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THE
Celestial Worlds
DISCOVER'D:

O R,

CONJECTURES

Concerning the

INHABITANTS,

PLANTS and PRODUCTIONS
OF THE

Worlds in the Planets.

Written in Latin by

CHRISTIANUS HUYGENS,

And inscrib'd to his Brother

CONSTANTINE HUYGENS

Late Secretary to his Majesty King *William*.

The Second Edition, Corrected and Enlarged.

L O N D O N :

Printed for JAMES KNAPTON, at the *Crown* in
St. *Paul's* Church-Yard. MDCCLXXII.



T O T H E
R E A D E R .

THIS Book was just finished, and designed for the Press, when the Author, to the great loss of the Learned World, was seized by a Disease that brought him to his Death. However he took care in his last Will of its Publication, desiring his Brother, to whom it was writ, to take that Trouble upon him. But he was so taken up with Business and Removals, (as being Secretary in *Holland* to the King of *Great Britain*) that he could find no time for it till a Year after the Death of the Author : When it so fell out, that the Printers being somewhat tardy, and this Gentleman dying, the Book was left without either Father or Guardian. Yet it

now ventures into the Publick, in the same Method that it was writ by the Author, and with the same Inscription to his Brother, tho' dead; in confidence that this last Piece of his will meet with as kind a Reception from the World as all the other Works of that Author have. 'Tis true there are not every where Mathematical Demonstrations; but where they are wanting, you have probable and ingenious Conjectures, which is the most that can be reasonably expected in such matters. What belongs to, or has any thing to do with Astronomy, you will see demonstrated, and the rest ingeniously and shrewdly guess'd at, from the Affinity and Relation of the heavenly Bodies to the Earth. For your farther Satisfaction read on, and farewell.

V

T H E
P U B L I S H E R
T O T H E
R E A D E R.

I Doubt not but I shall incur the Censures of learned Men for putting this Book into English, because, they'll say, it renders Philosophy cheap and vulgar, and, which is worse, furnishes a sort of injudicious People with a smattering of Notions, which being not able to make a proper use of, they pervert to the Injury of Religion and Science. I confess the Allegation is too true: but after Bishop Wilkins, Dr. Burnet, Mr. Whiston and others, to say nothing of the ancient Philosophers, who wrote in their own

The Publisher's Preface.

Tongues; I say, after these great Authors have treated on as learned and abstruse Subjects in the same Language, I hope their Example will be allowed a sufficient excuse for printing this Book in English.

Concerning this Edition I can say, that I have taken care to have the Cutts exactly done, and have placed each Figure at the Page of the Book that refers to it, which I take to be more convenient to the Reader than putting them all at the End.

I have been careful to procure the best Paper; that I might in some measure come up to the Beauty of the Latin Edition, though this bear but half the Price of it.

And I hope the Translator has expressed the Author's Sense aright, and has not committed Faults beyond what an ingenuous Reader can pardon.

NEW
CONJECTURES
Concerning the
Planetary Worlds,
THEIR
INHABITANTS
AND
PRODUCTIONS.


Written by CHRISTIANUS HUYGENS, and inscribed to his Brother
CONSTANTINE HUYGENS.

BOOK the First.

A Man that is of *Copernicus's*
Opinion, that this Earth of
ours is a Planet, carry'd
round and enlighten'd by
the Sun, like the rest of the Planets,
cannot but sometimes think, that it's

Book I. not improbable that the rest of the
 ~~~~~ Planets have their Drefs and Fur-  
 niture, and perhaps their Inhabitants  
 too as well as this Earth of ours:  
 Especially if he considers the later  
 Discoveries made in the Heavens  
 since *Copernicus's* time, viz. the  
 Attendants of *Jupiter* and *Saturn*,  
 and the champaign and hilly Coun-  
 tries in the Moon, which are a strong  
 Argument of a Relation and Kin  
 between our Earth and them, as  
 well as a Proof of the Truth of that  
 System. This has often been our  
 Talk, I remember, good Brother,  
 over a large Telescope, when we  
 have been viewing those Bodies, a  
 Study that your continual Business  
 and Absence have interrupted for  
 many Years. But we were always  
 apt to conclude, that 'twas in vain  
 to enquire after what Nature is doing  
 there, seeing there was no likelihood  
 of ever coming to any Certainty of  
 the Enquiry. Nor could I ever find  
 that any Philosophers, either antient  
 or modern, have attempted any thing  
 upon this Subject. At the very Birth  
 of

of Astronomy, when the Earth was first asserted to be Spherical, and to be surrounded with Air, even then there were some Men so bold as to affirm, there were an innumerable Company of Worlds in the Stars. But later Authors, such as Cardinal *Cusanus*, *Brunus*, *Kepler*, (and if we may believe him, *Tycho* was of that opinion too) have furnished the Planets with Inhabitants. Nay, *Cusanus* and *Brunus* have allowed the Sun and fixed Stars theirs too. But this was the utmost of their Boldness; nor has the ingenious *French* Author of the Dialogues about *the Plurality of Worlds* carried this Matter any farther. Only some of them have coined some Stories of the Men in the Moon, just as probable as *Lucian's* true History; among which I must count *Kepler's*, which he has diverted us with in his *Astronomical Dream*. But a while ago thinking somewhat seriously of this matter (not that I count my self quicker-sighted than those great Men, but that I had the Happiness to live after

Book I.  
  
 Some have already talk'd of the Inhabitants of the Planets, but went no farther.

most

Book I. most of them) the Enquiry appeared not so impracticable, nor the Way so stopt up with Difficulties, but that there was very good room left for probable Conjectures. As they came into my Head, I put them down into common Places, and shall now try to digest them into some Method for your better Conception of them, and add somewhat of the Sun and fix'd Stars, and the Extent of that Universe of which our Earth is but an inconsiderable Point. I know you have such an Esteem and Reverence for any thing that belongs to the Heavens, that I perswade my self you will read what I have written with some Pleasure: I'm sure I writ it with a great deal; but as often before, so now, I find the Saying of *Archytas* true, even to the Letter, *That tho' a Man were admitted into Heaven to view the wonderful Fabrick of the World, and the Beauty of the Stars, yet what would otherwise be Rapture and Extasie, would be but a melancholy Amazement if he had not a Friend to communicate*

*cate it to.* I could wish indeed that all the World might not be my Judges, but that I might chuse my Readers, Men like you, not ignorant in Astronomy and true Philosophy; for with such I might promise my self a favourable hearing, and not need to make an Apology for daring to vent any thing new to the World. But because I am aware what weak Hands it's likely to fall into, and what a severe Sentence I may expect from those whose Ignorance or Zeal is too great; it may be worth the while to guard my self beforehand against the Assaults of those sort of People.

There's one sort who knowing nothing of Geometry or Mathematicks, will laugh at it as a whimsical and ridiculous Undertaking. It's an incredible Thing to them to talk of measuring the Distance and Magnitude of the Stars: And for the Motion of the Earth, they count it, if not a false, at least a precarious Opinion; and no wonder then if they take what's built upon such a slippery Foundation

Book I.



*The Objections of ignorant Cavillers prevented.*

Book I. dation for the Dreams, of a fanciful  
 ~~~~~ Head and a distemper'd Brain. What  
 should we answer to these Men, but
 that their Ignorance is the Cause of
 their Dislike, and that if they had
 studied these things more, and view-
 ed the Works of Nature nicely, they
 would have fewer Scruples? But few
 People having had an opportunity of
 prosecuting these Studies, either for
 want of Parts, Learning or Leisure,
 we cannot blame their Ignorance;
 and if they resolve to find fault with
 us for spending time in such Matters,
 because they do not understand the
 Use of them, we must appeal to pro-
 perer Judges.

*These Con-
 jectures do
 not con-
 tradict the
 holy Scrip-
 tures.*

The other sort, when they hear us
 talk of new Lands, and Animals, and
 Creatures endued with as much
 Reason as themselves, will be ready
 to cry out, that we set up our Con-
 jectures against the Word of God,
 and broach Opinions directly oppo-
 site to Holy Writ. For we do not
 there read any thing of the Producti-
 on of such Creatures, no not so much
 as that they exist; nay rather we
 read

read the quite contrary. For, That Book I. only mentions this Earth with its Animals and Plants, and Man the Lord of them : To such Persons I answer, what has been often urged by others before me : That it's evident, God had no design to make a particular Enumeration in the Holy Scriptures, of all the Works of his Creation. When therefore it is plain that under the general Name of *Stars* or *Earth* at the Creation, are comprehended all the Heavenly Bodies, even the Attendants upon *Jupiter* and *Saturn*, why must all that Multitude of Beings which the Almighty Creator has been pleased to place upon them, be excluded the Privilege, and not suffered to have a Share in the Expression ? And these Men themselves can't but know in what Sense it is that all things are said to be made for the Use of Man, not certainly for us to look at through a Telescope, for that's very absurd. Since then the greatest part of God's Creation, that innumerable multitude of Stars, is placed out of the reach

Book I. reach of any Man's Eye; and many
 of them it's likely, of the best Glasses,
 so that they don't seem to belong to
 us; is it such an unreasonable Opini-
 on to think, that there are some
 reasonable Creatures who see and
 admire those glorious Bodies at a
 nearer distance?

*This En-
 quiry not
 over cu-
 rious.*

But perhaps they'll say, it does not
 become us to be so curious and inqui-
 sitive in these Things which the Su-
 preme Creator seems to have kept for
 his own Knowledge: For since he has
 not been pleased to make any farther
 Discovery or Revelation of them, it
 seems little better than presumption
 to make any inquiry into that which
 he has thought fit to hide. But these
 Gentlemen must be told, that they
 take too much upon themselves when
 they pretend to appoint how far and
 no farther Men shall go in their
 Searches, and to set bounds to other
 Mens Industry; as if they knew the
 Marks that God has placed to Know-
 ledge: or as if Men were able to pass
 those Marks. If our Forefathers had
 been at this rate scrupulous, we might
 have

have been ignorant still of the Magnitude and Figure of the Earth, or that there was such a Place as *America*. We should not have known that the Moon is inlightned by the Sun's Rays, nor what the Causes of the Eclipses of each of them are, nor a multitude of other Things brought to light by the late Discoveries in Astronomy. For what can a Man imagine more abstruse, or less likely to be known, than what is now as clear as the Sun? Whence it follows, that vigorous Industry, and piercing Wit were given Men to make Advances in the Search of Nature, and there's no Reason to put any Stop to such Enquiries. I must acknowledge that what I here intend to treat of is not of that Nature as to admit of a certain Knowledge; I can't pretend to assert any thing as positively true (for how is it possible) but only to advance a probable Guess, the Truth of which every one is at his own liberty to examine. If any one therefore shall gravely tell me, that I have spent my Time idly in a vain and fruitless Enquiry

Book I. quiry after what by my own ac-
 ~~~~~ knowledge I can never come to  
 be sure of; The Answer is, that at  
 this rate he would put down all Na-  
 tural Philosophy as far as it concerns  
 it self in searching into the Nature  
 of Things: In such noble and sub-  
 lime Studies as these, 'tis a Glory to  
 arrive at Probability, and the Search  
 it self rewards the Pains. But there  
 are many degrees of Probable, some  
 nearer Truth than others, in the de-  
 termining of which lies the chief ex-  
 ercise of our Judgment. But besides  
 the Nobleness and Pleasure of the  
 Studies, may not we be so bold as to  
 say, they are no small help to the Ad-  
 vancement of Wisdom and Morality?  
 so far are they from being of no use  
 at all. For here we may mount from  
 this dull Earth, and viewing it from  
 on high, consider whether Nature has  
 laid out all her Cost and Finery upon  
 this small Speck of Dirt. So, like  
 Travellers into other distant Coun-  
 tries, we shall be better able to judge  
 of what's done at home, know how  
 to make a true Estimate of, and set  
 its

*Conje-  
 ctures not  
 useless, be-  
 cause not  
 certain.*

*These Stu-  
 dies useful  
 to Religi-  
 on.*



Fig:1

# SYSTEMA COPERNICI.

p 11.

69

Saurni.



Jovis



Martis.

Telluris.

Veneris.

Merc.

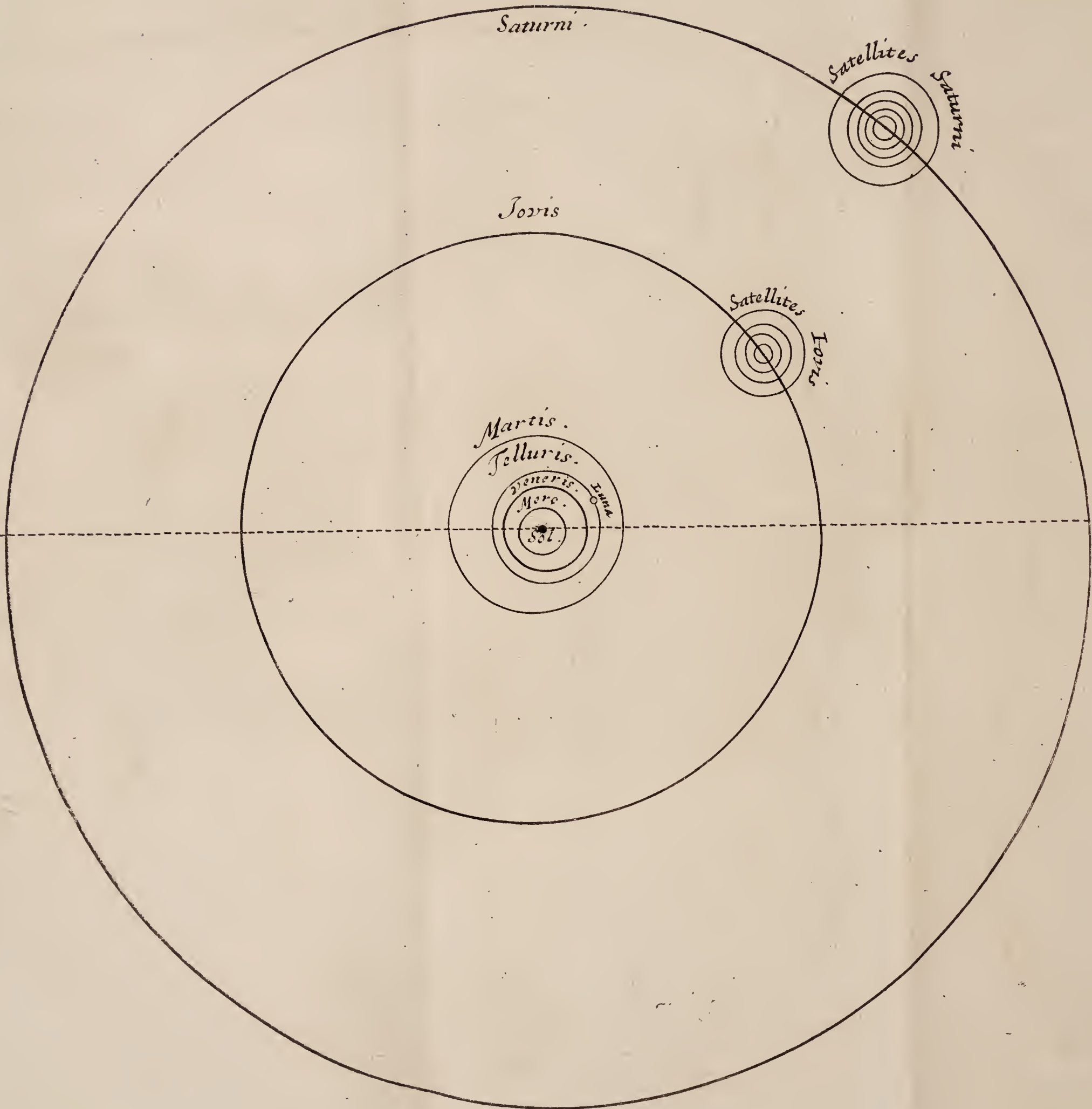
Luna.

Sol.

♁

♃

28



its own Value upon every Thing. **Book I.**

We shall be less apt to admire what this World calls Great, shall nobly despise those Trifles the generality of Men set their Affections on, when we know that there are a multitude of such Earths inhabited and adorned as well as our own. And we shall worship and reverence that God the Maker of all these things; we shall admire and adore his Providence and wonderful Wisdom which is displayed and manifested all over the Universe, to the Confusion of those who would have the Earth and all things formed by the shuffling Concourse of Atoms, or to be without beginning. But to come to our Purpose.

And now because the chief Argument for the Proof of what we intend will be taken from the Disposition of the Planets, among which without doubt, the Earth must be counted in the Copernican System, I shall here first of all draw two Figures. The first is a Description of

B

the

*Copernicus's System explained.*

Book I. the Orbs the Planets move in, in that order that they are placed round the Sun, drawn as near as can be in their true Proportions, like what you have seen in my Clock at home. The second shows the Proportions of their Magnitudes in respect of one another and of the Sun, which you know is upon that same Clock of mine too. In the first the middle Point or Center is the Place of the Sun, round which, in an order that every one knows, are the Orbits of *Mercury*, *Venus*, the Earth with that of the Moon about it; then those of *Mars*, *Jupiter* and *Saturn*: and about the two last the small Circles that their Attendants move in: about *Jupiter* four, and about *Saturn* five. Which Circles as well as that of the Moon are drawn larger than their true Proportion would admit, otherwise they could not have been seen. You may easily apprehend the Vastness of these Orbits by this, that the distance of the Earth from the Sun is ten or twelve thousand of the Earth's Diameters. Almost all these Circles are in the same Plane, declining very  
 little

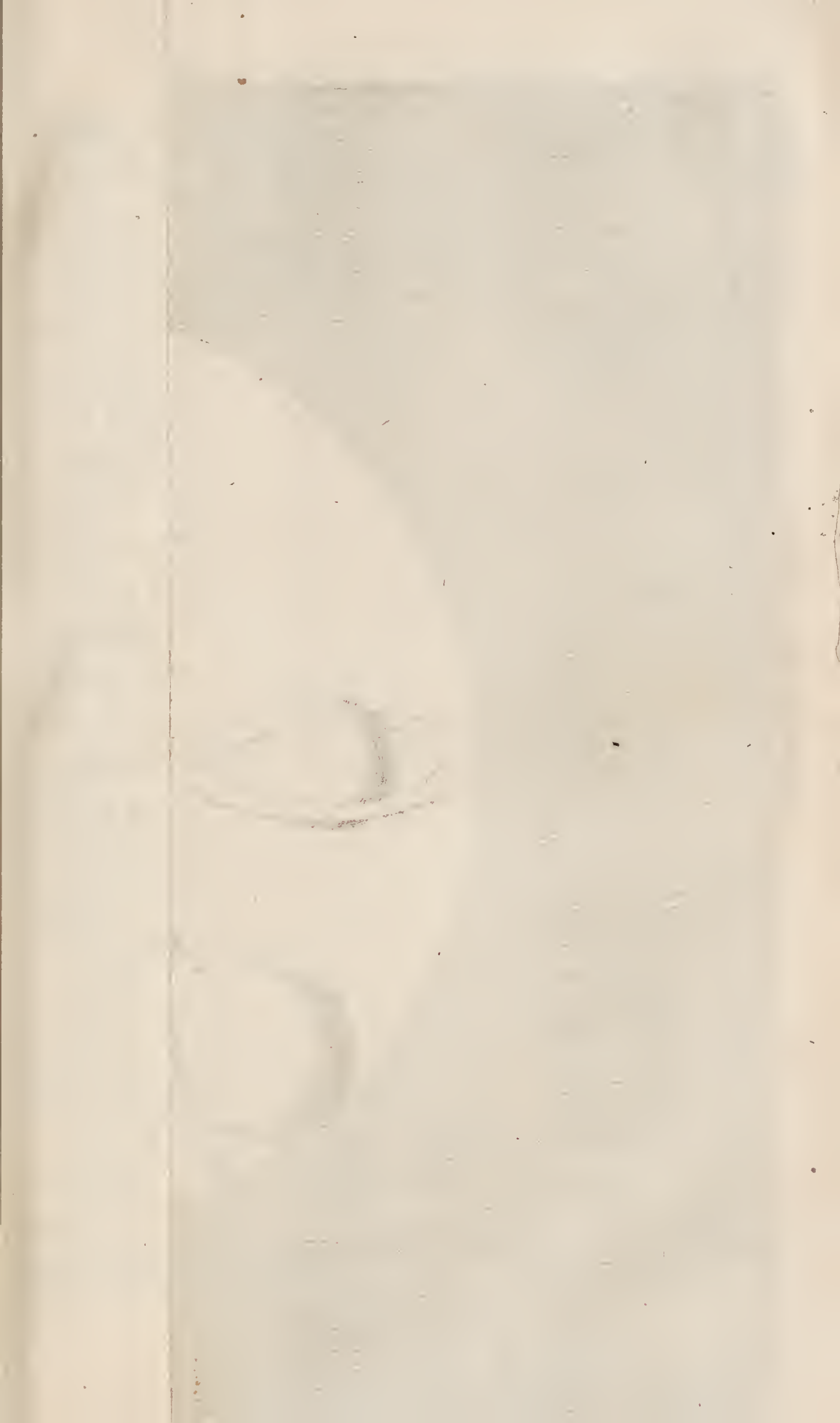


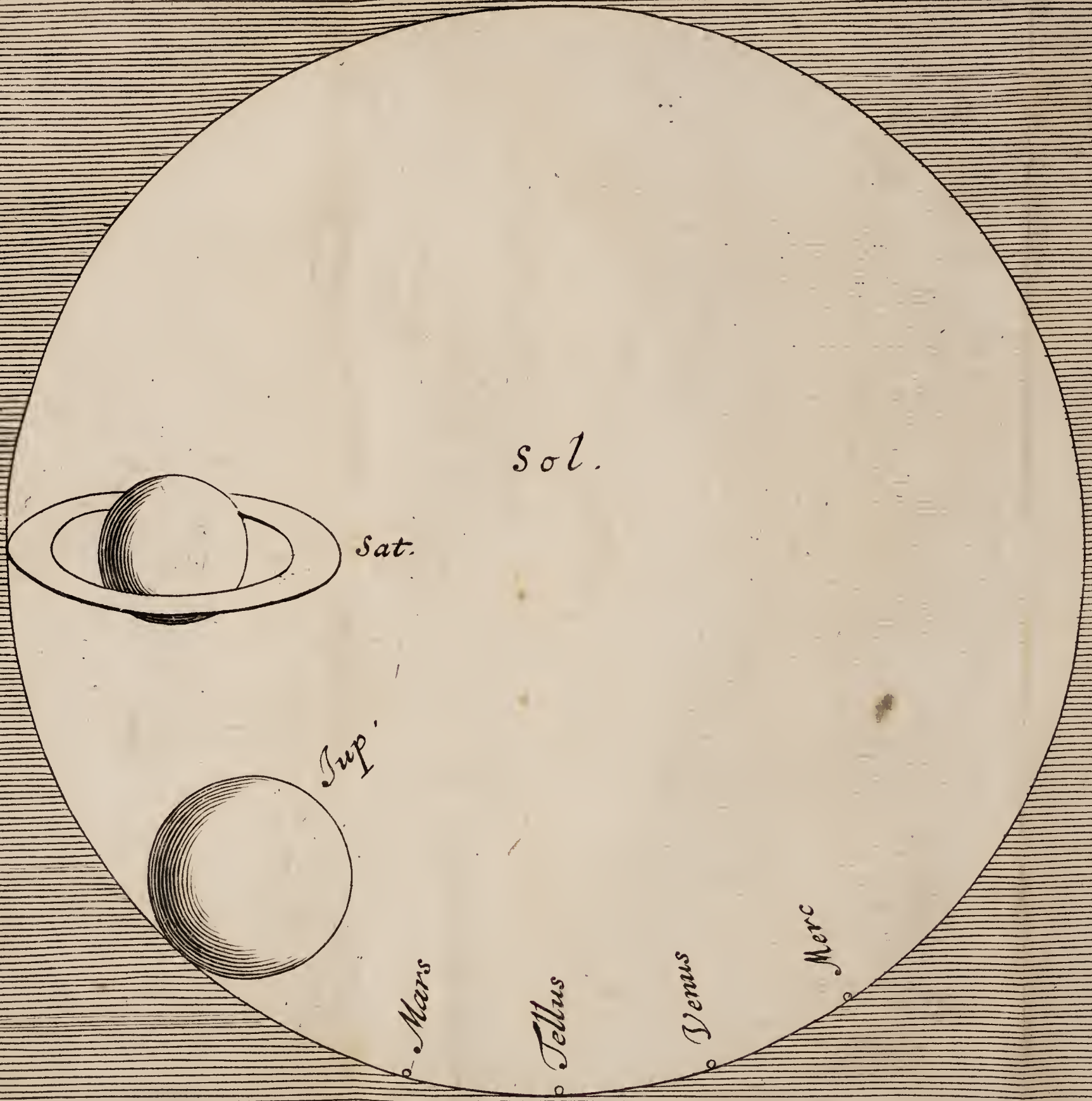
little from that in which the Earth moves, call'd *The Plane of the Ecliptick*. This Plane is cut obliquely by the Axis upon which the Earth turns it self round with respect to the Sun in 24 Hours, whence arise the Successions of Day and Night: The Axis of the Earth always keeping the same Inclination to the Ecliptick (except a small Change best known to Astronomers) while the Earth itself is carried in its yearly Course round the Sun, causes the regular Order of the Seasons of the Year: as you may see in all Astronomers Books. Out of which I shall transcribe hither the Periods of the Revolutions of the Planets, *viz.* *Saturn* moves round the Sun in 29 Years, 174 Days, and 5 Hours: *Jupiter* finishes his Course in 11 Years, 317 Days, and 15 Hours: *Mars* his in about 687 Days. Our Year is 365 Days 6 Hours: *Venus's* 224 Days 18 Hours: and *Mercury's* 88 Days. This is the now commonly received System, invented by *Copernicus*, and very agreeable to that frugal Simplicity Nature shows in all


Book I. her Works. If any one is resolved to find fault with it, let him first be sure he understands it. Let him first see in the Books of Astronomers with how much greater Ease and Plainness all the Motions of the Stars, and Appearances in the Heavens are explained and demonstrated in this than either in that of *Ptolomy* or *Tycho*. Let him consider that Discovery of *Kepler*, that the Distances of the Planets from the Sun, as well of the Earth as the rest, are in a fix'd certain proportion to the Times they spend in their Revolutions. Which Proportion it's since observed that their Satellites keep round *Jupiter* and *Saturn*. Let him examine what a contradictory Motion they are fain to invent for the Solution of the Polar Star's changing its Distance from the Pole. For that Star in the end of the little Bear's Tail which now describes so small a Circle round the Pole, that it is not above two Degrees and twenty Minutes, was observed about 1820 Years ago, in the Time of *Hipparchus*, to be above 12:

Argu-  
ments for  
the Truth  
on't.

and





and will within a few Ages more be Book I.  
45 Degrees distant from it: and af-   
ter 25000 Years more will return to  
the same Place it is now in. Now if  
with them we allow the Heavens to  
be turned upon their own Axis, at this  
rate they must have a new Axis eve-  
ry Day: a Thing most absurd, and  
repugnant to the Nature of all Mo-  
tion. Whereas nothing is easier with  
*Copernicus* than to give us Satisfacti-  
on in this Matter. Then he may im-  
partially weigh those Answers that  
*Galilæus*, *Gassendus*, *Kepler*, and others  
have given to all Objections proposed,  
which have so satisfied all Scruples,  
that generally all Astronomers now-  
a-days are brought over to our Side,  
and allow the Earth its Motion and  
Place among the Planets. If he can-  
not be satisfied with all this, he is  
either one whose Dulness can't com-  
prehend it, or who has his Belief at  
another Man's Disposal.

In the other Figure you have the  
Globes of the Planets, and of the  
Sun, represented to your Eyes as  
placed near one another. Where

Book I. I have observed the same Proportion, of their Diameters to that of the Sun, that I published to the World in my Book of *The Appearances of Saturn*: namely, the Diameter of the Ring round *Saturn* is to that of the Sun as 11 as to 37; that of *Saturn* himself about as 5 to 37; that of *Jupiter* as 2 to 11; that of *Mars* as 1 to 166; of the Earth as 1 to 111; and of *Venus* as 1 to 84: to which I shall now add that of *Mercury* observed by *Hevelius* in the Year 1661, but calculated by my self, and found to be as 1 to 290.

If you would know the way that we came to this Knowledge of their Magnitudes, by knowing the Proportion of their Distances from the Sun, and the Measures of their Diameters, you may find it in the Book before-mentioned: And I cannot yet see any Reason to make an Alteration in those I then settled, altho' I will not say they are without their Faults. For I can't yet be of their Mind, who think the Use of Micrometers, as they call them, is beyond that of

our

*The Proportion of the Magnitude of the Planets, in respect of one another, and the Sun.*

*The Lamellæ more convenient than Micrometers.*

our Plates, but must still think that those thin Plates or Rods of which I there taught the Use, not to detract from the due Praises of so useful an Invention, are more convenient than the Micrometers.

In this proportion of the Planets it is worth while to take notice of the prodigious Magnitude of the Sun in comparison with the four innermost, which are far less than *Jupiter* and *Saturn*. And 'tis remarkable, that the Bodies of the Planets do not increase together with their Distances from the Sun, but that *Venus* is much bigger than *Mars*.

Having thus explained the two Schemes, there's no Body I suppose but sees, that in the first the Earth is made to be of the same sort with the rest of the Planets. For the very Position of the Circles shows it. And that the other Planets are round like it, and like it receive all the Light they have from the Sun, there's no room (since the Discoveries made by Telescopes) to doubt. Another Thing they are like it in is, that they are mo-

*The Earth  
justly  
likened to  
the Pla-  
nets, and  
the Pla-  
nets to it.*

Book I. ved round their own Axis; for since  
 'tis certain that *Jupiter* and *Saturn*  
 are, who can doubt it of the others?  
 Again, as the Earth has its Moon mo-  
 ving round it, so *Jupiter* and *Saturn*  
 have theirs. Now since in so many  
 Things they thus agree, what can be  
 more probable than that in others  
 they agree too; and that the other  
 Planets are as beautiful and as well  
 stock'd with Inhabitants as the Earth?  
 Or what shadow of Reason can there  
 be why they should not?

If any one should be at the Dissecti-  
 on of a Dog, and be there shewn the  
 Intrails, the Heart, Stomach, Liver,  
 Lungs and Guts, all the Veins, Arte-  
 ries and Nerves; could such a Man  
 reasonably doubt whether there were  
 the same Contexture and Variety of  
 Parts in a Bullock, Hog, or any other  
 Beast, tho' he had never chanc'd to see  
 the like opening of them? I don't be-  
 lieve he would. Or were we tho-  
 roughly satisfy'd in the Nature of one  
 of the Moons round *Jupiter*, should  
 not we straight conclude the same of  
 the rest of them? So if we could be  
 assur'd



affur'd in but one Comet, what it was that is the Cause of that strange Appearance, should we not make that a Standard to judge of all others by ?

'Tis therefore an Argument of no small Weight that is fetch'd from Relation and Likeness; and to reason from what we see and are sure of, to what we cannot, is no false Logick.

*Argu-  
ments  
from their  
Similitude,  
of no small  
weight.*

This must be our Method in this Treatise, wherein from the Nature and Circumstances of that Planet which we see before our Eyes, we may guess at those that are farther distant from us.


And, First, 'tis more than probable that the Bodies of the Planets are solid like that of our Earth, and that they don't want what we call Gravity, that Virtue, which like a Loadstone attracts whatsoever is near the Body to its Center. And that they have such a Quality, their very Figure is a Proof; for their Roundness proceeds only from an equal pressure of all their Parts tending to the same Center. Nay more, we are so skilful now-a-days, as to be able to tell how much

*The Pla-  
nets are  
solid, and  
not with-  
out Gra-  
vity.*

Book I. much more or less the Gravitation in  
 ~~~~~ *Jupiter* or *Saturn* is than here ; of  
 which Discovery and its Author you
 may read my *Essay of the Causes of*
Gravitation.

