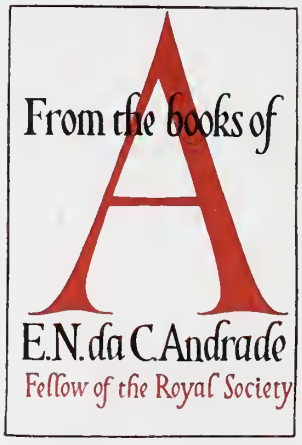

#9,300

A N

ORIGINAL THEORY

O R

NEW HYPOTHESIS

OF THE

UNIVERSE,

Founded upon the

LAWS of NATURE,

AND SOLVING BY

MATHEMATICAL PRINCIPLES

THE

General PHÆNOMENA of the VISIBLE CREATION;

AND PARTICULARLY

The VIA LACTEA.

Compris'd in Nine Familiar LETTERS from the AUTHOR to his FRIEND.

And Illuſtrated with upwards of Thirty Graven and Mezzotinto Plates,
By the Beſt MASTERS.

By THOMAS WRIGHT, of DURHAM.

One *Sun by Day, by Night* ten Thouſand *ſhine,*
And light us deep into the DEITY. Dr. YOUNG.

LONDON:
Printed for the AUTHOR, and ſold by H. CHAPELLE, in *Groſvenor-Street.*
MDCCL.

THE PREFACE.

THE Author of the following Letters having been flattered into a Belief, that they may probably prove of ſome Uſe, or at leaſt Amuſement to the World, he has ventured to give them, at the Requeſt of his Friends, to the Publick. His chief Deſign will be found an Attempt towards ſolving the Phænomena of the *Via Lactea*, and in conſequence of that Solution, the framing of a regular and rational Theory of the known Univerſe, before unattempted by any. But he is very ſenſible how difficult a Taſk it is to advance any new Doctrine with Succeſs, thoſe who have hitherto attempted to propagate aſtronomical Diſcoveries in all Ages, have been but ill rewarded for their Labours, tho' finally they have proved of the greateſt Benefit and Advantage to Mankind. This ungrateful Leſſon we learn from the Fate of thoſe ingenious Men, who, in ignorant Times, have unjuſtly ſuffered for their ſuperior Knowledge and Diſcoveries; they who firſt conceived the Earth a Ball, were treated only with Contempt for their idle and ridiculous Suppoſition, as it was called; and he who firſt attempted to explain the *Antipodes*, loſt his Life by it; but in this Age Philoſophers have nothing to fear of this ſort, the great Diſadvantages attending Authors now, are of a widely different

Nature, riſing from the infinite Number of Pretenders to Knowledge in this Science, and much is to be apprehended from improper Judges, tho' from real ones nothing; for nothing is more certain than this, as much as any Subject exceeds the common Capacity of Readers, ſo much will the Work in general be condemned; the Air of Knowledge is at leaſt in finding Fault, and this vain Pretence generally leads People, who have no real Foundation for their Judgment to argue from, to ridicule what they are too ſenſible they do not underſtand. Thus the ſame Diſadvantages too often attend both in publick and private an exceeding good Production equally the ſame as a very bad one: But the Author is not vain enough to think this Work without Faults, has rather Reaſon to fear, from the Weakneſs of his own Capacity, that there may be many; but he hopes the Deſign of the Whole will, in ſome meaſure, plead for the Imperfection of the Parts, if the Merits of the Plan ſhould be found inſufficient for his full Pardon, in attempting ſo extenſive a Subject.

In a Syſtem thus naturally tending to propagate the Principles of Virtue, and vindicate the Laws of Providence, we may indeed ſay too little, but cannot ſurely ſay too much; and to make any further Apology for a Work of ſuch Nature, where the Glory of the Divine Being of courſe muſt be the principal Object in View, would be too like rendering Virtue accountable to Vice for any Author to expect to benefit by ſuch Excuſe. The Motive which induces us to the Attempt of any Performance, where no good Reaſon can be ſuppoſed to be given for the Omiſſion, or Neglect of it, will always be judged an unneceſſary Promulgation, and conſequently every Attempt towards the Diſcovery of Truth, the Enlargement of our Minds, and the Improvement of our Underſtandings will naturally become a Duty. If therefore this Undertaking falls ſhort of being inſtrumental towards the advancing the Adoration of the Divine Being in his infinite Creation of higher Works, and proves unable to anſwer all Objections that may poſſibly ariſe againſt it, yet will its Imperfections appear of ſuch a Nature to every candid Reader, as to afford the Author a ſufficient Apology for producing them to the World: And it is to be hoped farther, that where a Work is entirely upon a new Plan, and the Beginning, as it were, of a new Science, before unattempted in any Language, the Author having dug all his Ideas from the Mines of Nature, is ſurely intitled to every kind of Indulgence.

To

To thoſe who are weak enough to think that ſuch Enquiries as theſe are over-curious, vain, and preſumptive, and would willingly, ſuitable to their own Ignorance and Comprehenſion, ſet Bounds to other People's Labours, I anſwer with Mr. *Huygens*, " That if our Forefathers had " been at this Rate ſcrupulous, we might 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 enlightened 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."

Had we ſtill paid that Homage to a Name,
Which only God and Nature juſtly claim;
The weſtern Seas had been our utmoſt Bound,
Where Poets ſtill might dream the Sun was drown'd;
And all the Stars that ſhine in Southern Skies,
Had been admir'd by none but ſavage Eyes.

DRYDEN.

Beſides the Nobleneſs and Pleaſure of theſe Studies, *Wiſdom* and *Morality* are naturally advanced, and much benefited by them, and even Religion itſelf receives a double Luſtre, " 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." In Aſtronomy, as well as in natural Philoſophy, though we cannot poſitively affirm every thing we ſay to be Facts and Truth, yet in ſo noble and ſublime a Study as that of *Nature*, it is glorious, as Mr. *Huygens* ſays, even to arrive at Probability.

Notwithſtanding then the Diſadvantages which ever have attended all new Diſcoveries, either thro' the Ignorance of the Age, or the univerſal Paſſion of Ridicule in ſuch contented Creatures, as can't comprehend, yet ever attacking with a fool-hardy Reſolution, the advancing Enſigns of Knowledge, if Ignorance was Virtue, and Wiſdom Vice; I ſay, regardleſs of this noiſy Shore, it is ſure our Duty to ſpring forward, and explore the ſecret Depths of Infinity, and the wonderful hidden Truths of this vaſt Ocean of Beings. But how the heavenly Bodies were made, when they were made

made, and what they are made of, and many other Things relating to their Entity, Nature, and Utility, ſeems in our preſent State not to be within the Reach of human Philoſophy; but then that they do exiſt, have final Cauſes, and were ordained for ſome wiſe End, is evident beyond a Doubt, and in this Light moſt worthy of our Contemplation.

> He who thro' vaſt Immenſity can pierce,
> See Worlds on Worlds compoſe one Univerſe,
> Obſerve how Syſtem into Syſtem runs,
> What other Planets, and what other Suns;
> What varied Being peoples ev'ry Star;
> May tell why Heav'n made all Things as they are.
>
> POPE.

To expect that ſo new an Hypotheſis ſhould meet with univerſal Approbation, would be an unpardonable Vanity; nor is it reaſonable every Reader ſhould think the Author obliged to remove all his Prejudices and Partialities, ſo far as to give him the perfect Picture of the Univerſe he likes beſt. In many Caſes it would be ſo far from being better for the World, if all Men judged and thought alike, that Providence ſeems rather to have guarded againſt it as an Evil, than any how to have promoted it as a general Good: But the following Theory regards the Whole rather than Individuals: And the many worthy Authors cited in the Work, who have all greatly favoured this extenſive Way of Thinking, will, I hope, be a ſufficient Excuſe for forming theſe obvious Conjectures into a Theory, eſpecially where ſo great a Problem is attempted as the Solution of the *Via Lacteal* Phænomenon, which has hitherto been looked upon as an inſurmountable Difficulty. How the Author has ſucceeded in this Point, is a Queſtion of no great Conſequence; he has certainly done his beſt; another, no Doubt, will do better, and a third perhaps, by ſome more rational Hypotheſis, may perfect this Theory, and reduce the Whole to infallible Demonſtration: The firſt Syſtem of the ſolar Planets was far from a true one, but it led the Way to Perfection, and the laſt we can never too much admire. It is well known, that the firſt Syſtem of the Planets was alſo but a Conjecture, yet none will deny that it was an happy one.

The

The Diſcovery of the Magnet Poles; the Government of the Tides; proportional Diſtance and Periods of the Planets, *&c.* have all their Uſes, and undoubtedly were deſigned to be known. Ignorance is the Diſgrace of Mankind, and ſinks human Nature almoſt to that of Reptiles. Knowledge is its Glory and the diſtinguiſhing Characteriſtic of rational Creatures.

To Enquiries of this ſort, then ſure we may ſay with *Milton*, That

GOD'S OWN EAR LISTENS DELIGHTED.

The Subject is, no Doubt, the nobleſt in Nature, and as ſuch, will always merit the Attention of the thinking Part of Mankind. Men of Learning and Science, in all Ages, have ever made it their peculiar Study. Towards the latter End of the Republic, and afterwards in the more peaceable Times of *Trajan* and the *Plinys*, we have no Reaſon to doubt but that Aſtronomy was in the higheſt Reputation: And notwithſtanding *Greece* had been the chief Seat of the Philoſophers, yet may we ſuppoſe *Rome* in thoſe Days little inferior in the Knowledge of the Stars, when we find Men * of the firſt Figure in Life become Authors upon the Subject.

We have many Inſtances to ſhew, that Aſtronomy was in the greateſt Repute amongſt the Antients of all Ranks, and almoſt every where looked upon as one of the greateſt, if not as one of the firſt Qualifications of their beſt Men. As a Confirmation of which, we find in the hiſtorical Accounts of the *Argives*, a very warm Conteſt betwixt the two Sons of *Pelops* 1205 Years before *Chriſt*, thus teſtified by *Lucian:* When the *Argives*, by publick Conſent, had decreed that the Kingdom ſhould fall to him of the two, who ſhould manifeſt himſelf the moſt learned in the Knowledge of the Stars, *Thyeſtes* thereupon is ſaid to have made known to them, the Conſtellation, or Sign of the *Zodiack* call'd *Aries:* But *Atreus* at the ſame time diſcovering to them the Courſe of the Sun, with his various Riſing and Setting, demonſtrating his Motion to be * contrary to that of the Heavens, or diurnal Motion of the Stars, was thereupon elected King.

* *Cicero* tranſlated the Phænomena of *Aratus* into *Latin* Verſe. *Julius Cæſar*, as *Pliny* relates, wrote of Aſtronomy in *Greek*, and is ſaid to have left ſeveral Books of the Motion of the Stars behind him, derived from the Doctrine of the *Egyptians*. *Ant. Chriſ.* 45. He with *Soſigenes* reformed the *Roman* Year, which was firſt invented by *Numa Pompilius*. *Germanicus Cæſar* alſo tranſlated *Aratus*'s Phænomena into *Latin* Verſe *Anno Dom.* 15. *Tiberius* and *Hadrian* are alſo ſaid to have wrote on Aſtronomy.

* Hence aroſe the Fable of the Sun's going backwards in the Days of *Atreus*, as if ſtruck with Abhorrence of his bloody Banquet. *Vide Ovid*'s Metamorphoſis.

To

To recite more of the moſt eminent Patrons and Profeſſors of this kind of Learning here, will carry me too far from my preſent Purpoſe; for farther Information therefore, I ſhall refer the inquiſitive Reader, to that curious Catalogue in *Sherburn*'s Sphere of *Manilius*, where ſo many ruling † Men of all Ages and Nations ſwell, and illuſtrate the Number.

In a Word, when we look upon the Univerſe as a vaſt Infinity of Worlds, acted upon by an eternal Agent, and crouded full of Beings, all tending through their various States to a final Perfection, and reflect upon the many illuſtrious Perſonages, who have, from time to time, thought it a kind of Duty to become Obſervers, and conſequently Admirers of this ſtupendious Sphere of primary Bodies, and diligent Enquirers into the general Laws and Principles of Nature, who can avoid being filled with a kind of enthuſiaſtic Ambition, to be acknowledged one of the Number, who, as it were, by thus adding his Atom to the Whole, humbly endeavours to contribute towards the due Adoration of its great and divine Author.

I judge it will be quite unneceſſary to ſay any thing about the Order of the Work, ſince that would be only a Repetition of the Table of Contents, to which the Reader is referred, as to the propereſt Account that can here be given.

† Seven Emperors, nine Kings, and as many ſovereign Princes. *Charlemagne* wrote *Ephemerides*, and named the Months and Winds in *High Dutch*, 770. *Rich.* II. *&c.*

THE

THE

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Some of the Principal ERRATA.

Page	*Line*	*the Words*	*Read.*
2	*ult.*	to ceaſe relating	ceaſing to relate
4	3	Phænomenon	Phænomena
16	15	incomſible	incomprehenſible
21	12	comprehend	comprehending
33	28	compared	is compared
34	37	form	from
43	20	volving	revolving
49	24	immoveable	moveable
61	19	much	much as
62	28	XXIII.	XXI.
65	4	where	any where
67	15	alſo	all ſo
69	29	one	our

Plate X. read the Characters of the Planets in this Order ☿ ♀ ♄ ♂ ♃

THE

A

LIST

OF THE

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Y.

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Dr. Arthur Young, *Preb. of* Cant.

LETTER THE FIRST.

Opinions of the moſt eminent Authors whoſe Sentiments on the following Subject have been publiſhed in their Works.

SIR,

REFLECTING upon the agreeable Converſation of our laſt Meeting, which you may remember chiefly turned upon the Stars, and the Nature of the planetary Bodies; a Subject, which is generally allowed to give true Pleaſure to all thoſe who take Delight in mathematical Enquiries; and having not a little Regard to the repeated Requeſt in your late Letters, I have at length undertaken to explain to you, as far as I am able, my Theory of the *Univerſe*, and the Ideas I have form'd of the known Creation.

The Hypotheſis upon which this new Aſtronomy is founded, and now reduced into a regular Syſtem, was the reſult of my Aſtronomical Studies * full fifteen years ago, hence I hope you will allow, I have more than obſerved *Horace*'s celebrated Aphoriſm,

Nonumque prematur in annum.

* The firſt Scheme of this Hypotheſis was plann'd in the Year 1734, repreſenting in a Section of the Creation, eighteen Feet long and one broad, ſeveral thouſand Worlds and Syſtems, and a great Number of emblematical Figures, now in the Author's Poſſeſſion, together with a Scheme of the entire Creation, completed ſince, nine Feet long and ſix broad, more fully illuſtrating upon the ſame Conſtruction the Innumerability of Syſtems and Worlds.

The Subject, I have often obſerved, you have liſtened to with a pleaſed Attention, and I am the more incouraged to explain it at large to you, as I am perſwaded you don't want to be convinced of its valuable Uſes and Importance.

I remember you have often told me, that to apply ourſelves to the Study of Nature, was the ſureſt and readieſt Way to come at any tolerable Knowledge of ourſelves, however difficult the Taſk might prove either in the Attempt, or the attaining it, and the leſs to be neglected, as it never fails to introduce a proper Knowledge of the DIVINE BEING, as a certain Conſequence along with it, and ſuch a Knowledge, as will naturally make every Man, who has but a tolerable Share of common Senſe, and is not a Slave to another's Reaſon, without any other Evidence or Motive, in all Stations, and under all Circumſtances, ACT JUSTLY, LIVE CHEARFULLY, and DIE full of Hope in the Expectation of a happy Sequel, in Futurity.

Eternity is written in the Skies:
Mankind's Eternity, nor *Faith* alone;
Virtue grows there ———

Dr. YOUNG.

A learned Author on the Attributes, recommending theſe Studies as a reaſonable and moral Service, ſays, "Sure, it is moſt becoming ſuch imperfect Creatures as we are, to contemplate the Works of God with this Deſign, that we may diſcern the Manifeſtations of Wiſdom in them; and thereby excite in ourſelves thoſe devout Affections, and that ſuperlative Reſpect, which is the very Eſſence of Praiſe."

Who turns his Eye, *on Nature's Midnight Face,*
But muſt enquire ——— what Hand behind the Scene,
What ARM ALMIGHTY, put theſe wheeling Globes
In Motion, and wound up the vaſt Machine?

The enchanting Idea *Milton* had of the Subjects of Aſtronomy (whoſe truly ſublime Way of thinking and writing perhaps was never ſo nearly equalled, or attempted before this Reverend Author's *Night-Thoughts*, appear'd is finely ſhewn in the Eighth Book of his *Paradiſe Loſt*, where he makes his *Adam*, ſo earneſtly attentive to the Angel *Gabriel*, as to ceaſe relating the Myſteries of Creation.

The

The Angel ended, and his *Adam*'s Ear
So charming left his Voice, that he awhile
Thought him ſtill ſpeaking; ſtill ſtood fix'd to hear.

Milton's own Ideas of the Univerſe too, which no doubt he had gathered from aſtronomical Authors, and had reconciled himſelf to, we are fully made acquainted with in the ſame Book, where the Arch-angel ſays, in anſwer to *Adam*'s Enquiries.

—— Other Suns perhaps
With their attendant Moons thou wilt deſcry
Communicating Male and Female Light,
Which two great Sexes animate the World,
Stor'd in each Orb, perhaps with ſome that live:
For ſuch vaſt Room in Nature, unpoſſeſt
By living Soul, deſert and deſolate,
Only to ſhine, yet ſcarce to contribute
Each Orb a Glimpſe of Light, convey'd ſo far
Down to this habitable, which returns
Light back to them, is obvious to Diſpute.

But before I preſume to plan my own Diſcoveries and Conjectures into a Theory, both in Juſtice to thoſe who have in ſome meaſure been in the ſame Way of Thinking, and alſo as a Defence of myſelf for producing ſo new an Hypotheſis to the World, which otherwiſe (though any Apology made to you I know will be unneceſſary) may appear to too many but an idle *Chimera* of my own. I judge it will be highly proper, by way of ſtrengthening my own Arguments, and adding more Weight to what I ſhall myſelf advance in the following Letters, to give you in this the Opinions of the moſt able Writers, whoſe Works I have read upon the Subject. I mean ſo far as relates to the now general received Notion, that the Stars are all Suns, and ſurrounded with planetary Bodies, with which I ſhall ſet out; and ſhew you, it is not a Thing merely taken for granted, but has ever been the concurrent Notion of the Learned of all Nations, as ſhall be further ſhewn, in its proper Place, and as nearly as Poſſibility will admit of, demonſtrated to be Truth.

The following is an Extract from Mr. *Toland*, in his Account of the Works of

JORDANUS BRUNO.

" The Divine Efficacy (ſays this Author in his infinite Creation) cannot " ſtand idle, without the Want of Will or Power; but any Imbecillity in

" ſuch a Being argues Imperfection, and ſince any finite Produce com-
" pared with Infinity is as nothing, or rather as the Beginning of Good,
" it muſtbe no leſs idle, and invidious in producing a finite Effect, than in
" producing none at all.

" Hence, as all Finites, ſingly conſidered, are but as Commencements
" of ſomething more to be expected.

" Omnipotence, in making the Creation finite, will appear to be no
" leſs blameable for not being willing, than for not being able, to make it
" otherwiſe; *i. e.* infinite, as being an infinite Agent upon a finite Subject,
" which is repugnant to Reaſon."

It follows then that, Creation muſt be not only extenſively, but intenſively indefinite, and beyond the Reach of the human Underſtanding to comprehend; and that the one is as neceſſary as the other, *i. e.* an infinite Expanſe is as reconcileable to our Reaſon, as infinite Parts are to our Senſes.

All the Attributes of the Divine Being are, as any one of them, incomſible to his Creatures; why ſhould our Imagination then be ſuppoſed to extend beyond the divine Activity?

" Thus, adds the above Author, the Excellency of God is adequately
" magnified, and the Grandeur of his Empire made manifeſt; he is not
" glorified in one, but in numberleſs Suns; not in one Earth, or in one
" World, but in ten thouſand thouſand of infinite Globes."

An infinite Repreſentation of an infinite Original, and a Spectacle befitting the Excellency and Eminence of him, that can neither be fully conceived, imagined, or comprehended.

> What read we here? th'Exiſtence of a GOD?
> Yes, and of other Beings, Man above,
> Natives of Æther! Sons of higher Climes!
>
> Dr. YOUNG.

" If the Exiſtence of this one World be good or convenient, it is not
" leſs good or convenient that there be infinite others like it.

" The infinite efficient Cauſe would be abſolutely defective, without an
" infinite Effect; and beſides, by conceiving the Infinity of the Univerſe
" and innumerable Beings, the Underſtanding reſts ſatisfied, and is recon-
" ciled with the Idea of an Eternity; whereas, by aſſerting the contrary,
" it is unavoidably plunged into innumerable Difficulties, and unſolvable
" Inconveniencies, Paradoxes, and Abſurdities.

Again, ſays the ſame Writer, " Did we but conſider and comprehend
" all this, oh! to what much further Conſiderations and Comprehenſions

" ſhoud

" ſhould we be carried! as we might be ſure to obtain that Happineſs
" by virtue of this Science, which *in other Sciences is ſought after in vain.*

This Proſpect vaſt, what is it? weigh'd aright,
'Tis Nature's Syſtem of Divinity,
And every Student of the Night inſpires.

Dr. YOUNG.

'Tis elder Scripture, writ by GOD's own Hand;
Scripture authentic! uncorrupt by Man.

" This then is that Philoſophy, which opens the Senſes, which ſatisfies
" the Mind, which enlarges the Underſtanding, and which leads Man-
" kind to the only true Beatitude, whereof they are capable according to
" their natural State and Conſtitution; for it frees us from the ſollicitous
" Purſuit of Pleaſure, and from the anxious Apprehenſions of Pain, mak-
" ing us to enjoy the good Things of the preſent Hour, and not to fear
" more, than we hope from the future; ſince that ſame Providence, or
" Fate, or Fortune, which cauſes the Viciſſitudes of our particular Being,
" will not let us know more of the one, than we are ignorant of the
" other."

And farther, " From theſe Contemplations, if we do but rightly conſider,
" it will follow, that we ought never to be diſpirited by any ſtrange Ac-
" cidents, through Exceſs of Fear or Pain, nor ever be elated by any proſ-
" perous Event, through Exceſs of Hope or Pleaſure; whence we have
" the Path to true Morality, and following it, we ſhall of courſe become
" the magnanimous Deſpiſers of what Men of weak Minds fondly
" Eſteem, and be wiſe Judges of the Hiſtory of Nature, which would be
" written in our Minds, and conſequently be chearful and ſtrict Execu-
" tioners of the divine Laws, which would thus be ingraved in the Cen-
" ter of our Hearts. Seeking, as it were, in ourſelves, an Approbation of
" our own Action, which alone is capable of true Content and Happi-
" neſs."

CHRISTOPHER HUYGENS,

To whom the World is much indebted for many curious Inventions, and Diſcoveries, ſays in his *Planetary Worlds*, " I muſt be of the ſame
" Opinion with all the great Philoſophers of our Age, that the
" Sun is of the ſame Nature with the fix'd Stars; and this will give us a
" greater

† The Pendulum Clock; the firſt Diſcovery of *Jupiter*'s Satellites, and *Saturn*'s Ring.

" greater Idea of the World than all other Opinions can. For then " why may not every one of theſe Stars, or Suns, have as great a Retinue, " as our Sun, of Planets, with their Moons to wait upon them? Nay, " there is 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 at all betwixt them.

" Why then may we not make uſe of the ſame Judgment that we " would in that Caſe; and conclude, that our Star has no better Atten- " dance than the others? So that what we allowed the Planets upon 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, their rational Creatures too, and thoſe as great " Admirers and as diligent Obſervers of the Heavens as ourſelves; and " muſt conſequently enjoy whatever is ſubſervient to, and requiſite for " ſuch Knowledge.

" What a wonderful and amazing Scheme have we here of the mag- " nificent Vaſtneſs of the Univerſe! So many Suns, ſo many Earths, and " every one of them ſtock'd with ſo many Herbs, Trees, and Animals, " and adorned with ſo many Seas and Mountains! And how muſt our " Wonder and Admiration be increaſed, when we conſider the prodi- " gious Diſtance and Multitude of the Stars?"

The Opinion of Sir ISAAC NEWTON.

This great Author, in his grand *Scholia* to the *Principia*, ſays: --- " The " moſt beautiful Syſtem of the Sun, Planets, and Comets, could only pro- " ceed from the Counſel and Dominion of an intelligent and powerful " Being: And if the fix'd Stars are the Centers of other like Syſtems, theſe, " being form'd by the like wiſe Counſel, muſt be all ſubject to the Do- " minion of One; eſpecially, ſince the Light of the fix'd Stars is of the " ſame Nature with the Light of the Sun, and from every Syſtem Light " paſſes into all the other Syſtems. And leaſt the Syſtems of the fix'd " Stars ſhould by their Gravity fall mutually on each other, he (the Di- " vine Being) hath placed thoſe Syſtems at immenſe Diſtances from one " another."

The

The Opinion of Dr. DERHAM, *in his* Aſtro-Theology.

" The new Syſtem, ſays he, ſuppoſeth there are many other Syſ-
" tems of Suns and Planets, beſides that, in which we have our
" Reſidence; namely, that every fix'd Star is a Sun, and incompaſſed
" with a Syſtem of Planets, both primary and ſecondary, as well as ours.

" Theſe ſeveral Syſtems of the fixed Stars, as they are at a great and
" ſufficient Diſtance from the Sun and us; ſo they are imagined to be at
" as due, and regular Diſtances from one another: By which means it is
" that thoſe Multitudes of fixed Stars appear to us of different Magnitudes,
" the neareſt to us large; thoſe farther and farther, leſs and leſs; and
" that ſome, if not all of thoſe vaſt Globes of the Univerſe, have a Mo-
" tion, is manifeſt to our Sight, and may eaſily be concluded of all, from
" the conſtant Similitude and Conſent that the Works of Nature have
" with one another."

To this we may add, that this Syſtem of the Univerſe, as it is phyſically demonſtrable, is far the moſt rational and probable of any. *Becauſe*,

" It is far the moſt magnificent of any, and worthy of an infinite
" CREATOR, whoſe *Power* and *Wiſdom*, as they are without Bounds and
" Meaſure, ſo may they, in all Probability, exert themſelves in the Creation
" of many Syſtems as well as one. And as Myriads of Syſtems are more
" for the *Glory* of GOD, and more demonſtrate his *Attributes* than one;
" ſo it is no leſs probable than poſſible, there may be many beſides this
" which we have the Privilege of living in." And as the ſtrongeſt Confirmation of this, " we ſee it is really ſo, as far as it is poſſible it can be
" diſcerned by us, at ſuch immenſe Diſtances as thoſe Syſtems of the fixed
" Stars are from us; and we cannot reaſonably expect more."

" Since the Sun and fix'd Stars, ſays Dr. *Gregory*, are the only great
" Bodies of the Univerſe that have any native Light, they are juſtly
" eſteemed by Philoſophers to be of the ſame Kind, and deſigned for the
" ſame Uſes; and it is the Effect of a Man's Temper that ſets a greater
" Value upon his own Things than he ought, that makes him judge
" the Sun to be the biggeſt of them all."

That, as an elegant * Writer obſerves, which we call the Morning, or the Evening Star, is, in reality, a *Planetary World*; which, with the four others, that ſo wonderfully, as *Milton* expreſſes it, " vary their myſtick
" Dance, are in themſelves dark Bodies, and ſhine only by Reflection;
" have Fields and Seas, and Skies of their own; are furniſhed with all
" Accommodations for animal Subſiſtence, and are ſuppoſed to be the Abodes

* Contemplations on the ſtarry Heavens.

" Abodes of intellectual Life. Again, The Sun, with all its attendent Planets " is but a very little Part of the grand Machine of the Univerſe. Every " Star— is really a vaſt Globe, like the Sun, in Size and in Glory, no leſs " ſpacious, no leſs luminous, than the radiant Source of our Day; ſo that " every Star is the Center of a magnificent Syſtem, has a Retinue of " Worlds irradiated by its Beams, and revolves round its active Influence; " all which are loſt to our Sight in immeaſurable Tracts of Æther.

" Could we, ſays the ſame Author, wing our Way to the higheſt ap- " parent Star — we ſhould there ſee other Skies expanded, other Suns, " that diſtribute their inexhauſtible Beams of Day; other Stars, that gild " the alternate Night; and other perhaps nobler Syſtems eſtabliſhed; " eſtabliſhed in unknown Profuſion, through the boundleſs Dimenſions " of Space. Nor does the Dominion of the great Sovereign end *there*, " even at the End of this vaſt Tour, we ſhould find ourſelves advanced " no farther than the Frontiers of Creation; arrived only at the Suburbs " of the great *Jehovah*'s Kingdom."

O for a Teleſcope his Throne to reach!
Tell me ye Learn'd on Earth! or Bleſt above!
Ye ſearching, ye *Newtonian* Angels! tell,
Where your great Maſters Orb? His Planets where?
Thoſe conſcious Satellites, thoſe Morning Stars,
Firſt-born of *Deity* from central Love.

Dr. YOUNG.

Many other Authorities might be produced from Writers of great Repute, were it neceſſary to trouble you with them †; but I believe thoſe above will be abundantly ſufficient for the preſent Purpoſe, if even an Apology were wanting for my own Conjectures. I ſhall therefore conclude this Letter with the following Paſſage out of *Pope*'s *univerſal Prayer*, and in my next ſhall proceed in the Work I have undertaken.

Yet not to Earth's contracted Span,
Thy Goodneſs let me bound;
Or think thee Lord alone of Man,
When thouſand Worlds are round.

I am, &c.

LETTER

† Particularly from *Fontenelle*, &c.

LETTER THE SECOND.

Concerning the Nature of Mathematical Certainty, and the various Degrees of Moral Probability proper for Conjecture.

SIR,

YOU know how much I am an Enemy to the taking of any thing for granted, merely becauſe a Perſon of reputed Judgment, has been heard to ſay, *it abſolutely is ſo*; an *Ipſe dixit*, and implicit Faith in ſome Caſes, may be both neceſſary and uſeful; but here, in Aſtronomy, I mean, every Man's Reaſon, by the Help of a very little Mathematicks, is able to bring wonderful Truths to Light without them; and Truths not only of the higheſt Importance to every Individual, but of a great and common Conſequence to all Mankind: And as ſuch, in all Ages of the World, have been judged worthy to be enquired into, by the beſt and wiſeſt of Philoſophers.

You are likewiſe very ſenſible how far the human Underſtanding is even at the beſt, from being infallible, and don't want to be told, how difficult it is in a Subject of this Nature to arrive at any tolerable Degree of Certainty, which before the Days of the ſagacious *Euclid*, and the penetrating *Archimedes*, was a Thing not to be expected. And many things which were then but barely Objects of Conjecture and Probability, have ſince been demonſtrated to be infallibly true. Time and Obſervation will undoubtedly, at laſt, diſcover every thing to us neceſſary to our Natures, and proper for us to know. As a Proof of which, we ſee human Wiſdom daily increaſes; and while a Capacity continues to make ourſelves ſtill more acquainted with the manifeſt Wiſdom and Power of GOD in the Works of his Creation, who is to tell us where to ſtop our Enquiries? Or who is ſo impious to ſet Bounds to a Science, which ſo evidently ſpreads through all Infinity, the Attributes of God, and an eternal Baſis for future Hope?

This Branch, or rather Body of Aſtronomy, I believe you will find to be quite new; and though evident Truths, are the principal Thing to be regarded in it, yet as being in its infant State, where lineal Demon-

 ſtration

ſtration fails, as in ſome Caſes it cannot be otherwiſe, I hope you will give me Leave to make uſe of a weaker Way of Reaſoning, to convince you of the Point in Diſpute, I mean of that by the Analogy of known and natural Things.

I ſhall be extremely unwilling to affirm any thing for a *Fact*, or Truth, without hearing, if not the real Evidence, at leaſt a plauſible Reaſon, next to a Conviction, or moral Certainty, along with it; and therefore I will here endeavour to explain to you what I mean by moral Certainty and alſo by mathematical Proof.

