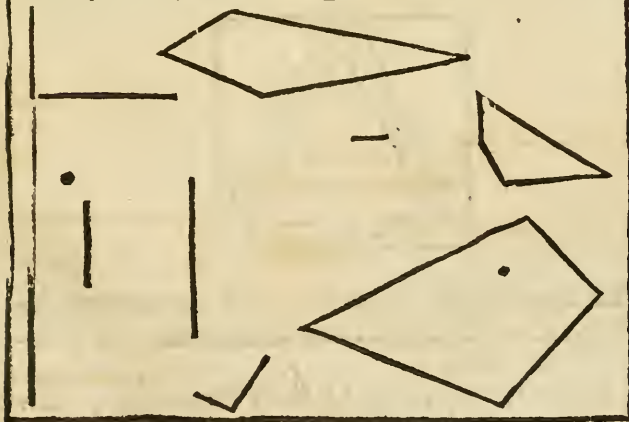
For the remedying of which, there have been some other Inventions of writing by *Points*, or *Lines*, or *Figures*; wherein a Man would never mistrust any private Message, there being nothing to be discerned in these *Kinds* of Intimation, but only either some Confused and Casual, or else some Mathematical Descriptions; as you may see in these following Examples.

*The Secret and Swift Messenger.**By Points alone.**By Lines alone.*

By Mathematical Figures.



By Points, Lines, and Figures mixed together.



Each of which Figures do express these Words :

There is no Safety but by Flight.

The

The Direction both for the making and unfolding of these Descriptions, is this: Let the Alphabet be described at equal Distances, upon some thin and narrow Plate, Pastboard, or the like, thus :



Let the sides of the Paper which you are to write upon, be secretly divided into equal Parts, according to the Breadth of the Plate; and then by Application of this to the Epistle, it is easy to conceive how such a Writing may be both composed and resolved. The Points, the Ends of the Lines, and the Angles of the Figures, do each of them, by their different Situations, express a several Letter.

This may likewise be otherwise performed, if the Alphabet be contrived in a Triangular Form, the Middle Part of it being cut out.



And so for
a Square
or round
Form.

The larger these Directories are, by so much the less liable unto Error will the Writing be, that is described from them.

It is easy to apprehend by these Particulars, how a Man may contrive any private Saying in the Form of a Landskip, or other Picture. There may be divers the like Ways, whereby this Invention of Secresy may be further obscured; but they are in themselves so obvious, that they need not any larger Expucation.

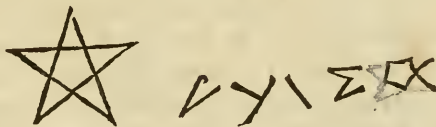
CH A P. XII.

Of Characters that express Words. The first Invention of these. Of those that signify Things and Notions, as Hieroglyphicks, Emblems.

THE next Particular to be discoursed of, is, concerning Characters that express Words. The writing by these is properly stiled *Stenography*, or Short-Hand; *Scripturæ Compendium*, cum verba non perscribimus, sed signamus, saith *Lyffius*. The Art of them is, to contrive such Figures for several Sylables, as may easily be joined together in one Form, according as different Words shall require. Thus 'tis ordinary to represent any proper Name by some such unusual Character, as may contain in it all the Letters of that Name for which it is intended. Of this Nature was that Angular Figure so much used by the *Gracians* of old, which might be resolved into the Letters *υπερα*.

Cent. 1. ad Belg. Epist. 27.

Schikard. Happer. Disp. 5.



This Mark was esteemed so Sacred amongst the Ancients, that *Antiochus Soter*, a perpetual Conqueror, did always instamp it upon his Coin, and inscribe it on his Ensigns; unto which he did pretend to be admonished in a Dream, by an Apparition of *Alexander* the Great. And there are many Superstitious Women in these Times, who believe this to be so lucky a Character, that they always work it upon the Swadling Clothes of their Young Children, thinking thereby to make them more healthful and prosperous in their Lives.. Unto this kind also,

also, some refer the Characters that are used in Magick, which are maintained to have, not only a secret Signification, but likewise a natural Efficacy.

This Short-hand Writing is now so ordinary in Practice (it being usual for any common Mechanick both to write and invent it) that I shall not need to set down any particular Example of it. In Ancient Times it was not so frequently used; but then there was a twofold Kind of it.

And therefore
Panciro-
lus reckon-
s it amongst
these latter
Inventions, *l. de
Repert. tit.*

14.
Casaubon.
notis in
*Æne. Poli-
orces. c. 31.*
*De notis
Tyronis &
Senec.*

* *De Doct.*
Christ. l. 2.
c. 26.
* *In Chron.*
† *De in-
vent. rerum
l. 2. c. 8.*
De Polygr.

*Lib. 13. ad
Attic. Ep.*
32.

Private.

Publick.

These private Characters were practised by the Roman Magistrates, and others of eminent Favour amongst them; who being often importuned to write in the Commendation of those Persons they knew not, were fain to agree upon some Secret Notes, whereby their Serious Epistles might be distinguished from those of Form. Whence the Proverb arose, *De meliori nota commendare.*

The other Characters of publick and common Use, are many of them explained by *Valerius Probus*, in his Book *de Literis Antiquis*; and there is a whole Volume, or Dictionary of them, set forth by *Jannus Gruterus*. From the Practice of these came the Word *Notarius*, as * *St. Austin* observes.

The first Invention of them is commonly ascribed to *Tyro*, who was a Servant unto *Cicero*. So * *Eusebius*, and † *Polydore Virgil*. But *Trithemius* affirms, That *Cicero* himself writ a Treatise on this Subject, which was afterwards augmented by *St. Cyprian*: And that he had found in an Old Library, the Copy of a Psalter written in these Characters, inscribed by some ignorant Man with this Title, *Psalterium in Lingua Armenica.*

That *Cicero* was not unacquainted with these Notes, may be evident from that Passage to *Atticus*: *Quod ad te de legatis scripsi, parum intellexit, credo, quia. Δὲ στυμειῶν scripseram.*

Pet. Diaconus attributes the first Invention of these to the Old Poet *Ennius*; whose Beginnings in this kind, did afterwards receive successive Addition from the Works of *Tyro*, *Philargirus*, *Aquila*, and *Seneca* the Father; by whom they were increased to the Number of 5000.

Prolog. not. Conrad. Imp. Isidor. Orig. l. 1. c. 21.

But *Hermannus Hugo*, a late Jesuit, will have this Short-hand Writing to be of far more ancient Use; affirming, that *David* alludes to the Practice of it, in that Phrase, *Psal. 45. 1. The Pen of a ready Writer.* And that the Writing upon the Wall, in *Dan. 5. 25.* which so puzzled the *Chaldean* Wizards, was described in such kind of Characters. But whether this were so, or not, is not much material: It is sufficiently pertinent to the present Enquiry, that the Use of these Word-Characters may well enough conduce to the Secresy of any written Message.

De Orig. scribendi, c. 18. juxta finem.

The third and last sort of Signs, that have been anciently used for the Expression of *Things* and *Notions*, are either *Hieroglyphicks*, or *Emblems*.

1. Concerning *Hieroglyphicks*. The Word signifies *Sacred Sculptures*, which were engraven upon Pillars, Obelisks, Pyramids, and other Monuments, before the Invention of Letters. Thus the *Egyptians* were wont to express their Minds, by the Pictures of such Creatures as did bear in them some natural Resemblance to the Thing intended. By the Shape of a Bee, they represented a King; intimating, that he should be endowed with Industry, Honey, and a Sting. By a Serpent, with his Tail in his Mouth, the Year, which returns into it self: And (which was a kind of Prophetical Hieroglyphick) by the Sign of a Cross, they did anciently denote *Spem venturæ Salutis*, or *Vitam Eternam*, as *Pet. Crinitus* relates out of *Ruffinus*. * *Philo* reckons up the Knowledge of these amongst those other abstruse *Egyptian Arts*, wherein *Moses* is said to be so expert. And *Clemens* relates of *Pythagoras*, how

Of Hieroglyphicks.

Tacit. Annal. l. 11.

Pol. Virgil de Invent. l. 3. c. 11.

*De honesta disciplina l. 7. c. 2. * Lib. de vita Moss. Lib. 1. Stromat.*

he

he was content to be circumcised, that so he might be admitted to the understanding of those many and great Mysteries which were this way delivered by the Ancient Priests, who did conceal all their Learning under such kind of Magical Expressions, as the Poet stiles them.

Lucan l. 3.

*Nondum flumineas Memphis contexere byblos
Noverat, & saxis tantum volucresque feræque,
Sculptaq; servabant magicas animalia linguas.*

Lib. de
Isid. &
Osiride.

Plutarch speaks of a Temple in *Aegypt* dedicated to *Minerva*, in the Front of which there was placed the Image of an *Infant*, an *Old Man*, a *Hawk*, by which they did represent God; a *Fish*, the Expression of Hatred; and a *Sea-horse*, the common Hieroglyphick of Impudence: The Construction of all being this; *O ye that are born to dye, know that God hateth Impudence.*

Herodot.
Melpom.
l. 4. c. 130.
Cl. Alex.
Strom. 5.

Of this Nature were those Presents sent unto *Darius*, when he was almost wearied in his War against the *Scythians*; which were; a Bird, a Mouse, a Frog, and certain Arrows; intimating, that unless the *Persians* could fly as *Birds*, or hide themselves under Water as *Frogs*, or inhabit the Caverns of the Earth as *Mice*, they should not escape the *Scythian Arrows*. Of this kind likewise were some Military Signs amongst the *Romans*. When any thing was to be carry'd with Silence and Secresy, they lifted up the Representation of a *Minotaur*; thereby reaching the Captains, that their Counsels and Contrivances must be as inextricable as a Labyrinth, which is feigned to be the Habitation of that Monster.

Pierius
Hieroglyph.
l. 3. c. 38.

Emblems
from the
Greek
Word ἐμ-
βαλλεῖν,
interferere,
injicere.

2. Like unto these Hieroglyphicks, are the Expressions by Emblems. They were usually inserted as Ornaments upon Vessels of Gold, and other Matters of State or Pleasure. Of this Nature are the Stamps of many Ancient Medals, the Impresses of Arms, the Frontispieces of Books, &c.

The

The Kinds of them are chiefly twofold.

1. *Natural*. Which are grounded upon some Resemblance in the Property and Essence of the Things themselves. So a Dolphin, which is a swift Creature, being described upon an Anchor, which serves for the Stay and Rest of a Ship, signifies *Festinate*, Deliberation in Counsel, and Dispatch in Execution: A Young Stork carrying the Old one, Filial Gratitude.

2. *Historical*, Those that refer to some common Relation. So the Picture of *Prometheus* gnawed by a Vulture, signifies the Desert of over-much Curiosity. *Phaeton*, the Folly of Rashness. *Narcissus*, the Punishment of Self-love.

It was formerly esteemed a great Sign of Wit and Invention, handsomely to convey any noted Saying under such kind of Expressions.

C H A P. XIII.

Concerning an Universal Character, that may be legible to all Nations and Languages. The Benefit and Possibility of this.

AFTER the Fall of *Adam*, there were two General Curses inflicted on Mankind: The one upon their *Labours*, the other upon their *Language*.

Against the first of these we do naturally endeavour to provide, by all those common Arts and Professions about which the World is busied; seeking thereby to abate the Sweat of their Brows in the Earning of their Bread.

Against the other, the best Help that we can yet boast of, is the *Latin* Tongue, and the other learned Languages, which by Reason of their Generality, do somewhat restore us from the first Confusion: But

now if there were such an Universal Character to express Things and Notions, as might be legible to all People and Countries, so that Men of several Nations might with the same ease both write and read it, this Invention would be a far greater Advantage in this Particular, and mightily conduce to the spreading and promoting of all Arts and Sciences : Because that great part of our Time which is now required to the Learning of Words, might then be employed in the Study of Things. Nay, the Confusion at *Babel* might this Way have been remedied, if every one could have expressed his own meaning by the same kind of Character. But then perhaps the Art of Letters was not invented.

That such a manner of Writing is already used in some Parts of the World, the Kingdoms of the high *Levant*, may evidently appear from divers credible Relations. *Trigaultius* affirms, that though those of *Cbina* and *Japan*, do as much differ in their Language as the *Hebrew* and the *Dutch*; yet either of them can, by this Help of a common Character, as well understand the Books and Letters of the others, as if they were only their own.

And for some particulars, this general kind of Writing is already attained amongst us also.

1. Many Nations do agree in the Characters of the common Numbers, describing them either the *Roman* Way by Letters, as I. II. V. X. C. D. M. or else the *Barbarian* Way by Figures, as 1. 2. 3. 10. &c. So likewise for that which we call Philosophical Number, which is any such Measure whereby we judge the Differences betwixt several Substances, whether in Weight, or Length, or Capacity; each of these are express'd in several Languages by the same Character. Thus 3 signifies a Scruple, 5 a Drachm, and so of the rest.

2. The Astronomers of several Countries do express

Histor. Sinenf. l. 1. c.

5. *Bacon Augment. Scient. l. 6. c.*

13. *Voss. Gr. l. 1. c. 41.*

Herm. Hugo de Orig. scrib. c. 4.

press both the Heavenly Signs, and Planets, and Aspects by the same kind of Notes : As, $\Psi, \Theta, \Pi, \Sigma, &c.$ $\bar{h}, \mathcal{A}, \mathcal{G}, \mathcal{F}, &c.$ $\mathcal{O}, \mathcal{K}, \Delta, \square, \mathcal{S}.$ Which Characters (as it is thought) were first invented by the Ancient Astrologers for the Secrefy of them, the better to conceal their Sacred and Myfterious Profeflion from vulgar Capacity.

3. The Chymical Treatifes that are written in different Languages, do all of them agree in the same Form of Writing their Minerals. Those that are attributed to any of the Planets, are decyphered by the Character of the Planet to which they belong. The rest by other particular Signs, as Δ for Salt Ammoniack, \mathcal{S} for Arfnick, &c.

4. Musical Notes in most Countries are the same : Nor is there any reason why there may not be such a general kind of Writing invented for the Expression of every Thing else as well as these particulars.

In the Contrivance of this there must be as many several Characters as there are primitive Words. To which purpose the *Hebrew* is the best Pattern, because that Language consists of fewest Radicals.

Each of these Primitives must have some particular Marks to distinguish the Cases, Conjugations, or other necessary Variations of those Derivatives that depend upon it.

In the Reading of such a Writing, though Men of several Countries should each of them differ in their Voices, and pronouncing several Words, yet the Sense would be still the same. As it is in the Picture of a Man, a Horse, or Tree ; which to all Nations do express the same Conceit, though each of these Creatures be stiled by several Names, according to the Difference of Languages.

Suppose that Astronomical Sign Θ were to be pronounced, a *Few* would call it $\gamma\psi$; a *Grecian*, *Ταύρον* ; an *Italian*, *Toro* ; a *Frenchman*, *Taureau* ; a *German*, *Stier* ; an *Englishman*, a *Bull*.

So likewise for that Character, which in *Tiro's* Notes signifies the World, a *few* would read it לָעוֹלָם ; a *Grecian*, κόσμος ; an *Italian*, *il monde*; a *Frenchman*, *le monde*; a *German*, *Belt*. Though several Nations may differ in the *Expression* of things, yet they all agree in the same *Conceit* of them.

The Learning of this Character will not be more difficult than the Learning of any one Language, because there needs not be more Signs for the Expression of Things, than there is now for the Expression of *Words*. Amongst those in *China* and *Japan*, there is said to be about Seven or Eight Thousand.

The perfecting of such an Invention were the only Way to unite the Seventy two Languages of the first Confusion; and therefore may very well deserve their Endeavours who have both Abilities and Leisure for such kind of Enquiries.

C H A P. XIV.

Concerning the third Way of Secret Discoursing by Signs and Gestures, which may signifie, either

ex } congruo.
 } placito.

THE third Way of Discoursing was by Signs and Gestures, which (as they are serviceable to this Purpose) may be distinguished into such as are significant, either

1. *Ex congruo*.
2. Or *ex placito*.

1. *Ex congruo*, when there is some natural Resemblance

blance and Affinity betwixt the Action done, and the thing to be exprest. Of which kind are all those outward Gestures, whereby not only dumb Creatures, but Men also do exprest their inward Passions, whether of Joy, Anger, Fear, &c. For,

Sæpe tacens vocem verbaque vultus habet.

And the Wise Man notes it of the Scorner, That *he winketh with his eyes, he speaketh with his feet, he teacheth with his fingers.* Prov. 6.
13.

Of this kind likewise are many Religious Actions, and Circumstances of Divine Worship, not only amongst the Ancient Heathen, but some that were particularly enjoyed the Priests and *Levites* of the old Law; and some too that are now in Use in these Times of the Gospel. For by such bodily Gestures and Signs, we may as well speak unto God as unto Men.

To this kind also are reducible those Actions of *Form*, that are required as necessary Circumstances in many civil Affairs and publick Solemnities, which are usually such, as in themselves are apt to signifie the thing for which they are meant.

But now sometimes the intended meaning of these Gestures is concealed under a secret Similitude. As it was in that Act of *Thrasylbulus*, who being consulted with, how to maintain a Tyranny that was newly usurped: He bid the Messenger attend him in the Field; where with his Wand he whipt off those higher Ears of Corn that did over-top the rest; intimating, that it consisted in cutting off the Peers and Nobility, who were likely to be most impatient of Subjection. This I may call a *Paraboli cal* Way of speaking by Gestures.

2. *Ex placito*, when these Signs have their Signification from Use and mutual Compact; which kind of Speaking, as it refers to lascivious Intimations, is largely handled by *Ovid, de Arte amandi*.

*Verba superciliis sine voce loquentia dicam,
Verba leges digitis, &c.*

By the Help of this it is common for Men of several Nations, who understand not one another's Languages, to entertain a mutual Commerce and Traffick. And 'tis a strange thing to behold, what Dialogues of Gestures there will pass betwixt such as are born both Deaf and Dumb; who are able by this means alone, to answer and reply unto one another as directly as if they had the Benefit of Speech. 'Tis a great part of the State and Majesty belonging to the *Turkish* Emperor, that he is attended by Mutes, with whom he may discourse concerning any private Business, which he would not have othersto understand,

It were a miserable thing for a Rational Soul to be imprisoned in such a Body as had no Way at all to express its Cogitations; which would be so in all that are born Deaf, if that which Nature denied them, were not in this Respect supplied by a second Nature, Custom and Use.

But (by the Way) 'tis very observable which * *Valliesus* relates of *Pet. Pontius* a Friend of his, who by an unheard-of Art taught the Deaf to speak. *Docens primum scribere, res ipsas digito indicando, quæ characteribus illis significarentur; deinde ad motus linguæ, qui characteribus responderent provocando.* First learning them to write the Name of any thing he should point to; and afterwards provoking them to such Motions of the Tongue as might answer the several Words. 'Tis probable that this Invention well followed, might be of singular Use for those that stand in need of such Helps. Tho' certainly that was far beyond it, (if true) which is related of an ancient Doctor, *Gabriel Neale*, that he could understand any Word by the meer Motion of the Lips, without any Utterance.

The particular Ways of Discourfing by Gestures, are not to be numbied, as being almost of infinite Variety, according as the several Fancies of Men shall

* *Sacra*
Philos. c. 3.

shall impose Significations upon all such Signs or Actions as are capable of sufficient Difference.

But some there are of more especial Note for their Use and Antiquity. Such is that upon the Joynts and Fingers of the Hand, commonly stiled *Arthrologia*, or *Dactylologia*; largely treated of by the venerable * *Bede*, † *Pierius*, and others. In whom you may see, how the Ancients were wont to express any Number by the several Postures of the Hands and Fingers: The Numbers under a hundred, were denoted by the Left Hand, and those above, by the Right Hand. Hence *Juvenal*, commending *Pyllias* for his old Age, says, That he reckoned his Years upon his Right Hand.

* *Lib. de lo-
quelâ per
gestum di-
gitorum
sive de in-
digitatione.*
† *Hierogly-
phic. l. 37.
c. 1. &c.*
*Cælius An-
tiq. l. 12.
l. 23. c. 12.*
Satyr. 10.

*Felix nimirum qui tot per sæcula vitam
Distulit, atque suos jam dextra computat annos.*

There are divers Passages in the Ancient Authors, both Sacred and Prophane, which do evidently allude to this kind of reckoning.

Hence it is easie to conceive, how the Letters as well as the Numbers, may be thus applied to the several Parts of the Hand, so that a Man might with divers Touches, make up any Sense that he hath occasion to discover unto a Confederate.

This may be performed, either as the Numbers are set down in the Authors before-cited; or else by any other Way of Compact that may be agreed upon.

As for Example: Let the Tops of the Fingers signify the five Vowels; the middle Parts, the five first Consonants; the Bottoms of them, the five next Consonants; the Spaces betwixt the Fingers the four next. One Finger laid on the side of the Hand may signify T, two Fingers V the Consonant, three W, the little Finger crossed X, the Wrist Y, the middle of the Hand Z.

But because such various Gesticulations as are required to this, will not be without Suspicion, therefore it were a better Way, to impose Significations

upon such Actions as are of more common unsuspected Use ; as scratching of the Head, rubbing the several Parts of the Face, winking of the Eyes, twisting of the Beard, &c. Any of which, or all of them together, may be as well contrived to serve for this Purpose, and with much more Secresy.

In which Art, if our gaming Cheats, and *Popish* Miracle-Impostors, were but well versed, it might much advantage them, in their cozening Trade of Life.

C H A P. XV.

Concerning the Swiftnes of Informations, either by Qualities, as the Impression of Imagination, and the Sensitive Species ; or by Spiritual Substances, as Angels.

HAVING already treated concerning the several Ways of *Secresy* in Discoursing, I shall in the next Place enquire, How a Man may with the greatest Swiftnes and Speed, discover his Intentions to one that is far distant from him.

There is nothing (we say) so swift as Thought, and yet the Impression of these in another, might be as quick almost as the first Act, if there were but such a great Power in Imagination, as some later * Philosophers have attributed to it.

Next to the Acts of Thought, the Species of Sight do seem to be of the quickest Motion. We see the Light of the *East* will in a Moment fill the Hemisphere, and the Eye does presently discern an Object that is very remote. How we may by this means communicate our Thoughts at great Distances, I shall discourse afterwards.

* *Maxim.*
Ficin Theolog.
Platon.
l. 3. c. 1.
Pomponatius de In-
cantat.
Paracelsus.

The Substances that are most considerable for the Swiftness of their Motion, are

Either { *Spiritual.*
 { *Corporeal.*

Amongst all created Substances, there are not any of so swift a Motion as Angels or Spirits. Because there is not either within their Natures, any such Indisposition and Reluctancy, or without them in the Medium, any such Impediment as may in the least manner retard their Courses. And therefore have the Ancient Philosophers employed these as the Causes of that mad Celerity of the Celestial Orbs ; tho' according to their Suppositions, I think it would be a hard Match, if there were a Race to be run betwixt the *Primum Mobile* and an Angel. It being granted that neither of them could move in an Instant, it would be but an even lay which should prove the swifter.

Spirits.

From the Fitness of Spirits in this regard to convey any Message, are they in the learned Languages called Messengers.

מלאך
ἀγγελός
Angelus.

Now if a Man had but such Familiarity with one of these, as *Socrates* is said to have with his Tutelary Genius : If we could send but one of them upon any Errand, there would be no quicker Way than this for the Dispatch of Business at all Distances.

Plutarch.
Maximus
Tyrius.
Dissertat.
26, 27.

That they have been often thus employed, is affirmed by divers Relations. *Vatinius* being at *Rome*, was informed by an Apparition of that Victory which *Paulus* their General had obtained over King *Perfes* in *Macedon*, the very same Day wherein the Battel was fought ; which was a long Time before any other Messenger could arrive with the News.

Lactant.
Inst. l. 2.
ep. 8.
Val. Max.
l. 1. c. 8.
Florus, lib.
2. c. 12.

And it is storied of many others, that whilst they have resided in remote Countries, they have known the Death of their Friends, even in the very Hour of their Departure ; either by Bleeding, or by Dreams, or some such Way of Intimation. Which, though it

be

be commonly attributed to the Operation of Sympathy ; yet it is more probably to be ascribed unto the Spirit or Genius. There being a more especial Acquaintance and Commerce betwixt the Tutelary Angels of particular Friends, they are sometimes by them informed (tho' at great Distances) of such Remarkable Accidents as befall one another.

But this way there is little Hopes to advantage our Enquiry, because it is not so easie to employ a good Angel, nor safe dealing with a bad one.

The Abbot *Trithemius*, in his Books concerning the severall Ways of secret and speedy Discoursing, does pretend to handle the Forms of Conjunction, calling each kind of Character by the Name of Spirits, thereby to deter the Vulgar from searching into his Works. But under this Pretence, he is thought also to deliver some Diabolical Magick. Especially in one Place, where he speaks of the three Saturnine Angels, and certain Images, by which, in the Space of twenty four Hours, a Man may be informed of News from any Part of the World. And this was the main Reason, why by *Junius* his Advice, *Frederick* the Second, Prince *Palatine*, did cause the Original Manuscript of that Work to be burned. Which Action is so much (though it should seem unjustly) blamed by *Selenus*.

Vossius
Gram. l. 1.
c. 41.
Polygraph.
l. 3. c. 16.

Cryprogr.
l. 3. c. 15.

C H A P. XVI.

Concerning the Swiftnes of Conveyance by Bodies, whether Inanimate, as Arrows, Bullets ; or Animate, as Men, Beasts, Birds.

THE Bodies that are most eminent for their Swiftness, may be distinguished into such as are

Either

Either } *Inanimate.*
 } *Animate.*

Inanimate
Bodies.

These Inanimate Bodies, as Arrows, Bullets, &c. have only a violent Motion; which cannot therefore be continued to so great a Distance, as some Occasions would require: But for so much Space as they do move, they are far swifter than the Natural Motion of any Animated Body. How these have been contrived to the speedy Conveyance of Secret Messages, hath been formerly discoursed, in the Fourth Chapter, which I now forbear to repeat.

Those Living Bodies that are most observable for their Speed and Celerity in Messages, are either Men, Beasts, Birds: Tho' I doubt not, but that Fishes also may be serviceable for this purpose, especially the Dolphin, which is reported to be of the greatest Swiftness, and most easily circurated, or made tame.

Amongst the Ancient Footmen, there are some upon Record for their incredible Swiftness. *Lædas* is reported to be so quick in his Running, *Ut arenis pendentibus & cavo pulvere, nulla indicia relinqueret vestigiorum*; that he left no Impression of his Footsteps on the Hollow Sands. And it is related of a Boy amongst the *Romans*, being but Eight Years old, that did run Five and forty Miles in an Afternoon. *Anistius* and *Philonides*, two Footmen unto *Alexander the Great*, are said to have run 1200 *Stadia* in a day. Which Relations will seem less incredible, if we consider the Ancient Exercises and Games of this kind, together with the publick Fame and Rewards for those that were most eminent.

Men.

Solinus
Polybist.
c. 6.

Ibid.

Amongst the Variety of Beasts, there are some of more especial Note for their Strength and Swift-ness. *Scaliger* mentions a Story, (tho' he distrusts the Truth of it) of a certain Beast called *Ellend*,

Swift-ness
of Beasts.
Exer. 205.

two of which being joined in a little Cart, are said to pass Three hundred Leagues a day upon the Ice.

In former Ages, and in other Countries, the Dromedary, and Camel, and Mule, were of more common Use; but in these Times and Places, the Horse (for the most part) serves instead of them all; by the Help of which, we have our swiftest Means of ordinary Conveyance. The Custom of Riding Post, by renewing both Horse and Man at set Stages, is of Ancient Invention. *Herodotus* relates it to be used by *Xerxes* in the *Grecian War*; and that it was by the *Persians* called *'Αγχαρπίον*. The Particulars that concern these kind of Conveyances amongst the Ancients, are largely handled by *Hermannus Hugo*, *Lib. 3. de Origine scribendi*, c. 14.

Nat. Hist.
L. 8. c. 42.

Pliny tells us of certain Mares in *Lusitania*, which do conceive meerly by the *West Wind*; that alone (without the Copulation of any Male) serving to actuate their Heat, and to generate their Young.

Georg. 3.

Which are likewise mentioned by *Virgil*:

*Exceptantq; auras leves, & saepe sine ullis
Conjugiis, vento gravidæ, &c.*

It methinks these Children of the Wind should, for their Fleetness, make excellent Post-Horses, and much conduce to the speedy Conveyance of any Message.

The *Paracelsians* talk of Natural Means to extract the Mettle and Spirit out of one Horse, and infuse it into another; of enabling them to carry a Man safely and swiftly through Enemies, Precipices, or other dangerous Places. And such Horses (say they) were used by the Wise Men of the *East* at our Saviour's Nativity; for they had not otherwise been able to have kept pace with a Star, or to have passed so great a Journey as it was to *Jerusalem*, which is thought to be Five or Six hundred Miles at the least, from the Places of their Habitation. If this Conceit were feasible, it would much promote the

the Speed of Conveyances ; but I think it may justly be referred amongst the other Dreams of the Melancholick Chymicks.

Amongst all Animate Bodies , there is not any that have naturally so swift a Motion as Birds ; which if a Man could well employ in the Dispatch of any Errand , there would be but little Fear that such Messenger should be either intercepted , or corrupted.

The
Swiftness
of Birds.

That this hath been attempted , and effected by many of the Ancients, is affirmed by divers Relations. *Pliny* tells us of *Volaterranus*, that he discover'd a Conquest he had gotten unto the City of *Rome*, by sending out Swallows, which should fly thither, being anointed over with the Colour of Victory. And of another, who sending one of these Birds into a besieged City , (whence she was before taken from her young ones) and tying a String unto her with certain Knots upon it, did thereby shew, after what Number of Days their Aids would come ; at which time they should make an Irruption upon the Enemy.

Nat. Hist.
l. 10. c. 24.

And elsewhere, in the same Book, he relates , How *Hircius* the Consul , and *Brutus* who was besieged in *Mutina* , did this way maintain mutual Intelligence, by tying their Letters unto such Pigeons, as were taught beforehand to fly from the Tents to the City, and from thence to the Tents again.

Cap. 37.

How *Thaurosthenes* did by this means send the News of his Victory at *Olympia* , to his Father at *Agina*, is related by *Ælian*.

Hist. Animalium,
l. 6. c. 7.

Anacreon has an Ode upon such a Pigeon, which he himself had often used as a Messenger, wherein the Bird is feigned to say,

Ἐρὸ δ' Ἀνακαιοῖντι
Διακονῶ τσαῶτα
Καὶ νῦν ὄρᾳς ἐκείνη
Ἐπιστάς κομίζω.

Sat. 4.
juxta fin.

Unto this Invention also, *Juvenal* is thought to allude; where he says,

—— *Tanquam è diversis partibus orbis,
Anxia præcipiti venisset Epistola pennâ.*

Saturn.
Serm. l. 2.
c. 6.

Lypsius relates out of *Varro*, That it was usual for the Roman Magistrates when they went unto the Theatre, or other such publick Meetings, whence they could not return at pleasure, to carry such a Pigeon with them; that if any unexpected Business should happen, they might thereby give Warning to their Friends or Families at home.

By which Relations you may see how commonly this Invention was practis'd amongst the Ancients. Nor hath it been less used in these later Times, especially in those Countries where by reason of continual Wars and Dissentions, there have been more particular and urgent Necessity for such kind of Conveyances. *Nunc vulgatissima res est, columbas habere, ad ejusmodi jussa paratas*, saith *Casaubon*. *Harum opere, nostrates hoc bello civili, frequenter adjuti sunt*, saith *Godesc. Steweckius*.

Not. in Æ-
nicæ Polior-
cet. c. 31.
Comment.
in Veget.
l. 3. c. 5.
See Nunt.

Inanimat.
concern-
ing *Ami-
raldus*.

*Porta de
furt. lit.*

l. 2. c. 21.
concern-
ing *Mar-
ches*.

*Herm. Hugo
de Orig.
scribendi,
c. 15.*

*Thuanus
Hist. l. 17.*

There are divers other Stories to this purpose, but by these you may sufficiently discern the common Practices of this kind. As it is usual to bring up Birds of Prey, as Hawks, Cormorants, &c. to an Obedience of their Keepers; so likewise have some attempted it in these other Birds, teaching them the Art of carrying Messages. There is a smaller sort of Pigeon, of a light Body, and swift Flight, which is usually made choice of for such particulars; and therefore the kind of them is commonly called by the Name of Carriers.

*a Pigeon, it is said, will fly Sixty
Miles in an hour. H*

C H A P. XVII.

Of Secret and Swift Informations by the Species of Sound.

HAVING in the former Chapters treated severally concerning the divers Ways of Secrefy and Swiftnefs in Difcourfe; it remains that I now enquire, (according to the Method propofed) how both thefe may be joined together in the Conveyance of any Message. The Refolution of which, fo far as it concerns the Particulars already fpecify'd, were but needlefs to repeat.

That which does more immediately belong to the prefent *Quære*, and was the main Occafion of this Difcourfe, does refer to other Ways of Intimation, befides thefe in ordinary Ufe, of Speaking, or Writing, or Geftures. For in the general we muft note, That *whatever is capable of a competent Difference, perceptible to any Senfe, may be a fufficient Means whereby to exprefs the Cogitations.* It is more convenient, indeed, that thefe Differences fhould be of as great Variety as the Letters of the Alphabet; but it is fufficient if they be but twofold, becaufe Two alone may, with fomewhat more Labour and Time, be well enough contrived to exprefs all the reft. Thus any two Letters or Numbers, fuppofe A. B. being tranfpofed through five Places, will yield Thirty two Differences, and fo confequently will fuperabundantly ferve for the Four and twenty Letters, as was before more largely explained in the Ninth Chapter.

Now the Sensitive Species, whereby fuch Informations muft be conveyed, are, either the Species of *Sound*, or the Species of *Sight*: The Ear and the Eye being the only Senfes that are of quick Perception, when their Objects are remote.

De re mi-
lit. l. 3. c. 5.

Vegetius distinguisheth all significatory Signs into these Three Sorts.

1. *Vocalia*. By articulate Sounds.
2. *Semivocalia*. By inarticulate Sounds.
3. *Muta*. By the Species of Sight.

The two last of these are chiefly pertinent to the present Enquiry. Concerning which, in the General it may be concluded, that any Sound, whether of Trumpets, Bells, Cannons, Drums, &c. or any Object of Sight, whether Flame, Smoak, &c. which is capable of a double Difference, may be a sufficient Means whereby to communicate the Thoughts.

The particular Application of these, to some Experiments, I shall treat more distinctly in the Remainder of this Discourse.

Secret and
speedy In-
formation
by the
Species of
Sound.

First, Concerning the Secresy and Swiftnes of any Message by the Species of Sound. Though these audible Species be much slower than those of Sight, yet are they far swifter than the natural Motion of any corporeal Messenger. The chief Use of these is for such as are within some competent Nearness, as perhaps a Mile off. But they may also by frequent Multiplication be continued to a far greater Distance.

Proem. in
lib. Plutar.
de defectu
oraculo-
rum.

There is a Relation in *Joach. Camerarius*, of some that have heard their Friends speaking to them distinctly, when they have been many Miles asunder. *Habui notos homines, neque leves, & non indoctos, qui affirmabant, se audiisse secum colloquentes diserte, eos quos tunc multorum millium passuum abesse certe scirent.* But this he justly refers to Diabolical Magick, and the Illusion of Spirits.

De rerum
Inventor.
lib. 2.

There are other *natural* Experiments in this kind, of more especial Note for their Antiquity. Such was that of King *Zerxes*, related by *Cleomenes*, as he is cited by *Sardus*. *Cleomenes in libro de circulis caelestibus scribit Xerxem toto itinere à Perside in Græciam stationes statuissè, & in iis homines ita prope, ut vocem alterius*

terius alter exaudiret; quo modo quadraginta horarum spatio, ex Græciâ in Persidem res nunciari poterat. But this Invention, besides the great Trouble and Uncertainty of it, is also too gross for Imitation, favouring somewhat of the Rudeness of those former and more barbarous Ages.

Much beyond it was that Experiment of the Romans, in the Contrivance of the *Picts* Wall, related by our Learned *Cambden*; this Wall was built by *Severus* in the North Part of *England*, above a hundred Miles long. The Towers of it were about a Mile distant from one another. Betwixt each of these Towers there passed certain hollow Pipes or Trunks in the Curtains of the Wall, through which the Defendants could presently inform one another of any thing that was necessary, as concerning that Place wherein the Enemy was most likely to assault them; &c.

Since the Wall is ruined, and this Means of swift Advertisement taken away, there are many Inhabitants thereabouts, which hold their Land by a Tenure in *Cornage* (as the Lawyers speak) being bound by blowing of a Horn to discover the Irruption of the Enemy.

There is another Experiment to this Purpose mentioned by *Walchius*, who thinks it possible so to contrive a Trunk or hollow Pipe, that it shall preserve the Voice entirely for certain Hours or Days, so that a Man may send his Words to a Friend instead of his Writing. There being always a certain Space of Intermission, for the Passage of the Voice, betwixt its going into these Cavities, and its coming out; he conceives that if both ends were seasonably stopped, whilst the Sound was in the midst, it would continue there till it had some vent. *Huic tubo verba nostra insusuramus, & cum probe munitur tabellario committamus, &c.* When the Friend to whom it is sent, shall receive and open it, the Words shall come out distinctly, and in the same Order wherein they were spoken. From

Britan. de Vallo sive the Picts Wall. p. 654. Boter. Geog. l. 2. & l. 4. where he mentions also another Wall of 8000 Furlongs in China.

Fabul. 9.

such a Contrivance as this, (saith the same Author) did *Albertus Magnus* make his Image, and Friar *Bacon* his Brazen Head, to utter certain Words. Which Conceit (if it have any Truth) may serve somewhat to extenuate the gross Absurdity of that *Popish* Relick, concerning *Josepb's* [Hah] or the Noise that he made (as other Carpenters use) in fetching of a Blow; which is said to be preserved yet in a Glass amongst other Ancient Relicks.

But against these Fancies it is considerable, that the Species of Sound are multiplied in the Air, by a kind of Continuation and Efflux from their first Original, as the Species of Light are from any luminous Body; either of which being once separated from their Causes, do presently vanish and die. Now as it would be a mad thing for a Man to endeavour to catch the Sun-beams, or enclose the Light; upon the same Grounds likewise must it needs be absurd, for any one to attempt the shutting in of articulate Sounds: Since both of them have equally the same intrinsical and inseparable Dependance upon their efficient Causes.

True, indeed, the Species of Sound may seem to have some kind of Self-continuance in the Air, as in Ecchoes; but so likewise is it in Proportion with those of Sight, as in the quick turning round of a Fire-stick, which will make the Appearance of a fiery Circle: And tho' the first kind of these be more lasting than the other, by reason their natural Motion is not so quick, yet neither of them are of such Duration as may be sufficient for the present Enquiry.

None of all these Inventions already specified, do sufficiently perform the Business that is here enquired after; nor are they either so generally or safely applicable for all Places and Exigencies.

The Discovery that is here promised, may be further serviceable for such Cases as these.

Suppose a Friend were perfidiously clapped up in
some

some close Dungeon, and that we did not know exactly where, but could only guess at the Place, within the Latitude of half a Mile or somewhat more; a Man might very distinctly by these other Inventions, discourse unto him. Or suppose a City were straitly Besieged, and there were either within it or without it, such a Confederate, with whom we should necessarily confer about some Design; we may by these Means safely discover to him our Intentions. By which you may guess that the Messenger which is here employed, is of so strang a Nature, as not to be barred out with Walls, or deterred by Enemies.

To the Performance of this, it is requisite that there be two Bells of different Notes, or some such other audible and loud Sounds, which we may command at Pleasure, as Muskets, Cannons, Horns, Drums, &c. By the various Sounding of these (according to the former Table) a Man may easily express any Letter, and so consequently any Sense.

These Tables I shall again repeat in this Place: Cap. 9.
That of two Letters may be contrived thus:

A.	B.	C.	D.	E.	F.	G.
aaaaa.	aaaab.	aaaba.	aaabb.	aabaa.	aabab.	aabba.

H.	I.	K.	L.	M.	N.	O.
aabbb.	abaaa.	abaab.	ababa.	ababb.	abbaa.	abbab.

P.	Q.	R.	S.	T.	V.	W.
abbba.	abbbb.	baaaa.	baaab.	baaba.	baabb.	babaa.

X.	Y.	Z.
babab.	babba.	babbb.

Suppose the Word *Victuals* were this Way to be expressed; let the bigger Sound be represented by A, and the lesser by B, according to which, the Word may be thus made up by five of these Sounds for each Letter.

V. I. C. T. U. A. L.
 baabb. abaaa. aaaba. baaba. baabb. aaaaa. ababa.
 S.
 baaab.

That is, the lesser Note sounded once, and then the bigger twice, and then again the lesser twice, as (baabb) will signifie the Letter (V.) So the bigger once, and then the lesser once, and after that the bigger thrice together, as (abaaa) will represent the Letter (I.) and so of the rest.

If the Sounds be capable of a triple Difference, then each Letter may be expressed by a threefold Sound, as may appear by this other Alphabet.

A. B. C. D. E. F. G. H. I. K. L.
 aaa. aab. aac. baa. bab. bba. bbb. bbc. caa. cba. cbb.

M. N. O. P. Q. R. S. T. V. W. X.
 cbc. cca. ccb. ccc. aba. abb. abc. aca. acb. acc. bca.

Y. Z.
 bcb. bcc.

V. I. C. T. U. A. L. S.
 acb. caa. aac. aca. acb. aaa. cbb. abc.

If these Sounds do contain a quintuple difference, then may every Letter be signified by two Sounds only, (which will much conduce to the Speed and Dispatch of such a Message.) As you may see in this other Table.

A. B. C. D. E. F. G. H. I. K. L. M. N. O. P.
 aa. ab. ac. ad. ae. ba. bb. bc. bd. be. ca. cb. cc. cd. ce.

Q. R. S. T. V. W. X. Y. Z.
 da. db. dc. dd. de. sa. eb. ec. ed.

V. I. C. T. U. A. L. S.
de. bd. ac. dd. de. aa. ca. dc.

'Tis related by *Porta*, that when the Citizens in the Siege of *Navarre* were reduced to such great Extremities that they were ready to yield, they did discover to their Friends the Greatness and Kind of their Wants, by discharging divers Cannons and Ordnances in the Night-time, according to a certain Order before agreed upon; and by this Means did obtain such fitting Supplies as preserved the City.

De furt. lit.
l. 1. c. 6.

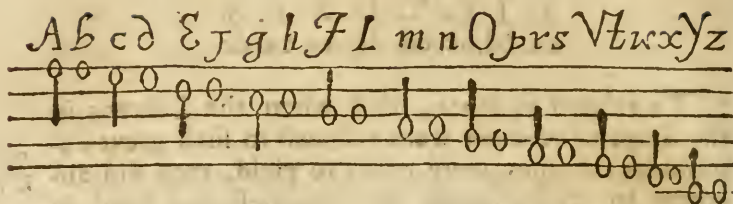
CHAP. XVIII.

Concerning a Language that may consist only of Tunes and Musical Notes, without any articulate Sound.

IF the Musical Instrument that is used to this Purpose, be able to express the Ordinary Notes, not only according to their different *Tones*, but their *Times* also, then may each Letter of the Alphabet be rendred by a single Sound.

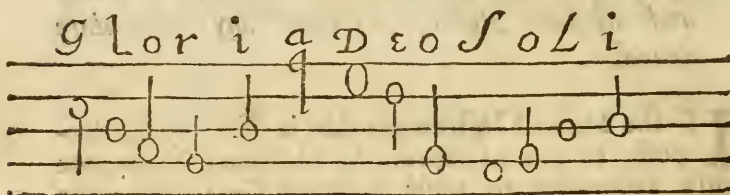
Whence it will follow, that a Man may frame a Language, consisting only of Tunes and such inarticulate Sounds, as no Letters can express. Which kind of Speech is fancied to be usual amongst the Lunar Inhabitants, who (as * *Domingo Gonsales* hath discovered) have contrived the Letters of the Alphabet upon the Notes after some such Order as this.