Have A-
nimals
and
Plants.

But now to carry the Search farther, let us see by what Steps we must rise to the attaining some knowledge in the deeper Secrets concerning the State and Furniture of these new Earths. And, first, how likely is it that they may be stock'd with Plants and Animals as well as we? I suppose no Body will deny but that there's somewhat more of Contrivance, somewhat more wonderful in the Production and Growth of Plants and Animals, than in Lifeless Heaps of inanimate Bodies, be they never so much larger ; as Mountains, Rocks, or Seas are. For the Finger of God, and the Wisdom of Divine Providence, is in them much more clearly manifested than in the other. One of *Democritus's* or *Carte's* Scholars may venture perhaps to give some tolerable Explication of the Appearances in Heaven and Earth, allow him but his Atoms
 and


and Motion; but when he comes to Book I.
Plants and Animals, he'll find himself 
non-plus'd, and give you no likely
account of their Production. For
every Thing in them is so exactly
adapted to some Design, every part
of them so fitted to its proper Use,
that they manifest an Infinite Wis-
dom, and exquisite Knowledge in
the Laws of Nature and Geometry,
as, to omit those Wonders in Genera-
tion, we shall by and by show; and
make it an Absurdity even to think of
their being thus happily jumbled to-
gether by a chance Motion of I don't
know what little Particles. Now
should we allow the Planets nothing
but vast Deserts, lifeless and inanimate
Stocks and Stones, and deprive them
of all those Creatures that more plain-
ly speak their Divine Architect, we
should sink them below the Earth in
Beauty and Dignity; a Thing very
unreasonable, as I said before.

Well then, we have gain'd the
Point thus far, and the Planets may
be allowed some Creatures capable of
moving themselves, not at all inferior
to