Mathematical Proof, or Certainty, proper for Conjectures, may, to almoſt every Capacity, be illuſtrated as follows:

Suppoſe you had accidentally found a very ſmall Part of a viſibly broken Medallion, with nothing more expreſs upon it, than what is repreſented at *Fig.* 1. *Plate* I. a Perſon totally unacquainted with the mathematical Sciences, we may naturally conclude, would not be able to make any thing of it, or in the leaſt comprehend what it originally was, or meant; but if an Aſtronomer ſhould chance to ſee it, who of courſe we are to ſuppoſe knew the Order and Proportion of the planetary Orbits, he would immediately conclude, and with great Probability, on the Side of his Conjectures, that it might be Part of a Medal repreſenting the Solar Syſtem. In ſuch a Caſe may we not very naturally ſuppoſe he would reaſon thus?

The Arches A and B ſeem to be Portions of the reſpective Orbits of *Saturn* and *Jupiter*, and what may lead us to believe, that they are really ſo, and Part of the Solar Syſtem, is the oblique Curve C, which looks not unlike the Trajectory of a Comet.

This ſurely would be far from an irrational Conjecture, and conſequently in ſome Degree probable: But this is not ſufficient you'll ſay; To prove it we muſt have farther recourſe to the Mathematicks, and a Mathematician would immediately thus demonſtrate it to be true.

Firſt, by compleating the Circles geometrically from the fourth Book of *Euclid*, by the Aſſiſtance of any three Points E. F. G. the original Figure will be reſtored, as at *Fig.* 2. And ſecondly, by aſſuming any two Points, as F, E in the Curve C, if admitted a Parabola, by a well-known Problem in Conic Sections the Heliocentric Portion X. Y. Z. will eaſily be projected and ſhewn, as in *Fig.* 3. Laſtly, join this in Poſition to the former, and it will juſtly ſupply the Orbit, or Path of ſome one of the Comets; and if required, even what Comet may be diſcovered by comparing the Perihelion Diſtance Y. S. with their general Elements or Theories, in Dr. *Hally*'s *Synopſis* of the Motion of theſe Bodies. And if a farther Confirmation of the Truth of theſe Conjectures were wanting, the

the ſmall concentric Circles at D would now be allowed beyond a Contradiction, to repreſent the ſecondary Orbits of *Saturn*; and thus the firſt Preſumption being carried thro' ſeveral corroborating Degrees of Probability, almoſt paſt a Diſpute, would become a mathematical Certainty; and the above imperfect Piece of Medallion, would evidently appear beyond a Contradiction to be Part of a Repreſentation of the ſaid ſolar Syſtem, and ſuch as is ſhewn in *Plate* II. Q. E. D. Thus in many Caſes, it often happens, that from a very ſmall Part of *orbicular Things*, we are able to determine the Form and Direction of the Whole: And hence you may conceive it no very difficult Taſk to a Mathematician, to deſcribe the Orbits of all the Planets in the ſolar Syſtem, though he had never obſerved them but in one and the ſame Sign of the *Zodiack*; thus far I have thought it would not be amiſs to explain to you the Nature of thoſe Steps, by which we arrive at moral Certainty, and where the Subject will admit of it, Mathematical Conviction, which will not a little contribute to ſtrengthen many of the Arguments hereafter made uſe of, and in ſome Degree ſerve to ſupply the Place of Proof, where infallible Demonſtration cannot from the Nature of the Thing be diſcovered.

But beſides the indiſputable Principles of Geometry, the univerſal Law of Analogy and Similitude of things, have a Privilege to aſſiſt us, in Conjectures relating to the heavenly Bodies, and though not of equal Force with the former, is often as concluſive as the Subject requires. This ſort of probable Evidence (as Dr. *Butler* obſerves,) is eſſentially diſtinguiſhed from "Demonſtrative by this, that it admits of Degrees; and "of all Variety of them, from the higheſt moral Certainty to the very "loweſt Preſumption; and that which chiefly conſtitutes Probability, is "expreſſed in the Word *Likely*, or Natural Likeneſs, as to State or Being." This general Way of arguing, I think, is allowed to be evidently natural, juſt and concluſive, and unqueſtionably to have its Weight in various Degrees, towards determining our Judgment: For Inſtance, ſhould any ignorant Perſon, endowed with rational Principles, cut open a *Pomegranate* of the natural Growth of *England*, and finding it full of ſmall Globules, or Kernels, upon being preſented with an every way ſimilar Fruit, ſaid to be the Produce of *Italy*, doubt of its being of the ſame Nature, and compoſed of like globular Seeds within; here indeed would be no mathematical Evidence to aſſiſt the Judgment, the Object of Proof being inviſible, but ſure from the external Similitude, the ſtrongeſt Probability of their being alſo internally the ſame. Again,

Is it natural to ſuppoſe, that the firſt Perſon who found a *Lark*'s Neſt, and in it ſeveral of the Female's Eggs, ſhould have any Apprehenſions of finding none in the *Nightingale*'s, only becauſe he had never ſeen one be-

fore, I believe the moſt illiterate Perſon of the earlieſt Ages, who had Curioſity enough for ſuch a Search, would be greatly diſappointed in ſuch a Caſe, and far from concluding that the *Nightingale* had none. Farther, ſhould any one who had ſeen ſeveral Sorts of Fiſh taken out of the River *Thames*, or out of the *Nyle*, have any ſort of Suſpicion that he ſhould find no ſuch Creatures in the *Seine* or the *Ganges*, though it ſhould be allowed that he had never ſeen any ſuch Creatures that were known to come from thence. Ocular Demonſtration, in ſuch a Caſe, would ſure be unneceſſary, and an Evidence of the firſt, I believe would be abundantly ſufficient to convince us of what we ought to look for at leaſt in the laſt: But then the Fiſhes of different Seas, and of Rivers are not of the ſame Species you'll ſay; but as it were infinitely diverſified through all the aqueous World, this is, and muſt be granted, and alike Variety of *Species* muſt alſo be granted, in the former Caſe of the Birds: But no Objection can poſſibly ariſe from any ſuch Diverſity, ſince we don't pretend to ſay, nor is it at all neceſſary, that the Beings in the ſidereal Planets ſhould be every where the ſame with theſe of our ſolar Syſtem, a Variety muſt every where be admitted, and will always be admired, where the Work is Nature's, and the Deſign GOD's.

All then that I here pretend to argue for, is a Univerſality of rational Creatures to people Infinity, or rather ſuch Parts of the Creation, as from the Analogy and Nature of Things, we judge to be habitable Seats for Beings, not unlike the mortal human.

Every Animal, and every Vegetable, that, as it were, naturally exiſts by the Virtues, Properties, or Laws of the mineral Kingdom, has ſomething of a ſecondary Nature, depending upon it as a Principle; and to ſay that the Stars, which are a certain viſible ſort of Cotemporaries in Space with the Sun, have no like planetary Bodies with ours moving round them, becauſe we cannot poſſibly ſee them, is no leſs abſurd and ridiculous, than to argue, that we can have no Reaſon to expect to find, in the proper Seaſon, Grapes upon every Vine — Figs upon every Tree — Roſes upon every Buſh — only becauſe ſome of them are at ſuch a Diſtance, that neither Roſe, Fig or Grape, can be diſcovered by the Eye.

This ſort of Reaſoning, though ſome perhaps may neglect it, I am perſwaded you will look upon as abundantly ſufficient for Things out of the Reach of Science to determine; and that the collective Body of Stars have not been diſcovered, to be together a proper Subject for ſuch Conjectures before, can ſurely only proceed from the Want of Time, neceſſary to compleat the Obſervations proper for a Foundation to build ſuch an Hypotheſis, or Theory upon. This is the great Article in which the Moderns have ſo much, and ever will have, an Advantage over the Antients. And hence it will appear, That

The

The Improvements and Diſcoveries of latter Ages are not at all owing to the greater Capacity of the Moderns, but from the Advantages received, or ariſing from the Inventions and Progreſs made by the Ancients. We at firſt in a manner walked by their Leading-ſtrings, and though many of them now are broke, or uſeleſs, none can deny, but that formerly they were of great Advantage in promoting and directing philoſophical Enquiries.

In an Aſſembly of the moſt eminent Men of all Ages, if we may ſuppoſe ſuch a Conference amongſt the illuſtrious Dead, on Purpoſe to deliver their ſeveral Sentiments familiarly together, on the moſt intereſting Subjects of natural Knowledge, who would not lament the Diſadvantages, poor old *Thales*, an *Hipparchus*, or a *Ptolomy*, would lie under, who had nothing but the Eye of Reaſon to direct them, in Oppoſition to the Judgment of a *Brahe*, or a *Galilæus*, who reaped ſo much Benefit from their compound Opticks? But on the other hand, perhaps if the ſolar Syſtem, was the Topic of Diſcourſe, a * *Pythagorean* might very pertinently ſay to a *Newtonian*, "You have not gone much farther in the Light with our "Direction, than we did in the Dark alone; for you are ſtill roving "round the ſame Circles." Much might be ſaid upon this Head; but I believe it would be a difficult Matter to do Juſtice to all Parties: So here I intend to leave them, only muſt obſerve, that Poſterity will always have the Advantage over their Predeceſſors; and that After-ages, in all Probability, will reap ſo great a Benefit from the Invention and Improvement of Fluxions, that ſcarce any thing, which is the immediate Object of ſuch Enquiry, will long lie concealed from a true mathematical Genius.

For this, in which he has ſurpaſſed all the Antients, and greatly advanced the philoſophical Sciences, the World is indebted to Sir *Iſaac Newton*.

But as many of his Diſcoveries, ſuch as relate particularly to the Laws of the planetary Syſtem, are but as ſo many Confirmations of the Conjectures and Imaginations of Aſtronomers and Philoſophers before him, it perhaps will not be amiſs to acquaint you a little with the Aſtronomy of the Antients concerning the Univerſe. And before I proceed to thoſe of my own, ſhew you in the firſt Place how far their Speculations in the viſible Creation have been carried; and with theſe I ſhall conclude this preparatory Epiſtle.

The Univerſe, or mundane Space, by which the Antients comprehend all Creation, has, from time to time, according to the Progreſs of Science, come under a ſort of Neceſſity of being variouſly modell'd agreeable to the Opinion

* The true Syſtem of the Planets have been diſcovered above two thouſand Years.

Opinion of the ſeveral Authors, who have judged themſelves wiſe enough to write upon it with a mathematical Foundation: And the coſmical Syſtem, by which is meant the Co-ordination of its conſtituent Parts has undergone almoſt as many Changes as its Elements are even capable of; every Age of the World, as Knowledge has increaſed, either from improved Imagination, or repeated Obſervations, producing ſomething new concerning it.

MILTON, no doubt, had all this Diverſity of Opinions in View, as appears from his ſuppoſed Pre-knowledge of *Raphael*, in the following Paſſage, *Book*. VIII.

> Hereafter, when they come to model Heaven,
> And calculate the Stars, how they will weild
> The mighty Frame! how build, unbuild, contrive
> To ſave Appearances, how gird the Sphere
> With centric and eccentric ſcribbl'd o'er;
> Cycle, and Epicycle, Orb in Orb.

But the following Synopſis, I believe, will abundantly convince you that from certain Obſervations only, we ought to form all our Notions of it, if we either hope to arrive at Truth, or expect our Ideas ſhould be ſupported by Reaſon.

ARISTOTLE was of Opinion, that the Univerſe, or Heaven, was all one World, and St. CHRYSOSTOM, TERTULLIAN, St. BONAVENTURE, TYCHO BRAHE, LONGOMONTANUS, KEPLER, BULIALDUS and TELLEZ, were of an united Opinion, that this one Heaven, or Univerſe, was all ſidereal and fluid. But AEGIDIUS, HURTADUS, CISALPINUS, and AVERSA, believing the ſame Heaven with them to be all one World, and that ſidereal, yet on the contrary held it to be ſolid.

CLEMENS, ACACIUS, THEODORET, ANASTASIUS, SYNAITA, PROCOPIUS, SUIDUS, S. BRUNO, and CLAUDIANUS MAMERTUS, ſuppoſed the univerſal mundane Space as divided into two Heavens, namely,

The Empyræum created the firſt Day,
And the Firmament created the ſecond Day.

Two Heavens were alſo held by JUSTIN MARTYR, the one ſidereal, and the other aerial. The firſt ſuppoſed by St. GREGORY NYSSENE, to be that of the fixed Stars, and the laſt, that of the Planets. But *Maſtrius* and *Bellutus*, though agreeing in the Number of Heavens, call one the *Primum Mobile*, and the other, the Starry Heaven.

Farther,

Farther, St. Basil, St. Ambrose, Damascene, Cassiodorus, Genebrardus, Suarez, Tannerus, Hurtadus, Oviedus, Tellez, and Borrus, distinguished the Universe as divided into three Portions, or Heavens.

The first called the Empyræum,	Or, as *Cajetan.*	Watery,	*Tho. Aquinas.*	
The second supposed Sidereal,		Sidereal,		Watery,
And the last of all, Aerial.		Aerial,		Sidereal.

Again, St. *Athanasius* adds to those of the fix'd Stars, the Planets, and the Air, that of the *Empyræum*, and makes in all four Heavens.

But as the Number of the Heavens thus increases, and will become subdivided in the subsequent Account of them, to give you a better Idea of the Order of these celestial Portions of the mundane Space, it will not be amiss to form what remains of them into regular Sections of their proper Spheres and Systems.

See *Plate* III. in which Figure, the first represents a Section of the cosmical Theory of *Oviedus* and *Ricciolus:* Both consisting of five Heavens, *viz.*

By *Oviedus*, sidereal and solid.	The fixed Stars,	A	By *Ricciolus*, sider. and fluid.	*Empyræum*,	G
	Saturn,	B		The Water,	F
	Jupiter,	C		The fixed Stars,	A
	Sol, with ♂, ☿ and ♀ included	D		The Planets,	H
	The Moon.	E		The Air.	I

Fig. II. represents that of venerable *Bede* and *Rabanus*, *viz.* of Seven Heavens.

And according to *Bede* composed of		But by *Rabanus*,
The Air,	P	The Atmosphere,
The Æther	O	The upper Air,
Olympus,	N	The inferior Fire,
The Element of Fire,	M	The superior Fire,
The Firmament,	A	Sphere of the fixed Stars,
The Angelical Region,	L	The Chrystalline Heaven,
Realm of the Trinity.	K	The *Empyræum.*

Fig.

Fig. III. Repreſents the Hypotheſes of *Eudoxus*, *Plato*, *Calippus*, *Cicero*, *Riccius*, *Philo*, *Remigius*, *Aben-Ezra*, *Carthuſianus*, *Lyranus*, *Toſtatus*, *Brugenſis*, *Orontius*, *Cremoninus*, *Philalethæus*, *Amicus*, and *Ruvius*; alſo the *Babylonians* and *Egyptians*.

Conſiſting of Eight Heavens,

All Sidereal, *viz.* The Sphere of the fix'd Stars, and thoſe of the Seven Planets.

Fig. IV. is that of *Macrobius*, *Haly Alpetragius*, *Rabbi-Joſue*, *Rabbi Moyſes*, *Scotus*, *Abraham Zagutus*, *Sacroboſcus*, *Claromontius*, *Avigra*, and *Arraiga*.

All of Nine Heavens,

Comprehend a *Primum Mobile* Q, or, according to *Arriaga*, a ſolid *Empyræum*. The Sphere, of fixed Stars A, and the ſeven Regions of the ſolar Planets.

Fig. V. is that of the great *Alphonſus*, *Fernelius*, *Regiomontanus*, *Amicus*, *Maurolycus* and *Langius*; alſo of *Azahel*, *Thebit*, and *Iſaac Iſraelita*; and likewiſe of *Gulielmus Pariſienſis*, and *Johannes Antonius Delphinus*.

Conſiſting of Ten Heavens, made up of

A *Primum Mobile* — — — —	S	*Empyræum.*
A Sphere of *Tripidation* in Longitude —	R	*Primum Mobile.*
The Sphere of the fixed Stars — —	A	
And thoſe of the ſeven ſolar Planets within.		

Note, Some Authors place the Sphere of *Tripidation* in Longitude below that of the *Aplain*, or Eighth Sphere.

Laſtly, Fig. VI. is the Heaven of *Petrus Alliacenſis*, the College of *Conimbra*, *Martinenſis*, (and ſometime) of *Clavius*; and alſo *Johannes Warnerus*, *Leopoldus de Auſtriâ*, *Johannes Antonius Maginus*; and laſtly, of *Clavius*.

In all Eleven Heavens containing,

T	A *Primum Mobile*, or, as others ſay, an *Empyræum.*
V	A Sphere of Libration in Latitude.
W	A Sphere of Libration in Longitude.
A	The Sphere of the fixed Stars, and thoſe of the Planets.

Thus you ſee how many various Opinions have from time to time been imbraced concerning the Fabric and Formation of the viſible Univerſe; all of which are now and have long been exploded; and although at firſt advanced by Men of the greateſt Learning, and of the deepeſt Penetration in natural Knowledge, it does not appear from any one of their Opinions, that they had any the leaſt Notion of infinite Space, but as it were

were confined the Divine BEING to their limited Notions, as one may ſay in an Egg-ſhell. If therefore what I ſhall hereafter advance, extend ſo far without the known Creation, that you can poſſibly conceive no Bounds to the Works of infinite Wiſdom and Power, I hope you will be in no Danger of looking upon it as more ridiculous, or abſurd, than what ſo many of the wiſeſt Men of every Age have thought proper to attempt, and have judged worthy of their Attention ſo long before me. If any thing leſs ſo, I ſhall think myſelf happy enough in having broke, or rather paſſed the narrow Limits to which the Creation has for ſo many Years been confined, in hopes of tempting Men of greater Talents to look up wards, and purſue ſo noble a Subject as far as the human Underſtanding is capable of comprehending it.

To the Opinions above might be added many more, particularly that of *Johannes Baptiſta Turrianus*, and *Fracaſtorius*, who increaſed the Number of Heavens to fourteen, *viz.* ſeven on each Side the *Aplané*.

But of this I have ſaid enough; in my next I ſhall proceed to Matter better grounded,

And am, &c.

LETTER THE THIRD.

Concerning the Nature, Magnitude, and Motion of the Planetary Bodies round the Sun, &c.

SIR,

THE younger *Pliny*, if I remember right, ſomewhere ſays, that there is, or ought to be, a wide Difference betwixt writing to a Friend, and writing to the Publick: I have indeed pleaſed myſelf with the one, but am far from thinking myſelf qualified for the other; I muſt therefore rather intreat you, though perhaps you cannot poſſibly overlook all my Faults as an Author, to excuſe them at leaſt in the Friend, and by ſuch kind of unlimited Indulgence, you will give me a much greater Chance to do the Subject ſome Juſtice, though I own I deſpair in this firſt Attempt, to reconcile every thing I advance to your more cool and impartial Reaſoning. But to the Buſineſs:

As I have no Ambition to have the Subſtance of my Theory more admired by you than underſtood, which is too often the Caſe in Works of this Nature, I muſt beg leave to repeat to you Part of a former Diſcourſe, which will refreſh in your Ideas the principal Laws of the Syſtem of our Sun, and make you properly acquainted with ſuch Things as are neceſſary to be known in the now-eſtabliſhed Aſtronomy of * *Copernicus*, &c. before I proceed to any new Matter.

The

* NICOLAUS COPERNICUS, ſtiled by *Bulialdus*, *Vir abſolutæ ſubtilitatis*, was a Native of *Thorn* in *Poliſh Pruſſia*, and Canon of the Church of *Frawenburgh*; he was Scholar to *Dominicus Maria* of *Ferrara*, to whom he was Aſſiſtant in his aſtronomical Obſervations at *Bologne*, and Profeſſor of the Mathematicks at *Rome*, in his noble Work, *De Revolutionibus Orbium Cæleſtium*; he fortunately revived, happily united, and formed into an Hypotheſis of his own, the ſeveral Opinions of *Philolaus*, *Heraclides Ponticus*, and *Ecphantus Pythagoreus*, *viz.* after the Opinion of *Philolaus* he made the Earth to move about the Sun, as the Center of its annual Motion; and according to *Heraclides* and *Ecphantus*, he likewiſe gave it a diurnal Rotation round its own Axis: Which Syſtem has withſtood all Oppoſition; and as *Ricciolus*, (though a Diſſenter from it) obſerves, *Per damna, per cædes, ab ipſo ſumit opes, animumque ferro.*

The Sun, you are not to learn, is the reputed Center of our *Planetary Syſtem*, and may remember, that the Earth on which we live, and theſe five following *Erratic Stars*, viz. SATURN, JUPITER, MARS, VENUS and MERCURY, have been demonſtrated to move round him in the Order and Manner following.

Saturn is found to complete one Revolution round the Sun in twenty-nine Years, one hundred and ſeventy-four Days, ſix Hours, and thirty-ſix Minutes; at the Diſtance of about ſeven hundred and ſeventy-ſeven Million of Miles. *Jupiter* performs a like Revolution in about eleven Years, three hundred and ſeventeen Days, twelve Hours, and twenty Minutes; diſtant from the Sun about four hundred and twenty-four Millions of Miles. *Mars* compleats his Circuit in one Year, three hundred and twenty-one Days, twenty-three Hours, and twenty-ſeven Minutes; and his mean Diſtance is about one hundred and twenty-three Millions of Miles.

Theſe three are called ſuperior Planets, as being farther from the Sun than the Earth, and circumſcribing its Orbit.

The Earth circumambiates her Orbit in one ſolar Year, *viz.* in three hundred and ſixty-five Days, five Hours, forty-eight Minutes, and fifty-ſeven Seconds; at the mean Diſtance of eighty-one Million of Miles.

The Radius of *Venus*'s Orbit is about fifty-nine Millions of Miles; and that of *Mercury* nearly thirty-two Millions, *ditto*.

The Heliocentric Revolution of *Venus*, is made in two hundred and twenty-four Days, ſixteen Hours, forty-nine Minutes, and twenty-ſeven Seconds; and that of *Mercury*, in eighty-ſeven Days, twenty-three Hours, fifteen Minutes, and fifty-four Seconds. Theſe two laſt Planets are called inferior Ones, as being circumſcribed by the Earth.

The Diameter of the Sun being demonſtrated to be nearly ſeven hundred and ſixty-three thouſand Miles:

The proportional Magnitudes of all the above Planets will be found nearly as follows, *viz.*

The Diameter of the Globe,

Of *Mercury*	4,240	Miles.
Venus	7,900	
the Earth	7,970	
Mars	4,440	
Jupiter	81,000	
and *Saturn*	61,000	

Thus much I have thought proper to premiſe, and for your immediate Inſpection, have added the following Schemes, that nothing may be wanting to give a general Idea of the Order of the celeſtial Bodies in our own Syſtem, before I attempt to lead you through the neighbouring Regions of the Stars to the more remote Tracts of Infinity.

PLATE IV.

Is a true Delineation of the ſolar Syſtem, with the Trajectories of three of the principal Comets, whoſe Periods and Orbits have been accurately determined, and are repreſented in their true Proportion and Poſition to one another, and the Order of the Planets round the Sun, marked with their reſpective Characters, *viz.* ♄, for *Saturn*, ♃, *Jupiter*, ♂, *Mars*, ⊕, the Earth, ♀, *Venus*, and ☿, *Mercury*. The Scale being nearly five hundred and eighteen Millions of Miles to an Inch.

PLATE V.

Is a true Projection of the Syſtem of the known Comets; in which are repreſented nine of the chief Trajectories, from their *Aphelii* to their *Perihelii*, all in juſt Proportion and Poſition to the Orbits of *Saturn* and *Jupiter*, which are alſo repreſented by the two concentric Circles, ſuppoſed to be drawn round the Sun as their Center.

The Ellipſis, or Trajectory, marked A, ſhews the Poſition and Path of the Comet which appeared in the Year 1684, whoſe Period is ſuppoſed to be about fifty Years, and has been obſerved within the Region of the Planets once.

That mark'd B, is the Way of the Comet of 1682;
The Period conjectured to be about ſeventy-five Years and a half, and has been obſerved thrice.

C, Way of the Comet of 1337;
The Period about 100 Years, obſerved once.

D, That of the Comet of 1661;
The Period about 129 Years, obſerved twice.

E, Tract of the Comet of 1618;
The Period about 160 Years, obſerved once.

F, Way of the Comet of 1677;
The Period about 200 Years, obſerved once.

G, Way of the Comet of 1744;
The Period about 300 Years, obſerved once.

H, Way of the Comet of 1665;
The Period about 400 Years, obſerved once.

I, Way of the Comet of 1680;
The Period about 575 Years, obſerved thrice.

The

The Scale of this Syſtem is equal to one Third of the former.

Here I muſt obſerve to you, as a Thing I judge may prove of great Conſequence with regard to the Syſtem of Comets, which is as yet very imperfect: That I am ſtrongly of Opinion, that the Comets in general, through all their reſpective Orbits, deſcribe one common Area, that is to ſay, all their Orbits with regard to the Magnitude of their proper Planes, are mathematically equal to one another; which, if it once could be proved, and confirmed by Obſervation, the Theories of all the Comets that have been juſtly obſerved, might eaſily be perfected, and their Periods at once determined, which now we can only gueſs at, or may wait whole Ages for more Certainty of. What leads me to believe, that this may prove to be really the Caſe is this.

I find by Calculation, that the Orbits of the two laſt Comets, whoſe Elements have been moſt corrected by Sir *Iſaac Newton* and Dr. *Hally*, are to one another, according to their Numbers, nearly as * 13 to † 17, notwithſtanding one of them is one of the moſt erratick that ever came under our Obſervation; and the other one of the moſt neighbouring to the Sun.

But it is well known to all Mathematicians, that the firſt of theſe Comets moved in ſo eccentric a Trajectory, that the leaſt Error in its almoſt incredible Proximity to the Sun will produce a very ſenſible Difference in the Area of the Orbit: And accordingly, if we moderate the Perihelion Diſtance of this Comet, by making it but 1000 inſtead of ‡ 612, which is but increaſing it a $\frac{1}{35000}^{th}$ Part of the great Radius of the Orbit, (which is an Error every Aſtronomer will readily grant is very eaſily made) and we ſhall find the Orbits of the ſaid two Comets to be exactly equal.

Further, I muſt inform you, that the Comet of 1682, which the above compared with, ſeems to have been ſo accurately obſerved, that it does not appear to have altered its Perihelion Diſtance half a 68th Part in one intire Revolution. Now, if we can with any Show of Reaſon, and a Probability on our Side, bring the Areas of theſe two extream Comets, as I may call them, to an *Equality*, ſure we may conclude, it is a Subject highly worthy to be more conſidered and enquired into.

PLATE

* 1316539,968282 Comet of 1680.
† 1708155,4644 Comet of 1682.
‡ The Number in Dr. *Hally*'s Synopſis.

PLATE VI.

Is a true Repreſentation of the ſatellite Syſtems, proportionable to one another, and to the Orb of the Sun's Body, that a juſt Idea of the Diſtances of thoſe ſecondary Planets, may be eaſier had from their reſpective primary ones.

S repreſents the ſolar Body with its Atmoſphere. *Fig.* 1. is the Syſtem of *Saturn* from the ſame Scale. *Fig.* 2. that of *Jupiter* from *ditto*. And *Fig.* 3. the Orbit of the Moon round the Earth, in the ſame Proportion.

But as you can have but a very imperfect Idea of the Magnitude of theſe laſt Circles, with regard to the Body of the Earth or Moon,

PLATE VII.

Is a true Projection of their real Globes, at their proper Diſtance from each other, with their common Center of Gravity, and the Point and Line of equal Suſpenſion betwixt them, *viz.*

A, repreſents the Globe of the Earth.
B, that of the Moon.
C, Point, and C D, Line of equal Suſpenſion betwixt them.
E, Common Center of Gravity, which deſcribes the *Orbis Magnus.*
E, F, and B, G, is the Orbit of the Moon.

Farther, that nothing may be wanting to give a true Notion of the whole together,

PLATE VIII.

Is a proportional Drawing of all the primary and ſecondary Planets together, diſtinguiſhed by their Characters, proper to attend a Globe of twelve Inches Diameter, ſuch a one being ſuppoſed to repreſent the Sun.

PLATE IX.

Is an exact Scheme of the principal known Comets, in juſt Proportion, to the Globe of the Earth repreſented at A, with the Nuclus, and Part of the Tail of the Comet of 1680, B, as it was obſerved in its Aſſent from the Sun, *viz. a a* the Comet's natural Atmoſphere, *z z z*, the *Denſer Matter* winding itſelf into the Axis of the Train *x x*, the inflam'd Atmoſphere and Tail dilated near the Sun. C, repreſents the Ball of the Comet of 1682, D, that of 1665, E, that of 1742, and F, the Head of the Comet of 1744.

And again, that you may have ſome Notion of the apparent Magnitudes of all theſe Planets and Comets, *&c.* as they appear at the Earth,

PLATE

PLATE X.

Repreſents the Sun and Moon in the juſt Proportion of their mean Diameters, with two of the Comets A and B, and the five erratick Planets, as they are obſerved at the Earth, in a middle State of their Diſtances from it.

For a more full and particular Deſcription of all the Parts of the ſolar Syſtem, and of the home Elements of Aſtronomy in general, I refer you to my *Clavis Cæleſtis*, &c. where every thing concerning the Planets, Comets, and Stars; and their real and apparent Motions, are at large repreſented, explained, and accounted for, for the Benefit of ſuch as have not made the Mathematicks their regular Study.

Now, to convince you that the Planets are all in their own Nature no other than dark opaque Bodies, reflecting only the borrowed Light of the Sun, I muſt recommend to your Obſervation, this natural and ſimple Experiment, which almoſt any Opportunity of ſeeing the *Moon* a little before the Full, will put into your Power to make; but beſt and eaſieſt when the Sun is in any of the North Signs, *i. e.* in *Summer*.

At ſuch a time, the Sun being near ſetting, the Moon will appear in the eaſtern Hemiſphere; and if there be any bright Clouds northward, or ſouthward near her, you will plainly perceive, that the *Light* of the one is of the ſame Nature with that of the other; I mean the Light of the Moon, and that of the Cloud. To me there never appeared any Difference at all; and I am perſwaded, were you to make but two or three Obſervations of this kind, which is from Nature itſelf, a ſort of ocular Demonſtration, you cannot fail of being convinced, that the Moon's Light, ſuch as it is, without Heat, can poſſibly proceed from no other Cauſe than that which illumines the Cloud: For if the Clouds, whoſe Compoſition we know to be but a thin light Fluid, formed of condenſed Vapours only, is capable of remitting ſo great a Luſtre, how much more may we not allow the Moon, which, Length of Time, and many other Circumſtances, have long confirmed to be a durable and ſolid Body.

The Increaſe of her Luſtre, indeed, during the Abſence of the Sun from us, to a leſs penetrating Genius than your's, may poſſibly afford ſome trifling Ground of Objection to the above Concluſions, as being drawn from the Phænomena of Day-light only; by reaſon in the Night, we have no Clouds in equal Circumſtances to compare with her.

But this I need not tell you, is all owing to her being ſeen through a darker Medium, and not to any real Increaſe of natural Light emitted from the Sun. As a Proof of which, were it neceſſary, you need only, ſhut out the Rays of the Atmoſphere, by the Help of a ſufficiently long

long Tube; and the Moon, or any other celeſtial Body, will appear through it, as bright in the Day-time as in the Night.

Thus all light Bodies of inferior Luſtre, whether ſhining by their own natural Radiences, or by a borrowed Reflection, partake of the ſame Advantage, when removed from the more potent Influence of a ſuperior one; and hence it is, that the **Aura Ætherea* ſhines out moſt manifeſt, when the Body of the Sun himſelf is hid, the Stars, and the *Via Lactea* moſt lively and numerous in the Abſence of the Moon, and thoſe Exhalations, or Meteors, vulgarly called Falling-ſtars, become only viſible (like Glow-worms) in the Night.

Here it may not be improper to tell you, that the Clouds are to us in effect no other than as ſo many Moons, whereby we have our artificial Day prolonged to us ſeveral Hours after the Sun is ſet, and likewiſe produced as much ſooner before he riſes; and were they to aſcend by ſtill ſtronger Power of Exhalation to an Elevation, all round the Atmoſphere, ſo as to form a Sphere equal to four Times the Globe of the Earth, there would then be no ſuch Thing as real nocturnal Darkneſs to any Part of the World.