* Or the Man in the Moon, written by the same Author of *Nuntius Inanimat.*



Where the 5 Vowels are represented by the Minnims on each of the five Lines, being most of them placed according to their right Order and Consequence, only the Letters K. and Q. are left out, because they may be otherwise expressed.

See Dom. According to this Alphabet of Notes, these Words,
Gonsal 94. Gloria Deo soli, must be thus contrived.



By this you may easily discern how two Musicians may discourse with one another, by playing upon their Instruments of *Musick*, as well as by talking with their Instruments of *Speech*. And (which is a singular Curiosity) how the Words of a Song may be contrived in the Tune of it.

I suppose that these Letters and Notes might be disposed to answer one another, with better Advantage than here they are expressed. And this perhaps, would be easie enough for those that are thoroughly versed in the Grounds of *Musick*, unto whose further Enquiry I do here only propose this Invention.

But now if these inarticulate Sounds be contrived
 for

for the Expression, not of Words and Letters, but of Things and Notions, (as was before explained, concerning the Universal Character) then might there be such a General Language, as should be equally speakable by all People and Nations; and so we might be restored from the second General Curse, which is yet manifested, not only in the Confusion of Writing, but also of Speech.

The Utterance of these Musical Tunes may serve for the Universal Language, and the Writing of them for the Universal Character. As all Nations do agree in the same Conceit of Things, so likewise in the same Conceit of Harmonies.

This Curiosity (for ought I know) has not yet been mentioned by any Author, but it may be (if well considered) of such excellent Use, as to deserve a more full and particular Enlargement in a Treatise by it self.

CHAP. XIX.

Of those common Relations that concern Secret and Swift Informations by the Species of Sight; which are either Fabulous, or Magical.

THE usual Relations that concern Secret and Swift Conveyances by the Species of Sight, may be distinguished into such as are, either

1. *Fabulous.*
2. *Magical.*
3. *Natural and true.*

First, Of those that are *Fabulous*. In which kind, that of the Loadstone is most remarkable, as it is maintained by * *Famianus Strada*, in his Imitation of *Lucretius's* Stile, and divers others. The Manner that is usually prescribed for the Performance of it,

1. Of those fabulous Relations to this purpose.
* *Lib. 2.*
Prot. 6.

is thus: Let there be two Needles provided, of an equal Length and Bigness, being both of them touched with the same Loadstone: Let the Letters of the Alphabet be placed in the Circles on which they are moved, as the Points of the Compass under the Needle of the Mariner's Chart. Let the Friend that is to travel take one of them with him, first agreeing upon the Days and Hours wherein they should confer together: At which times, if one of them move the Needle of his Instrument to any Letter of the Alphabet, the other Needle, by a Sympathy, will move unto the same Letter in the other Instrument, though they be never so far distant: And thus by several Motions of the Needle to the Letters, they may easily make up any Words or Sense which they have a mind to express.

*O utinam hæc ratio scribendi prædeat usu ;
Cautior & citior properaret Epistola, nullas
Latronum verita insidias, fluviisque morantes,
Ipse suis princeps manibus sibi conficeret rem, &c.*

Saith *Strada*. But this Invention is altogether imaginary, having no Foundation in any real Experiment. You may see it frequently confuted in those that treat concerning Magnetical Virtues. *Non solum exhibendi sunt, sed etiam male mulcandi Philosophicâ ferulâ, fabularum isti præcursores, qui suis portentis deterrent homines a præclarissimo causarum studio ;* saith *Cabæus* to this purpose.

The first Occasion of these Relations, was, the Proof of that strange immaterial Power of the Loadstone, whereby it did work through thick and solid Bodies, as a Table, or Wall, or the like ; as also of that directive Virtue, whereby it always tends to the Poles ; from whence others have conjectured, that it might be serviceable also for such a Business, at so great a Distance.

But against this, it is considerable,

1. That every Natural Agent is supposed to have some certain Sphere, which determines its Activity.

2. That Magnetical Operations do not arise (as some fondly conceive) from a Sympathetical Conformation of Natures, which is the same at all distances; but from such a Diffusion of these Magnetical Qualities through the *Medium*, that they may be continued from the Agent to the Patient. And so these Natural Powers will not be of so great an Extent, as they are supposed in this Experiment.

The utmost Distance, at which we may discourse with another by these Magnetical Virtues, is, two or three Foot, or thereabouts; and this we may do, tho' it be through a Wall of that Thickness. *Fieri enim posse me docuit experientia, ut ope Magnetis, & instrumenti ad id aptati, amicus cum amico, in cubiculo proximo, trans crassum murum (puta bipetalem) colloquatur, animi sui sententiam impertiat, & ad quesita respondeat*; saith a late Author. But in this Experiment, it is not only the secondary Virtue of the Needles that can be thus effectual, (as is supposed in the former Invention) but there must be the Help also of the Loadstone it self.

As for the Reason why these Magnetical Powers are able to work through Solid Bodies; 'tis considerable, that any Quality may be diffused through such a Substance, as hath no Natural Repugnancy unto it. We see, the Light does pass as well through hot Bodies as cold, through solid as fluid, &c. only Opacity keeps it out, because that Quality alone is contrary to its Nature. So likewise is it with Magnetical Virtues, which do equally spread themselves through all kind of Bodies, whether *rare* or *dense*, *diaphanous* or *opacous*; there being no Quality contrary to this, because it is that General Endowment of the whole Globe, that Universal Quality to which all other Particulars are naturally subservient.

S. Ward
Magnetis
Reduct.
c. 40.
See Cabæus
Phil.
Magn. l. 4.
c. 11.

The

2. Magi-
cal.

The second Sort of Relations to this purpose, are such as refer to *Diabolical Magick*; of which kind is that Invention thought to be, which is commonly ascribed to *Pythagoras*; of whom it is reported, that he could write any thing in the Body of the Moon, so as it might be legible to another at a great Distance. *Agrippa* affirms this to be naturally possible, and the way of performing it not unknown to himself, with some others in his time: And *Fredericus Risner* seems to believe it; for speaking of the strange Experiments to be wrought by some Glasses, he adds, *Denique certo artificio, depictas imagines, aut scriptas literas, nocte serena, plenæ lunæ sic opponi possunt, ut radiis lunam irradiantibus, ideoque reflexis, videas & legas, quæ Constantinopoli Lutetiam tibi nuncientur.*

Occult.
Philosoph.
l. 1. c. 6.

Optic. l. 3.
prop. 36.
Speculorum
persuasio
hoc per va-
sâ, &c.

There is an Experiment in Opticks, to represent any Writing by the Sun-beams, upon a Wall, or Front of a House: For which purpose, the Letters must be first described with Wax, or some other opacous Colour, upon the Surface of the Glass, in an inverted Form; which Glass afterwards reflecting the Light upon any Wall in the Shade, will discover these Letters in the right Form and Order. Unto some such Invention I did first (before I had well consider'd these particulars) attribute the Performance of those strange Promises in *Nuncius Inanimatus*; but upon better Thoughts it will be found, that the Species of Reflection in this Experiment are so weak, that unless the Glass and the Letters be very big, and the Wall somewhat near, there will be no distinct Appearance of the Writing. And therefore this way there can be no Thoughts of contriving any reflected Species, that shall be visible at so great a Distance as the Moon. Nor is there any other Natural Means conceivable, by which so strange an Effect may be performed; which is the Reason that it is so frequently attributed to
Diabo-

World in
the Moon,
c. 7.

Diabolical Magick, by almost all the Writers that have occasion to treat of it.

But *Agrippa* in another place speaking concerning this Invention, affirms that it was performed thus : *Pythagoras* did first describe with Blood any Letters which he thought fit, in some great Glass, and then opposing the Glass against the Full Moon, the Letters would appear thorough it, as if they were writ in the circumference of her Body. *Quæ collibuisse sanguine perscripsit in speculo, quo, ad pleni luminis lunæ orbem obverso, stanti à tergo, res exaratas in disco lunæ commonstravit.* In which Passage he seems to intimate, that this Writing in the Moon could not be visible at any great distance (as it is related in common Tradition), but that it did appear to such only, betwixt whose Eyes and the Moon this Glass might be interposed. And according to this, the Wonder of the Relation ceases, nor may it truly be referred to Diabolical Magick.

Agrippa de Vanit. Scient. c. 48.

More properly reducible to this kind, are those enchanted Glasses mentioned in divers Authors : In which some Magicians are said to contain such familiar Spirits, as do inform them of any Business they shall enquire after. I have heard a great Pretender to the knowledge of all secret Arts, confidently affirm, that he himself was able at that time, or any other, to shew me in a Glass what was done in any part of the World ; what Ships were sailing in the *Mediterranean* ; who were walking in any Street of any City in *Spain*, or the like. And this he did aver with all the labour'd Expressions of a strong Confidence. The Man, for his Condition, was an *Italian* Doctor of Physick ; for his Parts, he was known to be of extraordinary Skill in the abstruser Arts, but not altogether free from the Suspicion of this unlawful Magick.

Joach. Camerar. Præm. in lib. Plut. de defect. Orac.

C H A P. XX.

Of Informations by significatory Fires and Smoaks. Their Antiquity. The true manner of using them to this purpose. That these were meant in Nuntius inanimatus.

THE Experiments of this kind that are true, and upon Natural Grounds, have been made either by Fire in the Night, or Smoak and such other Signs visible at a distance in the Day-time.

These Informations by significatory Fires, have been of Ancient Use. The first Invention of them is commonly ascribed to *Sidon* in the *Trojan Wars*. *Specularem significationem Trojano Bello Sidon invenit, (saith Pliny.)* This was the Sign upon which he agreed to unlock the *Wooden Horse*.

Nat. Hist.
l. 7. c. 56.

Virgil.

Flammas cum regia puppis
Extulerat.

Biblioth.
l. 4.

* Polymn.
l. 7. c. 182.
† Hist. l. 2.
Rom, l. 3.
Sic Curtius
of Alex M.
l. 5.

To this purpose the Flags of Truce or Defiance.

† Dere mit. l. 3. c. 5.
Suff. de
in l. Rom.
l. 5. Di-
l. 8. 9.

But *Diodorus Siculus* affirms them to be practised by *Medea* in her Conspiracy with *Jason*. And they are frequently mentioned in other Ancient Historians. * *Herodotus* speaks of them in the *Grecian War* against *Xerxes*: And † *Thucydides* testifies of them in the Onsets that were made by the *Peloponnesians* against *Salamis*, and in the Siege of *Corcyra*. *Appian* speaking of *Scipio* at *Numantia*, how he divided his Camp into divers Companies, says, That he assigned each of them to several Tribunes, with this Charge, *Si impeterentur ab hoste, de die, * panno rubro in hasta sublato significarent; de nocte, igne*. If the Enemy did charge any of them, they should signify it to the others, in the Day-time by holding up a Red Cloth, in the Night by Fires. † *Vegetius* affirms it to be usual, when the Army was divided, to inform one another, in the Day by Smoak, in the Night by

by Fires. These significatory Fires were by the Grecians called *φύκτοι* (saith *Suidas*) and sometimes *Πυρραία*. The Use of them was chiefly for the Answer of some particular *Quære*, that was before agreed upon; as concerning the coming of Aids or Enemies; if the Enemies were coming, they were wont to shake these Torches, if the Aids, they held them still, (saith the *Scholiast* upon *Thucydides*.)

*Aeneas Po-
liorc. c. 31.*

*Schol. in
l. 2. Thucyd.*

But they have by more exact Inventions been enlarged to a greater Latitude of Signification: So that now, any thing which we have Occasion to discover, may be expressed by them.

*Wecker de
Secretis,
l. 14. c. 1.
Port. de
furt. lit.
l. 1. c. 10.
Cardan. de
Variet. Re-
rum, l. 1.
c. 61.*

The Ways by which they may be contrived to this purpose, are divers; I shall specify only the chief of them.

That which in ancient Times was used by the Grecians, and is particularly treated of in **Polybius*, adviseth thus:

Let the Letters be divided into Five Tablets or Columns.

**Hist. l. 10.
juxta fin.
By Ten
Torches.*

	I	II	III	IV	V
1	a	f	l	q	w
2	b	g	m	r	x
3	c	h	n	s	y
4	d	i	o	t	z
5	e	k	p	u	

Let there be provided Ten Torches, Five being placed on the Right Hand, and Five on the Left: Let so many Torches be lifted up on the Right Hand, as may shew the number of the Table; and so many on the Left, as may shew the number of that Letter

Letter in it which you would express: As in this following Example, wherein the several Numbers, both at the Right and Left Hand, do signify the word **H A S T E N**.

The Right Hand.

II
I
IV
IV
I
III

The Left Hand.

H
A
S
T
E
N

3
1
3
4
5
3

That is, Two Lights being lifted up on the Right Hand, shew the second Column; and at the same time Three Torches appearing on the Left Hand, denotes the Third Letter in that Column, which is *H*. Thus a single Torch being discovered on both sides, doth signify the first Letter of the first Column, which is *A*; and so of the rest.

By three
Torches.
*Lib. de Ex-
periment.*

There is another way mentioned by *Joachimus Fortius*, unto the performance of which there are only Three Lights required: One Torch being shewed alone, shall signify the Eight first Letters, *A. B. C. D. E. F. G. H.* Two together, the Eight next, *I. K. L. M. N. O. P. Q.* And all Three the rest, *R. S. T. V. W. X. Y. Z.*

One Light being discovered once, signifies *A*; if twice, *B*: Two Lights being shewed once, do denote the Letter *I*; if twice, *K*, &c.

According

According to this way, if I would express the word F A M I N, the Torches must be contrived; one Light must be lifted up six times for the Letter F; one Light once for A; two Lights four times for M; two Lights once for I; two Lights five times for N.

But here it will be requisite that there be some intermission betwixt the expression of several Letters, because otherwise there must needs be a great confusion amongst those that belong to the same number of Torches. In which respect, this way is much more tedious and inconvenient than the former Invention out of *Polybius*.

It is easie to conceive, how by the Alphabet consisting of two Letters transposed through five Places, such a Manner of Discourfing may be otherwise contrived, only by two Torches. But then there must be five Shews, to express every Letter. By two Torches.

There is another way of Speaking, by the Differences of Motion in two Lights; which for its Quickness and Speed, is much to be preferred before any of the rest; the manner of it is thus: Provide two Torches on long Poles: Let them be placed so far from one another, that they may seem unto your Confederate to be about four Cubits distance. By the divers Elevations or Depressions of these, inclining of them to the Right Hand, or to the Left, severally or both together, it is easie to express all the Alphabet.

One Light alone being discovered, must stand for A; lifted up, for E; depressed, for I; inclined to the Right Hand, for O; unto the Left Hand, for V.

Two Lights elevated, for B; depressed, for C; inclined to the Right Hand, for D; to the Left Hand, for F.

Two Lights being still discovered, and the Torch at the Right Hand being lifted up, shall signifie G; being

being depressed, *H*; inclined to the Right Hand, *K*; to the Left Hand, *L*.

The Torch at the Left Hand, being elevated, shall stand for *M*; depressed, for *N*; inclined to the Right Hand, for *P*; to the Left Hand, for *Q*.

The Torch at the Right Hand being moved towards the Left Hand, and that at the Left Hand being at the same time moved towards the Right Hand, shall signify *R*: The Right Hand Torch being inclined to the Left Hand, and the other at the same time being elevated, signifies *S*; being depressed, *T*: The Left Hand Torch being inclined to the Right Hand, and the other at the same time being elevated, signifies *W*; being depressed, *X*.

The Right Hand Torch being inclined to the Right Hand, and the other at the same time being elevated, may stand for *Y*; being depressed, for *Z*.

When any thing is thus to be expressed, the two Torches being discovered, must remain without any Motion, so long, till the Confederate shall by other Lights shew some Sign, that he is ready to take notice. After every one of these particular Motions, the Torches must be carefully hidden and obscured, that so the several Letters expressed by them, may be the better distinguished.

The day-time Informations by Smoak, cannot so conveniently be ordered according to this latter Contrivance, and therefore must be managed by some of those other Ways that were specified before: To which purpose there must be some Tunnels provided, for the orderly inclosing and conveying up the Smoak. The other particulars concerning this, are in themselves easie enough to be apprehended.

How these significatory Signs will be visible at a great Distance. How by Multiplication of them in several Places, they may be contrived for many Scores of Miles, will easily be discerned from the Situation and Use of Beacons, by which the Intima-

tions of Publick Danger and Preparations, have been oftentimes suddenly spread over this whole Island.

This may further be advantaged by the Use of *Galileus* his Perspective.

'Tis storied of the Inhabitants in *China*, that when any Merchants do happen upon the Shores of that Kingdom, they are presently examined, whence they come; what Commodities they bring, and of what Number they are: Which being known, the Watch (set for that purpose) do presently inform the King of their Answers, by Smoak in the Day, and Fires in the Night: Who by the same Means does as speedily return them his Pleasure, whether they shall be admitted or kept out: And so that is easily dispatched in some few Hours, which could not be performed the ordinary Way, without the Trouble of many Days.

The Practice of all these secret and swift Messages, may perhaps seem very difficult at the first; but so does also the Art of Writing and Reading to an unlettered Man: Custom and Experience will make the one as facile and ready as the other.

That these ways of Information already explained, whether by the Species of *Sound* or *Sight*, are the same with those intimated in *Nuntius Inanimatus*, may be clearly evident to any one who does but thoroughly peruse that Discourse, and compare it with divers other the like Passages of the same Author, in his *Domingo Gonsales*.

I. For the Species of *Sound*, his Words are these; *Auribus nihil percipi nisi personum, neminem fugit. Erit igitur necesse ut is, cui aliquid auditu mediante nunciatum fuerit, sonos audiat, eosque distinguibiles pro numero audientorum; quæ cum sint infinita, infinita, etiam sit oportet; sonorum edentorum varietas. Satis tamen erit ut distinguantur vel genere, vel tempore, modo etiam & numero.* Which Passage, together with that other Intention in *Domingo Gonsales*, concerning the Language

*Busbequius
Epist. Tur.
ep. 4.*

Polyb. l. 10.

*Nunc. Ina-
ni. p. 167*

guage of the Lunary Inhabitants, before explained in the eighteenth Chapter ; I say, both these, being compared with the Discoveries and Experiments of the same kind that are here discoursed of, may plainly manifest, that they are both performed by the same Means.

Nunc. In-
ni. p. 16.

2. For the Species of Sight, his words are these, *Si oculis amici absentis aliquid cupis representare, idque citius quam corpus aliquod sublunare ad locum tam longo intervallo disjunctum possit perferri ; oportet ut ideae, sive formae visibiles, augeantur, quantitate, multiplicentur numero, & pro rerum significandarum varietate variantur, vel qualitate, vel quantitate, vel situ, vel ordine.* Which Passage being compared with that other way of Compact, betwixt *Gonsales* and his *Man Diego*, mentioned in the other Discourse ; it may evidently appear, that the Ways of Intimation which were there meant, are performed after the same Manner, according to which they are here discoursed of.

Man in
the
Moon, p.
21.

He does indeed mention out of *Busbequius*, the Practice of those Informations amongst the Inhabitants of *China*, and thinks that they were used too by the *Romans* ; but withal he wonders how that now amongst us, they should be altogether forgotten ; and the restoring of them to these Places and Times, seems to be his chief Aim, in the Promises of that Discourse.

The particular Example which he mentions, is this : Suppose that one at *London* would send a Messenger to *Bristol*, *Wells*, *Exeter*, or though it were any remoter Place : *Neq; enim longinquitatem viae multum moror, si detur facultas sternendi, & permeabilem efficiendi.* That is, the Greatness of Distance can be no Impediment, if the Space betwixt be fitted with such high Mountains, and Beacon Hills, as may serve for these kind of Discoveries. Suppose (I say) this Messenger should set forth from *London*, in the very point of Noon, he would notwithstanding arrive

rive

rive at *Bristol* before Twelve of the Clock that Day : That is, a Message may by these means be conveyed so great a distance, in fewer Minutes than those which make the Difference betwixt the two Meridians of those Places.

If according to this, we should interpret that Passage out of *Trithemius*, concerning the three *Saturnine* Angels, that in Twenty four Hours can convey News from any part of the World ; that Author might then in one respect, be freed from the Aspersions of Diabolical Magick, which for this very Reason hath heretofore been imputed to him. But this by the Way.

See before
Cap. 15.

It may be, the Resolution of those great Promises in *Nuncius Inanimatus*, to such easie Causes as they are here ascribed unto, will not be answerable to Men's Expectation; every one will be apt to mistrust some greater matter than is here exprest : But 'tis thus also in every other the like Particular; for Ignorance is the Mother of Wonder, and Wonder does usually create unto it self many wild Imaginations; which is the Reason why Men's Fancies are so prone to attribute all unusual and unknown Events, unto stranger Causes than either Nature or Art hath designed for them.

CONCLUSION:

THE Poets have feigned *Mercury* to be the chief Patron of Thieves and Treachery,

Horat. l. 1. r.
Od. 10.
Ovid. Met.
tam. l. 11.
Homer. in
Hymnis.
Nat. Comes
Mytholog.
l. 5. c. 5.

Ἄρχος φιλητήων.

To which purpose they relate that he filched from *Venus* her Girdle; as She embraced him in Congratulation of a Victory ; that he robbed *Jupiter* of his Scepter, and would have stoln his Thunderbolt too,

but that he feared to burn his Fingers. And the Astrologers observe, that those who are born under this Planet, are naturally addicted to Theft and Cheating.

If it be feared that this Discourse may unhappily advantage others in such unlawful Courses; 'tis considerable, that it does not only teach how to deceive, but consequently also how to discover Delusions. And then besides, the chief Experiments are of such Nature, that they cannot be frequently practised, without just Cause of Suspicion, when as it is in the Magistrates Power to prevent them. However, it will not follow, that every thing must be suppress'd which may be abus'd. There is nothing hath more occasioned Troubles and Contentions, than the Art of Writing, which is the Reason why the Inventor of it is fabled to have sown Serpents Teeth: And yet it was but a barbarous Act of *Thamus*, the Egyptian King, therefore to forbid the Learning of Letters: We may as well cut out our Tongues, because that Member is *a world of wickedness*. If all those useful Inventions that are liable to abuse, should therefore be conceal'd, there is not any Art or Science which might be lawfully profess'd.

Cali. Rbo.
antiq. Lect.
l. 22. c. 15.

James 3.

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MAGICK:
OR THE
WONDERS

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Mechanical Geometry.

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PHYSICS 309

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BY

ROBERT A. FAY

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To His Highness the
Prince Elector PALATINE.

May it please Your Highness,

I Should not thus have presented my Diversions where I owe my Study and Business, but that where All is due, a Man may not justly withhold any Part.

This following Discourse was composed some Years since, at my spare Hours in the University. The Subject of it is mixed Mathematicks; which I did the rather at such Times make choice of, as being for the Pleasure of it more proper for Recreation, and for the Facility, more suitable to my Abilities and Leisure.

I should not, Sir, have been ambitious of any so Great (I could not of any Better) Patronage, had not my Relation both engaged and emboldened me to this Dedication.

They that know Your Highness, how great an Encourager You are, and how able a Judge in all Kind of Ingenious Arts and Literature, must needs acknowledge Your Pressures and Low Condition to be none of the least Mischiefs (amongst those many other) under which the Commonwealth of Learning does now suffer.

It would in many Respects much conduce to the general Advancement of Religion and Learning, if the Reformed Churches, in whose Cause and Defence Your Family hath so deeply suffer'd, were but effectually mindful of their Engagements to it. And particularly, if these present Unhappy Differences of this Nation, did not occasion too much Forgetfulness of their former Zeal and Professions for the Vindicating of Your Family, and the Restoring of Your Highness: The Hastening and Accomplishment of which, together with the Increase of all Heavenly Blessings upon Your Highness, shall be the hearty daily Prayer of,

Your Highness's
most Humble and most Devoted
Servant and Cbaplain,

G g 4

John Wilkins.

To the Reader.

IT is related of *Heraclitus*, That when his Scholars had found him in a Tradesman's Shop, whither they were ashamed to enter; he told them, *Quod neque tali loco dii desunt immortales*; That the gods were as well conversant in such Places, as in others: Intimating, that a Divine Power and Wisdom might be discerned, even in those common Arts which are so much despised: And tho' the Manual Exercise and Practice of them be esteemed ignoble, yet the Study of their General Causes and Principles, cannot be prejudicial to any other (tho' the most sacred) Profession.

It hath been my usual Custom in the Course of my other Studies, to propose diverse Mathematical or Philosophical Enquiries, for the Recreation of my Leisure Hours; and as I could gather Satisfaction, to compose them into some Form and Method.

Some of these have been formerly published, and I have now ventured forth this Discourse; wherein, besides the great *Delight and Pleasure*, (which every Rational Reader must needs find in such Notions as carry with them their own Evidence and Demonstration) there is also much *real Benefit* to be learned; particularly for such Gentlemen as employ their Estates in those chargeable Adventures of Draining Mines, Coalpits, &c. who may from hence learn the chief Grounds and Nature of Engines, and thereby more easily avoid the Delusions of any cheating Impostor: And also for such *common Artificers*, as are well skill'd in the Practice of these Arts, who may be much advantaged by the right Understanding of their Grounds and Theory.

To the READER.

Ramus hath observed, That the Reason why Germany hath been so Eminent for Mechanical Inventions, is, because there have been publick Lectures of this kind instituted amongst them; and those, not only in the Learned Languages, but also in the vulgar Tongue, for the Capacity of every Unlettered Ingenious Artificer.

Schol. Mathematic. l. 2.

This whole Discourse I call *Mathematical Magick*; because the Art of such Mechanical Inventions as are here chiefly insisted upon, hath been formerly so filed; and in Allusion to vulgar Opinion, which doth commonly attribute all such strange Operations unto the Power of Magick: For which Reason the Ancients did name this Art, *Θαυματουργική*, or *Mirandorum Effetrix*.

Agrippa, de Vanis. Scient. c. 42.

The First Book is called *Archimedes*, because he was the chiefest in discovering of Mechanical Powers.

The Second is filed by the Name of *Dædalus*, who is related to be one of the first and most famous amongst the Ancients, for his Skill in making *Automata*, or self-moving Engines: Both these being two of the first Authors, that did reduce Mathematical Principles unto Mechanical Experiments.

Other Discourses of this kind, are for the most part large and voluminous, of great Price, and hardly gotten; and besides, there are not any of them (that I know of) in our Vulgar Tongue, for which these Mechanical Arts of all other are most proper. These Inconveniencies are here in some measure remedied; together with the Addition (if I mistake not) of divers Things very considerable, and not insisted upon by others.

THE
CONTENTS and METHOD
Of this following Discourse.

The First Book.

- Chap I. **T**HE Excellency of these Arts. *Why they were concealed by the Ancients. The Authors that have treated of them.*
- Chap. II. *Concerning the Name of this Art. That it may properly be stiled Liberal. The Subject and Nature of it.*
- Chap. III. *Of the first Mechanical Faculty, the Balance.*
- Chap. IV. *Concerning the second Mechanick Faculty, the Leaver.*
- Chap. V. *How the Natural Motion of Living Creatures is conformable to these Artificial Rules.*
- Chap. VI. *Concerning the Wheel.*
- Chap. VII. *Concerning the Pulley.*
- Chap. VIII. *Of the Wedge.*
- Chap. IX. *Of the Screw.*
- Chap. X. *An Enquiry into the magnificent Works of the Ancients, which much exceeding our later Times, may seem to infer a Decay in these Mechanical Arts.*
- Chap. XI. *That the Ancients had divers Motives and Means for such vast magnificent Works, which we have not.*
- Chap. XII. *Concerning the Force of the Mechanick Faculties; particularly the Balance and Leaver: How they may be contrived to move the whole World, or any other conceivable Weight.*

Chap. XIII.

The CONTENTS.

- Chap. XIII. *Of the Wheel, by Multiplication of which, it is easy to move any imaginable Weight.*
- Chap. XIV. *Concerning the infinite Strength of Wheels, Pulleys, and Screws; that it is possible by the Multiplication of these, to pull up any Oak by the Roots with a Hair, lift it up with a Straw, or blow it up with ones Breath; or to perform the greatest Labour with the least Power.*
- Chap. XV. *Concerning the Proportion of Slowness, and Swiftness, in Mechanical Motions.*
- Chap. XVI. *That it is possible to contrive such an Artificial Motion, as shall be of a Slowness proportionable to the Swiftness of the Heavens.*
- Chap. XVII. *Of Swiftness: How it may be increased to any kind of Proportion. Concerning the great Force of Archimedes his Engines. Of the Ballista.*
- Chap. XVIII. *Concerning the Catapultæ, or Engines for Arrows.*
- Chap. XIX. *A Comparison betwixt these Ancient Engines, and the Gunpowder Instruments now in Use.*
- Chap. XX. *That it is possible to contrive such an Artificial Motion, as may be equally swift with the supposed Motion of the Heavens.*
-

The Second Book.

- Chap. I. **T**HE divers Kinds of Automata, or Self-movers. Of Mills. Of the Contrivance of several Motions by rarify'd Air. A brief Digression concerning Wind-guns.
- Chap. II. *Of a Sailing Chariot, that may without Horses be driven on the Land by the Wind, as Ships are on the Sea.*
- Chap. III. *Concerning the fixed Automata, Clocks; Spheres representing the Heavenly Motions. The several Excellencies that are most commendable in such kind of Contrivances.*
- Chap. IV.

The CONTENTS.

- Chap. IV. *Of the Moveable and Gradient Automata, representing the Motions of Living Creatures, various Sounds of Birds, or Beasts, and some of them articulate.*
- Chap. V. *Concerning the Possibility of framing an Ark for Submarine Navigations. The Difficulties and Conveniences of such a Contrivance.*
- Chap. VI. *Of the Volant Automata; Archytas his Dove, and Regiomontanus his Eagle. The Possibility and great Usefulness of such Inventions.*
- Chap. VII. *Concerning the Art of flying. The several Ways whereby this hath been, or may be attempted.*
- Chap. VIII. *A Resolution of the Two chief Difficulties that seem to oppose the Possibility of a flying Chariot.*
- Chap. IX. *Of a perpetual Motion. The seeming Facility, and real Difficulty of any such Contrivance. The several Ways whereby it hath been attempted; particularly by Chymistry.*
- Chap. X. *Of subterraneous Lamps. Divers Historical Relations concerning their Duration for many Hundred Years together.*
- Chap. XI. *Several Opinions concerning the Nature and Reason of these perpetual Lamps.*
- Chap. XII. *The most probable Conjecture how these Lamps were framed.*
- Chap. XIII. *Concerning several Attempts of contriving a perpetual Motion by Magnetical Virtues.*
- Chap. XIV. *The seeming Probability of effecting a continual Motion by Solid Weights, in a hollow Wheel or Sphere.*
- Chap. XV. *Of composing a perpetual Motion by fluid Weights. Concerning Archimedes his Water-Screw. The great Probability of accomplishing this Enquiry by the Help of that, with the Fallibleness of it upon Experiment.*

ARCHIMEDES,

OR,

MECHANICAL POWERS.

The First Book.

CHAP. I.

The Excellency of these Arts. Why they were concealed by the Ancients. The Authors that have treated of them.

ALL those various Studies about which the Sons of Men do busy their Endeavours, may be generally comprised under these Three Kinds.

{ Divine.
 { Natural.
 { Artificial.

To the first of these, is reducible, not only the Speculation of Theological Truths, but also the Practice of those Virtues, which may advantage our Minds in the Enquiry after their proper Happiness. And these Arts alone may truly be styled liberal, *Quæ liberum faciunt hominem, quibus curæ virtus est,* (saith the Divine Stoick) which set a Man at Liberty from his Lusts and Passions. Sen. Ep. 88.

To the second may be referred all that Knowledge which concerns the Frame of this great Universe, or the usual Course of Providence in the Government of these created Things.

To the last do belong all those Inventions, where-
by

by Nature is any way quickned or advanced in her Defects: These artificial Experiments being (as it were) but so many Essays, whereby Men do naturally attempt to restore themselves from the first General Curse inflicted upon their Labours.

This following Discourse does properly appertain to this latter Kind.

Now Art may be said, either to *imitate* Nature, as in *Limning* and *Pictures*; or to *help* Nature, as in *Medicine*; or to *overcome* and *advance* Nature, as in these *Mechanical Disciplines*, which in this Respect are by so much to be preferred before the other, by how much their End and Power is more excellent. Nor are they therefore to be esteemed less Noble, because more Practical; since our best and most Divine Knowledge is intended for Action; and those may justly be counted barren Studies, which do not conduce to Practice as their proper End.

But so apt are we to contemn every Thing which is common, that the Ancient Philosophers esteemed it a great Part of Wisdom to conceal their Learning from Vulgar Apprehension or Use, thereby the better to maintain it in its due Honour and Respect. And therefore did they generally veil all their Arts and Sciences under such mystical Expressions as might excite the Peoples Wonder and Reverence; fearing lest a more easy and familiar Discovery, might expose them to contempt. *Sic ipsa mysteria fabularum cuniculis operiuntur, summatibus tantum viris, sapientia interprete, veri arcani consciis; Contenti sint reliqui, ad venerationem, figuris defendentibus à vilitate secretum*, saith a Platonick.

Macrobias
Somn. Scip.
l. 1. c. 2.

Hence was it, that the Ancient Mathematicians did place all their Learning in abstracted Speculations; refusing to debase the Principles of that noble Profession unto Mechanical Experiments. Infomuch, that those very Authors amongst them, who were most eminent for their Inventions of this Kind, and
were

were willing by their own Practice to manifest unto the World those artificial Wonders that might be wrought by these Arts, as *Dædalus*, *Archytas*, *Archimedes*, &c. were notwithstanding so much infected with this blind Superstition, as not to leave any thing in Writing concerning the Grounds and Manner of these Operations.

Quintilian speaking to this Purpose of *Archimedes*, saith thus. *Quamvis tantum tamque singularem Geometriæ usum, Archimedes, singularibus exemplis, & admirandis operibus ostenderit, propter quæ non humanæ sed divinæ scientiæ laudem sit adeptus, hæsit tamen in illa Platonis persuasione, nec ullam Mechanicam literam prode-
re voluit.* *Quint. l. 1. c. 10.*

By which means, Posterity hath unhappily lost, not only the Benefit of those particular Discoveries, but also the Proficiency of those Arts in General. For when once the Learned Men did forbid the Reducing of them to particular Use, and Vulgar Experiment; others did thereupon refuse these Studies themselves, as being but empty and useles Speculations. Whence it came to pass that the Science of Geometry was so universally neglected, receiving little or no Addition for many Hundred Years together. *Pet. Ram. Schol. Mathem. l. 1.*

Amongst these Ancients, the Divine *Plato* is observed to be one of the greatest Sticklers for this fond Opinion; severely dehorting all his Followers from prostituting Mathematical Principles, unto common Apprehension or Practice. Like the envious Emperor *Tiberius*, who is reported to have killed an Artificer for making Glass malleable, fearing lest thereby the Price of Metals might be debased. So he, in his Superstition to Philosophy, would rather chuse to deprive the World of all those useful and excellent Inventions which might be thence contrived, than to expose that Profession unto the Contempt of the ignorant Vulgar. *Plin. Nat. l. 36. c. 26.*

But

Arist.
Quest.
Mechan.

But his Scholar *Aristotle*, (as in many other particulars, so likewise in this) did justly oppose him, and became himself one of the first Authors that hath writ any methodical Discourse concerning these Arts; chusing rather a certain and general Benefit, before the hazard that might accrue from the vain and groundless Disrepects of some ignorant Persons. Being so far from esteeming Geometry dishonoured by the Application of it to Mechanical Practices, that he rather thought it to be thereby adorned, as with curious Variety, and to be exalted unto its natural End. And whereas the Mathematicians of those former Ages, did possess all their Learning as covetous Men do their Wealth, only in Thought and Notion; the judicious *Aristotle*, like a wise Steward, did lay it out to particular Use and Improvement; rightly preferring the Reality and Substance of Publick Benefit, before the Shadows of some retired Speculation, or Vulgar Opinion.

Since him there have been divers other Authors who have been eminent for their Writings of this Nature. Such were *Hero Alexandrinus*, *Hero Mechanicus*, *Pappus Alexandrinus*, *Proclus Mathematicus*, *Vitruvius*, *Guidus Ubaldus*, *Henricus Monartholius*, *Galileus*, *Guevara*, *Mersennus*, *Bettinus*, &c. Besides many others that have treated largely of several Engines, as *Augustin Ramelli*, *Vittorio Zoncha*, *Jacobus Bessonius*, *Vegetius*, *Lipsius*.

Most of which Authors I have perused, and shall willingly acknowledge my self a Debtor to them for many Things in this following Discourse.

CHAP. II.

Concerning the Name of this Art. That it may properly be stiled Liberal. The Subject and Nature of it.

THE Word *Mechanick* is thought to be derived *ἄνω ἔς μῆκος ἔλθεν*, *multum ascendere, pertingere*: intimating the Efficacy and Force of such Inventions. Or else *παρὰ μὴ χεῖρας*, (saith *Eusebius*) *quia hircere non sinit*, because these Arts are so full of pleasant Variety, that they admit not either of Sloth or Weariness.

Lypsius. Poliorces. 1. 2. Dial. 3. That's a senseless absurd Etymology, imposed by some, Quia intellectus in eis mechanatur, as if these Arts did prostitute and adulterate the understanding.

According to ordinary Signification, the Word is used in Opposition to the liberal Arts: Whereas in Propriety of Speech those Employments alone may be stiled *Illiberal*, which require only some bodily Exercise, as Manufactures, Trades, &c. And on the contrary, that Discipline which discovers the general Causes, Effects, and Proprieties of Things, may truly be esteemed as a *Species* of Philosophy.

But here it should be noted, that this Art is usually distinguished into a twofold Kind:

1. *Rational.*
2. *Chirurgical.*

Pappus Proem. in Collect. Mathematic. 1. 8.

The *Rational* is that which treats of those Principles and fundamental Notions, which may concern these Mechanical Practices.

The *Chirurgical* or *Manual* doth refer to the making of these Instruments, and the Exercising of such particular Experiments. As in the Works of Architecture, Fortifications, and the like.

The first of these is the Subject of this Discourse, and may properly be stiled *Liberal*, as justly deserving the Prosecution of an ingenious Mind. For if we consider it according to its Birth and Original, we shall find it to spring from honourable Pa-

rentage, being produced by *Geometry* on the one side, and *natural Philosophy* on the other. If according to its Use and Benefit, we may then discern that to this should be referred all those Arts and Professions, so necessary for human Society, whereby Nature is not only directed in her usual Course, but sometimes also commanded against her own Law. The Particulars that concern Architecture, Navigation, Husbandry, Military Affairs, &c. are most of them reducible to this Art, both for their Invention and Use.

Those other Disciplines of Logick, Rhetorick, &c. do not more protect and adorn the Mind, than these Mechanical Powers do the Body.

And therefore are they well worthy to be entertained with greater Industry and Respect, than they commonly meet with in these Times; wherein there be very many that pretend to be Masters in all the Liberal Arts, who scarce understand any Thing in these Particulars.

The Subject of this Art is concerning the Heaviness of several Bodies, or the Proportion that is required betwixt any Weight, in relation to the Power which may be able to move it. And so it refers likewise to violent and artificial Motion, as Philosophy doth to that which is natural.

The proper End for which this Art is intended, is to teach how by Understanding the true Difference betwixt the *Weight* and the *Power*, a Man may add such a fitting Supplement to the Strength of the Power, that it shall be able to move any conceivable Weight, though it should never so much exceed that Force which the Power is naturally endowed with.

The Art it self may be thus described to be a Mathematical Discipline, which by the Help of Geometrical Principles doth teach to contrive several Weights and Powers unto any kind, either of Motion

tion, or Rest, according as the Artificer shall determine.

If it be doubted how this may be esteemed a *Species* of Mathematicks, when as it treats of Weights, and not of Quantity: For Satisfaction to this, there are two Particulars considerable.

Devis. Riv. vultus pref. in l. Archim. de centro gravitatis.

1. *Mathematicks* in its Latitude is usually divided into *Pure* and *Mixed*: And though the *Pure* do handle only *abstract Quantity* in the *General*, as *Geometry*, *Arithmetick*: Yet that which is *mixed*, doth consider the Quantity of some *particular determinate Subject*. So *Astronomy* handles the Quantity of *Heavenly Motions*; *Musick* of *Sounds*, and *Mechanicks* of *Weights and Powers*.

2. *Heaviness* or *Weight* is not here considered, as being such a *natural Quality*, whereby condensed *Bodies* do of themselves *tend downwards*; but rather, as being an *Affection*, whereby they may be measured. And in this Sense, *Aristotle* himself refers it amongst the other *Species* of *Quantity*, as having the same proper *Essence*, which is to be compounded of *integral Parts*. So a *Pound* doth consist of *Ounces*, *Drams*, *Scruples*. Whence it is evident, that there is not any such *Repugnancy* in the *Subject* of this *Art*, as may hinder it from being a true *Species* of *Mathematicks*.

Metaph. l. 10. c. 2.

C H A P. III.

Of the first Mechanical Faculty, the Balance.

THE Mechanical Faculties by which the Experiments of this Nature must be contrived, are usually reckoned to be these Six.

- | | |
|--------------------------------|-------------------------|
| 1. <i>Libra.</i> | 1. <i>The Ballance.</i> |
| 2. <i>Veſtis.</i> | 2. <i>The Leaver.</i> |
| 3. <i>Axis in Peritrochio.</i> | 3. <i>The Wheel.</i> |
| 4. <i>Trochlea.</i> | 4. <i>The Pulley.</i> |
| 5. <i>Cuneus.</i> | 5. <i>The Wedge.</i> |
| 6. <i>Cochlea.</i> | 6. <i>The Screw.</i> |

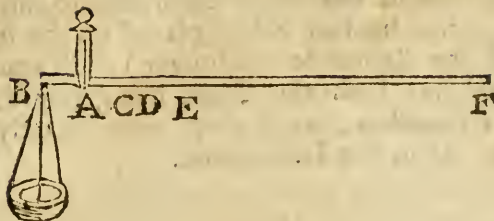
Unto some of which, the Force of all Mechanical Inventions must necessarily be reduced. I shall speak of them severally, and in this Order.

First, concerning the Balance: This and the Leaver are usually confounded together, as being but one Faculty; because the general Grounds and Proportions of either's Force is so exactly the same. But for better Distinction, and more clear Discovery of their Natures, I shall treat of them severally.

The first Invention of the Balance is commonly attributed to *Astrea*, who is therefore deified for the Goddess of Justice; and that Instrument it self advanced amongst the Celestial Signs.

The Particulars concerning it are so commonly known, and of such easie Experiment, that they will not need any large Explication. The chief End and Purpose of it, is for the Distinction of several Ponderosities: For the Understanding of which, we must note, that if the Length of the Sides in the Balance, and the Weights at the Ends of them, be both mutually equal, then the Beam will be in a horizontal Situation. But on the contrary, if either the Weights alone be equal, and not their Distances, or the Distances alone, and not the Weights, then the Beam will accordingly decline.

As in this following Diagram.



Suppose an equal Weight at *C*, unto that at *B*; (which Points are both equally distant from the Center *A*) it is evident that then the Beam *B F* will hang horizontally. But if the Weight supposed at *C*, be unequal to that at *B*, or if there be an equal Weight at *D E*, or any of the other unequal Distances; the Beam must then necessarily decline.