Book I. to ours; and these are Animals. And
 ~~~~~ if this be allowed, it almost necessarily  
 follows, that there must be Herbs  
 for Food for them. And as for the  
 Growth and Nourishment of all  
 these, 'tis no doubt the same with  
 ours, seeing they have the same  
 Sun to warm and enliven them as  
 ours have.

*Not to be  
 imagin'd  
 too unlike  
 ours.*

But perhaps some Body may say,  
 we conclude too fast. They will not  
 deny indeed but that there may be  
 Plants and Animals on the Surface of  
 the Planets, that deserve as well to be  
 provided for by their Creator as ours  
 do: but why must they be of the same  
 Kind with ours: Nature seems to love  
 variety in her Works, and may have  
 made them widely different from ours  
 either in their matter or manner of  
 Growth, in their outward Shape, or  
 their inward Contexture; she may  
 have made them such as neither our  
 Understanding nor Imagination can  
 conceive. That's the Thing we shall  
 now examine, and whether it be not  
 more likely that she has not observ'd  
 such a Variety as they talk of. Nature  
 seems


seems most commonly, and in most of Book I. her Works, to affect Variety, 'tis true;  But they should consider 'tis not the Business of Men to pretend to settle how great this Difference and Variety must be. Nor does it follow, because it may be Infinite, and out of our Comprehension and Reach, that therefore Things in reality are so. For suppose God should have pleased to have made all Things in the rest of the Planets just as he has here, the Inhabitants of those Places (if there are any such) would admire his Wisdom and Contrivance no less than if they were widely different; seeing they can't come to know what's done in the other Planets. Who doubts but that God, if he had pleased, might have made the Animals in *America* and other distant Countries nothing like ours? yet we see he has not done it. They have indeed some difference in their Shape, and 'tis fit they should, to distinguish the Plants and Animals of those Countries from ours, who live on this side the Earth; but even in this Variety there is an Agreement,  
an

*Conjectures concerning*

an exact Correspondence in Figure and Shape, the same ways of Growth, and new Productions, and of continuing their own Kind. Their Animals have Feet and Wings like ours, and like ours have Hearts, Lungs, Guts, and the Parts serving to Generation ; whereas all these Things, as well with them as us, might, if it had pleased Infinite Wisdom, have been order'd a very different Way. 'Tis plain then that Nature has not exhibited that Variety in her Works that she could, and therefore we must not allow that Weight to this Argument, as upon the Account of it to make every Thing in the Planets quite different from what is here. 'Tis more probable that all the Difference there is between us and them, springs from the greater or less distance and influence from that Fountain of Heat and Life the Sun ; which will cause a Difference not so much in their Form and Shape, as in their Matter and Contexture.


*Planets  
have Wa-  
ter.*

And as for the Matter whereof the Plants and Animals there consist, tho'  
it

it is impossible ever to come to the **Book I.**  
Knowledge of its Nature, yet this we   
may venture to assert (there being  
scarce any Doubt of it) that their  
Growth and Nourishment proceeds  
from some liquid Principle. For all  
Philosophers agree that there can be  
no other way of Nutrition; some of  
the Chief among them having made  
Water to be the Original of all Things:  
For whatsoever's dry and without  
Moisture, is without Motion too;  
and without Motion, it's impossible  
there should be any Increase. But the  
Parts of a Liquid being in continual  
Motion one with another, and insi-  
nuating and twisting themselves into  
the smallest Places, are thereby very  
proper and apt to add not themselves  
only, but whatsoever else they may  
bring along with them, to the Increase  
and Growth of Bodies. Thus we see  
that by the Means of Water the  
Plants grow, blossom, and bear  
Fruit; and by the Addition of that  
only, Stones grow together out of  
Sand. And there's no doubt but  
that Metals, Crystals, and Jewels,  
have

Book I. have the same Method of Production: Tho' in them there has been no opportunity to make the same Observation, as well by reason of their slow Advances, as that they are commonly found far from the Places of their Generation; thrown up I suppose by some Earthquakes, or Convulsions. That the Planets are not without Water, is made not improbable by the late Observations: For about *Jupiter* are observed some Spots of a darker Colour than the rest of his Body, which by their continual change show themselves to be Clouds: For the Spots of *Jupiter* which belong to him, and never remove from him, are quite different from these, being sometimes for a long time not to be seen for these Clouds; and again, when these disappear, showing themselves. And at the going off of these Clouds, some Spots have been taken notice of in him, much brighter than the rest of his Body, which remained but a little while, and then were hid from our Sight. These Monsieur *Cassini* thinks are only the Reflecti-



Reflection from the Snow that covers Book I.  
 the Tops of the Hills, in *Jupiter*: But   
 I should rather think that it is only the  
 Colour of the Earth, which happens  
 to be free from those Clouds that com-  
 monly darken it.

*Mars* too is found not to be without  
 his dark Spots, by means of which he  
 has been observed to turn round his  
 own Axis in 24 Hours and 40 Minutes;  
 the Length of his Day: but whether he  
 has Clouds or no, we have not had the  
 same opportunity of observing as in  
*Jupiter*, as well because even when he  
 is nearest the Earth, he appears to us  
 much less than *Jupiter*, as that his  
 Light not coming so far, is so brisk as  
 to be an Impediment to exact Obser-  
 vations: And this Reason is as much  
 stronger in *Venus* as its Light is. But  
 since 'tis certain that the Earth and  
*Jupiter* have their Water and Clouds,  
 there is no Reason why the other Pla-  
 nets should be without them. I can't  
 say that they are exactly of the same  
 nature with our Water; but that they  
 should be liquid their Use requires, as  
 their Beauty does that they should be  
 clear.

*But not  
 just like  
 ours.*

Book I. clear. For this Water of ours, in *Jupiter* or *Saturn*, would be frozen up instantly by reason of the vast distance of the Sun. Every Planet therefore must have its Waters of such a temper, as to be proportioned to its Heat: *Jupiter's* and *Saturn's* must be of such a Nature as not to be liable to Frost; and *Venus's* and *Mercury's* of such, as not to be easily evaporated by the Sun. But in all of them, for a continual supply of Moisture, whatever Water is drawn up by the Heat of the Sun into Vapours, must necessarily return back again thither. And this it cannot do but in Drops, which are caused as well there as with us, by their ascending into a higher and colder Region of the Air, out of that which, by reason of the Reflection of the Rays of the Sun from the Earth, is warmer and more temperate.

Here then we have found in these new Worlds Fields warm'd by the kindly Heat of the Sun, and water'd with fruitful Dews and Showers: That there must be Plants in them as well for Ornament as Use, we have shewn  
just

just now. And what Nourishment, what manner of Growth shall we allow them? Probably, there can be no better, nay no other, than what we here experience; by having their Roots fastened into the Earth, and imbibing its nourishing Juices by their tender Fibres. And that they may not be only like so many bare Heaths, with nothing but creeping Shrubs and Bushes, we may allow them some nobler and loftier Plants, Trees, or somewhat like them: These being the greatest, and, except Waters, the only Ornament that Nature has bestowed upon the Earth. For not to speak of those many uses that are made of their Wood, there's no one that is ignorant either of their Beauty or Pleasantness. Now what way can any one imagine for a continual Production and Succession of these Plants, but their bearing Seed? A Method so excellent, that it's the only one that Nature has here made use of, and so wonderful, that it seems to be designed not for this Earth alone. In fine, there's the same reason to think that this Method is observed in those


Book I.

*Plants grow and are nourished there as they are here.*


Book I. distant Countries, as there was of its  
 being followed in the remote Quar-  
 ters of this same Earth.


*The same  
 true of  
 their Ani-  
 mals.*

'Tis much the same in Animals as  
 'tis in Plants, as to their manner of  
 Nourishment, and Propagation of their  
 Kind. For since all the living Crea-  
 tures of this Earth, whether Beasts,  
 Birds, Fishes, Worms, or Insects, uni-  
 versally and inviolably follow the same  
 constant and fix'd Institution of Na-  
 ture; all feed on Herbs, or Fruits, or  
 the Flesh of other Animals that fed on  
 them: since all Generation is perform-  
 ed by the impregnating of the Eggs,  
 and the Copulation of Male and Fe-  
 male: Why may not the same Rule  
 be observed in the Planetary Worlds?  
 For 'tis certain that the Herbs and A-  
 nimals that are there would be lost,  
 their whole Species destroyed without  
 some daily new Productions: except  
 there be no such thing there as Mis-  
 fortune or Accident: except the Plants  
 are not like other humid Bodies, but  
 can bear Heat, Frost, and Age, with-  
 out being dry'd up, kill'd or decay'd:  
 except the Animals have Bodies as hard  
 and

and durable as Marble; which I think Book I.  
are gross Absurdities: If we should   
invent some new Way for their coming into the World, and make them drop like Soland Geese from Trees, how ridiculous would this be to any one that considers the vast Difference between Wood and Flesh? Or suppose we should have new ones made every Day out of some such fruitful Mud as that of *Nile*, who does not see how contrary this is to all that's reasonable? And that 'tis much more agreeable to the Wisdom of God, once for all to create of all sorts of Animals, and distribute them all over the Earth in such a wonderful and inconceivable way as he has, than to be continually obliged to new Productions out of the Earth? And what miserable, what helpless Creatures must these be, when there's no one that by his Duty will be obliged, or by that strange natural fondness, which God has wisely made a necessary Argument for all Animals to take care of their own, will be moved to assist, nurse or educate them?

Book I.


 As for what I have said concerning their Propagation, I cannot be so positive; but the other Thing, namely, that they have Plants and Animals, I think I have fully proved, *viz.* from hence, that otherwise they would be inferiour to our Earth. And by the same Argument, they must have as great a Variety of both as we have. What this is, will be best known to him that considers the different Ways our Animals make use of in moving from one Place to another. Which may be reduc'd, I think, to these; either that they walk upon two Feet or Four; or like Insects, upon Six, nay sometimes Hundreds; or that they fly in the Air bearing up, and wonderfully steering themselves with their Wings; or creep upon the Ground without Feet; or by a violent Spring in their Bodies, or paddling with their Feet, cut themselves a Way in the Waters. I don't believe, nor can I conceive, that there should be any other Way than these mentioned. The Animals then in the Planets must make use of one or more of these, like our amphibious Birds, which


which can swim in Water as well as Book I.  
walk on Land, or fly in the Air; or   
like our Crocodiles and Sea-Horses,  
must be Mongrels, between Land and  
Water. There can no other Method  
be imagined but one of these. For  
where is it possible for Animals to live,  
except upon such a solid Body as our  
Earth, or a fluid one like the Water, or  
still a more fluid one than that, such as  
our Air is? The Air I confess may be  
much thicker and heavier than ours,  
and so, without any Disadvantage to  
its Transparency, be fitter for the vo-  
latile Animals. There may also be ma-  
ny sorts of Fluids ranged over one ano-  
ther in Rows as it were. The Sea per-  
haps may have such a fluid lying on it,  
which tho' ten times lighter than Wa-  
ter, may be a hundred Times heavier  
than Air; whose utmost Extent may  
not be so large as to cover the higher  
Places of their Earth. But there's no  
Reason to suspect or allow them this,  
since we have no such Thing; and if  
we did, it would be of no Advantage  
to them, for that the former Ways of  
moving would not be hereby at all in-

Book I. creas'd : But when we come to meddle with the Shape of these Creatures, and consider the incredible Variety that is even in those of the different parts of this Earth, and that *America* has some which are no where else to be found, I must then confess that I think it beyond the Force of Imagination to arrive at any knowledge in the Matter, or reach to Probability concerning the Figures of these Planetary Animals. Altho' considering these Ways of Motion we e'en now recounted, they may perhaps be no more different from ours than ours (those of ours I mean that are most unlike) are from one another.

If a Man were admitted to a Survey of *Jupiter* or *Venus*, he would no doubt find as great a Number and Variety as he had at home. Let us then, that we may make as near a Guess at, and as reasonable a Judgment of the Matter as we can, consider the many Sorts, and the admirable Difference in the Shapes of our own Animals ; running over some of the Chief of them (for 'twould be tedious to set about a general Catalogue) that are notoriously

Great Variety of Animals in this Earth.



ously different from one another, either Book I.  
in the Figure or some peculiar Property   
belonging to them ; as they belong to  
the Land, or the Water, or the Air. A-  
mong the Beasts we may take notice  
of the great Distance between the  
Horse, the Elephant, the Lion, the  
Stag, the Camel, the Hog, the Ape,  
the Porcupine, the Tortoise, the Came-  
leon : in the Water, of that between  
the Whale, and the Sea-Calf, the Skait,  
the Pike, the Eel, the Ink-Fish, the Pour-  
control, the Crocodile, the Flying-fish,  
the Cramp-fish, the Crab, the Oister,  
and the Purple-Fish : and among Birds,  
of that between the Eagle, the Ostrich,  
the Peacock, the Swan, the Owl, and  
the Bat : and in Insects, of that between  
the Ants, the Spider, the Fly, and the  
Butterfly ; and of that Prodigy in their  
wonderful change from Worms. In  
this Roll I have pass'd by the creeping  
Kind as one Sort, and skip'd over that  
vast Multitude of less different Ani-  
mals that fill the intermediate Spaces.  
But be they never so many, there is no  
reason to think that the Planets cannot  
match them. For tho' we in vain guess *And no  
less in the  
Planets.*  
at

Book I. at the Figures of those Creatures, yet  
 we have discover'd somewhat of their  
 manner of Life in general; and of their  
 Senses we shall speak more by and by.

*The same  
 in Plants.*

The more considerable Differences  
 in our Plants ought to be thought on,  
 as well as the other. As in Trees,  
 that between the Fir and the Oak, the  
 Palm, the Vine, the Fig, and the Co-  
 co-Nut Tree, and that in the *Indies*,  
 from whose Boughs new Roots spring,  
 and grow downwards into the Earth.  
 In Herbs, the Difference is notable be-  
 tween Grass, Poppy, Colewort, Ivy,  
 Pompions, and the Indian Fig with  
 thick Leaves growing up without any  
 Stalk, and Aloe. Between every one  
 of which again there are many less  
 differing Plants not taken notice of.  
 Then the different Ways of raising  
 them are remarkable, whether from  
 Seeds, or Kernels, or Roots, or by  
 grafting or inoculating them. And  
 yet in all these, whether we consider  
 the Things themselves, or the Ways of  
 their Production, I make no doubt but  
 that the Planetary Worlds have as  
 wonderful a Variety as we.

But

But still the main and most agreeable Point of the Enquiry is behind, which is the placing some Spectators in these new Discoveries, to enjoy these Creatures we have planted them with, and to admire their Beauty and Variety. And among all, that have never so slightly meddled with these Matters, I don't find any that have scrupled to allow them their Inhabitants: not Men perhaps like ours, but some Creatures or other endued with Reason. For all this Furniture and Beauty the Planets are stock'd with seem to have been made in vain, without any Design or End, unless there were some in them that might at the same time enjoy the Fruits, and adore the wise Creator of them. But this alone would be no prevailing Argument with me to allow them such Creatures. For what if we should say, that God made them for no other Design, but that he himself might see (not as we do 'tis true; but that he that made the Eye sees, who can doubt?) and delight himself in the Contemplation of them? For was not

Man

Book I.

*Rational  
Animals  
in the Pla-  
nets.*

Book I. Man himself, and all that the whole  
 World contains, made upon this very  
 account? That which makes me of  
 this Opinion, that those Worlds are not  
 without such a Creature endued with  
 Reason, is, that otherwise our Earth  
 would have too much the Advantage  
 of them, in being the only part of the  
 Universe that could boast of such a  
 Creature so far above, not only Plants  
 and Trees, but all Animals whatsoever:  
 a Creature that has something  
 Divine in him, that knows, and un-  
 derstands, and remembers such an in-  
 numerable number of Things; that  
 deliberates, weighs and judges of the  
 Truth: A Creature upon whose Ac-  
 count, and for whose Use, whatsoever  
 the Earth brings forth seems to be pro-  
 vided. For every Thing here he con-  
 verts to his own Ends. With the  
 Trees, Stones, and Metals, he builds  
 himself Houses: the Birds and Fishes  
 he sustains himself with: and the Wa-  
 ter and Winds he makes subservient to  
 his Navigation; as he doth the sweet  
 Smell and glorious Colours of the Flow-  
 ers to his Delight. What can there be  
 in

in the Planets that can make up for its Book I.  
Defects in the want of so noble an Animal? If we should allow *Jupiter* a greater Variety of other Creatures, more Trees, Herbs and Metals, all these would not advantage or dignify that Planet so much as that one Animal doth ours by the admirable Productions of his penetrating Wit. If I am mistaken in this, I do not know when to trust my Reason, and must allow my self to be but a poor Judge in the true Estimate of Things.

Nor let any one say here, that there's so much Villany and Wickedness in Man that we have thus magnified, that it's a reasonable Doubt, whether he would not be so far from being the Glory and Ornament of the Planet that enjoys his Company, that he would be rather its Shame and Disgrace. For first, the Vices that most Men are tainted with, are no hindrance, but that those that follow the Dictates of true Reason, and obey the Rules of a rigid Virtue, are still a Beauty and Ornament to the Place that has the Happiness to harbour them.

Besides,

*Vices of Men no hindrance to their being the Glory of the Planet they inhabit.*

Book I. Besides, the Vices of Men themselves  
 are of excellent Use, and are not permitted and allowed in the World without wise Design. For since it has pleased God to order the Earth, and every Thing in it as we see it is (for it's absurd to say it happen'd against his Will or Knowledge) we must not think that so great a Diversity of Minds were placed in different Men to no End or Purpose: but that this mixture of bad Men with Good, and the Consequents of such a Mixture, as Misfortunes, Wars, Afflictions, Poverty, and the like, were permitted for this very good End, *viz.* the exercising our Wits, and sharpening our Inventions; by forcing us to provide for our own necessary Defence against our Enemies. 'Tis to the Fear of Poverty and Misery that we are beholden for all our Arts, and for that natural Knowledge which was the Product of laborious Industry; and which makes us that we cannot but admire the Power and Wisdom of the Creator, which otherwise we might have passed by with the same indifference as Beasts. And if Men were

were

were to lead their whole Lives in an **Book I.** undisturbed continual Peace, in no fear of Poverty, no danger of War, I doubt they would live little better than Brutes, without all knowledge or enjoyment of those Advantages that make our Lives pass on with Pleasure and Profit. We should want the wonderful Art of Writing, if its great Use and necessity in Commerce and War had not forced out the Invention. 'Tis to these we owe our Art of Sailing, our Art of Sowing, and most of those Discoveries of which we are Masters; and almost all the Secrets in experimental Knowledge. So that those very Things on account of which the Faculty of Reason seems to have been accused, are no small helps to its Advancement and Perfection. For those Virtues themselves, Fortitude and Constancy, would be of no use if there were no Dangers, no Adversity, no Afflictions for their Exercise and Trial.


If we should therefore imagine in the Planets some such reasonable Creature as Man is, adorn'd with the same Vir-

Book I. Virtues, and liable to the same Vices, it would be so far from degrading or vilifying them, that while they want such a one, I must think them inferior to our Earth.

*Reason there not different from what 'tis here.*

But if we allow these Planetary Inhabitants some sort of Reason, must it needs, may some say, be the same with ours? Certainly it must; whether we consider it as applied to Justice and Morality, or exercised in the Principles and Foundations of Science. For Reason with us is that which gives us a true Sense of Justice and Honesty, Praise, Kindness and Gratitude: 'tis That that teaches us to distinguish universally between Good and Bad; and renders us capable of Knowledge and Experience in it. And can there be any where any other Sort of Reason than this? or can what we call just and generous, in *Jupiter* or *Mars* be thought unjust Villany? This is not at all, I don't say probable, but possible. For the Aim and Design of the Creator is every where the Preservation and Safety of his Creatures. Now when such Reason as we are Masters of,




of, is necessary for the preservation of Book I.  
Life, and promoting of Society (a thing   
that they are not without, as we shall  
show) would it not be strange that the  
Planetary Inhabitants should have such  
a perverse Sort of Reason given them,  
as would necessarily destroy and con-  
found what it was design'd to maintain  
and defend? But allowing Morality  
and Passions with those distant Inha-  
bitants to be somewhat different from  
ours, and supposing they may act by  
other Principles in what belongs to  
Friendship and Anger, Hatred, Ho-  
nesty, Modesty, and Comeliness, yet  
still there would be no doubt, but that  
in the Search after Truth, in judging  
of the Consequences of Things, in  
Reasoning, particularly in that Sort  
which belongs to Magnitude or Quan-  
tity, about which their Geometry (if  
they have such a Thing) is employ'd,  
there would be no doubt, I say, but  
that their Reason here must be exact-  
ly the same, and go the same way to  
work with ours, and that what's true  
in one part will hold true over the  
whole Universe; so that all the diffe-  
D rence

Book I. *~* rence must lie in the Degrees of Knowledge, which will be proportional to the Genius and Capacity of the Inhabitants.

*They have Senses.*

But I perceive I am got somewhat too far : Let us first enquire a little concerning the bodily Senses of these Planetary Persons ; for without such, neither will Life be any Pleasure to them, nor Reason of any Use. And I think it very probable, that all their Animals, as well their Beasts as rational Creatures, are like ours in all that relates to the Senses : For without the Power of Seeing we should find it impossible for Animals to provide Food for themselves, or be fore-warn'd of any approaching Danger, so as to guard themselves from it. So that where-ever we plant any Animals, except we wou'd have them lead the Life of Worms or Moles, we must allow them Sight; than which nothing can conduce more either to the Preservation or Pleasure of their Lives. Then if we consider the wonderful Nature of Light, and the amazing Artifice in the fit framing the Eye for the Reception of it, we cannot  
but

*Sight.*

but see that Bodies so vastly remote Book I.  
could not be perceived by us in their   
proper Figures and just Distances, any  
other way than by Sight. For this  
Sense, and all others that we know of,  
must proceed from an external Motion.  
Which in the sense of Seeing must come  
either from the Sun, the fix'd Stars, or  
Fire: whose Particles being put into a  
very quick Motion, communicate it  
to the Celestial Matter about, whence  
'tis convey'd in a very short time to  
the most distant parts, just like Sound  
through the Air. If it were not for  
this Motion of the intermediate Æthe-  
rial Matter, we should be all in Dark-  
ness, and have Sight neither of Sun nor  
Stars, nor any thing else, for all other  
Light must come to us by Reflection  
from them. This Motion perceived  
by the Eyes is called Light. And the  
nice Curiosity of this Perception is ad-  
mirable, in that it is caused by the  
smallest Particles of the luminous Bo-  
dy brought to us by that fine Matter,  
which at the same time determine the  
Coast from whence the Motion comes;  
and in that all these different Roads of  
D 2 Motion,

Book I. Motion, these Waves crossing and interfering with one another, are yet no hindrance to every one's free Passage. All these Things are so wisely, so wonderfully contrived, that it's above the Power of humane Wit, to invent or frame any thing like them; nay, it is very difficult so much as to imagine and comprehend them. For what can be more amazing, than that one small Part of the Body should be so devised and framed, as by its means to show us the Shape, the Position, the Distance, and all the Motions, nay, and all the Colours, of a Body that is far remote from us, that it may appear the more distinct? And then the artful Composition of the Eye, drawing an exact Picture of the Objects without it, upon the concave Side of the Choroides, is even above all Admiration, nor is there any Thing in which God has more plainly manifested his excellent Geometry. And these Things are not only contriv'd and fram'd with so great Wisdom and Skill, as not to admit of better; but to any one that considers them attentively, they seem to be of such a Nature

ture as not to allow any other Method. For it's impossible that Light should represent Objects to us at so vast a distance, except by such an intervening Motion; and it's as impossible that any other Composition of the Eye should be equally fitted to the Reception of such Impressions. So that I cannot but think them greatly mistaken, that maintain these Things might have been contrived many other Ways. It's likely then, and credible, that in these Things the Planets have an exact correspondence with us, and that their Animals have the same Organs, and use the same way of Sight that we do. They must have Eyes therefore, and two at least we must grant them, otherwise they would not perceive those Things close to them, nor hardly be able to walk about with Safety. And if we must allow them to all Animals for the Preservation of their Life, how much more must they that make more, and more noble Uses of them, not be deprived of the Blessing of so advantageous Members? For by them we view the various Flowers, and the elegant Features of Beauty: with

Book I. them we read, we write, we contemplate the Heavens and Stars, and measure their Distances, Magnitudes, and Journeys: which how far they are common to the Inhabitants of those Worlds with us, I shall presently examine. But first I shall enquire whether now we have given them one, we ought also to give them the other

*Hearing.* four Senses. And indeed as to Hearing many Arguments perswade me to give it a Share in the Animals of those new Worlds. For 'tis of great consequence in defending us from sudden Accidents; and, especially when Seeing is of no use to us, it supplies its Place, and gives us seasonable warning of any imminent Danger. Besides, we see many Animals call their Fellow to them with their Voice, which Language may have more in it than we are aware of, tho' we don't understand it. But if we do but consider the vast Uses and necessary Occasions of Speaking on the one side, and Hearing on the other, among those Creatures that make use of their Reason, it will scarce seem credible that two such useful, such

excellent Things were designed only for us. For how is it possible but that they that are without these, must be without many other Necessaries and Conveniencies of Life? Or what can they have to recompense this Want? Then, if we go still farther, and do but meditate upon the neat and frugal Contrivance of Nature in making the same Air, by the drawing in of which we live, by whose Motion we sail, and by whose Means Birds fly, for a Conveyance of Sound to our Ears; and this Sound for the Conveyance of another Man's Thoughts to our Minds: Can we ever imagine that she has left those other Worlds destitute of so vast Advantages? That they don't want the Means of them is certain, for their having Clouds in *Jupiter* puts it past doubt that they have Air too; that being mostly formed of the Particles of Water flying about, as the Clouds are of them gathered into small Drops. And another Proof of it is, the necessity of breathing for the preservation of Life, a Thing that seems to be as universal a Dictate of Nature, as feeding upon the Fruits of the Earth.

*A Medium  
to convey  
Sound to  
the Ears.*

Book I.

*Touch.*

As for Feeling, it seems to be given upon necessity to all Creatures that are cover'd with a fine and sensible Skin, as a Caution against coming too near those Things that may injure or incommode them: and without it they would be liable to continual Wounds, Blows and Bruises. Nature seems to have been so sensible of this, that she has not left the least place free from such a Perception. Therefore it's probable that the Inhabitants of those Worlds are not without so necessary a Defence, and so fit a Preservative against Dangers and Mishaps.

*Smell and Taste.*

And who is there that doth not see the inevitable necessity for all Creatures that live by feeding to have both Taste and Smell, that they may distinguish those Things that are good and nourishing, from those that are mischievous and harmful? If therefore we allow the Planetary Creatures to feed upon Herbs, Seeds, or Flesh, we must allow them Taste and Smell, that they may chuse or refuse any Thing according as they find it likely to be advantageous or noxious to them.

I know



I know that it hath been a Question Book I. with many, whether there might not have been more Senses than these five.

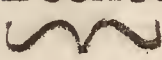
If we should allow this, it might nevertheless be reasonably doubted, whether the Senses of the Planetary Inhabitants are much different from ours. *Their Senses not very different from ours.*

I must confess, I cannot deny but there might possibly have been more Senses; but when I consider the Uses of those we have, I cannot think but they would have been superfluous. The Eye was made to discern near and remote Objects, the Ear to give us notice of what our Eyes could not, either in the Dark or behind our Back: Then what neither the Eye nor the Ear could, the Nose was made (which in Dogs is wonderfully nice) to warn us of. And if any thing escapes the notice of the other four Senses, we have Feeling to inform us of the too near Approaches of it before it can do us any mischief. Thus has Nature so plentifully, so perfectly provided for the necessary preservation of her Creatures here, that I think she can give nothing more to those there, but what will

Book I. will be needless and superfluous. Yet  
 ~~~~~ the Senses were not wholly designed  
 for use: but Men from all, and all
 other Animals from some of them,
 reap Pleasure as well as Profit, as from
 the Taste in delicious Meats; from the
 Smell in Flowers and Perfumes; from
 the Sight in the Contemplation of
 beauteous Shapes and Colours; from
 the Hearing in the Sweetness and Har-
 mony of Sounds; from the Feeling in
 Copulation, unless you please to count
 that for a particular Sense by it self.

*They have
 Pleasure
 arising
 from the
 Senses.*

Since it is thus, I think 'tis but reason-
 able to allow the Inhabitants of the
 Planets these same Advantages that we
 have from them. For upon this Consi-
 deration only, how much happier and
 easier a Man's Life is rendred by the
 enjoyment of them, we must be ob-
 liged to grant them these Blessings,
 except we would engross every thing
 that is good to our selves, as if we
 were worthier and more deserving
 than any else. But moreover, that
 Pleasure which we perceive in Eating
 or in Copulation, seems to be a necessa-
 ry and provident Command of Na-
 ture,


ture, whereby it tacitly compels us to Book I.
the preservation and continuance of 
our Life and Kind. It is the same in
Beasts. So that both for their Happi-
ness and Preservation it's very proba-
ble the rest of the Planets are not with-
out it. Certainly when I consider all
these Things, how great, noble, and
useful they are; when I consider what
an admirable Providence it is that
there's such a Thing as Pleasure in
the World, I can't but think that our
Earth, the smallest part almost of the
Universe, was never design'd to mo-
nopolize so great a Blessing. And thus
much for those Pleasures which affect
our bodily Senses, but have little or no
relation to our Reason and Mind.
But there are other Pleasures which
Men enjoy, which their Soul only and
Reason can relish: Some airy and
brisk, others grave and solid, and yet
nevertheless Pleasures, as arising from
the Satisfaction which we feel in
Knowledge and Inventions, and
Searches after Truth, of which whe-
ther the Planetary Inhabitants are not
partakers, we shall have an opportuni-
ty of enquiring by and by. There

Book I.



There are some other things to be consider'd first, in which it's probable they have some relation to us. That the Planets have those Elements of Earth, Air and Water, as well as we, I have already made not unlikely. Let us now see whether they may not have Fire also: which is not so properly call'd an Element, as a very quick Motion of the Particles in the inflammable Body. But be it what it will, there are many Arguments for their not being without it. For this Earth is not so truly call'd the Place of Fire as the Sun: and as by the Heat of that all Plants and Animals here thrive and live; so, no doubt, it is in the other Planets. Since then Fire is caused by a most intense and vigorous Heat, it follows that the Planets, especially those nearer the Fountain of it, have their proportionate degrees of Heat and Fire. And since there are so many ways of its Production, as by the collection of the Rays of the Sun, by the reflection of Mirrors, by the striking of Flint and Steel, by the rubbing of Wood, by the close loading of
moist


*All the
Planets
have Fire.*

moist Grass, by Lightning, by the Book I.
eruptions of Mountains and Volcanos, 
it's strange if neither Art should have
produced it, nor Nature effected it
there by one of these many means.
Then how useful and necessary is it to
us? By it we drive away Cold, and
supply the want of the Sun in those
Countries where his oblique Rays
make a less vigorous Impression, and
so keep a great part of the Earth from
being an uninhabited Desert: which
is equally necessary in all the Planets,
whether we allow them Succession of
Seasons, or a perpetual Spring and *Æ*-
quinox: for even then the Countries
near the Pole would receive but little
Advantage from the Heat of the Sun:
By the help of this we turn the Night
into Day, and thereby make a consi-
derable addition to the shortness of
our Lives. Upon all these Accounts
we ought not to think this Earth of
ours enjoy it all alone, and exclude all
the other Planets from so advantage-
ous and so profitable a Gift.

But perhaps it may be asked as well
concerning Brutes as rational Crea-
tures,

Book I. tures, and of their Plants and Trees
 too, whether they are proportionably
 larger or less than ours. For if the
 Magnitude of the Planets was to be the
 Standard of their measure, there would
 be Animals in *Jupiter* ten or fifteen
 times larger than Elephants, and as
 much longer than our Whales, and
 then their Men must be all Giants in
 respect to us. Now tho' I don't see
 any so great Absurdity in this as to
 make it impossible, yet there is no rea-
 son to think it is really so, seeing Na-
 ture has not always ty'd her self to
 those Rules which we have thought
 more convenient for her: For exam-
 ple, the Magnitude of the Planets is
 not answerable to their distances from
 the Sun; but *Mars*, tho' more remote,
 is far less than *Venus*: and *Jupiter*
 turns round his Axis in ten Hours,
 when the Earth which is much less
 than him, spends 24. But since Na-
 ture, perhaps some will say, has not
 observed such a Regularity in the pro-
 portion of Things, for ought we know
 there may be only a Race of Pygmies
 about the Bigness of Frogs and Mice,

The big-
 ness of
 their
 Creatures
 not right-
 ly guess'd at
 by the big-
 ness of the
 Planets.

poss'd of the Planets. But I shall show Book I.
 that this is very improbable by and 
 by.

There may arise another Question, *In the Pla-*
 whether there be in the Planets but *nets are*
 one sort of rational Creatures, or if *many*
 there be not several sorts possessed of *sorts of*
 different degrees of Reason and Sense. *rational*
Creatures
 There is something not unlike this to *as well as*
here.
 be observed among us. For to pass by
 those who have human Shape (altho'
 some of them would very well bear that
 Enquiry too) if we do but consider some
 sorts of Beasts, as the Dog, the Ape, the
 Beaver, the Elephant, nay some Birds
 and Bees, what Sense and Understand-
 ing they are masters of, we shall be
 forced to allow, that Man is not the
 only rational Animal. For we discover
 somewhat in them of Reason in-
 dependent on, and prior to all Teach-
 ing and Practice.