The lunar Light then we may very juſtly conclude, proceeds originally from the Sun: And notwithſtanding many more Arguments might be drawn from the Demonſtration of her Phaſes, Eclipſes, *&c.* to prove it, yet none of them need here be added, to what has been already ſaid, to convince you of the Truth of it. This being granted, let us now conſider what Effect this, or a like Quantity of borrowed Light, would have, when removed to a much greater Diſtance.

I may, I think, ſuppoſe, that you know ſo much of Opticks as to underſtand, that all viſible Objects apparently decreaſe in Magnitude, as their Diſtance from the Eye increaſes. Conſequently, that, if the Moon's Orbit was placed as far again from the Earth as it really is, her Globe, or rather *Diſk*, would then ſeem to be but half as big as to us ſhe now appears to be, and of courſe ſtill farther, were ſhe placed at ten times the Diſtance ſhe is known to revolve at, her apparent Diameter would be reduced to a tenth Part only of what it now appears to be in her preſent Orbit, that is, one hundred Times leſs in viſible Magnitude than her neighbouring Diſk is found to be where it now is ſeen. And ſuch, but ſomething leſs, the two Planets *Venus* and *Jupiter*, which are frequently, in their Turns, our Morning and Evening Stars, appear to be through a common Teleſcope.

Now

* An *Helios*, or golden Light, always attending the Sun, and ſuppoſed to ſpread itſelf all round his Body in the Direction of his Equator, was very viſible during the total Darkneſs of the Eclipſe of 1715, and may be always ſeen about the Autumnal Equinox.

Now theſe two Planets, together with the other three, which we find moving in regular Orbits round the Sun, are all found ſubject to the ſame * Changes of *Phænomena*, in their various Aſpects with the Sun; and who can doubt but that they are all of the ſame or like Nature? But you'll ſay, perhaps, how are we ſure that *Venus* and *Jupiter* have no native Light of their own, ſince many of the ancient Philoſophers, and in particular *Anaximander*, allowed even the Moon to have ſome; and beſides, in Philoſophy, as well as in Logick, I think you hold there is no proving a Negative, at leaſt at ſuch a Diſtance.

To make you conceive the Impoſſibility of ſuch a Light, and next to a Demonſtration, convince you of the Unnaturalneſs of ſuch a Suppoſition, I muſt put you in mind, that ſome time ago, when I was laſt in the Country with you, I think it was about the latter End of Autumn, near the Winſter Solſtice, as we were walking one Evening, I bid you take notice of the Moon, which was then near ſetting, and about two Days old. You may remember, her whole Globe appeared to us very conſpicuouſly within a manifeſt Circle. You immediately told me, that that kind of Phænomenon the Country People called a *Stork*, or the old Moon in the new one's Arms. This I then endeavoured to explain to you, and I think made you ſenſible it was intirely an Effect of the Earth's, and an Appearance always to be expected at that Time of the Year. The Earth being then in the State of a Full-Moon to that Part of the lunar Orbit, and near her Perihelion, at which time, the Earth ſends back a Reflection to the † Moon twenty-five times more potent than that of the Moon to us.

Now the Planet *Venus*, from undeniable Principles of Geometry, is allowed to be nearly ſuch another Globe as the Earth is; and ſince the Earth, as I have juſt now related, is found to reflect much more Light to the Moon, by reaſon of her ſuperior Magnitude, than the Moon can poſſibly reverberate to Earth again; and ſince alſo 'tis plain, the Earth has no Light of its own, why then ſhould we imagine *Venus* to be endowed with a Luſtre, which we can prove to be no more than a ſimilar Body, and governed by the ſame Laws as the Earth is?

Anaximander's Miſtake, in ſuppoſing the Moon in ſome ſmall Degree a radiant Body of itſelf, lay, in not conſidering, that the faint Illumination here deſcribed, and viſible all over her Globe, ſoon after almoſt every Conjunction with the Sun; and probably in Eclipſes, alſo proceeded from the Earth; but the thing I think is too evident to expect any ſort of Con-

 tradiction,

* *Venus* and *Mercury* in every Heliocentrick Revolution, perform all the Changes of our Moon in a like Gradation and Defection of Light, both horned and gibos'd.

† Their Diameters being nearly as 1 to 5.

tradiction, therefore I hope you will admit it as a Truth, and conſequently take it for granted, that the planetary Bodies in general, are meer terreſtrial, if not terraqueous Bodies, ſuch as this we live upon; which is the Thing I have chiefly in this Letter attempted to demonſtrate, or have rather explained; and now I hope, for the future, you will receive the Idea of a Plurality of Worlds more favourably, and look upon aſtronomical Conjectures in a leſs ridiculous Light than you uſed to do, eſpecially ſince you muſt allow, they give our unlimited Imaginations a like all endleſs Field of Contemplation, not only full of the wonderful Works of Nature, but alſo of a viſible Providence.

I think I cannot conclude this Letter to you more properly, than with the following fine Lines of Mr. *Addiſon*'s from the *Spectator*, Vol. VI. No. 465. which I hope you are not ſo polite as to look upon as an unfaſhionable Quotation.

The ſpacious Firmament on High,
With all the blue ethereal Sky,
And ſpangl'd Heav'ns, a ſhining Frame,
Their great Original proclaim:
Th' unwearied Sun, from Day to Day,
Does his Creator's Pow'r diſplay,
And publiſhes to ev'ry Land
The Work of an Almighty Hand.
Soon as the Ev'ning Shades prevail,
The Moon takes up the wond'rous Tale,
And nightly to the liſt'ning Earth,
Repeats the Story of her Birth:
Whilſt all the Stars that round her burn,
And all the Planets in their Turn,
Confirm the Tidings as they roll,
And ſpread the Truth from Pole to Pole.
What though, in ſolemn Silence, all
Move round the Dark terreſtrial Ball?
What tho' nor real Voice nor Sound
Amid their radiant Orbs be found?
In Reaſon's Ear, they all rejoice,
And utter forth a glorious Voice,
For ever ſinging, as they ſhine,
"*The Hand that made us is divine.*"

And am, &c.

LETTER

LETTER THE FOURTH.

Of the Nature of the heavenly Bodies continued, with the Opinions of the Antients concerning the Sun and Stars.

SIR,

YOU tell me you begin to be a tolerable good *Copernican*, and would now be glad to have my Opinion further upon the Nature of the Sun and Stars, with regard to the Suggeſtion of their being like Bodies of Fire. This you ſay will go a great Way towards confirming you in the Notion you have begun to embrace of a Plurality of Syſtems, and a much greater Multiplicity of Worlds than our little ſolar Syſtem can admit of. Beſides, ſhewing in a very evident Light, that the Authorities cited in my firſt Letter are founded upon the cleareſt Reaſon.

Anaxagoras, you ſay, believed the Sun to be a Lump of red-hot Iron; *Euripides* thought it a Clod of Gold; and others ſtill more ridiculouſly have imagined it to be a dark Body, void of all Heat. That the Sun is a vaſt Body of blazing Matter, notwithſtanding the various Opinions of thoſe primitive Sages, will, I think, hardly admit of a Queſtion: Since the known Warmth of his prolifick Beams, and the viſible Effect of the Burning-glaſs, puts it quite out of the Power of our preſent Set of Senſes, at leaſt to argue againſt it; and how reaſonably we may imagine the Stars to be all of the ſame or like Nature, will ſufficiently appear from theſe following Conſiderations: Firſt, it is well known to all Mathematicians, that any viſible Object of any determined Magnitude may be reduced to the Appearance of * a phyſical Point, by removing the Eye of the Obſerver to a proper or proportionable Diſtance from it, within the finite View: And that the apparent Diameter of every luminous celeſtial Body, will always be diminiſhed reciprocally, in Proportion to the Diſtance from the Eye, till they become altogether imperceptible.

* What is here meant by a phyſical Point, is a Point viſible to the naked Eye, which human Art cannot divide; and ſo far it partakes of the Property of a mathematical one, which is only to be conceived, and not ſeen.

Thus the Disk of the Sun, which appears to us at Earth under an Angle of about half a Degree, if seen from the Planet *Saturn*, would appear not much bigger than the Planet *Venus* or *Jupiter*, in their most neighbouring Vicinity does to us; and consequently to an Eye placed in the Aphelion Point of the Orbit of the great *Comet* of 1680, his apparent Diameter would be so reduced as to seem but little bigger than the largest of the Stars; and by the same Analogy, or Way of Reasoning, admitting Space and Distance infinite, which I humbly apprehend is not to be disputed, were all the Matter in the Universe united, and conglobed in one Mass, with respect to ocular Sensation, it might be diminished so near to a mathematical Punctum, as to be almost adequate to our Ideas of Nothing.

This to any tolerable Optician, must be an evident Conviction of the Truth of the modern Astronomy, which now universally allow all those radiant Bodies the Stars to be of the same Nature with the Sun; and that as certainly they are no other than vast Globes of blazing Matter, all undoubtedly shining by their own native Light.

But as you have often objected to what has been said of the Distance of the Stars in general, and may possibly from a Supposition, that they are, or may be, much nearer to us, infer, that their Light, like that of the Planets, may be also borrowed from the Sun, or from some other radiant Body, which, from the Nature of the Supposition, must of Consequence be invisible to us, I judge it will not be amiss to throw a few demonstrative Arguments in your Way, in order to lead you a little out of the Path of an early Prejudice, and draw you as it were by Degrees through the Dawn of astronomical Reasoning, out of your original Error, and rescue your Imagination from the false Notions imbibed from Phænomena only in your younger Years. This I guess cannot fail of reconciling you to this more rational Way of Thinking, and make you acquainted with Truths of much Consequence, which perhaps you have yet been an intire Stranger to. The grand *Deceptio Visus*, which I must first endeavour to remove, and which as a sort of Paradox in Nature, has, as I may say, imprisoned the Understanding of many superficial Reasoners, and in general all incurious Men, is this.

Most People are too apt to think originally, that as the Heavens appear to be a vast concave Hemisphere, that the Stars must of course, as of Consequence, be fixed there, like so many radiant Studs of Fire, of various Magnitudes; and take it for granted, chiefly designed for no other Purpose than to deck and adorn the Canopy of our Night. This was long ago the Opinion of *Thales* the *Milesian*, and wants not the Authority of many

many of the Antients to back it. Others, in particular * *Ptolomy* of *Peluſium* in *Africa*, who from his Experience in this Science, is called by ſome the Prince of Aſtronomers, believed them to be Loop-holes in the vaſt ſolid celeſtial Firmament, emitting the Light of the Cryſtalline Heaven through it to all within it. The famous *Diogenes*, Cotemporary with *Plato*, conceived them to be of the Nature of Pumice-ſtones, and inclined to an Opinion, that they were the *Spiracula*, or Breathing-holes of Heaven. *Anaxagoras* thought them Stones ſnatched up from the Earth by the Rapidity of its Motion, and ſet on Fire in the upper Regions above the Moon.

But how ridiculous and abſurd all theſe Opinions and Conjectures really are, will eaſily appear, if we but once conſider the Nature of an unbounded Æther, and the amazing Property of infinite Space.

This, with what has been ſaid before, will not a little aſſiſt your Imagination towards conceiving the Reaſonableneſs of the Notion modern Aſtronomers are now confirmed in, of their being abſolutely ſo many burning Balls, and which was no doubt, many Years ago, the Opinion of *Manilius*, as is evident from theſe Lines in his Poem of the Sphere.

> For how can we the riſing Stars conceive
> A caſual Production; or believe
> Of the chang'd Heav'ns the oft renaſcent State
> *Sol*'s † frequent Births, and his quotidian Fate.
>
> SHERBURNE.

And again in the ſame Poem:

> The fiery Stars, and Æther that creates
> Infinite Orbs, and others diſſipates.
>
> *Zoroaſter*,

* *Ptolomy* ſuppoſed two Heavens above that of the fixed Stars, which he called the eighth; *viz.* a ninth, the Cryſtalline, and a tenth the *Primum Mobile*. See Letter the ſecond.

> The ſacred Sun, above the Waters rais'd,
> Thro' Heav'ns eternal, brazen Portals blaz'd;
> And wide o'er Earth diffus'd his chearing Ray,
> To Gods and Men to give the golden Day.
>
> HOMER.

† *Xenophanes* believed the Stars to be no other than Clods ſet on Fire, quenched in the Day-time, and rekindled in the Night.

Zoroaſter, the firſt of all Philoſophers we read of who ſtudied the Stars, is reported to have believed them of a fiery Nature. *Empedocles* judged them to be Fire æthereal, ſtruck forth in its Secretion, and blazing in the upper Regions. *Plato* thought them Fire, with the Mixture of other Elements as Cements. *Heraclides* Worlds by themſelves, of *Earth*, *Air*, and *Fire*; and *Ariſtotle*, ſimple Bodies of the Subſtance of Heaven, but more condenſed.

But that I may not take up too much of your Time with Opinions that has been imbibed in the Infancy of Aſtronomy, and has long ago been exploded, I ſhall attempt but one Thing more to confirm your Sentiments in this new Doctrine.

Firſt, that the Stars are all at a Diſtance, not to be determined by the utmoſt Perfection of human Art, is manifeſt from their having very little, or no ſenſible Parallax; and conſequently, that any one of them is abſolutely bigger or leſs than another, from the ſimple Laws of Opticks, cannot poſſibly come under our Obſervation to be aſcertained; but that they all of them may be nearly of the ſame Size or Solidity, is as impoſſible, with any Shew of Reaſon to deny, ſince it is a known Principle in Geometry, that all viſible Objects naturally diminiſh, as has been ſaid before, or are magnified in a certain Proportion to their Diſtance from the Eye; and hence we may conclude, and not without Reaſon in its ſtrongeſt Light to ſupport us, that the ſmalleſt Stars, to the very leaſt Denomination, are only removed reſpectively more diſtant from the Obſerver's Station; and that at leaſt this we may be certain of, that they are all together undoubtedly an Infinity of like Bodies, diſtributed either promiſcuouſly, or in ſome regular Order throughout the mundane Space: And, as *Marino* ſays,

> Reſplendent Sparks of the firſt Fire!
> In which the Beauty we admire,
> And Light of thoſe eternal Rays,
> The uncreated Mind diſplays.

It remains now I think to ſhew, and endeavour to prove, that the Stars are not only light Bodies of the Nature of the Sun, but that they are really ſo many Suns, all performing like Offices of Heat and Gravity, in a regular Order, throughout the viſible Creation, in oppoſition to an Opinion you

* Mr. *Bradley*, Aſtronomer-Royal, has, in a great meaſure, proved that the Aberration of the Stars hitherto miſtaken for a Parallax, may ariſe from, and indeed ſeems to be no other than the progreſſive Motion of Light, and Change of Place to the Eye, ariſing from the Earth's annual Motion and Direction.

you have formerly hinted at, of their being in another Senſe of a ſecondary Nature.

All Objects within the ſenſible Sphere of the Sun's Attraction, or Activity, are in ſome meaſure magnified by a good Teleſcope: But the Stars are all placed ſo far without it, that the beſt Glaſſes has no other Effect upon them than making them appear more vivid or lively, but all inate opaque Bodies, reflecting only a borrowed Light from ſome primary one, contrary to this Property, are all obſerved to loſe their Light, in the ſame Proportion, as they are magnified, and through all Glaſſes become more dull than otherwiſe they appear to the naked Eye: And hence we may infer, without any further Evidence, that the Stars are all light Bodies endowed with native Luſtre; and that Bodies, like the known Planets, from the ſame Reaſoning, it is as clear they cannot be, becauſe their Diſtance, though uncertain as to the Truth of the whole, yet ſuch a Part of it as cannot be denied, would render them all in ſuch a Caſe inviſible.

A Proof of this will plainly preſent itſelf, if we conſider the Courſe of the known Comets, who all of them, without Exception, become imperceptible, and intirely diſappear; though moſt of them much bigger than the Earth, or any of the leſſer Planets, long before they arrive at their reſpective Aphelions.

But we are under a kind of Neceſſity to believe them either Suns or Planets, that is either dark or light Bodies; and ſince I have ſhewn the Improbability; nay, I may venture to ſay, the Impoſſibility of their being the firſt, it is natural ſure to conclude, that they muſt be of the laſt Sort; and I am perſuaded, if you but once conſider how ridiculous it is to imagine ſo vaſt a Number of Bodies, all rolling round a Number of inviſible Suns, which muſt otherwiſe be the Caſe, ſince they are ſeen on all Sides of ours, and cannot poſſibly be enlightened by him, or any, how all of them, by any one elſe, you cannot poſſibly have any ſort of Difficulty in this Determination: But that no Arguments may be wanting to enforce your Belief of what is here concluded, it will not be amiſs to put you in Mind of an optical Experiment or two, which cannot fail of convincing you of the vaſt Probability of what is here aſſerted of them; and next to a moral Certainty, demonſtrate the Truth of what ſo many of the beſt Aſtronomers have advanced, as before namely, that the Stars are all, or moſt of them, Suns like ours.

Place any concave Lenſe before your Eye, and you will find all viſible Objects will appear through it, as removed to a much greater Diſtance than they really are at, and reciprocally as much diminiſhed. Now, if you

you look upon one of theſe Glaſſes of a proper Concavity, oppoſed to the Sun or Moon, you will reſpectively have the Appearance of a real Star or Planet, the firſt exhibited by the Body of the Sun, the other by the Moon, and either more or leſs diminiſhed in Proportion to the Surface of the Sphere the Glaſs is ground to.

For Example, a double Concave, or Glaſs of a negative Focus, ground to a Sphere of about three Inches Diameter, will if oppoſed to the Sun's Diſk at a proper Diſtance from the Eye, help you to a very good Idea how the Sun appears to the Planet *Jupiter*; and if a proper Regard be had to the Diſtance of the Planet *Saturn*, a Lenſe ſtill more concave may be formed to give a juſt Idea of the Sun's Appearance to *Saturn*. Again, one much more concave than the former, proportioned to the Orbit of *Mars*, will naturally exhibit the ſolar Body, as ſeen from that Planet.

To the Planet *Venus* and *Mercury*, the Sun appearing much larger than to us at the Earth, to have any tolerable Notion of his varied Phænomena to them, it will be neceſſary to procure Glaſſes of a ſuitable Convexity, ground to reciprocal Concaves, which may eaſily be done to any Focus, ſo as to ſhew how the Sun, naturally appears to the Inhabitants of thoſe two Planets.

The various Appearances of the Planets themſelves to us at the Earth, may alſo well enough be had, if through Glaſſes analagous to their reſpective Diſtance and Magnitude, we look at the Moon, particularly all the Phaſes of *Venus*, and even of *Mercury*, and the Giboſity of *Mars*, *&c.* may be juſtly and beautifully repreſented at different Ages of the Moon, as thoſe Planets appear through the largeſt and beſt Teleſcopes.

This Way you may convince even your Friend * * *, who you tell me has reaſoned all his Senſes uſeleſs, and yet continues ſo great an Atheiſt in Aſtronomy, as not to believe the World turns round upon its Axis, though he gives no better Reaſon for it than that of his not being giddy.

After all theſe Arguments, I hope no new Difficulties will ariſe to retard your Belief, or deprive the Stars of their ſolar Nature, ſo juſtly due to them: This Point gained, the next Thing to be conſidered is, whether all thoſe glorious Bodies, the far greater Part of whom being inviſible to the naked Eye, were made purely and purpoſely for the ſole Uſe of this diminitive World, our little trifling Earth.

——Men, conceited Lords of all,
Walk proudly o'er this pendent Ball,
Fond of their little Spot below,
Nor greater Beings care to know,
But think thoſe Worlds, which deck the Skies,
Were only form'd to pleaſe their Eyes. DUCK.

The

The very Suppoſition not only implies a profound Ignorance of the Divine Attributes, but is as impious, and full of Vanity, as it is erroneous and abſurd, and even a Blindneſs ſufficient of itſelf, were there no other Cauſe for it, to introduce Idolatry in the Minds of Mortals, by ſinking the divine Nature ſo near to the human.

It being granted that the Stars are all of the ſame Kind, I think it may be agreed, that what we evince of any one may be allowed to be true of any other, and conſequently of all the reſt. This *Poſtulata* gained, I ſhall next proceed to enquire what the real Uſe and Deſign of ſo many radiant Bodies are, or may be made for.

The Sun we have juſtly reduced to the State of a Star, why then in Reaſon ſhould he have his attendant Planets round him, more than any of the reſt, his undoubted Equals? No Shadow even of a Reaſon can be given for ſuch an Abſurdity.

May we not with the greateſt Confidence imagine, that Nature as juſtly abhors a *Vacuum* in Place, as much as Virtue does in Time? Surely yes: And by ſuppoſing the Infinity of Stars, all centers to as many Syſtems of innumerable Worlds, all alike unknown to us; how naturally do we open to ourſelves a vaſt Field of Probation, and an endleſs Scene of Hope to ground our Expectation of an *ever*-future Happineſs upon, ſuitable to the native Dignity of the awful Mind, which made and comprehends it; and whoſe Works are all as the Buſineſs of an Eternity?

If the Stars were ordained merely for the Uſe of us, why ſo much Extravagance and Oſtentation in their Number, Nature, and Make? For a much leſs Quantity, and ſmaller Bodies, placed nearer to us, would every Way anſwer the vain End we put them to; and beſides, in all Things elſe, Nature is moſt frugal, and takes the neareſt Way, through all her Works, to operate and effect the Will of God. It ſcarce can be reckoned more irrational, to ſuppoſe Animals with Eyes, deſtined to live in eternal Darkneſs, or without Eyes to live in perpetual Day, than to imagine Space illuminated, where there is nothing to be acted upon, or brought to Light; therefore we may juſtly ſuppoſe, that ſo many radiant Bodies were not created barely to enlighten an infinite Void, but to make their much more numerous Attendants viſible; and inſtead of diſcovering a vaſt unbounded deſolate Negation of Beings, diſplay an infinite ſhapeleſs Univerſe, crowded with Myriads of glorious Worlds, all variouſly revolving round them; and which form an Atom, to an indefinite Creation, with an inconceivable Variety of Beings and States, animate and fill the endleſs Orb of Immenſity.

That the ſidereal Planets are not viſible to us, can be no Objection to their actual Exiſtence, and being there, is plain from this; it is well known, that the Stars themſelves, which are their Centeral, and only radiant Bodies, are little more to us at the Earth, than mathematical Points. How ridiculous then is it to expect, that any of their ſmall opaque Attendance, ſhould ever be perceived ſo far as the Earth by us; and beſides, to ſhow the Impoſſibility of ſuch a Diſcovery, we need only conſider, what is, and what is not to be expected, or known in our own home Syſtem. All the Planets in this our ſenſible Region, every Aſtronomer knows, is far from being viſible to one another, in every individual Sphere; for to an Eye at the Orb of *Saturn*, this Earth we live upon, which requires Years to circumſcribe, and Ages to be made acquainted with, and is far from being yet all known, cannot poſſibly from the above Planet be ſeen: And further, ſince *Saturn* and *Jupiter*, two of the moſt material and conſiderable Globes we know of, except the Sun himſelf, are Bodies apparently of the ſame kind, and are obſerved to have each a Number of leſſer Planets moving round them; why may we not expect with equal Certainty and Propriety, that all other Bodies, under the ſame Circumſtances, are in like manner attended; that is, ſeeing the Sun is found to be the Center of a Syſtem of Bodies, all variouſly volving round him? where lies the Improbability of his fellow Luminaries, the Stars, being ſurrounded in like ſort, with more or leſs of ſuch Attendance.

I ſhall offer but one Thing more to your Conſideration in this Affair, and which I am in great Hopes will be ſufficient to make you think theſe natural Suggeſtions a good deal more than probable, and that is this:

The modern Aſtronomers having, in a great meaſure, proved that the Stars are, in all reſpects, vaſt Globes of Fire like our Sun. Let us ſuppoſe a new-created Mind, or thinking Being, in a profound State of Ignorance, with regard to the Nature of all external Objects, but fully endowed with every human Senſe and Force of Reaſon, ſuſpended in Æther, exactly in the midway, betwixt * *Syrius* and the Sun; in which Caſe, both of theſe Luminaries would equally appear much about the Brightneſs of the largeſt of our Planets. Now ſhould ſuch a Being, determined either by Accident or Choice, arrive at this our Syſtem of the Sun, and ſeeing all the planetary Bodies moving round him, I would aſk you what you think he would imagine to be round *Syrius?* Your Anſwer, I think I may venture to ſay, would not be *nothing*; and methinks I already hear you ſay, Why Planets ſuch as ours.

* A Star of the firſt Magnitude in the greater *Dog*, and the moſt neighbouring to our Sun.

PLATE

PLATE XI.

Is deſigned as a geometrical Scale to all the primary Parts of the viſible Creation, with regard to the Diſtance of Orbits compared with the Globe of the Sun; by which at once may be conceived, and juſtly meaſured in the Mind, not only the mean Diſtance of the Planets with regard to one another, but alſo that of the Comets, and even the comparative Diſtances of the neareſt of the Stars, which will, I gueſs, greatly help you to form an Idea of the vaſt Extent of Space neceſſary to comprehend the whole Creation.

Fig. 1. Is a Radius of the Orbit of *Mercury*, in true Proportion to the Body of the Sun repreſented at S, ſhewing at the ſame time a ſmall Portion of the opaque Planet's Orbit, and the real Length of its Shadow at P.

Fig. 2. Is a Radius of the whole Syſtem of the Planets as far as the Orbit of *Saturn* in Proportion to a compleat Orbit of *Mercury*, much leſs than the former; the former ſerving as a better known Scale to conſider the amazing Diſtances of the more remote Planets by.

Laſtly, *Fig.* 3. Is a Repreſentation of the leaſt poſſible Diſtance of *Syrius* and the Sun, proportionable to the Magnitude of the Sphere of our Comets, *&c.* repreſented at S, whereby it evidently appears, that as all the Planets of *Syrius* muſt be included within the ſmall Sphere repreſented in the Center P, none of them could poſſibly be ſeen at the Sun, not only by reaſon of the Smallneſs of the Angle of Suſtenſion, or Elongation, but alſo as being loſt in the ſuperior Light of *Syrius* himſelf, in ſo minute an Orb of Vicinity.

Conſequently (as you muſt perceive) no Arguments can poſſibly be drawn to deny the Exiſtence of ſuch Bodies, with any Shew of Reaſon, from their not having been ſeen by us.

Here I muſt obſerve to you, that you cannot conſider this Scale of Orbits too much before you look upon Plate XVII.

To conclude, it evidently ſeems to be the End and Deſign of Providence, by this viſible Variety of Beings, to lift the Minds of Men above this narrow Earth, in Search of that powerful Being upon which we are all ſo much dependant; and the *Creator*, no doubt, in this vaſt Diſplay of his Wiſdom and Power, deſigned the amazing Whole, as the adequate Object of every Part, and as ſuch equally open on all Sides, to the penetrating Progreſs of human Minds, and through the moſt extenſive Faculty of Senſe, the *Sight*, to draw our Reaſon and Underſtanding by Degrees, from finite Objects into Infinity; and as the laſt Reſult of celeſtial Contemplations place within our Reach, a certain Evidence of a future State, *and the manifeſt Manſions of Rewards and Puniſhments, ſuited no doubt moſt equitably to all Degrees of Virtue, and to every Vice.*

" When I conſider (ſays Mr. *Addiſon*, ſpeaking as having taken particular " notice of a fine Evening) that infinite Hoſt of Stars, or to ſpeak more " philoſophically of Suns, which were then ſhining upon me, with thoſe " innumerable Sets of Planets or Worlds, which were then moving round " their reſpective Suns; when I ſtill enlarge the Idea, and ſuppoſed ano- " ther Heaven of Suns and Worlds riſing ſtill above this which we diſ- " covered; and theſe ſtill enlightened by a ſuperior Firmament of Lu- " minaries, which are planted at ſo great a Diſtance, that they may ap- " pear to the Inhabitants of the former as the Stars do to us; in ſhort, " whilſt I purſued this Thought, I could not but reflect on that little " inſignificant Figure which I myſelf bore amongſt the Immenſity of " God's Works:" This Reflection, I judge, as you are an Admirer of the Author, you will not look upon as impertinent in this Place, eſpecially as it muſt enforce what I have endeavoured to ſhew you, namely, the Reaſonableneſs of a Plurality of ſidereal Syſtems, and their Multiplicity of Worlds; which, if you are yet in Doubt of, I hope you will at leaſt forgive ſo well deſigned an Attempt with your uſual Candour.

I am now prepared to proceed in the chief Deſign of this Undertaking, which is to ſolve the Phænomena of the *Via Lactea*; and propoſe in my next to anſwer more fully your farther Requeſt.

I am, &c.

LETTER THE FIFTH.

Of the Order, Diſtance, and Multiplicity of the Stars, the Via Lactea, *and Extent of the viſible Creation.*

SIR,

WE are told, and, if I remember right, it is alſo your Opinion, that three of the fineſt Sights in Nature, are a riſing Sun at Sea, a verdant Landskip with a Rainbow, and a clear Star-light Evening: All of which I have myſelf often obſerved with vaſt Delight and Pleaſure. The firſt I have frequently beheld, and always with an agreeable Surprize; the ſecond I have as often taken notice of, with no ſmall Degree of Admiration; but the laſt I ſhall never look up to without an Aſtoniſhment, even mixed with a kind of Rapture. The Night you laſt left us, this admirable Scene was in its full Beauty; and, as *Milton* ſays,

Silence was pleas'd: now glow'd the Firmament
With living Saphirs; *Heſperus* that led
The ſtarry Hoſt rode brighteſt.———

I found it was impoſſible to look long upon this ſtupendious Scene, ſo full of amazing Objects, and particularly the *Via Lactea*, which (the Moon being abſent) was then in great Perfection, without being put in Mind of my Taſk. This ſurprizing Zone of Light being the chief Object I have undertaken to treat of and demonſtrate.

This amazing Phænomenon which have been the Occaſion of ſo many *Fables*, idle Romances, and ridiculous Opinions amongſt the Antients, ſtill continues to be unaccounted for, and even in an Age vain enough to boaſt Aſtronomy in its utmoſt Perfection.

What will you ſay, if I tell you, it is my Belief we are ſo far from the real Summit of the Science, that we ſcarce yet know the Rudiments of what may be expected from it. This luminous Circle has often engroſſed my Thoughts, and of late has taken up all my idle Hours; and I am now in great

great Hopes I have not only at laſt found out the real Cauſe of it, but alſo by the ſame Hypotheſis, which ſolves this Appearance, ſhall be able to demonſtrate a much more rational Theory of the Creation than hitherto has been any where advanced, and at the ſame Time give you an intire new Idea of the Univerſe, or infinite Syſtem of Things. This moſt ſurprizing Zone of Light, which have employed ſucceſſively for many Ages paſt, the wiſeſt Heads amongſt the Antients, to no other Purpoſe than barely to deſcribe it; we find to be a perfect Circle, and nearly biſecting the celeſtial Sphere, but very irregular in Breadth and Brightneſs, and in many Places divided into double Streams.

* The principal Part of it runs through the *Eagle*, the *Swan*, *Caſſiopea*, *Perſeus*, and *Auriga*, and continues its Courſe by the Head of *Monoceros*, along by the greater *Dog* through the Ship, and underneath the *Centaur*'s *Feet*, till having paſſed the *Alter*, the *Scorpion's Tail*, and the Bow of *Aquarius*, it ends at laſt where it begun.

PLATE XII, and XIII.

Repreſents the two Hemiſpheres, where its true Tract is diſtinguiſhed amongſt the principal Stars, and may eaſily be conceived by them to circumſcribe and biſect the whole Heavens.

This is that Phænomena I am about to explain and account for; but before I proceed farther, I judge it will be no *improper Precognita*, to give you the Thoughts of the Antients upon it; the Relation perhaps may require ſome Patience; but I gueſs, that after reading ſuch wild and extravagant Notions concerning it, you will naturally judge more favourably of the Conjectures of the Moderns upon it, and particularly of what is concluded in the ſucceeding Pages.