With this kind of Balance, it is usual, by the Help only of one Weight, to measure sundry different Gravities, whether more or less, than that by which they are measured. As by the Example here described, a Man may with one Pound alone, weigh any other Body within ten Pounds; because the Heaviness of any Weight doth increase proportionably to its Distance from the Center. Thus one Pound at *D*; will equiponderate unto two Pounds at *B*; because the Distance *A D* is double unto *A B*. And for the same Reason, one Pound at *E*, will equiponderate to three Pound at *B*; and one Pound at *F*, unto ten at *B*; because there is still the same Disproportion betwixt their several Distances.

Cardan.
Subtil. l. 1.

This kind of Ballance is usually stiled *Romana Statera*. It seems to be of ancient Use, and is mentioned by *Aristotle* under the Name of *φάλαγξ*.

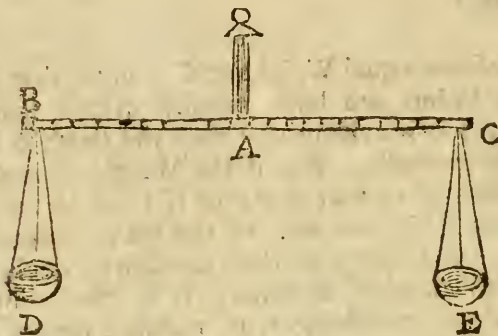
Mechan.
c. 21.

Hence it is easy to apprehend how that false Balance may be composed, so often condemned by the Wise-man, as being an Abomination to the Lord. If the Sides of the Beam be not equally divided, as

Prov. 11. 1.
c. 16. 11.
Item, cap.
20. 10, 23.

Pappus
Collect.
Math. 1. 8.

suppose one have 10 Parts, and the other 11; then any two Weights that differ according to this Proportion, (the heavier being placed on the shorter side, and the lighter on the longer) will equiponrate; and yet both the Scoles being empty, will hang in *Equilibrio*, as if they were exactly just and true: As in this Description.



Suppose AC to have 11 such Parts, whereof AB has but 10, and yet both of them to be in themselves of equal Weight; it is certain, that whether the Scoles be empty, or whether in the Scole D we put 11 Pound, and at E 10 Pound; yet both of them shall equiponderate, because there is just such a Disproportion in the Length of the Sides AC , being unto AB , as 11 to 10.

The Frequency of such Cozenages in these Days, may be evident from common Experience; and that they were used also in former Ages, may appear from *Aristotle's* Testimony concerning the Merchants in his time. For the remedying of such Abuses, the Ancients did appoint divers Officers, stiled *Zygestai*, who were to overlook the common Measures.

So great Care was there amongst the *Jews*, for the Preservation of Commutative Justice from all Abuse

Question.
Mechan.
c. 2.
Budaus.
Hencethe
Proverb,
Zygestatiga
Eides.

Abuse and Falsification in this kind, that the Publick Standards and Originals, by which all other Measures were to be try'd and allow'd, were with much Religion preserved in the Sanctuary; the Care of them being committed to the Priests and Levites, whose Office it was to look unto *all manner of Measures and Size*. Hence is that frequent Expression, *According to the Shekel of the Sanctuary*; and that Law, *All thy Estimations shall be according to the Shekel of the Sanctuary*: Which doth not refer to any Weight, or Coin, distinct from, and more than the Vulgar, (as some fondly conceive) but doth only oblige Men in their Dealing and Traffick, to make use of such just Measures, as were agreeable unto the Publick Standards that were kept in the Sanctuary.

1 Chron.
23. 29.
Exod. 30.
13.
Lev. 27.
25.

The manner how such Deceitful Balances may be discovered, is, by changing the Weights into each other Scales, and then the Inequality will be manifest.

From the former Grounds rightly apprehended, it is easy to conceive how a Man may find out the just Proportion of a Weight, which in any Point given, shall equiponderate to several Weights given, hanging in several Places of the Beam.

Some of these Balances are made so exact, (those especially which the Refiners use) as to be sensibly turned with the Eightieth Part of a Grain: Which (tho' it may seem very strange) is nothing to what * *Capellus* relates of one at *Sedan*, that would turn with the Four hundredth Part of a Grain.

Master
Greaves
Roman
Foot.

There are several Contrivances to make use of these, in measuring the Weight of Blows, the Force of Powder, the Strength of Strings, or other Oblong Substances; Condensed Air; the distinct Proportion of several Metals mixed together; the different Gravity of divers Bodies in the Water, from what they have in the open Air; with divers the like ingenious Enquiries.

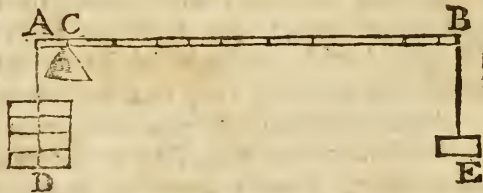
* *De ponderibus & nummis*,
l. 1.

CHAP. IV.

Concerning the second Mechanick Faculty, the
Leaver.

THE second Mechanical Faculty, is the Leaver: The first Invention of it is usually ascribed to *Neptune*, and represented by his Trident, which in the *Greek* are both called by one Name, and are not very unlike in Form, being both of them somewhat broader at one end, than in the other parts.

There is one main Principle concerning it, which is (as it were) the very Sum and Epitome of this whole Art. The meaning of it is thus expressed by *Aristotle*, "Ὁ τὸ κινούμενον ἑκάστος πρὸς τὸ κινεῖν, τὸ μῆκος πρὸς τὸ μῆκος ἀντιπαραπύδεν. That is, as the Weight is to an equivalent Power, so is the distance betwixt the Weight and the Center, unto the distance betwixt the Center and the Power, and so reciprocally. Or thus, the Power that doth equiponderate with any Weight, must have the same proportion unto it, as there is betwixt their several Distances from the Center or Fulciment; as in this following Figure.



Where suppose the Leaver to be represented by the Length *AB*, the Center or * Prop at the Point *C*, the Weight to be sustained *D*, the Power that doth uphold it *E*.

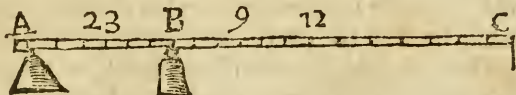
Now

μὲν ὅτι.
Aristotle
Quest.
Mechan.
cap. 4
Archimedes, de *Æ-*
quiponderant. l. 1.
prop. 7.
Vitruvius
Architect.
l. 10. c. 8.

* This *Ari-*
stotle calls
καρῶν χ-
λιον.
Vitruvius,
Presso.
Whalrus
Fulcimen-
tum. Dan.
Barbarus,
S: the Lum.

Now the meaning of the foresaid Principle doth import thus much ; that the Power at *E*, must bear the same proportion to the Weight *D*, as the Distance *CA* doth to the other *CB* ; which, because it is Octuple in the present Example, therefore it will follow that one Pound at *B*, or *E*, will equiponderate to eight Pounds at *A*, or *D* ; as is expressed in the Figure. The Ground of which Maxim is this, because the Point *C* is supposed to be the Center of Gravity, on either side of which, the Parts are of equal Weight.

And this kind of proportion is not only to be observed when the Power doth *press downwards*, (as in the former Example) but also in the other Species of violent Motion ; as *Lifting*, *Drawing*, and the like. Thus if the Prop or Fulciment were supposed to be at the extremity of the Lever,

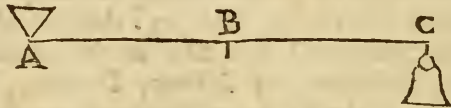


as in this Diagram at *A*, then the Weight *B* would require such a difference in the Strengths or Powers that did sustain it, as there is betwixt the several Distances *AC*, and *BC*. For as the Distance *AB* is unto *AC*, so is the Power at *C* to the Weight at *B* ; that is, the Power at *A* must be double to that at *C*, because the Distance *BC* is twice as much as *BA*. From whence it is easie to conceive, how any Burden carried betwixt two Persons, may be proportioned according to their different Strengths. If the Weight were imagined to hang at the Number 2, then the Power at *C* would sustain but two of those Parts, whereof that at *A* did uphold 16. If it be supposed at the Figure 3, then the Strength at *C*, to that at *A*, would be but as Three to Fifteen.

The right understanding of this doth much conduce to the Explication of the Pulley.

teen. But if it were situated at the Figure 9, then each of the Extremities would participate of it alike; because that being the middle, both the Distances are equal. If at the Number 12, then the Strength at *C* is required to be double unto that at *A*. And in the like manner are we to conceive of the other intermediate Divisions.

Thus also must it be, if we suppose the Power to be placed betwixt the Fulciment and the Weight, as in this Example.



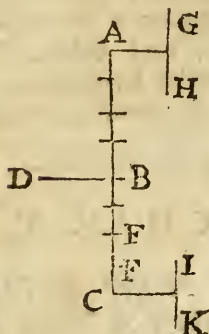
Where, as *AC* is to *AB* so is the Power at *B*, to the Weight at *C*.

Hence likewise may we conceive the Reason why it is much harder to carry any long Substance, either on the Shoulders, or in the Hand, if it be held by either of the Extreams, than if it be sustained by the middle of it. The Strength that must equiponderate at the nearer end, sometimes increasing the Weight almost double to what it is in it self.



Imagine the Point *A* to be the place where any long Substance (as suppose a Pike) is sustained; it is evident from the former Principle, that the strength at *B* (which makes it lie level) must be equal to all the length *AC*, which is almost the whole Pike.

And as it is in the depressing, or elevating, so likewise is it in the drawing of any Weight, as a Coach, Plow, or the like. Let



Let the Line DB represent the Pole or Carriage on which the Burden is sustained, and the Line AC the Cross-Bar ; at each of its Extremities, there is a several Spring-Tree GH , and IK , to which either Horses or Oxen may be fastned. Now because A and C are equally distant from the middle B , therefore in this case the Strength must be equal on both sides ; but if we suppose one of these Spring-Trees to be fastned unto the Points E or F , then the Strength required to draw on that side, will be so much more, as the distance EB or FB is less than that of AB ; that is, either as three to four , as EB to BA , or as one to two , as FB to BA . So that the Beast fastned at A , will not draw so much by a quarter as the other at E , but half as much as one at F .

Whence it is easie to conceive how a Husbandman (*cum inaequales veniunt ad aratra juvenci*) may proportion the Labour of Drawing, according to the several strength of his Oxen.

Unto this Mechanical Faculty should be reduced sundry other Instruments in common use. Thus the Oars, Stern, Masts, &c. according to their force whereby they give Motion to the Ship, are to be conceived under this Head.

Arist. Mechan. c. 5, 6, 7
Vide Guevar. Comment.

Thus

Mechan.
c. 29.
Pet. Crimi-
nus, de
honestâ
Disciplina
l. 19. c. 2.
calls it
corruptly
Tellenon.

Thus likewise for that Engine, whereby Brewers and Dyers do commonly draw Water, which *Aristotle* calls *κλόνειον*, and others *Tollenon*. This being the same kind of Instrument, by which *Archimedes* drew up the Ships of *Marcellus*.

CHAP. V.

How the Natural Motion of Living Creatures is conformable to these Artificial Rules.

THE former Principle being already explained, concerning artificial and dead Motions, it will not be altogether impertinent, if in the next place we apply it unto those that are natural in living Bodies, and examine whether these also are not governed by the same kind of Proportions.

In all perfect living Creatures, there is a twofold kind of motive Instruments :

1. Primary, the Muscles.
2. Secondary, the Members.

The Muscles are naturally fitted to be Instruments of Motion, by the manner of their Frame and Composition; consisting of Flesh as their chief Material, and besides of Nerves, Ligatures, Veins, Arteries, and Membranes.

The *Nerves* serve for the conveyance of the motive Faculty from the Brain. The *Ligatures* for the strengthening of them, that they may not flag and languish in their Motions. The *Veins* for their Nourishment. The *Arteries* for the supplying of them with Spirit and natural Vigor. The *Membranes* for the comprehension or inclosure of all these together, and for the distinction of one Muscle from another. There are besides divers *Fibræ*, or hairy Substances, which Nature hath bestowed for the farther corroborating

borating of their Motions ; these being dispersed through every Muscle, do so joyn together in the end of them, as to make entire Nervous Bodies, which are called *Tendons*, almost like the Gristles. Now this (saith *Galen*) may fitly be compared to the broader part of the Leaver, that is put under the Weight ; which, as it ought to be so much the stronger, by how much it is put to a greater force, so likewise by this, doth Nature enable the Muscles and Nerves for those Motions, which otherwise would be too difficult for them.

*De Placit.
Hippoc. &
Platon. l. 1.
cap. 10.*

Whence it may evidently appear, that according to the Opinion of that eminent Physician, these natural Motions are regulated by the like Grounds with the artificial.

2. Thus also is it in those secondary Instruments of Motion, the Members : Amongst which, the Hand is *ὄργανον ὄργανων*, the Instrument of Instruments, (as *Galen* styles it ;) and as the Soul of Man doth bear in it the Image of the Divine Wisdom and Providence, so this part of the Body seems in some sort to represent the Omnipotency of God, whilst it is able to perform such various and wonderful Effects by the help of this Art. But now for its own proper natural Strength, in the lifting any great Weight, this is always proportioned according to its Extension from the Body, being of least force when it is fully stretched out, or at Arms-end, (as we say) because then the Shoulder-Joynt is as the Center of its Motion, from which the Hand in that posture being very remote, the weight of any thing it holds must be accordingly augmented. Whereas the Arm being drawn in, the Elbow-Joynt doth then become its Center, which will diminish the weight proportionably, as that part is nearer unto it than the other.

*De usu part.
l. 1. c. 2.*

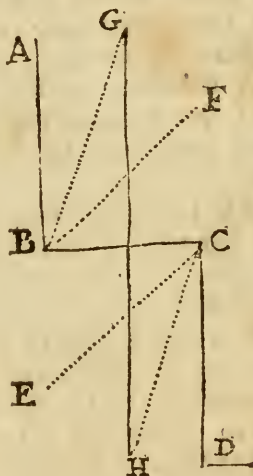
To this purpose also, there is another subtle Problem proposed by *Aristotle*, concerning the Postures of

*Mechan.
c. 3 l.*

of

of sitting and rising up. The Quære is this, Why a Man cannot rise up from his Seat, unless he first either bend his Body forward, or thrust his Feet backward?

In the Posture of Sitting, our Legs are supposed to make a right Angle with our Thighs, and they with our Backs, as in this Figure.



Where let AB represent the Back, BC the Thighs, CD the Legs. Now it is evident, that a Man cannot rise from this Posture, unless either the Back AB do first incline unto F , to make an acute Angle with the Thighs BC ; or else that the Legs CD do incline towards E , which may also make an acute Angle with the Thighs BC ; or lastly, unless both of them do incline to the Points GH , where they may be included in the same Perpendicular.

For the Resolution of which, the Philosopher proposes these two Particulars.

1. A right Angle (saith he) is a kind of Equality, and that being naturally the Cause of Rest, must needs be an Impediment to the Motion of Rising.

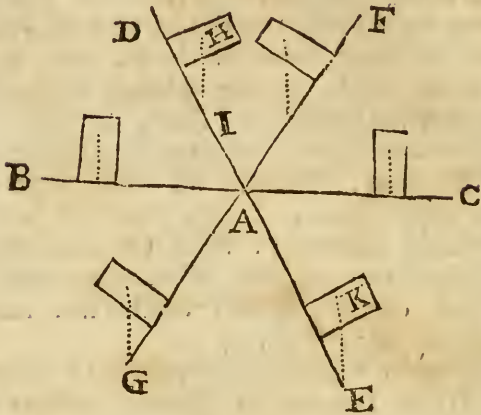
2. Because when either of the Parts are brought into an Acute Angle, the Head being removed over the Feet, or they under the Head; in such a Posture the whole Man is much nearer disposed to the Form of standing, wherein all these Parts are in one strait perpendicular Line, than he is by the other of Right Angles, in which the Back and Legs are two Parallels; or that of turning these strait Angles into obtuse, which would not make an erect Posture, but declining.

But neither of these Particulars (as I conceive) do fully satisfy the present *Quære*; neither do the Commentators, *Monantholius*, or *Guevara*, better resolve it. Rather suppose *BC* to be a *Vectis*, or Leaver, towards the Middle of which is the Place of the Fulciment, *AB* as the Weight, *CD* the Power that is to raise it.

Now the Body being situate in this Rectangular Form, the Weight *AB* must needs be augmented proportionably to its Distance from the Fulciment, which is about half the Thighs: Whereas, if we suppose either the Weight to be inclined unto *F*, or the Power to *E*, or both of them to *GH*; then there is nothing to be lifted up, but the bare Weight it self; which in this Situation, is not at all increased with any Addition by Distance.

For in these Conclusions concerning the Leaver, we must always imagine that Point which is touched by a Perpendicular from the Center of Gravity, to be one of the Terms. So that the diverse Elevation or Depression of the Instrument, will infer a great Alteration in the Weight it self; as may more clearly be discerned by this following Diagram.

Where



Where A is supposed to be the Place of the Prop, or Fulciment; BC , a Leaver which stands horizontally; the Power and the Weight belonging unto it being equal, both in themselves, and also in their Distances from the Prop.

But now suppose this Instrument to be alter'd according to the Situation DE ; then the Weight D will be diminished by so much, as the Perpendicular from its Center of Gravity HI , doth fall nearer to the Prop or Fulciment at A : And the Power at E will be so much augmented, as the Perpendicular from its Center (KE) does fall farther from the Point at A . And so on the contrary, in that other Situation of the Leaver, FG : Whence it is easy to conceive the true Reason, why the Inclining of the Body, or the putting back of the Leg, should so much conduce to the Facility of rising.

Sir Fr. Bacon's
Nat. Hist. Exp.
731.

From these Grounds likewise may we understand, why the Knees should be most weary in Ascending, and the Thighs in Descending; which is, because the Weight of the Body doth bear most upon the Knee-joints, in raising it self up; and most upon

the

the Muscles of the Thighs, when it stays it self in coming down.

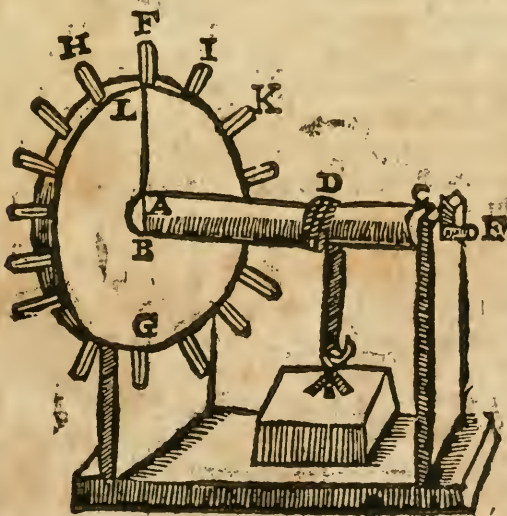
There are divers other Natural Problems to this purpose, which I forbear to recite. We do not so much as go, or sit, or rise, without the Use of this Mechanical Geometry.

C H A P. VI.

Concerning the Wheel.

THE Third Mechanical Faculty is commonly stiled, *Axis in Peritrochio*. It consists of an Axis, or Cylinder, having a Rundle about it, where-in there are fastned divers Spokes, by which the whole may be turned round; according to this Figure.

Called likewise
ov ⊙.
Arist. Mechano
 c. 14.

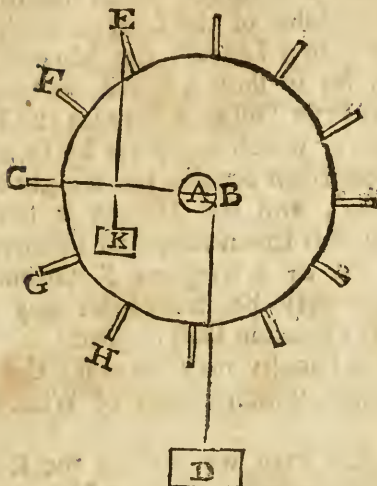


Where BC does represent the Cylinder, which is supposed to move upon a smaller Axis at E ; (this being all one, in comparison to the several Proportions, as if it were a mere Mathematical Line;) LG is the Rundle, or Wheel; $HFIK$, several Spokes or Handles that are fastned in it; D , the Place where the Cord is fastned, for the drawing or lifting up of any Weight.

The Force of this Instrument doth consist in that Disproportion of Distance which there is betwixt the Semidiameter of the Cylinder AB , and the Semidiameter of the Rundle with the Spokes, FA . For let us conceive the Line FB to be as a Leaver, wherein A is the Center or Fulciment, B the Place of the Weight, and F of the Power. Now it is evident from the former Principles, that by how much the Distance FA is greater than AB , by so much less need the Power be at F , in respect of the Weight at B . Suppose AB to be as the Tenth part of AF , then that Power or Strength, which is but as a Hundred Pound at F , will be equal to a Thousand Pound at B .

For the clearer Explication of this Faculty, it will not be amiss to consider the Form of it, as it will appear, being more fully exposed to the View: As in this other Diagram.

Suppose



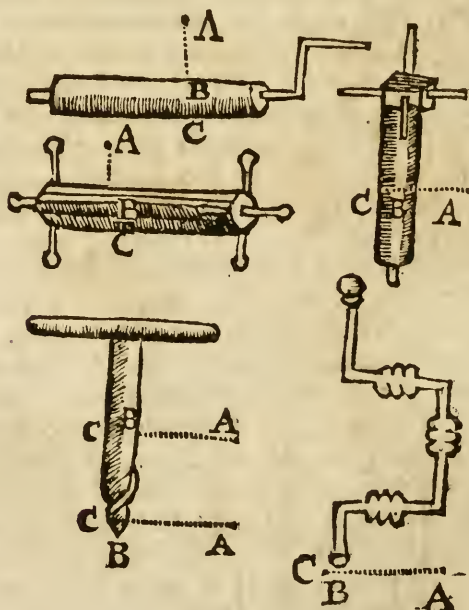
Suppose AB for the Semidiameter of the Axis or Cylinder, and AC for the Semidiameter of the Rundle with the Spokes; then the Power at C , which will be able to support the Weight D , must bear the same Proportion unto it, as AB doth to AC : So that by how much shorter the Distance AB is, in comparison to the Distance AC , by so much less need the Power be at C , which may be able to support the Weight D hanging at B .

And so likewise is it for the other Spokes or Handles, $EFGH$; at either of which, if we conceive any Power, which shall move according to the same Circumference wherein these Handles are placed; then the Strength of this Power will be all one, as if it were at C . But now, supposing a dead Weight hanging at any of them, (as at E) then the Disproportion will vary: The Power being so much less than that at C , by how much the Line AC is longer than AI ; the Weight K being of the same Force at E , as if it were hung at I , in which Point the Perpendicular of its Gravity doth cut the Diameter.

The chief Advantage which this Instrument doth bestow above that of the Leaver, doth consist in this Particular : In a Leaver, the Motion can be continued only for so short a Space, as may be answerable to that little Distance betwixt the Fulciment and the Weight ; which is always by so much lesser, as the Disproportion betwixt the Weight and the Power is greater, and the Motion it self more easy : But now in this Invention, that Inconvenience is remedied ; for by a frequent Rotation of the Axis, the Weight may be moved for any Height, or Length, as Occasion shall require.

Unto this Faculty may we refer the Force of all those Engines, which consist of Wheels with Teeth in them.

Hence also may we discern the Reason, why sundry Instruments in common Use, are framed after the like Form with these following Figures.



All which are but several kinds of this Third Mechanical Faculty. In which, the Points *A B C* do represent the Places of the Power, the Fulciment, and the Weight; the Power being in the same proportion unto the Weight, as *B C* is unto *B A*.

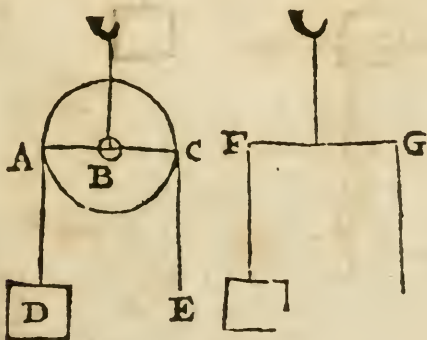
C H A P. VII.

Concerning the Pulley.

THAT which is reckon'd for the Fourth Faculty, is the Pulley; which is of such ordinary Use, that it needs not any particular Description. The chief Parts of it are divers little Rundles, that are moveable about their proper Axes. These are usually divided, according to their several Situations, into the upper and lower. If an Engine have two of these Rundles above, and two below, it is usually called *διπλάσις*, if three, *τριπλάσις*, if many, *πολύπλάσις*.

Arif. Mechan. c. 19.

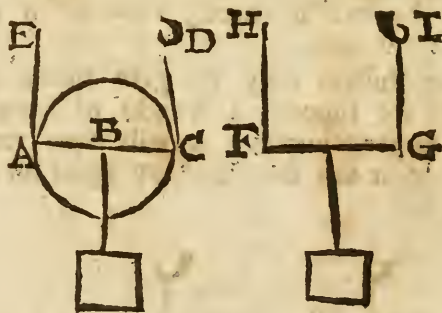
The lower Pulleys only do give Force to the Motion. If we suppose a Weight to hang upon any of the upper Rundles, it will then require a Power that in it self shall be fully equal for the sustaining of it.



The Diameter AC being as the Beam of a Balance, of which B is the Prop or Center. Now the Parts A and C being equally distant from this Center, therefore the Power at E must be equal to the Weight at D ; it being all one, as if the Power and the Weight were fastned by two several Strings, at the Ends of the Balance FG .

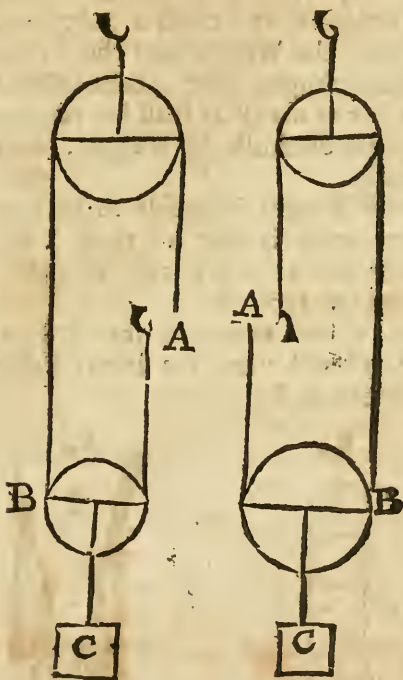
Now all the upper Pulleys being of the same Nature, it must necessarily follow, that none of them do in themselves conduce to the easing of the Power, or lightening the Weight, but only for the greater Conveniency of the Motion; the Cords by this means running more easily moved, than otherwise they would.

But now, suppose the Weight to be sustained above the Pulley, as it is in all those of the lower sort; and then the Power which supports it, need be but half as much as the Weight it self.



Let AC represent the Diameter of a lower Pulley, on whose Center at B the Weight is fastned, one end of the Cord being ty'd to a Hook at D . Now it is evident, that half the Weight is sustained at D , so that there is but the other half left to be sustained by the Power at E : It being all one, as if the Weight were ty'd unto the middle of the Balance FG , whose Ends were upheld by two several Strings, FH , and GI . And

And this same Subduple Proportion will still remain, tho' we suppose an upper Pulley joined to the Power; as in these two other Figures.

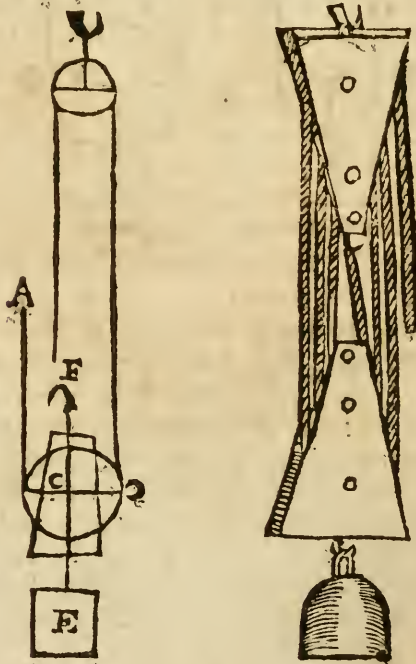


Where the Power at *A* is equal to the Weight at *B*: Now the Weight at *B* being but half the Ponderosity *C*, therefore the Power at *A*, notwithstanding the Addition of the upper Rundle, must be equivalent to half the Weight; and as the upper Pulley alone doth not abate any thing of the Weight, so neither being joined with the lower; and the same Subduple Difference betwixt the Power and the Weight, which is caused by the lower Pulley alone, doth still remain unalter'd, tho' there be an upper Pulley added unto it.

Now, as one of these Under-Pulleys doth abate half of that Heaviness which the Weight hath in it self, and cause the Power to be in a Subduple Proportion unto it; so two of them do abate half of that which remains, and cause a Subquadruple Proportion betwixt the Weight and the Power; three of them a Subsextuple, four a Suboctuple: And so for five, six, or as many as shall be required; they will all of them diminish the Weight, according to this Proportion.

Suppose the Weight in it self to be 1200 Pound, the applying unto it one of these lower Pulleys, will make it but as 600; two of them, as 300; three of them, as 150, &c.

But now, if we conceive the first part of the String to be fasten'd unto the lower Pulley, as in this other Figure at F;



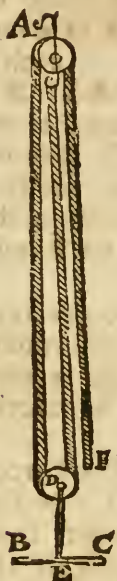
then the Power at *A*, will be in a subtriple Proportion to the Weight *E*, because the Heaviness would be then equally divided unto the Three Points of the lower Diameter *B*, *C*, *D*, each of them supporting a like Share of the Burden. If unto this lower Pulley there were added another, then the Power would be unto the Weight in a subquintuple Proportion. If a Third, a Subsextuple, and so of the rest. For we must note, that the Cords in this Instrument are as so many Powers, and the Rundles as so many Leavers, or Balances.

Hence it is easie to conceive, how the Strength of the Power may be proportioned according to any such Degree, as shall be required; and how any Weight given may be moved by any Power given.

'Tis not material to the Force of this Instrument, whether the Rundles of it be big or little, if they be made equal to one another in their several Orders: But it is most convenient, that the upper should each of them increase as they are higher, and the other as they are lower; because by this means the Cords will be kept from tangling.

These Pulleys may be multiplied according to sundry different Situations, not only when they are subordinate, as in the former Examples, but also when they are placed collaterally.

From the former Grounds it is easie to contrive a Ladder, by which a Man may pull himself up unto any Height. For the Performance of this, there is required only an upper and a lower Rundle.



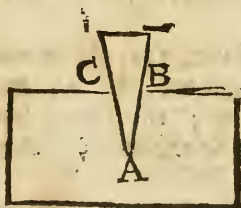
To the uppermost of these at *A*, there should be fastned a sharp Grapple or Cramp of Iron, which may be apt to take hold of any Place where it lights. This part being first cast up and fastned, and the Staff *DE*, at the nether End, being put betwixt the Legs, so that a Man may sit upon the other *BC*, and take hold of the Cord at *F*, it is evident that the Weight of the Person at *E*, will be but equal to half so much Strength at *F*; so that a Man may easily pull himself up to the Place required, by leaning but little more than half of his own Weight on the String *F*. Or if the Pulleys be multiplied, this Experiment may then be wrought with less Labour.

C H A P: VIII.

Of the Wedge.

THE Fifth Mechanical Faculty is the Wedge, which is a known Instrument, commonly used in the Cleaving of Wood. The Efficacy and great Strength of it may be resolved unto these two Particulars :

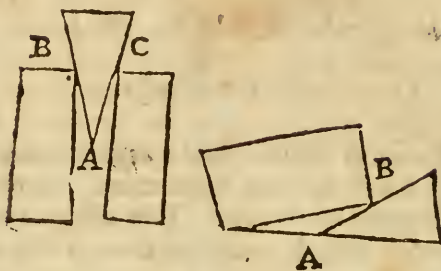
1. The Form of it.
 2. The Manner whereby the Power is impressed upon it, which is by the Force of Blows.
1. The Form of it represents (as it were) two Leavers.



Each side $A D$, and $A E$, being one, the Points $B C$, being instead of several Props or Fulciments; the Weight to be moved at A , and the Power that should move it, being applyed to the Top $D E$, by the Force of some Stroke or Blow : As *Aristotle* hath explained the several Parts of this Faculty. But now, because this Instrument may be so used that the Point of it shall not touch the Body to be moved, as in these other Figures :

Mechan. c.
18.

There-



Therefore *Ubaldu*s hath more exactly applyed the several Parts of it according to this Form, that the Point *A*, should be as the common Fulciment, in which both the Sides do meet, and (as it were) uphold one another; the Points *B*, and *C*, representing that part of the Leavers where the Weight is placed.

It is a general Rule, that the more acute the Angles of these Wedges are, by so much more easie will their Motion be; the Force being more easily impressed, and the Space wherein the Body is moved, being so much the less.

The second Particular whereby this Faculty hath its force, is the *Manner* whereby the Power is impress'd upon it, which is by a Stroke or Blow; the Efficacy of which doth much exceed any other Strength. For tho' we suppose a Wedge being laid on a Piece of Timber, to be pressed down with never so great a Weight; nay, tho' we should apply unto it the Power of those other Mechanical Engines, the Pulley, Screw, &c. yet the Effect would be scarce considerable in comparison to that of a Blow. The true Reason of which, is one of the greatest Subtilties in Nature, nor is it fully rendred by any of those who have undertaken the Resolution of it. * *Aristotle*, *Cardan*, and *Scaliger*, do generally ascribe it unto the Swiftnes of that Motion: But there seems

seems to be something more in the Matter then so ; for otherwise it would follow that the quick Stroke of a light Hammer should be of greater Efficacy than any softer and more gentle Striking of a great Sledge. Or according to this, how should it come to pass, that the Force of an Arrow or Bullet discharged near at Hand (when the Impression of that Violence whereby they are carried, is most fresh, and so in probability the Motion at its swiftest) is yet notwithstanding much less then it would be at a greater Distance. There is therefore further considerable, the Quality of that Instrument by which this Motion is given, and also the Conveniency of Distance thro' which it passes.

Unto this Faculty is usually reduced the Force of Files, Saws, Hatchets, &c. which are as it were but so many Wedges fastned unto a Vectis or Leaver.

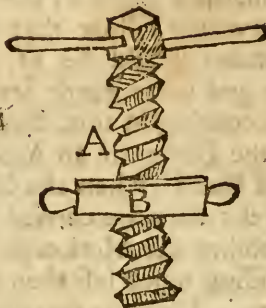
C H A P. IX.

Of the Screw.

TH A T which is usually recited for the Sixth and last Mechanick Faculty, is the Screw, which is described to be a kind of Wedge that is multiplied, or continued by a helical Revolution about a Cylinder, receiving its Motion not from any Stroke, but from a Vectis at one End of it. It is usually distinguished into two several Kinds: The Male which is meant in the former Description, and the Female which is of a concave Superficies.

*Pappus
Collect.
Mathemat.
l. 8.*

The



The former is noted in the Figure with the Letter *A*, the other with *F*.

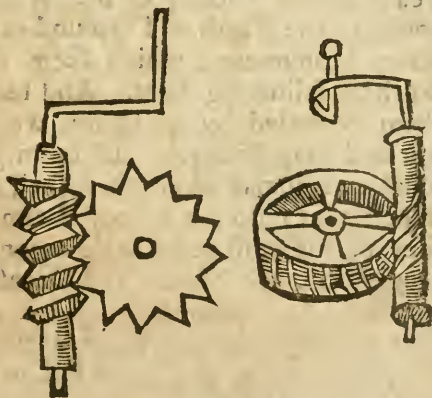
Aristotle himself doth not so much as mention this Instrument, which yet notwithstanding is of greater Force and Subtilty than any of the rest. It is chiefly applied to the Squeezing or Pressing of things downwards, as in the Presses for Printing ; for Wine, Oyl, and extracting the Juice from other Fruits. In the Performance of which, the Strength of one Man, may be of greater Force than the Weight of a heavy Mountain. It is likewise used for the Elevating or Lifting up of Weights.

The Advantage of this Faculty above the rest, doth mainly consist in this : The other Instruments do require so much Strength for the Supporting of the Weight to be moved, as may be equal unto it, besides that other superadded Power whereby it is out-weighed and moved ; so that in the Operations by these, a Man does always spend himself in a continued Labour.

Thus (for Example) a Weight that is lifted up by a Wheel or Pulley, will of it self descend, if there be not an equal Power to sustain it. But now in the Composure of a Screw, this Inconvenience is perfectly remedied ; for so much Force as is communicated

municated unto this Faculty from the Power that is applied unto it, is still retained by the very Frame and Nature of the Instrument it self ; since the Motion of it cannot possibly return, but from the very same Place where it first began. Whence it comes to pass, that any Weight lifted up with the Assistance of this Engine, may likewise be sustained by it without the Help of any external Power ; and cannot again descend unto its former Place, unless the handle of the Screw (where the Motion first began) be turned back : So that all the Strength of the Power may be employed in the Motion of the Weight, and none spent in the Sustaining of it.

The chief Inconvenience of this Instrument is, that in a short Space it will be screwed unto its full length, and then it cannot be of any further Use for the Continuance of the Motion, unless it be returned back, and undone again as at the first. But this is usually remedied by another Invention, commonly styled a *perpetual Screw*, which hath the Motion of a *Wheel*, and the Force of a *Screw*, being both infinite.



For the Composure of which, instead of the Female

It is used
in some
Watches.

male, or concave Screw, there must be a little Wheel with some Notches in it, equivalent to Teeth, by which the other may take hold of it, and turn it round, as in these other Figures.

This latter Engine does so far exceed all other Contrivances to this purpose, that it may justly seem a Wonder why it is not of as common Use in these Times and Places, as any of the rest.

CH A P. X.

An Enquiry into the magnificent Works of the Ancients, which much exceeding our latter Times, may seem to infer a Decay in these Mechanical Arts.

THUS have I briefly treated concerning the general Principles of Mechanicks; together with the distinct Proportions betwixt the Weight and the Power in each several Faculty of it: Whence it is easie to conceive the Truth and Ground of those famous Ancient Monuments, which seem almost incredible to these following Ages. And because many of them recorded by Antiquity, were of such vast Labour and Magnificence, and so mightily disproportionable to human Strength, it shall not therefore be impertinent unto the Purpose I aim at, for to specify some of the most remarkable amongst them, and to enquire into the Means and Occasion upon which they were first attempted.

Amongst the *Egyptians* we read of divers Pyramids of so vast a Magnitude, as Time it self in the Space of so many Hundred Years hath not yet devoured. *Herodotus* mentions one of them, Erected by *Cleopes* an *Egyptian King*, wherein there was not any one Stone

Stone less than 30 Foot long, all of them being fetched from *Arabia*. And not much after, the same Author relates, how *Amasis* another *Egyptian*, made himself a House of one entire Stone, which was 21 Cubits long, 14 broad, and 8 Cubits high. The same *Amasis* is reported to have made the Statue of a *Sphinx*, or *Egyptian Cat*, all of one single Stone; whose Length was 143 Foot, its Height 62 Foot, the Compass of this Statue's Head containing 102 Foot. In one of the *Egyptian* Temples consecrated to *Jupiter*, there is related to be an *Obelisk*, consisting of 4 Smaragds or Emeralds; the whole is 40 Cubits high, 4 Cubits broad at the Bottom, and two at the Top. *Sesostris* the King of *Egypt*, in a Temple at *Memphis*, dedicated to *Vulcan*, is reported to have Erected two Statues; one for himself, the other for his Wife, both consisting of two several Stones, each of which were 30 Cubits high.

Plin. 1. 36.
c. 12.

Plin. 1. 37.
cap. 5.

Diodor: Sicul. Biblioth. 1. 1.
Sect. 2.

Amongst the *Jews* we read in Sacred Writ of *Solomon's* Temple, which for its State and Magnificence, might have been justly reckoned amongst the other Wonders of the World; wherein besides the great Riches of the Materials, there were Works too of as great Labour. Pillars of Brass 18 Cubits high, and 12 Cubits round; great and costly Stones for the Foundation of it: *Josephus* tells us that some of them were 40 Cubits, others 45 Cubits long. And in the same Chapter he mentions the three famous Towers built by *Herod*; wherein every Stone being of white Marble, was 20 Cubits long, 10 broad, and 5 high. And which was the greatest Wonder, the old Wall it self was situated on a steep rising Ground, and yet the Hills upon it, on the Tops of which these Towers were placed, were about 30 Cubits high, that 'tis scarce imaginable by what Strength so many Stones of such great Magnitude should be conveyed to so high a Place.

1 King. 7.
15.

c. 5. v. 17.

De bello
Juda. 1. 6.
cap. 6.

Amongst the *Grecians* we read of the *Ephesian* Tem-

Plin. l. 36.
cap. 14.
Pancirof.
Deperd.
Tit. 32.

ple dedicated to *Diana*; wherein there were 127 Columns made of so many several Stones, each of them 60 Foot high, being all taken out of the Quarries in *Asia*. 'Tis storied also of the Brazen *Colossus*, or great Statue in the Island of *Rhodes*, that it was 70 Cubits high. The Thumbs of it being so big that no Man could grasp one of them about with both his Arms; when it stood upright, a Ship might have passed betwixt the Legs of it, with all its Sails fully displayed; being thrown down by an Earthquake, the Brass of it did load 900 Camels. But above all Ancient Designs to this Purpose, that would have been most wonderful, which a *Grecian* Architect did propound unto *Alexander*, to cut the Mountain *Athos* into the Form of a Statue, which in his Right Hand should hold a Town capable of Ten thousand Men, and in his Left a Vessel to receive all the Water that flowed from the several Springs in the Mountain. But whether *Alexander* in his Ambition did fear that such an Idol should have more Honour than he himself, or whether in his good Husbandry, he thought that such a *Microcosm* (if I may so style it) would have cost him almost as much as the Conquering of this great World, or whatever else was the Reason, he refused to attempt it.

Plin. l. 34.
cap. 3.

Vitruv.
Archit. l. 2.

Suet. Ner.

Amongst the *Romans* we read of a Brazen *Colossus*, made at the Command and Charges of *Nero*, which was 120 Foot high; *Martial* calls it *Sydereus*, or *Starry*.

Hic ubi Sydereus propius videt astra Colossus.

Pancirof.
Deperd.
Tit. 28.

And it is storied of *M. Curio*, that he erected two *Theatres* sufficiently capacious of People, contrived moveable upon certain Hinges; sometimes there were several Plays and Shows in each of them, neither being any Disturbance to the other; and sometimes they were both turned about, with the People in them, and the Ends meeting together, did make a perfect *Amphitheatre*; So that the Spectators which were

were in either of them, might jointly behold the same Spectacles.

There were besides at *Rome* sundry *Obelisks*, made of so many entire Stones, some of them 40, some 80, and others 90 Cubits high. The chief of them were brought out of *Egypt*, where they were dug out of divers Quarries, and being wrought into Form, were afterwards (not without incredible Labour, and infinite Charges) conveyed unto *Rome*: In the Year 1586, there was erected an old *Obelisk* which had been formerly dedicated unto the Memory of *Julius Caesar*. It was one solid Stone, being an Ophite or kind of spotted Marble. The Height of it was 107 Foot, the Breadth of it at the Bottom was 12 Foot, at the Top 8. Its whole Weight is reckoned to be 956148 Pounds; besides the Heaviness of all those Instruments that were used about it; which (as it is thought) could not amount to less than 1042824 Pounds. It was transplac'd at the Charges of Pope *Sixtus* the Fifth, from the left Side of the *Vatican* unto a more eminent Place about a hundred Foot off, where now it stands. The moving of this *Obelisk* is celebrated by the Writings of above 56 several Authors, (saith *Monantholius*) all of them mentioning it, not without much Wonder and Praise. Now if it seem so strange and glorious an Attempt to move this *Obelisk* for so little a Space, what then may we think of the Carriage of it out of *Egypt*, and divers other far greater Works performed by Antiquity? This may seem to infer that these Mechanical Arts are now lost, and decayed amongst the many other Ruins of Time: Which yet notwithstanding cannot be granted, without much Ingratitude to those Learned Men, whose Labours in this kind we enjoy, and may justly boast of. And therefore for our better understanding of these Particulars, it will not be amiss to enquire both *why*, and *how* such Works should be performed in those former

Idem Tit.
31.