But still no Body can doubt, but
 that the Understanding and Reason
 of Man is to be preferr'd to theirs, as
 being comprehensive of innumerable
 Things, indued with an infinite memo-
 ry of what's past, and capable of pro-
 viding


Book I. viding against what's to come. That
 there is some such Species of rational
 Creatures in the other Planets, which
 is the Head and Sovereign of the rest,
 is very reasonable to believe: for o-
 therwise, were many Species endued
 with the same Wisdom and Cunning,
 we should have them always doing
 Mischief, always quarrelling and fight-
 ing one with another for Empire and
 Sovereignty, a Thing that we feel too
 much of where we have but one such
 Species. But to let that pass, our next
 Enquiry shall be concerning those Ani-
 mals in the Planets which are furnish-
 ed with the greatest Reason, whether
 it's possible to know wherein they em-
 ploy it, and whether they have made
 as great Advances in Arts and Know-
 ledge as we in our Planet. Which de-
 serves most to be considered and ex-
 amined of any thing belonging to their
 Nature; and for the better Perform-
 ance of it we must take our Rise some-
 what higher, and nicely view the
 Lives and Studies of Men.

And in those things wherein Men
 provide and take care only of what's
 ab-

absolutely necessary for the preservati-
on of their Life; in defending them-
selves from the Injuries of the Air; in
securing themselves against the Incur-
sions of Enemies by Walls; and a-
gainst Fraud and Disturbances by
Laws; in educating their Children,
and providing for themselves and
them: In all these I can see no great
reason that Man has to boast of the
Pre-eminency of his Reason above
Beasts and other Animals. For most
of these Things they perform with
greater Ease and Art than we, and
some of them they have no need of.
For that Sense of Virtue and Justice in
which Man excels, of Friendship,
Gratitude and Honesty, of what use
are they, but either to put a stop to
the Wickedness of Man, or to secure
us from mutual Assaults and Injuries,
Things wherein the Beasts want no
Guide but Nature and Inclination?
Then if we set before our Eyes the
manifold Cares, the Disturbances of
Mind, the restless Desires, the dread
of Death, that are the result of this
our Reason; and compare them with
E that

Book I. that easy, quiet, and harmless Life
 which other Animals enjoy, we should
 be apt to wish a Change, and conclude
 that they, especially Birds, lived with
 more Pleasure and Happiness than
 Man could with all his Wisdom. For
 they have as great a Relish of bodily
 Pleasures as we, let the new Philoso-
 phers say what they will, who would
 have them to be nothing but Clocks
 and Engines of Flesh; a Thing which
 Beasts so plainly confute by crying
 and running away from a Stick, and
 all other Actions, that I wonder how
 any one could subscribe to so absurd
 and cruel an Opinion. Nay, I can
 scarce doubt but that Birds feel no
 small Pleasure in their easy, smooth
 sailing through the Air; and would
 much more if they but knew the Ad-
 vantages it hath above our slow and
 laborious Progression. What is it
 then after all that sets human Reason
 above all other, and makes us prefera-
 ble to the rest of the Animal World?
 Nothing in my Mind so much as the
 Contemplation of the Works of God,
 and the Study of Nature, and the im-
 proving

*Men chief-
 ly differ
 from
 Beasts in
 the Study
 of Nature.*

proving those Sciences which may Book I.
bring us to some knowledge in their 
Beauty and Variety. For without
Knowledge what would be Contem-
plation? And what difference is there
between a Man, who with a careless
supine Negligence views the Beauty
and Use of the Sun, and the fine gol-
den Furniture of the Heaven, and one
who with a learned Niceness searches
into their Courses; who understands
wherein the Fix'd Stars, as they are
call'd, differ from the Planets, and
what is the Reason of the regular Vi-
cissitude of the Seasons; who by sound
Reasoning can measure the Magnitude
and Distance of the Sun and Planets?
Or between such a one as admires per-
haps the nimble Activity and strange
Motions of some Animals, and one
that knows their whole Structure, un-
derstands the whole Fabrick and Ar-
chitecture of their Composition? If
therefore the Principle we before laid
down be true, that the other Planets
are not inferiour in Dignity to ours,
what follows but that they have Crea-
tures not to stare and wonder at the
Works *They have
Astrono-
my.*

Book I. Works of Nature only, but who employ their Reason in the Examination and Knowledge of them, and have made as great Advances therein as we have? They do not only view the Stars, but they improve the Science of Astronomy: nor is there any thing can make us think this improbable, but that fond Conceitedness of every Thing that we call our own, and that Pride that is too natural to us to be easily laid down. But I know some will say, we are a little too bold in these Assertions of the Planets, and that we mounted hither by many Probabilities, one of which, if it chance to be false, and contrary to our Supposition, would, like a bad Foundation, ruin the whole Building, and make it fall to the Ground. But I would have them to know, that all I have said of their Knowledge in Astronomy, has Proofs enough, antecedent to those we now produced. For supposing the Earth, as we did, one of the Planets of equal Dignity and Honour with the rest, who would venture to say, that nowhere else were to be found any that

enjoy'd the glorious Sight of Nature's Theatre? Or if there were any Fellow-Spectators, yet we were the only ones that had dived deep into the Secrets and Knowledge of it? So that here's a Proof not so far fetch'd for the Astronomy of the Planets, the same which we used for their having rational Creatures, and enjoying the other Advantages we before talk'd of, which serves at the same time for the Confirmation of our former Conjectures. But if Amazement and Fear at the Eclipses of the Moon and Sun gave the first occasion to the Study of Astronomy, as probably they did, then it's almost impossible that *Jupiter* and *Saturn* should be without it; the Argument being of much greater force in them, by reason of the daily Eclipses of their Moons, and the frequent ones of the Sun to their Inhabitants. So that if a Person disinterested in his Judgment, and equally ignorant of the Affairs of all the Planets, were to give his Opinion in this Matter, I don't doubt he would give the Cause for Astronomy to those two Planets rather than us.

Book I.

and Use of Astronomy in the Planetary Worlds, will afford us many new Conjectures about their manner of Life, and their State as to other things.

*And all its
subserving
Arts.*

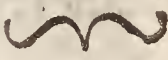
For, First : No Observations of the Stars that are necessary to the Knowledge of their Motions, can be made without Instruments; nor can these be made without Metal, Wood, or some such solid Body. Here's a necessity of allowing them the Carpenters Tools, the Saw, the Ax, the Plane, the Mallet, the File : and the making of these requires the Use of Iron, or some equally hard Metal.

*Geometry
and Arithmetick:*

Again, these Instruments can't be without a Circle divided into equal Parts, or a strait Line into unequal. Here's a necessity for introducing Geometry and Arithmetick. Then the Necessity in such Observations of marking down the Epochas or Accounts of Time, and of transmitting them to Posterity, will force us to grant them the Art of Writing; perhaps very different from ours which is commonly used, but I dare affirm not more ingenious

And Writing.

ingenious

nious or easy. For how much more Book I.
 ready and expeditious is our Way, than 
 by that multitude of Characters used
 in *China*; and how vastly preferable to
 Knots tied in Cords, or the Pictures
 in use among the barbarous People of
Mexico and *Peru*? There's no Nation
 in the World but has some way or
 other of writing or marking down
 their Thoughts: So that it's no won-
 der if the Planetary Inhabitants have
 been taught it by that great School-
 mistress Necessity, and apply it to the
 Study of Astronomy and other Scien-
 ces. In Astronomical Matters the Ne-
 cessity of it is moreover apparent from
 hence, that the Motion of the Stars is
 as 'twere to be fancied and guess'd at
 in different Systems, and these Systems
 to be continually improved and cor-
 rected, as later and more exact Obser-
 vations shall convince the old ones of
 Faults: all which can never be deli-
 ver'd down to succeeding Generations,
 unless we make use of Letters and
 Figures.

But after all these large and liberal
 Allowances to Them, they will still


Book I. be behind-hand with us. For we have
 ~~~~~  
*And Op-  
 ticks.* so certain a Knowledge of the true  
 System and Frame of the Universe; we have so admirable an Invention of Telescopes to help our failing Eye-sight in the view of the Bigness and different Forms of the Planetary Bodies, in the discovery of the Mountains, and the Shadows of them on the Surface of the Moon, in the bringing to light an innumerable multitude of Stars otherwise invisible, that we must necessarily be far their Masters in that Knowledge. Hence it is almost necessary (except we have a Mind to flatter and complement our selves as the only People that have the Advantage of such excellent Inventions) either to allow the Planetary Inhabitants such sharp Eyes as not to need them, or else the use of Glasses to help the Deficiency of their Sight. And yet I dare not assert this, lest any one should be so disturbed at the Extravagancy of such an Opinion, as to take the measure of my other Conjectures by it, and hiss them all off, upon the account of this alone.

But




But some Body may perhaps object, Book I.  
 and that not without reason at first  
 sight, that the Planetary Inhabitants it's  
 likely are destitute of all refined Know-  
 ledge, just as the *Americans* were before  
 they had Commerce with the *Europe-  
 ans*. For if one considers the Ignorance  
 of those Nations, and of others in *Asia*  
 and *Africa* equally barbarous, it will  
 appear as if the main Design of the  
 Creator in placing Men upon the Earth  
 was that they might live, and, in a  
 just sense of all the Blessings and Plea-  
 sure they enjoy, worship the Foun-  
 tain of their Happiness; but that some  
 few went beyond the Bounds of Na-  
 ture in their Enquiries after Know-  
 ledge. There does not want an An-  
 swer to these Men. For God could  
 not but foresee the Advances Men  
 would make, in their enquiring into  
 the Heavenly Bodies: that they would  
 discover Arts useful and advantageous  
 to Life: that they would cross the Seas,  
 and dig up the Bowels of the Earth.  
 Nothing of all this could happen contra-  
 ry to the Mind and Knowledge of the  
 Infinite Author of all Things. And if  
 he

*These Sci-  
 ences not  
 contrary  
 to Na-  
 ture.*

Book I. he foresaw these Things would be,  he so appointed and destin'd them to humane kind. And the Studies of Arts and Sciences cannot be said to be contrary to Nature, since in the search thereof they are employ'd : especially if we consider how great the natural desire and love of Knowledge, rooted in all Men is. For it's impossible this should have been given them upon no Design or Account. But they will urge, that if such a Knowledge is natural, if we were born for it, why are there so very few, especially in Astronomy, that prosecute these Studies? For *Europe* is the only Quarter of the Earth in which there have been any Advancements made in Astronomy. And as for the Judicial Astrology, which pretends to foretel what is to come, it is such a wretched and oftentimes mischievous piece of Madness, that I do not think it ought to be so much as named here. And even in *Europe*, not one in a hundred Thousand meddles with these Studies. Besides, its Original and Rise is so late, that many Ages were past before the

the

the very first Rudiments of Astronomy Book I.  
or Geometry (which is necessary to the   
learning of it) were known. For every Body is acquainted almost with its first Beginnings in *Egypt* and *Greece*. Add to this, that 'tis not yet above fourscore Years since the bungling Epicycles were discarded, and the true and easy plain Motion of the Planets was discovered. For the Satisfaction of these Scruples, to what we said before, concerning the Fore-knowledge of God, may be added this; That God never designed we should come into the World Astronomers or Philosophers; these Arts are not infused into us at our Birth, but were ordered, in long Tracts of Time, by degrees to be the Rewards and Result of laborious Diligence; especially those Sciences which are now in debate, are so much the more difficult and abstruse, that their late Invention and slow Progress are so far from being a Wonder, that it is rather strange they were ever discover'd at all. There are but few, I acknowledge one or two perhaps in an Age, that pursue them,

or

Book I. or think them their Business: but their  
 ~~~~~ Number will be very considerable if we  
 take in those that have lived in all the
 Ages in which Astronomy hath flour-
 rished: and no Body can deny them
 that Happiness and Contentment which
 they have pretended to above all others.
 In fine, it was sufficient that so small
 a Number should make it their Study,
 so that the Profit and Advantage of
 their Inventions might but spread it
 self over all the World. Since then
 the Inhabitants of this Earth, let them
 be never so few, have had Parts and
 Genius sufficient for the Attainment of
 this Knowledge; and there's no reason
 to think the Planetary Inhabitants less
 ingenious or happy than our selves; we
 have gain'd our Point, and 'tis probable
 that they are as skilful Astronomers as
 we can pretend to be. So that now
 we may venture to deduce some Con-
 sequences from such a Supposition.

We have before shew'd the necessa-
 ry Dependence and Connexion; not
 only of Geometry and Arithmetick,
 but of Mechanical Arts and Instru-
 ments with this Science. This leads

us naturally to the Enquiry how they can use these Instruments and Engines for the Observation of the Stars, how they can write down such their Observations, and perform other Things which we do with our Hands. So that we must necessarily give them Hands, or some other Member, as convenient for all those Uses, instead of them. One of the ancient Philosophers laid such Stress upon the Use and Conveniency of the Hands, that he made no scruple to affirm, they were the Cause and Foundation of all our Knowledge. By which, I suppose, he meant no more, than that without their Help and Assistance Men could never arrive to the Improvement of their Minds in natural Knowledge: And indeed not without Reason. For suppose instead of them they had had Hoofs like Horses or Bullocks given them, they might have laid indeed the Model and Design of Cities and Houses in their Head, but they would never have been able to have built them. They would have had no Subject of Discourse but what belong'd to their

*They have
Hands.*

Book I. Victuals, Marriages, or Self-preservation. They would have been void of all Knowledge and Memory, and indeed would have been but one degree distant from brute Beasts. What could we invent or imagine that could be so exactly accommodated to all the design'd Uses as the Hands are? Elephants can lay hold of, or throw any thing with their Proboscis, can take up even the smallest Things from the Ground, and can perform such surprising Things with it, that it has not very improperly been call'd their Hand, tho' indeed it is nothing but a Nose somewhat longer than ordinary. Nor do Birds show less Art and Design in the Use of their Bills in the picking up their Meat, and the wonderful Composure of their Nests. But all this is nothing to those Conveniences the Hand is so admirably suited to; nothing to that amazing Contrivance in its Capacity of being stretched, or contracted, or turned to any Part as Occasion shall require. And then, to pass by that nice Sense that the Ends of the Fingers are endued with, even to the feeling and

di-

distinguishing most sorts of Bodies in Book I. the Dark, what Wisdom and Art is show'd in the Disposition of the Thumb and Fingers, so as to take up or keep fast hold of any Thing we please? Either then the Planetary Inhabitants must have Hands, or somewhat equally convenient, which it is not easy to conceive; or else we must say that Nature has been kinder not only to us, but even to Squirrels and Monkeys than them.

That they have Feet also scarce any one can doubt, that does but consider what we said but just now of Animals different Ways of going along, which it's hard to imagine can be perform'd any other ways than what we there recounted. And of all those, there's none can agree so well with the state of the Planetary Inhabitants, as that that we here make use of. Except (what is not very probable, if they live in Society, as I shall show they do) they have found out the Art of flying in some of those Worlds.


The Stature and Shape of Men here does show forth the Divine Providence

That they are upright.

Book I. dence so much in its being so fitly adapted to its design'd Uses, that it is not without reason that all the Philosophers have taken notice of it, nor without Probability that the Planetary Inhabitants have their Eyes and Countenance upright, like us, for the more convenient and easy Contemplation and Observations of the Stars. For if the Wisdom of the Creator is so observable, so Praise-worthy in the Position of the other Members; in the convenient Situation of the Eyes, as Watches in the higher Region of the Body; in the removing of the more uncomely Parts out of sight as 'twere; we cannot but think he has almost observed the same Method in the Bodies of those remote Inhabitants. Nor does it follow from hence that they must be of the same Shape with us. For there is such an infinite possible variety of Figures to be imagined, that both the Structure of their whole Bodies, and every part of them, both outside and inside, may be quite different from ours. How warmly and conveniently are some Creatures cloath'd with

It follows not therefore that they have the same Shape with us.

Wool,


Wool, and how finely are others deck- Book I.
ed and adorn'd with Feathers? Per- 
haps among the rational Creatures in
the Planets there may some such distin-
ction be observ'd in their Garb and Co-
vering; a Thing in which Beasts seem
to excel Men in here. Unless per-
haps Men are born naked, for this
reason to put them upon employ-
ing and exercising their Wits, in the
inventing and making that Attire that
Nature had made necessary for them.
And 'tis this Necessity that has been
the greatest, if not only occasion of all
the Trade and Commerce, of all the
Mechanical Inventions and Discove-
ries that we are Masters of. Besides,
Nature might have another great Con-
veniency in her Eye, by bringing Men
into the World naked, namely, that
they might accommodate themselves
to all places of the World, and go
thicker or thinner cloth'd, according as
the Season and Climate they liv'd in
requir'd. There may still be conceiv-
ed a greater difference between us and
the Inhabitants of the Planets; for
there are some sort of Animals, such

Book I. as Oysters, Lobsters, and Crab-fish, whose Flesh is on the inside of their Bones as 'twere. But that which hinders me from ascribing such a kind of Frame and Composition to the Planetary Inhabitants, is that Nature seems to have done it only in a few of the meanest Sort of Creatures, and that hereby they would be deprived of that quick easy motion of their Hands and Fingers, which is so useful and necessary to them, otherwise I should not be much affected with the odd Shape and Figure.

*A rational
Soul may
inhabit a-
nother
Shape than
ours.*

For 'tis a very ridiculous Opinion, that the common People have got, that 'tis impossible a rational Soul should dwell in any other Shape than ours. And yet as silly as 'tis, it has been the occasion of many Philosophers allowing the Gods no other Shape; nay, the Foundation of a Sect among the Christians, that from hence have the Name of *Anthropomorphites*. This can proceed from nothing but the Weakness, Ignorance, and Prejudice of Men; the same as that other concerning humane Shape, that it is

tha

the handsomest and most excellent of Book I.
 all others, when indeed it's nothing 
 but a being accustomed to that Figure
 that makes us think so, and a Conceit
 that we and all other Animals natu-
 rally have, that no Shape or Colour can
 be so good as our own. Yet so power-
 ful are these, that were we to meet
 with a Creature of a much different
 Shape from Man, with Reason and
 Speech, we should be much surpris'd
 and shocked at the Sight. For if we
 try to imagine or paint a Creature like
 a Man in every Thing else, but that
 has a Neck four times as long, and great
 round Eyes five or six times as big, and
 farther distant, we cannot look upon't
 without the utmost Aversion, altho'
 at the same time we can give no ac-
 count of our Dislike.

When I just now mentioned the *The Planetary*
 Stature of the Planetary Inhabitants, *tarians*
 I hinted that 'twas improbable they *not less*
 should be less than we are. For *than we.*
 it's likely, that as our Bodies are
 made in such a proportion to our
 Earth, as to render us capable of tra-
 velling about it, and making Observa-
 tions

Book I. tions upon its Bulk and Figure, the same Order is observ'd in the Inhabitants of the other Planets, unless in this Particular also, which is very considerable, we would prefer our selves to all others. Then seeing we have before allow'd them Astronomy and Observations, we must give them Bodies and Strength sufficient for the ruling their Instruments, and the erecting their Tubes and Engines. And for this the larger they are the better. For if we should suppose them Dwarfs not above the Bigness of Rats or Mice, they could neither make such Observations as are requisite; nor such Instruments as are necessary to those Observations. Therefore we must suppose them larger than, or at least equal to, our selves, especially in *Jupiter* and *Saturn*, which are so vastly bigger than the Planet which we inhabit.

*They live
in Society.*

Astronomy, we said before, could never subsist without the writing down the Observations: Nor could the Art of Writing (any more than the Arts of Carpenters and Founders) ever be found out except in a Society of

of

of reasonable Creatures, where the Necessities of Life forc'd them upon Invention : So that it follows from hence, (as was before said) that the Planetary Inhabitants must in this be like us, that they maintain a Society and Fellowship with, and afford mutual Assistances and Helps to one another. Hereupon we must allow them a settled, not a wandring *Scythian* way of living, as more convenient for Men in such Circumstances. But what follows from hence? Must they not have every thing else proper for such a manner of living granted them too? Must they not have their Governours, Houses, Cities, Trade and Bartering? Why should they not, when even the barbarous People of *America* and other Places were at their first Discovery found to have somewhat of that nature in use among them. I don't say, that Things must be the same there as they are here. We have many that may very well be spared among rational Creatures, and were design'd only for the preservation of Society from all Injury, and for the curbing of those

Book I. Men who make an ill use of their Reason to the Detriment of others. Perhaps in the Planets they have such plenty and affluence of all good Things, as they neither need or desire to steal from one another; perhaps they may be so just and good as to be at perpetual Peace, and never to lie in wait for, or take away the Life of their Neighbour: perhaps they may not know what Anger or Hatred are; and if so, they must be much happier than we. But it's more likely they have such a mixture of Good with Bad, of Wise with Fools, of War with Peace, and want not that School-mistress of Arts Poverty. For, as was before shown, some good use may be made of these things, but if not, there is no Reason why we should prefer their Condition to our own.

*They enjoy
the Plea-
sures of
Society.*


What I am now going to say may seem somewhat more bold, and yet is not less likely than the former. For if these Nations in the Planets live in Society, as I have pretty well show'd they do, 'tis somewhat more than probable that they enjoy not only the Profit,

Profit, but the Pleasures arising from Society: such as Conversation, Amours, Jestings, and Shews. Otherwise we should make them live without Diversion or Merriment; we should deprive them of the great Sweetness of Life, which it can't well be without, and give our selves such an Advantage over them as Reason will by no means admit of.

But to proceed to a farther Enquiry into their Business and Employment, let's consider what we have not yet mention'd, wherein they may bear any Likeness to us. And first we have good Reason to believe they build themselves Houses, because we are sure they are not without their Showers. For in *Jupiter* have been observed Clouds, big no doubt with Vapours and Water, which hath been proved by many other Arguments, not to be wanting in that Planet. They have Rain then, for otherwise how could all the Vapours drawn up by the Heat of the Sun be disposed of? And Winds, for they are caused only by Vapours dissolved by Heat, and it's

Book I. plain that they blow in *Jupiter* by the continual Motion and Variety of the Clouds about him. To protect themselves from these, and that they may pass their Nights in Quiet and Safety, they must build themselves Tents or Huts, or live in Holes of the Earth. But why may we not suppose the Planetary Inhabitants to be as good Architects, have as noble Houses, and as stately Palaces as our selves? Unless we think that every Thing which belongs to our selves is the most beautiful and perfect that can be. And who are we, but a few that live in a little Corner of the World, upon a Ball ten Thousand times less than *Jupiter* or *Saturn*? And yet we must be the only skilful People at Building; and all others must be our Inferiours in the Knowledge of uniform Symetry; and not be able to raise Towers and Pyramids as high, magnificent, and beautiful, as our selves. For my part, I see no reason why they may not be as great Masters as we are, and have the Use of all those Arts subservient to it, as Stone-cutting and Brick-making,

They have Houses to secure 'em from Weather.

king, and whatsoever else is necessary Book I.
for it, as Iron, Lead and Glafs; or or- 
namental to it, as Gilding and Picture.