Theophraſtus

* ——— Carried toward the oppoſed *Bears*,
Its Courſe cloſe by the *Artick* Circle ſteers,
And by inverted *Caſſiopea* tends;
Thence by the *Swan* obliquely it deſcends
The Summer Tropick, and *Jove's* Bird divides;
Then croſs the Equator, and the Zodiack glides
'Twixt *Scorpio*'s burning Tail, and the left Part
Of *Sagitarius*, near the fiery Dart;
Then by the other *Centaur*'s Legs and Feet,
Winding remounts the Skies (again to meet).
By *Argos*' Topſail, and Heav'ns middle Sphere,
Paſſing the *Twins*, t' o'ertake the Charioteer;
Thence *Caſſiopea* ſeeking thee does run,
O're *Perſeus* Head, and Ends where it begun.

SHER. MANILIUS.

Theophraſtus * was of Opinion, that the Hemiſpheres, which, by many of the Antients were imagined to be ſolid, was joined together here; and that this was the ſoldering of the two Parts into one. † DIODORUS thought it celeſtial Fire, of a denſe and compact Nature, ſeen through the Clifts or Cracks of the parting Hemiſphere: But as *Manilius* ſays,

Aſtoniſhment muſt ſure their Senſes reach,
To ſee the World's wide Wound, and Heav'n's eternal Breach.

OENOPIDES ‖ believed it the ancient Way of the Sun, till frighted at the bloody Banquet of *Thyeſtis*. ** ERATOSTHENES ſuppoſed it *Juno*'s Milk, ſpilt whilſt giving Suck to *Hercules*. ‡‡ PLUTARCH makes it the Effect of *Phaeton*'s confuſed Erratication; but I think it is plain †† OVID judged them to be Stars, and the ancient *Ethnicks* believed them to be the bliſsful Seats of valiant and heroic Souls.

——Valiant Souls, freed from corporeal Gives,
Thither repair, and lead æthereal Lives.

MANILIUS.

* *Macrobius*, lib. i. cap. 15.

Or meets Heaven here! and this white Cloud appears
The Cement of the cloſe-wedg'd Hemiſpheres!

† The ſacred Cauſes human Breaſts enquire,
Whether the heavenly Segments there retire,
(The whole Maſs ſhrinking, and the parting Fame
Thro' cleaving Chinks admits the ſtranger Flame.

‖ Or ſeems that old Opinion of more Sway,
That the Sun's Horſes here once run aſtray,
And a new Path mark'd in their ſtraggling Flight,
Of ſcorching Skies, and Stars aduſted Light.

** Nor muſt that gentle Rumour be ſuppreſt,
How Milk once flowing from fair *Juno*'s Breaſt
Stain'd the celeſtial Pavement, from whence came
This milky Path, its Cauſe ſhewn in its Name.

‡‡ When from the hurried Chariot Light'ning fled,
And ſcatter'd blazes all the Skies o'erſpread;
By whoſe Approach new Stars enkindled were,
Which ſtill as Marks of that ſad Chance appear.

MANILIUS.

†† A Way there is in Heaven's expanded Plain
Which when the Skies are clear, is ſeen below,
And Mortals by the Name of *Milky*, know,
The Ground-work is of Stars ----

Ovid's Met. lib. i.

But

But * DEMOCRITUS long ago believed them to be an infinite Number of ſmall Stars; and ſuch of late Years they have been diſcovered to be, firſt by *Gallaleo*, next by *Keplar*, and now confirmed by all modern Aſtronomers, who have ever had an Opportunity of ſeeing them through a good Teleſcope.

PLATE XIV.

Is from an Obſervation I made myſelf, of a bright Part of this Zone near the Feet of *Antinous*; which, (by a Miſtake of the Engraver) is, as it appears through a Tube of two convex Glaſſes. I ſaw it through a very good Reflector, and formed the Plan by a Combination of Triangles.

Milton takes notice of this Zone in a moſt beautiful Manner, where he deſcribes the Creator's Return from his ſix Day's Work to Heaven, he introduces it as a Simile to expreſs his Idea of the eternal Way, or Road to the celeſtial Manſions.

——— A broad and ample Road, whoſe Duſt is Gold
And Pavement Stars, as Stars to thee appear,
Seen in the *Galaxie*, that Milky Way,
Which nightly as a circling Zone thou ſeeſt
Powder'd with Stars.

But to infer from their Appearance only, that they are really Stars, without conſidering their Nature and Diſtance; and that nothing but Stars could poſſibly produce ſuch an Effect, may perhaps be aſſuming too much, when we have nothing but the bare Credit of the *Belgic* Glaſſes to ſupport our Conjectures; and although this may be ſufficient for any Mathematician, yet for your greater Satisfaction, I have thought proper to give two or three more evincing Arguments, to confirm theſe important Diſcoveries. *Democritus*, as I have ſaid before, believed them to be Stars long before Aſtronomy reaped any Benefit from the improved Sciences of Optics; and ſaw, as we may ſay, through the Eye of Reaſon, full as far into Infinity as the moſt able Aſtronomers in more advantageous Times have done ſince, even aſſiſted with their beſt Glaſſes: And his Conjectures are almoſt as old as the philolaic Syſtem of the Planets itſelf; the Conſtruction of which, though attempted by many, none have ever yet been able to confute.

The Light which naturally flows from this Crowd of radiant Bodies is mixt and confuſed, chiefly occaſioned by the Agitation of our Atmoſphere, and from a Union of their Rays of Light, by a too near Proximity of their Beams, altogether they appear like a River of Milk, but more of a pelucid Nature, running all round the ſtarry Regions.

For

* *Plutarch (in Placitis Philoſoph.)*

For in the azure Skies its candid Way
Shines like the dawning Morn, or cloſing Day.

There are alſo many more ſuch luminous Spaces to be found in the Heavens of the ſame Nature with theſe, which we know to be Stars; in particular the *Nebulæ*, or cloudy Star in the *Præſepe* of 36; a cloudy Star in *Orion* of 21; * a cloudy † Knot not far from this in the ſame Aſteriſm of 80; in one Degree of the ſame Conſtellation 500, and in the whole Form above ‡ 2000. All of which are great Confirmations of the Truth of our Aſſertion, *i. e.* that this Zone of Light proceeds from an infinite Number of ſmall Stars. Here it will not be amiſs to obſerve, that it has been conjectured, and is ſtrongly ſuſpected, that a proper Number of Rays, meeting from different Directions, become Flame; and that hence it may prove not the Sun's real Body which we daily ſee, but only his inflamed Atmoſphere. I begin to be of Opinion, and I think not without Reaſon, that the true Magnitude of the Sun is not near what the modern Aſtronomers have made it; and that it may not poſſibly be much above two Thirds of what it appears to us; I don't mean that this Expanſion of the ſolar Flame is any Part of that dilated Light mentioned by Sir *Iſaac Newton*, and conceived to be round all light Bodies in general; but you may conſider it as not much differing from it, not of an unlike Nature, only greater in Degree, and peculiar to the Sun and Stars, who are all, as has been before in a manner demonſtrated to be actually Globes of Fire.

This, tho' I preſume to call it at preſent only meer Hypotheſis, will in a great meaſure account for the exceſſive Changes in the Conſtitution of our Air and Atmoſphere, which we often find very unnatural to the Seaſon; alſo be a Means perhaps of reconciling the vaſt Diſproportion ſo very remarkable betwixt the Sun and the leſſer Planets, and many other Circumſtances in the Syſtem of no ſmall Conſequence in Aſtronomy: One of which Particulars you have frequently expreſſed a great Miſtruſt and Diſapprobation of, as ſuſpecting ſome kind of a Fallacy in the Computation; and the other is Matter of general Complaint, being by many attributed to a Change in the Direction of the Earth's Axis ‖; and by ſome, eſpecially the Vulgar, to too near an Approximation of the Earth to ſome one of the celeſtial Bodies. But all this will very naturally be accounted for by the Levity, or expanding Quality of the Sun's circumambient

* Vide *Galilæo*.
† Betwixt the Sword and Girdle of *Orion*.
‡ Vide *Reitha*.
‖ Which, through Ignorance of the true Caſe, is commonly called a Shock, a Bruſh, or Shove.

Flame, or Atmoſphere; and hence, according to its various State, being more condenſed, or rare, we may have Heat or Cold in the greateſt Extream, and alternately ſo, in a perpetual Viciſſitude.

The Truth of this Doctrine will evidently appear from the Obſervations of the Sun's Diameter through the Year 1660, by the indefatigable *Mouton:* And, I muſt own, I am not a little ſurprized to find that no Concluſions have been drawn from them of this Kind. I am perſwaded, if you once compare thoſe Numbers, you will be very far from thinking this an improbable Suggeſtion. But this Digreſſion has led me a little too far from the *Via Lactea*, and too near home again; I muſt now think of returning to the Stars, and my next Endeavours muſt be to give you ſome Idea of the Number of them. Through very good Teleſcopes there have been diſcovered in many Parts of this enlightened Space, and even out of it, ſeveral thouſand Stars in the Compaſs of one ſquare Degree; in particular near the Sword of *Perſeus*, and in the Conſtellations of * *Taurus* and *Orion*.

PLATE XV.

Repreſents the *Pleides*, a well known Knot of Stars in the Sign *Taurus*, as they appeared to me thro' a one Foot reflecting Teleſcope: And *Plate* XVI. is a View of the *Perſides*, another ſurprizing Knot of Stars in the Conſtellation *Perſeus*, exactly as they appear through a Tube of two convex Glaſſes. There are alſo other luminous Spaces in the ſtarry Regions, not unlike the Milky Way, which I have had no Opportunity of obſerving; ſuch as the *Nebeculæ*, near the South Pole, called by the Seamen *Magellanic* Clouds; and which likewiſe viewed through Teleſcopes, preſent us with little *Nebulæ*, and ſmall Stars interperſed: One of theſe Kind is ſituated between *Hydrus* and *Dorado*; and another, ſomething leſs than this, betwixt *Hydrus* and the *Toucan*.

Now admitting the Breadth of the *Via Lactea* to be at a Mean but nine Degrees, and ſuppoſing only twelve hundred Stars in every ſquare Degree, there will be nearly in the whole orbicular Area 3,888,000 Stars, and all theſe in a very minute Portion of the great Expanſe of Heaven. What! a vaſt Idea of endleſs Beings muſt this produce and generate in our Minds; and when we conſider them all as flaming Suns, Progenitors, and *Primum Mobiles* of a ſtill much greater Number of peopled Worlds, what leſs than an Infinity can circumſcribe them, leſs than an Eternity comprehend them,

* *Galilæo* in one cloudy Star of this Conſtellation, diſcovered no leſs than twenty-one, and in that of the *Præſepe* thirty-ſix.

or

or leſs than Omnipotence produce and ſupport them, and where can our Wonder ceaſe?

In this Place perhaps I ought not to paſs over the aſtoniſhing Phenomenon of ſeveral new Stars, *&c.* which have frequently appeared, and ſoon again vaniſhed, in the ſame Point of the Heavens. But as the Buſineſs of this Theory is rather to ſolve the general, than any particula Phænomenon, I ſhall only here by way of Note ſubjoin a Table of ſuch as has been regularly obſerved, and by whom they were firſt diſcovered.

A Table of ſeveral new Stars, Nebulæ, *and double Stars,* &c.

Nomina Stellarum.	*Obſervationum.*
Septima Pleiadum	Loſt after the burning of *Troy*, but now returned; ſee *Ricciolus.*
A new Star appeared in *Caſſiopea*, nearly in the ſame Place with that of 1572.	*Anno Dom.* 945, bright as *Jupiter*; ſee *Ricciolus.*
The new Star in *Caſſiopea*'s Chair.	Bright as *Venus*, from *November* 1572 to *March* 1574.
A new Star in *Collo Ceti.*	Of the 3d Magnitude, is ſaid to have appear'd periodically, ſeven Times in ſix Years, *i. e.* every three hundred and thirteen Days: It was firſt obſerved in *Auguſt* 1596, for two Months, by *D. Fabricius.*
A new Star in the Swan's Neck,	Obſerved by *Kepler* in 1600, of the third Magnitude, till the Year 1659; then gradually decreaſing; in 1661 it diſappeared; in 1666 it became viſible again, and is yet to be ſeen of the ſixth Magnitude.
A new Star in the Right Foot of *Serpentarius*,	Bright as *Venus* from *October* 1604 to *October* 1605: ſee *Kepler.*
A new Star in *Andromeda*'s Girdle,	Seen by *Simon Marius* and *Fabricius*, *Anno* 1612.
A new Star in *Antinous*,	Seen by *Juſtus Byrgius.*
A new Star ſeen in the Whale,	In 1638, by *John Procyclides Holuarda*, of the third Magnitude, which diſappeared periodically, every three hundred and thirty Days.
A new Star in the Fox's Head,	Of the third Magnitude, ſeen by *Hevelius* in *July* 1670, and till *Auguſt* 1671, alſo from *March* 1672 to *September* 1672.
A new Star in the Swan's Neck.	This appear'd periodically every four hundred and four Days, and about ſix Months at a Time; it was ſeen at its brighteſt, *September* 10, 1714.

Of the Nebulæ, *or Cloudy Stars.*

Nebuloſe in *Orion*'s Sword.	
Nebuloſe in *Andromeda*'s Girdle	
Nebuloſe in the Bow of *Sagitarius*,	Small, but very luminous.
Nebuloſe in *Centaurus*,	Never ſeen in *England.*
A *Nebuloſe* preceding the right Foot of *Antinous*,	Obſcure, but with a Star in the Middle of it.
Nebulæ in *Dorſo Herculis*,	Diſcovered by Dr. *Halley.*

Beſides the *Nebulæ*, and new Stars, it appears from the ancient Catalogues of *Hevelius*, &c. that ſome of the old ones have intirely vaniſhed; in particular, one in the left Thigh of *Aquarius*, the contiguous one preceding in the Tail of *Capricorn*; the ſecond on the Belly of the Whale; the firſt of the unformed ones after the Scales of *Libra*, and ſeveral others. Many of the Stars alſo appear to be double, as the firſt Star of *Aries* and *Caſtor*; others triple, as one in the *Pleiades*; and the middle one in *Orion*'s Sabre; and others again, quadruple, *&c.*

I would now willingly help you to conceive the indefinite mutual Diſtance of the Stars, in order to give you ſome ſmall Notion of the Immenſity of Space; but as this will be a Taſk merely conjectural, I ſhall only deſire you to believe it as far as your Reaſon will carry you, ſafely ſupported by an obvious Probability.

Perhaps it may be neceſſary here to acquaint you, that all the Stars are ſo far apparently of different Magnitudes, that no two of them are to be found in the whole Heavens exactly the ſame, either in Bigneſs or Brightneſs *. The largeſt we have ſufficient Reaſon to believe is the neareſt to us; the next in Bigneſs and Brightneſs more remote; and ſo on to the leaſt we ſee, which we judge to be the moſt remote of all.

The firſt Degree, or that of the largeſt Magnitude, we give to Syrius, the ſecond to Arcturus, the third to Aldebaran, the fourth to Lyra, the fifth to Capella, the ſixth to Regulus, the ſeventh to Rigel, the eighth to Fomahaunt, and the ninth to Antarus: Theſe are all ſaid to be of the firſt Claſs; and beſides which, there are at leaſt, within the Reach of our lateſt improved Opticks, nine more Denominations within the Radius of the viſible Creation.

Now, by the certain Return of the Comets, which we find are all governed by the Laws of this Syſtem, and ſuppoſed to be undiſturbed by any of the others, we cannot avoid concluding, if we conſider them at all to the Purpoſe, that the neareſt Stars cannot be leſs diſtant than twice the Radius of the greateſt Orbit belonging to the Sun. Moſt Mathematicians think this a great deal too near, as it muſt of courſe make all the Syſtems join, as in Contact; and I think we may ſafely add, to ſeparate their Spheres of Attraction, at leaſt one Half of this Diſtance more, which will make in the Whole about four hundred and twenty Semi-orbits of the Earth, or 33,600,000,000 Miles. This even the ingenious Mr. *Huygins* endeavours to prove ſtill much too little, and his Arguments are ſuch as cannot eaſily be refuted. His Principle is grounded upon the known Laws of Analogy, as conſidered in the Proportion of light Surfaces, and is as follows. Having reduced the Sun's Diſk to the Appearance of the Star Syrius, by the Help of a ſmall Hole at the End of his Teleſcope, and comparing this Part of his Surface to the whole Diſk of the Sun, he infers that the Stars Diſtance to that of the Sun muſt be as 27,664 to 1. Hence *Syrius* from us will be nearly (avoiding Units) 2,213,120,000,000 Miles: But this I take to be as much too large as the former is too little; yet, as

* A very little Knowledge in Opticks will render this indiſputable, and has been in a great meaſure demonſtrated before; 1. in the Great Dog; 2. in Bootes; 3. in the Bull; 4. in the Harp of *Apollo*; 5. in *Auriga*; 6. in the Lion; 7. in *Orion*; 8. in the Southern Fiſh; 9. at the End of *Erridanus*.

Mr.

Mr. *Bradley* has, with ſome Shew of Reaſon, baniſhed all the Stars out of the Sphere of Parallax, the laſt is the only Method we can poſſibly make uſe of with any kind of Confidence; and Sir *Iſaac Newton* endeavours to recommend it with great Force of Argument, as the only probable Means by which we can give any tolerable Gueſs at theſe immenſe Meaſurements of Space.

To moderate the Matter then if you pleaſe, allow me but to make uſe of a Mean betwixt the two fore-mentioned Numbers; and we may take it for granted, a Diſtance ſufficiently exact, to ſuit all our Wants in the preſent Caſe, namely, to give a very tolerable Idea of the Extent of the viſible Creation, which is all I propoſe in this Place to attempt; but I mean to be much more exact in another.

Now as the Diſtance from the Sun to the Earth is ſo ſmall in Proportion to the Diſtance of the Stars from us, and from one another, we may very well conſider the Sun as the Center of our Station, or Poſition in the general Syſtem or Frame of Nature. And as the Stars are very viſible thro' good Teleſcopes, to the ninth or tenth Magnitude, if we multiply the primary Diſtance of *Syrius*, or of any other of his Claſs, by this Number of common intermediate Spaces, the Product will be equal to the Radius of the viſible Creation to the ſolar Eye; which, by this Rule, you will find in capital Numbers to be * nearly 6,000,000,000,000 Miles, taking in a Star of the ſixth Magnitude, and to a Star of the ninth, 9,000,000,000,000 Miles: But this Computation ſuppoſes a mean common Diſtance of the Stars in a ſort of Syzygia, or Direction of a Right Line, which is not the real Caſe; for the Stars cannot be ſuppoſed to diminiſh in a proportional Magnitude by any mathematical *Ratio*, but by ſome geometrical, or rather muſical one; for Inſtance, if the Diſtance of a firſt be 3, that of a ſecond ſhould be about 5, and of a proportional Third 8,333, *&c. ad infinitum:* But as their true proportional Diſtance is unknown, the above will be ſufficient for our preſent Purpoſe; which is only to ſhew, without Exaggeration, the Space we now are truly ſenſible of.

This I have here conſidered more extenſively, to obviate all Objections that you may make to the Probability of the general Motion of the Stars, by ſhewing no Difficulty can poſſibly ariſe from their apparent Proximity, Number, or irregular Diſtribution: Their Diſtances being ſo immenſely large, no Diſorder or Confuſion can be ſuppoſed in any Direction of them, or Motion whatever. The greateſt Diſtance of the Planets, which all move undiſturbed round the Sun, is about three hundred and fifty-three Million of Miles: But the leaſt Diſtance of one Star from another, is

* If the Diſtance of the Sun and Earth is found too much, which I muſt own I have a violent Suſpicion of, theſe Numbers muſt be reduced in like Proportion.

upwards

upwards of two thouſand eight hundred and thirty-two Times that Diſtance, or one Million of Millions of Miles: And as no ſenſible Diſorder can be obſerved amongſt the ſolar Planets, what Reaſon have we to ſuppoſe any can be occaſioned amongſt the Stars, or that a general Motion of theſe primary Luminaries round a common Center, ſhould be any way irrational, or unnatural?

What an amazing Scene does this diſplay to us! what inconceivable Vaſtneſs and Magnificence of Power does ſuch a Frame unfold! Suns crowding upon Suns, to our weak Senſe, indefinitely diſtant from each other; and Miriads of Miriads of Manſions, like our own, peopling Infinity, all ſubject to the ſame Creator's Will; a Univerſe of Worlds, all deck'd with Mountains, Lakes, and Seas, Herbs, Animals, and Rivers, Rocks, Caves, and Trees; and all the Produce of indulgent Wiſdom, to chear Infinity with endleſs Beings, to whom his Omnipotence may give a variegated eternal Life.

The aſtoniſhing Diſtance of the ſtarry Manſions undoubtedly was deſign'd to anſwer ſome wiſe End: One Conſequence is this, and probably is not without its Uſe: To every Planet of the ſame Syſtem, the ſame ſidereal Face of Heaven appears without the leaſt Degree of Change; and as the remoteſt Regions upon Earth ſee the ſame Moon and Planets, ſo alſo the Inhabitants of the moſt diſtant Planets in ours, or in any other Syſtem, ſee the ſame Forms and Order of the Stars in common with the reſt. The whole Sphere of Heaven being common and unchangeable through all their various Revolutions.

Thus thoſe (the People) in the Planet *Venus* will ſee the Conſtellation of *Orion* juſt as we do, and the People in the Planet *Saturn*, much farther ſtill removed, alike will view this Conſtellation in all reſpects the ſame; here then, (in the Syſtem of the Sun) the Eye removed from us muſt only hope to find a new Earth ſurrounded with the ſame ſort of Sky: But Beings in another Syſtem, behold not only a new Heaven above, but alſo new Earths below; and all the Frame of Nature to them puts on a new Dreſs, new Signs, new Seaſons, and new Planets roll, and a new Sun renews the Day.

The Heathen Fables here are all eraſed with all the Immortality of their vain earthly Gods and Heroes; *Perſeus* and *Alcides* are no more, and both the *Bears* are vaniſhed; the *Pleiads* and the *Hyads* join, and ſhining *Leo*, though boaſting two Stars of the firſt Magnitude with us, there no where can be found, loſt in the common undiſtinguiſhed Herd. But ſtill Aſtronomy will exiſt, and new-framed Forms may fill the varied Scene.

Perhaps you may expect that I ſhould here give you my Conjectures of what ſort of Beings may be ſuppoſed to reſide in the *Ens Primum*, or *Sedes Beatorum*

Beatorum of the known Univerſe, whether mortal, immortal, or Creatures partaking in ſome Degree of the Properties of both; as ſuch may be conceiv'd to change their Natures and States, without a total Diſſolution of their Senſes by Death: And farther, it may poſſibly be judged unpardonable in me not to point out every bleſſed Abode, ſuited to the Virtues, and all the various States an immortal Soul may be tranſlated to; but this is a Taſk above the human Capacity, or is the pure Province of Religion alone; the Buſineſs of a Revelation rather than Reaſon to diſcover. Beſides, it is enough for the preſent Purpoſe, to prove, that Miriads of celeſtial Manſions, are to be diſcovered within our finite View, and by a kind of ocular Revelation, which viſibly extends the human Proſpect, as it were, far beyond the Grave. It matters not whether a Race of Heroes fill theſe Worlds, or a Tribe of happy Lovers people thoſe; whether a Peaſant in the Realms of *Orion* ſhall ever become a Prince in the Regions of *Arcturus*, or a Patriarch in *Procion*, a Prophet in the *Precepæ*. Not to mention all the Stages human Nature may, or have been deſtined to in any one World, as believ'd by the ancient Philoſophers, beſides the final Coalition of all Beings much more naturally to be expected in the *Sedes Beatorum*.

I ſay, whatever our Caſe may be with regard to theſe *Queries* and Futurity, the Plan and Principles of this Theory will not be at all changed by it, ſince what it is chiefly founded upon may be clearly demonſtrated, ſo clearly and inconteſtably, that, with the Reverend Dr. *Young*, we may juſtly conclude,

Devotion! Daughter of Aſtronomy!

and affirm with him alſo, That,

An indevout Aſtronomer is mad.

But I find what I at firſt propoſed will prove too long for this Letter. However, I will endeavour to reward your Patience in my next, and continue, *&c.*

LETTER

LETTER THE SIXTH.

Of General Motion amongſt the Stars, the Plurality of Syſtems, and Innumerability of Worlds.

SIR,

SINCE my laſt, you'll find by this, ſpeaking in the Stile of *Kercher*, that I have been very far from home, round almoſt the viſible Creation. I have indeed applied myſelf very cloſely to tranſcribe my Thoughts to you upon the old Subject the *Milky Way*, which my former Letter left imperfected. To return then to the Theory of the Stars, and that yet unreconciled Phænomenon; let us reaſon a little upon the viſible Order of the Stars in general, and ſee what Concluſions can be drawn from what every Aſtronomer knows of them, and cannot be diſputed.

Firſt then, that the Stars are not infinitely diſperſed and diſtributed in a promiſcuous Manner throughout all the mundane Space, without Order or Deſign, is evident beyond a Doubt from this vaſt collective Body of Light, ſince no ſuch Phænomenon could poſſibly be produced by Chance, or exhibited without a deſigned Diſpoſition of its conſtituent Bodies.

If any regular Order of the Stars then can be demonſtrated that will naturally prove this Phænomenon to be no other than a certain Effect ariſing from the Obſerver's Situation, I think you muſt of courſe grant ſuch a Solution at leaſt rational, if not the Truth; and this is what I propoſe by my new Theory.

To a Spectator placed in an indefinite Space, all very remote Objects appear to be equally diſtant from the Eye; and if we judge of the *Via Lactea* from Phænomena only, we muſt of courſe conclude it a vaſt Ring of Stars, ſcattered promiſcuouſly round the celeſtial Regions in the Direction of a perfect Circle.

But when we conſider the explanick Poſition of many other Stars, all of the ſame Nature, and not leſs numerous, together forming the great Sphere of Heaven, we generally find ourſelves quite at a Loſs how to reconcile the two apparent Claſſes; and I know none who have ever been ſucceſsful enough to reduce them to any one general Order.

You'll

You'll ſay probably how ſhall we make this chaoſic Diſpoſition of the primary Luminaries agree with the ſecondary Laws, and the juſt Harmony obſerved in the third * Creation, *&c.*

The Work now you ſee is undertaken, and chiefly at your own Requeſt, therefore I have a Right to expect you'll be very indulgent to the Author, and paſs over all his Faults, and allow him free Argument in Purſuit of theſe important Truths, which will in the End open perhaps a much wider Field of Contemplation to us, than at firſt could be ſuppoſed to be intended by the *Geneſis* of *Moſes*.

That Deſcription of the Beginning of Nature is not without its Beauty and Nobleneſs, ſuitable to the Dignity both of the Author and Subject. But ſhould we even in this knowing Age of the World pretend to account for the Original of Things, as *Moſes* to ſupport his believed divine Legation, was obliged in ſome meaſure to do, we ſhould ſoon be reduced to talk in the ſame Stile, and perhaps with leſs Probability, than then at leaſt appeared in his elegant Account of the Origin of the Univerſe, eſpecially if we do but conſider, that what he wrote, was only to the Senſes of a People who had not yet learnt to make uſe of their Reaſon any other way, but from the Appearance of Things, and upon a Subject too ſublime for vulgar Capacities in any Age, and had only been attempted in the deepeſt Learning of *Egypt*, which, he though well acquainted with, the Generality of them were totally Strangers to.

In the firſt Place it muſt be granted, that the Stars being all of the ſame Nature, are either all immoveable, or all fixed, that is all governed by one and the ſame Principle.

Now to ſuppoſe them all fixed, and diſperſed in an endleſs Diſorder thro' the infinite Expanſe, which has long been the Opinion of many very able Aſtronomers amongſt the Antients, and even now received by too many of the Moderns, implies an Inactivity in thoſe vaſt and principal Bodies, ſo much the Reverſe of what may be expected, and what we daily obſerve through all the reſt of their Attendants, namely, their own reſpective Satellites, that we cannot poſſibly upon any rational Grounds, advance one ſingle Argument to ſupport ſo much as a Conjecture towards it, without betraying the greateſt Simplicity, and next to an Affirmation reduce the whole Frame of Nature, and all corporeal Beings to a wild unmeaning Chance, ariſing from an unnatural Diſcord and Confuſion.

For upon the Principles of Locality and Materiality, you having allowed me the Uſe of my Senſes and Reaſon, as abſolutely neceſſary towards conceiving any Idea of our preſent State, or of Futurity: Upon

* The Moon, Satellites of *Saturn* and *Jupiter*, &c.

theſe Principles I ſay, unleſs our Faculties are uſeleſs, if there are no other Bodies or Beings in the Univerſe than what we ſee, and are now ſenſible of, we muſt now at the Height of this our preſent State, be as near Perfection as we can reaſonably expect, and as ſuch ourſelves the ſupreme Beings of all Beings. To what End then do we form Ideas of a ſucceeding Life, where a more exalted State cannot be hoped for.

How abſurd and impious this is I leave to your own Reaſon and Reflection: This is the fatal Rock upon which all weak Heads and narrow Minds are loſt and ſplit upon, conſequently ought to be the moſt carefully avoided, not only as the Nurſe of Atheiſm, but as the dreadful Father of Deſpair: "For, ſay they, theſe unhappy Wretches, to be always the "ſame, is inconſiſtent with a Change; and to be leſs than what we are, "any where hereafter, is full as difficult to conceive as to be more." Thus, unleſs we admit of ſuperior Seats and much more glorious Habitations than theſe we are ſenſible of, we ſtrike at the very Root of a fair flouriſhing Tree of Immortality, and muſt become Authors of our own Deſpair. I have often wonder'd how thinking Men could poſſibly fall into ſo groſs an Error, as that of a Spirit's Annihilation; and I ſhould be glad to aſk one of thoſe fruitleſs Students, whether, upon the Evidence of our preſent Being, it is not much more rational, to hope for a future, than to expect a *Ne plus ultra* upon no Evidence at all. The Affirmative is certainly much more natural to be conceiv'd than the Negative. But if Chance were the Caſe, and that Chance produced all theſe regular and wondrous Works, 'tis to be wiſhed at leaſt, that Chance might do the ſame again; and if not Chance, of courſe an eternal Direction: But Chance only can effect Diſorder, Diſcord, and Confuſion; *ergo*, the viſible Harmony and Beauty of the Creation declare for a Direction; and this muſt of Conſequence, from its perfect Nature, proceed from the Wiſdom and Power of an eternal Being, *God of Infinity*, the Author of all Ideas: And if this primitive Power produced us his Creatures from nothing, nothing can be wanting to revive our Frames again; and if from ſomething, that ſomething muſt remain to eſtabliſh us in a future Life. But to return, how abſurd it is to ſuppoſe one Part of the Creation regular, and the other irregular, or a viſible circulating Order of Things, to be mixed with Diſorder, and circumſcribing Part of an endleſs Confuſion, is obvious to the weakeſt Underſtanding, and conſequently we may reaſonably expect, that the *Via Lactea*, which is a manifeſt Circle amongſt the Stars, conſpicuous to every Eye, will prove at laſt the Whole to be together a vaſt and glorious regular Production of Beings, out of the wondrous Will or Fecundity of the eternal and infinite *one* ſelf-ſufficient Cauſe; and that all its Irregularities are only ſuch as naturally ariſe from our excentric View: To demonſtrate which

which abſolutely and inconteſtibly, we ſhall only want this one *Poſtulata* to be granted, *viz. That all the Stars are, or may be in Motion:* This, if one may be allowed to judge of the Whole by the Similitude and Government of its Parts, I am perſwaded you will think a very reaſonable Aſſumption; but that you may imbibe a good Opinion of this Aſſumption, and entirely come into this much better to be wiſhed Hypotheſis, I would have you conſult theſe following Arguments.

Firſt, it is allowed, as I have endeavoured to ſhew, by all modern Philoſophers, that the Sun and Stars are all of the ſame or like Nature; conſequently, that the Stars are all Suns, and that the Sun himſelf is a Star.

PLATE XVII.