Comment.
in Mech.
Arist. G. 1. 3.

and ruder Ages, which *are not*, and (as it should seem) *cannot* be effected in these later and more Learned Times. In the Examination of which, we shall find that it is not the want of Art that disables us for them, since these Mechanical Discoveries are altogether as perfect, and (I think) much more exact now, than they were heretofore; but it is, because we have not either the same *Motives* to attempt such Works, or the same *Means* to effect them as the Ancients had.

C H A P. XI.

That the Ancients had divers Motives and Means for such vast Magnificent Works, which we have not.

THE *Motives* by which they were excited to such Magnificent Attempts, we may conceive to be chiefly Three:

{ *Religion.*
 { *Policy.*
 { *Ambition.*

1. *Religion.* Hence was it that most of these stately Buildings were intended for some Sacred Use, being either Temples or * Tombs, all of them Dedicated to some of their Deities. It was an inbred Principle in those ancient Heathen, that they could not chuse but merit very much by being liberal in their outward Services. And therefore we read of *Cræsus*, that being overcome in a Battel, and taken by *Cyrus*, he did revile the Gods of Ingratitude, because they had no better Care of him, who had so frequently adored them with costly Oblations. And as they did conceive themselves bound to part with their Lives in defence of their Religion,

* As Pyramids, Obelisks.

Herodot.
 l. 1.

so

so likewise to employ their utmost Power and Estate about any such Design which might promote or advance it. Whereas now, the generality of Men, especially the wisest Sort amongst them, are in this respect of another Opinion, counting such great and immense Labours, to be at the best but Glorious Vanities. The Temple of *Solomon* indeed was to be a Type, and therefore it was necessary that it should be so extraordinarily Magnificent, otherwise perhaps a much cheaper Structure might have been as commendable and serviceable.

2. *Policy*. That by this means they might find out Employment for the People, who of themselves being not much civiliz'd, might by Idleness quickly grow to such a Rudeness and Barbarism, as not to be bounded within any Laws of Government. Again, by this Means the Riches of the Kingdom did not lie idly in their Kings Treasuries, but was always in Motion; which could not but be a great Advantage and Improvement to the Commonwealth. And perhaps some of them feared lest if they should leave too much Money unto their Successors, it might be an occasion to ensnare them in such idle and vain Courses, as would ruin their Kingdoms: Whereas in these latter Ages, none of all these politick Incitements can be of any force, because now there is Employment enough for all, and Money little enough for every one.

*Plin. l. 6.
c. 12.*

3. *Ambition* to be known unto Posterity; and hence likewise arose that incredible Labour and Care they bestowed, to leave such Monuments behind them as might * *continue for ever*, and make them famous unto all After-ages. This was the reason of *Absalom's* Pillar, spoken of in Scripture, to keep his Name in remembrance. And doubtless this too was the end which many other of the Ancients have aimed at, in those (as they thought) everlasting Buildings.

*Psal. 4.
11.*

*2 Sam. 18.
18.*

But now these later Ages are much more active and stirring; so that every ambitious Man may find so much Business for the present, that he shall scarce have any leisure to trouble himself about the future. And therefore in all these Respects, there is a great disproportion betwixt the Incitements of those former and these later times, unto such Magnificent Attempts.

Again, as they differ much in their *Motives* unto them, so likewise in the Means of effecting them.

There was formerly more Leisure and Opportunity, both for the Great Men to undertake such Works, and for the People to perfect them. Those past Ages were more quiet and peaceable, the Princes rather wanting Employment, than being overpress'd with it, and therefore were willing to make choice of such great Designs, about which to busy themselves. Whereas now the World is grown more politick, and therefore more troublesome; every Great Man having other private and necessary Business about which to employ both his Time and Means. And so likewise for the Common People, who then living more wildly, without being confined to particular Trades and Professions, might be more easily collected about such famous Employments; whereas now, if a Prince have any occasion for an Army, it is very hard for him to raise so great a Multitude as were usually employed about these Magnificent Buildings. We read of 360000 Men that were busied for Twenty Years in making one of the *Egyptian* Pyramids. And *Herodotus* tells us of 1000000 Men who were as long in building another of them. About the Carriage of one Stone for *Amasis* the distance of twenty Days Journey, there was for Three Years together employed 2000 chosen Men, Governors, beside many other Under-Labourers. 'Twas the Opinion of * *Josephus* and *Nazianzen*, that these Pyramids were built by *Joseph* for Grana-

Lib. 2.

* *Antiq. l. 2.*

e. 5.

Granaries against the Years of Famine. Others think that the Brick made by the Children of *Israel*, was employed about the framing of them, because we read that the Tower of *Babel* did consist of Brick or artificial Stone, *Gen.* 11. 3. And if these were the Labourers that were busied about them, 'tis no wonder though they were of so vast a Magnitude ; for we read that the Children of *Israel* at their coming out of *Agypt*, were numbred to be Six hundred thousand, and Three thousand, and Five hundred and Fifty Men, *Numb.* 1. 46. So many handfuls of Earth would almost make a Mountain, and therefore we may easily believe that so great a Multitude in so long a space as their Bondage lasted, for above four hundred Years, might well enough accomplish such vast Designs.

In the building of *Solomon's* Temple, there were Threescore and Ten thousand that bare Burdens, and Fourscore thousand Hewers in the Mountains, *1 Kings* 5. 15.

The *Ephesian* Temple was built by all *Asia* joyning together ; the 127 Pillars were made by so many Kings, according to their several Successions, the whole Work being not finished under the space of Two hundred and Fifteen Years. Whereas the transplacing of that Obelisk at *Rome* by *Sixtus* the Vth. (spoken of before) was done in some few Days by Five or Six hundred Men ; and as the Work was much less than many other recorded by Antiquity, so the Means by which it was wrought, was yet far less in this respect than what is related of them.

2. The abundance of Wealth, which was then ingrossed in the possession of some few particular Persons, being now diffused amongst a far greater Number. There is now a greater equality amongst Mankind, and the flourishing of Arts and Sciences hath so stirred up the Sparks of Men's natural Nobility, and made them of such active and industri-

ous Spirits, as to free themselves in a great measure from that Slavery, which those former and wilder Nations were subjected unto.

In building one of the Pyramids, there was expended for the Maintenance of the Labourers with Radish and Onyons, no less than Eighteen hundred Talents, which is reckoned to amount unto 1880000 Crowns, or thereabouts. And considering the cheapness of these things in those Times and Places, so much Money might go farther than a Sum ten times greater could do in the Maintenance of so many now.

In Solomon's Temple we know how the extraordinary Riches of that King, the general flourishing of the whole State, and the Liberality of the People did jointly concur to the Building of the Temple. *Pecuniarum copia & populi largitas, majora dictu conabatur,* (saith Josephus.) The Rhodian Colossus is reported to have cost Three hundred Talents the making; and so were all those other famous Monuments of proportionable Expence.

Pancirollus speaking of those Theatres that were erected at the Charges of some private Roman Citizens, saith thus: *Nostro hoc saculo vel Rex satis haberet quod ageret ædificio ejusmodi erigendo;* and a little after upon the like Occasion, *Res mehercule miraculosa, quæ nostris temporibus vix à potentissimo aliquo rege pissit exhiberi.*

3. Add unto the two former Considerations, that exact Care and indefatigable Industry which they bestowed in the raising of those Structures; these being the chief and only Designs on which many of them did employ all their best Thoughts and utmost Endeavours. *Cleopes* an Egyptian King is reported to have been so desirous to finish one of the Pyramids, that having spent all about it he was worth, or could possibly procure, he was forced at last to prostitute his own Daughter for necessary Maintenance.

*De Bell.
Jud. l. 6.
cap. 6.*

*Depend.
Tit. 18.*

nance. And we read of *Ramises* another King of *Egypt*, how that he was so careful to erect an *O-belisk*, about which he had employed 20000 Men, that when he feared lest through the negligence of the Artificers, or weakness of the Engine, the Stone might fall and break, he tyed his own Son to the Top of it, that so the care of his Safety might make the Workmen more circumspect in their Business. And what strange Matters may be effected by the meer diligence and labour of great Multitudes, we may easily discern from the wild *Indians*, who having not the Art or Advantage of Engines, did yet by their unwearied Industry remove Stones of an incredible greatness. *Acosta* relates that he himself measured one at *Tiaguanaco*, which was Thirty eight Foot long, Eighteen broad, and Six thick; and he affirms, that in their stateliest *Ædifices* there were many other of much vaster Magnitude.

Plin. l. 36. c. 9.
Histor. Ind. l. 6. c. 14.

From all which Considerations, it may appear, that the strangeness of those ancient Monuments above any that are now effected, does not necessarily infer any defect of Art in these later Ages. And I conceive, it were as easie to demonstrate the Mechanical Arts in these times to be so far beyond the knowledge of former Ages, that had we but the same Means as the Ancients had, we might effect far greater Matters than any they attempted, and that too in a shorter space, and with less Labour.

C H A P. XII.

Concerning the Force of the Mechanick Faculties; particularly the Balance and Leaver. How they may be contrived to move the whole World, or any conceivable Weight.

ALL these Magnificent Works of the Ancients before specify'd, are scarce considerable in respect of Art, if we compare them with the famous Speeches and Acts of *Archimedes*: Of whom it is reported, that he was frequently wont to say, how that he could move *Datum pondus, cum data potentiâ*; the greatest conceivable Weight, with the least conceivable Power: And that if he did but know where to stand and fasten his Instrument, he could move the World, all this great Globe of Sea and Land. Which *Promises*, tho' they were altogether above the vulgar Apprehension or Belief, yet because his Acts were somewhat answerable thereunto, therefore the King of *Syracuse* did enact a Law, whereby every man was bound to believe whatever *Archimedes* would affirm.

'Tis easy to demonstrate the Geometrical Truth of those strange Assertions, by examining them according to each of the forenamed *Mechanick* Faculties, every one of which is of infinite Power.

To begin with the two first of them, the Balance and the Leaver, (which I here join together, because the Proportions of both are wholly alike;) 'tis certain, tho' there should be the greatest imaginable Weight, and the least imaginable Power, (suppose the whole World, and the Strength of one Man, or Infant;) yet if we conceive the same Disproportion betwixt their several Distances in the former Faculties, from the Fulciment, or Center of Gravity, they would both equiponderate. And if the

ry ordinary Instrument doth include all these Parts really, tho' not sensibly distinguished.

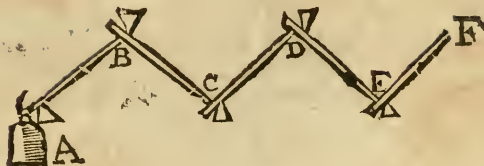
Lipſius Po-
liorct. L. I.
Dialog. 6.

Under this latter Faculty, I did before mention that Engine, by which *Archimedes* drew up the Roman Ships at the Siege of *Syracuse*. This is usually ſtil'd *Tollenon*, being of the ſame Form with that which is commonly uſed by Brewers and Dyers, for the drawing of Water. It conſiſts of two Poſts; the one faſten'd perpendicularly in the Ground, the other being jointed on croſs to the top of it. At the end he faſten'd a ſtrong Hook or Grapple of Iron, which being let over the Wall to the River, he would thereby take hold of the Ships, as they paſſed under; and afterwards, by applying ſome Weight, or perhaps the Force of Screws to the other end, he would thereby liſt them into the open Air; where having ſwinged them up and down till he had ſhaken out the Men and Goods that were in them, he would then daſh the Veſſels againſt the Rocks, or drown them in their ſudden Fall: Inſomuch that *Marcellus*, the Roman General, was wont to ſay, ἦ μὲν τανούτων ἀπὸ κακίζεν ἐκ θαλάττης Ἀρχιμήδην, That *Archimedes* made uſe of his Ships inſtead of Buckets to draw Water with.

Plutarch
in his Life.

This Faculty will be of the ſame Force, not only when it is continued in one, but alſo when it is multiplied in divers Inſtruments; as may be conceived in this other Form; which I do not mention, as if it could be ſerviceable for any other Motion, (ſince the Space by which the Weight would be moved, will be ſo little as not to fall under Senſe) but only for the better Explication of this Mechanick Principle, and for the right underſtanding of that Force ariſing from Multiplication in the other Faculties, which do all depend upon this. The Wheel, and Pulley, and Screw, being but as ſo many Leavers of a Circular Form and Motion, whoſe Strength may be therefore continued to a greater Space.

Imagine



Imagine the Weight *A* to be a Hundred thousand Pounds, and the Distance of that Point, wherein every Leaver touches either the Weight, or one another from the Point where they touch the Prop, to be but one such Part, whereof the Remainder contains ten; then according to the former Grounds, 10000 at *B* will equiponderate to *A*, which is 100000; so that the second Leaver hath but 10000 Pounds to move. Now, because this observes the same Proportions with the other, in the Distances of its several Points, therefore 1000 Pounds at *C* will be of equal Weight to the former: And the Weight at *C* being but as a Thousand Pound, that which is but as a Hundred at *D*, will be answerable unto it; and so still in the same Proportion, that which is but 10 at *E*, will be equal to 100 at *D*; and that which is but one Pound at *F*, will also be equal to ten at *E*. Whence it is manifest, that one Pound at *F* is equal to 100000 at *A*; and the Weight must always be diminished in the same Proportion as ten to one, because in the multiplication of these Leavers, the Distance of the Point where the Instrument touches the Weight, from that where it touches the Prop, is but as one such Part, whereof the Remainder contains ten. But now if we imagine it to be as the Thousandth Part, then must the Weight be diminished according to this Proportion; and then in the same multiplication of Leavers, 1 Pound will be equal to 1000 000 000 000 000 Pounds: So that tho' we suppose

suppose the Weight to be never so heavy, yet let the Disproportion of Distances be greater, or the Leavers more, and any little Power may move it.

C H A P. XIII.

Of the Wheel: By Multiplication of which, it is easy to move any imaginable Weight.

See the figure, c. 6.

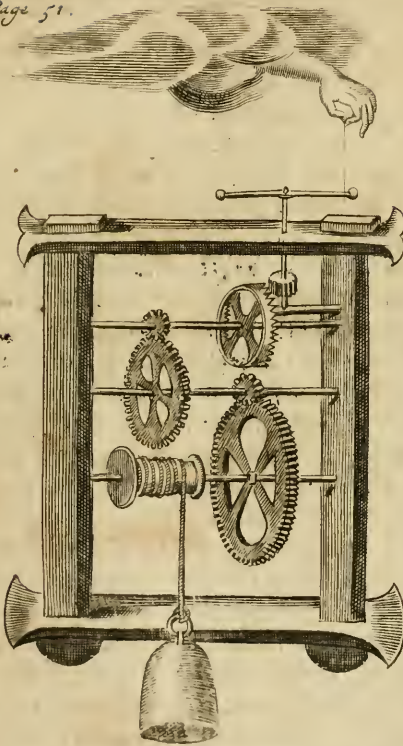
THE Wheel, or *Axis in Peritrochio*, was before demonstrated to be of equivalent Force with the former Faculties. If we conceive the same Difference betwixt the Semidiameter of the Wheels, or Spokes *AC*, and the Semidiameter of the *Axis AB*, as there is betwixt the Weight of the World, and the Strength of a Man; it may then be evident, that this Strength of one Man, by the help of such an Instrument, will equiponderate to the Weight of the whole World. And if the Semidiameter of the Wheel *AC*, be but any thing more in respect of the Semidiameter of the *Axis AB*, than the Weight of the World supposed at *D*, is in comparison to the Strength of a Man at *C*; it may then be manifest from the same Grounds, that this Strength will be of so much greater Force than the Weight, and consequently able to move it.

An Engine of many Wheels is commonly called *Glossocomus*. How to pull a man above Ground with a single Hair.

The Force of this Faculty may be more conveniently understood and used by the Multiplication of several Wheels, together with Nuts belonging unto each of them; as it may be easily experimented in the ordinary Jacks that are used for the roasting of Meat, which commonly consist but of three Wheels; and yet if we suppose a Man ty'd in the place of the Weight, it were easy by a single Hair fastned unto the Fly or Balance of the Jack, to draw him up from the Ground: As will be evident from this following Figure.

Where

Page 51.



Where suppose the Length of the Fly or Balance in comparison to the Breadth of its Axis, to be as 10 to one, and so for the three other Wheels in respect of the Nuts that belong unto them; (tho' this Difference be oftentimes less, as we may well allow it to be); withal suppose the Weight (or a Man tied in the Place of it) to be a hundred Pounds: I say according to this Supposition, it is evident that the Power

Power at the Balance which shall be equal to the Weight, need be but as 1 to 10000. For the first Axis is conceived to be but as the tenth Part of its Wheel ; and therefore tho' the Weight in it self be as 10000, yet unto a Power that hath this Advantage, it is but as 1000, and therefore this Thousand unto the like Power at the second Wheel, will be but as 100, and this 100 at the third but as 10 ; and lastly, this Ten at the Balance but as one. But the Weight was before supposed to be 100, which to the first Wheel will be but 10, to the second as one, to the third as a decimal, or one Tenth to the Sails as one hundredth Part : So that if the Hair be but strong enough to lift $\frac{1}{10000}$ that is, one ten thousandth Part of a Man, or (which is all one) one hundredth Part of a Pound, it may as well serve by the Help of this Instrument for the drawing of him up. And tho' there be not altogether so great a Disproportion betwixt the several Parts of a Jack (as in many perhaps there is not ;) and tho' a Man may be heavier than is here supposed, yet 'tis withal considerable, that the Strength of a Hair is able to bear much more than the hundredth Part of a Pound.

Comment.
in Gen. c. 1.
v. 10. art. 6.
De viribus
motricibus
Theor. 16.

Upon this Ground *Mersennus* tells us out of *Solomon de Carvet*, that if there were an Engine of 12 Wheels, each of them with Teeth, as also the Axes or Nuts that belong unto them ; if the Diameter of these Wheels were unto each *Axis*, as a hundred to one ; and if we suppose these Wheels to be so placed, that the Teeth of the one might take hold of the *Axis* that belongs unto the next, and that the *Axis* of the Handle may turn the first Wheel, and the Weight be tied unto the *Axis* of the last ; with such an Engine as this, saith he, a Child (if he could stand any where without this Earth) might with much ease move it towards him.

For according to the former Supposition; that this Globe of Sea and Land did contain as many hundred Pounds as it doth Cubical Feet, *viz.* 240000000000000000000000, it may be evident that any Strength, whose Force is but equivalent to $\frac{1}{2}$ Pounds, will by such an Engine be able to move it.

Of this kind was that Engine so highly extolled by *Stevinus*, which he calls *Pancration*, or *Omnipotent*, preferring it before the Inventions of *Archimedes*. It consisted of Wheels and Nuts, as that before specified is supposed. Hither also should be referred the Force of Racks, which serve for bending of the strongest Bows, as also that little Pocket Engine, wherewith a Man may break or wrench open any Door, together with divers the like Instruments in common Use.

*De Staticæ
præxi.*

*Ramelli
Fig. 160.*

C H A P. XIV.

Concerning the infinite Strength of Wheels, Pulleys, and Screws. That it is possible by the Multiplication of these, to pull up any Oak by the Roots with a Hair, lift it up with a Straw, or blow it up with ones Breath, or to perform the greatest Labour with the least Power.

From what hath been before delivered concerning the Nature of the Pulley, it is easie to understand how this Faculty also may be proportioned betwixt any Weight, and any Power, as being likewise of infinite Strength.

'Tis reported of *Archimedes*, that with an Engine of Pulleys, to which he applied only his Left Hand, he lifted up * 5000 Bushels of Corn at once, and drew

* 7000
saith *Zetzelus*
Chilii
nd. 2.
Hist. 35.

drew a Ship with all its Lading upon dry Land. This Engine *Zetzes* calls *Trispatum*, or *Trispastum*, which signifies only a threefold Pulley: But herein he doth evidently mistake, for 'tis not possible that this alone should serve for the Motion of so great a Weight; because such an Engine can but make a Subsextuple, or at most a Subseptuple Proportion betwixt the Weight and Power; which is much too little to reconcile the Strength of a Man unto so much Heaviness. Therefore *Ubaldu*s doth more properly style it, *Polyspaston*; or an Instrument of many Pulleys. How many, were easie to find out, if we did exactly know the Weight of those Ancient Measures; supposing them to be the same with our Bushel in *England*, which contains 64 Pints or Pounds, the whole would amount to 320000 Pounds; half of which would be lightned by the Help of one Pulley, Three Quarters by two Pulleys, and so onward, according to this Subduple, Subquadruple, and Subsextuple Proportion. So that if we conceive the Strength of the Left Hand to be equivalent unto 20 or 40 Pounds, it is easie to find out how many Pulleys are required to enable it for the Motion of so great a Weight.

*Præf. ad
Mechan.*

*Comment.
in Gen. c.
I. v. 10.
art. 6.*

*Præf. ad
Mechan.
Aristotle.*

Upon this Ground *Mersennus* tells us, that any little Child with an Engine of an hundred double Pulleys, might easily move this Great Globe of Earth, tho' it were much heavier than it is. And in reference to this kind of Engine (saith *Monantholizus*) are we to understand that Assertion of *Archimedes*, (as he more immediately intended it) concerning the Possibility of moving the World.

The Wedge was before demonstrated to be as a double Vectis or Leaver, and therefore it would be needless to explain particularly how this likewise may be contrived of infinite Force.

The Screw is capable of Multiplication, as well
as

as any of the other Faculties, and may perhaps be more serviceable for such great Weights, than any of the rest. *Archimedes* his Engine of greatest Strength, called *Caristion*, is by some thought to consist of these. *Axes habebat cum infinitis Cochleis*. And that other Engine of his called *Helix*, (mentioned by * *Athenæus*) wherewith he lifted *Hiero's* great Ship into the Sea, without any other Help, is most likely to be framed of perpetual Screws, saith *Rivaltus*.

Stevin. de Static. prax.
See *Besson.*
* *Deipnosophist. l. 5.*
Oper. extec. Archimedes.

Whence it may evidently appear, that each of these Mechanick Faculties are of infinite power, and may be contrived proportionable unto any conceivable Weight. And that no natural Strength is any way comparable unto these artificial Inventions.

'Tis reported of *Sampson*, that he could carry the Gates of a City upon his Shoulders; and that the strongest Bonds were unto him but as Flax burnt with Fire, and yet his Hair being shaved off, all his Strength departed from him. We * read of *Milo* that he could carry an Ox upon his Back, and yet when he tried to tear an Oak asunder that was somewhat riven before, having drawn it to its utmost, it suddenly joined together again, catching his Hands in the Cleft, and so strongly manacled him, that he became a Prey to the wild Beasts.

Judg. 15.

* *A. Gell. Noct. Att. l. 15. c. 15.*

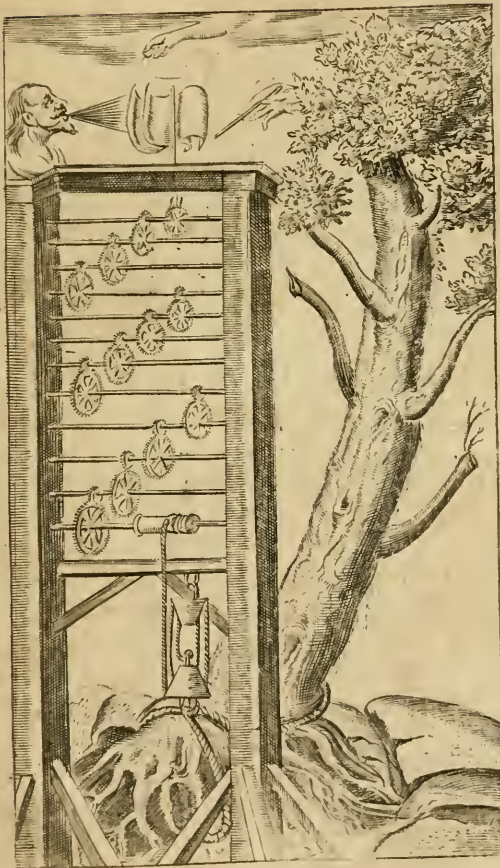
But now by these Mechanical Contrivances, it were easy to have made one of *Sampson's* Hairs that was shaved off, to have been of more Strength than all of them when they were on. By the Help of these Arts it is possible (as I shall demonstrate) for any Man to lift up the greatest Oak by the Roots with a Straw, to pull it up with a Hair, or to blow it up with his Breath.

Suppose the Roots of an Oak to extend a thousand Foot Square, (which is almost a Quarter of a Mile) and Forty Foot deep, each Cubical Foot being an

hundred Pound Weight ; which tho' it be much beyond the Extension of any Tree, or the Weight of Earth ; the Compass of the Roots in the Ground (according to common Opinion) not extending further than the Branches of it in the Air, and the Depth of it not above ten Foot, beyond which the greatest Rain doth not penetrate (saith * Seneca.) *Ego vinearum diligens fossor affirmo nullam pluviam esse tam magnam, quæ terram ultra decem pedes in altitudinem madefaciat.* And because the Root must receive its nourishment from the Help of Showers, therefore it is probable that it doth not go below them. So that (I say) tho' the Proportions supposed do much exceed the real Truth, yet it is considerable that some great Overplus must be allowed for that Labour which there will be in the forcible Divulsion or Separation of the Parts of the Earth which are continued.

* Nat. Qua.
l. 3. c. 7.

According to this Supposition, the Work of forcing up the Oak by the Roots, will be equivalent to the lifting up of 4000000000 Pound Weight, which by the Advantage of such an Engine, as is here described, may be easily performed with the least conceivable Power.



The whole Force of this Engine doth consist in two double Pulleys, twelve Wheels, and a Sail. One of these Pulleys at the Bottom will diminish half of the Weight, so that it shall be but as 2000000000, and the other Pulley will abate $\frac{3}{4}$ three quarters of it ; so that it shall be but as 1000000000. And because the Beginning of the String being fast-

ned unto the lower Pulley, makes the Power to be in a subquintuple Proportion unto the Weight, therefore a Power that shall be as 100000000, that is, a Subquadruple, will be so much stronger than the Weight, and consequently able to move it. Now
 See ch. 7. suppose the Breadth of all the Axes and Nuts to be unto the Diameters of the Wheel as ten to one; and it will then be evident that to a Power at the First Wheel, the Weight is but as 100000000. To the Second as 10000000. To the Third as 1000000. To the Fourth as 100000. To the Fifth as 10000. To the Sixth as 1000. To the Seventh as 100. To the Eighth as 10. To the Ninth as 1. To the Tenth as $\frac{1}{10}$, one Decimal. To the Eleventh as $\frac{1}{100}$. To the Twelfth as $\frac{1}{1000}$. And to the Sails yet less. So that if the Strength of the Straw, or Hair, or Breath, be but equal to the Weight of one thousandth Part of a Pound, it may be of sufficient Force to pull up the Oak.

If in this Engine we suppose the Disproportion betwixt the Wheels and Nuts to be as a hundred to one, then it is very evident that the same Strength of Breath, or a Hair, or a Straw, would be able to move the whole World, as will be easily found by Calculation. Let this great Globe of Sea and Land be imagined (as before) to weigh so many hundred Pounds as it contains Cubical Feet; namely, 240000000000000000000000 Pounds. This will be to the first Pulley, 120000000000000000000000. To the 2d less than 60000000000000000000000. But for more easie and convenient reckoning, let it be supposed to be somewhat more, viz. 100000000000000000000000. This to the first
 Wheel

C H A P. XV.

*Concerning the Proportion of Slowness and Swift-
ness in Mechanical Motions.*

HAVING already discoursed concerning the Strength of these Mechanical Faculties; it remains for the more perfect Discovery of their Natures, that we treat somewhat concerning those two Differences of Artificial Motion:

} Slowness,
and
{ Swiftmess.

Without the right understanding of which, a Man shall be expos'd to many absurd Mistakes, in attempting of those Things which are either in themselves impossible, or else not to be performed with such Means as are apply'd unto them. I may safely affirm, that many, if not most Mistakes in these Mechanical Designs, do arise from a Misapprehension of that Difference which there will be betwixt the Slowness or Swiftmess of the Weight and Power, in comparison to the Proportion of their several Strengths.

Hence it is, that so many Engines invented for Mines and Water-works, do so often fail in the Performance of that for which they were intend'd; because the Artificers many times do forget to allow so much time for the working of their Engine, as may be proportionable to the Difference betwixt the Weight and Power that belong unto them: Whereas, he that rightly understands the Grounds of this Art, may as easily find out the Difference

ference of Space and Time required to the Motion of the Weight and Power, as he may their different Strengths ; and not only tell how any Power may move any Weight, but also in what a Space of *Time* it may move it any Space or *Distance*.

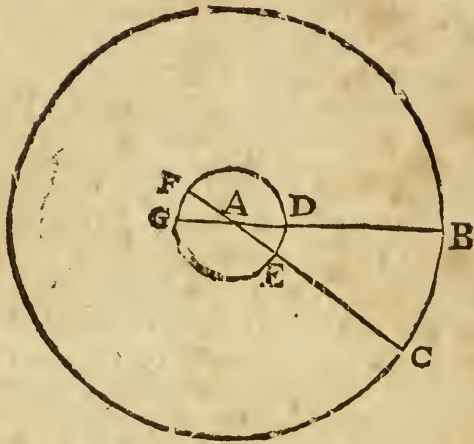
If it were possible to contrive such an Invention, whereby any conceivable Weight may be moved by any conceivable Power, both with the same Quickness and Speed, (as it is in those Things which are immediately stirred by the Hand, without the Help of any other Instrument ;) the Works of Nature would be then too much subjected to the Power of Art, and Men might be thereby encouraged (with the Builders of *Babel*, or the Rebel Gyants) to such bold Designs as would not become a created Being. And therefore the Wisdom of Providence hath so confined these Human Arts, that what any Invention hath in the *Strength* of its Motion, is abated in the *Slowness* of it ; and what it hath in the extraordinary *Quickness* of its Motion, must be allowed for in the great *Strength* that is required unto it.

For it is to be observed as a general Rule, that the Space of Time or Place, in which the Weight is moved, in comparison to that in which the Power doth move, is in the same Proportion as they themselves are unto one another.

So that if there be any great Difference betwixt the Strength of the Weight and the Power, the same kind of Differences will there be in the Spaces of their Motion.

To illustrate this by an Example :

Let

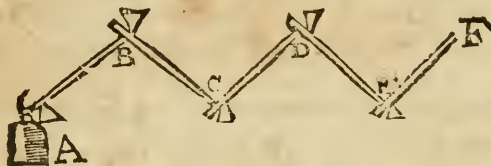


Let the Line GAB represent a Balance, or Lever; the Weight being supposed at the Point G , the Fulcrum at A , and the Power sustaining the Weight at B . Suppose the Point G , unto which the Weight is fastned, to be elevated unto F , and the opposite Point B to be depressed unto C ; 'tis evident that the Arch FG , or (which is all one) DE , doth shew the Space of the Weight, and the Arch BC the Motion of the Power. Now both these Arches have the same Proportion unto one another, as there is betwixt the Weight and the Power, or (which is all one) as there is betwixt their several Distances from the Fulcrum. Suppose AG unto AB to be as one unto four; it may then be evident, that FG , or DE , will be in the same Proportion unto BC : For as any two Semidiameters are unto one another, so are the several Circumferences described by them, as also any proportional Parts of the same Circumferences.

And as the Weight and Power do thus differ in the Spaces of their Motions, so likewise in the Slowness

ness of it ; the one moving the whole Distance BC , in the same time wherein the other passes only GF . So that the Motion of the Power from B to C , is four times swifter than that of the Weight from G to F . And thus will it be, if we suppose the Disproportions to be far greater ; whether or no we conceive it , either by a *Continuation* of the same Instrument and Faculty, as in the former Example ; or by a *Multiplication* of divers, as in Pulleys, Wheels, &c. By how much the Power is in it self less than the Weight , by so much will the Motion of the Weight be slower than that of the Power.

To this purpose, I shall briefly touch at one of the Diagrams expressed before in the Twelfth Chapter, concerning the Multiplication of Leavers.



In which , as each Instrument doth diminish the Weight according to a decuple Proportion , so also do they diminish the *Space* and *Slowness* of its Motion. For if we should conceive the first Leaver B to be depressed unto its lowest, suppose ten Foot, yet the Weight A would not be raised above one Foot : But now the second Leaver , at its utmost, could move but a Tenth Part of the first , and the third Leaver but a Tenth Part of the second ; and so of the rest. So that the last Leaver F being depressed , will pass a *Space* 100000 greater , and by a Motion, 100000 swifter than the Weight at A .

Thus are we to conceive of all the other Faculties, wherein there is constantly the same Disproportion

portion betwixt the Weight and Power, in respect of the Spaces and Slowness of their Motions, as there is betwixt their several Gravities. If the Power be unto the Weight but as One unto a Hundred, then the Space through which the Weight moves, will be a hundred times less, and consequently the Motion of the Weight a hundred times slower than that of the Power.

So that it is but a vain and impossible Fancy for any one to think that he can move a great Weight with a little Power, in a little Space; but in all these Mechanical Attempts, that Advantage which is gotten in the Strength of the Motion, must be still allowed for the Slowness of it.

Tho' these Contrivances do so extremly increase the Power, yet they do proportionably protract the Time. That which by such Helps one man may do in a hundred Days, may be done by the immediate Strength of a hundred Men in one Day.

C H A P. XVI.

That it is possible to contrive such an Artificial Motion, as shall be of a Slowness proportionable to the Swiftnes of the Heavens.

IT were a pretty Subtilty to enquire after, Whether or no it be not possible to contrive such an Artificial Motion, that should be in such a Proportion slow, as the Heavens are supposed to be swift.

For the exact Resolution of which, it would be requisite that we should first pitch upon some *Medium*, or indifferent Motion, by the Distance from which, we may judge of the Proportions on either side, whether Slowness, or Swiftnes. Now, because there is not any such *Natural Medium*, which may

may be absolutely filed an indifferent Motion, but that the Swiftneſs and Slowneſs of every thing is ſtill proportioned either to the Quantity of Bodies in which they are, or ſome other particular End for which they are deſigned; therefore we muſt take Liberty to ſuppoſe ſuch a Motion; and this we may conceive to be about 1000 Paces, or a Mile in an Hour.

The Starry Heaven, or 8th Sphere is thought to move 42398437 Miles in the ſame Space: So that if it may be demonſtrated that it is poſſible to contrive ſuch a Motion, which going on in a conſtant direct Courſe, ſhall paſs but the 42398437 Part of a Mile in an Hour; it will then be evident, that an artificial Motion may be ſlow, in the ſame Proportion as the Heavens are ſwift.

Now it was before manifeſted, that according to the Difference betwixt the Weight and Power, ſo will the Difference be betwixt the Slowneſs or Swiftneſs of their Motions; whence it will follow, that in ſuch an Engine, wherein the Weight ſhall be 42398437 Pounds, and the Power that doth equi-ponderate it, but the 42398437 Part of a Pound (which is eaſie to contrive) in this Engine the Power being ſuppoſed to move with ſuch a Swiftneſs as may be answerable to a Mile an Hour, the Weight will paſs but the 42398437 Part of a Mile in the ſame Space, and ſo conſequently will be proportionably ſlow unto the Swiftneſs of the Heavens.

It is related by our Country-man *I. Dee*, that he and *Cardan* being both together in their Travels, did ſee an Inſtrument which was at firſt ſold for 20 Talents of Gold, wherein there was one Wheel, which conſtantly moving round amongſt the reſt, did not finiſh one Revolution under the Space of Seven thouſand Years.

But if we farther conſider ſuch an Inſtrument of Wheels as was mentioned before in the 14th Chapter, with

Preface to
Euclid.

with which the whole World might be easily moved, we shall then find that the Motion of the Weight by that, must be much more slow, than the Heavens are swif. For tho' we suppose (saith *Stevinus*) the Handle of such an Engine with 12 Wheels to be turned about 4000 Times in an Hour, (which is as often as a Man's Pulse doth beat) yet in 10 Years Space the Weight by this would not be moved above $\frac{1}{255}$ Parts of one Foot, which is nothing near so much as a Hairs breadth. And it could not pass an Inch in 1000000 Years, saith *Mersennus*.

*De stat.
pract.*

*Phenom.
Mechan.
Prop. 11.*

The Truth of which we may more easily conceive, if we consider the Frame and Manner of this 12 wheel'd Engine. Suppose that in each Axis or Nut, there were ten Teeth, and on each Wheel a thousand: Then the Sails of this Engine must be turned a hundred Times, before the first Wheel, (reckoning downward) could be moved round once, and Ten thousand Times before the second Wheel can finish one Revolution, and so through the 12 Wheels, according to this multiplied Proportion.

So that besides the Wonder which there is in the Force of these Mechanical Motions, the extreme Slowness of them is no less admirable. If a Man considers that a Body should remain in such a constant direct Motion, that there could not be one Minute of Time, wherein it did not rid some Space and pass on further, and yet that this Body in many Years together should not move so far as a Hair's Breadth.

Which notwithstanding may evidently appear from the former Instance. For since it is a natural Principle, that there can be no Penetration of Bodies; and since it is supposed, that each of the Parts in this Engine do touch one another in their Superficies; therefore it must necessarily follow, that the Weight

Weight does begin and continue to move with the Power ; and (however it is insensible) yet it is certain there must be such a Motion so extremely slow as is here specified. So full is this Art of rare and incredible Subtilties.

I know it is the Assertion of *Cardan*, *Motus valde tardi, necessario quietes habent intermedias*. Extream slow Motions have necessarily some intermediate Stops and Rests. But this is only said, not proved, and he speaks it from sensible Experiments, which in this case are fallible : Our Senses being very incompetent Judges of the several Proportions, whether Greatness or Littleness, Slowness or Swiftmess, which there may be amongst things in Nature. For ought we know, there may be some *Organical Bodies* as much less than ours, as the Earth is bigger. We see what strange Discoveries of extream minute Bodies, (as Lice, Wheal-worms, Mites, and the like) are made by the *Microscope*, wherein their several Parts (which are altogether invisible to the bare Eye) will distinctly appear : And perhaps there may be other Insects that live upon them as they do upon us. 'Tis certain that our Senses are extremely disproportioned for comprehending the whole Compass and Latitude of Things. And because there may be such difference in the *Motion* as well as in the *Magnitude* of Bodies ; therefore, tho' such extream Slowness may seem altogether impossible to Sense and common Apprehension, yet this can be no sufficient Argument against the Reality of it.

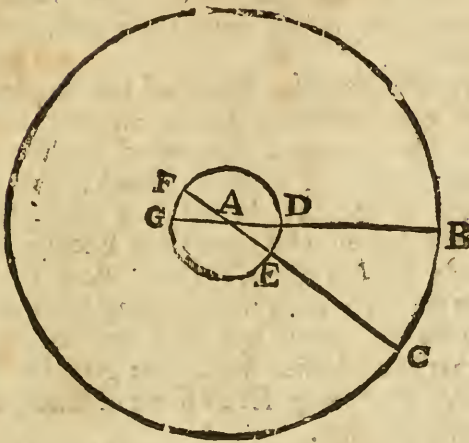
De varietate rerum
l. 9. c. 47.

C H A P. XVII.

Of Swiftneſs: How it may be increaſed to any kind of Proportion. Concerning the great Force of Archimedes his Engines. Of the Balliſta.

BY that which hath been already explained concerning the Slowneſs of Motion, we may the better underſtand the Nature of Swiftneſs, both of them (as is the Nature of Oppoſites) being produced by contrary Cauſes. As the greatneſs of the Weight in reſpect of the Power, and the great diſtance of the Power from the Fulciment in comparison to that of the Weight, does cauſe a ſlow Motion; ſo the greatneſs of the Power above the Weight, and the greater diſtance of the Weight from the Center, in comparison to that of the Power, does cauſe a ſwift Motion.

And as it is poſſible to contrive a Motion unto any kind of Slowneſs, by finding out an answerable Diſproportion betwixt the Weight and Power, ſo likewiſe unto any kind of Swiftneſs: For ſo much as the Weight does exceed the Power, by ſo much will the Motion of the Weight be ſlower, and ſo much as the Power does exceed the Weight, by ſo much will the Motion of the Weight be ſwifter.



In the Diagram set down before, if we suppose *F* to be the place of the Power, and *C* of the Weight, the Point *A* being the Fulciment or Center, then in the same space of time wherein the Power does move from *F* to *G*, the Weight will pass from *C* to *B*. These Distances having the same disproportion unto one another, as there is betwixt *AF* and *AC*, which is supposed to be Quadruple. So that in this Example, the Weight will move four times swifter than the Power; and according as the Power does exceed the Weight in any greater disproportion, so will the swiftness of the Weight be augmented.

Hence may we conceive the Reason of that great Force which there is in Slings, which have so much a greater swiftness than a Stone thrown from the Hand, by how much the end of the Sling is farther off from the Shoulder-Joint, which is the Center of Motion. The Sacred History concerning *David's* Victory over *Goliath*, may sufficiently evidence the force of these. *Vegetius* relates that it was usual this way to strike a Man dead, and beat the Soul out of

1 Sam. 17.
49.

Lipsius Po-
lior. l. 4.
Dialog. 2.

his Body, without so much as breaking his Armour, or fetching Blood. *Membris integris læthale tamen vulnus important, & sine invidia sanguinis, hostis lapidis ictu intereat.*

In the use of these, many of the Ancients have been of very exquisite and admirable Skill. We read of *seven hundred Benjamites Left-handed, that could sling a Stone at a Hair's breadth, and not miss.* And there is the like storied of a whole Nation amongst the *Indians*, who from their Excellency in this Art, were stiled *Baleares*. They were so strict in teaching this Art unto their young ones, *Ut cibum puer à matre non accipit, nisi quem ipsa monstrante percussit*; that the Mother would not give any Meat to her Child, till (being set at some distance) he could hit it with Slings.

Judges 20.
16.

ἀπο τῆς
ἐπιπέδου,
Diodor. Si-
cul. Bibli-
oth. l. 5.
L. Florus
Hist. l. 3.
cap. 8.

Io. Boemus
Aubanus de
morbis
gentium,
l. 3. c. 26.

^a Histor. l. 4.

^b Histor.

Chilios 2.

Histor. 35.

^c Li. 2. c. 3.

^d Marcell-

lus.

^e Histor.

l. 24.

Histor. l. 4.

juxta ini-

sium.

For the farther Illustration of this Subject, concerning the *Swiftness* of Motion, I shall briefly specify some Particulars concerning the Engines of War used by the Ancients. Amongst these, the most famous and admirable were those invented by *Archimedes*; by which he did perform such strange Exploits, as (were they not related by so many and such judicious Authors) would scarce seem credible even to these more Learned Ages. The Acts of that most famous Engineer, are largely set down by ^a *Polybius*, ^b *Tzetzes*, ^c *Proclus*, ^d *Plutarch*, ^e *Livy*, and divers others. From the first of whom alone, we may have sufficient Evidence for the Truth of those Relations: For besides that he is an Author noted to be very grave and serious in his Discourse, and does solemnly promise in one Place that he will relate nothing, but what either he himself was an Eye-witness of, or else what he had received from those that were so: I say, besides all this, it is considerable, that he himself was Born not above Thirty Years after the Siege of *Syracuse*. And afterwards having occasion to tarry some Weeks in that City, when

when he travelled with *Scipio*, he might there perhaps see those Engines himself, or at least take his Information from such as were Eye-witnesses of their force: So that there can be no colourable Preference for any to distrust the Particulars related of them.