If their Globe is divided like ours, into Sea and Land, as it's evident it is (else whence could all those Vapours in *Jupiter* proceed?) we have great Reason to allow them the Art of Navigation, and not vainly ingross so great, so useful a Thing to our selves. Especially considering the great Advantages *Jupiter* and *Saturn* have for Sailing, in having so many Moons to direct their Course, by whose Guidance they may attain easily to the Knowledge that we are not Masters of, of the Longitude of Places. And what a Multitude of other Things follow from this Allowance? If they have Ships, they must have Sails and Anchors, Ropes, Pullies, and Rudders, which are of particular Use in directing a Ship's Course against the Wind, and in sailing different Ways with the same Gale. And perhaps they may not be without the Use of the Compass too, for the magnetical Matter, which continually passes thro' the Pores of our Earth,
is

Book I. is of such a Nature, that it's very probable the Planets have something like *They have Navigation, and all Arts subservient.* it. But there's no doubt but that they must have the Mechanical Arts and Astronomy, without which Navigation can no more subsist, than they can without Geometry.

But Geometry stands in no need of being prov'd after this manner. Nor doth it want Assistance from other Arts which depend upon it, but we may have a nearer and shorter Assurance of their not being without it in those Earths. For that Science is of such singular Worth and Dignity, so peculiarly imployes the Understanding, and gives it such a full Comprehension and infalible certainty of Truth, as no other Knowledge can pretend to: it is moreover of such a Nature, that its Principles and Foundations must be so immutably the same in all Times and Places, that we cannot without Injustice pretend to monopolize it, and rob the rest of the Universe of such an incomparable Study. Nay Nature it self invites us to be Geometricians; it presents us with Geometrical

As Geometry.

metrical Figures, with Circles and Squares, with Triangles, Polygons, and Spheres, and proposes them as it were to our Consideration and Study, which abstracting from its Usefulness, is most delightful and ravishing. Who can read *Euclid*, or *Apollonius*, about the Circle, without Admiration? Or *Archimedes* of the Surface of the Sphere, and Quadrature of the Parabola without Amazement? or consider the late ingenious Discoveries of the Moderns with Boldness and Unconcernedness? And all these Truths are as naked and open, and depend upon the same plain Principles and Axioms in *Jupiter* and *Saturn* as here, which makes it not improbable that there are in the Planets some who partake with us in these delightful and pleasant Studies. But what's the greatest Argument with me, that there are such, is their Use, I had almost said Necessity, in most Affairs of humane Life. Now we are got thus far, what if we should venture somewhat farther, and say, that they have our Inventions of the Tables of Sines, of Logarithms, and Algebra?

Book I. Algebra? I know it would sound very odd, and perhaps a little ridiculous, and yet there's no reason but the thinking our selves better than all the World, to hinder them from being as happy in their Discoveries, and as ingenious in their Inventions as we our selves are.

*They have
Musick.*


It's the same with Musick as with Geometry, it's every where immutably the same, and always will be so. For all Harmony consists in Concord, and Concord is all the World over fix'd according to the same invariable Measure and Proportion. So that in all Nations the Difference and Distance of Notes is the same, whether they be in a continued gradual Progression, or the Voice makes skips over one to the next. Nay very credible Authors report, that there's a sort of Bird in *America*, that can plainly sing in order six musical Notes: Whence it follows, that the Laws of Musick are unchangeably fix'd by Nature, and therefore the same Reason holds for their Musick, as we e'en now shewed for their Geometry. For why, supposing other
Na-

Nations and Creatures, endued with Reason and Sense as well as we, should not they reap the Pleasures arising from these Senses as well as we too? I don't know what Effect this Argument, from the immutable Nature of these Arts, may have upon the Minds of others; I think it no inconsiderable or contemptible one, but of as great Strength as that which I made use of above to prove that the Planetary Inhabitants had the Sense of Seeing.

But if they take delight in Harmony, there is no doubt but that they have invented Musical Instruments. For they could scarce help lighting upon some or other by chance; the Sound of a tight String, the Noise of the Winds, or the whistling of Reeds, might have given them the hint. From these small Beginnings they perhaps, as well as we, have advanced by degrees to the Use of the Lute, Harp, Flute, and many string'd Instruments. But altho' the Tones are certain and determinate, yet we find among different Nations a quite different manner and rule for Singing; as for-

Book I. formerly among the *Dorians, Phrygi-
 ~~~~~ans, and Lydians,* and in our Time  
 among the *French, Italians,* and *Per-  
 sians.* In like manner it may so hap-  
 pen, that the Musick of the Inhabi-  
 tants of the Planets may widely differ  
 from all these, and yet be very good.  
 But why we should look upon their  
 Musick to be worse than ours, there's  
 no reason can be given; neither can  
 we well presume that they want the  
 Use of Half-Notes and Quarter-Notes,  
 seeing the Invention of Half-Notes is so  
 obvious, and the Use of them so agree-  
 able to Nature. Nay, to go a Step far-  
 ther, what if they should excel us in the  
 Theory and practick part of Musick,  
 and outdo us in Conforts of vocal and  
 instrumental Musick, so artificially  
 compos'd, that they shew their Skill by  
 the Mixtures of Discords and Concords?  
 and of this last sort 'tis very likely the  
 5th and 3d are in use with them.

This is a very bold Assertion, but it  
 may be true for ought we know, and  
 the Inhabitants of the Planets may pos-  
 sibly have a greater insight into the  
 Theory of Musick than has yet been  
 dis-

discover'd among us. For if you ask Book I:  
 any of our Musicians, why two or more   
 perfect Fifths cannot be used regularly  
 in Composition; some say 'tis to avoid  
 that Sweetness and Lushiousness which  
 arises from the Repetition of this plea-  
 sing Chord. Others say, this must be  
 avoided for the sake of that Variety of  
 Chords that are requisite to make a  
 good Composition; and these Reasons  
 are brought by *Cartes* and others. But  
 an Inhabitant of *Jupiter* or *Venus* will  
 perhaps give you a better Reason for  
 this, *viz.* because when you pass from  
 one perfect Fifth to another, there is  
 such a Change made as immediately  
 alters your Key, you are got into a  
 new Key before the Ear is prepared  
 for it, and the more perfect Chords  
 you use of the same kind in Consecu-  
 tion, by so much the more you offend  
 the Ear by these abrupt Changes.

Again, one of these Inhabitants per-  
 haps can show how it comes about, that  
 in a Song of one or more Parts, the Key  
 cannot be kept so well in the same a-  
 greeable Tenour, unless the intermedi-  
 ate Closes and Intervals be so temper'd,

as

Book I. as to vary from their usual Proportions, and thereby to bear a little this way or that, in order to regulate the Scale. And why this Temperature is best in the System of the Strings, when out of the Fifth the fourth Part of a Comma is usually cut off; This same thing I have formerly shew'd at large.

But for the regulating the Tone of the Voice (as I before hinted) that may admit of a more easy proof, and we shall give you an Essay of it, since I have mentioned a thing that is not mere Imagination only: I say therefore, if any Person strike those Sounds which the Musicians distinguish by these Letters, C, F, D, G, C, by these agreeable Intervals, altogether perfect, interchangeable, ascending and descending with the Voice: Now this latter sound C will be one Comma, or very small portion lower than the first sounding of C. Because of these perfect Intervals, which are as 4 to 3, 5 to 6, 4 to 3, 2 to 3, an account is made in such a Proportion, as 160 to 162. that is, as 80 to 81, which is what they call a Comma. So that if the same Sound should



should be repeated nine times, the Book I. Voice would fall near the Matter a greater Tone, whose proportion is as 8 to 9. But this the Sense of the Ears by no means endures, but remembers the first Tone, and returns to it again. Therefore we are compell'd to use an occult Temperament, and to sing these imperfect Intervals, from doing which less Offence arises. And for the most part, all Singing wants this Temperament, as may be collected by the aforesaid Computations. And these things we have offer'd to those that have some Knowledge in Geometry.

We have spoke of these Arts and Inventions, which it is very probable the Inhabitants of the Planets partake of in common with us, besides which it seems requisite to take in many other Things that serve either for the Use or Pleasure of their Lives. But what these Things are we shall the better account for, by laying before us many of those Things which are found among us. I have before mention'd the Variety of Animals and Vegetables, which very much differ from each other,

G

among

Book I. among which there are some that differ but little; and I have said, that there are no less differences in these Things in the Planetary Worlds.


I shall now take a short view of the Benefits we receive both from those Herbs and Animals, and see whether we may not with very good reason conclude that the Planetary Inhabitants reap as great and as many from those that their Countries afford them.

And here it may be worth our while to take a Review of the Variety and Multitude of our Riches. For Trees and Herbs do not only serve us for Food, they in their delicious Fruits, these in their Seeds, Leaves and Roots; but Herbs moreover furnish us with Physick, and Trees with Timber for our Houses and Ships. Flax, by the means of those two useful Arts of Spinning and Weaving, affords us Clothing. Of Hemp or Matweed we twist our selves Thread and small Ropes, the former of which we employ in Sails and Nets, the latter in making larger Ropes for Masts and Anchors. With the sweet Smells and  
bean-

beauteous Colours of Flowers we feast  
 our Senses: and even those of them  
 that offend our Nostrils, or are mis-  
 chievous to our Bodies, are seldom  
 without excellent Uses: or were made  
 perhaps by Nature as a Foil to set off,  
 and make us the more value the Good  
 by comparing them with these. What  
 vast Advantages and Profit do we reap  
 from the Animals? The Sheep give us  
 Clothing, and the Cows afford us  
 Milk: and both of them their Flesh  
 for our Sustenance. Asses, Camels,  
 and Horses do, what if we wanted  
 them we must do our selves, carry  
 our Burdens; and the last of them we  
 make use of, either themselves to car-  
 ry us, or in our Coaches to draw us.  
 In which we have so excellent, so use-  
 ful an Invention of Wheels, that I  
 can't suppose the Planets to enjoy Soci-  
 ety and all its Consequences, and be  
 without them. Whether they are Py-  
 thagoreans there, or feed upon Flesh  
 as we do, I dare not affirm any Thing.  
 Tho' it seems to be allowed Men to  
 feed upon whatsoever may afford them  
 Nourishment, either on Land, or in

*Book I.*  
 ~~~~~  
*The Ad-
 vantages
 we reap
 from Herbs
 and Ani-
 mals.*

Book I. Water, upon Herbs, and Pomes, Milk, Eggs, Honey, Fish, and no less upon the Flesh of many Birds and Beasts. But it is a surprizing thing! that a rational Creature should live upon the Ruin and Destruction of such a number of other his Fellow-Creatures! And yet it does not seem at all unnatural, since not only he, but even Lions, Wolves, and other ravenous Beasts, prey upon Flocks of other harmless Things, and make mere Fodder of them; as Eagles do of Pidgeons and Hares; and large Fish of the helpless little ones. We have different sorts of Dogs for Hunting, and what our own Legs cannot, that their Nose and Legs can help us to. But the Use and Profit of Herbs and Animals are not the only Things they are good for, but they raise our Delight and Admiration when we consider their various Forms and Natures, and enquire into all their different ways of Generation: Things so infinitely multifarious, and so delightfully amazing, that the Books of natural Philosophers are deservedly filled with their Encomiums. For even in the
very

very Insects, who can but admire the Book I.
six-corner'd Cells of the Bees, or the 
artificial Web of a Spider, or the fine
Bag of a Silk-worm, which last affords
us, with the Help of incredible Indu-
stry, even Shiploads of soft delicate
Clothing. This is a short Summary
of those many profitable Advantages
the animal and herbal World serve
us with.

But this is not all. The Bowels of
the Earth likewise contribute much to
Man's Happiness. For what Art and
Cunning does he employ in finding, in
digging, in trying Metals, and in
melting, refining, and tempering them?
What Skill and Nicety in beating, *And from*
drawing or dissolving Gold, so as with *Metals.*
inconsiderable Changes to make every
Thing he pleases put on that noble
Lustre? Of how many and admirable
Uses is Iron? and how ignorant in all
Mechanical Knowledge were those
Nations that were not acquainted with
it, so as to have no other Arms but
Bows, Clubs, and Spears, made of Wood.
There's one Thing indeed we have,
which it's a Question whether it has
G 3 done

Book I. done more harm or good, and that is
 ~~~~~ Gun-powder made of Nitre and Brim-  
 stone. At first indeed it seem'd as if  
 we had got a more secure Defense than  
 former Ages against all Assaults, and  
 could easily guard our Towns, by the  
 wonderful Strength of that Invention,  
 against all hostile Invasions: but now  
 we find it has rather encouraged them,  
 and at the same time been no small Oc-  
 casion of the Decay of Valour, by ren-  
 dering it and Strength almost usefess in  
 War. Had the *Grecian* Emperor who  
 said, *Virtue was ruin'd* only when  
 Slings and Rams first came into use,  
 liv'd in our Days, he might well have  
 complain'd; especially of Bombs, a-  
 gainst which neither Art nor Nature  
 is of sufficient Proof: but which lays  
 every Thing, Castles and Towers, be  
 they never so strong, even with the  
 Ground. If for nothing else, yet up-  
 on this one account, I think we had  
 better have been without the Discove-  
 ry. Yet, when we were talking of  
 our Discoveries, it was not to be  
 pass'd over, for the Planets too may  
 have their mischievous as well as use-  
 ful Inventions: We


We are happier in the Uses for Book I.  
which the Air and Water serves us ;  
both of which helps us in our Navigation, and furnishes us with a Strength sufficient, without any Labour of our own, to turn round our Mills and Engines ; Things which are of use to us in so many different Employments. For with them we grind our Corn, and squeeze out our Oil ; with them we cut Wood, and mill Cloth, and with them we beat our Stuff for Paper. An incomparable Invention ! Where the nastiest useles Scraps of Linen are made to produce fine white Sheets. To these we may add the late discovery of Printing, which not only preserves from Death Arts and Knowledge, but makes them much easier to be attained than before. Nor must we forget the Arts of Engraving and Painting, which from mean Beginnings have improved to that Excellence, that nothing that ever sprung from the Wit of Man can claim Pre-eminence to them. Nor is the way of melting and blowing Glasses, and of polishing and spreading Quick-silver

Book I. over Looking-Glasses, unworthy of being mention'd, nor above all, the admirable uses that Glasses have been put to in natural Knowledge, since the Invention of the Telescope and Microscope. And no less nice and fine is the Art of making Clocks, some of which are so small as to be no weight to the Bearer; and others so exact as to measure out the Time in as small Portions as any one can desire: the Improvement of both which the World owes to my  
 \* *The Author invented the Pendulum for Clocks.* \* Inventions.


*From the discoveries of our Age.*

I might add much here of the late Discoveries, most of them of this Age, which have been made in all sorts of Natural Knowledge as well as in Geometry and Astronomy, as of the Weight and Spring of the Air, of the Chymical Experiments that have shown us a way of making Liquors that shall shine in the Dark, and with gentle moving shall burn of themselves. I might mention the Circulation of the Blood through the Veins and Arteries, which was understood indeed before; but now, by the help of the Microscope, has an ocular demon-



monstration in the Tails of some Book I.  
Fishes: of the Generation of Animals,   
which now is found to be perform'd  
no otherwise than by the Seed of one  
of the same kind; and that in the  
Seed of the Male are discover'd, by  
the help of Glasses, Millions of spright-  
ly little Animals, which it's probable  
are the very Offspring of the Animals  
themselves: a surprising thing, and  
never before now known!

Thus have I put together all *The Pla-*  
these late Discoveries of our Earth: *nets have,*  
and now, tho' perhaps some of them *tho' not*  
may be common to the Planetary In- *these same,*  
habitants with us, yet that they should *yet as use-*  
have all of them is not credible. But *ful In-*  
then they may have somewhat to make *ventions.*  
up that Defect, others as good and as  
useful, and as wonderful, that we want.  
We have allow'd that they may have  
rational Creatures among them, and  
Geometricians, and Musicians: We  
have prov'd that they live in Societies,  
have Hands and Feet, are guarded  
with Houses and Walls: Wherefore if  
a Man could be carried thither by some  
powerful Genius, some *Mercury*, I don't  
doubt

Book I. doubt 'twould be a very curious sight,  curious beyond all Imagination, to see the odd ways, and the unusual manner of their setting about any thing, and their strange methods of living. But since there's no hopes of our going such a Journey, we must be contented with what's in our Power: we may suppose our selves there, and inquire as far as we can into the Astronomy of each Planet, and see in what manner the Heavens present themselves to their Inhabitants. We shall make some Observations of the Eminence of each of them, in respect of their Magnitude, and number of Moons they have to wait on them; and shall propose a new Method of coming to some Knowledge of the incredible distance of the fix'd Stars. But first after this long and deep Thoughtfulness we will give our selves a little Rest, and so put an end to this Book.

*New Conjectures concerning the  
Planetary Worlds.*

Book 2.


BOOK the Second.

**T** WAS a pretty many Years ago that I chanc'd to light upon *Athanasius Kircher's* Book, call'd *The Ecstatick Journey*, which treats of the nature of the Stars, and of the Things that are to be found in the Superficies of the Planets: I wondered to see nothing there of what I had often thought not improbable, but quite other Things, nothing but a Heap of idle unreasonable Stuff: which I was the more confirm'd in, when, after the writing of the former part, I ran over the Book again. And I thought mine were very considerable and weighty Matters if compar'd with *Kircher's*. That other People may be satisfied in this, and see how vainly those, who cast off the only Foundations of Probability in such Matters, which we have all the way made use of, pretend to philosophize

Book 2. phize in this case, I think it will not  
 be beside the Purpose to bestow some  
 few Reflections upon that Book.

Kircher's  
 Journey in  
 Ecstasy ex-  
 amin'd.

That ingenious Man supposing him-  
 self carried by some Angel thro' the  
 vast Spaces of Heaven, and round the  
 Stars, tells us, he saw a great many  
 things, some of which he had out of  
 the Books of Astronomers, the rest are  
 the Product of his own Fancy and  
 Thoughts. But, before he enters up-  
 on his Journey, he lays down these two  
 Things as certain; that no Motion  
 must be allowed the Earth, and that  
 God has made nothing in the Planets,  
 no not so much as Herbs, which has  
 either Life or Sense in it. Leaving  
 then the System of *Copernicus*, he chu-  
 ses *Tycho* for his Guide. But when  
 he supposes all the fix'd Stars to be  
 Suns, and round each of them places  
 their Planets, here (against his Will I  
 suppose) he has unawares made an in-  
 finite number of *Copernican* Systems.  
 All which, beside their own Motion,  
 he absurdly makes to be carried, with  
 an incredible swiftness, in twenty four  
 Hours round the Earth. Since most  
 of

of these Worlds are out of the Reach Book 2.  
of any Man's sight, as he owns they   
are, I cannot think for what purpose  
he makes so many Suns to shine upon  
desolate Lands (like our Earth in every  
thing, he says, only that they have nei-  
ther Plants nor Animals) where there's  
no one to whom they should give light.  
And from hence he still falls into more  
and more Absurdities. And because  
he could find no other use of the Pla-  
nets, even in our System, he is forc'd  
to beg Help of the Astrologers; and  
would have all those vast Bodies made  
upon no other account than that the  
whole Universe might be preserved  
and continue secure by their means,  
and that they might govern the Mind  
of Man by their various and regular  
Influences. Accordingly, to gratify  
Astrology, he says that *Venus* was the  
most pleasant Place, every thing fine  
and handsome, its Light gentle, its  
Waters sweet and purling, and it self  
beset all about with shining Chrystals.  
In *Jupiter* he found wholesome and  
sweet Gales, delicate Waters, and a  
Land shining like Silver. For from  
these

Book 2. these two Planets it seems, Men have  
 all that is happy and healthful poured  
 down upon them; and all that renders  
 them handsome and lovely, wise and  
 grave, is owing to their Influences.  
*Mercury* had I don't know what Airi-  
 ness and Briskness in it; whence Men  
 derive, when they are first born, all  
 their Wit and Cunning. *Mars* was no-  
 thing but infernal, stinking, black  
 Flames and Smoke: and *Saturn* was all  
 melancholy, dreadful, nasty, and dark:  
 for these are the Planets (I don't know  
 why, but all Fortune-tellers hate them)  
 that bring all the Plagues and Mischiefs  
 that we feel upon us, and would exer-  
 cise their Spite still more, unless they  
 were sometimes mitigated and correct-  
 ed by the benign and kind Influences  
 of the other Planets. All this and such  
 like Stuff his Genius teaches him.  
 Which he makes give a serious An-  
 swer to this idle Question, Whether a  
 Jew or Heathen could be duly and  
 rightly baptized in the Waters of *Vea-*  
*nus*? Of him too he learns that the  
 Heaven of the fix'd Stars is not made  
 of solid Matter, but of a thin fluid,  
 where-

wherein an innumerable company of Book 2.  
Stars and Suns lie floating here and there, not chain'd down to any Place, (thus far he's in the right) and describing in the Space of a Day these prodigious Circles round the Earth. He forgets here, if there were such a Motion, with what an incredible swiftness they would fly off from every part of their Orbits. But I suppose the Intelligences that he has plac'd in them are to take care of that, those Angels that preside over, and regulate their Motions. And in that he follows a company of Doctors that harbour'd that idle fancy of *Aristotle* upon no Account or Consideration. But *Copernicus* has freed those Intelligences of all that Labour and Trouble, only by bringing in the Motion of the Earth: which, if upon no other Account, every one that is not blind purposely, must own to be necessary upon this. I dare say *Kircher*, if he had dar'd freely to speak his Mind, could have afforded us better sort of Things than these. But when he could not have that liberty, I think he might as well have let  
let

Book 2. let the whole Matter alone. But enough of this ; let's have have done with this famous Author: And now that we have ventur'd to place Spectators in the Planets, let us examine each of them, and see what their Years, Days, and Astronomy are.

*The System  
of the Pla-  
nets in  
Mercury.*

To begin with the innermost and nearest the Sun: We know that *Mercury* is three times nearer that vast Body of Light than we are. Whence it follows that they see him three times bigger, and feel him nine times hotter than we do. Such a degree of Heat would be intolerable to us, and set a-fire all our dry'd Herbs, our Hay and Straw that we use. And yet there is no doubt but that the Animals there, are made of such a Temper, as to be but moderately warm, and the Plants such as to be able to endure the Heat. The Inhabitants of *Mercury*, it's likely, have the same opinion of us that we have of *Saturn*, that we must be intolerably cold, and have little or no Light, we are so far from the Sun. There's reason to doubt, whether the Inhabitants of *Mercury*, tho' they live so much near-  
er



er the Sun, the Fountain of Life and Vi- Book 2.  
gour, are much more airy and ingeni-  
ous than we. For if we may guess at  
them by what we see here, we shall  
not be obliged to grant it. The Inha-  
bitants of *Africa* and *Brasil*, that have  
got for their Share the hottest Places  
in the Earth, being neither so wise nor  
so industrious as those that belong to  
colder and more temperate Climates;  
they have scarce any Arts or Knowledge  
among them; and those of them that  
live upon the very Shore, understand  
little or no Navigation. Nor can I be  
willing to make all that vast number  
that must inhabit those two large Pla-  
nets, *Jupiter* and *Saturn*, and have such  
noble Attendance, mere dull Block-  
heads, or without as much Wit as our  
selves, tho' they are so far more distant  
from the Sun. The Astronomy of those  
that live in *Mercury*, and the appear-  
ance of the Planets to them, opposite  
at certain times to the Sun, may be  
easily conceived by the Scheme of the  
*Copernican* System in the former  
Part. At the times of these Oppositi-  
ons *Venus* and the Earth must needs

Book 2. appear very bright and large to them..  
 ~~~~~ For if *Venus* shines so gloriously to us when she is new and horned, she must necessarily in opposition to the Sun, when she is full, be at least six or seven times larger, and a great deal nearer to the Inhabitants of *Mercury*, and afford them Light so strong and bright, that they have no reason to complain of their want of a Moon. What the Length of their Days are, or whether they have different Seasons in the Year, is not yet discovered, because we have not yet been able to observe whether his Axis have any inclination to his Orbit, or what Time he spends in his diurnal Revolution about his own Axis. And yet seeing *Mars*, the Earth, *Jupiter* and *Saturn*, have certainly such Successions, there's no reason to doubt but that he has his Days and Nights as well as they. But his Year is scarce the fourth part so long as ours.