Repreſents a kind of perſpective View of the viſible Creation, wherein A repreſents the Syſtem of our Sun, B, that ſuppoſed round *Syrius*, and C, the Region about *Rigel*. The reſt is a promiſcuous Diſpoſition of all the Variety of other Syſtems within our finite Viſion, as they are ſuppoſed to be poſited behind one another, in the infinite Space, and round every viſible Star. That round every Star then we may juſtly conjecture a ſimilar Syſtem of Bodies, governed by the ſame Laws and Principles with this our ſolar one, though to us at the Earth for very good Reaſons inviſible *. Secondly,

The Sun is alſo obſerved to have a Motion round his own Axis in about twenty-five Days. Now, ſince all the other † Planets which move in Orbits round him, and are within our Obſervation, are found to have a like Rotation round their Axis, may we not as reaſonably imagine, that that Power which was able to give the Sun a Motion round his Axis, could and would at the ſame time, with adequate Eaſe, give him alſo an orbitular one? and why not, ſince no progreſſive Mutability can either take from, or diſturb the boundleſs Property of an Infinity; and beſides, ſeeing to imagine him at reſt, is to impoſe ſuch an unnatural Stagnation upon the eternal Faculty, quite repugnant to that imparable Power which we ſuppoſe ſtands in need of neither Sleep nor Reſt?

'Tis true, the Sun may be ſaid to be the Governor of all thoſe Bodies round him; but how? no otherwiſe than he himſelf may be governed by a ſuperior Agent, or a ſtill more active Force; and methinks it is not a

* *Anaximines* believed the Stars to be of a fiery Nature; and that there were certain terreſtrial Bodies that are not ſeen by us, carried together round them. *Stob. Ecl. Phyſ.* cap. 25. *Pythagoras* affirmed, that every Star is a World, containing Earth, Air, and Æther.

† *Saturn*, *Jupiter*, *Mars*, *Venus*, the Earth, Moon, and *Mercury*.

little abſurd to ſuppoſe he is not, ſince we have diſcovered by undoubted Obſervations, that the ſame gravitating Power is common to all; and that the Stars themſelves are ſubject to no other Direction than that which moves the whole Machine of Nature.

Thirdly, From many Obſervations of the polar Points, and the Obliquity of the Earth's Equator to the Plane of her ſolar Orbit compared together, the Sun is very juſtly ſuſpected to have changed his ſidereal Situation; and this muſt either ariſe from a Change in the Poſition of the Earth's diurnal Axis, or from a Removal of the Sun himſelf, out of the primitive Plane of the *Orbis Magnus*. I believe you are ſo much of a Mathematician, as to know that if either of theſe Facts be allowed, the Conſequence I want will follow. I ſhall not therefore here enter into any farther Diſpute about it; but I think it will be neceſſary to ſubmit ſome Obſervations to your Conſideration, that may convince you that there is a Motion ſomewhere to be thus diſcovered, and whether in the Sun, or in the Stars, or in both, I leave to your own Determination, but to aſſiſt your Imagination, I refer you to

PLATE XVIII.

The Globe S is here ſuppoſed to repreſent the Sun, having changed its Situation by a local Motion from A to C, and B repreſents the Globe of the Earth in a permanent Poſition, with its principal Points and Circles, reſpecting the primitive Plane A, B, K. Now in Conſequence of the Angle of Variation, A, B, C, it evidently appears that a new ecliptic Plane, will be produced, as C, B, and alſo a Variation in the greateſt Declination of the Sun, North and South from the Line of the *Equator* D, L. Hence, as in this Figure, the Obliquity of the Poles P, N, and G, F, will naturally decreaſe, and is ſhewn in Quantity by the Line of Aberration H, I.

Here follows a Table of the Change obſerved in the Obliquity of the Ecliptic by Aſtronomers of different Ages.

A Table of the Obliquity of the Ecliptic.

Ante Chriſti		°	′
124	ARATO - - - - - - - - - - -	24	00
——	HIPARCHUS - - - - - - - - -	23	51 $\frac{1}{3}$
127	ERATOSTHENES - - - - - - - - -	23	51 $\frac{1}{2}$

Anno

Anno Dom.		°	′	
140	PTOLOMY	23	51	⅓
749	ABATEGNIUS	23	35	½
1070	AIRAHEL	23	34	
1140	ALOMEAN	23	33	
1300	PROFATIOGRAD	23	32	
1458	PURBACCHIO	23	29	½
1490	REGIOMONTAUS	23	30	
1500	COPERNICUS	23	28	½
1592	TYCHO BRAHE	23	21	½
1656	CASSINI	23	29	½

Now ſure, if we conſider this continual Decreaſe of the Sun's Declination, which can proceed from no other Cauſe than that of his having moved out of the primitive Plane; we need make no great Difficulty thus far, to think our Conjectures not irrational.

The following is a Citation from Dr. *Edmund Hally*, Aſtronomer-Royal. See *Philoſophical Tranſactions*, N°. 355. p. 736.

" But while I was upon this Enquiry (*of the Obliquity of the Ecliptic*) I was ſurprized to find the Latitudes of three of the principal Stars in the Heavens, directly to contradict the ſuppoſed greater Obliquity of the Ecliptic, which ſeems confirmed by the Latitudes of moſt of the reſt; they being ſet down in the old Catalogues, as if the Plane of the Earth's Orbit had changed its Situation amongſt the fixed Stars, about 20′ ſince the Time of *Hipparchus*, particularly all the Stars in *Gemini* are put down, thoſe to the Northward of the Ecliptic, with ſo much leſs Latitude than we find, and thoſe to the Southward, with ſo much more ſoutherly Latitude; and yet the three Stars *Palilicium*, *Sirius*, and *Arcturus*, do contradict this Rule: For by it, *Palilicium*, being in the Days of *Hipparchus*, in about 10 gr. of *Taurus*, ought to be about 15′ more ſoutherly than at preſent, and *Sirius* being then in about 15 gr. of *Gemini*, ought to be 20′ more ſoutherly than now; yet *Ptolomy* places the firſt 20′, and the other 22′ more northerly in Latitude than we now find them: Nor are theſe the Errors of Tranſcribers, but are proved to be right by the Declination of them ſet down by *Ptolomy*, as obſerved by *Timocharis*, *Hipparchus*, and himſelf; which ſhew, that theſe Latitudes are the ſame as thoſe Authors intended. As to *Arcturus*, he is too near the Equinoctial Colour, to argue from him concerning the Change of the Obliquity of the Ecliptic; but *Ptolomy* gives him 33′ more North Latitude than

than he is now found to have; and that greater Latitude is likewiſe confirmed by the Declinations delivered by the aboveſaid Obſervations: So then theſe three Stars are found to be above half a Degree more ſoutherly at this Time than the Antients reckoned them. When, on the contrary, at the ſame time, the bright Shoulder of *Orion*, has, in *Ptolomy* almoſt a Degree more ſoutherly Latitude than at preſent, what ſhall we ſay then? It is ſcarce to be believed, that the Antients could be deceived in ſo plain a Matter, three Obſervers confirming each other. Again, theſe Stars being the moſt conſpicuous in Heaven, are in all Probability the neareſt to the Earth; and if they have any particular Motion of their own, it is moſt likely to be perceived in them, which in ſo long a Time as eighteen hundred Years, may ſhew itſelf by the Alteration of their Places, though it be intirely imperceptible in the Space of one ſingle Century of Years: Yet, as to *Syrius*, it may be obſerved, that *Tycho Brahe* makes him 2 Min. more northerly than we now find him; whereas he ought to be above as much more ſoutherly from his Ecliptic (whoſe Obliquity he makes $2' \frac{1}{2}$ greater than we eſteem it at at preſent) differing in the Whole $4' \frac{1}{2}$.

One Half of this Difference may perhaps be excuſed, if Refraction were not allowed in this Caſe by *Tycho*; yet 2 Min. in ſuch a Star as *Syrius*, is ſomewhat too much for him to be miſtaken in.

But a more evident Proof of this Change is drawn from the Obſervation of the Application of the Moon to *Pallicium*, *An. Chriſ.* 509. *Mar.* 11. when, in the Beginning of the Night, the Moon was ſeen to follow that Star very near, and ſeemed to have eclipſed it, ἐπέβαλλε γὰρ ὁ ἀστηρ τῳ πᾶρα την διχοτομίαν μέρει τῆς κυρτυς περιφειας τοῦ πεφωτισμένου μερους, *i. e. Stella appoſita erat parti per quam biſecabatur limbus Lunæ illuminatus*, as *Bullialdus*, to whom we are beholden for this ancient Obſervation, has tranſlated it. Now, from the undoubted Principles of Aſtronomy, this could never be true at *Athens*, or near it, unleſs the Latitude of *Palilicium* were much leſs than we at this Time find it *.

The Motion of *Arcturus* ſeems further confirmed, from the Obſervations of *Tycho Hevelius* and *Flamſtead*; for *Hevelius* ſets down the Diſtance of that Star from *Lyra* $4'$ greater than *Tycho* had obſerved it ſeventy-two Years before him, and *Flamſtead* twenty-two Years after meaſured

* Vide *Bulialdi Aſtr. Philolaica*, p. 172.

† Theſe are the neareſt and greateſt of the fixed Stars, the Motion of the others not having been obſerved, or being at too great a Diſtance, are either imperceptible, or have not been taken notice of.

the

the Diſtance betwixt the ſame two Stars, ſtill 3′ greater than *Hevelius* found it; ſo that if *Lyra* had ſtood ſtill all that while, there was an Appearance of *Arcturus*'s having gone 7′ out of his Place in the Space of an hundred Years. See Dr. *Long*'s Aſtronomy, p. 274.

It is further to be obſerved, in Confirmation of the Motion of one of theſe Stars, that *Flamſtead* found the Diſtance of *Arcturus*, from the Head of *Hercules* 3′ greater than it is ſet down by the Prince of *Heſſe*; and that his Diſtance from the *Lion's Tail* was a little decreaſed with 5′ ½ leſs Latitude than *Tycho* had obſerved. Hence, to make theſe Obſervations agree, one or both of them muſt have moved together equal to 7′. This Change of Place, which is quite contrary to all known Cauſes proceeding from the Earth, muſt therefore be occaſioned either by the Motion of the Sun, or by a particular Motion of their own; but if, amongſt themſelves, they muſt all move, and if all be in Motion, the Sun muſt alſo move.

If theſe Obſervations, delivered down to us by very able Aſtronomers, be either true or near it, as great Allowances have been made for the Ignorance of the Ages in which they were taken, and the Inaccuracy of the Inſtruments, we may naturally conclude, that theſe Stars muſt have a Motion; and if they move, as has been before obſerved, the Sun muſt alſo; hence he cannot now be in the original Plane of the Earth's annual Direction, or at leaſt in the ſame identical Place he was at firſt poſſeſſed of: And if ſo, the Stars muſt alſo have the like Motion, though in different Directions, and all may thus be governed by the ſame impulſive Power.

To illuſtrate this primitive Motion of the Stars, and at the ſame time to ſhow that the Variety which appears in the Quantity of Motion can be no Objection to it,

See PLATE XVIII. *Fig.* 2.

Where A repreſents the Eye of an Obſerver, and B, E, F, H, various Syſtems, moving in different Directions thro' the mundane Space; it is evident that the Sphere B, having moved from C, and that of E, not having appeared to move at all, there muſt be a ſenſible Change in the new Poſition of theſe two Syſtems to one another, and ſo of the reſt; and tho' the apparent Motion of H, be much more than that of F, from the Point A, yet from C, they will appear leſs different, and from B, they will appear nearly equal. And farther, as the Direction from H, is in the Line I, H, and that of F, in the Line K, G, thoſe two Syſtems will appear to approximate, and the Magnitude of the Star in the firſt will be increaſed,

creaſed, and in the latter diminiſhed. Thus, many of the Stars in the oldeſt Catalogues, which were ſaid to be of the ſecond Magnitude, are now become of the firſt, and ſeveral of the firſt are now judged to be of the ſecond, *&c.*

But as this apparent Motion of the Stars at the Earth, muſt, from its Nature, be very ſmall, ſo as ſcarce to be diſcovered in ſome of them in leſs than an Age, with any Inſtrument by the niceſt Obſerver, I judge it will be extremely proper in this Place to propoſe ſome Method, by which, in proceſs of Time, the Truth of the Theory may be aſcertained. The Way I think moſt likely to ſucceed is this.

PLATE XIX.

Is a Plan of the principal Stars that form the PLEIADES, correctly taken by a Combination of Triangles, as in the Figure, from whence it will naturally follow, all the whole Form being comprehended in much leſs than one Degree. That the moſt minute local Motion in any one of thoſe Stars in a very few Years, will be made ſenſible to an Eye at the Earth. For Inſtance, if any of the Stars that form the Letter A, or T, within the Term of ten or twenty Years, be found in the leaſt to deviate from the Lines of their preſent Poſition and Direction, it will be evident beyond a Contradiction, that they have a Motion amongſt themſelves, and ſince at ſuch a Diſtance they cannot poſſibly be affected by the Earth, it muſt be a Motion of their own; and thus if any one can be proved, to change its Situation, with regard to the reſt, we can have no new Difficulty in concluding that they all may do the ſame.

Thus if any of the regular Triangles M B Z, Z P H, A Z M, Υ A Γ, or Π O I, *&c.* in due Time be carefully noted, we may venture to ſay with great Safety, that the thouſandth Part of a Degree will be plainly diſcovered.

PLATE XX.

Is a true Plan and Combination of the principal Stars that form the PERSEDES, in which other Obſervations may be made in a different Part of the Heavens, and perhaps with an Opportunity of being ſtill more exact, the Areas of theſe Triangles, particularly that of Θ I K, and thoſe of ρ and δ, being much leſs than the former, where the leaſt Alteration poſſible muſt render them ſenſibly diſtorted. But here it muſt be conſidered, that the real Motion of the Stars, as well as their apparent, may be, and in all

all Likelihood, is extreamly ſlow, for the moſt minute, viſible, local Motion, will anſwer all the Purpoſes we know in Nature, and the greateſt ſeems to be that of the projectile, or centrifugal Force, which not only preſerves them in their Orbits, but prevents them from ruſhing all together, by the common univerſal Law of Gravity, which otherwiſe, as a finite Diſtribution of either regular or irregular Bodies, they muſt at length do by Neceſſity.

I muſt now inform you, that the above Obſervations were compleated in the AUTUMN SEASON, 1747, and were taken by myſelf; the Letters A, T, in *Plate* XIX, and the W in the XXth, as you may ſee, having a very near Reſemblance, or Similitude, to the Order theſe Stars are found to be in, together with the *Greek* Alphabet, I judged neceſſary, by way of *Aſteriſm* and *Nomenclatura*, in caſe ſuch ſhould be wanted, as *Data* in future Diſcoveries.

I come now to the principal Point in Queſtion, which is to find a regular Diſpoſition of the Stars amongſt themſelves, which will naturally ſolve both their general and particular Phænomena, eſpecially the *Nebulæ* and *Milky Way*.

I am now, &c.

LETTER THE SEVENTH.

The Hypotheſis, or Theory, fully explained and demonſtrated, proving the ſidereal Creation to be finite.

SIR,

I KNOW you are an Enemy to all Sorts of Schemes where they are not abſolutely neceſſary, and may poſſibly be avoided; and for that Reaſon I have purpoſely omitted many geometrical Figures, and other Repreſentations in this Work, which might have been inſerted and in ſome Places, eſpecially here I might have introduced Diagrams, perhaps more explicit than Words; but as you have frequently obſerved, they are only of Uſe to the few Learned, and contribute more to the taking away the little Ideas and Knowledge the more ignorant Many may be endued with, by a prejudicial Impreſſion of imperfect Images, rather than the adding any new Light to their Underſtanding, I have purpoſely avoided, as much as poſſible, both here and every where, all ſuch complex Diagrams as might be in Danger of betraying any the leaſt ſuch conſcious Diffidence in you, ariſing from the Want of a proper *Precognita* in the Sciences.

This Imperfection, much to be lamented, as greatly to the Diſadvantage of all mathematical Reaſoning, I would willingly always prevent, in my Readers, and to chuſe in my Friend; I ſhall therefore content myſelf with referring you to a few orbicular Figures, concave and convex, as may beſt ſuggeſt to your Fancy the ſimpleſt Way, a juſt Idea of the Hypotheſis I have fram'd, and naturally enough I hope, render my Theory ſo intelligible, as to help you ſufficiently to conceive the Solution aimed at, of the important Problem I have attempted.

As I have ſaid before, we cannot long obſerve the beauteous Parts of the viſible Creation, not only thoſe of this World on which we live, but alſo the Myriads of bright Bodies round us, with any Attention, without being convinced, that a Power ſupreme, and of a Nature unknown to us, preſides in, and governs it.

The

The Courſe and Frame of this vaſt Bulk, diſplay
A Reaſon and fix'd Law, which all obey.

SHER. MANILIUS.

And notwithſtanding the many wonderful Productions of Nature in this our known Habitation, yet the Earth, when compared with other Bodies of our own Syſtem, ſeems far from being the moſt conſiderable in it; and it appears not only very poſſible, but highly probable, from what has been ſaid, and from what we can farther demonſtrate, that there is as great a Multiplicity of Worlds, variouſly diſperſed in different Parts of the Univerſe, as there are variegated Objects in this we live upon. Now, as we have no Reaſon to ſuppoſe, that the Nature of our Sun is different from that of the reſt of the Stars; and ſince we can no way prove him ſuperior even to the leaſt of thoſe ſurpriſing Bodies, how can we, with any Shew of Reaſon, imagine him to be the general Center of the whole, *i. e.* of the viſible Creation, and ſeated in the Center of the mundane Space? This, in my humble Opinion, is too weak even for Conjecture, their apparent Diſtribution, and * irregular Order argue ſo much againſt it.

The Earth indeed has long poſſeſſed the chief Seat of our Syſtem, and peaceably reigned there, as in the Center of the Univerſe for many Ages paſt; but it was human Ignorance, and not divine Wiſdom, that placed it there; ſome few indeed from the Beginning have diſputed its Right to it, as judging it no way worthy of ſuch high Eminence. Time at length has diſcovered the Truth to every body, and now it is juſtly diſplaced by the united Conſent of all its Inhabitants, and inſtead of being thought the moſt majeſtick of all Nature's lower Works, now rather diſgraces the Creation, ſo much it is reduced in its preſent State from what it had Reaſon to expect in the former.

Now it is no longer the only terreſtrial Globe in the Univerſe, but is proved to be one of the leaſt Planets of the ſolar Syſtem, and ſurprizingly inferior to ſome of its Fellow Worlds. The Sun, or rather the Syſtem, has almoſt as long uſurped the Center of Infinity, with as little Pretence to ſuch Pre-heminence; but now, Thanks to the Sciences, the Scene begins to open to us on all Sides, and Truths ſcarce to have been dreamt of, before Perſons of Obſervation had proved them poſſible, invades our Senſes

* See the Zodaical Conſtellations, you'll find that in ſome Signs there are ſeveral Stars of the firſt, ſecond, and third Magnitude, and in many others none of theſe at all.

with a Subject too deep for the human Underſtanding, and where our very Reaſon is loſt in infinite Wonders. How ought this to humble every Mind ſuſceptible of Reaſon!

In this Place, I believe, you will pardon a Digreſſion; which, in Anſwer to Part of your laſt Letter, I judge will not be very impertinent, tho' perhaps juſt here I cannot ſo well juſtify it.

Your late Converſation with our Friend Mr. * * *, I am perſwaded, muſt have been very entertaining; but I cannot help thinking his Reflections upon the Wonders of Nature and the Wiſdom of Providence, though I muſt allow them all to be very juſt and curious, inſtead of elevating the Mind to the Pitch he would have it, rather as conſidered above, depreſs it below the proper, nay I might ſay neceſſary, Standard of human Ideas.

This, probably, you'll ſay is an odd Turn, and may want ſome Explanation, ſince every Object in the Chain of Nature, muſt of Force be granted, a Subject worthy of our Speculations, being all together made, as in the Maximum of Wiſdom: But what I mean is this, ſince nothing is more natural for Beings in every State in ſearch after their own Advantages, and the Enlargement of their Ideas to look upward, ſure it may be preſumed, that Time may be miſpent, if not loſt in inſpecting too narrowly Things ſo little benefical in States below us; as Mr. *Pope* ſays,

> Why has not Man a microſcopic Eye?
> For this plain Reaſon, Man is not a Fly.
> Say what the Uſe, were finer Opticks given,
> To inſpect a Mite, not comprehend the Heav'n.
>
> *Eſſay on Man.*

Amuſement alone can never be ſuppoſed to be the ſole End of human Life, where even true Happineſs is a Thing we rather taſte than enjoy. The Mind we find capable of much more rational Pleaſure than can poſſibly fall within the Reach of human Power, either to promiſe or procure it; but then this very Defect in our preſent State of Exiſtence affords us no leſs than a moral Aſſurance, that ſome where in a future, we may, if we pleaſe, be entitled to the very *Plenum* of all Enjoyments.

The peculiar Buſineſs then of the human Mind naturally precedes its Amuſements, as evidently ordained to ſoar above all the inferior Beings of this World; and however our Natures may, thro' Indolence, or thro' Ignorance, degenerate, that of the Man can never be ſuppoſed to ſink into the Mole.

The propereſt Way then ſure for Men to preſerve their Pre-heminence over the Brute Creation, is to make uſe of that Reaſon and Reflection, which

which ſo manifeſtly diſtinguiſhes their natural Superiority. A right Application of which, muſt of courſe then direct us to a forward, rather than a backward Search in the vaſt viſible Chain of our Exiſtence, which clearly connects all Beings and States as under the Direction of one ſupreme Agent.

This is all I would have underſtood by the foregoing Poſition, which, in one Word, implies no more than that the ſublime Philoſophy ought in all Reaſon to be preferred to the Minute; but I hope you will not infer from this my ſeeming Partiality for the celeſtial Sciences, that I mean to inſinuate, that the Study of terreſtrial Phyſicks is not a rational Amuſement.

Mr. ***, you ſay, ſeems to lament the Taſte of Mankind in general much in the ſame Degree as you do his I readily grant you; a Man who can talk ſo well upon an Ant, might make a more entertaining Diſcourſe upon the Eagle; but I beg his Pardon, and though we are all too ready, and moſt apt to condemn all ſuch Pleaſures as vain or trifling, which we have no Share in, or Taſte for ourſelves; yet I don't think it follows, that thoſe ingenious Labours of his are uſeleſs. The Pleaſures ariſing from natural Philoſophy are all undoubtedly great ones, whether we conſider Nature in her higheſt, or in her loweſt Capacity; the Beauties of the Creation are every Day varied to us below, as much they are every Night above, and in both Caſes, through every Object, the Creator ſhines ſo manifeſt, that we may juſtly conſider him every where ſmiling full in the Face of all his Creatures, commanding as it were an awful Reverence, and Reſpect, due not only to his Omnipotency, but alſo to his infinite Goodneſs and endleſs Indulgencies. This is the only Return our Gratitude can make for all thoſe Bleſſings he daily beſtows upon us, and to this great Author of her Laws, Nature herſelf cries aloud through Myriads of various Objects, and after her own expreſſive and peculiar Manner, ſeems to command us with an attractive Grace, to obſerve her Sovereign, and admire his Wiſdom. The Majeſty, Power, and Dominion of God is beſt diſplayed in the external Direction of Things, his Wiſdom and viſible Agency in the internal: Hence, by proper Objects, ſelected from both, attended with juſt Reflections, we may certainly raiſe our Ideas almoſt to the Pitch of Immortals; but how far the human Imagination may poſſibly go, or how much Minds like ours may be improved, is a Queſtion not eaſily determined; but as natural Knowledge evidently increaſes daily, and aſtronomical Enquiries are the moſt capable of opening our Minds, and enlarging our Conception, of conſequence they muſt be moſt worthy our Attention of all other Studies. But of this I have ſaid enough, and think it is now more than Time to attempt the remaining Part of my Theory.

When

When we reflect upon the various Aſpects, and perpetual Changes of the Planets, both with regard to their * heliocentric and geocentric Motion, we may readily imagine, that nothing but a like eccentric Poſition of the Stars could any way produce ſuch an apparently promiſcuous Difference in ſuch otherwiſe regular Bodies. And that in like manner, as the Planets would, if viewed from the Sun, there may be one Place in the Univerſe to which their Order and primary Motions muſt appear moſt regular and moſt beautiful. Such a Point, I may preſume, is not unnatural to be ſuppoſed, altho' hitherto we have not been able to produce any abſolute Proof of it. See *Plate* XXV.

This is the great Order of Nature, which I ſhall now endeavour to prove, and thereby ſolve the Phænomena of the *Via Lactea*; and in order thereto, I want nothing to be granted but what may eaſily be allowed, namely, that the *Milky Way* is formed of an infinite Number of ſmall Stars.

Let us imagine a vaſt infinite Gulph, or Medium, every Way extended like a Plane, and incloſed between two Surfaces, nearly even on both Sides, but of ſuch a Depth or Thickneſs as to occupy a Space equal to the double Radius, or Diameter of the viſible Creation, that is to take in one of the ſmalleſt Stars each Way, from the middle Station, perpendicular to the Plane's Direction, and, as near as poſſible, according to our Idea of their true Diſtance.

But to bring this Image a little lower, and as near as poſſible level to every Capacity, I mean ſuch as cannot conceive this kind of continued Zodiack, let us ſuppoſe the whole Frame of Nature in the Form of an artificial Horizon of a Globe, I don't mean to affirm that it really is ſo in Fact, but only ſtate the Queſtion thus, to help your Imagination to conceive more aptly what I would explain *. *Plate* XXIII. will then repreſent a juſt Section of it. Now in this Space let us imagine all the Stars ſcattered promiſcuouſly, but at ſuch an adjuſted Diſtance from one another, as to fill up the whole Medium with a kind of regular Irregularity of Objects. And next let us conſider what the Conſequence would be to an Eye ſituated near the Center Point, or any where about the middle Plane, as at the Point A. Is it not, think you, very evident, that the Stars would there appear promiſcuouſly diſperſed on each Side, and more and more inclining to Diſorder, as the Obſerver would advance his Station towards either Surface, and nearer to B or C, but in the Direction of the general Plane towards H or D, by the continual Approximation of the viſual Rays, crowding together as at H, betwixt the Limits D and G, they muſt in-

* Not to mention their ſeveral Conjunctions and Apulces to fixed Stars, *&c.* ſee the State of the Heavens in 1662, *December* the firſt, when all the known Planets were in one Sign of the Zodiac, *viz. Sagittarius.*

fallibly

fallibly terminate in the utmoſt Confuſion. If your Opticks fails you before you arrive at theſe external Regions, only imagine how infinitely greater the Number of Stars would be in thoſe remote Parts, ariſing thus from their continual crowding behind one another, as all other Objects do towards the Horizon Point of their Perſpective, which ends but with Infinity: Thus, all their Rays at laſt ſo near uniting, muſt meeting in the Eye appear, as almoſt, in Contact, and form a perfect Zone of Light; this I take to be the real Caſe, and the true Nature of our *Milky Way*, and all the Irregularity we obſerve in it at the Earth, I judge to be intirely owing to our Sun's Poſition in this great Firmament, and may eaſily be ſolved by his Excentricity, and the Diverſity of Motion that may naturally be conceived amongſt the Stars themſelves, which may here and there, in different Parts of the Heavens, occaſion a cloudy Knot of Stars, as perhaps at E.

But now to apply this Hypotheſis to our preſent Purpoſe, and reconcile it to our Ideas of a circular Creation, and the known Laws of orbicular Motion, ſo as to make the Beauty and Harmony of the Whole conſiſtent with the viſible Order of its Parts, our Reaſon muſt now have recourſe to the Analogy of Things. It being once agreed, that the Stars are in Motion, which, as I have endeavoured in my laſt Letter to ſhew is not far from an undeniable Truth, we muſt next conſider in what Manner they move. Firſt then, to ſuppoſe them to move in right Lines, you know is contrary to all the Laws and Principles we at preſent know of; and ſince there are but two Ways that they can poſſibly move in any natural Order, that is, either in right Lines, or in Curves, this being one, it muſt of courſe be the other, *i. e.* in an Orbit; and conſequently, were we able to view them from their middle Poſition, as from the Eye ſeated in the Center of *Plate* XXV. we might expect to find them ſeparately moving in all manner of Directions round a general Center, ſuch as is there repreſented. It only now remains to ſhew how a Number of Stars, ſo diſpoſed in a circular Manner round any given Center, may ſolve the Phænomena before us. There are but two Ways poſſible to be propoſed by which it can be done, and one of which I think is highly probable; but which of the two will meet your Approbation, I ſhall not venture to determine, only here incloſed I intend to ſend you both. The firſt is in the Manner I have above deſcribed, *i. e.* all moving the ſame Way, and not much deviating from the ſame Plane, as the Planets in their heliocentric Motion do round the ſolar Body. In this Caſe the primary, ſecondary, and tertiary conſtituent Orbits, *&c.* framing the Hypotheſes, are repreſented in *Plate* XXI, and the Conſequence of ſuch a Theory ariſing from ſuch an univerſal Law of Motion

tion in *Plate* XXII. where B, D denotes the local Motion of the Sun in the true *Orbis Magnus*, and E, C that of the Earth in her proper ſecondary Orbit, which of courſe is ſuppoſed, as is ſhewn in the Figure to change its ſidereal Poſitions, in the ſame Manner as the Moon does round the Earth, and conſequently will occaſion a kind of Proceſſion, or annual Variation in the Place of the Sun, not unlike that of the Equinoxes, or Motion of all the Stars together, from Weſt to Eaſt round the Ecliptic Poles, and probably may in ſome Degree be the Occaſion of it. This Angle is repreſented, but much magnified, by the Lines F, C, G, and the Unnaturalneſs, or Abſurdity of a right Line Motion of the Sun by the Line I, H.

The ſecond Method of ſolving this Phænomena, is by a ſpherical Order of the Stars, all moving with different Direction round one common Center, as the Planets and Comets together do round the Sun, but in a kind of Shell, or concave Orb. The former is eaſily conceived, from what has been already ſaid, and the latter is as eaſy to be underſtood, if you have any Idea of the Segment of a Globe, which the adjacent Figures, will, I hope, aſſiſt you to. The Doctrine of theſe Motions will perhaps be made very obvious to you, by inſpecting the following Plates.

PLATE XXIV.

Is a Repreſentation of the Convexity, if I may call it ſo, of the intire Creation, as a univerſal Coalition of all the Stars conſphered round one general Center, and as all governed by one and the ſame Law.

PLATE XXV.

Is a centeral Section of the ſame, with the Eye of Providence ſeated in the Center, as in the virtual Agent of Creation.

PLATE XXVI.

Repreſents a Creation of a double Conſtruction, where a ſuperior Order of Bodies C, may be imagined to be circumſcribed by the former one A, as poſſeſſing a more eminent Seat, and nearer the ſupream Preſence, and conſequently of a more perfect Nature. Laſtly,

PLATE XXVII.

Repreſents ſuch a Section, and Segments of the ſame, as I hope will give you a perfect Idea of what I mean by ſuch a Theory.

Fig. 1. is a correſponding Section of the Part at A, in *Fig.* 2. whoſe verſed Sine is equal to half the Thickneſs of the ſtarry Vortice A C, or B A. Now I ſay, by ſuppoſing the Thickneſs of this Shell, 1. you may imagine the middle Semi-Chord A D, or A E, to be nearly 6; and conſequently,

thus in a like regular Diſtribution of the Stars, there muſt of courſe be at leaſt three Times as many to be ſeen in this Direction of the Sine, or Semi-chord A E, itſelf, than in that of the ſemi-verſed Sine A C, or where near the Direction of the Radius of the Space G. *Q. E. D.*

But we are not confined by this Theory to this Form only, there may be various Syſtems of Stars, as well as of Planets, and differing probably as much in their Order and Diſtribution as the Zones of *Jupiter* do from the Rings of *Saturn*, it is not at all neceſſary, that every collective Body of Stars ſhould move in the ſame Direction, or after the ſame Model of Motion, but may as reaſonably be ſuppoſed as much to vary, as we find our Planets and Comets do.