In brief, the Sum of their Reports is this: When the *Roman* Forces under the Conduct of *Marcellus*, had laid Siege unto that famous City, (of which, both by their former Successes, and their present Strength, they could not chuse but promise themselves a speedy Victory;) yet the Arts of this one Mathematician, notwithstanding all their Policies and Resolutions, did still beat them back to their great Disadvantage. Whether they were near the Wall, or farther from it, they were still exposed to the force of his Engines; *ἡ μὲν γὰρ ἀφροσύνη, ἡ συνέσις ὄντας, ἡ μόνον ἀπερίκτους παρεσκεύαζε πρὸς τὰς ἰδίας ἐπιβολὰς; ἀλλὰ ἡ δὲ φέρει τὰς πλείους αὐτῶν.* From the Multitude of those Stones and Arrows which he shot against them, was he stiled *ἐκατόγχεις* or *Briareus*. Those Defensive Engines that were made by the *Romans* in the form of Pent-Houses, for to cover the Assailants from the Weapons of the Besieged; these would he presently batter in pieces with great Stones and Blocks. Those high Towers erected in some of the Ships, out of which the *Romans* might more conveniently fight with the Defendants on the Wall, these also were so broken by his Engines, that no Cannon, or other Instrument of Gunpowder, (saith a Learned Man) had they been then in use, could have done greater Mischief. In brief, he did so molest them with his frequent and prodigious Batteries, that the Common Soldiers were utterly discouraged from any hopes of Success.

What was the particular Frame and Manner of these Engines, cannot certainly be determined; but to contrive such as may perform the like strange Effects,

Cal. Rhod. Ant. lect. l. 2. c. 16. Plutem Testudo.

Sir Wair. Raleigh Histor. l. 5. c. 3. S. 16.

Effects, were not very difficult to any one who is thoroughly versed in the Grounds of this Art. Tho' perhaps those of *Archimides* in respect of divers Circumstances, were much more exact and proper for the Purposes to which they were intended, than the Invention of others could be; he himself being so extraordinarily subtle and ingenious above the common sort of Men.

'Tis probable that the general kind of these Engines were the same with those that were used afterwards, amongst the *Romans* and other Nations. These were commonly divided into two sorts; stiled

{ *Ballistæ.*

{ *Catapultæ.*

*Vid. Nau-
deum de
Stud. Mi-
litar. l. 2.*

† Στο τὸ
καὶ ἐπὶ
καλεῖται

καὶ ἐπὶ
καλεῖται

*Fundiba-
lus. Pe-
traria.*

Lib. 3.

Both which Names are sometimes used promiscuously; but according to their Propriety, † *Ballistæ* does signifie an Engine for the shooting of Stones, and *Catapulta* for Darts or Arrows.

The former of these was fitted either to carry divers lesser Stones, or else one greatest one. Some of these Engines made for great Stones, have been proportioned to so vast and immense a Weight, as may seem almost incredible; which occasioned that in *Lucan*,

*At saxum quoties ingenti verberis ictu
Excutitur, qualis rupes quam vertice montis
Abscidit impulsu ventorum adjuncta vetustas,
Frangit cuncta rumes; nec tantum corpora pressa
Exanimat, totos cum sanguine dissipat artus.*

With these they could easily batter down the Walls and Towers of any Fort. So *Ovid*.

*Quam grave ballistæ mania pulsat onus.
And Statius--- Quò turbine bellicæ quondam.*

Librati saliant portarum in claustrâ molares.

*Lipsius Po-
liorcet. l. 3.
Dial. 3.*

The Stones that were cast from these, were of any form, *Enormes & sepulchræles*, Mill-stones, or Tomb-stones. Sometimes for the farther annoyance and

and terror of any Besieged Place, they would by these throw into it dead Bodies, either of Men or Horses, and sometimes only parts of them as Men's Heads.

Athenæus mentions one of these *Ballistæ* that was proportioned unto a Stone of three Talents Weight, each Talent being 120 Pounds (saith *Vitruvius*), so that the whole will amount to 360 Pounds. But it is storied of *Archimedes*, that he cast a Stone into one of *Marcellus* his Ships, which was found to weigh ten Talents. There is some difference amongst * Authors, concerning what kind of Talent this should be understood, but it is certain that in *Plutarch's* Time, (from whom we have this Relation) one Talent did amount to 120 Pounds (saith *Suidas*;) According to which Account, the Stone it self was of no less then twelve hundred pound Weight. A Weapon (one would think) big enough for those Rebel Gyants that fought against the Gods. Now the greatest Cannon in use, does not carry above 64 pound Weight, which is far short of the strength in these Mathematical Contrivances. Amongst the *Turks* indeed, there have been sometimes used such Powder Instruments, as may equal the force of those invented by *Archimedes*. *Gab. Naudæus* tells us of one Bullet shot from them at the Siege of *Constantinople*, which was of above 1200 pound Weight; This he affirms from the Relation of an Archbishop, who was then present, and did see it; the Piece could not be drawn by less then a hundred and fifty Yoak of Oxen, which might almost have served to draw away the Town it self. But though there hath been perhaps some one or two Cannons of such a prodigious Magnitude, yet it is certain that the biggest in common Use, does come far short of that Strength which was ordinarily in these Mechanical Engines.

*Deipno-
soph. l. 5.*

*Archit. l.
10. c. ult.
λίτρν δέ-
κατάλα-
τον.*
*Plut. Mar-
cell.*
** Dav. Ri-
vultus Com-
men. in Ar-
chim. Oper.
Ext.*

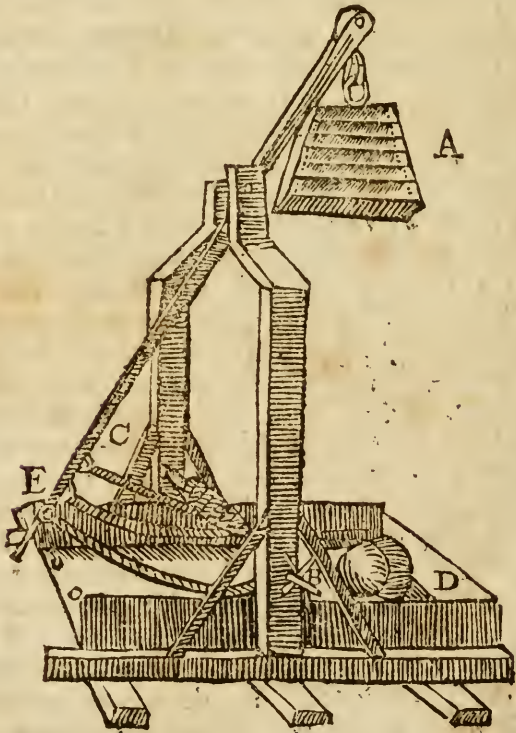
*Naudæus
de studio.
Mil. l. 2.*

*De Stud.
Mil. l. 2.*

See Rob.
Valteurius
de re Milit.
 l. 10. c. 4.

There are divers Figures of these *Ballistæ*, set out by *Vegetius*, *Lipsius*, and others; but being without any Explication, it is not very facil to discover in what their Forces did consist

I have here expressed one of them most easy to be apprehended; from the Understanding of which, you may the better guess at the Nature of the rest.



That great Box or Cavity at *A*, is supposed to be full of some heavy Weight, and is forced up by the turning of the Axis and Spokes *B C*. The Stone or Bullet to be discharged, being in a kind of Sling at

at *D*; which when the greater Weight *A* descends, will be violently whirled upwards, till that end of the Sling at *E*, coming to the Top will fly off, and discharge the Stone as the skilful Artist should direct it.

CHAP. XVIII.

Concerning the Catapultæ, or Engines for Arrows.

THE other kind of Engine was called *Catapulta*, In Greek *καταπέλτις*, which signifies a Spear or Dart, because it was used for the Shooting off such Weapons: Some of these were proportioned unto Spears of twelve Cubits long; they did carry with so great a Force, *ut interdum nimio ardore scintillant*, (saith *Am- mianus*) that the Weapons discharged from them were sometimes (if you can believe it) set on Fire by the swiftness of their Motion.

In Greek
*καταπέλ-
τις.*
Athenens.
Deipnos.
l. 5.
Lib. 23.
*Lipsius Po-
liorcet. l. 3.*
Dial. 2.

The first Invention of these is commonly ascribed to *Dionysius* the younger, who is said to have made them amongst his other Preparations against *Carthage*. But we have good Reason to think them of more ancient Use, because we read in Scripture, That *Uzziah* made in *Jerusalem* Engines invented by cunning Men to shoot Arrows and great Stones withal; though it is likely these Inventions were much bettered by the Experience of after Ages.

Diod. Sicul.
Biblioth.
l. 14.
Sardus de
Invent. Re-
rum. l. 2.
2 Chron.
26. 15.

The usual Form of these *Catapultæ*, was much after the manner of great Bows placed on Carriages, and wound up by the Strength of several Persons. And from that great Force which we find in lesser Bows, we may easily guess at the greater Power of these other Engines. 'Tis related of the *Turkish* Bow, that it can strike an Arrow through a piece of Steel

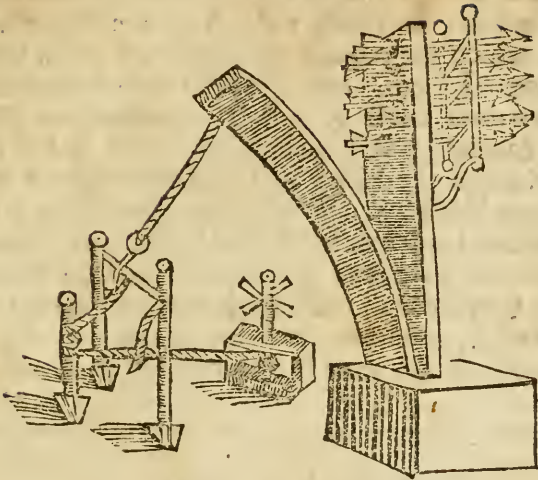
Sir Fran-
Bacon.
Nat. Hist.
Exp. 704.

or Brass two Inches thick, and being headed only with Wood, it pierces Timber of eight Inches. Which though it may seem incredible, yet it is attested by the Experience of divers unquestionable Witnesses: *Barclay* in his *Icon animorum*, a Man of sufficient Credit, affirms that he was an Eye-witness, how one of these Bows with a little Arrow did pierce through a piece of Steel three Fingers thick. And yet these Bows being somewhat like the long Bows in use amongst us, were bent only by a Man's immediate Strength, without the help of any Bender or Rack that are used to others.

Some *Turkish* Bows are of that Strength, as to pierce a Plank of six Inches in thickness, (I speak what I have seen) saith *M. Jo. Greaves* in his *Pyramodographia*. How much greater Force then may we conceive to be impressed by the *Catapultæ*?

These were sometimes framed for the discharging of two or three Arrows together, so that each of them might be directed unto a several Aim. But it were as easy to contrive them after the like manner for the Carriage of twenty Arrows, or more; as in this Figure.

Both



Both these kinds of Engines, when they were used at the Siege of any City, were commonly carried in a great wooden Turret (first invented by *Demetrius.) It was driven upon four Wheels at the bottom, each of its Sides being forty five Cubits, its Height ninety. The whole was divided in nine several Partitions, every one of which did contain divers Engines for Battery: From its Use in the battering and taking of Cities it is styled by the Name of *Helepolis*.

He that would be informed in the nature of Bows, let him consult *Mersennus de Ballistica & Acontismologia*, where there are divers subtile Enquiries and Demonstrations, concerning the Strength required to the bending of them to any Distance. The Force they have in the Discharge, according to several Bents, the Strength required to be in the String of them, the several Proportions of Swiftnes and Distance in an Arrow shot Vertically, or Horizontally, or Transversally.

*Who was therefore styled *Pollorces*. This kind of Turret was first used at the Siege of *Cyprus*, & is thus described by *Diodorus Sicul. Biblioth. l. 20.*

Those

Those strange Effects of the *Turkish Bow* (mentioned before) so much exceeding the Force of others, which yet require far greater Strength for the Bending of them, may probably be ascribed either to the natural cause of *Attraction by similitude of Substance* (as the *Lord Bacon* Conjectures:) For in these Experiments the Head of the Arrow should be of the same Substance (whether Steel or Wood) with that which it pierces: Or else to that *just Proportion* betwixt the weight of the Arrow, and the strength of the Bow, which must needs much conduce to the Force of it, and may perhaps be more exactly discovered in these, than it is commonly in others.

C H A P. XIX.

A Comparison betwixt these ancient Engines, and the Gunpowder Instruments now in Use.

IT shall not be altogether Impertinent to enquire somewhat concerning the Advantages and Disadvantages betwixt those Military offensive Engines used amongst the Ancients, and those of these later Ages.

In which Enquiry there are two Particulars to be chiefly examined.

1. The Force of these several Contrivances, or the utmost that may be done by them.

2. Their Price, or the greatness of the Charges required unto them.

1. As for the Force of these ancient Inventions, it may sufficiently appear from those many credible Relations mentioned before; to which may be added that in *Josephus*, which he sets down from his own Eye-sight, being himself a chief Captain at the Siege of *Jotapata*, where these Events happened. He tells

us that besides the multitude of Persons, who were slain by these *Roman Engines*, being not able to avoid their Force, by reason they were placed so far off, and out of Sight; besides this, they did also carry such great Stones, with so great a Violence, that they did therewith batter down their Walls and Towers. A great Bellied Woman walking about the City in the Day-time, had her Child struck out of her Womb, and carried half a Furlong from her. A Soldier standing by his Captain *Josephus*, on the Wall, had his Head struck off by another Stone sent from these *Roman Engines*, and his Brains carried three Furlongs off.

To this purpose *Cardan* relates out of *Ammianus Marcellinus*. *Tanto impetu fertur lapis ut uno viso lapide quamvis intacti barbari fuerint ab eo, destiterunt à pugna & abierunt.* Many foreign People being so amazed at the strange force of these Engines, that they durst not contest with those who were Masters of such Inventions. 'Tis frequently asserted, that Bullets have been melted in the Air, by that Extremity of violent Motion imprest from these Slings.

Fundaque contorto transverberat aëra plumbo,

Et mediis liquidæ glandes in nubibus errant.

So *Lucan*, speaking of the same Engines.

Inde faces & saxa volant, spatioque solutæ

Aeris & calidæ liquefactæ pondere glandes.

Which Relations, though they may seem somewhat Poetical and Improbable, yet *Aristotle* himself (*De celo lib. 2. c. 7.*) doth suppose them as unquestionable. From whence it may be inferred, that the force of these Engines does rather exceed than come short of our Gunpowder Inventions.

Add to this that Opinion of a Learned Man (which I cited before) that *Archimedes* in the Siege of *Syracuse* did more mischief with his Engines, than could have been wrought by any Cannons, had they been then in Use.

De variet.
l. 12. c. 58.

Sir Walt.
Raleigh.

Hist. l. 5.
c. 3. Sect.
16.

See *Lipsius*
de militia
Romanâ.

l. 5.
In

In this perhaps there may be some Disadvantage, because these Mathematical Engines cannot be so easily and speedily wound up, and so certainly levelled as the other may.

2. As for the Price or Charges of both these, it may be considered under three Particulars :

1. Their making.
2. Their Carriage or Conveyance.
3. Their Charge and Discharging.

In all which respects, the Cannons now in Use, are of much greater Cost than these other Inventions.

1. The Making or Price of these Gun-powder Instruments is extremely Expensive, as may be easily judged by the weight of their Materials. A whole Cannon weighing commonly 8000 *l.* a half Cannon 5000, a Culverin 4500, a Demiculverin 3000 ; which whether it be in Iron or Brass, must needs be very Costly, only for the Matter of them ; besides the farther Charges required for the Form and Making of them, which in the whole must needs amount to several hundred Pounds. Whereas these Mathematical Inventions consisting chiefly of Timber, and Cords, may be much more cheaply made ; The several degrees of them which shall answer in proportion to the Strength of those other, being at the least ten times Cheaper ; that is, ten Engines that shall be of equal force either to a Cannon or Demicannon, Culverin or Demiculverin, may be framed at the same Price that one of these will amount to : So that in this respect there is a great Inequality.

2. As for their Carriage or Conveyance ; a whole Cannon does require at the least 90 Men, or 16 Horses, for the Draught of it ; a half Cannon 56 Men, or 9 Horses ; a Culverin 50 Men, or 8 Horses ; a Demiculverin 36 Men, or 7 Horses ; Supposing the Way to be hard and plain, in which notwithstanding the Motion will be very slow. But if the
Passage

Passgae prove rising and steep, or rotten and dirty, then they will require a much greater Strength and Charge for the conveyance of them. Whereas these other Inventions are in themselves more light (if there be occasion for the Draught of them) being easily taken asunder into several Parts. And besides, their Materials are to be found every where, so that they need not be carried up and down at all, but may be easily made in the Place where they are to be used.

3. The Materials required to the Charging of these Gun-powder Instruments, are very Costly. A whole Cannon requiring for every Charge 40 Pound of Powder, and a Bullet of 64 Pounds; a half Cannon 18 Pound of Powder, and a Bullet of 24 Pounds; a Culverin 16 Pounds of Powder, and a Bullet of 19 Pounds; a Demiculverin 9 Pounds of Powder, and a Bullet of 12 Pounds: Whereas those other Engines may be charged only with Stones, or (which may serve for Terror) with dead Bodies, or any such Materials as every Place will afford without any Cost.

So then, put all these together: If it be so that those ancient Inventions did not come short of these other in regard of Force, and if they do so much excel them in divers other Respects; it should seem then, that they are much more Commodious then these latter Inventions, and should be preferred before them. But this Enquiry cannot be fully determined without particulat Experience of both.

C H A P. XX.

That it is possible to contrive such an Artificial Motion, as may be equally swift with the supposed Motion of the Heavens.

FOR the Conclusion of this Discourse, I shall briefly Examine (as before concerning Slowness) whether it be possible to contrive such an Artificial Motion, as may be equal unto the supposed swiftness of the Heavens. This Question hath been formerly proposed and answered by *Cardan*, where he applies it unto the swiftness of the Moon's Orb; but that Orb being the lowest of all, and consequently of a dull and sluggish Motion, in comparison to the rest; therefore it will perhaps be more convenient to understand the Question concerning the eighth Sphere, or starry Heaven.

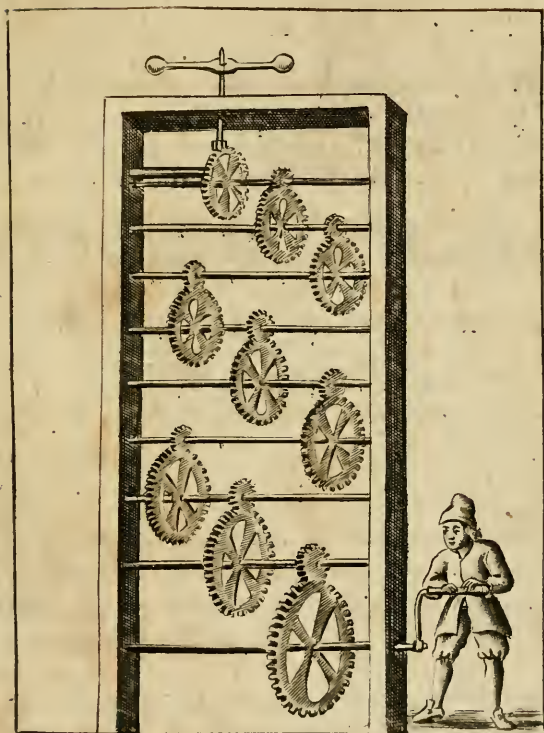
For the true Resolution of this, it should be first observed, that a material Substance is altogether incapable of so great a Celerity, as is usually ascribed to the Celestial Orbs, (as I have proved elsewhere) and therefore the Quære is not to be understood of any real and experimental, but only Notional, and Geometrical Contrivance.

Now that the swiftness of Motion may be thus increased according to any conceivable Proportion, will be manifest from what hath been formerly delivered concerning the Grounds and Nature of Slowness and Swiftness. For according as we shall suppose the Power to exceed the Weight: So may the Motion of the Weight be swifter than that of the Power.

But to answer more particularly: Let us imagine every Wheel in this following Figure to have a hundred Teeth in it, and every Nut ten:

*De Variet.
Revin l. 9.
c. 47.*

The Earth
a Planet,
Prop. 9.



It may then be evident, that one Revolution of the first Wheel, will turn the Nut, and consequently the second Wheel on the same Axis ten times, the third Wheel a hundred times, the fourth a thousand times, the fifth 10000, the sixth a hundred thousand times, the seventh 1000000 times, the eighth 10000000 times, the ninth 100000000 times, the Sails 1000000000 times: So that if we suppose the compass of these Sails to be five Foot, or one Pace: And that the first Wheel is turned about after the rate of one thousand times in an Hour: It will then be evident, that the Sails shall be turned 1000000000000 times,

times, and consequently shall pass 100000000 Miles in the same space. Whereas a Star in the Æquator (according to common *Hypothesis*) does move but 42398437 Miles in an Hour: And therefore it is evident that 'tis possible Geometrically to contrive such an Artificial Motion, as shall be of greater swiftness then the supposed Revolutions of the Heavens.

I have been told that the Revolutions of the
 Heavens are such, that they will last
 for ever, and that they are not
 to be measured by any
 finite time. But I think
 that they are to be measured
 by a finite time, and that
 they will last for a certain
 number of years. I think
 that they will last for
 a certain number of years,
 and that they will last
 for a certain number of years.
 D E D A

D Æ D A L U S :

O R,

Mechanical Motions.

The Second Book.

C H A P. I.

The divers kinds of Automata, or Self-movers. Of Mills, and the Contrivance of several Motions by rarify'd Air. A brief Digression concerning Wind-Guns.

AMongst the Variety of Artificial Motions, those are of most Use and Pleasure, in which, by the Application of some continued Strength, there is bestowed a regular and lasting Motion.

These we call the *αὐτόματα*; or *Self-movers*; Which Name, in its utmost Latitude, is sometimes ascribed unto those Motions, that are contrived from the Strength of Living Creatures, as Chariots, Carts, &c. But in its Strictness and Propriety, it is only applicable unto such Inventions, wherein the Motion is caused either by something that belongs unto its own Frame, or else by some External Inanimate Agent.

Whence these *ἀντιματα* are easily distinguishable into Two sorts :

1. Those that are moved by something which is extrinſical unto their own Frame ; as Mills, by Water or Wind.

2. Those that receive their Motion from something that does belong to the Frame it self ; as Clocks, Watches, by Weights, Springs, or the like.

Of both which sorts, there have been many excellent Inventions : In the Recital of them, I shall insist chiefly on such as are most eminent for their Rarity and Subtilty.

Amongst the *ἀντιματα* that receive their Motion from some external Agent, those of more common use are Mills.

And first, the Water-Mills ; which are thought to be before the other, tho' neither the first Author, nor so much as the Time wherein they were invented is fully known. And therefore *Polydore Virgil* refers them amongst other fatherless Inventions. *Pliny* indeed doth mention them, as being commonly used in his time ; and yet others affirm, that *Beilifarius*, in the Reign of *Justinian*, did first invent them : Whence *Pancirollus* concludes, that it is likely their Use was for some Space intermitted, and being afterwards renewed again, they were then thought to be first discovered.

However, 'tis certain that this Invention hath much abridged and advantaged the Labours of Men, who were before condemned unto this Slavery, as now unto the Gallies. And as the Force of Waters hath been useful for this, so likewise may it be contrived to divers other Purposes. Herein doth the Skill of an Artificer chiefly consist, in the Application of these common Motions unto various and beneficial Ends ; making them serviceable, not only
for

*De invent.
rerum, l. 3.
c. 18.*

*Nat. Hist.
l. 18. c. 10.*

*De Reper.
Tit. 22.*

*Ad Pisit.
num.*

for the Grinding of Corn, but for the preparing of Iron, or other Oar; the making of Paper, the elevating of Water, or the like.

To this purpose also are the Mills that are driven by Wind, which are so much more convenient than the other, by how much their Situations may be more easie and common. The Motions of these may likewise be accommodated to as various Uses as the other; there being scarce any Labour, to the Performance of which, an ingenious Artificer cannot apply them. To the Sawing of Timber, the Plowing of Land, or any other the like Service, which cannot be dispatched the ordinary Way, without much Toil and Tedioufness. And it is a wonderful thing to consider, how much Men's Labours might be eased and contracted in sundry Particulars, if such as were well skilled in the Principles and Practices of these Mechanical Experiments, would but thoroughly apply their Studies unto the Enlargement of such Inventions.

There are some other Motions by Wind or Air, which (tho' they are not so common as the other, yet) may prove of excellent Curiosity, and singular Use. Such was that Musical Instrument invented by *Cornelius Dreble*; which being set in the Sunshine, would of it self render a soft and pleasant Harmony; but being removed into the Shade, would presently become silent. The Reason of it was this: The Warmth of the Sun working upon some Moisture within it, and rarifying the inward Air unto so great an Extension that it must needs seek for Vent or Issue, did thereby give several Motions unto the Instrument.

Somewhat of this Nature are the *Aeolipiles*, which are Concave Vessels, consisting of some such Material as may endure the Fire, having a small Hole, at which they are filled with Water, and out of which (when the Vessels are heated) the Air doth

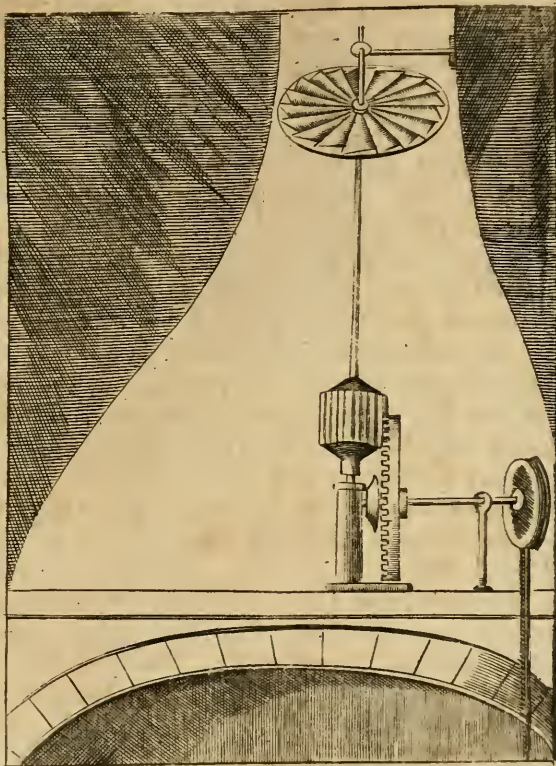
*Marcell.
Frank-
hein. Epist.
ad Job.
Ernestum.
Like that
Statue of
Memnon,
in Egypt,]
which
makes a
strange
noise
whenever
the Sun
begins to
shine up-
on it.
Tacit. An-
nal. 2.
Strabo af-
firms, that
he had
both seen
and heard
it.*

doth issue forth with a strong and lasting Violence. These are frequently used for the exciting and contracting of Heat in the melting of Glasses, or Metals: They may also be contrived to be serviceable for sundry other pleasant Uses; as for the moving of Sails in a Chimney-corner; the Motion of which Sails may be applied to the Turning of a Spit, or the like.

*De Variet.
Rerum,
l. 12. c. 58.*

But there is a better Invention to this purpose, mentioned in *Cardan*, whereby a Spit may be turned (without the Help of Weights) by the Motion of the Air that ascends the Chimney; and it may be useful for the Roasting of many, or great Joints: For as the Fire must be increased according to the Quantity of Meat, so the Force of the Instrument will be augmented proportionably to the Fire. In which Contrivance, there are these Conveniences above the Jacks of ordinary Use:

1. It makes little or no Noise in the Motion.
2. It needs no winding up, but will constantly move of it self, while there is any Fire to rarify the Air.
3. It is much cheaper than the other Instruments that are commonly used to this purpose; there being required unto it only a pair of Sails, which must be placed in that part of the Chimney where it begins to be straitned; and one Wheel, to the Axis of which the Spit-line must be fastned, according to this following Diagram.



The Motion of these Sails may likewise be serviceable for sundry other Purposes, besides the turning of a Spit ; for the Chiming of Bells , or other musical Devices ; and there cannot be any more pleasant Contrivance for continual and cheap Musick. It may be useful also for the Reeling of Yarn, the Rocking of a Cradle, with divers the like domestick Occasions. For (as was said before) any constant Motion being given, it is easie for an ingenious Artificer to apply it unto various Services.

These Sails will always move both Day and Night, if there is but any Fire under them , and sometimes

though there be none. For, if the Air without be much colder than that within the Room, then must this which is more warm and rarified, naturally ascend through the Chimney, to give Place unto the more condensed and heavy, which does usually blow in at every Chink or Cranny, as Experience shews.

Unto this kind of Motion may be reduced all those Representations of living Creatures, whether Birds, or Beasts, invented by *Ctesibius*, which were for the most part performed by the Motion of Air, being forced up either by *Rarefaction*, with Fire, or else by *Compression*, through the Fall of some heavier Body, as Water, which by possessing the Place of the Air, did thereby drive it to seek for some other Vent.

I cannot here omit (tho' it be not altogether so pertinent) to mention that late ingenious Invention of the Wind-gun, which is charged by the forcible Compression of Air, being injected through a Syringe; the Strife and Distention of the imprisoned Air, serving by the Help of little Falls or Shuts within; to stop and keep close the Vents by which it was admitted. The Force of it in the Discharge is almost equal to our Powder-guns. I have found upon frequent Trials (saith *Mersennus*) that a leaden Bullet Shor from one of these Guns against a stone Wall, the Space of 24 Paces from it, will be beaten into a thin Plate. It would be a considerable Addition to this Experiment, which the same Author mentions a little after, whereby he will make the same Charge of Air to serve for the Discharge of several Arrows or Bullets after one another, by giving the Air only so much Room, as may immediately serve to impress a Violence in sending away the Arrow or Bullet, and then screwing it down again to its former Confinement, to fit it for another Shooting. But against this there may be many considerable

siderable Doubts, which I cannot stand to discuss.

CHAP. II.

Of a Sailing Chariot, that may without Horses be driven on the Land by the Wind, as Ships are on the Sea.

THE Force of Wind in the Motion of Sails may be applied also to the driving of a Chariot, by which a Man may sail on the Land, as well as by a Ship on the Water. - The Labour of Horses or other Beasts, which are usually applied to this Purpose, being artificially supplied by the Strength of Winds.

That such Chariots are commonly used in the Champion Plains of *China*, is frequently affirmed by divers credible Authors. *Boterus* mentions that they have been tried also in *Spain*, tho' with what Success he doth not specify. But above all other Experiments to this Purpose, that sailing Chariot at *Scceveling* in *Holland*, is more eminently remarkable. It was made by the Direction of *Stephinus*, and is celebrated by many Authors. * *Walchius* affirms it to be of so great a Swiftness for its Motion, and yet of so great a Capacity for its Burden: *Ut in medio freto secundis ventis commissas naves, velocitate multis parasangis post se relinquat, & paucarum horarum spatio, viginti aut triginta milliaria Germanica continuo cursu emeriat, concreditosque sibi plus minus vectores sex aut decem, in petitum locum transferat, facillimo illius ad clavum qui sedet nutu, quaque versum minimo labore velis commissum, mirabile hoc continentis currus navigium dirigentis.* That it did far exceed the Speed of any Ship, though we should suppose it to be carried in

De incremento Urbium l. 1. c. 10.

* *Fabularum decas, Fab. 9.*

the open Sea with never so prosperous Wind : And that in some few Hours Space it would convey Six or Ten Persons, 20 or 30 German Miles, and all this with very little Labour of him that sitteth at the Stern, who may easily guide the Course of it as he pleaseth.

That eminent inquisitive Man *Peireskius*, having travelled to *Scaveling* for the Sight and Experience of this Chariot, would frequently after with much Wonder mention the extream Swiftnes of its Motion. *Commemorare solebat stuporem quo correptus fuerat cum vento translatus citatissimo non persentiscere tamen, nempe tam citus erat quam ventus.* Though the Wind were in it self very swift and strong, yet to Passengers in this Chariot it would not be at all discernible, because they did go with an equal Swiftnes to the Wind it self: Men that ran before it seeming to go backwards, Things which seem at a great Distance being presently overtaken and left behind. In two Hours Space it would pass from *Scaveling* to *Putten*, which are distant from one another above 14 *Horaria Milliaria*, (saith the same Author), that is, more than Two and forty Miles.

Grotius is very copious and elegant in the celebrating of this Invention, and the Author of it in divers Epigrams.

*Ventivolum Tiphys deduxit in æquora navim,
Jupiter in stellas, æthereamque domum.
In terrestre solum virtus Stevinia, nam nec
Tiphy tuum fuerat, nec Jovis istud opus.*

And in another Place,

*Imposuit plastro vectantem carbasa, malum
An potius navi, subdidit ille rotas?
— Scandit aquas navis currus ruit aere prono,
Et merito dicas hic volat, illa natat.*

These Relations did at the first seem unto me, (and per-

*Pet. Gas-
sendus. Vi-
ta Peires-
kii, l. 2.*

*Grotii Po-
emata, Ep.
19.*

Ep. 5.

perhaps they will so to others) somewhat strange & incredible. But upon farther Enquiry, I have heard them frequently attested from the particular Eye-sight and Experience of such eminent Persons, whose Names I dare not cite in a Business of this Nature, which in those Parts is so very common, and little observed.

I have not met with any Author who doth treat particularly concerning the Manner of framing this Chariot, tho' *Grotius* mentions an elegant Description of it in Copper by one *Geynius*: And *Hendius* in one of his large Maps of *Asia*, does give another conjectural Description of the like Chariots used in *China*.

Epig. 20.
& 21.

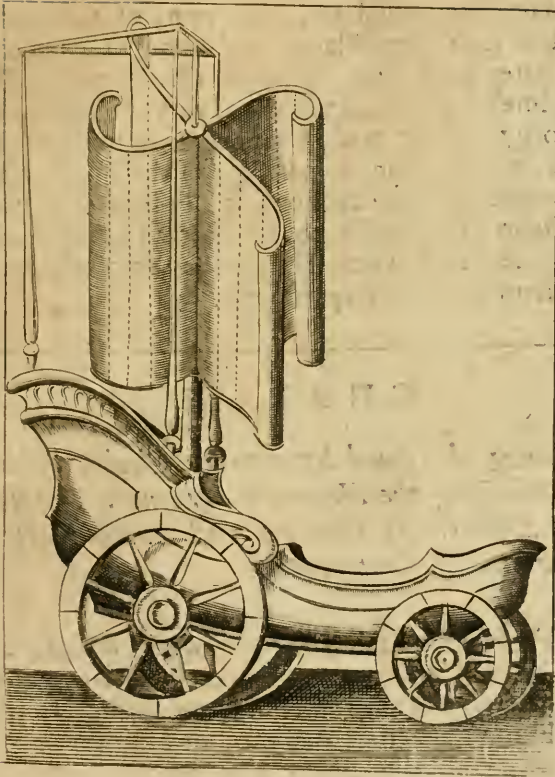
The Form of it is related to be very simple and plain, after this manner.



The Body of it being somewhat like a Boat, moving upon 4 Wheels of an equal Bigness, with two Sails like those in a Ship; there being some Contrivance to turn and steer it, by moving a Rudder which is placed beyond the two hindmost Wheels; and for the stopping of it, this must be done, either by letting down the Sail, or turning it from the Wind.

Of this kind they have frequently in *Holland* other little Vessels for one or two Persons to go upon the Ice, having Sledges instead of Wheels, being driven with a Sail; the Bodies of them like little Boats, that if the Ice should break, they might yet safely carry a Man upon the Water, where the Sail would be still useful for the Motion of it.

I have often thought that it would be worth the Experiment to enquire, whether or no such a sailing Chariot might not be more conveniently framed with moveable Sails, whose Force may be imprest from their Motion, equivalent to those in a Wind-mill. Their foremost Wheels (as in other Chariots) for the greater Facility, being somewhat lower than the other, answerable to this Figure.



In which the Sails are so contrived, that the Wind from any Coast will have a Force upon them to turn them about ; and the Motion of these Sails must needs turn the Wheels, and consequently carry on the Chariot it self to any Place (though fully against the Wind) whither it shall be directed.

The chief doubt will be, whether in such a Contrivance, every little Ruggedness or Unevenness of the Ground, will not cause such a jolting of the Chariot, as to hinder the Motion of its Sails. But this perhaps (if it should prove so) is capable of several Remedies.

I have

I have often wondred, why none of our Gentry who live near great Plains, and smooth Champions, have attempted any thing to this Purpose. The Experiments of this kind being very pleasant, and not costly: What could be more delightful, or better Husbandry, than to make use of the Wind (which costs nothing, and eats nothing) instead of Horses? This being very easie to be effected by those, the Convenience of whose Habitations doth accommodate them for such Experiments.

C H A P. III.

Concerning the fixed Automata, Clocks, Spheres, representing the Heavenly Motions: The several Excellencies that are most commendable in such kind of Contrivances.

THe second kind of *αὐτόματα* were described to be such Engines, as did receive a Regular and lasting Motion from something belonging to their own Frame, whether Weights, or Springs, &c.

They are usually distinguished into *αὐτόματα*

{ *στατά*, fixed and stationary.

{ *κινούμενα*, moveable and transient.

i. The fixed are such as move only according to their several Parts, and not according to their whole Frame; in which, though each Wheel hath a distinct Rotation, yet the whole doth still remain unmoved. The chiefest Kind of these are the Clocks and Watches in ordinary use; the framing of which is so commonly known by every Mechanick, that I shall not trouble the Reader with any Explication of it. He that desires fuller Satisfaction, may see them particularly described by * *Cardan*, † *D. Flood*, and others.

* *De Vari-
et. Rec.* l. 9.

c. 47.

† *Tract.* 2.

part. 7. l.

1. cap. 4.

The first Invention of these (saith *Pancirollus*) was taken from that Experiment in the Multiplication of Wheels, mentioned in *Vitruvius*, where he speaks of an Instrument, whereby a Man may know how many Miles or Paces he doth go in any space of Time, whether or no he do pass by Water in a Boat, or Ship, or by Land in a Chariot, or Coach: They have been contrived also into little Pocket-Instruments, by which, after a Man hath walked a whole Day together, he may easily know how many Steps he hath taken. I forbear to enter upon a larger Explication of these kind of Engines, because they are impertinent unto the chief Business that I have proposed for this Discourse. The Reader may see them more particularly described in the above-cited Place of *Vitruvius*, in * *Cardan*, † *Bessonius*, and others; I have here only mentioned them, as being the first occasion of the chiefest ἀντίματα, that are now in Use.

Repert. Tit.
10.
Architect.
l. 10. c. 14.

* *Subtil.*
l. 18.
† *Theatrum*
instrumentorum.
Wecker de
secretis. l.
15. c. 32.

Of the same kind with our Clocks and Watches (though perhaps more Elaborate, and Subtle) was that Sphere invented by *Archimedes*, which did represent the Heavenly Motions: The Diurnal, and Annual Courses of the Sun, the Changes, and Aspects of the Moon, &c. This is frequently celebrated in the Writings of the Ancients, particularly in that known *Epigram* of *Claudian*:

Mentioned by *Cicero. Tuscul. Quæst.*
l. 1. item
De Nat. Deorum
l. 2.

Jupiter in parvo cum cerneret æthera vitro,
Risit, & ad superos talia dicta dedit;
Huccine mortalis progressa potentia curæ?
Fam meus in fragili luditur orbe labor.
Jura poli, rerumque fidem, legesque Deorum,
Ecce Syracusius transtulit arte senex.
*Inclusus variis famulatur * spiritus astris,*
Et vivum certis motibus urget opus.
Percurrit proprium mentitus Signifer annum;
Et simulata novo Cynthia mense redit.

* The secret force from which the Motion was impressed.

Famq;

*Famq; suum volvens audax industria mundum
Gaudet, & humanâ sidera mente regit.
Quid falso insontem tonitru Salmonea miror?
Amula naturæ parva reperta manus.*

Excellently Translated by T. Randolph.

Howe saw the Heavens fram'd in a little Glass,
And Laughing, to the Gods these Words did pass;
Comes then the Power of mortal Cares so far?
In brittle Orbs my Labours acted are.
The Statutes of the Poles, the Faith of Things,
The Laws of Gods, this *Syracusan* brings
Hither by Art: Spirits inclos'd attend
Their severall Spheres, and with set Motions bend
The living Work: Each Year the feigned Sun,
Each Month returns the counterfeited Moon.
And viewing now her World, bold Industry
Grows Proud, to know the Heavens his Subjects be.
Believe, *Salmoneus* hath false Thunders thrown,
For a poor Hand is Nature's Rival grown.

*Instit. l. 2.
c. 5.*

*Antiq. lect.
l. 2. c. 16.*

*Guid Ubal-
dus præf.
ad Mechan.*

*Collect.
Mathem.
Proæm. ad
l. 8.*

But, that this Engine should be made of Glass, is scarce credible. *Lactantius*, mentioning the Relation of it, affirms it to consist of Brass, which is more likely. It may be the Outside, or Case was Glass, and the Frame it self of Brass. *Cælius Rhodoginus*, speaking of the wondrous Art in the contrivance of this Sphere, breaks out into this Quære. *Nonne igitur miraculorum omnium, maximum miraculum est homo?* He might have said *Mathematicus*: And another to this purpose, *Sic manus ejus naturam, ut natura ipsa manum imitata putetur.* *Pappus* tells us, that *Archimedes* writ a Book *de Sphæropœia*, concerning the manner of framing such Engines; and after him, *Possidonius* compos'd another Discourse on the same Subject; though now either the Ignorance, or the Envy of Time hath deprived us of both those Works.

And

And yet the Art it self is not quite perished, for we read of divers the like Contrivances in these latter Times. *Agrippa* affirms, that he himself had seen such a Sphere; and *Ramus* tells us how he beheld two of them in *Paris*, the one brought thither amongst other Spoils from *Sicily*, and the other out of *Germany*. And it is commonly reported, that there is yet such a Sphere at *Strasburg* in *Germany*. * *Rivaltus* relates how *Marinus Burgesius* a *Norman* made two of them in *France* for the King. And perhaps these latter (saith he) were more Exact than the former, because the Heavenly Revolutions are now much better understood than before. And besides it is questionable, whether the use of Steel-springs was known in those ancient Times; the Application of which unto these kind of Spheres, must needs be much more convenient than Weights.

*De vanit. Scient. c. 22. Schol. Mathem. l. 1. So. Cardan too, l. 17. Monanthan Mecha. Ar. rift. Com. c. 1. Dr. Hackwell, Apol. l. 3. c. 10. sect. 1. * De vita Archimedis.*

'Tis related also of the Consul *Boethius*, that amongst other Mathematical Contrivances, (for which he was Famous) he made a Sphere to represent the Sun's Motion; which was so much admired, and talked of in those Times, that *Gundibaldus*, King of *Burgundy*, did purposely send over Ambassadors to *Theodoricus* the Emperor, with Intreaties that he would be a means to procure one of these Spheres from *Boethius*; the Emperor thinking hereby to make his Kingdom more Famous and Terrible unto foreign Nations, doth write an Epistle to *Boethius*, perswading him to send this Instrument. *Quoties non sunt credituri quod viderint? Quoties hanc veritatem lusoria somnia putabunt? Et quanto fuerint à stupore conversi, non audebunt se æquales nobis dicere, apud quos sciunt sapientes talia cogitasse.* So much were all these kind of Inventions admired in those ruder and darker Times: Whereas the Instruments that are now in Use amongst us (though not so much Extolled) yet do altogether equal (if not exceed) the other, both in Usefulness and Subtilty. The chiefest of these former

Cassiodor. Chron. Pet. Bertius pref. ad Consolat. Philos.