The Inhabitants of *Venus* have much the same Face of Things as those in *Mercury*, only they never see him in opposition to the Sun, which is occasioned

sioned by his never removing above 38 degrees, or thereabouts, from it. The Sun appears to them larger by half in his Diameter, and above twice in his Circumference, than to us : and by consequence affords them but twice as much Light and Heat, so that they are nearer our Temperature than *Mercury*. Their Year is completed in seven and a half of our Months. In the Night our Earth, when 'tis on the other side of the Sun from *Venus*, must needs seem much larger and lighter to *Venus* than she doth ever to us ; and then they may easily see, if their Eyes be not weaker than ours, our constant Attendant the Moon. I have often wonder'd that when I have view'd *Venus* when she is nearest to the Earth, and resembled an Half-moon, just beginning to have something like Horns, through a Telescope of 45 or 60 Foot long, she always appeared to me all over equally lucid, that I can't say I observed so much as one Spot in her, tho' in *Jupiter* and *Mars*, which seem much less to us, they are very plainly perceiv'd.

Book 2. For if *Venus* had any such Thing as Sea and Land, the former must necessarily show much more obscure than the other, as any one may satisfy himself, that from a very high Mountain will but look down upon our Earth. I thought that perhaps the too brisk Light of *Venus* might be the occasion of this equal appearance; but when I used an Eye-glass that was smok'd for the Purpose, it was still the same Thing. What then, has *Venus* no Sea, or do the Waters there reflect the Light more than ours do, or their Land less? Or rather (which is most probable in my Opinion) is not all that Light we see reflected from an Atmosphere surrounding *Venus*, which being thicker and more solid than that in *Mars* or *Jupiter*, hinders our seeing any thing of the Globe it self, and is at the same time capable of sending back the Rays that it receives from the Sun? For it is certain that if we looked on the Earth from the outside of the Atmosphere, we should not perceive such a difference as we do from a Mountain; but by reason of the inter-

posed

posed Atmosphere, we should observe very little Disparity between Sea and Land. 'Tis the same Thing that hinders us from seeing the Spots in the Moon as plain in the Day as in the Night, because the Vapours that surround the Earth being then enlightned by the Rays of the Sun, are an Impediment to our Prospect.

Book 2.



But *Mars*, as I said before, has some Parts of him darker than other some. By the constant Returns of which his Nights and Days have been found to be of about the same length with ours: But the Inhabitants have no perceivable Difference between Summer and Winter, the Axis of that Planet having very little or no Inclination to his Orbit, as has been discover'd by the Motion of his Spots. Our Earth must appear to them almost as *Venus* doth to us, and by the Help of a Telescope will be found to have its Wane, Increase, and Full, like the Moon: and never to remove from the Sun above 48 Degrees, by whose Discovery they see it, as well as *Mercury* and *Venus*, sometimes pass over the Sun's Disk. They as seldom see

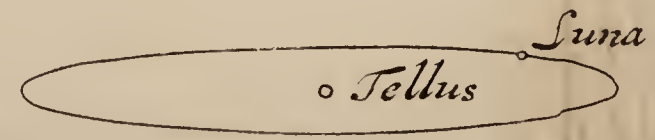
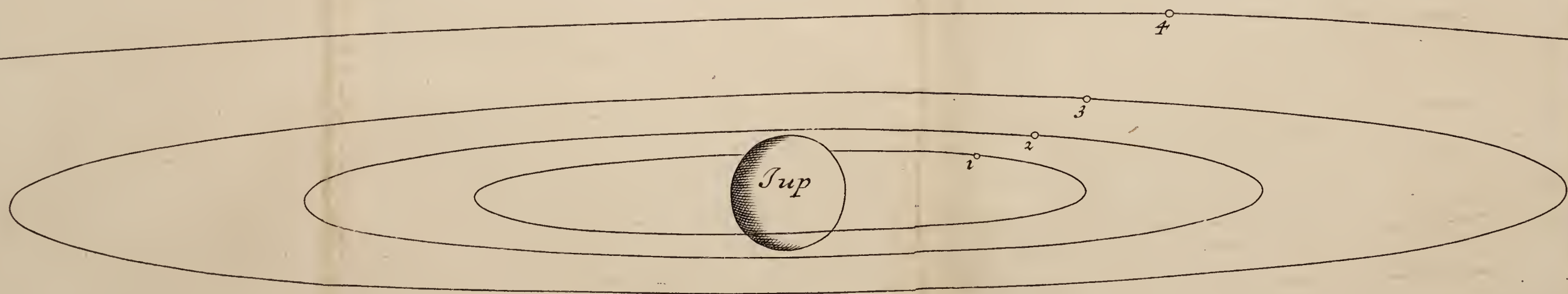
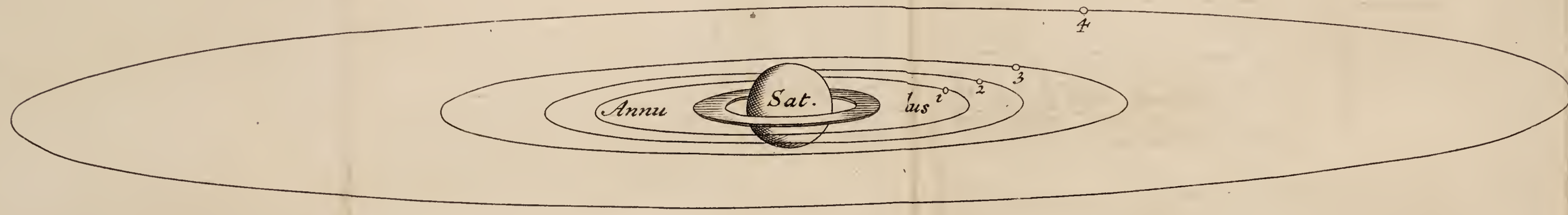
In Mars.

Book 2. *Venus* as we do *Mercury*. I am apt to believe, that the Land in *Mars* is of a blacker Colour than that of *Jupiter* or the Moon, which is the reason of his appearing of a Copper Colour, and his reflecting a weaker Light than is proportionable to his distance from the Sun. His Body, as I observed before, tho' farther from the Sun, is less than *Venus*. Nor has he any Moon to wait upon him, and in that, as well as *Mercury* and *Venus*, he must be acknowledged inferiour to the Earth. His Light and Heat is twice, and sometimes three times less than ours, to which I suppose the Constitution of his Inhabitants is answerable.

Jupiter
and Saturn
the most e-
minent of
the Pla-
nets both
for bigness
and atten-
dants.

If our Earth can claim pre-eminence of the fore-mention'd Planets, for having a Moon to attend upon it, (for its Magnitude can make but a small difference) how much Superiour must *Jupiter* and *Saturn* be to those three and the Earth also? For whether we consider their Bulk, in which they far exceed all the others, or the Number of Moons that wait upon them, it's very probable that they are the chief, the pri-





primary Planets in our System, in Book 2. comparison with which the other four are nothing, and scarce worth mentioning. For the easier Conception of their vast Disparity, I have thought fit to add a Scheme of our Earth, with the Moon's Orbit, and the Globe of the Moon itself, and the Systems of *Jupiter* and *Saturn*, where I have drawn every thing as near the true Proportion as possible. *Jupiter* you see is adorned with four, and *Saturn* with five Moons, all placed in their respective Orbits. The Moons about *Jupiter* we owe to *Galilæo*, 'tis well known: and any one may imagine he was in no small Rapture at the Discovery. The outermost but one, and brightest of *Saturn*'s, it chanc'd to be my lot, with a Telescope not above 12 foot long, to have the first sight of in the Year 1655. The rest we may thank the industrious *Cassini* for, who used the Glasses of *Jos. Campanus*'s grinding, first of 36, and afterwards of 136 foot long. He has often, and particularly in the Year 1672, shew'd me the Third and Fifth. The First and Second he gave

Fig. 3.

Book 2. me notice of by Letters in the Year
 1684 ; but they are scarce ever to be
 seen, and I can't positively say, I had e-
 ver that Happiness; but am as satisfied
 that they are there, as if I had ; not in
 the least suspecting the Credit of that
 worthy Man. Nay, I am afraid there
 are One or Two more still behind, and
 not without reason. For between the
 Fourth and Fifth there's a Distance not
 at all proportionable to that between
 all the others : Here, for ought I know,
 there may be a Sixth ; or perhaps there
 may be another without the Fifth that
 may yet have escaped us : for we can
 never see the Fifth but in that part
 of his Orbit, which is towards the
 West : for which we shall give you a
 very good reason.

Perhaps when *Saturn* comes into
 the Northern Signs, and is at a good
 height from the Horizon (for at the
 writing of this he is at his lowest)
 you may happen to make some new
 Discoveries, good Brother, if you
 would but make use of your two Te-
 lescopes of 170 and 210 Foot long ;
 the longest, and the best I believe now
 in

in the World. For tho' we have not yet had an opportunity of observing the Heavens with them (as well by reason of their Unweildiness, as for the Interruption of our Studies by your Absence) yet I am satisfied of their Goodness by our trial of them one Night, in reading a Letter at a vast distance by the Help of a Light. I cannot but think of those times with Pleasure, and of our diverting Labour in polishing and preparing such Glasses, in inventing new Methods and Engines, and always pushing forward to still greater and greater Things. But to return to the Figures, of which there remains something further to be said.

I have there made the Diameter of *Jupiter* about two third parts of our distance from the Moon: for the Diameter of *Jupiter* is above twenty times bigger than that of the Earth; which is about a thirtieth part of the Moon's distance. The Orbit of the outermost of *Jupiter's* Satellites is to that of the Moon round the Earth, as 8 and $\frac{1}{2}$ is to 1. And each of these Moons, by the Shadow they make upon *Jupiter*, can-

The proportion of the Diameter of Jupiter, and of the Orbs of his Satellites, to the Orbit of the Moon round the Earth.

Book 2. cannot be less than our Earth. Their
 Periods, that I may not omit them,
 are according to *Cassini's* Account:
 these. That of the inmost is one
 day, 18 hours, 28 minutes, and 36
 seconds. The Second spends 3 days,
 13 hours, 13 min. 52 seconds in
 going round him. The Third 7 days,
 3 hours, 59 min. 40 sec. The Fourth
 16 days, 18 hours, 5 min. 6 sec. The
 Distance of the innermost from *Jupiter*
 himself is $2 \frac{1}{2}$ of his Diameters. That
 of the Second is 4 and a half: Of the
 Third 7 and one sixth part: Of the
 Fourth 12 and two thirds, of the same
 Diameters. The Innermost of *Sa-*
turn's Satellites moves round him in 1
 day, 21 hours, 18 min. 31 sec. The
 Second in 2 days, 17 hours, 41 min.
 27 sec. The Third in 4 days, 13
 hours, 47 min. 16 sec. The Fourth
 in 15 days, 22 hours, 41 min. 11 sec.
 The Fifth in 79 days, 7 hours, 53 min.
 57 sec. Their Distances from the Cen-
 ter of *Saturn* are, that of the first al-
 most one, that is 39 fortieth parts of
 the Diameter of his Ring; that of the
 second one and a quarter of those Dia-
 meters;

The Peri-
 ods of Ju-
 piter's
 Moons.

And Sa-
 turn's.

meters ; of the third one and three quarters of them ; of the fourth four, or according to my Calculation, but 3 and a half ; of the 5th 12, which were found with vast Pains and Labour.

Book 2.



Now can any one look upon, and compare these Systems together, without being amazed at the vast Magnitude and noble Attendance of these two Planets, in respect of this little Earth of ours? Or can they force themselves to think, that the wise Creator has disposed of all his Animals and Plants here, has furnish'd and adorn'd this Spot only, and has left all those Worlds bare and destitute of Inhabitants, who might adore and worship him ; or that all those prodigious Bodies were made only to twinkle to, and be studied by some few perhaps of us poor Mortals ?


I do not doubt but there will be some who will think we are very much mistaken about the Magnitude of these Planets. For will you pretend to make them who are taken up in admiring the Largeness of this Globe,


This proportion true according to all modern Observations.

its

Book 2. its multitude of Nations, Cities, and
 ~~~~~ Empires; can you pretend I say to  
 make them ever believe that there are  
 Places in comparison of which the  
 Earth is as inconsiderable as this Fi-  
 gure would make it? But they ought  
 to be inform'd, that these Proportions  
 are those which the best Astronomers  
 of this Age have agreed upon. For if  
 the Earth be distant from the Sun ten  
 or eleven thousand of its own Diame-  
 ters, according to the Accounts of Mon-  
 sieur *Cassini* in *France*, and Mr. *Flam-*  
*sted* in *England*, wherein they made  
 use of very exact Observations of the  
 Parallaxes of *Mars*; or if, according  
 to a very probable Conjecture of mine,  
 it be distant twelve thousand, then the  
 Magnitudes of the other Orbs will ve-  
 ry near answer the Proportions here  
 settled.

The appa- But to return to *Jupiter*. The Sun  
 rent mag- appears to them who are upon it five  
 nitude of times less than to us, and consequent-  
 the Sun in ly they have but the five and twen-  
 Jupiter, tieth part of the Light and Heat that  
 and a way we receive from it. But that Light  
 of finding is not so weak as we imagine, as is  
 what plain  
 Light they  
 there en-  
 joy.

plain by the Brightness of that Planet Book 2.  
in the Night; and also from hence,   
that when the Sun is so far eclipsed to  
us, as that only the 25th part of his  
Disk remains uncovered, he is not  
sensibly darken'd. But if you have a  
mind exactly to know the Quantity of  
Light that *Jupiter* enjoys, you may take  
a Tube of what Length you please. Let  
one end of it be closed with a Plate of  
Brass, or any such thing, in the mid-  
dle of which there must be a Hole,  
whose Breadth must have the same  
proportion to the length of the Tube,  
as the Chord of 6 Minutes bears to the  
Radius; that is, about as one is to 570.  
Let the Tube be turned so to the Sun,  
that no Light may fall upon a white  
Paper placed at the End of it, but what  
comes through the little Hole at the  
other end of the Tube. The Rays  
that comes through this will represent  
the Sun upon the Paper of the same  
Brightness that the Inhabitants of  
*Jupiter* see it in a clear Day. And if  
removing the Paper you place your  
Eye in the same Place, you will see the  
Sun of the same Magnitude and  
Bright-

Book 2. Brightness as you would were you in  
 *Jupiter.*


*And in  
Saturn.*

If you make the Hole twice as little in breadth, you will see the same in *Saturn*. And altho' his Light be but the hundredth part of ours, yet you see it makes him shine tolerably bright in a dark Night. But in both these Planets, if there ever be any cloudy Days, it must be very dark in comparison of us ; yet without doubt the Inhabitants have no more reason to complain of the want of Light, than our Owls and Batts, to whom the Twilight or the Night itself is more agreeable than the Brightness of the Day.

*In Jupiter  
their days  
are five  
Hours.*

But it's a little strange, that when *Jupiter* is so much bigger than our Planet, their Days and Nights should be but five of our Hours. By this we may see that Nature has not observ'd that proportion that their Bulk seems to require, seeing in *Mars* the Days are very little different from ours. But in the length of their Years, that is, in the Revolution of the Planets round the Sun, there is an exact proportion to  
 their



their distances from the Sun followed. Book 2.  
For as the Cubes of their Distances, so   
are the Squares of their Revolutions,  
as *Kepler* first found out. Which pro-  
portion the Moons of *Jupiter* and *Sa-*  
*turn* keep in their Courses round those  
Planets. As the Years and Days in *Jupiter*  
are different from ours in this respect, so are the Days in another;  
Always of the same lengths  
namely, that they are all of the same  
length. For they there enjoy a perpe-  
tual Equinox, their Axis having little  
or no inclination to their Orbit, as the  
Earth's has, as has been discovered by  
Telescopes. The Countries that lie  
near their Poles have little or no Heat,  
by reason the Rays of the Sun fall so  
obliquely upon them; but then they  
are freed from the Inconveniency that  
ours are troubled with, of tedious long  
half-year Nights, and have the con-  
stant returns of Day and Night every  
five Hours. Indeed such short Days  
would not be agreeable to us, but we  
think our selves much better done by,  
that ours are more than twice as long,  
tho' upon no other account, but that  
whatever is our own, we are apt to  
imagine, must be best. The

Book 2. The rest of the Planets are so near  
 the Sun (*Mars* himself never being  
 above 18 degrees from it) that in *Ju-*  
*piter* they have the sight only of *Sa-*  
*turn*. But we cannot deny but that  
 their four Moons stand them in greater  
 stead than our one doth us, if 'twere  
 only that they seldom know any such  
 Thing as to be without Moonshiny  
 Nights. And they are of great Advan-  
 tage to them, as we said before, in  
 their Navigation, if they have any  
 such thing. Not to mention the plea-  
 sant Sights of their frequent Conjun-  
 ctions and Eclipses, Things that they  
 are seldom a Day without.

*Saturn* enjoys all those Pleasures and  
 Advantages in a still higher Degree, as  
 well for his five Moons, as for the de-  
 lightful Prospect that the Ring about  
 him affords his Inhabitants Night and  
 Day. But we will give an account  
 of their Astronomy, as we have done  
 of the rest of the Planets.

*They see  
 the fix'd  
 Stars just  
 as we do.*

And first of all we shall observe  
 what we might have remark'd before,  
 but which will be more strange here,  
 that the fix'd Stars appear to them of  
 the

the same Figure and Magnitude, and with the same degree of Light that they do to us: and this, by reason of their immense distance, of which we shall have occasion to speak by and by. In comparison with which the Space that a Bullet-shot out of a Cannon could travel in 25 Years, would be almost nothing. Book 2.

Their Astronomers have all the same Signs of the Bear, the Lion, Orion, and the rest, but not turning upon the same Axis with us: for that's different in all the Planets.

As *Jupiter* can see no Planet but *Saturn*, so *Saturn* knows of no Planet but *Jupiter*; which appears to him much as *Venus* doth to us, never removing above 37 Degrees from the Sun. The Length of their Days I cannot determine: But if from the Distance and Period of his innermost Attendant, and comparing it with the innermost of *Jupiter's*, a Man may venture to give a Guess, they are very little different from *Jupiter's*, 10 Hours or somewhat less. But whereas in *Jupiter* these are equally divided be-


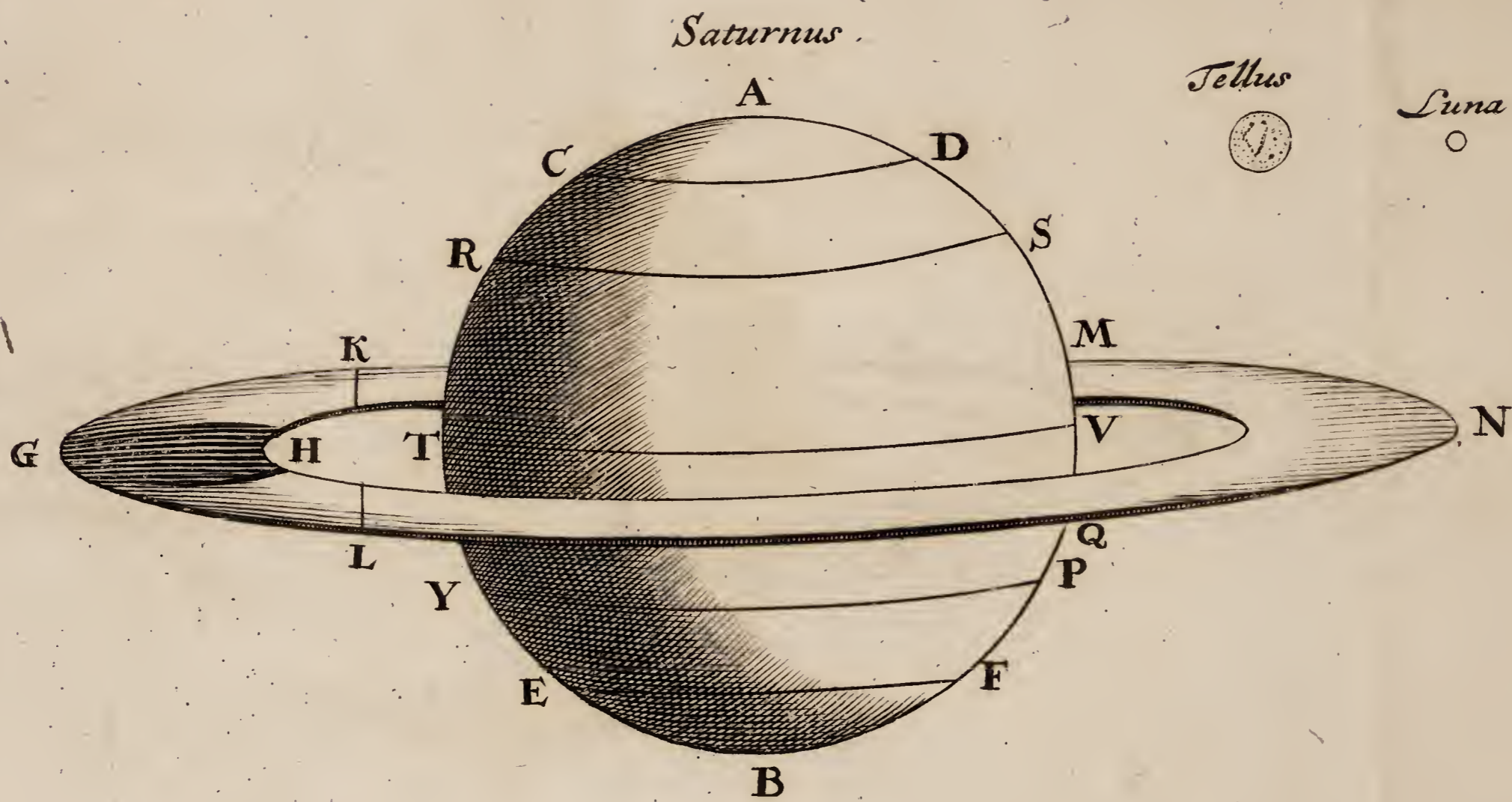
Book 2.  tween Light and Darkneſs, the Inhabitants of *Saturn* muſt perceive a more ſenſible difference than we, eſpecially between Summer and Winter. For our Axis inclines to the Plane of the Eclip-tick but 23 degrees and a half, but there's above 31. Upon this Account his Moons muſt decline very much from the Path that the Sun ſeems to move in, and his Inhabitants can never have a full Moon but juſt at the Equinoxes; Two of which fall out in 30 of our Years. 'Tis this Poſition of the Axis too that is the Cauſe of thoſe delightful Appearances, and wonderful Proſpects that its Inhabitants enjoy: For the better underſtanding of which I ſhall draw a Figure of *Saturn* with his Ring about him: in which the Proportion between the Diameters of the Globe and Ring is as 9 to 4. And the empty Space between them is of the ſame Breadth with the Ring itſelf. All Obſervations conſpire to prove that That is of no great Thickneſs, altho' if we ſhould allow it fix hundred *German* Miles, I think, conſidering its Diameter, we ſhould not overdo the Matter.



Fig. 4.

p. 125



Suppose then, agreeable to what has Book 2:  
 been said, the Globe of *Saturn*,  
 whose Poles are A, B. GN is the  
 Diameter of the Ring, as you view it  
 sideways, representing a narrow O-  
 val. Those that live about the Poles  
 within the Arches CAD, EBF,  
 each of which are 54 Degrees, (if  
 the Cold will suffer any Body to live  
 there) never have a Sight of the Ring.  
 From all other parts it is continually to  
 be seen for fourteen Years and nine  
 Months, which is just half their Year.  
 The other Half it is hid from their  
 View. Those then that dwell between  
 the Polar Circle CD, and the Equator  
 TV, all that time that the Sun en-  
 lightens the Part opposite to them;  
 have every Night the Sight of a Piece  
 of it HGL, much in the Shape of a  
 shining Bow, which comes from the  
 Horizon, but is darken'd in the Mid-  
 dle by the Shadow of *Saturn* GH,  
 which reaches most commonly to the  
 outermost Rim of it. But after Mid-  
 night that Shadow by little and little  
 begins to move towards the right Hand  
 to those in the Northern, but the Left

  
 Fig. 4.

*The Ap-  
 pearances  
 of the Ring  
 in Saturn.*

Book 2. to those in the Southern Hemisphere.