Hence we may imagine ſome Creations of Stars may move in the Direction of perfect Spheres, all variouſly inclined, direct and retrograde; others again, as the primary Planets do, in a general Zone or Zodiack, or more properly in the Manner of *Saturn*'s Rings, nay, perhaps Ring within Ring, to a third or fourth Order, as ſhewn in *Plate* XXVIII. nothing being more evident, than that if all the Stars we ſee moved in one vaſt Ring, like thoſe of *Saturn*, round any central Body, or Point, the general Phænomena of our Stars would be ſolved by it; ſee *Plate* XXIX. *Fig.* 1. and 2. the one repreſenting a full Plane of theſe Motions, the other a Profile of them, and a viſible Creation at B and C, the central Body A, being ſuppoſed as *incognitum*, without the finite View; not only the Phænomena of the *Milky Way* may be thus accounted for, but alſo all the cloudy Spots, and irregular Diſtribution of them; and I cannot help being of Opinion, that could we view *Saturn* thro' a Teleſcope capable of it, we ſhould find his Rings no other than an infinite Number of leſſer Planets, inferior to thoſe we call his Satellites: What inclines me to believe it, is this, this Ring, or Collection of ſmall Bodies, appears to be ſometimes very excentric, that is, more diſtant from *Saturn*'s Body on one Side than on the other, and as viſibly leaving a larger Space between the Body and the Ring; which would hardly be the Caſe, if the Ring, or Rings, were connected, or ſolid, ſince we have good Reaſon to ſuppoſe, it would be equally attracted on all Sides by the Body of *Saturn*, and by that means preſerve every where an equal Diſtance from him; but if they are really little Planets, it is clearly demonſtrable from our own in like Caſes, that there may be frequently more of them on one Side, than on the other, and but very rarely, if ever, an equal Diſtribution of them all round the *Saturnian* Globe.

How much a Confirmation of this is to be wiſhed, your own Curioſity may make you judge, and here I leave it for the Opticians to determine. I ſhall content myſelf with obſerving that Nature never leaves us without

a ſufficient Guide to conduct us through all the neceſſary Paths of Knowledge; and it is far from abſurd to ſuppoſe Providence may have every where throughout the whole Univerſe, interſperſed Modules of every Creation, as our Divines tell us, Man is the Image of God himſelf.

Thus, Sir, you have had my full Opinion, without the leaſt Reſerve, concerning the viſible Creation, conſidered as Part of the finite Univerſe; how far I have ſucceeded in my deſigned Solution of the *Via Lactea*, upon which the Theory of the Whole is formed, is a Thing will hardly be known in the preſent Century, as in all Probability it may require ſome Ages of Obſervation to diſcover the Truth of it.

It remains that I ſhould now give you ſome Idea of Time and Space; but this will afford Matter ſufficient for another Letter.

I am, &c.

LETTER THE EIGHTH.

Of Time and Space, with regard to the known Objects of Immenſity and Duration.

SIR,

THE Opportunity you gave me in your laſt Viſit, of ſhewing you my general Scheme of the Univerſe, I find, beſides the Pleaſure it then gave, is now attended with many uſeful Advantages.

I now not only hope to be better underſtood for the future, but have reaſon to expect what I now write will merit your Attention more, and have ſome Title to your Approbation. The Ideas I have fram'd of Time and Space, will now more gradually fill your Imagination both with Wonder and Delight, before they can ariſe ſo high as to be loſt in an Eternity and the Infinity of Space. And I am fully perſwaded your farther Inquiries into theſe vaſt Properties of the Deity, will here be anſwered intirely to your Satisfaction. You muſt allow me now to be in ſome meaſure a Judge of what I think will pleaſe you moſt, from the Obſervations you have made upon my general Syſtem, or otherwiſe you would have reaſon to think me perhaps too preſuming: But I flatter myſelf the great Difficulty is now over; and what remains to be ſaid, will alſo naturally follow from what has gone before, that this Letter, I gueſs, will go near to furniſh you with all the Ideas you with to form upon the Subject. To what you have ſaid of my having left out my own Habitation in my Scheme of the Univerſe, having travell'd ſo far into Infinity as both to loſe ſight of, and forget the Earth, I think I may juſtly anſwer as *Ariſtotle* did when *Alexander*, looking over a Map of the World, enquir'd of him for the City of *Macedon*; 'tis ſaid the Philoſopher told the Prince, That the Place he ſought for was much too ſmall to be there taken Notice of, and was not without ſufficient Reaſon omitted.

The Syſtem of the Sun compar'd but with a very minute Part of the viſible Creation, takes up ſo ſmall a Portion of the known Univerſe, that in a very finite View of the Immenſity of Space, I judg'd the Seat of the Earth to be of very little Conſequence, could I have poſſibly repreſented it, as not only being one of the ſmalleſt Objects in our Regions, but in a

manner infinitely leſs than even her own annual Orbit, and had nothing to do with my main Deſign, which was to repreſent all our planetary Worlds as one collective Body, and begin my comparative Scale of Magnitude from the Sun only and his Sphere of activity; as the ſmalleſt Object I could with any Propriety pretend to expreſs in ſuch a Plan.

In ſome Meaſure to convince you that I have committed no Error in this, I will try by ſome leſs mathematical Method than that of meer Numbers, to imprint an Idea in your Mind of the true Extent of the ſolar Syſtem, and the Magnitude of all its moving Bodies, by natural Objects moſt familiar to your Senſes. When we endeavour to form any Idea of Diſtance, Magnitude, or Duration, by Numbers only, we ſo ſoon exceed the Limits of Conception, that this way we find our Faculties of reaſoning as finite as our Senſes; and no doubt 'tis right it ſhould be ſo, Providence, as it were, having ordain'd that the firſt ſhould only attend the laſt, in ſuch an adequate Degree to a determin'd Diſtance; but what Diſtance or Degree of Knowledge is deſtin'd to human Nature, none but the Power that gave it can tell. 'Tis certain that beyond the third or fourth Place of our Nomenclator, we receive but very faint Impreſſions of the thing expreſt, and can frame ſcarce any Notion at all of either Number, Diſtance, or Magnitude, ſignified beyond it: Hence Aſtronomers are frequently oblig'd to have recourſe to mixt Ideas, and make Things of different Natures and Properties aſſiſt each other, to excite more adequate Ideas of what they would have conceived. Thus to expreſs immenſe Diſtances and Magnitude, they frequently apply themſelves to Time and Motion; and *vice verſa*, to ſignify a long Duration, they have often recourſe to Diſtance and Matter, removing, in Imagination, Worlds of Sand, Grain after Grain, to ſome remote known Region.

Heſiod, * to expreſs his Idea of the Diſtance from his higheſt Heaven to Earth, and from Earth to Hell, or *Tartarus*, ſuppoſes an Anvil to be let fall from one to the other, which he ſays in nine natural Days would reach the Earth from Heaven, and in the ſame time would fall from the Earth to Hell. † *Homer* makes his *Vulcan* fall from Heaven to the Iſland of *Lemnos* in much leſs Time, not exceeding one full artificial Day.

* From the high Heaven a brazen Anvil caſt,
Nine Nights and Days in rapid Whirls would laſt,
And reach the Earth the Tenth, whence ſtrongly hurl'd;
The ſame the Paſſage to th' infernal World.

COOKE.

† Hurl'd headlong downward from th' etherial Height;
Toſs'd all the Day in rapid Circles round,
Nor till the Sun deſcended touch'd the Ground.

POPE.

Modern

Modern Aſtronomers have made uſe of the ſwifteſt Velocity of a Cannon-Ball as continued thro' the Space they would ſo deſcribe, and in this Light, the Diſtance to the Sun has been by many compar'd to twenty-five Years Motion of a Cannon-Ball, ſuppoſing it to travel at the Rate of 100 Fathom in a Moment, *i. e. the Pulſe of an Artery*; and that a Journey ſo performed to one of the neareſt fix'd Stars, would take the ſame Body at leaſt 100,000 Years before it could arrive there. But the Method I have choſe to convey my Ideas of the Magnitude of the planetary Bodies, and the Extent of the viſible Creation to you, I am willing to hope you will find ſtill more familiar, comprehenſive, and eaſy: And it only depends upon your Remembrance of a very few known Objects, and their neighbouring Diſtances, which may be preſumed you are, or have been, very well acquainted with. You have not only very lately but very often been in *London*, and muſt, I think, retain ſome Idea of the Dome of St. *Paul*'s, tho' I own I ought not to be ſorry if you ſhould chance to have forgot it, provided it might prove a Means of making your Viſits more frequent. The Diameter of the Dome of this Church is 145 Feet: Now if you can imagine this to repreſent the Surface of the Sun, a ſpherical Body 18 Inches diameter, will juſtly repreſent the Earth in like Proportion; and another of only five Inches diameter, will repreſent the Moon. The Truths of theſe Proportions I have ſhewn in my *Clavis Cæleſtis*; and the Reaſon why I have here fixt upon the Dome of this Church for my firſt Object of Compariſon, will naturally appear from what follows.

From the Magnitude of the Earth on which we live, as from a known Scale with reſpect to its Parts compar'd with our own Bodies, we naturally frame our firſt Ideas of Extent, and fix our Rationale of Remoteneſs; by which we are ſufficiently enabled to judge of all other ſenſible Diſtances within one finite View. And hence by the undoubted Principles of Geometry, having firſt given the Meaſurement of the Earth in any known Proportion with any other Quantity moſt familiar to our Senſes, and the Angle of Appearance, or Parallax to any perceivable Object, we can eaſily find in homogenial Parts its true Diſtance from the Eye. And thus allowing for ſome ſmall tho' unavoidable Errors, that may poſſibly ariſe from the Difficulties of Obſervation (eſpecially ſmall Angles and minute Quantities) we can always determine to a ſufficient, and very frequently to a juſt Exactneſs, the relative Diſtance of all viſible Bodies, remote or near, ſuch as the Planets, Comets, and the Sun.

* In this Manner Aſtronomers having procur'd a comparative Standard, reduc'd to ſome known Meaſure, as *Engliſh* Miles, Leagues, Semi-Orbs or Orbits,

* Parallax is the changeable Poſition of Bodies to different Situations of the Eye. Firſt having found the Quantity of a Degree (*i. e.* a 60th Part of the Circumference) upon the Earth's

Orbits, with all the Force of analogical Reaſoning, clearly can demonſtrate the Place and Diſtance of any Object within the Reach of Obſervation, and judge of Diſtances almoſt indefinite.

PLATE XXX.

Will help you to very correct Ideas of the real Magnitude of the Globe of the Earth, compar'd with the juſt Extent of the Iſland of *Great-Britain*, which you will find with *Ireland*, and the reſt of its Iſlands, ſeated near the Center of the Projection. This as a Standard will enable you to judge of all other Diſtances more perfectly; and firſt I ſhall conſider that of the Sun.

The Sun is found to be mean diſtant from the Earth nearly 81 Millions of Miles, or 6877,5 Diameters of the Earth; and *Saturn*, the remoteſt Planet from him is at his greateſt Diſtance from us about 858 Millions of Miles: Yet theſe Diſtances are but the beginning of Space, and only ſerve to open our Ideas for farther Search.

The great Comet of 1680, as I have ſome where ſaid before, was found to move in ſo vaſt an excentrick Orbit, that in its aphelion Point it would be 14,4 Times as far from the Sun, as the Orbit of *Saturn*, and hence at leaſt eleven thouſand and two hundred Millions of Miles from us. Now ſince the wiſe Creator hath ſo diſpos'd all the independent Parts of the Creation, ſuch as the ſeveral Syſtems of primary and ſecondary Planets, *&c.* at ſo great a Diſtance from each other, that the Laws of any one in no wiſe ſhall interfere, diſturb, or interrupt the Principles of another; this Comet, which we can eaſily prove belong'd to our own Sun, we may well imagine came not near any other; and tho' at that vaſt Diſtance from the ſolar Body, yet ſtill there muſt have remain'd a Space ſufficient to divide or ſeperate the ſenſible activity of neighbouring Syſtems, that they may not ruſh upon each other. Hence we may reaſonably ſuppoſe, that the neareſt Star can be no nearer than a triple Radius of its active Sphere; and provided they are all in regular Order, and much of the ſame Magnitude with one another (which no Arguments can poſſibly contradict) this Radius we may juſtly make 2000 times the Diſtance of our Earth. For admitting the utmoſt Limits of the Sun's Attraction to exceed this Sphere of the Comets, as far as the Sphere of the Comets

Earth's Surface, *Aratoſthenes* diſcover'd that the Magnitude of the whole was eaſily known; and then from the Moon's horizontal Parallax having given the Radius of the Earth, the Diſtance of the Moon is ſoon determined; next by the menſtrual Parallax of the Lunar Orbit, the Diſtance of the Sun is found; and by the Elongation of the inferior Planets, their mutual Diſtance from each other; and, laſtly, from the annual Parallax of the Earth's Orbit, all the other Orbits of the ſuperior Planets are eaſily found.

exceeds

exceeds that of the Planets, which is nearly 14,4 times, the Radius of the ſolar Syſtem will be extended every way 200 Radius's of the Orbit of *Saturn*, and conſequently the Diſtance from Star to Star will not be leſs than 6000 times the Radius of our *Orbis Magnus*, and conſequently upwards of 480,000,000,000 Miles. That this is even leſs than the real Truth, and may be defended as a very moderate Computation, grounded upon Reaſon, we have infallible Demonſtration to witneſs, and make appear as thus.

We know from the Nature of Diſtance and Motion that the Stars may have an annual Parallax, but it is ſo very ſmall, that the very beſt Aſtronomers have never yet been able to aſſign what the Quantity really is. Yet it is allow'd by univerſal Conſent, that it can't poſſibly be more that one Minute of a Degree, and may probably be much leſs. Mr. *Flamſtead*, by repeated Obſervations, made it in ſome of them upwards of 40″; but Mr. *Bradley* has endeavour'd to prove it is every where too ſmall to be determined, and aſſigns this Angle to another Cauſe. This way then we cannot make their Diſtance leſs; and to prove that it is ſomething more than I have ſaid it is, let us even increaſe the doubtful Parallax of 40″ to the moſt it poſſibly can be, *viz.* to 60″ or 1′; and by the Solution of the Triangle, we ſhall find that the neareſt Star is 6875 times the Radius of the Earth's Orbit from the Sun: And this tho' more than any other Proportion makes them, is ſtill undeniably leſs than the Truth, which every Mathematician will of courſe be convinc'd of; and you yourſelf of force muſt believe, when you are told, that the ſmaller the Angle of Parallax is, the farther the Body is remov'd from us. By which Rule, according to Mr. *Flamſtead*'s Obſervations, the Diſtance muſt be ſtill greater: By the optical Experiment of * Mr. *Huygins*, greater ſtill than this; and according to Mr. *Bradley*, ſo much more as not even too be determin'd.

Now if the reſt are in general from each other, allowing the ſame Extent of Syſtem, and as much to part the like Extreams of active Virtue, be in ſuch Proportion of aerial Space, it will appear, that to paſs from any one Star to another, we muſt fly thro' ſo vaſt a Tract of pure Expanſe or Ether, that to viſit any one of the moſt neighbouring Syſtems, could we travel even as faſt as the ſwifteſt Eagle flies, for Inſtance, 500 Miles *per* Day, yet ſhould we be 3,000,000 of Years upon our way before we could arrive there; and if continuing on to view the Regions of the reſt within the known Creation, Myriads of Ages would be ſpent, and yet we could not hope to ſee the whole of but the ſmalleſt Conſtellation.

* 27664 Radius's of the *Orbis Magnus*, equal to the Diſtance of *Syrius*, whoſe Parallax ſhould be to anſwer it but 14″ 48‴.

But

But what Idea of Diſtance can you receive from this ſort of Eſtimation, where Numbers ariſe ſo very high. I own to you mine are ſoon quite loſt by this Method of counting, either, Diſtances or Duration. I believe few People can range their Ideas with ſuch Perſpicuity, as to arrive at any adequate Notion of any Number above a thouſand.

To give you therefore a clearer Idea of Diſtance, and impreſs the Proportions of Space more ſtrongly and fully in your Mind, let us ſuppoſe the Body of the Sun, as I have ſaid before, to be repreſented by the Dome of St. *Paul*'s; in ſuch Proportion a ſpherical Body eighteen Inches Diameter, moving at *Mary-le-bone*, will juſtly repreſent the Earth, and another of five Inches Diameter, deſcribing a Circle of forty-five Feet and a half Radius round it, will repreſent the Orbit and Globe of the Moon. A Body at the *Tower* of 9,7 Inches, will repreſent *Mercury*; and one of 17,9 Inches at St. *James*'s Palace will repreſent the Planet *Venus*; *Mars* may be ſuppoſed at a Diſtance, like that of *Kenſington* or *Greenwich*, 10 Inches Diameter: *Jupiter*, imagined to be at *Hampton-Court*, or *Dartford* in *Kent*; and *Saturn*, at *Cliefden*, or near *Chelmsford:* The firſt repreſented by a Globe 15 Foot 4 Inches Diameter, the latter by one of 11 Feet $\frac{1}{2}$ and his Ring four Feet broad: Theſe would all naturally repreſent the planetary Bodies of our Syſtem in their proper Orbits and proportional Magnitudes, as moving round the Cupola of St. *Paul*'s, as their common Center the Sun. And preſerving the ſame natural Scale, the Aphelion of the firſt Comet would be about *Bury*, the ſecond at *Briſtol*, and the third near the City of *Edinburgh*. But if you will take into your Idea one of the neareſt Stars; inſtead of the Dome of St. *Paul*'s, you muſt ſuppoſe the Sun to be repreſented by the gilt Ball upon the Top of it, and then will another ſuch upon the Top of St. *Peter*'s at *Rome* repreſent one of the neareſt Stars.

The whole Syſtem exhibited in the above Proportion, would be nearly as follows:

Diameter of the Sun	145	Feet.
Saturn	11,587,	his Ring 27,54, its Breadth 4.
Jupiter,	15,39.	
Mars,	10,15	Inches.
the Earth,	18,125.	
Venus,	17,98	
Mercury,	9,715	
and the Moon,	4,93	

Diſtance

* Diſtance of *Saturn* from the Sun, 27 Miles, and 1700 Yards.
Jupiter, 15 Miles, and 458 Yards.
Mars, 4 Miles, and 751 Yards.
the Earth, 2 Miles, and 1632 Yards.
Venus, 2 Miles, and 217 Yards.
Mercury, 1 Mile, and 267 Yards.
and of the Moon, from us, 45 Yards and a half.

That of the moſt diſtant Comet 390, and the neareſt of the Stars not leſs than 6875, † Radius's of the *Orbis Magnus*.

Now, if like Creations crowd the vaſt Depths of Infinity, and if each are adapted to receive Beings of different Natures, where muſt our Wonder and Ideas have end?

As it is evident in the Sign *Taurus*, in *Perſeus*, and *Orion*, that we can plainly perceive Stars to the ſixth and ninth Magnitude, the former with our naked Eye, the other by the Help of Teleſcopes, the viſional ocular Creation cannot be leſs than 4,320,000,000,000 Miles in ſemi Diameter, and admitting a regular Diſtribution of thoſe primordial Bodies amongſt themſelves, the Depth, or moſt remote Limits of the *Vortex Magnus* from Side to Side, cannot be leſs than 8 m, m, 640 thouſand of Million of Miles, admitting it is no more than what we ſee; and laſtly, ſuppoſing our Syſtem to be ſituated nearly in the Middle of the *Vortex Magnus* (which, from the viſible Order of the Stars, we may juſtly conjecture, with the higheſt Probability of Truth) the neareſt Diſtance of the *Ens Primum*, in the Realms of eternal Day, will riſe to 30,000,000,000,000 Miles, but more probably to 100,000,000,000,000 Miles, making the Confines of Creation from Verge to Verge in the firſt Caſe, upwards of 68 Million of Millions of Miles, Diameter, and by the laſt above 200′. But, if we compute the Diſtance of the Stars after the Manner of *Huygens*, for his Diſtance of *Syrius* from the Sun, the Diſtance of the Region of Immortality without exceeding Probability may riſe to near 1,000,000,000,000,000 Miles.

Now to paſs by any progreſſive Motion from the outward Verge, or Borders of the Creation, thro' the ſtarry Regions of Mortality, if I may call

* Of the Satellites of *Saturn* in the above Proportion.

The 1 2 3 4 5 would be 27,96 35,52 50, 114, 341,9 Feet diſtant from his Center.

And thoſe of *Jupiter*.

The 1 2 3 4 would be 28,51 69,177 110,224 190, Feet diſtant from him.

	°	′	″			
* Radius, or Sign of	89	59	30	—	—	10,0000000
Sine ſubſtract of	0	0	30	—	—	6,1626961
Hence the Diſtance	6875,5			—	—	3,8373039

them ſo, as far as the Center of the *Ens Primum*, or *Sedes Beatorum*, according to *Homer*, or *Milton*'s Manner of meaſuring Space, a Body falling, or a Being moving with a Velocity but of 1000 Feet *per* Minute, *i. e.* at the Rate of 20,000 Yards *per* Hour, or about 300 Miles *per* Day, would be at leaſt 300,000,000 Years upon its Journey thither, if not 1,000, m, and perhaps much more, without offending Probability; but even three Million Centuries, or Ages, ſure is enough to be employ'd, in paſſing from one Place to another; therefore, we may conclude, the Soul muſt have ſome other Vehicle than can be found in the Ideas of Matter to convey it ſo far, at leaſt at once. Hence we may truly infer, that the Soul muſt be immaterial, and that in all Probability there may be States in the Univerſe ſo much more longer lived than ours, that, compared with the Age of Man, the Age of ſuch Beings may be almoſt as an Eternity, or rather, as that of the human Species to that of a Sun-born Inſect.

Again, if there are ſtill Stars beyond all theſe of other Denomination, which we do not here perceive, how vaſtly muſt theſe Numbers be increaſed, to expreſs, almoſt without Idea, the amazing Whole of this one viſible Creation; but what has been already ſaid, I judge will be ſufficient to ſhow the Immenſity of Space, and help you to conceive the ſtupendious Nature of an endleſs Univerſe; every where the home Poſſeſſion, Production, and inſtantaneous Care, of an infinite good Being, perfectly wiſe, and powerful, of whom we can have no Idea more, than a Being in dark Privation can have of Light, but through the Luſtre of his own reſplendent Attributes.

Thus, having attempted to enlarge your Ideas of the Creation in general, and in ſome meaſure having conſidered the Indefinity of Space, I ſhall in the next Place proceed to give you ſome Account of my Notions of Time.

As Diſtance is the Meaſure of Magnitude and of all Extent, and helps our Imagination to the Ideas of Space, ſo are progreſſive Moments the Meaſure of Velocity, and makes us ſenſible of Duration: And as Space may be extended through all Infinity, ſo Time may be continued as to Eternity. This Succeſſion of temporal Ideas impreſſed, or excited in the Mind, as an Effect of Matter in Motion, producing a perpetual Change, both of Objects earthly and celeſtial, enables us not only to reflect upon paſt Viciſſitudes of Nature, but from their regular Courſes, known Order and Returns, predict Phænomena to come, and prove the periodical Effects of Nature's conſtant Laws ſo juſt and certain, that Time may be ſaid with Truth, to co-exiſt with Motion.

Meaſure being a certain Quantity of Senſation interwove with our Ideas of Diſtance and Duration, proceeding from a Reflection of what is impreſſed upon the Mind by ſome external Object, I muſt again return to our Mother of Ideas the Earth, and from thence, as I did, of Diſtance, frame

frame the original Images beſt ſuited to the Underſtanding, proper for our Judgment of Duration.

Time takes its firſt Denomination from the diurnal Rotation of the Earth upon its Axis, which we call a natural Day, and this for obvious Reaſons we ſubdivide in twenty-four Parts or Hours. This diurnal Motion having been ſucceſſively repeated, and the Day renewed three hundred and ſixty-five Times, we find that all the vegetable World has gone through all its Variegations, and Nature has again put on the ſame Face, adapted to the Seaſon; during which Time, and indeed which occaſions this general Change and Repetition, the Earth is found to make one intire Revolution round the Sun. This Space, or Period of Time, we call a ſolar, or rather a natural Year; and from our Senſibility of this, and its conſtituent Parts, both horary and diurnal, we form our general Judgment of Duration.

Saturn, the moſt remote, and moſt regular Planet in our Syſtem, as has been ſaid before, performs one Revolution round the Sun in about twenty-nine of the above ſolar Years: The great Comet of 1680 makes but one periodical Return in five hundred and ſeventy-five of thoſe Years, and the general Motion of the Stars, ariſing from the Proceſſion of the Equinoxes, altogether continually changing their Aſpect, or Poſition, at the Rate of 50″ *per* Year round the ecliptic Poles, compleats but one Revolution in 25920 Years; in which Time the whole ſidereal Frame of Heaven has changed, and every Star returned to the ſame Point of the ſolar Sphere it ſet out from. This is by many called the great *Saturnian* Year: Concerning which, Mr. *Addiſon* has thus tranſlated an eminent Author.

> When round the great *Saturnian* Year has turn'd,
> In their old Ranks the wandering Stars ſhall ſtand,
> As when firſt marſhall'd by the Almighty's Hand.
>
> ADDISON.

Now, if this ſidereal Revolution, ariſing from a ſecondary Cauſe, require this Number of Years to perfect one Rotation, what muſt their primitive Orbits take to circumſcribe the *Vortex Magnus*.

It has been obſerved, that the biggeſt Star to us ſcarce moves a Minute in an hundred Years, and the moſt remote as inſenſibly for Ages, from whence and what has been already ſaid of the imagined Diſtance of the general Center, we may frame this probable and well-grounded Gueſs, that the mean Revolution of a Star near the Middle of the *Vortex Magnus*, cannot be made in leſs than a Million of Years, and though to us imperceptible, our Sun in his own orbicular Direction, may be moving many Miles *per* Day. Beſides, if local Motion can be proved amongſt the Stars, what leſs than an Eternity can again reſtore them to their original Order and primitive State.

Such vaſt Room in Nature, as *Milton* finely expreſſes it, cannot be without its Uſe; and nothing but abſolute Demonſtration is wanting (which from their Nature and Diſtance cannot be expected) to confirm the grand Deſign, ſo ſuited to the Deity's infinite Capacity, and of eternal Benefit to all his Creatures, eſpecially Beings of a rational Senſe, and in particular Mankind.

Of theſe habitable Worlds, ſuch as the Earth, all which we may ſuppoſe to be alſo of a terreſtrial or terraqueous Nature, and filled with Beings of the human Species, ſubject to Mortality, it may not be amiſs in this Place to compute how many may be conceived within our finite View every clear Star-light Night. It has already been made appear, that there cannot poſſibly be leſs than 10,000,000 Suns, or Stars, within the Radius of the viſible Creation; and admitting them all to have each but an equal Number of primary Planets moving round them, it follows that there muſt be within the whole celeſtial Area 60,000,000 planetary Worlds like ours. And if to theſe we add thoſe of the ſecondary Claſs, ſuch as the Moon, which we may naturally ſuppoſe to attend particular primary ones, and every Syſtem more or leſs of them as well as here; ſuch Satellites may amount in the Whole perhaps to 100,000,000, or more, in all together then we may ſafely reckon 170,000,000, and yet be much within Compaſs, excluſive of the Comets which I judge to be by far the moſt numerous Part of the Creation.

In this great Celeſtial Creation, the Cataſtrophy of a World, ſuch as ours, or even the total Diſſolution of a Syſtem of Worlds, may poſſibly be no more to the great Author of Nature, than the moſt common Accident in Life with us, and in all Probability ſuch final and general Doom-Days may be as frequent there, as even Birth-Days, or Mortality with us upon the Earth.

This Idea has ſomething ſo chearful in it, that I own I can never look upon the Stars without wondering why the whole World does not become Aſtronomers; and that Men endowed with Senſe and Reaſon, ſhould neglect a Science they are naturally ſo much intereſted in, and ſo capable of inlarging the Underſtanding, as next to a Demonſtration, muſt convince them of their Immortality, and reconcile them to all thoſe little Difficulties incident to human Nature, without the leaſt Anxiety.

Such a Protheſis can ſcarce be called leſs than an ocular Revelation, not only ſhewing us how reaſonable it is to expect a future Life, but as it were, pointing out to us the Buſineſs of an Eternity, and what we may with the greateſt Confidence expect from the eternal Providence, dignifying our Natures with ſomething analogous to the Knowledge we attribute to Angels; from whence we ought to deſpiſe all the Viciſſitudes of adverſe Fortune, which make ſo many narrow-minded Mortals miſerable.

I am now, &c.

LETTER THE NINTH.

Reflections, by Way of General Scolia, *of Conſequences relating to the Immortality of the Soul, and concerning Infinity and Eternity.*

SIR,

THIS my laſt Letter to you, I mean my final aſtronomical one, I propoſe as a *General Scolia* to the reſt, the principle Matter being Reflections upon what is gone before, with ſome Concluſion naturally following or appendant to what has been already ſaid; but which, I could not in any other Place, ſo properly remark to you.

The Probability of the foregoing Conjectures, chiefly built upon very diſtant Obſervations, ſhew an apparent Neceſſity for ſome other kind of Doctrine permitted by Providence, to give Mankind a Knowledge of their Immortality and Dependance upon it, in the firſt Ages of the World.

And for the ſame Reaſon it evidently appears, that the ancient Philoſophers had it not in their Power to prove a ſupream *Being* and Director of all Things this Way.

And yet, as by a Sort of Inſtinct, or natural Reaſon, and Conſciouſneſs of a *good Principle*, we ſee how many noble Steps they made towards it, and was convinc'd at laſt of this *great Truth*, that ſince there was a *Mind* in ſo imperfect a Creature as Man, the *perfect Univerſe*, which comprehended all Things, could not poſſibly be without one; and as Sir *Iſaac Newton* has juſtly obſerved in his *Principia*, " If every Par-" ticle of Space be *always*, and every individual Moment of Duration " *every where*; ſurely the Maker and Lord of all Things, cannot be *never* " and *no where*."

To make manifeſt the infinite Empire and Agency of God, from celeſtial Motion, became the Taſk, but of very late Years; and I can't help being of Opinion, that by means of theſe primary Bodies, only, we ſhall at length be able to trace the greater Circulations, and Laws of Nature, to their real original and fountain Head.

Theſe

Theſe, were any thing wanting, beſides the *Miracle ourſelves*, to convince us of a divine Origination, are all infallible Proofs, that the Univerſe is governed by an intelligent and all-powerful Being, whoſe Exiſtence is too nearly related to a ſelf-evident Truth to be more clearly demonſtated, than it is manifeſt of itſelf, both from the particular Laws of Nature, and the general Order of Things. An Argument which has been thought of no ſmall Force, and well worth obſerving in the Infancy of *Chriſtianity*. *The inviſible Things of God are clearly ſeen, being underſtood by the Things that are made, even his eternal Power and Godhead.* Rom. i. 20.

But 'tis now high time to look back upon my Theory, and tell you it is a vain Suppoſition, to imagine I ſhall ever be able to convince every Reader, either of the Truth or Probability of what I have advanced to you: Mathematical Aſſiſtance not being to be expected, where perhaps it has never been thought of; and I allow you, it is much more reaſonable to expect, that fifty Perſons will read theſe Letters without perceiving the Reaſonableneſs of them, than that five ſhould conſider them with proper Judgment.

I muſt ingenuouſly confeſs to you, that nothing is wanting to convince me intirely of the Certainty of what I here advance by way of Conjecture to you. But this you muſt only look upon as an happy Partiality, which generally attends all Authors, and always will be the chief Support of their tedious Labours. I aſſure you, I have neither Hopes nor Expectation, no, not the weak Breath of a Wiſh, to be admitted a proper Judge of my own Works. But I ſhall always take their Imperfection to be rather, (like my own Faults) to be too near me to be ſeen; I therefore truſt all to my Friend, and if I am ſo fortunate as to excite his Approbation, I ſhall think myſelf very happy in a very favourite Point; which is, The advancing nothing which a rational Reader would willingly overlook, or be ignorant of.

But if I have been ſo happy as to come ſo near the Mark, as to border upon Truth, I believe you will allow me to carry my Conjectures a little further, and point out ſome farther pleaſing Conſequences, which I begin to perceive may naturally follow.