*Polyd. Vir-
gil. de In-
vent. rerum
l. 2. c. 5.
Cardan
Subtil.*

former Engines receiving their Motion from Weights, and not from Springs, (which as I said before) are of later and more excellent Invention.

The particular Circumstances, for which the *Automata* of this kind are most eminent, may be reduced to these four.

1. The lastingness of their Motion, without needing of any new supply; for which purpose there have been some Watches contrived to continue without winding up for a Week together, or longer.

2. The easiness and simplicity of their Composition; Art it self being but the facilitating and contracting of ordinary Operations; therefore the more easy and compendious such Inventions are, the more artificial should they be esteemed. And the addition of any such unnecessary Parts, as may be supplied some other way, is a sure sign of Unskilfulness and Ignorance. Those antiquated Engines that did consist of such a needless multitude of Wheels, and Springs, and Screws, (like the old *Hypothesis* of the Heavens) may be compared to the Notions of a confused Knowledge, which are always full of Perplexity and Complications, and seldom in Order; whereas the Inventions of Art are more regular, simple, and perspicuous, like the apprehensions of a distinct and thoroughly-informed Judgment. In this respect the manner of framing the ordinary *Automata*, hath been much bettered in these later Times above the former, and shall hereafter perhaps be yet more advantaged. These kind of Experiments (like all other human Arts) receiving Additions from every Days Experiment.

To this purpose there is an Invention consisting only of one hollow Orb or Wheel, whereby the Hours may be as truly distinguished, as by any ordinary Clock or Watch. This Wheel should be divided into several Cavities, through each of which successively either Sand or Water must be contrived

to pass; the heaviness of these Bodies (being always in the ascending side of the Wheel) must be counterpoised by a Plummet that may be fastned about the Pulley on the Axis: This Plummet will leisurely descend, according as the Sand by running out of one Cavity into the next, doth make the several parts of the Wheel lighter or heavier, and so consequently there will be produced an equal and lasting Motion, which may be easily applied to the distinction of Hours.

3. The multitude and variety of those Services for which they may be useful. Unto this kind may we refer those Watches by which a Man may tell not only the Hour of the Day, but the Minute of the Hour, the Day of the Month, the Age and Aspects of the Moon, &c. Of this nature likewise was that Larum mentioned by *Walchius*, which tho' it were but two or three Inches big, yet would both wake a Man, and of it self light a Candle for him at any set Hour of the Night. And those Weights or Springs which are of so great Force as to turn a Mill, (as some have been contrived) may be easily applied to more various and difficult Labours.

4. The littleness of their Frame. *Nunquam ars magis quam in minimis nota est* (saith *Aquinas*.) The smallness of the Engine doth much commend the Skill of the Artificer; to this purpose there have been Watches contrived in the form and quantity of a Jewel for the Ear, where the striking of the Minutes may constantly whisper unto us, how our Lives do slide away by a swift Succession. *Cardan* tells us of a Smith who made a Watch in the Jewel of a Ring, to be worn on the Finger, which did shew the Hours, (*non solum sagitta, sed ictu*) not only by the Hand, but by the Finger too (as I may say) by pricking it every Hour.

Fab. 9.

Ramel. fig.
130.

Jacks no bigger than a Walnutto turn any Joint of Meat.

De subtil.
l. 2. item
l. 17.

C H A P. IV.

Of the Moveable and Gradient Automata, representing the Motions of Living Creatures, various Sounds, of Birds, or Beasts, and some of them Articulate.

THUS much of those *Automata*, which were said to be fixed and stationary.

The other kind to be enquired after, are those that are moveable and transient, which are described to be such Engines as move not only according to their several Parts, but also according to their whole Frames. These are again distinguishable into Two Sorts :

1. *Gradient.*
2. *Volant.*

I. The *Gradient* or *Ambulatory*, are such as require some Basis or Bottom to uphold them in their Motions. Such were those strange Inventions (commonly attributed to *Dædalus*) of self-moving Statues, which (unless they were violently detained) would of themselves run away. * *Aristotle* affirms that *Dædalus* did this by putting Quicksilver into them. But this would have been too gross a way for so excellent an Artificer ; it is more likely that he did it with Wheels and Weights. Of this kind likewise were *Vulcan's Tripodes*, celebrated by *Homer*, that were made to move up and down the House, and fight with one another. He might as well have contrived them into Journey-men Statues, each of which with a Hammer in his Hand should have worked at the Forge.

But amongst these fighting Images, that in *Cardan* may deserve a mention, which holding in its

Hand

Plato in Menone.
Arist. Polit. l. 1. c. 3.

* *De Anima l. 1. c. 3.*
Iliad. 18.
There have been also Chariots driven by the force of a Spring contrived within them.
De Variet. Rerum l. 12. c. 58.

Hand a Golden Apple, beautified with many costly Jewels; if any Man offered to take it, the Statue presently shot him to Death. The touching of this Apple serving to discharge several short Bows, or other the like Instruments that were secretly couched within the Body of the Image. By such a Treachery was King *Chemettus* murdered (as *Boetius* relates.)

It is so common an Experiment in these Times to represent the Persons and Actions of any Story by such self-moving Images, that I shall not need to explain the Manner how the Wheels and Springs are contrived within them.

Amongst these Gradient *Automata*, that Iron-Spider mentioned in *Walchius*, is more especially remarkable, which being but of an ordinary Bigness, besides the outward Similitude, (which was very exact) had the same kind of Motions with a living Spider, and did creep up and down as if it had been alive. It must needs argue a wonderful Art and Accuracy, to contrive all the Instruments requisite for such a Motion in so small a Frame.

There have been also other Motions contrived from Magnetical Qualities, which will shew the more wonderful, because there is no apparent Reason of their Motion, there being not the least Contiguity or Dependance upon any other Body that may occasion it; but it is all one as if they should move up and down in the open Air. Get a Glass Sphere, fill it with such Liquors as may be clear of the same Colour, immixable, such as are Oyl of Tartar, and Spirit of Wine: In which, it is easie so to poise a little Globe or other Statue, that it shall swim in the Center. Under this Glass Sphere, there should be a Loadstone concealed, by the Motion of which, this Statue (having a Needle touched within it) will move up and down, and may be contrived to shew the Hour or Sign. See several Inventions of this Kind in *Kircher de Arte Magnetica*, l. 2.

Fab. 9.
There have been other Inventions to move on the Water.
Navigium sponse mobile, ac sui remigii autorem, faciamus in lo negotio, scilicet Scylliger, Exerc. 326.

There have been some artificial Images, which besides their several Postures in walking up and down, have been made also to give several Sounds, whether of Birds, as Larks, Cuckoes, &c. or Beasts, as Hares, Foxes. The Voices of which Creatures shall be rendred as clearly and distinctly by these artificial Images, as they are by those natural living Bodies, which they represent.

There have been some Inventions also which have been able for the Utterance of articulate Sounds, as the Speaking of certain Words. Such are some of the Egyptian Idols related to be. Such was the Brazen Head made by Friar Bacon, and that Statue, in the framing of which *Albertus Magnus* bestowed 30 Years, broken by *Aquinas*, who came to see it, purposely that he might boast, how in one Minute he had ruined the Labour of so many Years.

Now the Ground and Reason how these Sounds were contrived, may be worth our Enquiry.

First then, for those of Birds or Beasts, they were made from such Pipes or Calls, as may express the several Tones of those Creatures which are represented: These Calls are so commonly known and used, that they need not any further Explication.

But now, about articulate Sounds there is much greater Difficulty. *Walchius* thinks it possible entirely to preserve the Voice, or any Words spoken in a hollow Trunk, or Pipe, and that this Pipe being rightly opened, the Words will come out of it in the same Order wherein they were spoken. Somewhat like that cold Countrey, where the Peoples discourse doth freeze in the Air all Winter, and may be heard the next Summer, or at a great Thaw. But this Conjecture will need no Refutation.

The more substantial Way for such a Discovery, is by marking how Nature her self doth employ the several Instruments of Speech, the Tongue, Lips, Throat,

*CæL. Rhod.
lect. Ant.
l. 2. c. 17.
Maiolus
Collog.*

Fab. 9.

Throat, Teeth, &c. To this purpose the *Hebrews* have assigned each Letter unto its proper Instrument. And besides, we should observe what inarticulate Sounds do resemble any of the particular Letters. Thus we may note the trembling of Water to be like the Letter *L*, the quenching of hot things to the Letter *Z*, the sound of Strings, unto the Letters *Ng*, the jirking of a Switch the Letter *Q*, &c. By an exact Observation of these Particulars, it is (perhaps) possible to make a Statue speak some Words.

Bacon. Nat. hist. exper.
139. 200.

C H A P. V.

Concerning the Possibility of Framing an Ark for submarine Navigations. The Difficulties and Conveniences of such a Contrivance.

IT will not be altogether impertinent unto the Discourse of these gradient *Automata*, to mention what *Mersennus* doth so largely and pleasantly descant upon, concerning the making of a Ship, wherein Men may safely swim under the Water.

Tract. de Magnetis Proprietatibus.

That such a Contrivance is feasible and may be effected, is beyond all Question, because it hath been already experimented here in *England* by *Cornelius Dreble*; but how to improve it unto Publick Use and Advantage, so as to be serviceable for remote Voyages, the carrying of any considerable Number of Men, with Provisions and Commodities, would be of such excellent Use, as may deserve some further Enquiry.

Concerning which there are two things chiefly considerable :

The } many Difficulties with their Remedies.
 } great Conveniences.

1. The Difficulties are generally reducible to these Three Heads.

1. The letting out, or receiving in any thing, as there shall be occasion without the Admission of Water. If it have not such a Convenience, these kind of Voyages must needs be very dangerous and uncomfortable, both by Reason of many noisome, offensive Things, which should be thrust out, and many other needful Things which should be receiv'd in. Now herein will consist the Difficulty, how to contrive the opening of this Vessel, so, that any thing may be put in or out, and yet the Water not rush into it with much Violence, as it doth usually in the Leak of a Ship.

In which Case, this may be a proper Remedy ; let there be certain Leather Bags made of several Bignesses, which for the Matter of them should be both *tractable* for the Use and Managing of them, and strong to keep out the Water ; for the Figure of them, being long and open at both Ends. Answerable to these, let there be divers Windows, or open Places in the Frame of the Ship, round the Sides of which one End of these Bags may be fixed, the other End coming within the Ship, being to open and shut as a Purse. Now if we suppose this Bag thus fastned, to be tied close about towards the Window, then any thing that is to be sent out, may be safely put into that End within the Ship, which being again close shut, and the other End loosened, the thing may be safely sent out without the Admission of any Water.

So again, when any thing is to be taken in, it must be first receiv'd into that Part of the Bag towards the Window, which being (after the thing is
 with-

within it) close tied about, the other end may then be safely opened. It is easie to conceive, how by this means any Thing or Person may be sent out, or receiv'd in, as there shall be occasion; how the Water, which will perhaps by Degrees leak into several Parts, may be emptied out again, with divers the like Advantages. Tho' if there should be any Leak at the Bottom of this Vessel, yet very little Water would get in, because no Air could get out.

2. The second Difficulty in such an Ark will be the Motion or fixing of it according to occasion: The directing of it to several Places, as the Voyage shall be designed, without which, it would be very useles, if it were to remain only in one Place, or were to remove only blindfold, without any certain Direction: And the Contrivance of this may seem very difficult, because these submarine Navigators will want the usual Advantages of Winds and Tides for Motion, and the Sight of the Heavens for Direction.

But these Difficulties may be thus remedied; As for the *Progressive* Motion of it, this may be effected by the Help of several Oars, which in the outward Ends of them, shall be like the Fins of a Fish to contract and dilate. The Passage where they are admitted into the Ship being tied about with such Leather Bags (as were mentioned before) to keep out the Water. It will not be convenient perhaps that the Motion in these Voyages should be very swift, because of those Observations and Discoveries to be made at the Bottom of the Sea, which in a little space may abundantly recompense the Slowness of its Progress.

If this Ark be so ballast as to be of equal Weight with the like Magnitude of Water, it will then be easily moveable in any Part of it.

As for the Ascent of it, this may be easily contrived, if there be some great Weight at the Bottom

of the Ship (being part of its Ballast) which by some Cord within may be loosened from it : As this Weight is let lower, so will the Ship ascend from it (if need be) to the very Surface of the Water ; and again, as it is pulled close to the Ship, so will it *descend*.

For *Direction* of this Ark, the Mariners Needle may be useful in respect of the *Latitude* of Places ; and the Course of this Ship being more regular than others, by reason it is not subject to Tempests or unequal Winds, may more certainly guide them in judging of the *Longitude* of Places.

3. But the greatest Difficulty of all will be this, how the Air may be supplied for Respiration : How constant Fires may be kept in it for Light and the Dressing of Food, how those Vicissitudes of Rarefaction and Condensation may be maintained.

It is observed, that a Barrel or Cap, whose Cavity will contain Eight Cubical Feet of Air, will not serve a Urinator or Diver for Respiration, above one quarter of an Hour ; the Breath which is often sucked in and out, being so corrupted by the mixture of Vapours, that Nature rejects it as unserviceable. Now in an Hour a Man will need at least 300 and Sixty Respirations, betwixt every one of which there shall be 10 second Minutes, and consequently a great Change and Supply of Air will be necessary for many Persons, and any long Space.

And so likewise for the keeping of Fire ; a close Vessel containing 10 Cubical Feet of Air, will not suffer a Wax Candle of an Ounce to burn in it above an Hour before it be suffocated ; tho' this Proportion (saith *Mersennus*) doth not equally increase for several Lights, because Four Flames of an equal Magnitude will be kept alive the Space of 16 second Minutes, tho' one of these Flames alone in the same Vessel will not last above 35, or at most 30 seconds ; which may be easily tried in large glass Bottles, having Wax Candles lighted in them, and with their Mouths inverted in Water.

For the Resolution of this Difficulty, though I will not say, that a Man may, by Custom (which in other things doth produce such strange incredible Effects) be enabled to live in the open Water, as the Fishes do, the Inspiration and Expiration of Water serving instead of Air, this being usual with many Fishes that have Lungs; yet it is certain, that long Use and Custom may strengthen Men against many such Inconveniencies of this kind, which to unexperienced Persons may prove very hazardous: And so it will not perhaps be unto these so necessary, to have the Air for breathing so pure and defecated, as is required for others.

But further, there are in this Case these Three Things considerable.

1. That the Vessel it self should be of a large Capacity, that as the Air in it is corrupted in one part, so it may be purified and renewed in the other: Or if the meer Refrigeration of the Air would fit it for Breathing, this might be somewhat helped with Bellows, which would cool it by Motion.

2. It is not altogether improbable, that the Lamps or Fires in the Middle of it, like the reflected Beams in the first Region, rarefying the Air, and the circumambient Coldness towards the sides of the Vessel, like the second Region, cooling and condensing of it, would make such a Vicissitude and Change of Air, as might fit it for all its proper Uses.

3. Or if neither of these Conjectures will help, yet *Mersennus* tells us in another Place, that there is in *France* one *Barrieus* a Diver, who hath lately found out another Art, whereby a Man might easily continue under Water for six Hours together; and whereas Ten Cubical Feet of Air will not serve another Diver to breathe in for half an Hour, he by the Help of a Cavity, not above one or two Foot at most, will have Breath enough for six Hours, and a Lanthorn scarce above the usual Size to keep a
Can-

Harmon.
l. 4. prop. 6.
Monit. 5.

Candle burning as long as a Man please, which (if it be true, and were commonly known) might be a sufficient Help against this greatest Difficulty.

As for the many Advantages and Conveniences of such a Contrivance, it is not easie to recite them.

1. 'Tis *Private*; a Man may thus go to any Coast of the World invisibly, without being discovered or prevented in his Journey.

2. 'Tis *Safe*; from the Uncertainty of *Tides*, and the Violence of *Tempests*, which do never move the Sea above Five or Six Paces deep. From *Pirates* and *Robbers* which do so infest other Voyages: From Ice and great Frosts, which do so much endanger the Passages towards the Poles.

3. It may be of very great Advantage against a Navy of Enemies, who by this means may be undermined in the Water, and blown up.

4. It may be of special use for the Relief of any Place that is Besieged by Water, to convey unto them Invisible Supplies; and so likewise for the Surprizal of any Place that is accessible by Water.

5. It may be of unspeakable Benefit for Submarine Experiments and Discoveries; as,

The several Proportions of Swiftnesse betwixt the ascent of a Bladder, Cork, or any other light Substance, in comparison to the descent of Stones or Lead. The deep Caverns, and Subterraneous Passages, where the Sea-water, in the Course of its Circulation, doth vent it self into other Places, and the like. The Nature and Kinds of Fishes, the several Arts of Catching them, by alluring them with Lights, by placing divers Nets about the Sides of this Vessel, shooting the greater sort of them with Guns, which may be put out of the Ship by the help of such Bags as were mentioned before, with divers the like Artifices and Treacheries, which may be more successfully practised by such who live so famili-

familiarly together. These Fish may serve not only for Food, but for Fewel likewise, in respect of that Oil which may be extracted from them; the way of Dressing Meat by Lamps, being in many Respects the most convenient for such a Voyage.

The many fresh Springs that may probably be met with in the bottom of the Sea, will serve for the Supply of Drink, and other Occasions.

But above all, the Discovery of submarine Treasures is more especially considerable; not only in regard of what hath been drowned by Wrecks, but the several precious Things that grow there; as Pearl, Coral, Mines; with innumerable other Things of great Value, which may be much more easily found out, and fetch'd up by the help of this, than by any other usual way of the Urinators.

To which purpose, this great Vessel may have some lesser Cabins tyed about it, at various Distances; wherein several Persons, as Scouts, may be lodged for the taking of Observations, according as the Admiral shall direct them: Some of them being frequently sent up to the Surface of the Water, as there shall be Occasion.

All kind of Arts and Manufactures may be exercised in this Vessel. The Observations made by it, may be both Written, and (if need were) Printed here likewise. Several Colonies may thus inhabit, having their Children born, and bred up without the knowledge of Land, who could not chuse but be amazed with strange Conceits upon the Discovery of this Upper World.

I am not able to judge what other Advantages there may be suggested, or whether Experiment would fully answer to these Notional Conjectures. But however, because the Invention did unto me seem ingenious and new, being not impertinent to the present Enquiry, therefore I thought it might be worth the mentioning.

C H A P. VI.

Of the volant Automata, Archytas his Dove, and Regiomontanus his Eagle. The Possibility, and great Usefulness of such Inventions.

THE volant, or flying Automata, are such Mechanical Contrivances as have a Self-motion, whereby they are carried aloft in the open Air like the flight of Birds. Such was that Wooden Dove made by Archytas, a Citizen of Tarentum, and one of Plato's Acquaintance: And that Wooden Eagle framed by Regiomontanus at Noremberg, which, by way of Triumph, did fly out of the City to meet Charles the Fifth. This latter Author is also reported to have made an Iron Fly, *Quæ ex artificis manu egressa, convivas circumvolitavit, tandemque veluti defessa in Domini manus reversa est*; which, when he invited any of his Friends, would fly to each of them round the Table, and at length (as being weary) return unto its Master.

Cardan seems to doubt the possibility of any such Contrivance: His Reason is, because the Instruments of it must be firm and strong, and consequently they will be too heavy to be carried by their own force; but yet (saith he) if it be a little helped in the first rising, and if there be any Wind to assist it in the Flight, then there is nothing to hinder, but that such Motions may be possible. So that he doth in effect grant as much as may be sufficient for the Truth and Credit of those ancient Relations; and to distrust them without a stronger Argument, must needs argue a blind and perverse Incredibility. As for his Objection concerning the heaviness of the Materials in such an Invention, it may be answered,

That

J
Biog. Laer.

l. 8.

Pet. Crini-

us de ho-

nest. discip.

l. 17. c. 12.

Ramus

Schol. Ma-

them. l. 2.

Dubartas

6 days 1

W. I. Dee

Preface to

Euclid.

De Variet.

rerum lib.

12. c. 58.

That it is easie to contrive such Springs, and other Instruments, whose Strength shall much exceed their Heaviness. Nor can he shew any cause why these Mechanical Motions may not be as strong, (though not so lasting) as the natural Strength of Living Creatures.

Scaliger conceives the framing of such volant Automata to be very easie. *Volantis columbæ machinulam, cujus autorem Archytam tradunt, vel facillime profiteri audeo.* Those ancient Motions were thought to be contrived by the force of some included Air: So Gellius, *Ita erat scilicet libramentis suspensum, & aurâ spiritus inclusa, atque occultâ confitum, &c.* As if there had been some Lamp, or other Fire within it, which might produce such a forcible Rarefaction, as should give a Motion to the whole Frame.

But this may be better performed by the strength of some such Spring, as is commonly used in Watches. This Spring may be applied unto one Wheel, which shall give an equal Motion to both the Wings; these Wings having unto each of them another smaller Spring, by which they may be contracted and lifted up: So that being forcibly depressed by the strength of the great and stronger Spring, and lifted up again by the other two; according to this Supposition, it is easie to conceive how the Motion of Flight may be performed and continued.

The Wings may be made either of several Substances joined, like the Feathers in ordinary Fowl, as *Dædalus* is feigned to contrive them, according to that in the Poet,

---*Ignotas animum dimittit in artes,
Naturamque novat, nam ponit in ordine pennas
A minimo cæptas longam brevior sequente,
Ut clivo crevisse putes, &c.*

Or else of one continue Substance, like those of Bats. In framing of both which, the best Guidance is to follow (as near as may be) the Direction of Nature,

*Subtil.
Exercit.
326.*

*Noë. At-
tic. l. 10.
cap. 12.* where he thinks it so strange an Invention, that he styles it *Res abhorrens à fide.* *Athan.* *Kircher de Magnete l. 2. par. 4. Proem.* doth promise a large Discourse concerning these kind of Inventions in another Treatise, which he styles *Oedipus Aegyptiacus.*

*Ovid. Me-
tam. l. 8.*

ture, this being but an Imitation of a Natural Work. Now in both these, the strength of each part is proportioned to the force of its Employment. But nothing in this kind can be perfectly determined without a particular Trial.

Though the composing of such Motions may be a sufficient Reward to any one's Industry in the searching after them, as being in themselves of excellent Curiosity, yet there are some other Inventions depend upon them of more general Benefit, and greater Importance. For, if there be any such artificial Contrivances that can fly in the Air, (as is evident from the former Relations, together with the Grounds here specified, and, I doubt not, may be easily effected by a diligent and ingenious Artificer) then it will clearly follow, that it is possible also for a Man to fly himself; it being easie from the same Grounds, to frame an Instrument wherein any one may sit, and give such a Motion unto it, as shall convey him aloft through the Air. Than which there is not any imaginable Invention, that could prove of greater Benefit to the World, or Glory to the Author; and therefore it may justly deserve their Enquiry, who have both Leisure and Means for such Experiments.

But in these practical Studies, unless a Man be able to go the Tryal of Things, he will perform but little. In such Matters,

Horace.

---*Studium sine divite vendi,*

(as the Poet saith) a general Speculation, without particular Experiment, may conjecture at many things, but can certainly effect nothing; and therefore I shall only propose unto the World, the Theory and general Grounds that may conduce to the easie and more perfect Discovery of the Subject in Question, for the Encouragement of those that have both Minds and Means for such Experiments. This same Scholar's Fate,

Res

Res angusta domi, and

---*Curta suppellex,*

is that which hinders the promoting of Learning in sundry Particulars, and robs the World of many excellent Inventions. We read of *Aristotle*, that he was allowed by his Pupil *Alexander* 800 Talents a Year, for the Payment of Fishers, Fowlers, and Hunters, who were to bring him in several Creatures, that so by his particular Experience of their Parts and Dispositions, he might be more fitly prepared to write of their Natures. The Reason why the World hath not many *Aristotles*, is because it hath so few *Alexanders*.

Amongst other Impediments of any strange Invention, or Attempts, it is none of the meanest Discouragements, that they are so generally derided by common Opinion; being esteemed only as the Dreams of a melancholy and distempered Fancy. *Eusebius* speaking, with what necessity every thing is confined by the Laws of Nature, and the Decrees of Providence, so that nothing can go out of that way unto which naturally it is designed; as a Fish cannot reside on the Land, nor a Man in the Water, or aloft in the Air; infers, that therefore none will venture upon any such vain Attempt, as passing in the Air, ἢ μελαγχολίας νοσήματα ὄν ἀεπέσοι, unless his Brain be a little crazed with the Humour of Melancholy; whereupon he advises, that we should not in any Particular, endeavour to transgress the Bounds of Nature, ἐδὲ ἀπτερον ἔχοντι τὸ σῶμα, πῶς πτηνῶν ὀπιπτεῦεν, and since we are destitute of Wings, not to imitate the Flight of Birds. That Saying of the Poet,

Contra Hierocli. confut. l. 1.

Demens, qui nimbos, & non imitabile fulmen, &c.

Virgil Aeneid. l. 6.

hath been an old Censure, applyed unto such as ventured upon any strange or incredible Attempt.

Hence may we conceive the Reason, why there is so little Intimation in the Writings of Antiquity,

con-

concerning the possibility of any such Invention. The Ancients durst not so much as mention the Art of Flying, but in a Fable.

*Dædalus, ut fama est; fugiens Minoia regna,
Præpetibus pennis ausus se credere cælo,
Insuetum per iter gelidas enavit ad arctos, &c.*

It was the Custom of those former Ages, in their over-much Gratitude, to advance the first Authors of any useful Discovery amongst the Number of their Gods. And *Dædalus*, being so famous amongst them for sundry Mechanical Inventions (especially the Sails of Ships) though they did not for these place him in the Heavens, yet they have promoted him as near as they could, feigning him to fly aloft in the Air, when as he did but fly in a swift Ship, as *Diodorus* relates the Historical Truth on which that Fiction is grounded.

So *Eusebius* too.

CH A P. VII.

Concerning the Art of Flying. The several ways whereby this hath been, or may be attempted.

*World in the Moon, cap. 14. *Mercury*, or the Secret and Swift Messenger, c. 4.

I Have formerly in two other * Discourses mentioned the possibility of this Art of Flying, and intimated a farther Enquiry into it, which is a kind of Engagement to some fuller Disquisitions and Conjectures to that purpose.

There are four several ways whereby this Flying in the Air hath been, or may be attempted. Two of them by the strength of other things, and two of them by our own Strength.

1. By Spirits, or Angels.
2. By the help of Fowls.
3. By Wings fastned immediately to the Body.
4. By a Flying Chariot.

1. For

1. For the first, we read of divers that have passed swiftly in the Air, by the help of Spirits and Angels; whether good Angels, as * *Elias* was carried unto Heaven in a Fiery-Chariot, as † *Philip* was conveyed to *Azotus*, and *Habakkuk* from *Jewry* to *Babylon*, and back again immediately: Or by evil Angels, as our Saviour was carried by the Devil to the top of a high Mountain, and to the Pinnacle of the Temple. Thus Witches are commonly related to pass unto their usual Meetings, in some remote Place; and, as they do sell Winds unto Mariners, so likewise are they sometimes hired to carry Men speedily through the open Air. *Acosta* affirms, that such kind of Passages are usual amongst divers Sorcerers with the *Indians* at this day.

So *Kepler*, in his *Astronomical Dream*, doth fancy a Witch to be conveyed unto the Moon by her Familiar.

Simon Magus was so eminent for Miraculous Sorceries, that all the People in *Samaria*, from the least to the greatest, did esteem him as the great Power of God. And so famous was he at *Rome*, that the Emperor erected a Statue to him with this Inscription, *Simoni Deo Sancto*. 'Tis storied of this Magician, that having challenged *St. Peter* to do Miracles with him, he attempted to fly from the Capitol to the *Arventine Hill*; but when he was in the midst of the way, *St. Peter's* Prayers did overcome his Sorceries, and violently bring him to the Ground; in which Fall having broke his Thigh, wltin a while after he Died.

But none of all these Relations may conduce to the Discovery of this Experiment, as it is here enquired after, upon *Natural* and *Artificial* Grounds.

2. There are others, who have conjectured a possibility of being conveyed through the Air by the help of Fowls; to which purpose, that Fiction of the *Gargasa's* is the most pleasant and probable. They

Zanch. de oper. part
1. l. 4.

* 2 Kings
2. 11.

† Acts 8.

39.

Dan. Apoc. 39.

Luke 4.

Erastus de Lamus.

Hist. Ind.

l. 5. c. 26

Acts 8.10

Hegefp. l. 3.

c. 2.

Pol. Virgil. de Inven.

Rerum. l. 8.

c. 3.

Pet. Crinitus de Honesta Dis-

ciplin. l. 8.

c. 1. mi-

strusts
this Rela-

tion as fa-

bulous.
Non enim Lucas hoc omisisset.

are supposed to be great Fowl, of a strong lasting Flight, and easily tameable: Divers of which may be so brought up, as to join together in the carrying the weight of a Man, so as each of them shall partake his proportionable share of the Burden, and the Person that is carried may by certain Reins, direct and steer them in their Courses. However this may seem a strange Proposal, yet it is not certainly more improbable than many other Arts, wherein the Industry of Ingenious Men hath instructed these Brute Creatures. And I am very confident, that one whose Genius doth enable him for such kind of Experiments upon Leisure, and the advantage of such Helps as are requisite for various and frequent Trials, might effect some strange things by this kind of Enquiry.

'Tis reported as a Custom amongst the *Leucatiens*, that they were wont upon a Superstition, to precipitate a Man from some high Cliff into the Sea, tying about him with Strings at some distance, many great Fowls, and fixing upon his Body divers Feathers, spread to break the Fall; which (saith the Learned *Bacon*, if it were diligently and exactly contrived) would be able to hold up, and carry any proportionable Weight; and therefore he advises others to think further upon this Experiment, as giving some Light to the Invention of the Art of Flying.

3. 'Tis the more obvious and common Opinion, that this may be effected by Wings fastned immediately to the Body, this coming nearest to the Imitation of Nature, which should be observed in such Attempts as these. This is that way which *Fredericus Hermannus*, in his little Discourse *de Arte volandi*, doth only mention and insist upon; and if we may trust credible Story, it hath been frequently attempted not without some Success. 'Tis related of a certain *English Monk*, called *Elmerus*, about the Con-

fessor's

Nat. Hist.
Experim.
886.

So the an-
cient Bri-
tish Bla-
duds.

fessor's time, that he did by such Wings fly from a Tower above a Furlong; and so another from Saint Mark's Steeple in Venice; another at Norinberg; and *Busbequius* speaks of a Turk in Constantinople, who attempted something this way. *M. Burton* mentioning this Quotation, doth believe that some new-fangled Wit ('tis his Cynical Phrase) will some time or other find out this Art. Though the truth is, most of these Artists did unfortunately miscarry by falling down, and breaking their Arms or Legs, yet that may be imputed to their want of Experience, and too much Fear, which must needs possess Men in such dangerous and strange Attempts. Those things that seem very difficult and fearful at the first, may grow very facil after frequent Trial and Exercise: And therefore he that would effect any thing in this kind, must be brought up to the constant practice of it from his Youth; trying first only to use his Wings, in running on the Ground, as an Estrich or tame Geese will do, touching the Earth with his Toes; and so by degrees learn to rise higher, till he shall attain unto Skill and Confidence. I have heard it from credible Testimony, that one of our own Nation hath proceeded so far in this Experiment, that he was able by the help of Wings, in such a running Pace, to step constantly ten Yards at a time.

It is not more incredible, that frequent Practice and Custom should enable a Man for this, than for many other things which we see confirmed by Experience. What strange Agility and Activeness do our common Tumblers and Dancers on the Rope attain to by continual Exercise? 'Tis related of certain *Indians*, that they are able, when a Horse is running in his full Career, to stand upright on his Back, to turn themselves round, to leap down, gathering up any thing from the Ground, and immediately to leap up again, to shoot exactly at any

Ernestus Burgravus in Panoplia Physico-Vulcania. Sturmius in Lat. linguae resolut.

Melancholy, Par. 2. Sect. 1. Mem. 3.

Maffeus Hist. Ind. l. 1.

Mark, the Horse not intermitting his Course : And so upon two Horses together, the Man setting one of his Feet upon each of them. These things may seem impossible to others, and it would be very dangerous for any one to attempt them, who hath not first gradually attained to these Arts by long Practice and Trial ; and why may not such Practice enable him as well for this other Experiment, as for these Things ?

There are others, who have invented ways to walk upon the Water as regularly and firmly as upon the Land. There are some so accustomed to this Element, that it hath been almost as natural to them as to the Fish ; Men that could remain for above an Hour together under Water. *Pontanus* mentions one, who could swim above a hundred Miles together, from one Shoar to another, with great speed, and at all times of the Year. And it is storied of a certain young Man, a *Sicilian* by Birth, and a *Diver* by Profession, who had so continually used himself to the Water, that he could not enjoy his Health out of it. If at any time he staid with his Friends on the Land, he should be so tormented with a Pain in his Stomach, that he was forced for his Health to return back again to Sea ; wherein he kept his usual Residence, and when he saw any Ships, his Custom was to swim to them for Relief ; which kind of Life he continued till he was an old Man, and died.

I mention these things, to shew the great Power of Practice and Custom, which might more probably succeed in this Experiment of Flying (if it were but regularly attempted) than in such strange Effects as these.

It is a usual Practice in these Times, for our *Fu-nambulones*, or Dancers on the Rope, to attempt somewhat like to Flying, when they will with their Heads forwards, slide down a long Cord extended ;
being

being fastned at one end to the top of some high Tower, and the other at some distance on the Ground, with Wings fixed to their Shoulders, by the shaking of which they will break the force of their Descent. It would seem that some attempts of this kind were usual amongst the *Romans*. To which that Expression in * *Salvian* may refer; where, amongst other publick Shews of the Theatre, he mentions the *Petaminaria*; which Word (saith *Jo. Brassicanus*) is scarce to be found in any other Author, being not mentioned either in *Julius Pollux*, or *Politian*. 'Tis probably derived from the *Greek* word $\pi\epsilon\tau\alpha\delta\gamma$, which signifies to Fly, and may refer to such kind of Rope-Dancers.

* *De guber.*
Dei. l. 6.
Annot. in
Salvi.

But now, because the Arms extended are but weak, and easily wearied, therefore the Motions by them are like to be but short and slow, answerable it may be to the Flight of such Domestick Fowl as are most conversant on the Ground, which of themselves we see are quickly weary; and therefore much more would the Arm of a Man, as being not naturally designed to such a Motion.

It were therefore worth the Enquiry, to consider whether this might not be more probably effected by the Labour of the Feet, which are naturally more strong and indefatigable: In which Contrivance, the Wings should come down from the Shoulders on each side, as in the other, but the Motion of them should be from the Legs, being thrust out, and drawn in again one after another, so as each Leg should move both Wings; by which means a Man should (as it were) walk or climb up into the Air; and then the Hands and Arms might be at leisure to help and direct the Motion, or for any other Service proportionable to their Strength. Which Conjecture is not without good Probability, and some special Advantages above the other.

4. But the fourth and last way seems unto me altogether as probable, and much more useful than any of the rest. And that is by a flying Chariot, which may be so contrived as to carry a Man within it ; and though the strength of a Spring might perhaps be serviceable for the Motion of this Engine, yet it were better to have it assisted by the Labour of some intelligent Mover, as the Heavenly Orbs are supposed to be turned. And therefore if it were made big enough to carry sundry Persons together, then each of them in their several turns might successively Labour in the causing of this Motion ; which thereby would be much more constant and lasting, than it could otherwise be, if it did wholly depend on the Strength of the same Person. This Contrivance being as much to be preferred before any of the other, as swimming in a Ship before swimming in the Water.

C H A P. VIII.

A Resolution of the two chief Difficulties that seem to oppose the Possibility of a flying Chariot.

THE chief Difficulties against the possibility of any such Contrivance, may be fully removed in the Resolution of these two *Quæries*.

1. Whether an Engine of such Capacity and Weight, may be supported by so thin and light a Body as the Air ?

2. Whether the Strength of the Persons within it, may be sufficient for the Motion of it ?

1. Concerning the first ; when *Callias* was required by the Men of *Rhodes*, to take up that great *Helepolis*, brought against them by *Demetrius*, (as he had done before unto some less which he himself had made)

made) He answered that it could not be done. *Nonnulla enim sunt quæ in exemplaribus videntur similia, cum autem crescere cæperunt, dilabuntur.* Because those Things that appear probable in lesser Models, when they are increased to a greater Proportion, do thereby exceed the Power of Art. For Example, though a Man may make an Instrument to bore a Hole, an Inch wide, or half an Inch, and so less; yet to bore a Hole of a Foot wide, or two Foot, is not so much as to be thought of. Thus, though the Air may be able to uphold some lesser Bodies, as those of Birds, yet when the quantity of them is increased to any great Extension, it may justly be doubted, whether they will not exceed the Proportion that is naturally required unto such kind of Bodies.

So Ramus
Schol. Ma-
them. l. 1.

To this I answer, that the Engine can never be too big or too heavy, if the space which it possesses in the Air, and the Motive-Faculty in the Instrument be answerable to its Weight. That Saying of *Callias* was but a groundless Shift and Evasion, whereby he did endeavour to palliate his own Ignorance and Disability. The utmost Truth which seems to be implied in it, is this: That there may be some Bodies of so great a Bigness, and Gravity, that it is very difficult to apply so much Force unto any particular Instrument, as shall be able to move them.

Against the Example it may be affirmed and easily proved, that it is equally possible to bore a Hole of any bigness, as well great as little, if we suppose the Instrument, and the Strength, and the Application of this Strength to be proportionable; But because of the difficulty of these concurrent Circumstances in those greater and more unusual Operations, therefore do they falsely seem to be absolutely impossible.

So that the chief Inference from this Argument and Example, doth imply only thus much, that it is very difficult to contrive any such motive Power, as shall be answerable to the Greatness and Weight of such an Instrument as is here discoursed of; which doth not at all impair the Truth to be maintained: For if the possibility of such a Motion be yielded, we need not make any scruple of granting the Difficulty of it; It is this must add a Glory to the Invention; and yet this will not perhaps seem so very difficult to any one who hath but diligently observed the Flight of some other Birds, particularly of a Kite, how he will swim up and down in the Air, sometimes at a great height, and presently again lower, guiding himself by his Train, with his Wings extended without any sensible Motion of them; and all this, when there is only some gentle breath of Air stirring, without the help of any strong forcible Wind. Now I say, if that Fowl (which is none of the lightest) can so very easily move it self up and down in the Air, without so much as stirring the Wings of it, certainly then it is not improbable, but that when all the due Proportions in such an Engine are found out, and when Men by long Practice have arrived to any Skill and Experience, they will be able in this (as well as in many other Things) to come very near unto the imitation of Nature.

Sen. Nat.
Qu. l. 1.
a. 25.

As it is in those Bodies which are carried on the Water, tho' they be never so big or so ponderous, (suppose equal to a City or a whole Island) yet they will always swim on the Top, if they be but any thing lighter than so much Water as is equal to them in Bigness: So likewise is it in the Bodies that are carried in the Air. It is not their Greatness (tho' never so immense) that can hinder their being supported in that light Element, if we suppose them to be extended unto a proportionable Space of Air. And

And as from the former Experiments, *Archimedes* hath composed a subtle *Science* in his Book *De insidentibus humido*, concerning the Weight of any heavy Body, in reference to the Water wherein it is; so from the particular Trial of these other Experiments, that are here enquired after, it is possible to raise a new Science, concerning the Extension of Bodies, in comparison to the Air, and motive Faculties by which they are to be carried.

We see a great difference betwixt the several Quantities of such Bodies as are commonly upheld by the Air; not only little Gnats, and Flies, but also the Eagle and other Fowl of vaster Magnitude. *Cardan* and *Scaliger* do unanimously affirm, that there is a Bird amongst the *Indians* of so great a Bigness, that his Beak is often used to make a Sheath or Scabbard for a Sword. And *Acosta* tells us of a Fowl in *Peru* called *Candores*, which will of themselves kill and eat up a whole Calf at a time. Nor is there any Reason why any other Body may not be supported and carried by the Air, though it should as much exceed the Quantity of these Fowl, as they do the quantity of a Fly.

*Subtil. l. 10.
Exercit.
231.*

*Histor.
Nov. Orb.
l. 4. c. 37.*

Marcus Polus mentions a Fowl in *Madagascar*, which he calls a *Ruck*, the Feather of whose Wings are 12 Paces, or Threescore Foot long, which can with as much ease scoop up an Elephant, as our Kites do a Mouse. If this Relation were any thing credible, it might serve as an abundant Proof for the present *Quære*. But I conceive this to be already so evident, that it needs not any Fable for its further Confirmation.

2. The other doubt was, whether the Strength of the other Persons within it, will be sufficient for the moving of this Engine? I answer, the main Difficulty and Labour of it will be in the raising of it from the Ground; near unto which, the Earths attractive Vigor is of greatest Efficacy. But for the better effecting of this, it may be

be helped by the Strength of Winds, and by taking its first Rise from some Mountain or other high Place. When once it is aloft in the Air, the Motion of it will be easie, as it is in the Flight of all kind of Birds, which being at any great Distance from the Earth, are able to continue their Motion for a long Time and Way, with little Labour or Weariness.

Plin. l. 10.
6. 23.

'Tis certain from common Relation and Experience that many Birds do cross the Seas for divers hundred Miles together: Sundry of them amongst us, which are of a short Wing and Flight, as Black-birds, Nightingales, &c. do flie from us into Germany, and other remoter Countries. And Mariners do commonly affirm that they have found some Fowl above six hundred Miles from any Land. Now if we should suppose these Birds to labour so much in those long Journies, as they do when they fly in our Sight and near the Earth, it were impossible for any of them to pass so far without resting. And therefore it is probable, that they do mount unto so high a Place in the Air, where the natural Heaviness of their Bodies does prove but little or no impediment to their Flight: Tho' perhaps either Hunger, or the Sight of Ships, or the like accident, may sometimes occasion their descending lower; as we may guess of those Birds which Mariners have thus beheld, and divers others that have been drowned and cast up by the Sea.

Whence it may appear, that the Motion of this Chariot (tho' it may be difficult at the first) yet will still be easier as it ascends higher, till at length it shall become utterly devoid of Gravity, when the least Strength will be able to bestow upon it a swift Motion: As I have proved more at large in another Discourse.

World in
the Moon,
cap. 14.

But then, (may some object) If it be supposed that a Man in the Æthereal Air does lose his own Heavi-

Heaviness, how shall he contribute any force towards the Motion of this Instrument ?

I answer, The Strength of any living Creature in these external Motions, is something really distinct from, and superadded unto its natural Gravity : As common Experience may shew, not only in the Impression of Blows or violent Motions, as a River Hawk will strike a Fowl with a far greater Force, than the meer Descent or Heaviness of his Body could possibly perform : But also in those Actions which are done without such Help, as the Pinching of the Finger, the Biting of the Teeth, &c. all which are of much greater Strength than can proceed from the meer Heaviness of those Parts.

As for the other particular Doubts, concerning the extream Thinness and Coldness of this Æthereal Air, by reason of which, it may seem to be altogether impassible, I have already resolved them in the above-cited Discourse.

The Uses of such a Chariot may be various : Besides the Discoveries which might be thereby made in the Lunary World, it would be serviceable also for the Conveyance of a Man to any remote Place of this Earth : As suppose to the *Indies* or *Antipodes*. For when once it was elevated for some few Miles, so as to be above that Orb of Magnetick Virtue, which is carried about by the Earth's diurnal Revolution, it might then be very easily and speedily directed to any particular Place of this great Globe.

If the Place which we intended were under the same Parallel, why then the Earth's Revolution once in Twenty four Hours, would bring it to be under us ; so that it would be but descending in a straight Line, and we might presently be there. If it were under any other Parallel, it would then only require that we should direct it in the same Meridian, till

till we did come to that Parallel ; and then (as before) a Man might easily descend unto it.