~~~~~ In the Morning it disappears, leaving behind it a Likeness indeed of a Bow, but much paler and weaker than our Moon is in the Day time. For they, as I said before, have an Atmosphere, or an Air surrounding them enlighten'd by the Sun. Otherwise Night and Day they would have their Ring, their Moons, and all the fix'd Stars, equally conspicuous. Another thing that must make the Sight of their Ring very curious, is, that by some Spots in it, it is discover'd to turn round upon it self: A thing that those that are so near cannot but take notice of, when we that live at this Distance can descry a great Inequality, the inside of it being brighter much than the outside is. When the Shadow of the Globe falls upon that part of the Ring  $GH$ , the Shadow of the Ring at the same time darkens another Part of the Globe about  $PF$ , which otherwise would have the Sun upon it. So that there is always a Zone of the Globe  $PYFE$ , sometimes of a larger extent than at others, which is depriv'd of the Sight  
both

both of the Sun and Ring for a considerable time, the latter of which hides some part of the Stars from it too. And certainly an amazing Thing it must be, all of a sudden to have the Sun intercepted and to become as dark as Midnight, without seeing any Cause of such an Accident. All which time their Moons are their only Comfort. The other half of the Year the Hemisphere T B V enjoys the same Light that T A U before did, and then this undergoes those long Eclipses that That before suffer'd. At the Equinoxes, when the Sun is in the same Plane with the Ring, the Inhabitants of *Saturn* cannot well perceive it: no not even we with our Glasses, by reason of its Darkness. This happens when *Saturn*, view'd from the Sun, is advanced one and twenty degrees and a half in *Virgo* or *Pisces*, as I have shew'd formerly in my System of *Saturn*: Where there is an Account given of the Risings of the Sun above the Ring, throughout all the Saturnian Year.

Book 2.



With *Saturn* in this Scheme you have the Globes of the Earth and Moon drawn in their true proportion, to put you in mind again of a Thing worth remembring, *viz.* how very small our Habitation is when compar'd with that Globe or the Ring about it. And now any one, I suppose, can frame to himself a Picture of the Night in *Saturn*, with two Arches of the Ring, and five Moons shining about, and adorning him. This then is what I had to say to the primary Planets.

We are now come a little lower, to make an enquiry into the Attendants of these Planets, especially our own. And here we shall not only consider their Astronomy, but shall also search into their Furniture and Ornament, if they are found to have any such thing, which we have deferred considering till now.

*Very little
to be said
of the
Moons.*

And here one would think that when the Moon is so near us, and by the Means of a Telescope may be so nicely and exactly observ'd, it should afford us Matter for more probable


Con-

Conjectures than any of the other re- Book 2.
 mote Planets. But it is quite other-
 wise, and I can scarce find any thing
 to say of it, because I have not a Pla-
 net of the same Nature before my Eyes,
 as in all the primary ones I have. For
 they are of the same kind with our
 Earth; and seeing all the Actions, and
 every thing that is here, we may make
 a reasonable Conjecture at what we
 cannot see in those Worlds.

But this we may venture to say, *The*
 without fear, that all the Attendants *Guards of*
 of *Jupiter* and *Saturn* are of the same *Jupiter*
 Nature with our Moon, as going round *and Sa-*
 them, and being carried with them *turn of the*
 round the Sun just as the Moon is with *same na-*
 the Earth. Their Likeness reaches to *ture with*
 other Things too, as you'll see by and *our Moon.*
 by. Therefore whatsoever we can
 with reason affirm or conjecture of our
 Moon (and we may say a little of it)
 must be suppos'd with very little Alte-
 ration to belong to the Satellites of *Ju-*
piter and *Saturn*, as having no reason
 to be at all inferior to that.

The Surface of the Moon then is *The Moon*
 found, by the least Telescopes of about *hath*
Moun-
 I 4 three *tains.*

Book 2. three or four Foot, to be diversified
 with long Tracts of Mountains, and
 again with broad Valleys. For in
 those Parts opposite to the Sun you
 may see the Shadows of the Moun-
 tains, and often discover the little
 round Valleys between them, with a
 Hillock or two perhaps rising out of
 them. *Kepler* from the exact round-
 ness of them would prove that they
 are some vast work of the rational
 Inhabitants. But I can't be of his
 mind, both for their incredible Large-
 ness, and that they might easily be
 occasioned by natural Causes. Nor
 can I find any thing like Sea there,
 tho' he and many others are of the con-
 trary Opinion I know. For those vast
 Countries which appear darker than
 the other, commonly taken for and
 called by the Names of Seas, are disco-
 ver'd with a good long Telescope, to
 be full of little round Cavities; whose
 Shadow falling within themselves,
 makes them appear of that Colour;
 and those large Champains there in the
 Moon you will find not to be always
 even and smooth, if you look carefully
 upon

upon them: neither of which two Book 2.
Things can agree to the Sea. There- 
fore those Plains in her that seem *But no Sea.*
brighter than the other Parts, must
consist, I suppose, of a whiter sort of
Matter than they. Nor do I believe
that there are any Rivers, for if there *Nor Ri-*
were, they could never escape our *vers.*
Sight, especially if they run between
the Hills as ours do. Nor have they
any Clouds to furnish the Rivers with *Nor*
Water: For if they had, we should *Clouds.*
sometimes see one part of the Moon
darken'd by them, and sometimes
another, whereas we have always the
same Prospect of her.

'Tis certain moreover, that the *Nor Air,*
Moon has no Air or Atmosphere sur- *and Water.*
rounding it as we have. For then we
could never see the very outermost
Rim of the Moon so exactly as we do,
when any Star goes under it, but its
Light would terminate in a gradual
faint Shade, and there would be a sort
of a Down as it were about it; not to
mention that the Vapours of our At-
mosphere consist of Water, and con-
sequently that where there are no Seas

or

Book 2. or Rivers, there can be no Atmosphere. This is that notable difference between the Moon and us that hinders all probable Conjectures about it. If we could but once be sure that there were Seas and Rivers in it, it would be no weak Argument to prove that it has also all other Furniture which belongs to our Earth, and the Opinion of *Xenophanes* might be true, that it has its Inhabitants, Cities, and Mountains. But as 'tis, I cannot imagine how any Plants or Animals, whose whole nourishment comes from liquid Bodies, can thrive in a dry, waterless, parch'd Soil.


The Conjecture of its Plants and Animals very dubious.

What then, Is it credible that this great Ball was made for nothing but to give us a little Light in the Night-time, or to raise our Tides in the Sea? May there not be some People there that may have the Pleasure of seeing our Earth turn upon itself, presenting them sometimes with a Prospect of *Europe* and *Africa*, and then of *Asia* and *America*; sometimes half of it bright, and sometimes full? And must all those Moons round *Jupiter* and *Saturn*

turn be condemned to the same Use-Book².
lessness? I do not know what to say concerning it, because I know of nothing like them to found a Conjecture upon. And yet 'tis not improbable that those great and noble Bodies have somewhat or other growing and living upon them, though very different from what we see and enjoy here. Perhaps their Plants and Animals may have another sort of Nourishment there. Perhaps the Moisture of the Earth there is but just sufficient to cause a Mist or Dew, which may be very suitable to the Growth of their Herbs. This I remember is *Plutarch's* Opinion, in his Dialogue upon this Subject. For in our Earth a very little Water drawn from the Sea into Dew, and falling down again upon the Herbs, would be sufficient for all our Needs, without any Rain or Showers. But these are mere Guesses, or rather Doubts, but yet they are the best we can make of this, and all those other Moons: for, as I said before, they are all of the same nature, which is proved likewise by this, that as our Moon

Jupiter's
and Sa-
turn's
Moonsturn
always the
same Side
to them.

Book 2. Moon can afford us the Sight never
but of one Side of her, so they turn al-
ways the same Face to their primary
Planets. It may perhaps seem strange,
how we should come to know this; but
'tis no hard matter, after that Obser-
vation which I just now made, that
the outermost of *Saturn's* Moons can
never be seen but when she is on the
West-side of her Planet. The reason
of which is plainly this, that one Side
of her is darker, and does not reflect
the Light so much as the other, which
when it is turned towards us, we can-
not see by reason of its weak Light.
This always happening when 'tis East
of him, and never on the other Side, is
a manifest proof that she always keeps
the same Side toward *Saturn*. Now
since the outermost of *Saturn's* and our
Moon carry themselves thus to the
Planets round which they move, who
can well doubt it of all the rest round
Jupiter and *Saturn*? And there's a
very good reason for it, namely, that
the matter of which those Moons con-
sist, being heavier, and more solid on
the Side that is averse from us, than on
that

that which we have the Sight of, does consequently fly with a greater force from the Centre of its Orbit : for otherwise, according to the Laws of Motion, it should turn the same Side always, not to its Planets, but to the same fix'd Stars. 

This Position of the Moons, in respect of their Planets, must occasion a great many very surprizing Appearances to their Inhabitants, if they have any, which is very doubtful, but may for the present be suppos'd. An enquiry into our Moon may serve for all the rest. Its Globe is divided into two Parts, in such a manner, that those who live on one Side never lose the sight of us, and those on the other never enjoy it. Except only some few who live on the Confines of each of these, who lose us, and see us again by turns. The Earth to them must seem much larger than the Moon doth to us, as being in Diameter above four times bigger. But that which is most surprizing, is, that Night and Day they see it always in the very same part of the Heaven, as if it never moved : some of them as if 'twas falling

The Astronomy of the Inhabitants of the Moons

Book 2. ling upon their Heads: others somewhat above the Horizon, and others always in the Horizon, still turning upon it self, and presenting them every twenty four Hours with a View of all its Countries, even of those that lie near the Poles (I could wish my self in the Moon only for the sight of them) yet unknown and undiscovered by us. They have it in its monthly Wane and Increase, they see it half, and horned, and full, by turns, just as we do the Body of the Moon. But the Light that they receive of us is five times larger than what we receive from them. So that in dark Nights that part that hath the Advantage of being towards us, receives a very glorious Light from us, tho' *Kepler* thought otherwise. Their Days are always of the same Length with their Nights; and the Sun rising and setting to them but once in one of our Months, makes the time both of their Light and Darknes to be equal to 15 of our Days. If their Bodies were of the same Materials with ours, those that have the Sun pretty high in their Horizon, would be almost roasted

ed in such long Days. For the Sun is not farther from them than he is from us. This will be the Case of those that live upon the Borders of the two Hemispheres we mentioned; but those that live under the Poles of the Moon will be just about as hot as our Whale-fishers about *Island* and *Nova Zemla* are, in the Summer-time: who are in so little danger of being roasted, that in the middle of their Summer, in their Days of three Months length, they very often find it extreme Cold. I call those the Poles of the Moon, round which the fix'd Stars seem to turn to its Inhabitants, which are different from ours, and also from those of the Ecliptick, although they move round these latter, at the distance of five Degrees, in a period of nineteen Years: Their Year they count by the Motion of the Stars, and their return to the Sun, and 'tis the same with ours. They can easily do it, because they have the Stars Day and Night, notwithstanding the Light of the Sun: for they have no Atmosphere (which is the only reason that we don't every
Day

Book 2.
~

Book 2. Day enjoy the same Sight) to hinder their Observations. Nor have they any Clouds to obstruct their View, so that it is easier for them to find out the Courses of the Planets, but more difficult to make a true System of them. For they will be apt to lay a wrong Foundation, by supposing that their Earth stands still, which will lead them into more dangerous Errors than ever it did us. All that I have said belongs as well to *Jupiter's* and *Saturn's* Satellites as to our Moon, in respect of the Planets they move round. The Length of their Day and Night is always equal to the Time of their Revolution: For example, the fifth Moon moves round *Saturn* in 80 Days, and the Days and Nights there are equal to Forty of ours. Both their Summer and Winter (*Saturn* moving round the Sun in thirty Years) are fifteen Years long. Therefore it is impossible but that their way of living must be very different from ours, having such tedious Winters, and such long watching and sleeping times.

This may be applied to the Moons about Jupiter and Saturn.

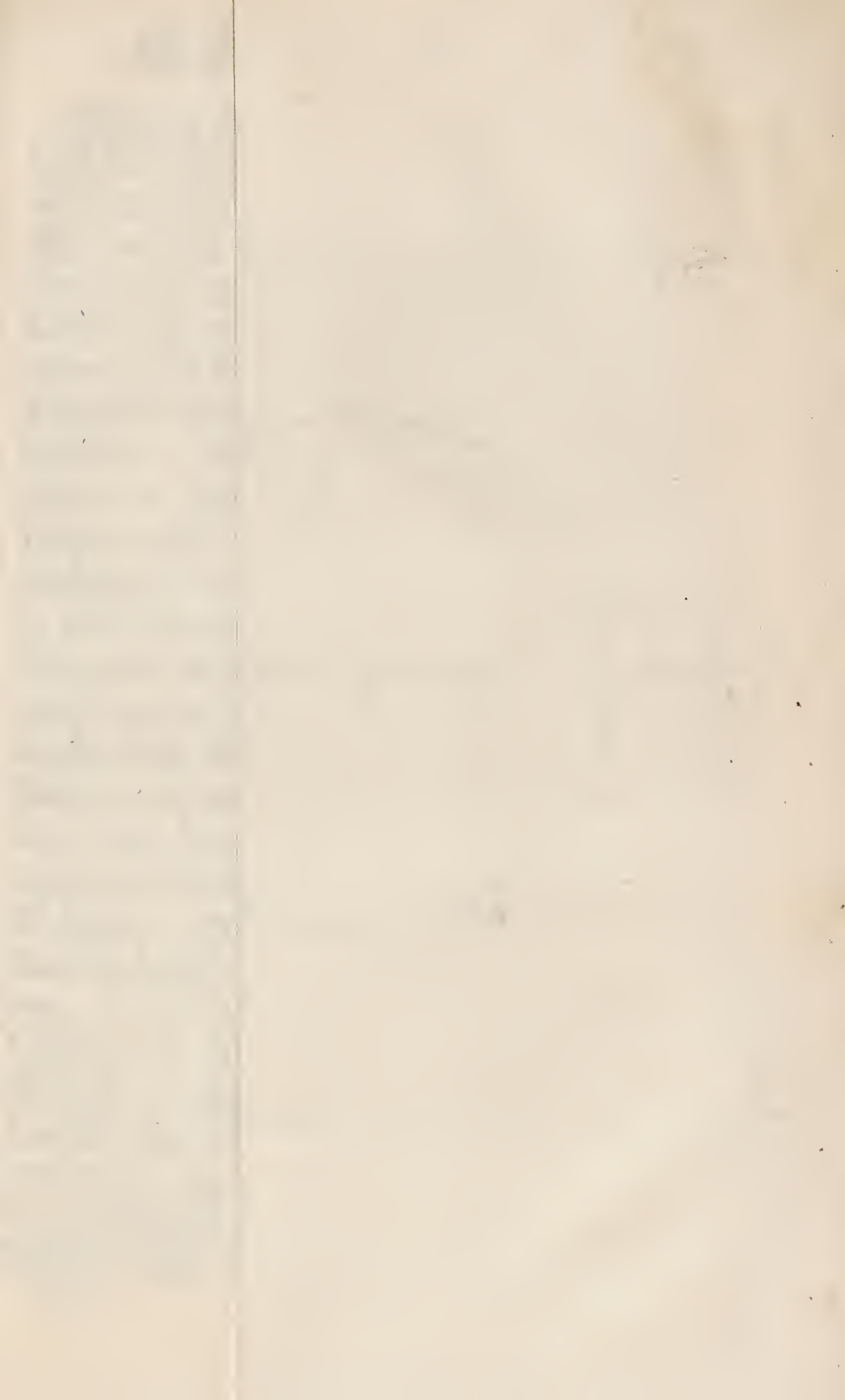


Fig: 5.

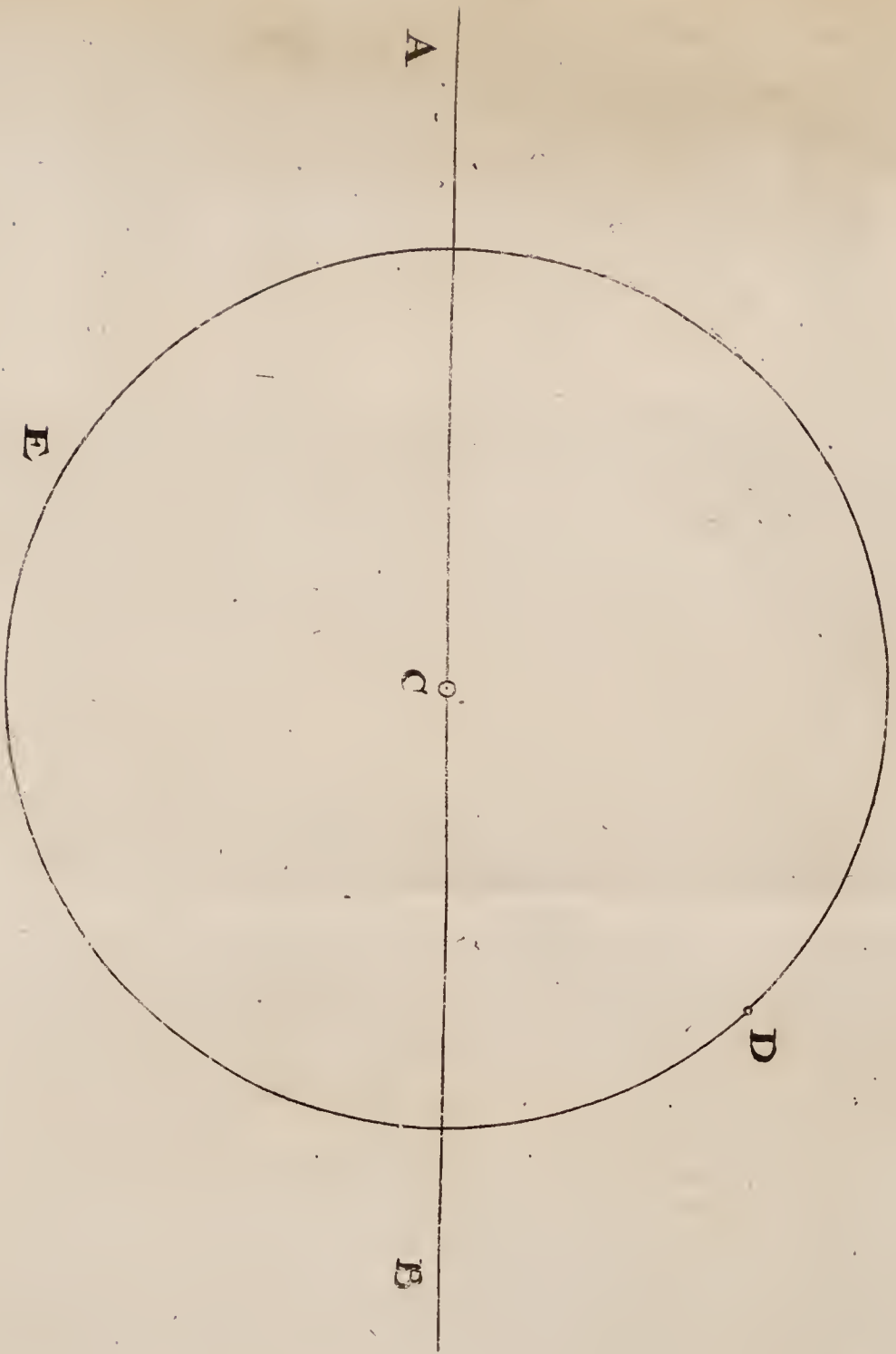
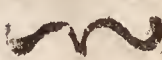


Fig: 5.