Should it be granted, that the Creation may be circular or orbicular, I would next ſuppoſe, in the general Center of the whole an intelligent Principle, from whence proceeds that myſtick and paternal Power, productive of all Life, Light, and the Infinity of Things.

Here the to-all extending Eye of Providence, within the Sphere of its Activity, and as omnipreſently preſiding, ſeated in the Center of Infinity, I would imagine views all the Objects of his Power at once, and every Thing immediately direct, diſpenſing inſtantaneouſly its enlivening Influence,

to

to the remoteſt Regions every where all round. I know you'll ſay Aſtronomers are never to be ſatisfied, and I muſt own where there is ſo much rational Entertainment for the human Mind, and ſo ſuitable to the true Dignity of God, and moſt worthy of Man, it is not eaſy to know where to ſtop in ſuch a Scene of Wonders.

Having, I ſay, once granted that all the Stars may move round one common Center, I think it is very natural to one, who loves to purſue Nature as far as we may, to enquire what moſt likely may be in that Center; for ſince we muſt allow it to be far ſuperior to any other Point of Situation in the known Univerſe, it is highly probable, there may be ſome one Body of ſiderial or earthy Subſtance ſeated there, where the divine Preſence, or ſome corporeal Agent, full of all Virtues and Perfections, more immediately preſides over his own Creation. And here this primary Agent of the omnipotent and eternal Being, may ſit enthroned, as in the *Primum Mobile* of Nature, acting in Concert with the eternal Will. To this common Center of Gravitation, which may be ſuppoſed to attract all Vertues, and repel all Vice, all Beings as to Perfection may tend; and from hence all Bodies firſt derive their Spring of Action, and are directed in their various Motions.

Thus in the *Focus*, or Center of Creation, I would willingly introduce a primitive Fountain, perpetually overflowing with divine Grace, from whence all the Laws of Nature have their Origin, and this I think would reduce the whole Univerſe into regular Order and juſt Harmony, and at the ſame time, inlarge our Ideas of the divine Indulgence, open our Proſpect into Nature's fair Vineyard, the vaſt Field of all our future Inheritance.

But what this central Body really is, I ſhall not here preſume to ſay, yet I can't help obſerving it muſt of Neceſſity, if the Creation is real and not merely Ideal, be either a Globe of Fire ſuperior to the Sun, or otherwiſe a vaſt terraqueous or terreſtial Sphere, ſurrounded with an Æther like our Earth, but more refined, tranſparent and ſerene. Which of theſe is moſt probable, I ſhall leave undetermined, and muſt acknowledge at the ſame time, my Notions here are ſo imperfect, I hardly dare conjecture. 'Tis true, I have ventur'd to think it may be one of theſe, and ſince ſo glorious a Situation can hardly be ſuppoſed without its proper Inhabitants, 'tis moſt natural to conclude it may be the latter. In the firſt Caſe, beſides our having no Idea of Beings exiſting in Fire, it would not, notwithſtanding its Diſtance, be ſo eaſy to account for its being inviſible; and ſince the Luſtre of the Stars are all innate, they could receive no Benefit from it, and conſequently ſuch a Nature as a ſolar Compoſition, muſt in this Place be render'd uſeleſs; but in the latter Suppoſition.

poſition of its being a dark Body, we have no Difficulty attending us, having ſeveral Inſtances of like Bodies, moving round an opaque one. Now when we conſider, that all thoſe radient Globes, which adorn the Skies, thoſe bright ætherial Sparks of elemental Fire, thick ſtrewed like Seeds of Light all round our Hemiſphere, are each to us the Embrio of a glorious Sun; how awful and ſtupendious muſt that Region be, where all their Beams unite and make one inconceivable eternal Day?

Though the Deity, ſays a learned Writer "be eſſentially preſent thro' "all the Immenſity of Space, there is one Part of it in which he diſco- "vers himſelf in a moſt tranſcendent and viſible Glory. This is that Place "which is mark'd out in Scripture, under the different Appellations "of PARADICE; *the third Heaven*; *the Throne of* GOD, *and the Habi- "tation of his Glory.*"

THIS continues the ſame Author, is "that Preſence of God, which "ſome of the Divines call his glorious, and others his majeſtick Pre- "ſence."

It is here, and here only, as in the Center of his infinite Creations, where he reſides in a ſenſible Magnificence, and in the midſt of thoſe Splendors, which can Effect the Imagination of his Creatures; and though the moſt ſacred and ſupreme Divinity be allowed as eſſentially preſent in all other Places as well as in this, as being a BEING whoſe Center is every where, and Circumference no where; yet it is here only, or in ſuch Senſorium of his Unity, where he manifeſts his corporeal Agency, as in the Foci of his infinite Empire over all created Beings. It is to this majeſtick Preſence of GOD, we may apply thoſe beautiful Expreſſions of Scripture, "*Behold even to the Moon and it ſhineth not*; *yea the Stars* "*are not pure in his Sight.*"

"The Light of the Sun, and all the Glories of the World, on which "we live, are but as weak and ſickly Glimmerings, or rather Dark- "neſs it ſelf, in Compariſon of thoſe Splendors, which encompaſs this "Throne of GOD."

Here Heav'ns wide Realms an endleſs Scene diſplays,
And Floods of Glory thro' its Portals blaze;
The Sun himſelf loſt in ſuperior Light,
No more renews the Day, or drives away the Night:
The Moon, the Stars, and Planets diſappear,
And Nature fix't makes one eternal Year.

Here and here alone center'd in the Realms of inexpreſſible Glory, we juſtly may imagine that primogenial Globe or Sphere of all Perfections, ſubject

ſubject to the Extreams of neither Cold nor Heat, of eternal Temperance and Duration. Here we may not irrationally ſuppoſe the Vertues of the meritorious are at laſt rewarded and received into the full Poſſeſſion of every Happineſs, and to perfect Joy. The final and immortal State ordain'd for ſuch human Beings, as have paſſed this Vortex of Probation thro' all the Degrees of human Nature with the ſupream Applauſe.

What vaſt room is here, for infinite Power and Wiſdom to act in, and that ſo viſibly takes Delight to bleſs all his Beings with his Bounty. And endleſs as his Preſcience, Attributes, and Goodneſs, are undoubtedly all thoſe natural and apparent Joys with which he manifeſts his Love to all his Creatures, a Multiplicity of Objects not to be enumerated. For where-ſoever we turn our Eyes, and follow with our Reaſon, we may meet with Worlds of all Formations, ſuited no doubt to all Natures, Taſtes, and Tempers, and every Claſs of Beings.

Here a Groupe of Worlds, all Vallies, Lakes, and Rivers, adorn'd with Mountains, Woods, and Lawns, Caſcades and natural Fountains; there Worlds all fertile Iſlands, cover'd with Woods, perhaps upon a common Sea, and fill'd with Grottoes and romantick Caves. This Way, Worlds all Earth, with vaſt extenſive Lawns and Viſtoes, bounded with perpetual Greens, and interſperſed with Groves and Wilderneſſes, full of all Varieties of Fruits and Flowers. That World ſubſiſting perhaps by ſoft Rains, this by daily Dews, and Vapours; and a third by a central, ſubtle Moiſture, ariſing like an Effluvia, through the Pores and Veins of the Earth, and exhaling or abſorbing as the Seaſon varies to anſwer Nature's Calls. Round ſome perhaps, ſo denſe an Atmoſphere, that the Inhabitants may fly from Place to Place, or be drawn through the Air in winged Chariots, and even ſleep upon the Waves with Safety; round others poſſibly, ſo thin a fluid, that the Arts of Navigation may be totally unknown to it, and look'd upon as impracticable and abſurd, as Chariot flying may be here with us; and ſome where not improbably, ſuperior Beings to the human, may reſide, and Man may be of a very inferior Claſs; the ſecond, third, or fourth perhaps, and ſcarce allow'd to be a rational Creature. Worlds, with various Moons we know of already; Worlds, with Stars and Comets only, we equally can prove is very probable; and that there may be Worlds with various Suns, is not impoſſible. And hence it is obvious, that there may not be a Scene of Joy, which Poetry can paint, or Religion promiſe; but ſomewhere in the Univerſe it is prepared for the meritorious Part of Mankind. Thus all Infinity is full of States of Bliſs; Angelic Choirs, Regions of Heroes, and Realms of Demi-Gods; Elyſian Fields, Pindaric Shades, and Myriads of inchanting Manſions,

not to be conceived either by Philoſophy or Fancy, aſſiſted by the ſtrongeſt Genius and warmeſt Imagination.

All harmoniouſly crowded and provided with every Object of Beatitude, that Friendſhip, Love, or Society can inſpire, the Muſes or the Graces Frame; and all as permanent and perfect, that is deſtin'd to a Duration, ſuited to the Nature of their Exiſtence and Degree of Cogniſance; for as a very learned Writer obſerves upon this ſame Subject;

" How can we tell, but that there may be above us Beings of greater " Powers, and more perfect Intellects, and capable of mighty Things, " which yet may have corporeal Vehicles as we have, but *finer* and " *inviſible?* Nay, who knows, but that there may be even of theſe " many *Orders*, riſing in Dignity of Nature, and Amplitude of Power, " one above another? It is no Way below the Philoſophy of theſe Times, " which ſeems to delight in inlarging the Capacities of Matter, to aſſert " the Poſſibility of this."

From theſe amazing Ideas of Space in general, and from the particular Diſtance of the Stars, which ſeparates as it were, one Syſtem of Bodies from another, and by ſo prodigious an extent, as ſcarce to be ſuppos'd a temporal Taſk. I think it naturally follows, had we no other Way to prove it, or any other Reaſon to believe it, that the Soul muſt of Neceſſity be immaterial; for as this Space ſeems ſo impaſſible to Matter, as not to be undertaken and performed without the Loſs of Ages, in a State only of Tranſmigration, we may well imagine, that Change of Place is not effected this Way, but by ſome other Vertue or Property, more immediate, if not inſtantaneous.

I own next to *Annihilation* is the State of Oblivion, and this Way we may ſolve all Difficulties with regard to our being ſenſible of ſuch a Loſs of Exiſtence; but if we allow the Soul to be immaterial, it no longer has any thing to do with Space, but as operating by Reflection only, or the Faculty of Thinking; it may be like the Imagination where it pleaſes in a Moment.

Objects of the Mind abſtracted from the Senſes of the Body, has no real or comparative Magnitude; that is, I would ſay, an Inch, a Foot, a Yard, a Mile, or a Million of Miles are all equally indefinite, and is thus prov'd; every finite Line is formed of an infinite Number of Points, and no finite Line can be ſolv'd into more. Thus if you will allow me the Expreſſion, the Mind being magnified as all Objects are diminiſhed, what ſeems impracticable in the natural State of Things, in an Ideal one, becomes very poſſible; that is, to make myſelf more intelligible, though we can hardly conceive, how any Being can paſs from *Syrius* to the Sun, by natural Laws in their proper State, yet if proportionally reduced by a new

new Modification of Ideas, to the Bigneſs of a Ball 6 Feet Diameter, and to be only 680 Miles aſunder; the Thing is very comprehenſive and eaſy.

Hence Viſion, Light, and Electrical Virtue, ſeem to be propagated with ſuch Velocity, that nothing but God can poſſible be the Vehicle; and hence we may juſtly ſay with St. *Paul*, *Acts* xvii. 28. *In him we live, in him we move, in him we have our Being.*

It will further appear, from the foregoing Letters, that all the Stars and planetary Bodies within the finite View, are altogether but a very minute Part of the whole rational Creation; I mean that vaſt collective Body of habitable Beings, which I have endeavoured to demonſtrate, are all govern'd by the ſame Laws, though variouſly revolving round one common Center, in which Center we may not impertinently venture to ſuppoſe the prime Agent of our Natures; or otherwiſe, the moſt perfect of all created Beings, illimitable in his Ideas and Faculties of Senſation particularly preſide.

> But tho' paſt all diffus'd, without a Shore
> His Eſſence; *local* is his Throne, (as meet)
> To gather the diſperſt, (as Standards call
> The liſted from afar) to fix a Point;
> A central Point, collective of his Suns,
> Since finite ev'ry Nature, but his own. Dr. *Young*.

And farther ſince without any Impiety; ſince as the Creation is, ſo is the Creator alſo magnified, we may conclude in Conſequence of an Infinity, and an infinite all-active Power; that as the viſible Creation is ſuppoſed to be full of ſiderial Syſtems and planetary Worlds, ſo on, in like ſimilar Manner, the endleſs Immenſity is an unlimited Plenum of Creations not unlike the known Univerſe. See *Plate* XXXI. which you may if you pleaſe, call a partial View of Immenſity, or without much Impropriety perhaps, a finite View of Infinity, and all theſe together, probably diverſified; as at A, B and C. in *Plate* XXXII. which repreſents their Sections, if all may be a proper Term for an infinite or indefinite Number, we may juſtly imagine to be the Object of that incomprehenſible Being, which alone and in himſelf comprehends and conſtitutes ſupreme Perfection.

That this in all Probability may be the real Caſe, is in ſome Degree made evident by the many cloudy Spots, juſt perceivable by us, as far without our ſtarry Regions, in which tho' viſibly luminous Spaces, no one Star or particular conſtituent Body can poſſibly be diſtinguiſhed; thoſe in all

all likelyhood may be external Creation, bordering upon the known one, too remote for even our Teleſcopes to reach.

With the raptur'd Poet may we not juſtly ſay

O, what a Root! O what a Branch is here!
O what a Father! what a Family!
Worlds! Syſtems! and Creations!

And in Conſequence of this

In an Eternity, what Scenes ſhall ſtrike?
Adventures thicken? Novelties ſurprize?
What Webs of Wonder ſhall unravel there?

Night Thoughts.

So many varied Seats where every Element may have its proper Beings and all adapted to partake of every thing ſuited to their Natures, argue ſuch Maturity of Wiſdom, and the vaſt Production ſuch myſterious Power; 'tis hardly poſſible for Mortals not to ſee divine Intelligence preſide, and that every Being ſomewhere muſt be happy.

A Univerſe ſo well deſigned, and fill'd with ſuch an endleſs Structure of material Beings, and all the Reſult of Preſcience and infinite reflected Reaſon, flowing from a Mind all perfect, full of all Ideas, could never be deſigned in vain; and tho' our narrow Bounds of Reaſon limited, by finite Senſes, cannot directly ſee the Conſequence dependant on a Sequel, yet from what we do ſee, great Room we have to hope the next Stage of Exiſtence will be more laſting and more perfect; and it is highly probable, the nobleſt Suggeſtion of the moſt luxuriant Fancy may fall infinitely ſhort of what we are deſigned for.

But here, even in this World, are Joys which our Ideas of Heaven can ſcarce exceed, and if Imperfection appear thus lovely, what muſt Perfection be, and what may we not expect and hope for, by a meritorious Acquieſcence in Providence, under the Direction, Indulgence, and Protection of infinite Wiſdom and Goodneſs, who manifeſtly deſigns perfect Felicity, as the Reward of Virtue in all his Creatures, and will at proper Periods anſwer all our Wiſhes in ſome predeſtined World.

All this the vaſt apparent Proviſion in the ſtarry Manſions, ſeem to promiſe: What ought we then not to do, to preſerve our natural Birthright to it and to merit ſuch Inheritance, which alas we think created all to gratify alone, a Race of vain-glorious gigantick Beings, while they are confined to this World, chained like ſo many Atoms to a Grain of Sand.

I am, &c.

PLATE. I.

Fig. 1.

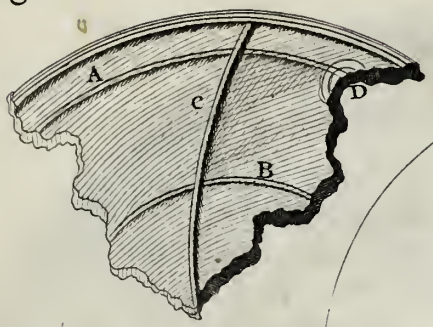
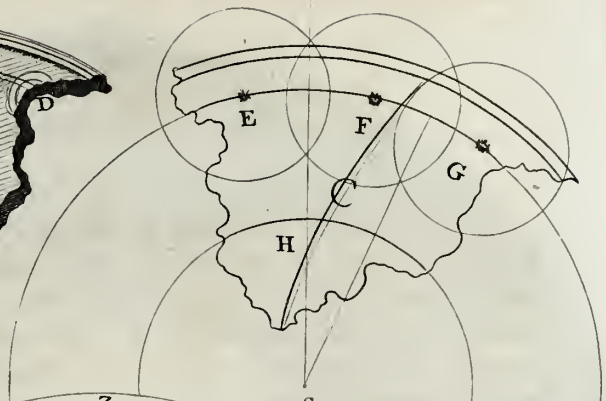


Fig. 2



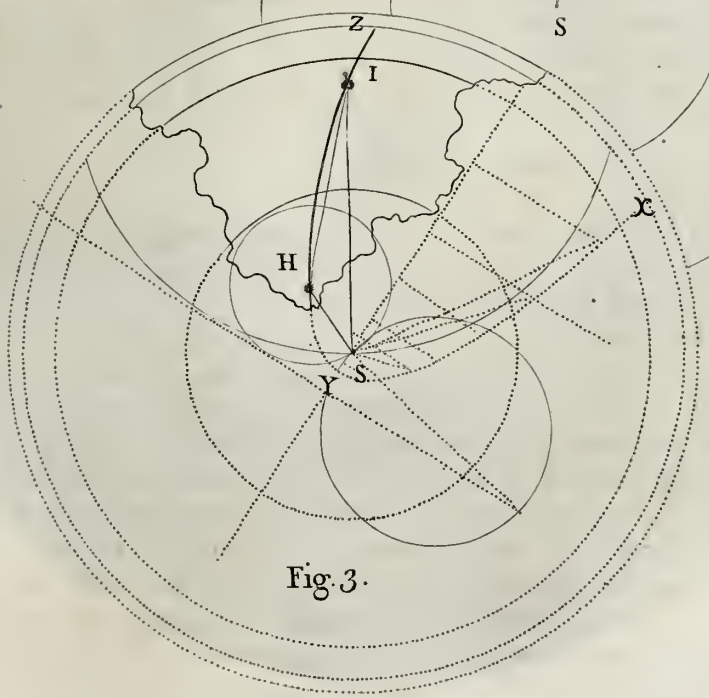


Fig. 3.

PLATE II.

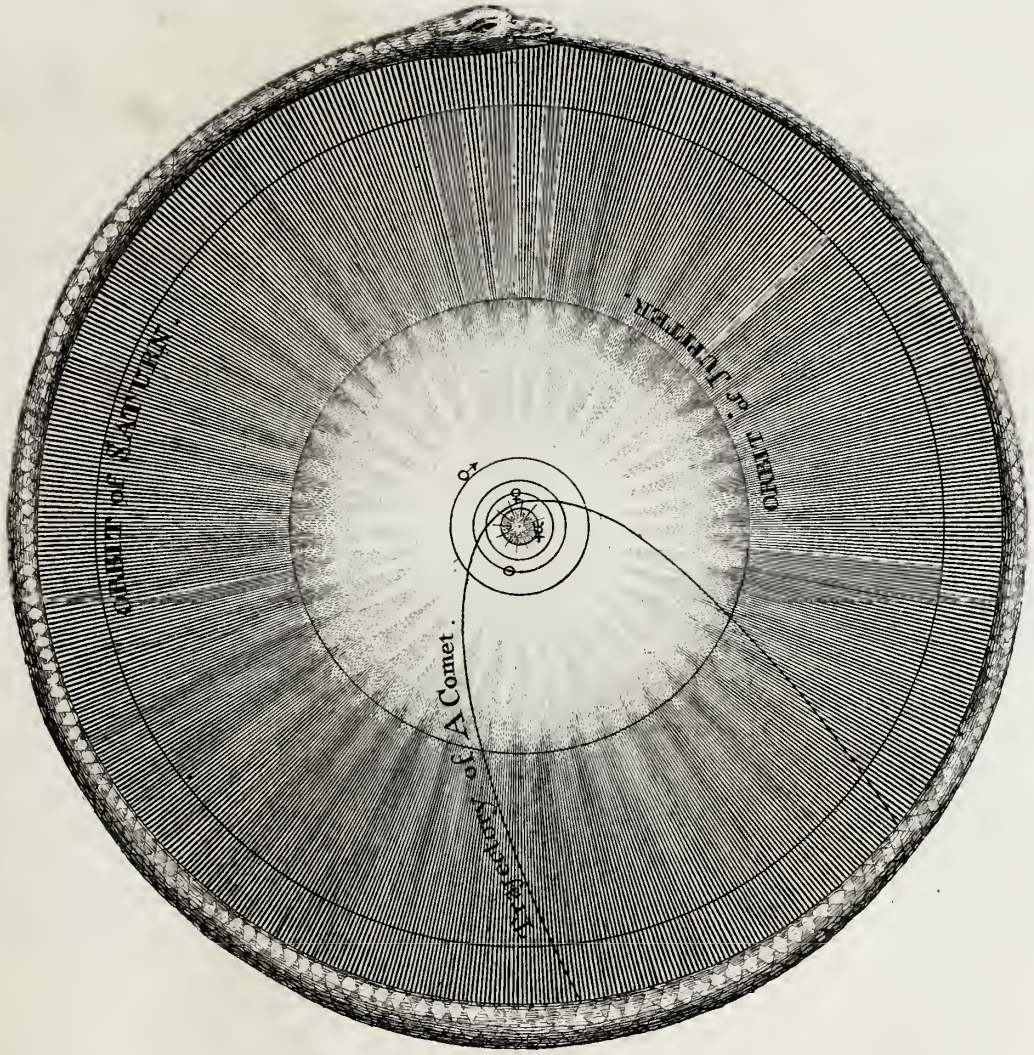
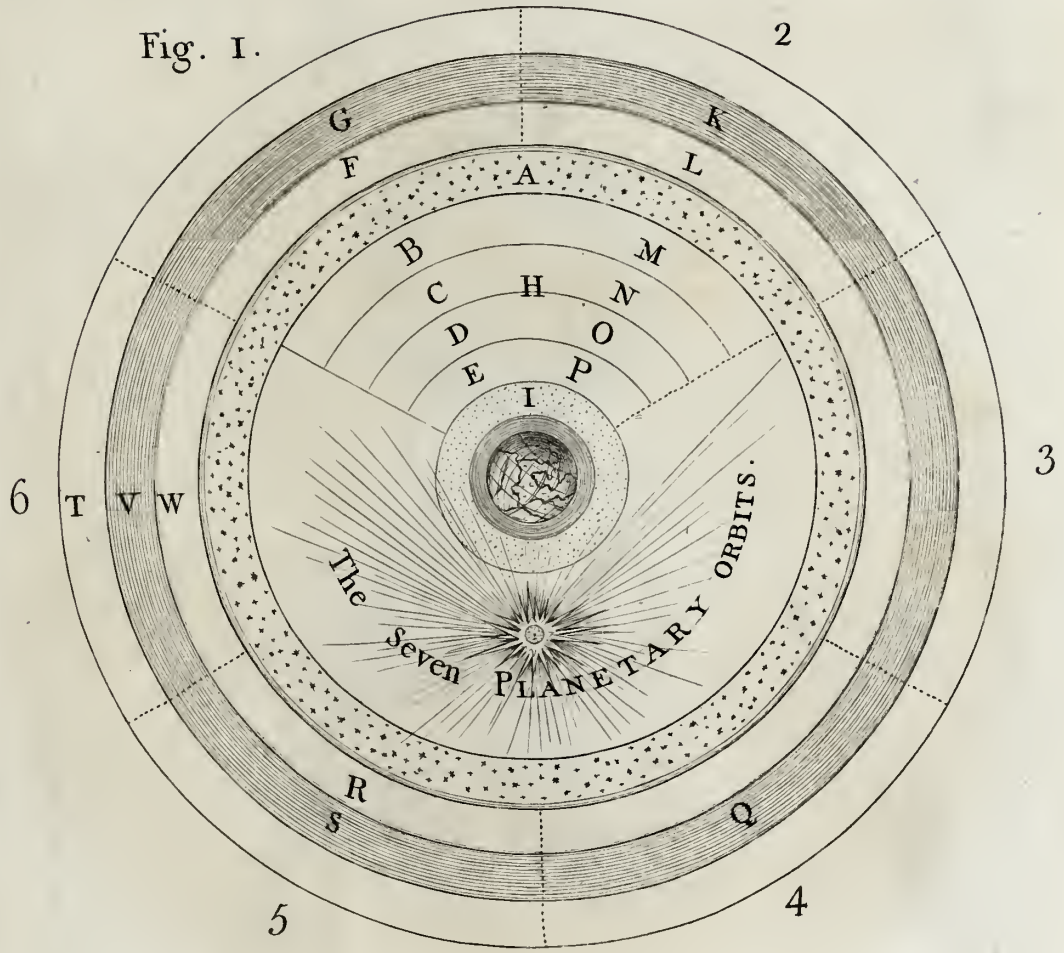


PLATE III.

Fig. I.



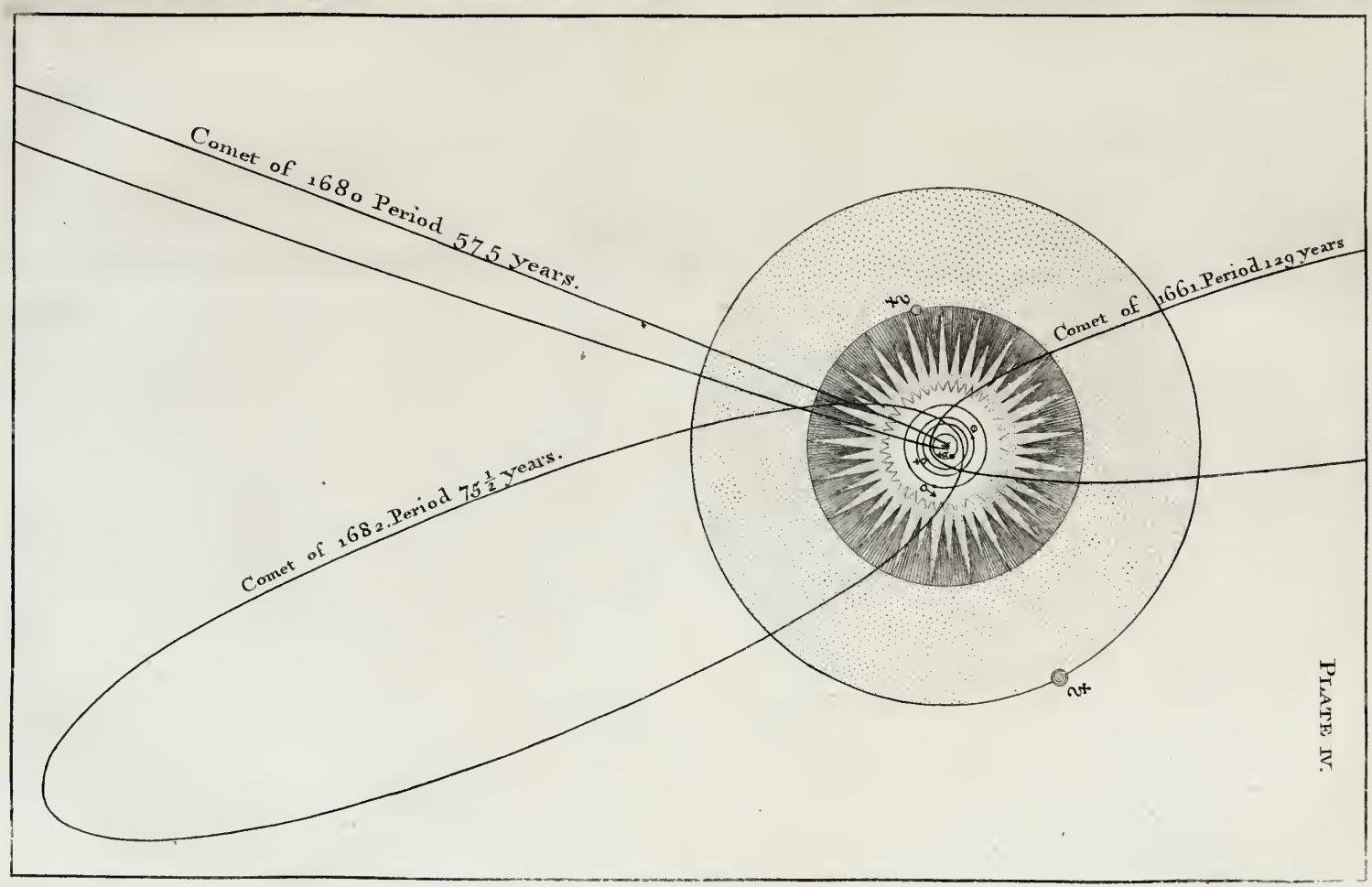

Comet of 1680 Period 575 years.
Comet of 1661 Period 129 years
Comet of 1682 Period 75½ years.

PLATE IV.

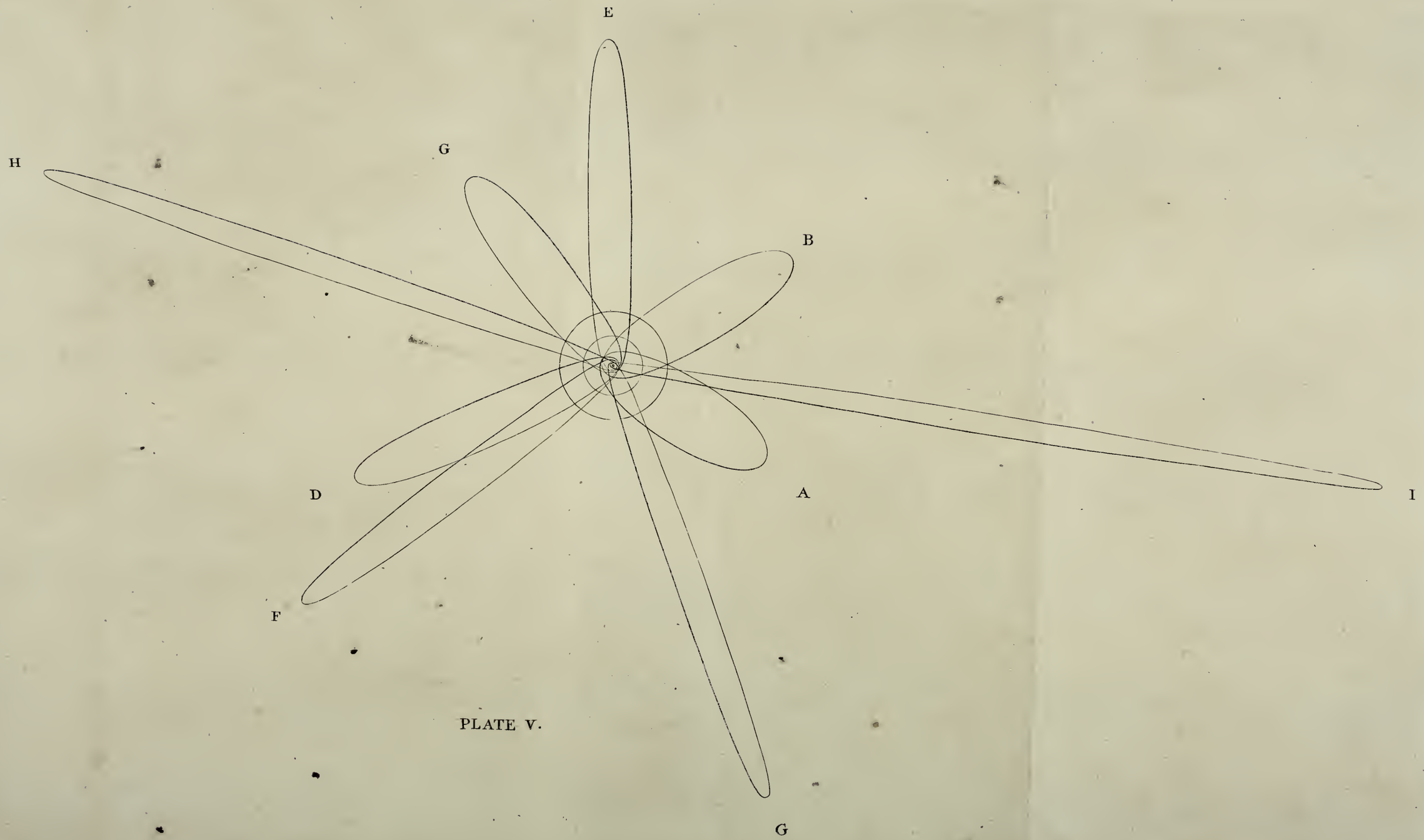


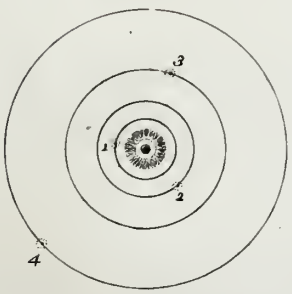
PLATE V.