It would be one great Advantage in this kind of Travelling, that one should be perfectly freed from all Inconveniencies of Ways or Weather, not having any Extremity of Heat or Cold, or Tempests to molest him. This Æthereal Air being perpetually in an equal Temper and Calmness. *Pars superior mundi ordinatior est nec in nubem cogitur, nec in tempestatem impellitur, nec versatur in turbinem, omni tumultu caret, inferiora fulminant.* The upper Parts of the World are always quiet and serene, no Winds and Blustering there, they are these lower cloudy Regions that are so full of Tempests and Combustion.

As for the Manner how the Force of a Spring, or (instead of that) the Strength of any living Person, may be applied to the Motion of these Wings of the Chariot, it may easily be apprehended from what was formerly delivered.

There are divers other particulars to be more fully enquired after, for the perfecting of such a flying Chariot ; as concerning the Proportion of the Wings both for the Length and Breadth, in comparison to the Weight which is to be carried by them ; as also concerning those special Contrivances, whereby the Strength of these Wings may be severally applied, either to ascent, descent, progressive, or a turning Motion ; all which, and divers the like Enquiries can only be resolved by particular Experiments. We know the Invention of Sailing in Ships does continually receive some new Addition from the Experience of every Age, and hath been a long while growing up to that Perfection unto which it is now arrived. And so must it be expected for this likewise, which may at first perhaps seem perplexed with many Difficulties and Inconveniencies, and yet upon the Experience of frequent Trials, many things may

*Sen de Ira.
l. 3. c. 6.
Pacem
summa te-
nent. Lu-
can.*

As well too long as too short, too broad as too narrow, may be an impediment to the motion, by making it more difficult, slow and flagging.

may be suggested to make it more facil and commodious.

He that would regularly attempt any Thing to this Purpose, should observe this Progress in his Experiments; he should first make Enquiry what kind of Wings would be most useful to this End; those of a Bat being most easily imitable, and perhaps Nature did by them purposely intend some Intimation to direct us in such Experiments; that Creature being not properly a Bird, because not amongst the *Ovipara*, to imply that other kind of Creatures are capable of Flying as well as Birds; and if any should attempt it, that would be the best Pattern for Imitation.

After this he may try what may be effected by the Force of Springs in lesser Models, answerable unto *Archytas* his Dove, and *Regiomontanus* his Eagle: In which he must be careful to observe the various Proportions betwixt the Strength of the Spring, the Heaviness of the Body, the Breadth of the Wings, the Swiftness of the Motion, &c.

From these he may by Degrees ascend to some larger Essays.

CHAP. IX.

Of a perpetual Motion. The seeming Facility and real Difficulty of any such Contrivance. The several Ways whereby it hath been attempted, particularly by Chymistry.

IT is the chief Inconvenience of all the *Automata* before-mentioned, that they need a frequent Repair of new Strength, the Causes whence their Motion does proceed, being subject to fail, and come
to

to a Period ; and therefore it would be worth our Enquiry, to examine whether or no there may be made any such artificial Contrivance, which might have the Principle of moving from it self ; so that the present Motion should constantly be the cause of that which succeeds.

This is that great Secret in *Art*, which, like the Philosopher's Stone in *Nature*, hath been the Business and Study of many more refined Wits, for divers Ages together ; and it may well be questioned, whether either of them as yet hath ever been found out ; though if this have, yet, like the other, it is not plainly treated of by any Author.

Not but that there are sundry Discourses concerning this Subject, but they are rather *Conjectures* than *Experiments*. And though many Inventions in this kind, may at first view bear a great shew of probability, yet they will fail, being brought to Trial, and will not answer in Practice what they promised in Speculation. Any one who hath been versed in these Experiments must needs acknowledge that he hath been often deceived in his strongest Confidence ; when the Imagination hath contrived the whole Frame of such an Instrument, and conceives that the Event must infallibly answer its hopes, yet then does it strangely deceive in the Proof, and discovers to us some Defect which we did not before take Notice of.

Hence it is, that you shall scarce talk with any one who hath never so little smattering in these Arts, but he will instantly promise such a Motion, as being but an easy Atchievement, till further Trial and Experience hath taught him the Difficulty of it. There being no Enquiry that does more entice with the *Probability*, and deceive with the *Subtilty*. What one speaks wittily concerning the Philosopher's Stone, may be justly applied to this, that it is *Castra Meretrix*, a chaste Whore. *Quia multos invitat, nemi-*

nem admittit, because it allures many, but admits none.

I shall briefly recite the several ways whereby this hath been attempted, or seems most likely to be effected; thereby to contract and facilitate the Enquiries of those who are addicted to these kind of Experiments; for when they know the defects of other Inventions, they may the more easily avoid the same or the like in their own.

The ways whereby this hath been attempted, may be generally reduced to these three Kinds:

1. By Chymical Extractions.
2. By Magnetical Virtues.
3. By the natural Affection of Gravity.

1. The discovery of this hath been attempted by Chymistry. *Paracelsus* and his Followers have bragged, that by their Separations and Extractions, they can make a little World which shall have the same perpetual Motions with this *Microcosm*, with the Representation of all Meteors, Thunder, Snow, Rain, the Courses of the Sea in its Ebbs and Flows, and the like; But these miraculous Promises would require as great a Faith to believe them, as a Power to perform them: And tho' they often talk of such great Matters,

At nusquam totos inter qui talia curant,

Apparet ullus, qui re miracula tanta

Comprobet ———

yet we can never see them confirmed by any real Experiment; and then besides, every particular Author in that Art hath such a distinct Language of his own, (all of them being so full of Allegories and affected Obscurities) that 'tis very hard for any one (unless he be thoroughly versed amongst them) to find out what they mean, much more to try it.

One of these ways (as I find it set down) is this. Mix five Ounces of ϱ , with an equal Weight of ψ , grind them together with ten Ounces of Sublimate, dissolve them in a Cellar upon some Marble for the space

Etten. Ma-
them Re-
creat. prob.
118.

space of four Days, till they become like Oil Olive; distil this with Fire of Chaff, or driving Fire, and it will sublime into a dry Substance: And so by repeating of these Dissolvings and Distillings, there will be at length produced divers small Atoms, which being put into a Glass well luted, and kept dry, will have a perpetual Motion.

I cannot say any thing from Experience against this; but methinks it does not seem very probable, because Things that are forced up to such a Vigorousness and Activity as these Ingredients seem to be by their frequent Sublimatings and Distillings, are not likely to be of any Duration; the more any thing is stretched beyond its usual Nature, the less does it last; Violence and Perpetuity being no Companions. And then besides, suppose it true, yet such a Motion could not well be applied to any Use, which must needs take much from the Delight of it.

Amongst the Chymical Experiments to this purpose, may be reckoned up that famous Motion invented by *Cornelius Dreble*, and made for King *James*; wherein was represented the constant Revolutions of the Sun and Moon, and that without the help either of Springs or Weights. *Marcellus Vranckbein*, speaking of the Means whereby it was performed, he calls it, *Scintillula animæ magneticæ mundi, seu Astralis & insensibilis spiritus*; being that grand Secret, for the discovery of which, those Dictators of Philosophy, *Democritus*, *Pythagoras*, *Plato*, did Travel unto the *Gymnosophists*, and *Indian Priests*. The Author himself in his Discourse upon it, does not at all reveal the way how it was performed. But there is one *Thomas Tymme*, who was a familiar Acquaintance of his, and did often pry into his Works, (as he professes himself) who affirms it to be done thus; *By extracting a fiery Spirit out of the Mineral Matter, joining the same with his proper Air, which in-*
cluded

Celebrated in an Epigram by *Hugo Grotius*, l. 1. *Epist. ad Ernestum de Lamp. Vita.*

Epist. ad Jacobum Regem.

cluded in the Axle Tree (of the first moving Wheel) being hollow, carrieth the other Wheels, making a continual Rotation, except issue or vent be given in this hollow Axle Tree, whereby the imprisoned Spirit may get forth.

Philosophical Dialogue. Confer. 2. cap. 3.

What strange Things may be done by such Extractions, I know not, and therefore dare not condemn this Relation as impossible; but methinks it sounds rather like a Chymical Dream, than a Philosophical Truth. It seems this imprisoned Spirit is now set at Liberty, or else is grown weary, for the Instrument (as I have heard) hath stood still for many Years. It is here considerable that any Force is weakest near the Center of a Wheel; and therefore though such a Spirit might of it self have an Agitation, yet 'tis not easily conceivable how it should have Strength enough to carry the Wheels about with it. And then the Absurdity of the Author's citing this, would make one mistrust his Mistake; he urges it as a strong Argument against *Copernicus*, as if because *Dreble* did thus contrive in an Engine the Revolution of the Heavens, and the Immoveableness of the Earth, therefore it must needs follow that 'tis the Heavens which are moved, and not the Earth. If his Relation were no truer than his Consequence, it had not been worth the Citing.

CHAP. X.

Of Subterraneous Lamps; divers Historical Relations concerning their Duration for many Hundred Tears together.

UNTO this kind of Chymical Experiments, we may most probably reduce those perpetual Lamps, which for many Hundred Years together

have continued burning without any new supply in the Sepulchres of the Ancients, and might (for ought we know) have remained so for ever. All Fire, and especially Flame, being of an active and stirring Nature, it cannot therefore subsist without Motion; whence it may seem, that this great Enquiry hath been this way accomplished: And therefore it will be worth our Examination to search further into the Particulars that concern this Experiment. Though it be not so proper to the chief purpose of this Discourse, which concerns *Mechanical Geometry*, yet the Subtilty and Curiosity of it may abundantly requite the Impertinency.

There are sundry Authors, who Treat of this Subject on the by, and in some particular Passages, but none that I know of (except *Fortunius Licetus*) that hath writ purposely any set and large Discourse concerning it: Out of whom I shall borrow many of those Relations and Opinions, which may most naturally conduce to the present Enquiry.

For our fuller understanding of this, there are these Particulars to be explained:

- $$\left\{ \begin{array}{l} 1. \ \delta\pi, \text{ or } \textit{quod sit.} \\ 2. \ \delta\acute{\iota}\pi \left\{ \begin{array}{l} \textit{cur sit.} \\ \textit{quomodo sit.} \end{array} \right. \end{array} \right.$$

I. First then, for the $\delta\pi$, or that there have been such Lamps, it may be evident from sundry plain and undeniable Testimonies: *St. Justin* mentions one of them in a Temple dedicated to *Venus*, which was always exposed to the open Weather, and could never be consumed or extinguished. To him assents the judicious *Zanchy*. *Pancyröllus* mentions a Lamp found in his Time, in the Sepulchre of *Tullia*, *Cicero's* Daughter, which had continued there for about 1550 Years, but was presently extinguished upon the admission of new Air. And 'tis commonly related

*Lib. de re-
conditis
antiquo-
rum lucer-
nis.*

*De civitat.
Dei l. 21.
c. 6.*

*De operibus
Dei, pars 1.
l. 4. c. 12.
De deperd.
Tit. 35.*

of *Cedrenus*, that in *Justinian's* Time there was another burning Lamp found in an old Wall at * *Edessa*, which had remained so for above 500 Years, there being a Crucifix placed by it, whence it should seem, that they were in Use also amongst some Christians.

* Or *Antioch. Licetus de Lucernis, l. 1. c. 7.*

But more especially remarkable, is that Relation celebrated by so many Authors, concerning *Olybius* his Lamp, which had continued burning for 1500 Years. The Story is thus: As a Rustick was digging the Ground by *Padua*, he found an Urn or Earthen Pot, in which there was another Urn, and in this lesser, a Lamp clearly burning; on each side of it there were two other Vessels, each of them full of a pure Liquor; the one of Gold, the other of Silver. *Ego Chymiaæ artis, (simodo vera potest esse ars Chymia) jurare ausim elementa & materiam omnium,* (saith *Maturantius*, who had the Possession of these things after they were taken up.) On the bigger of these Urns there was this Inscription:

*Plutoni sacrum munus ne attingite fures.
 Ignotum est vobis hoc quod in orbe latet,
 Namque elementa gravi clausit digesta labore
 Vase sub hoc modico, Maximus Olybius.
 Adsit fecundo custos sibi copia cornu,
 Ne tanti pretium depereat laticis.*

The lesser Urn was thus inscribed.

*Abite hinc pessimi fures,
 Vos quid vultis, vestris cum oculis emissitiis?
 Abite hinc, vestro cum Mercurio
 Petasato Caduceatoque,
 Donum hoc Maximum, Maximus Olybius
 Plutoni sacrum facit.*

Whence we may probably conjecture that it was some Chymical Secret, by which this was contrived:

Mag. Natural. l. 12. cap. ult.

Baptista Porta tells us of another Lamp burning in an old marble Sepulchre, belonging to some of the Ancient Romans, inclosed in a Glass Vial, found in his Time, about the Year 1550, in the Isle *Nefis*, which had been buried there before our Saviour's coming.

Chron. Martin. Fort. Licet. de lucern. l. 1. c. 11.

In the Tomb of *Pallas*, the *Archeadian* who was slain by *Turnus* in the *Trojan War*, there was found another burning Lamp, in the Year of our Lord 1401. Whence it should seem, that it had continued there for above Two thousand and Six hundred Years: And being taken out, it did remain burning, notwithstanding either Wind or Water, with which some did strive to quench it; nor could it be extinguished till they had spilt the Liquor that was in it.

Not. ad August. de civit. Dei, l. 21. c. 6.

Ludovicus Vives tells us of another Lamp, that did continue burning for 1050 Years, which was found a little before his Time.

Such a Lamp is likewise related to be seen in the Sepulchre of *Francis Rosicrosse*, as is more largely expressed in the Confession of that Fraternity.

There is another Relation of a certain Man, who upon occasion digging somewhat deep in the Ground did meet with something like a Door, having a Wall on each Hand of it; from which having cleared the Earth, he forced open this Door, upon this there was discovered a fair Vault, and towards the further Side of it, the Statue of a Man in Armour, sitting by a Table, leaning upon his Left Arm, and holding a Scepter in his Right Hand, with a Lamp burning before him; the Floor of this Vault being so contrived, that upon the first Step into it, the Statue would erect it self from its leaning Posture; upon the second Step it did lift up the Scepter to strike, and before a Man could approach near enough to take hold of the Lamp, the Statue did strike and break it to Pieces: Such Care was there taken that

it might not be stoln away, or discovered.

Our Learned *Cambden* in his Description of *Yorkshire*, speaking of the Tomb of *Constantius Cblerus*, broken up in these later Years, mentions such a Lamp to be found within it. Pag. 572.

There are fundry other Relations to this Purpose.

Quod ad lucernas attinet, illæ in omnibus fere monumentis inveniuntur, (saith *Gutherius*.) In most of the Ancient Monuments there is some kind of Lamp, (tho' of the ordinary Sort:) But those Persons who were of greatest Note and Wisdom, did procure such as might last without Supply, for so many Ages together. De jure manium, l. 2. c. 32.

Pancirollus tells us, that it was usual for the Nobles amongst the *Romans*, to take special Care in their last Wills, that they might have a Lamp in their Monuments. And to this Purpose they did usually give Liberty unto some of their Slaves on this Condition, that they should be watchful in maintaining and preserving it. From all which Relations, the first particular of this Enquiry, concerning the Being or Existence of such Lamps, may sufficiently appear. De perdit. Tit. 62.

C H A P. XI.

Several Opinions concerning the Nature and Reason of these perpetual Lamps.

THere are two Opinions to be answered, which do utterly overthrow the chief Consequence from these Relations.

1. Some think that these Lights so often discovered in the Ancient Tombs, were not Fire or Flame, but only some of those bright Bodies which do usually shine in dark Places.

2. Others grant them to be Fire, but yet think them

them to be then first enkindled by the Admission of new Air, when these Sepulchres were opened.

I. There are divers Bodies (saith *Aristotle*) which shine in the Dark, as rotten Wood, the Scales of some Fishes, Stones, the Glowworm, the Eyes of divers Creatures. *Cardan* tells us of a Bird in new Spain, called *Cocoyum*, whose whole Body is very bright, but his Eyes almost equal to the Light of a Candle, by which alone in a dark Night, one may both write and read: By these the *Indians* (saith he) use to eat their feasting Suppers.

It is commonly related and believed, that a Carbuncle does shine in the Dark like a burning Coal, from whence it hath its * Name. To which Purpose there is a Story in *Ælian* of a Stork, that by a certain Woman was cured of a broken Thigh, in Gratitude to whom, this Fowl afterwards flying by her, did let fall into her Lap a bright Carbuncle, which (saith he) would in the Night Time shine as clear as a Lamp. But this and the like old Relations are now generally disbelieved and rejected by learned Men: *Doctissimorum omnium consensu, hujusmodi gemmæ non inveniuntur*, (saith *Boetius de Boot*) a Man very much skilled in, and inquisitive after such Matters; nor is there any one of Name that does from his own Eye-sight or Experience, affirm the real Existence of any Gem so qualified.

Some have thought that the Light in Ancient Tombs hath been occasioned from some such Bodies as these. For if there had been any Possibility to preserve Fire so long a Space, 'tis likely then that the *Israelites* would have known the Way, who were to keep it perpetually for their Sacrifices.

But to this Opinion it might be replied, that none of these *Noctiluce*, or Night-shining Bodies have been observed in any of the Ancient Sepulchres, and therefore this is a mere imaginary Conjecture; and then

De anima,
l. 2. c. 7.

Subtil. l. 9.

* *Carlo*
Pyropus.
Historia
Anim. l. 8.

De Lapid.
& Gemmis.
l. 2. c. 8.

Vide Li-
cer. de lu-
cern. l. 2.

then besides, some of these Lamps have been taken out burning, and continued so for a considerable Space afterwards. As for the supposed Conveniency of them, for the perpetuating of the Holy Fire amongst the *Jews*, it may as well be feared lest these should have occasioned their Idolatry, unto which that Nation was so strongly addicted, upon every slight Occasion; nor may it seem strange, if the Providence of God should rather permit this Fire sometimes to go out, that so by their earnest Prayers, being again renewed from Heaven, (as it * sometimes was) the Peoples Faith might be the better stirred up and strengthened by such frequent Miracles.

2. It is the Opinion of *Gutherius*, that these Lamps have not continued burning for so long a Space, as they are supposed in the former Relations; but that they were then first enflamed by the Admission of new Air, or such other occasion, when the Sepulchres were opened: As we see in those fat Earthy Vapours of divers Sorts, which are oftentimes enkindled into a Flame. And 'tis said, that there are some Chymical Ways, whereby Iron may be so heated, that being closely luted in a Glass, it shall constantly retain the Fire for any Space of Time, though it were for a thousand Years or more; at the end of which, if the Glass be opened, and the fresh Air admitted, the Iron shall be as red Hot as if it were newly taken out of the Fire.

But for answer to this Opinion, 'tis considerable that some Urns have had Inscriptions on them, expressing that the Lamps within them were burning, when they were first buried. To which may be added the Experience of those which have continued so for a good Space afterwards; whereas the Inflammation of fat and viscous Vapours does presently vanish. The Lamp which was found in the Isle *Nefis*, did burn clearly while it was inclosed in

* Levit. 9.

24.

2 Chron.

7. 1.

1 King. 18.

38.

De jure

Mani. l. 2

c. 32.

the Glass, but that being broken, was presently extinguished. As for that Chymical Relation, it may rather serve to prove that Fire may continue so many Ages, without consuming any Fewel.

So that notwithstanding the opposite Opinions, yet 'tis more probable that there have been such Lamps as have *remained burning*, without any new Supply, for many hundred Years together ; which was the first Particular to be explained.

Cur sint.

2. Concerning the Reason why the Ancients were so careful in this Particular, there are divers Opinions. Some think it to be an Expression of their Belief, concerning the Soul's Immortality, after its departure out of the Body ; a Lamp amongst the *Egyptians* being the *Hieroglyphick* of Life. And therefore they that could not procure such Lamps, were yet careful to have the Image and Representation of them engraved on their Tombs.

Others conceive them to be by way of Gratitude to those infernal Deities, who took the Charge and Custody of their dead Bodies *remaining* always with them in their Tombs, and were therefore called *Dii manes*.

Others are of Opinion, that these Lamps were only intended to make their Sepulchres more pleasant and lightsome, that they might not seem to be imprisoned in a dismal and uncomfortable Place. True indeed, the dead Body cannot be sensible of this Light, no more could it of its want of Burial ; yet the same Instinct which did excite it to the Desire of one, did also occasion the other.

De Lucernis, l. 3. c. 8.

Licetus concludes this Ancient Custom to have a double End. 1. *Politick*, for the Distinction of such as were nobly born, in whose Monuments only they were used. 2. *Natural*, to preserve the Body and Soul from Darkness ; for it was a common Opinion amongst them, that the Souls also were much conversant about those Places where the Bodies were buried.

CHAP.

C H A P. XII.

The most probable Conjecture, how these Lamps were framed.

THE greatest difficulty of this Enquiry doth consist in this last Particular, concerning the manner how, or by what possible Means any such perpetual Flame may be contrived.

Quomodo sint.

For the discovery of which, there are two things to be more especially considered.

1. The Snuff, or Wick, which must administer unto the Flame.

2. The Oil, which must nourish it.

For the first, it is generally granted that there are divers Substances which will retain Fire without consuming: Such is that Mineral which they call the Salamanders Wooll, saith our Learned * Bacon. *Ipse expertus sum villos Salamandræ non consumi*, saith † Joachimus Fortius. And * Wecker, from his own knowledge, affirms the same of *Plumeallum*, that being formed into the likeness of a Wick, will administer to the Flame, and yet not consume it self. Of this Nature likewise was that which the Ancients did call *Linum Virum*, or *Asbestinum*: Of this they were wont to make Garments, that were not destroyed, but purified by Fire; and whereas the Spots or Foulness of other Cloaths are washed out, in these they were usually burnt away. The Bodies of the ancient Kings were wrapped in such Garments, when they were put in the Funeral Pile, that their Ashes might be therein preserved, without the mixture of any other. The Materials of them were not from any Herb or Vegetable, as other Textiles, but from a Stone called *Amiantus*; which being bruised by a Hammer,

* Nat. Hist.

Exper. 774.

† Lib. Exper.

per.

* De Secretis, l. 3. c. 2.

Or *Linum*

Carpasium.

Plutarch,

de Oracul.

defectu.

Plin. Hist.

l. 19. c. 1.

Hammer, and its earthly Nature shaken out, retains certain hairy Substances, which may be Spun and Woven, as Hemp or Flax. *Pliny* says, that for the Preciousness of it, it did almost equal the Price of Pearls. *Pancirollus* tells us, that it was very rare, and esteemed precious in ancient Times, but now is scarce found or known in any Places, and therefore he reckons it amongst the things that are lost. But *L. Vives* affirms, that he hath often seen Wicks made of it at *Paris*, and the same Matter woven into a Napkin at *Louvaine*, which was cleansed by being burnt in the Fire.

*De perd.
Tit. 4.*

*In August.
de Civit.
Dei, l. 21.
c. 6.*

'Tis probable from these various Relations, that there was several Sorts of it; some of a more precious, other of a baser kind, that was found in *Cyprus*, the Deserts of *India*, and a certain Province of *Asia*; this being common in some Parts of *Italy*, but is so short and brittle, that it cannot be spun into a Thread; and therefore is useful only for the Wicks of perpetual Lamps, saith *Boetius de Boot*. Some of this, or very like it, I have upon Enquiry lately procured and experimented; but whether it be the Stone *Asbestus*, or only *Plumeallum*, I cannot certainly affirm; for it seems they are both so very like, as to be commonly Sold for one another (saith the same Author.) However, it does truly agree in this common Quality ascribed unto both, of being Incombustible, and not consumable by Fire: But yet there is this Inconvenience, That it doth contract so much Fuliginous Matter from the Earthly Parts of the Oil, (though it was tryed with some of the purest Oil which is ordinary to be bought) that in a very few Days it did choak and extinguish the Flame. There may possibly be some Chymical way, so to purifie and defecate this Oil, that it shall not spend into a sooty Matter.

*De lapid.
& gemmis,
l. 2. c. 204.*

However, if the Liquor be of a close and Glutinous Consistency, it may burn without any Snuff,

as we see in Camphire, and some other Bituminous Substances. And it is probable that most of the ancient Lamps were of this kind, because the exactest Relations (to my Remembrance) do not mention any that have been found with such Wicks.

But herein will consist the greatest Difficulty, to find out what Invention there might be for their Duration: Concerning which there are sundry Opinions.

St. *Austin* speaking of that Lamp in one of the Heathen Temples, thinks that it might either be done by Magick, (the Devil thinking thereby to promote the Worship and Esteem of that Idol to which it was Dedicated) or else, that the Art of Man might make it of some such Material, as the Stone *Asbestos*, which being once kindled, will burn without being consumed. As others (saith he) have contrived as great a Wonder in appearance, from the natural Virtue of another Stone, making an Iron Image seem to hang in the Air, by reason of two Loadstones, the one being placed in the Ceiling, the other in the Floor.

Deciv. Dei,
l. 21. c. 6.

Zanch. de
Operibus
Dei, par. 1.
l. 4. c. 12.

Others are of Opinion, that this may be effected in a hollow Vessel, exactly luted or stopped up in all the Vents of it: And then, if a Lamp be supposed to burn in it but for the least moment of time, it must continue so always, or else there would be a *Vacuum*, which Nature is not capable of. If you ask how it shall be nourished, it is answered, That the Oil of it being turned into Smoak and Vapours, will again be converted into its former Nature; for otherwise, if it should remain Rarified in so thin a Substance, then there would not be room enough for that Fume which must succeed it; and so on the other side, there might be some danger of the Penetration of Bodies, which Nature doth as much abhor. To prevent both which, as it is in the Chymical Circulations, where the same Body is often-

times

times turned from Liquor into Vapour, and from Vapour into Liquor again; so in this Experiment, the same Oil shall be turned into Fume, and that Fume shall again convert into Oil. Always provided, that this Oil which nourishes the Lamp, be supposed of so close and tenacious a Substance, that may slowly evaporate, and so there will be the more Leisure for Nature to perfect these Circulations. According to which Contrivance, the Lamp within this Vessel can never fail, being always supplied with sufficient Nourishment. That which was found in the Isle *Nefis*, inclosed in a Glass-Vial, mentioned by *Baptista Porta*, is thought to be made after some such manner as this.

Others conceive it possible to extract such an Oil out of some Minerals, which shall for a long space serve to nourish the Flame of a Lamp, with very little or no Expence of its own Substance. To which purpose (say they) if Gold be dissolved into an unctuous Humour, or if the radical Moisture of that Metal were separated, it might be contrived to burn (perhaps for ever, or at least) for many Ages together, without being consumed. For, if Gold it self (as Experience shews) be so untameable by the Fire, that after many Meltings and violent Heats, it does scarce diminish, 'tis probable then, that being dissolved into an Oily Substance, it might for many hundred Years together continue burning.

There is a little Chymical Discourse, to prove that *Urim* and *Thummim* is to be made by Art. The Author of this Treatise affirms that place, *Gen. 6. 16.* where God tells *Noah*, *A Window shalt thou make in the Ark*, to be very unfitly rendred in our Translation, a *Window*; because the original Word *צַדִּיק* signifies properly Splendor, or Light: And then besides, the Air being at that time so extremely darkened with the Clouds of that excessive Rain, a Window could be but of very little use in regard of

Light,

Wolphang.
Lazius, l. 3.
c. 18.
Camb. Brit.
p. 572.

Light, unless there were some other help for it. From whence he conjectures, that both this Splendor, and so likewise the *Urim* and *Thummim* were artificial Chymical Preparations of Light, answerable to these subterraneous Lamps; or in his own Phrase, it was *the universal Spirit fixed in a transparent Body*.

It is the Opinion of *Licetus*, (who hath more exactly searched into the Subtilties of this Enquiry) that Fire does not need any Humour for the Nourishment of it, but only to detain it from flying upwards: For, being in it self one of the chief Elements (saith he out of *Theophrastus*) it were absurd to think that it could not subsist without something to feed it. As for that Substance which is consumed by it, this cannot be said to foment or preserve the same Fire, but only to generate new. For the better understanding of this, we must observe, that there may be a threefold proportion betwixt Fire, and the Humour, or Matter of it. Either the Humour does exceed the strength of the Fire, or the Fire does exceed the Humour; and according to both these, the Flame doth presently vanish. Or else lastly, they may be both equal in their Virtues, (as it is betwixt the Radical Moisture, and Natural Heat in Living Creatures) and then neither of them can overcome, or destroy the other.

Those ancient Lamps of such long Duration, were of this later kind: But now, because the Qualities of Heat or Cold, Dryness or Moisture in the ambient Air, may alter this Equality of Proportion betwixt them, and make one stronger than the other; therefore to prevent this, the Ancients did hide these Lamps in some Caverns of the Earth, or close Monuments. And hence is it, that at the opening of these, the admission of new Air unto the Lamp does usually cause so great an Inequality betwixt the Flame and the Oil, that it is presently extinguished.

But

De Lucernis, c. 20, 21.

But still, the greatest Difficulty remains how to make any such exact Proportion betwixt an unctuous Humour, and such an active Quality as the heat of Fire ; or this Equality being made, it is yet a further Difficulty, how it may be preserved. To which purpose, *Licetus* thinks it possible to extract an inflammable Oil from the Stone *Asbestos*, *Amiantus*, or the Metal Gold ; which being of the same pure and homogeneous Nature with those Bodies, shall be so proportioned unto the heat of Fire, that it cannot be consumed by it ; but being once inflamed, should continue for many Ages, without any sensible Diminution.

If it be in the power of Chymistry to perform such strange Effects, as are commonly experimented in that which they call *Aurum Fulminans*, one Scruple of which shall give a louder Blow, and be of greater force in Descent, than half a Pound of ordinary Gunpowder in Ascend ; why may it not be as feasible by the same Art, to extract such an Oil as is here enquired after ? since it must needs be more difficult to make a Fire, (which of its own Inclination shall tend downwards) than to contrive such an unctuous Liquor, wherein Fire shall be maintained for many Years without any new supply.

Thus have I briefly set down the Relations and Opinions of divers Learned Men, concerning these perpetual Lamps ; of which, though there have been so many sundry kinds, and several ways to make them, (some being able to resist any Violence of Weathers, others being easily extinguished by any little alteration of the Air, some being inclosed round about within Glass, others being open ;) yet now they are all of them utterly perished amongst the other Ruins of Time ; and those who are most versed in the search after them, have only recovered such dark Conjectures, from which a Man cannot clearly deduce any evident Principle, that may encourage him to a particular Trial.

C H A P. XIII.

Concerning several Attempts of Contriving a perpetual Motion, by Magnetical Virtues.

THE second way whereby the making of a perpetual Motion hath been attempted, is by Magnetical Virtues; which are not without some strong Probabilities of proving effectual to this purpose: Especially when we consider, that the Heavenly Revolutions, (being as the first Pattern imitated and aimed at in these Attempts) are all of them performed by the help of these Qualities. This great Orb of Earth, and all the other Planets, being but as so many Magnetical Globes, endowed with such various and continual Motions, as may be most agreeable to the Purposes for which they were intended. And therefore most of the Authors, who treat concerning this Invention, do agree, that the likeliest way to effect it, is by these kind of Qualities.

It was the Opinion of *Pet. Peregrinus*, and there is an Example pretended for it in *Bettinus*, (*Apiar. 9. Progym. 5. pro. 11.*) that a Magnetical Globe, or Terella, being rightly placed upon its Poles, would of it self have a constant Rotation, like the Diurnal Motion of the Earth: But this is commonly exploded, as being against all Experience.

Others think it possible, so to contrive several Pieces of Steel and a Load-Stone, that by their continual Attraction, and Expulsion of one another, they may cause a perpetual Revolution of a Wheel. Of this Opinion were ^a *Taisner*, ^b *Pet. Peregrinus*, and ^c *Cardan*, out of *Antonius de Fantis*. But *D. Gilbert*, who was more especially versed in Magnetical Experiments, concludes it to be a vain and groundless Fancy.

Gilbert de Magnet.
Cabæus Philos.
Magnet.
l. 4. c. 20.

Atkanas.
Kincher, de Arte Magnet.
l. 1. par. 2, prop. 13.
Item l. 2. p. 4.

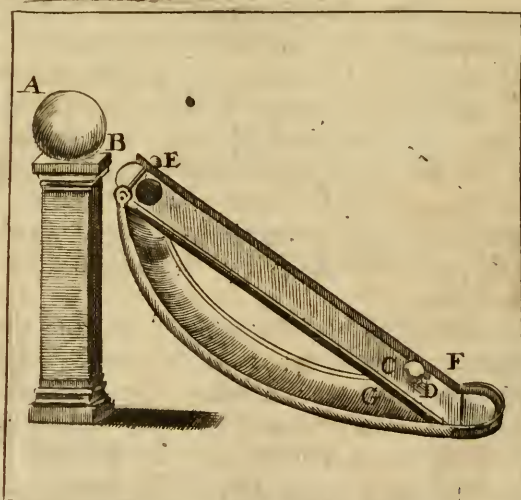
^a *Tract. de motu continuo.*

^b *De Rota perpetui motus par.*
2. c. 3.

^c *De Variet. rerum,*
l. 9. c. 48.
De Magnet.

But *l. 2. c. 35.*

But amongst all these kind of Inventions, that is most likely, wherein a Load-Stone is so disposed, that it shall draw unto it on a reclined Plane, a Bullet of Steel, which Steel as it ascends near to the Load-stone, may be contrived to fall down thro' some Hole in the Plane, and so to return unto the Place from whence at first it began to move; and being there, the Loadstone will again attract it upwards, till coming to this Hole, it will fall down again; and so the Motion shall be perpetual, as may be more easily conceivable by this Figure.



Suppose the Load-Stone to be represented at *AB*, which, though it have not strength enough to attract the Bullet *C* directly from the Ground, yet may do it by the help of the Plane *EF*. Now, when the Bullet is come to the top of this Plane, its own Gravity (which is supposed to exceed the strength of

of the Loadstone) will make it fall into that Hole at E ; and the force it receives in this fall, will carry it with such a violence unto the other end of this Arch, that it will open the Passage which is there made for it, and by its return will again shut it; so that the Bullet, (as at the first) is in the same Place whence it was attracted, and consequently must move perpetually.

But however this Invention may seem to be of such strong probability, yet there are sundry Particulars which may prove it insufficient: For;

1. This Bullet of Steel must first be touched, and have its several Poles, or else there can be little or no Attraction of it. Suppose C in the Steel to be answerable unto A in the Stone, and to B ; in the Attraction, CD must always be directed answerable to AB , and so the Motion will be more difficult, by reason there can be no Rotation, or turning round of the Bullet, but it must slide up with the Line CD , answerable to the Axis AB .

2. In its fall from E to G , which is *motus elementaris*, and proceeds from its Gravity, there must needs be a Rotation of it, and so 'tis odds but it happens wrong in the rise, the Poles in the Bullet being not in the same Direction to those in the Magnet: And if in this Reflex, it should so fall out, that D should be directed towards B , there should be rather a Flight than an Attraction, since those two ends do *repel*, and not draw one another.

3. If the Loadstone AB have so much strength, that it can attract the Bullet in F when it is not turned round, but does only slide upon the Plane, whereas its own Gravity would rowl it downwards; then it is evident, the Sphere of its Activity and Strength would be so increased when it approaches much nearer, that it would not need the assistance of the Plane, but would draw it immediately to it self without that help; and so the Bullet would not fall

down through the Hole, but ascend to the Stone, and consequently cease its Motion: For, if the Loadstone be of force enough to draw the Bullet on the Plane, at the distance FB , then must the strength of it be sufficient to attract it immediately unto it self, when it is so much nearer as EB . And if the Gravity of the Bullet be supposed so much to exceed the strength of the Magnet, that it cannot draw it directly when it is so near, then will it not be able to attract the Bullet up the Plane, when it is so much further off.

So that none of all these Magnetical Experiments, which have been as yet discovered, are sufficient for the effecting of a perpetual Motion, though these kind of Qualities seem most conducive unto it, and perhaps hereafter it may be contrived from them.

C H A P. XIV.

The seeming Probability of effecting a continual Motion by solid Weights, in a hollow Wheel or Sphere.

THE third way whereby the making of a perpetual Motion hath been attempted, is by the natural Affection of Gravity; when the Heaviness of several Bodies is so contrived, that the same Motion which they give in their Descent, may be able to carry them up again.

But, (against the Possibility of any such Invention) it is thus objected by *Cardan*. All Sublunary Bodies have a direct Motion either of Ascent, or Descent; which, because it does refer to some Term, therefore cannot be perpetual, but must needs cease, when it is arrived at the Place unto which it naturally tends.

*Subtil. l. 17.
De Var.
Rerum, l. 9.
c. 48.*

I answer, Though this may prove that there is no Natural Motion of any particular heavy Body, which is perpetual, yet it doth not hinder, but that it is possible from them to contrive such an artificial Revolution, as shall constantly be the cause of it self.

Those Bodies which may be serviceable to this purpose, are distinguishable into two kinds.

1. Solid and Consistent, as Weights of Metal, or the like.

2. Fluid, or Sliding; as Water, Sand, &c.

Both these ways have been attempted by many, though with very little or no success. Other Mens Conjectures in this kind you may see set down by divers Authors. It would be too tedious to repeat them over, or set forth their Draughts. I shall only mention two new ones, which (if I am not overpartial) seem altogether as probable as any of these kinds that have been yet invented; and till Experience had discovered their Defect and Insufficiency, I did certainly conclude them to be Infallible.

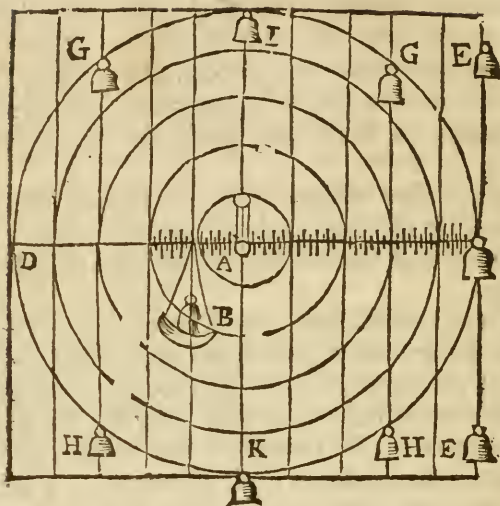
The first of these Contrivances was by solid Weights being placed in some hollow Wheel or Sphere, unto which they should give a perpetual Revolution: For (as the Philosopher hath largely proved) only a Circular Motion can properly be perpetual.

But for the better conceiving of this Invention, it is requisite that we rightly understand some Principles in *Trochilicks*, or the Art of Wheel-Instruments: As chiefly, the Relation betwixt the Parts of a Wheel, and those of a Ballance; the several Proportions in the Semidiameter of a Wheel, being answerable to the Sides in a Ballance, where the Weight is multiplied according to its distance from the Center.

D. Flud.
Tract. 2. }
pars 7. l. 2.
c. 4. & 7.

Arist. Phys.
l. 8. c. 12.

Arist. Me-
chan. c. 2.
De ratione
libra ad
circularem



Thus, suppose the Center to be at *A*, and the Diameter of the Wheel *D C* to be divided into equal Parts (as is here expressed) it is evident, according to the former Ground, that one Pound at *C* will equiponderate to Five Pound at *B*, because there is such a proportion betwixt their several Distances from the Center. And it is not material, whether or no these several Weights be placed Horizontally; for though *B* do hang lower than *C*, yet this does not at all concern the Heaviness; or though the Plummet *C* were placed much higher than it is at *E*, or lower at *F*, yet would it still retain the same Weight which it had at *C*; because these Plummets (as in the Nature of all heavy Bodies) do tend downwards by a strait Line: So that their several Gravities are to be measured by that part of the Horizontal Semidiameter, which is directly either below or above them. Thus when the Plummet *C* shall be moved either to *G* or *H*, it will lose $\frac{1}{5}$ of its

for

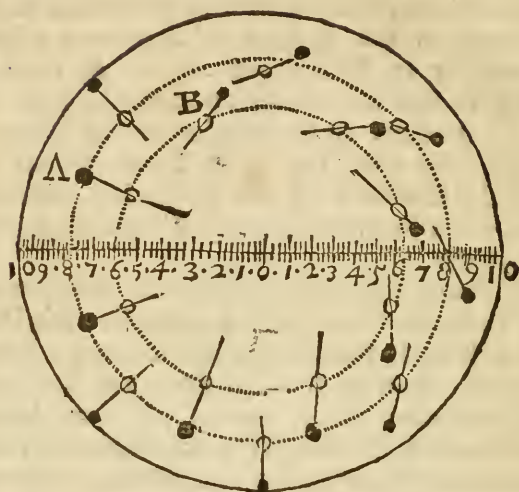
former Heaviness, and be equally ponderous as if it were placed in the Balance at Number 3; and if we suppose it to be situated at *I* or *K*, then the Weight of it will lie wholly upon the Center, and not at all conduce to the Motion of the Wheel on either side. So that the strait Lines which pass through the Divisions of the Diameter, may serve to measure the Heaviness of any Weight in its several Situations.

These things throughly considered, it seems very possible and easie for a Man to contrive the Plumets of a Wheel, that they may be always heavier in their Fall, than in their Ascent; and so consequently, that they should give a perpetuall Motion to the Wheel it self; since it is impossible for that to remain unmoved, as long as one side in it is heavier than the other.

For the performance of this, the Weights must be so ordered, 1. That in their Descent they may fall from the Center, and in their Ascent may rise nearer to it. 2. That the Fall of each Plummet may begin the Motion of that which should succeed it. As in this following Diagram.

R r 3

Where



Where there are 16 Plummetts, 8 in the inward Circle, and as many in the outward, (the inequality being to arise from their Situation, it is therefore most convenient that the Number of them be even.) The 8 inward Plummetts are supposed to be in themselves so much heavier than the other, that in the Wheel they may be of equal Weight with those above them, and then the Fall of these will be of sufficient Force to bring down the other. For Example, if the outward be each of them Four Ounces, then the inward must be Five; because the outward is distant from the Center Five of those Parts, whereof the inward is but Four. Each Pair of these Weights should be joined together by a little String or Chain, which must be fastned about the middle, betwixt the Bullet and the Center of that Plummet which is to fall first, and at the Top of the other.

When these Bullets in their Descent are at their farthest Distance from the Center of the Wheel, then shall

shall they be stopped, and rest on the Pins placed to that Purpose ; and so in their rising, there must be other Pins to keep them in a convenient Posture and Distance from the Center, lest approaching too near unto it, they thereby become unfit to fall, when they shall come to the Top of the descending Side.

This may be otherwise contrived with some different Circumstances, but they will all redound to the same Effect. By such an Engine it seems very probable, that a Man may produce a perpetual Motion. The Distance of the Plummetts from the Center increasing their Weight on one Side, and their being tied to one another, causing a constant Succession in their falling,

But now, upon Experience I have found this to be fallacious, and the Reason may sufficiently appear by a Calculation of the Heaviness of each Plummet, according to its several Situation ; which may easily be done by those Perpendiculars that cut the Diameter, (as was before explained, and is here expressed in 5 of the Plummetts on the descending Side.) From such a Calculation it will be evident, that both the Sides of this Wheel will equiponderate ; and so consequently that the supposed Inequality whence the Motion should proceed, is but Imaginary and Groundless. On the descending Side, the Heaviness of each Plummet may be measured according to these Numbers, (supposing the Diameter of the Wheel to be divided into Twenty Parts, and each of those subdivided into Four.)