Having thus explain'd the primary Book 2.
 and secondary Planets round the Sun, 
 we should next set about the third Sort;
 the Sun and fix'd Stars; but before we
 do that, it would be worth while to set
 before you at once, in a clearer and
 more plain Method than hitherto, the
 Magnificence and Fabrick of the Solar
 System. Which we can't possibly
 do in so small a Space as one of our
 Leaves will but admit of, because the
 Bodies of the Planets are so prodigious-
 ly small in comparison of their Orbs.
 But what is wanting in Figure shall be
 made up in Words. Going back then
 to the first Scheme, suppose another
 like it, and proportionable, drawn up- Fig. 1.
 on a very large smooth Plain; whose
 outermost Circle representing the Orb
 of *Saturn*, must be conceived three
 hundred and sixty Foot in Semidiamete-
 ter. In which you must place the
 Globe and Ring of *Saturn* of that
 Bigness as the 2d Figure shows you. Fig. 2.
 Let all the other Planets be supposed
 every one in his own Orbit, and in
 the middle of all the Sun, of the same
 Bigness that That Figure represents,
 K namely,

Book 2. namely, about four Inches in Diameter. And then the Orbit or Circle in which the Earth moves, which the Astronomers call the *Magnus Orbis*, must have about six and thirty Foot in Semidiameter. In which the Earth must be conceived moving, not bigger than a grain of Millet, and her Companion the Moon scarcely perceivable, moving round her in a Circle a little more than two Inches Diameter, as in the Figure here adjoined, where the Line A B represents a small portion of that Circle which the Earth moves in: the small Circle therein C is the Earth, and the Circle D E the Path of the Moon round it, in which the Body of the Moon is D.

Fig. 5.

The outermost of *Saturn's* Moons moves in an Orbit whose Semidiameter is 29 Inches; that of *Jupiter* in a somewhat smaller, whose Semidiameter is 19 and a quarter.

And thus we have a true and exact Description of the Sun's Palace, where the Earth will be Twelve thousand of its Semidiameters distant from him, which in *German* Miles makes above seven-

seventeen Millions. But perhaps we may have a clearer Comprehension of this vast Length, by comparing it with some very swift Motion after the Example of *Hesiod* the Poet, who imagin'd that an Anvil let fall from the Top of Heaven, reach'd the Earth the tenth Day of its Journey, and in ten more arriv'd at the Bottom of Hell, the end of it: so making the Earth the mid-way between Heaven and Hell. I shan't make use of the Anvil, but of something as good, namely, a Bullet shot out of a great Gun, which may travel perhaps in a Moment, or Pulse of an Artery, about a hundred Fathom, as is proved by those Experiments that *Mersennus* in a Treatise of his relates; by which the Sound was found to extend itself eighty hundredth parts in the same time. I say then, that supposing a Bullet to move with this Swiftnes from the Earth to the Sun, it would spend 25 Years in its Passage. To make a Journey from *Jupiter* to the Sun, would require 125, and from *Saturn* thither 250 Years. This account depends upon the measure of the Earth's

The immense distance between the Sun and Planets illustrated.

Book 2. Diameter, which, according to the accurate Observations of the *French*, is 6538594 times six *Paris* Feet, one Degree being 57060 of that Measure. This shows us how vast those Orbs must be, and how inconsiderable this Earth, the Theatre upon which all our mighty Designs, all our Navigations, and all our Wars are transacted, is when compared to them. A very fit Consideration, and Matter of Reflection, for those Kings and Princes who sacrifice the Lives of so many People, only to flatter their Ambition in being Masters of some pitiful Corner of this small Spot. But to return to the matter in hand, now we have given you an account of the Sun's proportion to those Orbs and Bodies, we'll see what more we can say of him.

No ground
for Conje-
cture in the
Sun.

And some have thought it not improbable but that the Sun himself has also his Inhabitants. But upon what reason I cannot imagine, there being less ground for a Probability in him than in the Moon. For we are not yet sure, whether he be a solid or liquid Globe; altho', if my Notion of Light be

be true, upon that account I should rather think him liquid: which his Roundness and equal distribution of his Light to all parts are an Argument for. For that very small inequality on his Surface, which is discovered by the Telescopes, (and that not always neither) which makes Men fancy they see boiling Seas and belching Mountains of Fire, is nothing but the trembling Motion of the Vapours our Atmosphere is full of near the Earth; which is likewise the Cause of the Stars twinkling. Nor could I ever have the Luck to discern those bright Spots in the Sun which they boast as much of as they do of his dark ones, which latter I have very often seen; so that I have very good Reason to doubt whether there be anything in the Sun brighter than the Sun itself. For by the most exact Observations, I could never find any such pretended to be seen any where but just about his dark Spots; and it is no great wonder that those Parts which are so near the darker, should appear somewhat brighter than the rest. That the Sun is extremely hot and fiery, is beyond

Book 2.



The Faculae in the Sun not easily seen.

By reason of its Heat no Inhabi-

Book 2.
 ~~~~~  
 tants like  
 ours can  
 live in the  
 Sun.

yond all dispute, and such Bodies as ours could not live one Moment in such a Furnace. We must suppose a new sort of Animals then, such as we have no Idea or Likeness of among us, such as we can neither imagine nor conceive: which is as much as to say, that we can make no Supposition at all about them. No doubt that glorious and vast Body was made for some noble End and Use, and fram'd with excellent Design. And I think we all very well know and feel its Usefulness in that effusion of Light and Heat to all the Planets round it; in the Preservation and Happiness of all living Creatures, and that not only in our Ball, but in those vast Globes of *Jupiter* and *Saturn*, not contemptible when compared with its own. These are such great, such wise Ends, that it is not strange that the Sun should have been made, if it had been only upon their account. For, as for *Kepler's* Fancy, that he hath another Office, namely, to help on the Motion of the Planets in their own Orbs, by turning about his own Axis (which he would fain establish in his Epitome of the *Coper-*

*nican* System) I shall give good Reasons why I cannot assent to it. Book 2:

Before the Invention of Telescopes, it seemed to contradict *Copernicus's* Opinion, to make the Sun one of the fix'd Stars. For the Stars of the first Magnitude being esteem'd to be about three Minutes Diameter ; and *Copernicus* (observing that tho' the Earth changed its Place, they always kept the same distance from us) having ventur'd to say that the *Magnus Orbis* was but a Point in respect of the Sphere in which they were placed, it was a plain Consequence that every one of them that appeared any thing bright, must be larger than the Path or Orbit of the Earth : which is very absurd. This is the principal Argument that *Tycho Brahe* set up against *Copernicus*. But when the Telescopes took away those Rays of the Stars which appear when we look upon them with our naked Eye, (which they do best when the Eye-glass is black'd with Smoke) they seem'd just like little shining Points, and then that Difficulty vanished, and the Stars may yet be so many Suns. Which is


*The fix'd Stars so many Suns.*

Book 2. the more probable, because their Light is certainly their own : for it's impossible that ever the Sun should send, or they reflect it at such a vast Distance. This is the Opinion that commonly goes along with *Copernicus's* System. And the Patrons of it do also with reason suppose, that all these Stars are not in the same Sphere, as well because there's no Argument for it, as that the Sun, which is one of them, cannot be brought to this Rule. But it's more likely they are scatter'd and dispers'd all over the immense Spaces of the Heaven, and are as far distant perhaps from one another, as the nearest of them are from the Sun.

*They are not all in the same Sphere.*

Here again too I know *Kepler* is of another Opinion in his *Epitome of Copernicus's* System, that we mention'd above. For tho' he agrees with us, that the Stars are diffus'd through all the vast Expanse of the Heavens, yet he cannot allow that they have as large an empty Space about them as our Sun has. For then 'twas his Opinion, we should see but very few, and those of very different Magnitudes : For, seeing


*ing the largest of all appear so small to us, that we can scarce observe or measure them with our best Instruments; how must those appear that are three or four times farther from us? Why, supposing them no larger than these, they must seem three or four times less, and so on 'till a little farther they will not be to be seen at all: Thus we shall have the sight of but very few Stars, and those very different one from another; Whereas we have above a 'Thousand, and those not considerably bigger or less than one another. But this by no means proves what he would have it; and his Mistake was chiefly, that he did not consider the Nature of Fire and Flame which may be seen at such distances, and at such small Angles as all other Bodies would totally disappear under. A thing that we need go no farther than the Lamps set along the Streets to prove. For altho' they are a hundred Foot from one another, yet you may count Twenty of them in a continued Row with your Eyes, and yet the twentieth Part of them scarce makes an Angle of six Seconds. Certainly*

Book 2. 

Book 2. tainly then the glorious Light of the  
 Stars must do much more than this ;  
 so that it's no wonder we should see a  
 Thousand or two of them with our  
 bare Eyes, and with a Telescope dis-  
 cover twenty times that number. But  
*Kepler* had a private Design in making  
 the Sun thus superiour to all the other  
 Stars, and planting it in the Middle of  
 the World, attended with the Planets :  
 For his Aim was hereby to strengthen  
 his Cosmographical Mystery, that the  
 Distances of the Planets from the Sun  
 are in a certain proportion to the Dia-  
 meters of the Spheres that are inscri-  
 bed within, and circumscribed about  
*Euclid's* Regular Bodies. Which  
 could never be so much as probable,  
 except there were but one Chorus of  
 Planets moving round the Sun, and  
 so the Sun were the only one of his  
 kind.


But that whole Mystery is nothing  
 but an idle Dream taken from *Pytha-  
 goras* or *Plato's* Philosophy. And the  
 Author himself acknowledges that the  
 Proportions do not agree so well as  
 they should, and is fain to invent two



or three very silly Excuses for it. And Book 2.  
 he uses yet poorer Arguments to prove   
 that the Universe is of a spherical Figure, and that the Number of the Stars  
 must necessarily be finite, because the Magnitude of each of them is so. But  
 what is worst of all is, that he settles the Space between the Sun and the  
 Concavity of the Sphere of the fix'd Stars, to be six hundred thousand of  
 the Earth's Diameters. For this reason, which he has no Foundation for,  
 that as the Diameter of the Sun is to that of the Orbit of *Saturn*, which he  
 makes to be as 1 to 2000, so is this Diameter to that of the Sphere of the fix-  
 ed Stars. I cannot but wonder how such things as these could fall from so  
 ingenious a Man, and so great an Astronomer. But I must be of the same  
 Opinion with all the greatest Philosophers of our Age, that the Sun is of the  
 same Nature with the fix'd Stars. And this will give us a greater Idea of the  
 World, than all those other Opinions. For then why may not every one of  
 these Stars or Suns have as great a Re-  
 tinue as our Sun, of Planets, with their  
 Moons,

*The Stars  
 have Pla-  
 nets about  
 them like  
 our Sun.*

Book 2. Moons, to wait upon them? Nay, there's a manifest reason why they should. For if we imagine our selves placed at an equal distance from the Sun and fix'd Stars; we should then perceive no difference between them. For, as for all the Planets that we now see attend the Sun, we should not have the least glimpse of them, either because their Light would be too weak to affect us, or that all the Orbs in which they move would make up one lucid Point with the Sun. In this Station we should have no occasion to imagine any difference between the Stars, and should make no doubt if we had but the Sight, and knew the Nature of one of them, to make that the Standard of all the rest. We are then plac'd near one of them, namely, our Sun, and so near as to discover six other Globes moving round him, some of them having others performing them the same Office. Why then may not we make use of the same Judgment that we would in that case; and conclude, that our Star has no better attendance than the others? So that  
what

what we allowed the Planets, upon Book 2.  
the account of our enjoying it, we must   
likewise grant to all those Planets that  
surround that prodigious number of  
Suns. They must have their Plants and  
Animals, nay and their rational Crea-  
tures too, and those as great Admirers,  
and as diligent Observers of the Hea-  
vens as our selves; and must consequent-  
ly enjoy whatsoever is subservient to,  
and requisite for such Knowledge.

What a wonderful and amazing  
Scheme have we here of the magnifi-  
cent Vastness of the Universe! So ma-  
ny Suns, so many Earths, and every  
one of them stock'd with so many  
Herbs, Trees, and Animals, and a-  
dorn'd with so many Seas and Moun-  
tains! And how must our Wonder and  
Admiration be encreas'd when we  
consider the prodigious Distance and  
Multitude of the Stars?

That their Distance is so immense,  
that the Space between the Earth and  
Sun (which is no less than Twelve  
thousand of the Earth's Diameters)  
is almost nothing when compar'd to  
it, has more Proofs than one to con-  
firm

Book 2. firm it. And this among the rest. If  
you observe two Stars near one another, as for example those in the middle of the Great Bears Tail, differing very much from one another in Clearness, notwithstanding our changing our Position in our Annual Orbit round the Sun, and that there would be a Parallax were the Star which is brighter nearer to us than the other, as is very probable it is, yet whatever Part of the Year you look upon them, they will not in the least have altered their distance. Those that have hitherto undertook to calculate their Distance, have not been able perfectly to compass their Design, by reason of the extreme Niceness and almost Impossibility of the Observations requisite for their Purpose. The only Method that I see remaining, to come at any tolerable Probability in so difficult a Case, I shall here make use of. Seeing then that the Stars, as I said before, are so many Suns, if we do but suppose one of them equal to ours, it will follow that its distance from us is as much greater than that of the Sun, as its ap-  
parent

parent Diameter is less than the Dia-  
meter of the Sun. But the Stars, even  
those of the first Magnitude, though  
view'd through a Telescope, are so  
very small, that they seem only like so  
many shining Points, without any per-  
ceivable Breadth. So that such Obser-  
vations can here do us no good. When  
I saw this would not succeed, I studied  
by what way I could so lessen the Dia-  
meter of the Sun, as to make it not  
appear larger than the Dog, or any  
other of the chief Stars. To this pur-  
pose I clos'd one End of my twelve-  
foot Tube with a very thin Plate, in  
the Middle of which I made a Hole not  
exceeding the twelfth Part of a Line,  
that is the hundred and forty fourth  
Part of an Inch. That End I turn'd  
to the Sun, placing my Eye at the  
other, and I could see so much of the  
Sun as was in Diameter about the 182d  
part of the Whole. But still that lit-  
tle piece of him was brighter much  
than the Dog-star is in the clearest  
Night. I saw that this would not do,  
but that I must lessen the Diameter of  
the Sun a great deal more. I made  
then

Book 2.




*A way of  
making a  
probable  
guess at  
the di-  
stance of  
the Stars.*

Book 2. then such another Hole in a Plate, and  
 against it I plac'd a little round Glass  
 that I had made use of in my Microscopes,  
 of much about the same Diameter with the  
 former Hole. Then looking again towards the  
 Sun (taking care that no Light might come  
 near my Eye to hinder my Observation) I  
 found it appeared of much the same Clearness  
 with *Sirius*. But casting up my account,  
 according to the Rules of *Dioptricks*, I found  
 his Diameter now was but  $\frac{1}{152}$  part of that  
 hundred and eighty second part of his whole  
 Diameter that I saw through the former  
 Hole. Multiplying  $\frac{1}{152}$  and  $\frac{1}{152}$  into one  
 another, the Product I found to be  $\frac{1}{27664}$ .  
 The Sun therefore being contracted into such  
 a Compass, or being removed so far from us  
 (for it's the same thing) as to make his  
 Diameter but the  $\frac{1}{27664}$  part of that we  
 every Day see, will send us just the same  
 Light as the Dog-star now doth. And his  
 distance then from us will be to his present  
 distance undoubtedly as  $\frac{1}{27664}$  is to 1; and  
 his Diameter little above four Thirds,  $4'''$ .  
 Seeing then

then *Sirius* is supposed equal to the Sun, it follows that his Diameter is likewise  $4'''$ , and that his Distance to the Distance of the Sun from us is as 27664 to 1. And what an incredible Distance that is, will appear by the same way of reasoning that we used in measuring that of the Sun. For if 25 Years are required for a Bullet out of a Cannon, with its utmost Swift-ness, to travel from the Sun to us; then by multiplying the Number 27664 into 25, we shall find that such a Bullet would spend almost seven hundred thousand Years in its Journey between us and the nearest of the fix'd Stars. And yet when in a clear Night we look upon them, we cannot think them above some few Miles over our Heads. What I have here enquir'd into, is concerning the nearest of them. And what a prodigious Number must there be besides of those which are placed in the vast Spaces of Heaven, as to be as remote from these as these are from the Sun! For if with our bare Eyes we can observe above a Thousand, and with a Telescope can

L discover

Book 2. discover ten or twenty times as many ;  
~~~~~  
what bounds of Number can we set to those which are out of the Reach even of these Assistances! especially if we consider the infinite Power of God. Really, when I have been reflecting thus with my self, methoughts all our Arithmetick was nothing, and we are vers'd but in the very Rudiments of Numbers, in comparison of this great Sum. For this requires an immense Treasury, not of twenty or thirty Figures only, in our decuple Progression, but of as many as there are Grains of Sand upon the Shore. And yet who can say, that even this Number exceeds that of the Fix'd Stars? Some of the Ancients, and *Jordanus Brunus* carry'd it further, in declaring the Number infinite : he would perswade us that he has prov'd it by many Arguments, tho' in my opinion they are none of them conclusive. Not that I think the contrary can ever be made out. Indeed it seems to me certain, that the Universe is infinitely extended; but what God has been pleas'd to place beyond the Region of
the

the Stars, is as much above our Knowledge, as it is beyond our Habitation. Book 2. 

Or what if beyond such a determinate Space he has left an infinite Vacuum; to show, how inconsiderable all that he has made is, to what his Power could, had he so pleas'd, have produced? But I am falling, before I am aware, into that intricate Dispute of Infinity: Therefore I shall wave this, and not, as soon as I am free of one, take upon me another difficult Task. All that I shall do more is to add somewhat of my Opinion concerning the whole World, as it is a Place for the Reception of the Suns or fix'd Stars, every one of which, I have showed, may have their Planetary Systems about them.

I am of Opinion then that every Sun is surrounded with a Whirl-pool or Vortex of Matter in a very swift Motion; tho' not in the least like *Cartes's* either in their Bulk, or manner of Motion. For *Cartes* makes his so large, as every one of them to touch all the others round them, in a flat Surface, just as you have seen the Bladders that

Every Sun has a Vortex round it, very different from those of Cartes.


Book 2. Boys blow up in Soap-buds do; and would have the whole Vortex to move round the same way. But the Angles of every Vortex will be no small hindrance to such a Motion. Then the whole Matter moving round at once, upon the Axis as it were of a Cylinder, did not a little puzzle him in giving Reasons for the Roundness of the Sun: which however they may satisfy some People that do not consider them, really prove nothing of the Matter. In this æthereal Matter the Planets float, and are carried round by its Motion: and the thing that keeps them in their own Orbs is, that they themselves, and the Matter in which they swim, equally strive to fly off from the Center of this Motion. Against all which there are many Astronomical Objections, some of which I touch'd upon in my Essay of the Causes of Gravity. Where I gave another Account of the Planets not deserting their own Orbs; which is their Gravitation towards the Sun. I show'd there the Causes of that Gravitation, and cannot but wonder that

Cartes,

Cartes, the first Man that ever began Book 2. to talk reasonably of that Matter, should never meddle with, or light on it. *Plutarch* in his Book of the Moon above-mentioned says, that some of the Ancients were of Opinion, that the Reason of the Moon's keeping her Orbit was, that the Force of her Circular Motion was exactly equal to her Gravity, the one of which pull'd her to, as much as the other forc'd off from the Centre. And in our Age *Alphonsus Borellus*, who was of this same Opinion in the other Planets as well as the Moon, makes the Gravitation of the primary Planets to be towards the Sun, as that of the Secondary is towards the Planets round which they move: Which *Sir Isaac Newton* has more fully explain'd, with a great deal of Pains and Subtilty; and how from that Cause proceeds the Ellipticity of the Orbs of the Planets, found out by *Kepler*. According to my Notion of the Gravitation of the Planets to the Sun, the Matter of his Vortex must not at all move the same way,

Book 2. way, but after such a manner as to
 have its Parts carry'd different ways
 on all Sides. And yet there is no fear
 of its being destroyed by such an irre-
 gular Motion, because the Æther
 round it, which is at rest, keeps the
 Parts of it from flying out. With the
 Help of such a Vortex as this I have
 undertook in that Essay to explain
 the Gravity of Bodies on this Earth,
 and all the Effects of it. And I sup-
 pose there may be the same Cause
 as well of the Gravitation of the
 Planets, and of our Earth among the
 rest, towards the Sun, as of their
 Roundness: A Thing so very hard
 to give an Account of in *Cartes's*
 System.

I must differ from him too in the
 Bigness of the Vortices, for I cannot
 allow them to be so large as he would
 make them. I would have them dis-
 persed all about the immense Space,
 like so many little Whirl-pools of Wa-
 ter, that one makes by the stirring of
 a Stick in any large Pond or River, a
 great way distant from one another.
 And as their Motions do not all in-
 termix

termix or communicate with one another, so in my Opinion must the Vortices of Stars be placed as not to hinder one anothers free Circumrotations. Book 2. 

So that we may be secure, and never fear that they will swallow up or destroy one another ; for that was a mere Fancy of *Cartes's*, when he was a showing how a fix'd Star or Sun might be turn'd into a Planet. And 'tis plain that when he writ it, he had no Thoughts of the immense Distance of the Stars from one another ; particularly, by this one Thing, that he would have a Comet as soon as ever it comes into our Vortex, to be seen by us. Which is as absurd as can be. For how could a Star, which gives us such a vast Light only from the Reflection of the Beams of the Sun, as he himself owns they do ; how I say could that be so plainly seen at a distance Ten thousand times larger than the Diameter of the Earth's Orbit ? He could not but know that all round the Sun there is a vast *Extensum* ; so vast, that in *Copernicus's* System the

magnus

Book 2. *magnus Orbis* is counted but a Point
in comparison with it. But indeed all
the whole Story of Comets and Pla-
nets, and the Production of the World,
is founded upon such poor and trifling
Grounds, that I have often wonder'd
how an ingenious Man could spend all
that pains in making such Fancies hang
together. For my part, I shall be ve-
ry well contented, and shall count I
have done a great Matter, if I can but
come to any Knowledge of the Na-
ture of Things, as they now are, ne-
ver troubling my self about their Be-
ginning, or how they were made,
knowing that to be out of the reach
of human Knowledge, or even Con-
jecture.

F I N I S.