The outward Plummetts.

$$\left[\begin{array}{cc} 7 & 0 \\ 10 & 0 \\ 7 & 0 \end{array} \right] \quad \text{The Sum } 24.$$

The inward Plummetts.

$$\left[\begin{array}{cc} 1 & 0 \\ 7 & 2 \\ 7 & 2 \\ 3 & 0 \end{array} \right] \quad \text{The Sum } 19.$$

On the ascending Side, the Weights are to be reckoned according to these Degrees.

The outward.

$$\left. \begin{array}{l} \{ 1 \quad 3 \} \\ \{ 7 \quad 2 \} \\ \{ 9 \quad 0 \} \\ \{ 5 \quad 3 \} \\ \{ 0 \quad 0 \} \end{array} \right\} \text{The Sum } 24.$$

The inward.

$$\left. \begin{array}{l} \{ 4 \quad 1 \} \\ \{ 7 \quad 0 \} \\ \{ 5 \quad 2 \} \\ \{ 2 \quad 1 \} \end{array} \right\} \text{The Sum } 19.$$

The Sum of which last Numbers is equal with the former, and therefore both the Sides of such a Wheel, in this Situation will equiponderate.

If it be objected, that the Plummet *A* should be contrived to pull down the other at *B*, and then the descending Side will be heavier than the other.

For answer to this, it is considerable,

1. That these Bullets towards the Top of the Wheel, cannot descend till they come to a certain kind of Inclination.

2. That any lower Bullet hanging upon the other above it, to pull it down, must be conceived, as if the Weight of it were in that Point where its String touches the upper; at which Point this Bullet will be of less Heaviness in respect of the Wheel, than if it did rest in its own Place: So that both the Sides of it, in any kind of Situation may equiponderate.

C H A P. XV.

Of composing a perpetual Motion by fluid Weights. Concerning Archimedes his Water-Screw. The great Probability of accomplishing this Enquiry by the Help of that; with the Fallibleness of it upon Experiment.

THAT which I shall mention as the last Way, for the Trial of this Experiment, is by contriving it in some Water-Instrument; which may seem altogether as probable and easie as any of the rest; because that Element by reason of its fluid and subtle Nature (whereby of its own accord it searches out the lower and more narrow Passages) may be most pliable to the Mind of the Artificer. Now the usual Means for the Ascent of Water, is either by *Suckers* or *Forces*, or something equivalent thereunto: Neither of which may be conveniently applied unto such a Work as this, because there is required unto each of them so much or more Strength, as may be answerable to the full Weight of the Water that is to be drawn up; and then besides, they move for the most part by Fits and Snatches, so that it is not easily conceivable, how they should conduce unto such a Motion, which by reason of its Perpetuity must be regular and equal.

But amongst all other ways to this Purpose, that Invention of *Archimedes* is incomparably the best, which is usually called *Cochlea*, or the *Water-screw*; being framed by the helical Revolution of a Cavity about a Cylinder. We have not any Discourse from the Author himself concerning it, nor is it certain whether he ever writ any thing to this Purpose. But if he did, yet as the Injury of Time hath deprived us of many other his excellent Works, so likewise of this amongst the Rest.

Athen.

Deipnosop.
l. 5.

Athenæus speaking of that great Ship built by *Hiero*, in the framing of which, there were Three hundred Carpenters employed for a Year together, besides many other Hirelings for Carriages, and such servile Works; mentions this Instrument as being instead of a Pump for that vast Ship; by the Help of which, one Man might easily and speedily drain out the Water, though it were very deep.

Biblioth.
l. 1.

Diodorus Siculus speaking of this Engine, tells us, that *Archimedes* invented it when he was in *Egypt*, and that it was used in that Countrey, for the draining of those Pits and lower Grounds, whence the Waters of *Nilus* could not return. Φιλοτέχνος δ' ὄντος τῶ ὀργάνου καὶ ὑπερβολῆν, (saith the same Author.) It

Cardan.
Subtil. l. 1.
Desapient.
l. 5.

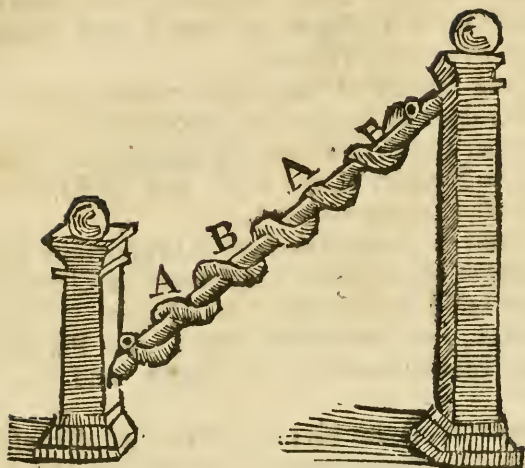
being an Engine so Ingenious and Artificial, as cannot be sufficiently expressed or commended. And so (it should seem) the Smith in *Milan* conceived it to be, who having without any Teaching or Information found it out, and therefore thinking himself to be the first Inventor, fell mad with the meer Joy of it.

The Nature and Manner of making this, is more largely handled by *Virruvius*.

Architect.
l. 10. c. 11.

The Figure of it is after this Manner.

Where



Where you see there is a Cylinder *AA*, and a spiral Cavity or Pipe twining about it, according to equal Revolutions *BB*. The Axis and Centers of its Motions are at the Points *CD*; upon which being turned, it will so happen, that the same part of the Pipe which was now lowermost, will presently become higher, so that the Water does ascend by descending; ascending in comparison to the whole Instrument, and descending in respect of its several Parts. This being one of the strangest Wonders amongst those many wherein these Mathematical Arts do abound, that a heavy Body should rise by falling down, and the farther it passes by his own natural Motion of Descent, by so much higher still shall it ascend; which though it seem so evidently to contradict all Reason and Philosophy, yet in this Instrument it may be manifested both by Demonstration and Sense.

This Pipe or Cavity, for the Matter of it, cannot easily be made of Metal, by reason of its often turn-

turnings; but for Trial, there might be such a Cavity cut in a Column of Wood, and afterwards covered over with Tin-plate.

For the Form and Manner of making this Screw, *Vitruvius* does prescribe these two Rules:

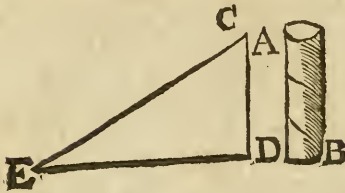
1. That there must be an Equality observed betwixt the Breadth of the Pipe, and the Distance of its several Circumvolutions.

2. That there must be such a Proportion betwixt the Length of the Instrument, and its Elevation, as is answerable to the *Pythagorical Trigon*. If the Hypotenusal, or Screw be Five, the Perpendicular or Elevation must be Three, and the Basis Four.

*David Ri-
vult. Com.
in Archim.
opera exte.*

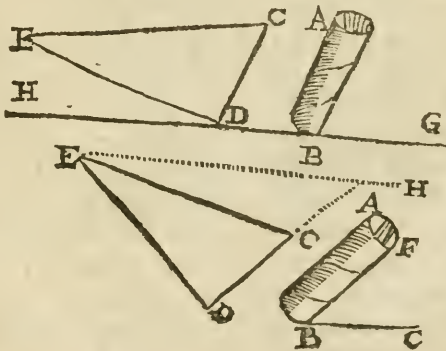
However, (with his Leave) neither of these Proportions are generally necessary, but should be varied according to other Circumstances. As for the Breadth of the Pipe in respect of its Revolutions, it is left at Liberty, and may be contrived according to the Quantity of Water which it should contain. The chief thing to be considered, is the Obliquity or Closeness of these Circumvolutions. For the nearer they are unto one another, the higher may the Instrument be erected; there being no other guide for its true Elevation but this.

And because the right understanding of this particular is one of the principal Matters that concerns the use of this Engine, therefore I shall endeavour with Brevity and Perspicuity to explain it. The first thing to be enquired after, is, what kind of Inclination these Helical Revolutions of the Cylinder have unto the Horizon; which may be thus found out.



Let AB represent a Cylinder with two perfect Revolutions in it, unto which Cylinder the Perpendicular Line CD is equal : The Basis DE being supposed to be double unto the Compass or Circumference of the Cylinder. Now it is certain, that the Angle CED , is the same with that by which the Revolutions on the Cylinder are framed, and that the Line EC , in comparison to the Basis ED , does shew the Inclination of these Revolutions unto the Horizon. The Grounds and Demonstration of this, are more fully set down by *Guidus Ubaldus*, in his *Mechanicks*, and that other Treatise *De Cochlea*, which he writ purposely for the Explication of this Instrument, where the Subtilties of it are largely and excellently handled.

Now if this Screw which was before Perpendicular, be supposed to decline unto the Horizon by the Angle FBG , as in this second Figure ;



then

then the Inclination of the Revolutions in it will be increased by the Angle $E D H$; though these Revolutions will still remain in a kind of Ascend, so that Water cannot be turned through them.

But now, if the Screw be placed so far declining, that the Angle of its Inclination $F B G$, be less than the Angle $E C D$, in the Triangle; as in this other Diagram under the former; then the Revolutions of it will descend to the Horizon, as does the Line $E C$; and in such a Posture, if the Screw be turned round, Water will ascend through its Cavity. Whence it is easie to conceive the certain Declination, wherein any Screw must be placed for its own Conveyance of Water upwards. Any Point betwixt H and D being in descent, but yet the more the Screw declines downwards towards D , by so much the more Water will be carried up by it.

If you would know the just Quantity of Water which every Revolution does contain and carry, according to any Inclination of the Cylinder; this may be easily found, by ascribing on it an *Ellipsis*, parallel to the Horizon; which *Ellipsis* will shew how much of the Revolution is empty, and how much full.

The true Inclination of the Screw being found, together with the certain Quantity of Water which every *Helix* does contain; it is further considerable, that the Water by this Instrument does ascend naturally of it self, without any Violence or Labour; and that the Heaviness of it does lie chiefly upon the Centers or Axis of the Cylinder, both its sides being of equal Weight (saith *Ubaldu*;) So that (it should seem) though we suppose each Revolution to have an equal Quantity of Water, yet the Screw will remain with any Part upwards, (according as it shall be set) without turning it self either way. And therefore the least Strength being added to either of its sides, should make it descend, according

See a further explanation of this in *Ubaldu de Cochlea*, l. 2. *prop.* 25.

Ibid. 3. *prop.* 4.

according to that common Maxim of *Archimedes* ; any Addition will make that which equiponderates with another, to tend downwards.

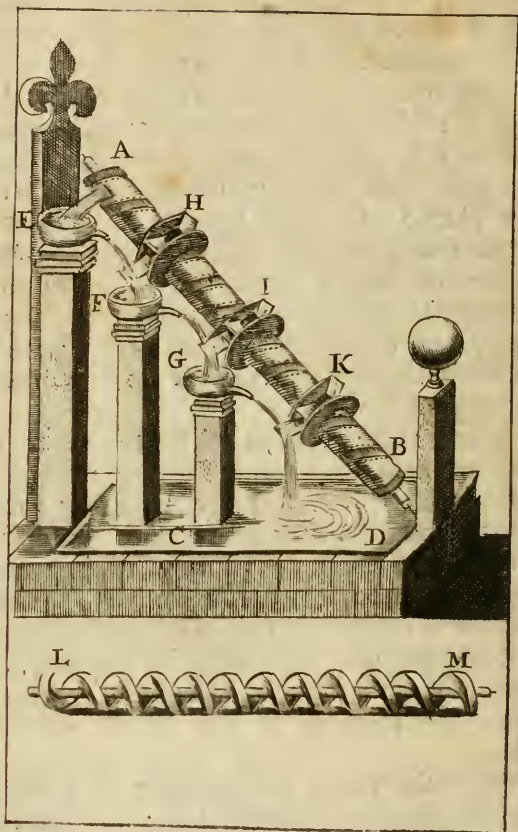
*De Æquipond. Sup-
pos. 3.*

But now, because the Weight of this Instrument, and the Water in it does lean wholly upon the Axis, hence is it (saith *Ubalduſ*) that the grating and rubbing of these Axes against the Sockets wherein they are placed, will cause some Ineptitude and Resistency to that Rotation of the Cylinder ; which would otherwise ensue upon the Addition of the least Weight to any one Side ; but (saith the same Author) any Power that is greater than this Resistency which does arise from the Axis, will serve for the turning of it round.

These things considered together, it will hence appear, how a perpetual Motion may seem easily contrivable. For if there were but such a Water-wheel made on this Instrument, upon which the Stream that is carried up may fall in its descent, it would turn the Screw round, and by that Means convey as much Water up as is required to move it ; so that the Motion must needs be continual, since the same Weight which in its Fall does turn the Wheel, is by the turning of the Wheel carried up again.

Or if the Water falling upon one Wheel, would not be forcible enough for this Effect, why then there might be two or three, or more, according as the Length and Elevation of the Instrument will admit : By which means, the Weight of it may be so multiplied in the Fall, that it shall be equivalent to twice or thrice that quantity of Water which ascends. As may be more plainly discerned by this following Diagram.

Where



Where the Figure *L M*, at the Bottom, does represent a wooden Cylinder with helical Cavities cut in it; which at *A B*, is supposed to be covered over with Tin-plates, and three Water-wheels upon it *H I K*. The lower Cistern which contains the Water being *C D*. Now this Cylinder being turned round, all the Water which from the Cistern ascends through it, will fall into the Vessel at *E*, and from that Vessel being conveyed upon the Water-wheel *H*, shall consequently give a circular Motion to the whole

whole Screw : Or if this alone should be too weak for the turning of it, then the same Water which falls from the Wheel *H*, being received into the other Vessel *F*, may from thence again descend on the Wheel *I* ; by which means the force of it will be doubled. And if this be yet insufficient, then may the Water which falls on the second Wheel *I*, be received into the other Vessel *G*, and from thence again descend on the third Wheel at *K* : And so for as many other Wheels as the Instrument is capable of. So that besides the greater Distance of these three Streams from the Center or Axis, by which they are made so much heavier, and besides, that the Fall of this outward Water is forcible and violent, whereas the Ascent of that within is natural ; besides all this, there is thrice as much Water to turn the Screw, as is carried up by it.

But on the other side, if all the Water falling upon one Wheel, would be able to turn it round, then half of it would serve with two Wheels ; and the rest may be so disposed of in the Fall, as to serve unto some other useful-delightful Ends.

When I first thought of this Invention, I could scarce forbear with *Archimedes* to cry out *ευρηκα, ευρηκα* ; it seeming so infallible a way for the effecting of a perpetual Motion, that nothing could be so much as probably objected against it : But upon Trial and Experience I find it altogether insufficient for any such Purpose, and that for these two Reasons :

1. The Water that ascends, will not make any considerable Stream in the Fall.

2. This Stream (tho' multiplied) will not be of Force enough to turn about the Screw.

1. The Water ascends gently, and by Intermissions ; but it falls continually, and with Force ; each of the three Vessels being supposed full at the first, that so the Weight of the Water in them might add the greater Strength and Swiftnes to the

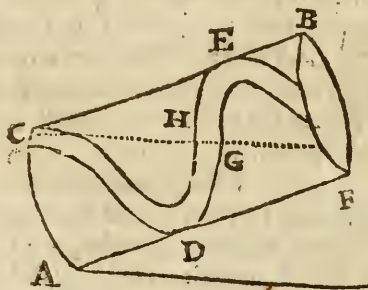
S f

Streams;

There is another like contrivance to this purpose in *Pet. Bettin. Apiar. 4. Pogym. 1. Prop. 10.* but with much less advantage than 'tis here proposed.

Streams, that descend from them. Now this Swift-ness of Motion will cause so great a Difference betwixt them, that one of these little Streams may spend more Water in the Fall, than a Stream six times bigger in the Ascent, tho' we should suppose both of them to be continuat; How much more then, when as the ascending Water is vented by Fits and Intermiſſions; every Circumvolution voiding only so much as is contained in one *Helix*? And in this particular, one that is not versed in these kind of Experiments, may be easily deceived.

But *Secondly*, tho' there were so great a Disproportion, yet notwithstanding, the Force of these outward Streams might well enough serve for the turning of the Screw; if it were so, that both its sides would equiponderate the Water being in them (as *Ubalduſ* hath affirmed.) But now, upon farther Examination, we shall find this Assertion of his to be utterly against both Reason and Experience. And herein does consist the chief Mistake of this Contrivance: For the ascending side of the Screw is made by the Water contained in it, so much heavier than the descending side, that these outward Streams thus applied, will not be of force enough to make them equiponderate, much less to move the whole; as may be more easily discern'd by this Fig.



Where *AB* represents a Screw cover'd over,
CDE one *Helix*, or Revolution of it, *CD* the Ascending
 cending

ending side, *ED* the Descending side, the Point *D* the middle. The Horizontal Line *CF*, shewing how much of the *Helix* is filled with Water, *viz.* of the Ascending side, from *C* the beginning of the *Helix*, to *D* the middle of it; and on the Descending side, from *D* the middle, to the Point *G*, where the Horizontal does cut the *Helix*. Now it is evident, that this latter part *DG*, is nothing near so much, and consequently not so heavy as the other *DC*. And thus is it in all the other Revolutions; which, as they are either more or larger, so will the Difficulty of this Motion be increased. Whence it will appear, that the outward Streams which descend, must be of so much Force, as to countervail all that Weight whereby the Ascending side in every one of these Revolutions does exceed the other. And tho' this may be effected by making the Water-wheels larger, yet then the Motion will be so slow, that the Screw will not be able to supply the outward Streams.

There is another Contrivance to this purpose, mentioned by *Kircher de Magnete*, l. 2. p. 4. depending upon the Heat of the Sun, and the Force of Winds; but it is liable to such abundance of Exceptions, that it is scarce worth the mentioning, and does by no means deserve the Confidence of any Ingenious Artist.

Thus have I briefly explained the Probabilities and Defects of those subtle Contrivances, whereby the making of a perpetual Motion hath been attempted. I would be loth to discourage the Enquiry of any ingenious Artificer, by denying the Possibility of effecting it with any of these Mechanical Helps: But yet (I conceive) if those Principles which concern the Slowness of the Power, in comparison to the Greatness of the Weight, were rightly understood, and thoroughly considered, they would make this Experiment to seem (if not al-

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of before,
l. 1. c

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together impossible, yet) much more difficult than otherwise perhaps it will appear. However, the Enquiring after it cannot but deserve our Endeavours, as being one of the most noble amongst all these Mechanical Subtilties. And (as it is in the Fable of him who dug the Vineyard for a hid Treasure, tho' he did not find the Money, yet he thereby made the Ground more fruitful; so) tho' we do not attain to the effecting of this particular, yet our searching after it may discover so many other excellent Subtilties, as shall abundantly recompence the Labour of our Enquiry.

And then besides, it may be another Encouragement, to consider the Pleasure of such Speculations; which do ravish and sublime the Thoughts with more clear Angelical Contentments. *Archimedes* was generally so taken up in the Delight of these Mathematical Studies of this familiar Siren, (as *Plutarch* styles them) that he forgot both his Meat and Drink, and other Necessities of Nature; nay, that he neglected the saving of his Life, when that rude Soldier, in the Pride and Haste of Victory, would not give him leisure to finish his Demonstration. What a Ravishment was that, when having found out the way to measure *Hiero's* Crown, he leaped out of the Bath, and (as if he were suddenly possess'd) ran naked up and down, crying, εὐρηξα, εὐρηξα! It is storied of *Thales*, that in his Joy and Gratitude for one of these Mathematical Inventions, he went presently to the Temple, and there offer'd up a solemn Sacrifice. And *Pythagoras*, upon the like Occasion, is related to have sacrificed a Hundred Oxen. The Justice of Providence having so contriv'd it, that the Pleasure which there is in the Success of such Inventions, should be proportioned to the great Difficulty and Labour of their Enquiry.

διχέας κ)
αυρίνα
αυρίνα
Plutarch.
Marcell.
Joan. Tzet-
zes, Chil.
2. Hist. 35.
Valer.
Maxim.
l. 8. c. 7.

A N
A B S T R A C T
O F

Dr. *W I L K I N S*'s
E S S A Y

Towards a

Real Character,

A N D A

Philosophical Language.

Which was Printed by Order of the *Royal Society*, 1668.

IT appears by the Author's Dedication to the President, Council and Fellows of the *Royal Society*, that they had several Times requir'd his Papers of him relating to this Subject, and that in obedience to their Orders, he had reduced them into Method. He tells them, he was not so vain as to think he had finish'd this great Undertaking with all the Advantages of which it was capable: Nor was he so diffident of his Essay, but that he thought it sufficient for what it pretended to, *viz.* the distinct Expression of all Things and Notions that fall under Discourse. He was sensible of sundry Defects in several parts of the Book, and therefore desired they

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would

would appoint some of their Number to consider the whole, and to offer their Observations as to what they thought fit to be amended. Accordingly several of the Society, as appears by the Philosophical Transactions of *Monday, May, 18. 1668.* were appointed to answer his Desire, for the furthering and facilitating the Practice of what he aim'd at. But what Progress they made in it does not appear. Our Author was sensible that his Design might lie neglected as other good Designs had done; and the only Expedient he could think of to prevent it, was, that it might be sent abroad with the Approbation of the Royal Society, which might provoke at least the Learned part of the World to take notice of, and encourage it, according as they should think it deserv'd.

The Advantages propos'd by this Philosophical Language were, The facilitating of mutual Commerce among the several Nations of the World; the improving of Natural Knowledge; and the Propagation of Religion: Our Author was also of Opinion, that it might contribute much to the clearing of some Modern Differences in Religion, by unmasking many wild Errors that shelter themselves under the Disguise of Affected Phrases; which being philosophically unfolded, and rendred according to the Genuine and Natural Importance of Words, would appear to be Inconsistencies and Contradictions; and several of those pretended Mysterious Profound Notions, express'd in Big Swelling Words, by which Men set up for Reputation, being this way examin'd, would either appear to be Nonsense, or very jejune. But whatever might be the issue of this Attempt, as to the establishing of a Real Character, and bringing it into common Use among several Nations of the World, of which our Author had but very slender Expectations, yet of this he was confident, that the reducing of all Things and Notions to such kind of
Tables

Tables as he propos'd, were it as compleatly done as it might be, would prove the shortest and plainest Way for the attainment of Real Knowledge, that had yet been offer'd to the World. To which he added, That he thought his Tables, as now they are, were a much better and readier Course for training up Men in the knowledge of Things, than any other Way that he knew of. And indeed since his Design of the Real Character is wholly neglected, that seems now to be the principal use of the Book, and alone makes it truly valuable.

In his Preface to the Reader he gives an Account how he came to engage in this Work, *viz.* That by his Converse with Dr. *Seth Ward*, then Bishop of *Salisbury*, upon the various *Desiderata*, propos'd by Learned Men to be still wanting to the Advancement of several parts of Learning, he found this of an *Universal Character*, to be one of the principal and most feasible, if regularly prosecuted; but most of those who had attempted any thing like it, mistook their Foundation, by proposing a Character according to some particular Language, without reference to the Nature of Things, and that Common Notion of them wherein Mankind agrees: This Suggestion gave him the first distinct Apprehension of the proper Course to be taken for advancing such a Design.

He says it was a considerable time after this before he attempted it; and the first Occasion of it was; his desire to assist another Person in framing a Real Character from the Natural Notion of Things. In order to promote that Person's Design, he drew up the Tables of Substances, or the Species of Natural Bodies, reduced under their several Heads, much the same as they are publish'd in this Essay. But the Person thinking this Method of too great a compass, and conceiving that he could provide for all the chief Radicals in a much shorter and easier Way, he did not make use of the Doctor's Tables. Our Author

however being convinc'd that this was the only way to effect such a Work, and being unwilling to lose so much Pains, he went on with the other Tables of Accidents, and then attempted the reduction of all other Words in the Dictionary to these Tables, either as they were synonymous to them, or to be defin'd by 'em; which was a true way to try the Fulness of those Tables, and likewise a Help to Learners, who without such a Direction, might not perhaps be able at first to find out the true Place and Notion of many Words.

For the farther compleating of this Work, our Author found it necessary to frame such a Natural Grammar, as might be suited to the Philosophy of Speech, abstracting from many unnecessary Rules belonging to instituted Languages.

He takes notice of the Assistance he receiv'd from his Learned Friends in several Faculties; particularly from Mr. *Francis Willoughby*, as to the several Species of Animals; from Mr. *John Ray*, as to the Tables of Plants; and for the other principal Difficulties from Dr. *William Lloyd*, than whom he knew none fitter, because of his Accurate Judgment in Philology and Philosophy; and to him particularly he ow'd the suiting the Tables to the Dictionary, and the drawing up of the Dictionary it self, which he doubts not will be found the most perfect ever yet made for the *English* Tongue.

'Tis observable however, that though he mentions others of his Friends by Name, from whom he had any Light or Help towards this Design, he does not at all name Mr. *George Dalgarno*, a *Scotch* Gentleman, born at *Aberdeen*, and bred in the University there, who printed a Book upon the same Subject, and with the same View, before him. This is the more remarkable, because Dr. *Wilkins's* own Name is printed in the Margin of King *Charles* the II^{d's} Letter, prefix'd to Mr. *Dalgarno's* Book, as one of those who inform'd

form'd his Majesty of Mr. *Dalgarno's* Design; and
' approv'd it as a thing that might be of singular use
' to facilitate an Intercourse between People of differ-
' ent Languages, and consequently a proper and ef-
' fectual Means for advancing all the Parts of Real
' and Useful Knowledge, civilizing Barbarous Nati-
' ons, propagating the Gospel, and increasing Traffick
' and Commerce ; which prevail'd with his Majesty
' to grant his said Letters of Recommendation to as
' many of his Subjects, especially the Clergy, as were
' truly apprehensive and sensible of the defectiveness
' of Art, chiefly in this Particular of Language, what
' a great loss Mankind is at thereby, how acceptable
' it would be before God, and praise-worthy among
' Men, to encourage and advance those Ways of
' Learning, wherein the general Good of Mankind is
' intended; that such Persons would, as their Affe-
' ctions shall incline them, and their Places enable
' them, put their helping Hands to the bringing forth
' this (as yet) Infant Design, now sticking in the
' Birth.

These are the Words of his Majesty's Letters, where-
in he was pleas'd to declare he would give some To-
ken of his Royal Favour for the helping forward that
so laudable and hopeful Enterprize.

There is no Conjecture to be made why the Bishop
should have forborn to name this Gentleman, but
what is to be collect'd from his own Epistle, and
from Mr. *Dalgarno's* Book. In the former it appears
that the Bishop had form'd his Tables for the assi-
stance of another Person in so worthy an Undertak-
ing; but that Person did not think fit to make use of
those Tables. And by Mr. *Dalgarno's* Book, it is evi-
dent that he was in his Judgment against those Tables,
as being too tedious and difficult, and such as Philo-
sophers were not agreed in, and by consequence
other Men of different Languages and Nations, could
not have the same Idea's about them; by which it is

probable he gave the Bishop some Disgust, which might be the occasion why he did not mention his Name.

The Title of Mr. Dalgarno's Book is, *Ars Signorum, vulgo Character Universalis & Lingua Philosophica. Qua poterunt, homines diversissimorum Idiomatum, Spatio duarum septimanarum, omnia Animi sui sensa (in rebus familiaribus) non minus intelligibiliter, sive scribendo, sive loquendo, mutuo communicare, quam linguis propriis vernaculis. Præterea, hinc etiam poterunt Juvenes Philosophiæ, Principia & veram Logicæ praxin, citius & facilius multo imbibere, quam ex vulgaribus Philosophorum Scriptis.*

This is enough to shew that Mr. Dalgarno's Design, tho' he differ'd in the Method, was the same, in the main, with the Bishop's, to which we now return. He divides his Book into four Parts; the first contains the *Prolegomena*, and is divided into Five Chapters. The First Chapter hath Four Sections: The First contains the Introduction; the Second, the Original of Languages; wherein he delivers his Opinion, That the first Language was concreated with our First Parents. The Rise of the Confusion of Languages is well enough known, but what number of Languages sprung up at that Confusion, is not certain; the most receiv'd Conjecture is, that they were 70, or 72, tho' there be strong Probabilities to prove that there were not so many, and that the first Dispersion did not divide Mankind into so many Colonies. But the Languages now us'd in the World, do far exceed this Number. *Pliny* and *Strabo* make mention of 300 Nations of different Languages, from whence People resorted to *Dioscuria*, a great Mart-Town in *Colchos*; which considering the narrow compass of Traffick, before the Invention of the Magnetick Needle, must needs be but a small proportion, in comparison to the rest of the World. Some *American* Histories say, That in every 80 Miles of. that
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Country, the Inhabitants speak a different Language. *Joseph Scaliger* reckons Eleven Mother Tongues in *Europe*, which have no dependance on one another; but they are so well known, that we need not insist upon them. Besides this difference of Languages in their first Derivation, every particular Tongue has its several Dialects in one and the same Nation. The *Hebrew* is by many Learned Men suppos'd to be the first Mother Tongue of those now known in the World. When the *Jews* were Captives at *Babylon*, their Language was mix'd with the *Caldean*; and after the Captivity, the Pure *Hebrew* ceas'd to be Vulgar, and remain'd only amongst Learned Men; as we find by *Nehemiah*, 8. 7, 8. And the Pure *Hebrew* now in being is only that of the Old Testament; which tho' sufficient to express what is there intended, is not so for Conversation, and therefore is guess'd not to be the same which was concreated with our First Parents, and spoken in Paradise.

The Second Chapter consists of Four Sections. The First concerns the various Changes to which all Vulgar Tongues are obnoxious. The Second gives Proofs of such Changes in the *English* Tongue in the Lord's Prayer, from the Year of *Christ* 700, to 1537. The Third Section determines in the Affirmative, that several of the Ancient Languages are lost, since 'tis evident from the Instance of our own, that in some few hundreds of Years, a Language may be so chang'd, as to be scarce intelligible. The Fourth Section accounts for the Rise and Occasion of New Languages; which he says proceeds from Commerce, and Mixture of People by Conquests, Marriage of Princes, or otherwise; and instances in that call'd the *Malayan* Tongue, the newest in the World, and as common among the Natives of the *East Indies*, as *Latin* and *French* in *Europe*. It was invented or occasion'd by a Concourse of Fishermen from *Pegu*, *Siam*, *Bengala*, and other Nations at *Malacca*, where they built

the Town of that Name, and agreed upon a distinct Language made up of the easiest Words belonging to each Nation.

The Third Chapter consists of 4 Sections. The First treats of the Original of Letters and Writing. Our Author tells us, it is most generally agreed, That *Adam* in process of time, upon his Experience of the great necessity of Letters, did first invent the ancient *Hebrew* Character; but he rejects those particular Alphabets which are by some ascrib'd to *Adam*, *Enoch*, and *Noah*; and adds, that it has been abundantly cleared by Learned Men, that the ancient *Hebrew* Character has the Priority before any now known. And 'tis none of the least Arguments for the Truth and Divine Authority of the Holy Scriptures, to consider the general Concurrence of all manner of Evidence for the Antiquity of the *Hebrew*, and the Derivation of all other Letters from it. In the Second Section he gives us the Opinion of many of the Ancients, to confirm the Derivation of other Letters and Languages from the *Hebrew*. In the Third, he shews us that the Use of Letters is less ancient, and the Kinds of them less numerous than the Languages themselves. He proves this by several Instances, that many Nations do not yet understand the Use of Letters, and that tho' the *German* and *French* Tongues be ancient, it is not much above 400 Years since Books began to be writ in those Languages: And the reason why Letters are less numerous than Languages, is, That several Nations borrow'd the Use of Letters from their Neighbours, and adapted them to their own Languages. In the Fourth Section, he gives us an Account of the Hieroglyphicks of the Ancients, which was a meer Shift they were put to for want of Letters, and was a slight and imperfect Invention, suitable to those first and ruder Ages. He treats also of the secret and occult ways of Writing, taught by the Abbot *Tritheimius*,

mius, for which he was falsely accused of Magick. He gives us some Hints about Letters or Marks used by the Ancients for Brevity sake ; of which Nature is Short-Hand, so common in *England*. In the Fifth Section, he gives an Account of some ancient Attempts towards a Real Character, to signify Things and Notions. And in the Sixth informs us, that no Alphabet now in being, was invented at once, or by Rules of Art ; but all of 'em, except the *Hebrew*, were taken up by Imitation.

The Fourth Chapter consists of Six Sections. The First treats of the Defects in the Common Alphabets, as to their true Order, which is inartificial and confus'd, the Vowels and Consonants being huddled together without any Distinction ; whereas the Vowels and Consonants should be reduc'd into Classes, according to their several kinds. In the Second Section, he takes notice of the Redundancy and Deficiency of the *Hebrew* Alphabet, and likewise of the *Greek* and *Latin*. In the Third Section, he shews that they are very uncertain as to their Powers and Signification ; of which he gives several Instances in our own Language. In the Fourth Section, he takes notice that the Names of the Letters in most Alphabets are very improperly expressed by Words of several Syllables. In this respect, the *Roman* and *English* Alphabet are more convenient than the rest, though not without some Defects of the same Nature. In the Fifth Section, he says their Figures do not correspond sufficiently with their Natures and Powers, and observes that the manner of Writing the Oriental Tongues from Right to Left, is as unnatural as to write with Light on the wrong side. In the Sixth Section, he takes notice of the Defects of Words as well as Letters ; some of them being Equivocal, others Synonymous, besides the Irregularities in Grammar, and the difference betwixt writing and pronouncing Words. On this Occasion, he takes notice

tice of the Endeavours of Sir *Thomas Smith*, and others, to rectify our *English* Orthography, tho' we still obstinately retain the Errors of our Ancestors.

The Fifth Chapter has Three Sections. The First maintains, That neither Letters nor Languages have been regularly Established by Rules of Art : Nor cou'd it be otherwise, because Grammar (by which they should be regulated) is of a much later Invention than the Languages themselves; as is evident from the *Hebrew*; which, tho' the oldest of all, was not reduc'd into Order of Grammar till the Year 1040. In the Second, he treats of the Natural Ground and Principle of the several Ways of Communication among Men; where he tells us, That as they generally agree in the same Principle of Reason, they likewise agree in the same Internal Notion or Apprehension of Things; and those Internal Notions they communicate to the Ear by Sounds, and particularly by Words, and to the Eye they communicate them by Motion and Figure, &c. and more particularly by Writing: So that if Men should generally agree upon the same way of Expression as they agree in the same Notion, we should then be free from that Curse of the Confusion of Tongues, and all the unhappy Consequences of it. This is only to be done by some one Language and Character to be universally practis'd, and enjoined by Authority; which cannot be expected without an *Universal Monarchy*; and perhaps not then: Or else by some Method which (without such Authority) might engage Men to learn it, because of its Facility and Usefulness, which was the Design of this *Essay*. The Third Section informs us, That in order to this, the first thing to be consider'd, was a just Enumeration and Description of such things as were to have Marks or Names assign'd them, and to be so contriv'd, as to be full and adequate without Redundancy or Defect as to their Number, and regular as to their Place and Order.

der. And, if every Thing and Notion had a distinct Mark, with some Provision to express Grammatical Derivations and Inflections, it would answer one great End of a Real Character, to signify Things and not Words. And if several distinct Words were assigned for the Names of such Things, with fixed Rules for such Grammatical Derivations and Inflections as are natural and necessary, it would make a more easie and convenient Language than any yet in being.

Then if these Marks or Notes could be so contriv'd, as to have such a dependance upon, and relation to one another, as might suit the Nature of the Things and Notions they represent; and likewise, if the Names of Things could be so ordered, as to contain such an Affinity or Opposition in their Letters and Sounds, as might some way answer the Nature of the Things they signify, it would be a further Advantage, by which, besides helping the Memory by Natural Method, the Understanding would be improv'd; and by learning the Characters and Names of Things, we should likewise learn their Natures.

Thus our Author concludes the First Part, and comes to the Second; which contains a regular Enumeration and Description of all those Things and Notions to which Names are to be assigned, and forms a System of Universal Philosophy. This Part is divided into Twelve Chapters. The First contains Six Sections. The First Section has a Scheme of Genus's, or more common Heads of Things belonging to this Design. Then he shews how each of them may be subdivided by its peculiar Differences, which for the better Conveniency of the Design, he determines for most part to the Number of Six, except in the Numerous Tribes of Herbs, Trees, Exanguious Animals, Fishes and Birds, which cannot be comprehended in so narrow a Compass. Then
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he enumerates the several Species belonging to each of those Differences, in such an Order and Dependance, as may contribute to define them, and determine their primary Significations. These Species he commonly joins together in Pairs, for helping the Memory; and so likewise are some of the Genus's and Differences; those things which naturally have Opposites, are join'd with them, according to such Opposition, whether single or double; and those things that have no Opposites, are commonly join'd together with respect to some Affinity which they have to one another, tho' sometimes those Affinities are less proper and more remote; there being several things shifed into those Places, because the Author did not know how to provide for them better. The Second Section relates to the more general Notions of Things, and the difficulty of Establishing those Notions aright. The Third treats of Transcendentals General. The Fourth of Transcendental Relations mix'd. The Fifth of Transcendental Relations of Action; and the Sixth of the several Notions belonging to Grammar or Logick. But these Things being digested into Tables, we must refer the Reader to the Book it self, for a distinct Idea of them.

The Second Chapter consists of Two Sections. The First is concerning God; and the Second concerning the several Things and Notions reducible under that Collective *Genus* of the World: Which is also digested into Tables.

The Third Chapter consists of Three Sections. The First is of Elements and Meteors; the Second of Stones; and the Third of Metals: Digested also into Tables.

The Fourth Chapter has Seven Sections. The First of Plants; the Second concerning a more general Distribution of 'em; the Third, Fourth, and Fifth, treat of Herbs; consider'd according to their Leaves, Flowers, and Seed-Vessels. The Sixth treats
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of Shrubs ; and the Seventh of Trees. All of 'em likewise in Tables.

The Fifth Chapter has Six Sections. The First concerns Animals , and the general Distribution of 'em ; the Second is of Exanguious Animals ; the Third of Fish ; the Fourth of Birds ; the Fifth of Beasts ; and the Sixth has a Digression concerning *Noah's Ark* : Wherein he maintains the Truth and Authority of the Scripture, against the Objections of Atheists and Hereticks, That a Vessel of such Dimensions could not contain so vast a Multitude of Animals, with a whole Year's Provision for 'em.

The Sixth Chapter relates to the Parts of Animate Bodies ; First, peculiar ; Secondly, general : And these are also digested into Tables.

The Seventh Chapter relates to the Predicament of Quantity. 1. Of Magnitude. 2. Of Space. 3. Of Measure. All digested into Tables.

The Eighth Chapter relates to Quality, and its several *Genus's*. 1. Of Natural Power. 2. Of Habit. 3. Of Manners. 4. Of sensible Quality. 5. Of Diseases. With the various Differences and Species under each.

The Ninth Chapter treats of Action, and its several *Genus's*. 1. Spiritual. 2. Corporeal. 3. Motion. 4. Operation.

The Tenth Chapter concerns more private Relation. 1. Of Family Relation ; with the several kinds of Things belonging to those in that Capacity, either as Possessions, or Provisions.

The Eleventh Chapter concerns Publick Relations ; as Civil, Judiciary, Naval, Military, and Ecclesiastical.

The Twelfth Chapter explains the Design of the foregoing Tables ; gives particular Instances of the 6 principal *Genus's* of it ; has some Notes concerning Opposites and *Synonyma's* ; and an Account of such Things as ought not to be provided for in those Tables.

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The Third Part contains a Philosophical Grammar; and is divided into Fourteen Chapters.

The First Chapter concerns the several Kinds and Parts of Grammar. 2. Of Etymology; and the more General Scheme of Integrals and Particles. 3. Of Nouns in general. 4. Of Substantives common, denoting either Things, Actions, or Persons. 5. Rules concerning Nouns of Action. 6. Of Substantives Abstracts. 7. Of Adjectives, according to the true Philosophical Notion of them. 8. The true Notion of a Verb. 9. Of derived Adverbs. 10. A General Scheme of the forementioned Derivations.

The Second Chapter concerns Particles in general. 2. Of the *Copula*. 3. Of Pronouns more generally. 4. More particularly. 5. Of Interjections more generally. 6. More particularly.

The Third Chapter treats of Prepositions in general. 2. The particular Kinds of them enumerated. 3. An Explication of the Four last Combinations of them, relating to Place or Time.

The Fourth Chapter concerns Adverbs in general. 2. The particular Kinds of them. 3. Conjunctions.

The Fifth Chapter treats of Articles. 2. Of Moods. 3. Of Tenses. 4. The most distinct way of expressing the Differences of Time.

The Sixth Chapter concerns Transcendental Particles, and the End and Use of them. 2. The usual ways for enlarging the Sense of Words in instituted Languages. 3. The General Heads of Transcendental Particles.

The Seventh Chapter has Instances of the great Usefulness of those Transcendental Particles; with Directions how they are to be applied.

The Eighth Chapter treats of the Accidental Differences of Words. 1. Inflexion. 2. Derivation. 3. Composition.

The Ninth Chapter is of the Second Part of Grammar, called *Syntax*. The

The Tenth Chapter is of Orthography ; and contains Three Sections. The First concerning Letters ; and the Authors who have treated of this Subject : Of whom Dr. *Wallis* seems with the greatest Accurateness and Subtilty to have consider'd the Philosophy of Articulate Sounds. The Second contains a brief Table of all such Kinds of simple Sounds, as can be framed with the Mouths of Men. The Third contains a further Explanation of this Table, as to the Organs of Speech, and as to the Letters framed by those Organs.

The Eleventh treats of Vowels. The Twelfth of Consonants. The Thirteenth of Compound Vowels and Consonants. The Fourteenth treats of the Accidents of Letters : 1. Their Names. 2. Their Order. 3. Affinities and Oppositions. 4. Their Figures ; with a Twofold Instance of a more regular Character for the Letters : The latter of which may be esteemed Natural. 5. Of Pronunciation. 6. The several Letters difus'd by several Nations.

The Fourth Part contains a Real Character and Philosophical Language. This consists of Six Chapters : The 1st. treats of a Proposal of one kind of Real Character amongst many others which might be offer'd both for the Integrals, whether *Genus's*, Differences, or Species, together with the Derivations and Inflexions belonging to them ; as likewise for all the several kinds of Particles. Here our Author acquaints us, That it were exceeding desirable that the Names of Things might consist of such Sounds as should bear in them some Analogy to their Natures, and the Figure or Character of these Names should bear some proper resemblance to those Sounds ; but he does not understand how this Character can be adjusted any otherwise than by Institution : And in the framing of those Characters, he says, special Regard must be had to these Four Properties. 1. That the Figure be plain and easy, so as it may be made
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by one or at most by Two strokes of the Pen.
 2. That they be sufficiently distinguished from one another.
 3. Graceful to the Eye.
 4. Methodic.
 But we must refer to the Book it self for our Authors Specimen.

The Second Chapter contains an instance of the Real Character in the Lord's Prayer and Creed.

The Third shews how this Character may be made Affable in a distinct Language, and what kind of Letters or Syllables may be conveniently assign'd to each Character.

The Fourth has a Comparison of the Lord's Prayer and Creed in this Language, with 50 other Languages as to the Facility and Euphony of them. The Fifth contains Directions for the more easy learning this Character and Language; with a brief Table containing the Radicals both Integrals and Particles, together with the Character and Language by which each of 'em are to be express'd.

The Sixth is a Comparison betwixt this Natural Philosophical Grammar, and that of other Instituted Languages, particularly the *Latin*, in respect of the Multitude of unnecessary Rules, and of Anomalies. It treats also concerning the *China* Character; the several Attempts and Proposals made by others towards a new kind of Character and Language, and the Advantage in respect of Facility which the Philosophical Language has above the *Latin*. In the last place comes an Alphabetical Dictionary where all *English* Words according to their various Significations, are either refer'd to their Places in the Philosophical Tables, or explained by such Words as are in those Tables.

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