Plate VI.

Figure. I.

Fig III

Fig. II.



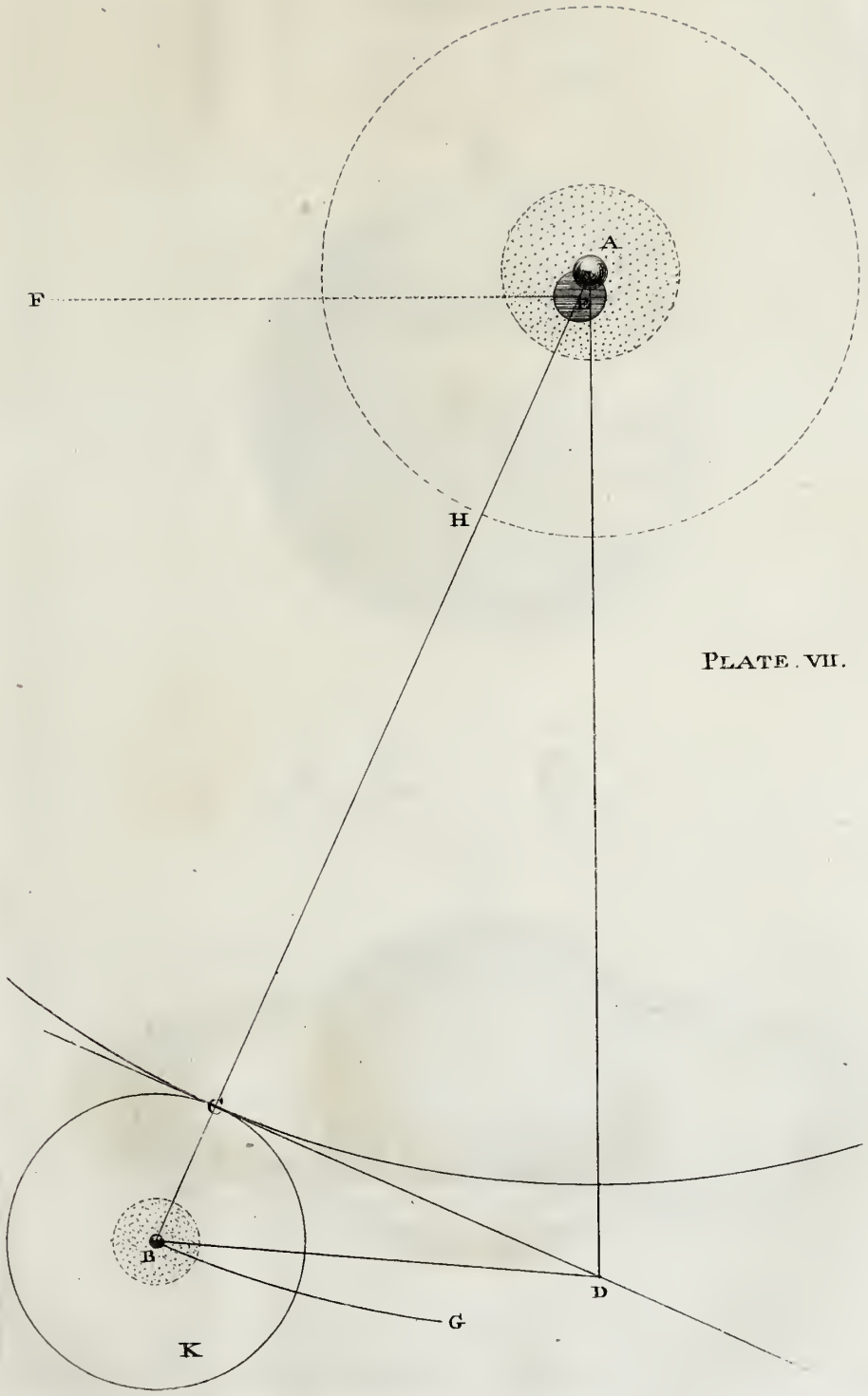


PLATE. VII.

PLATE. VIII.

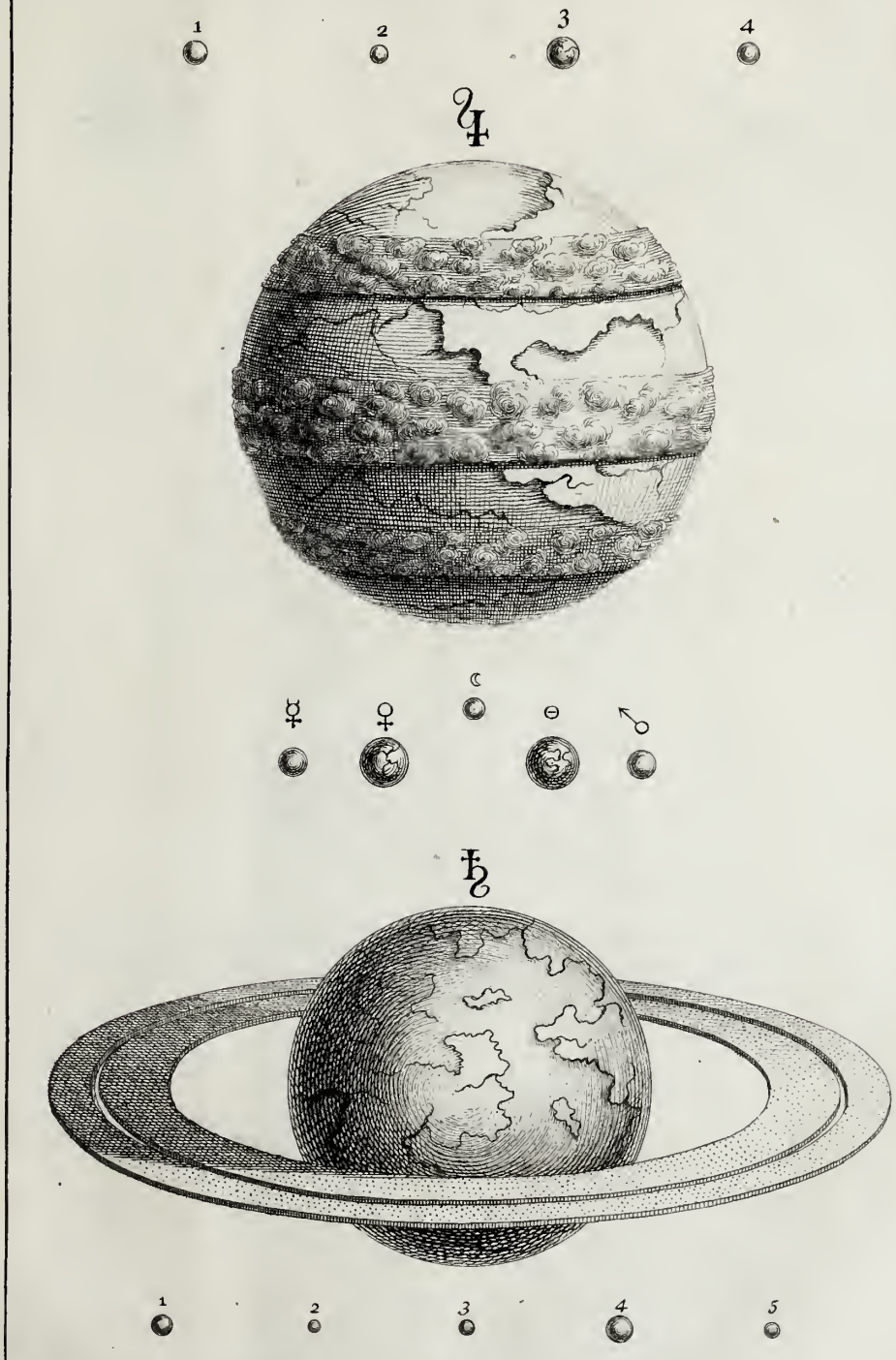


PLATE IX.

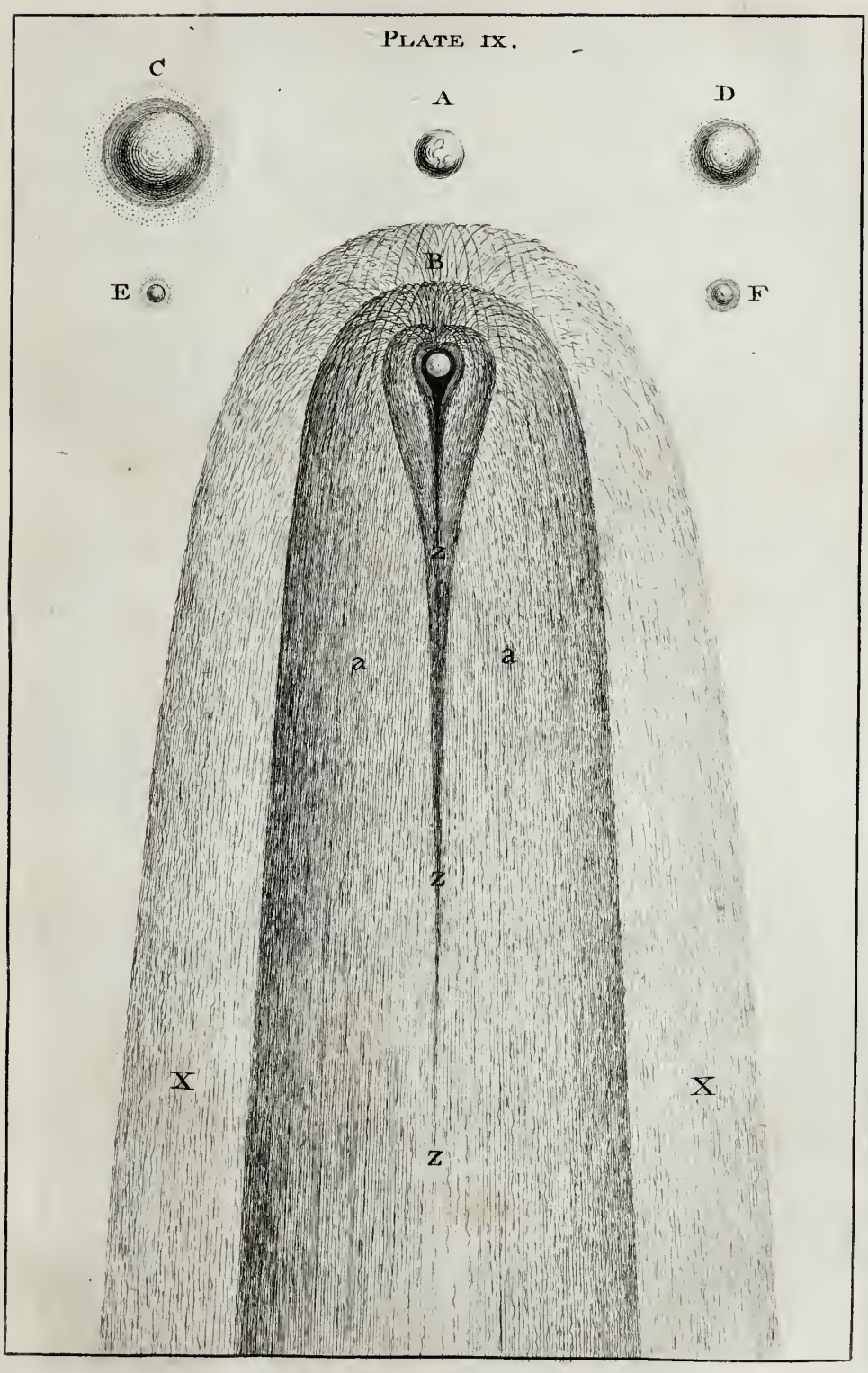


PLATE X.

Figure 1.

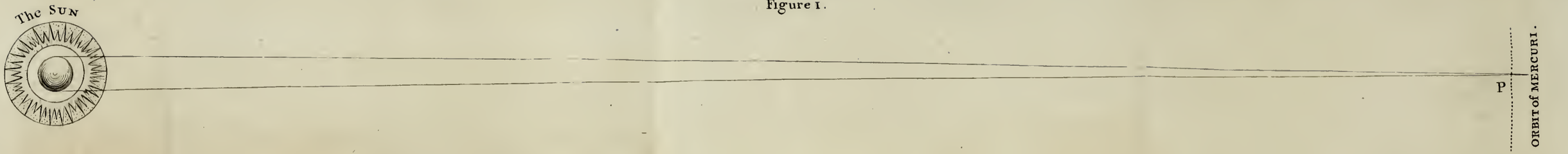


Plate xi.

Fig. 3.

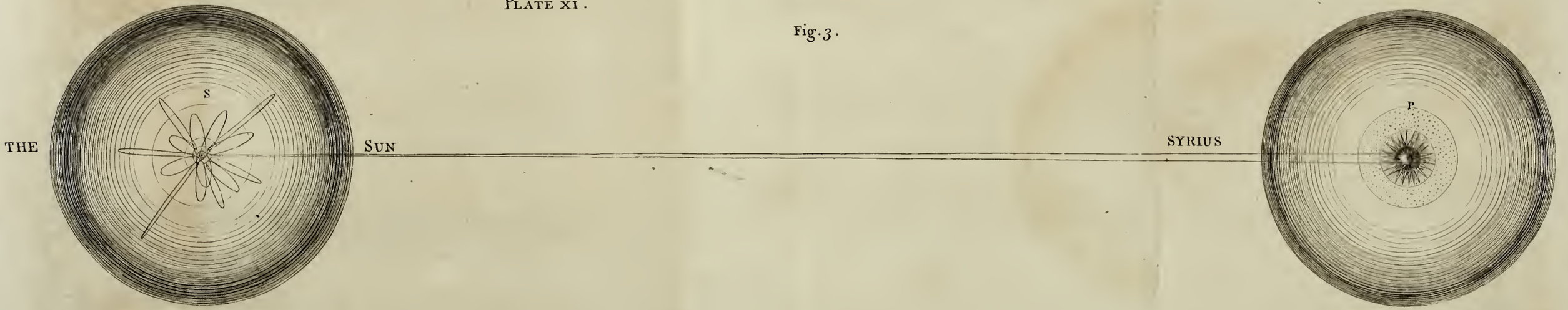


Fig. 2.

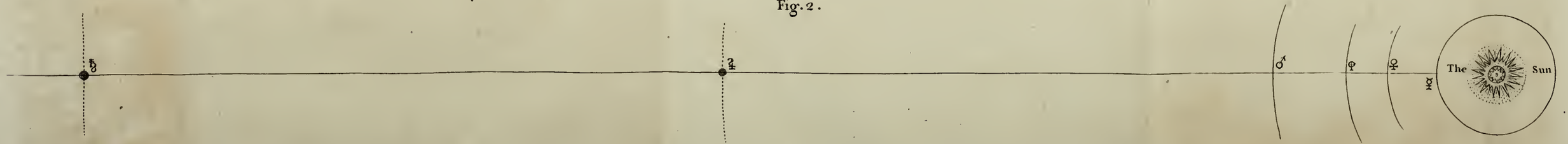
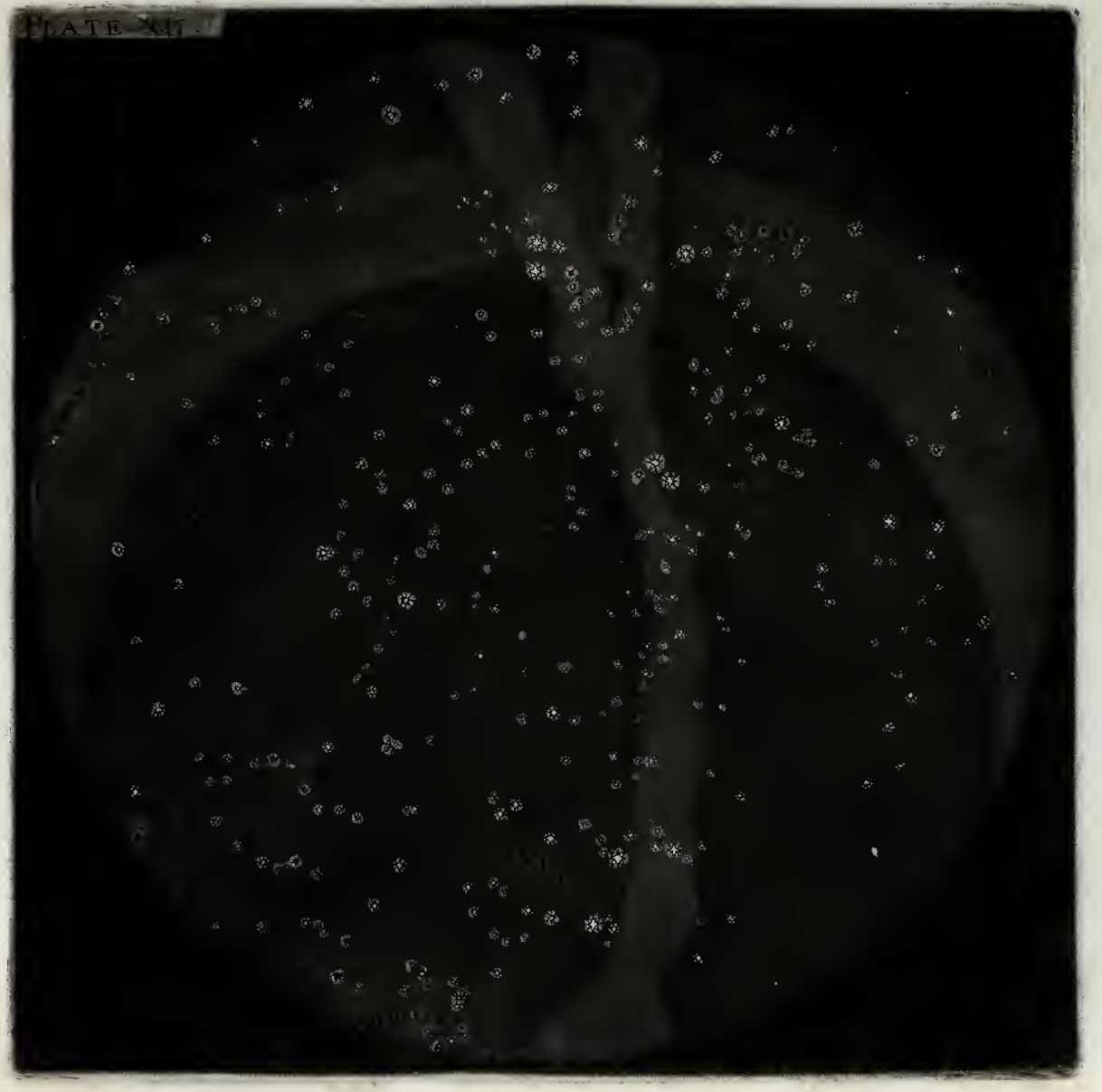


PLATE XII.



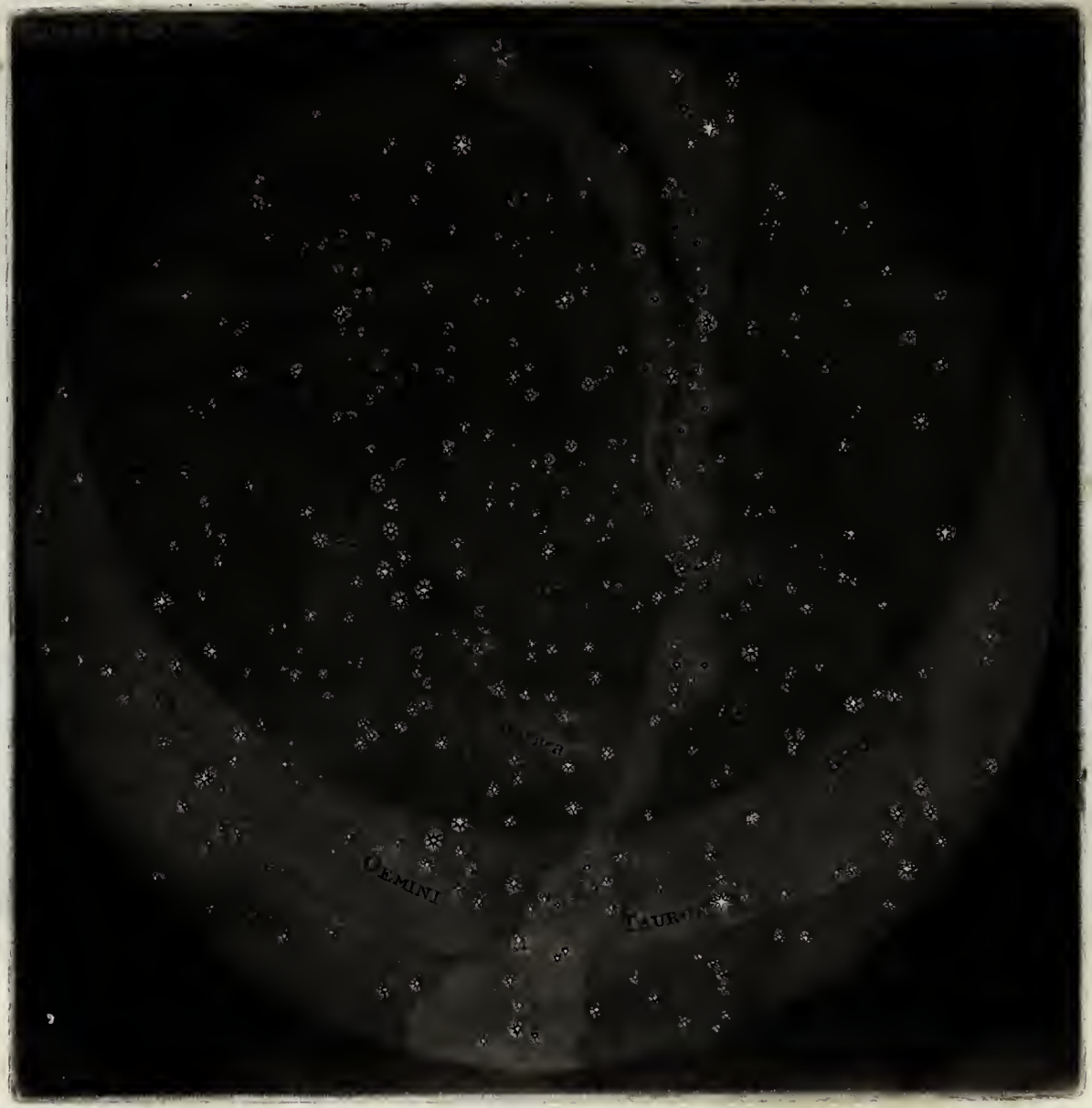

GEMINI
TAURUS

PLATE XIV.

PLATE. XV.

PLATE XVI.

PLATE XVII.

Figure 1.

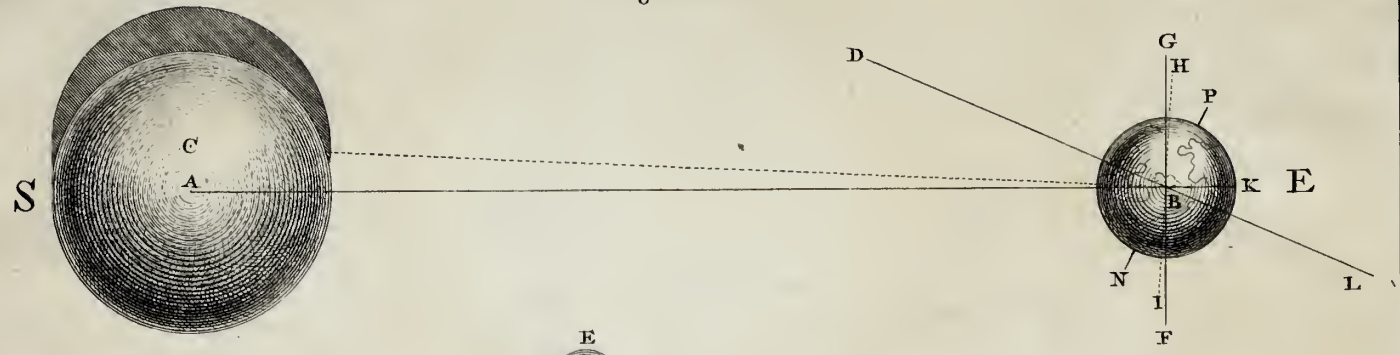


PLATE XVIII.

Fig. 2.

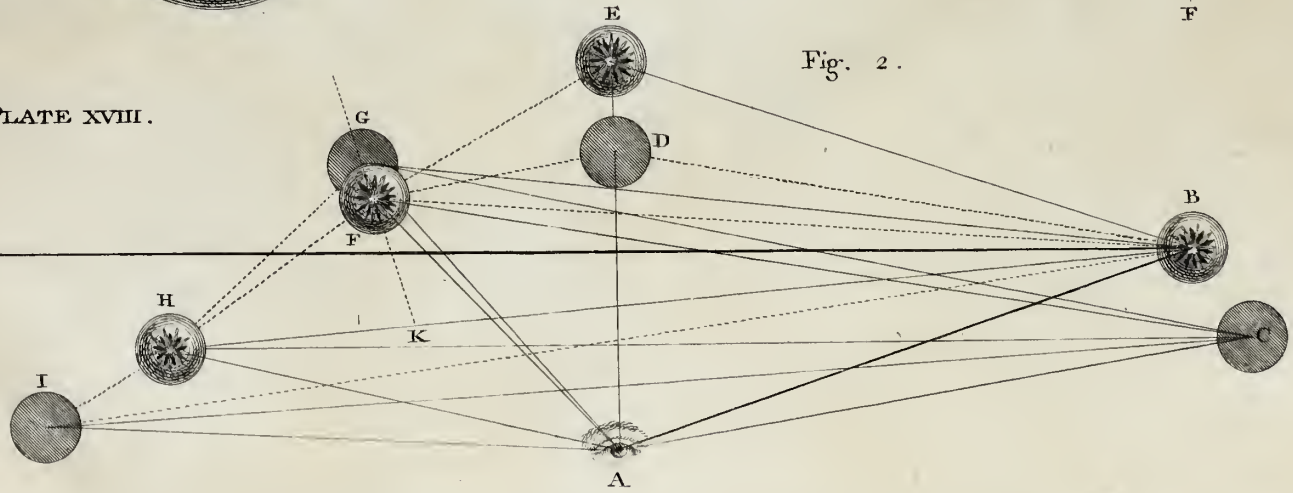


Plate. XIX.

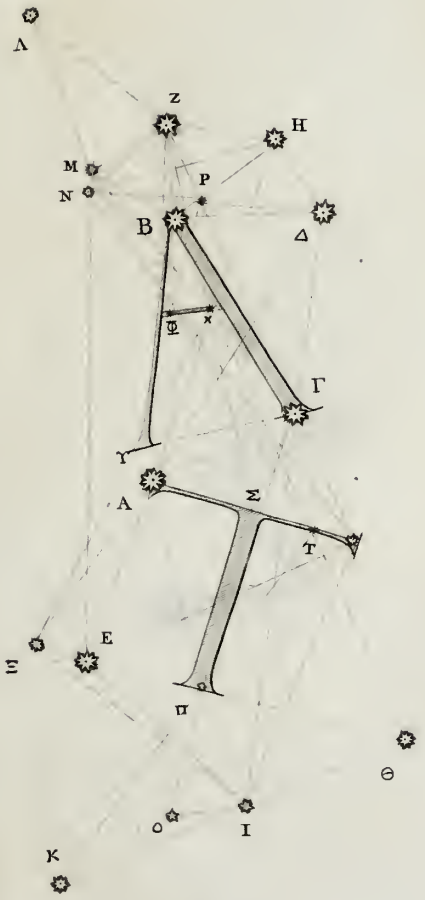


PLATE. XX.

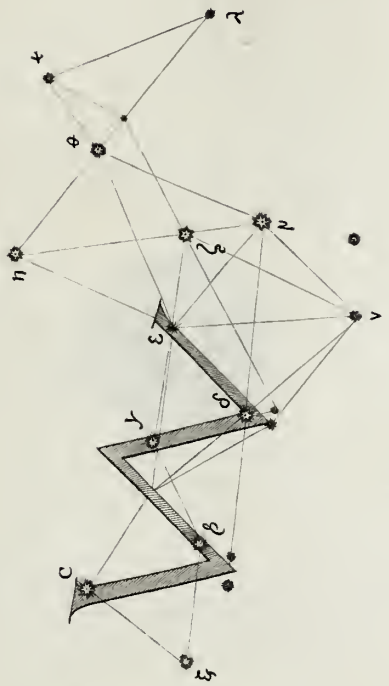


PLATE. XXI.

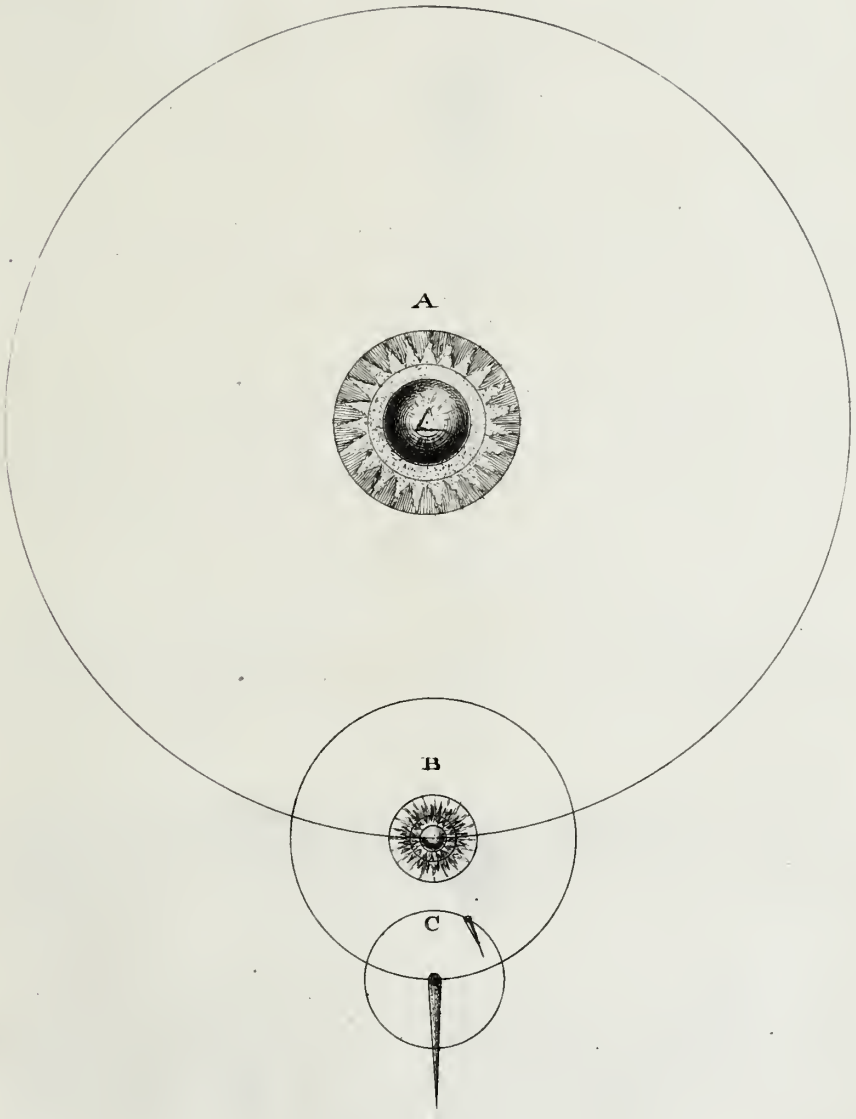
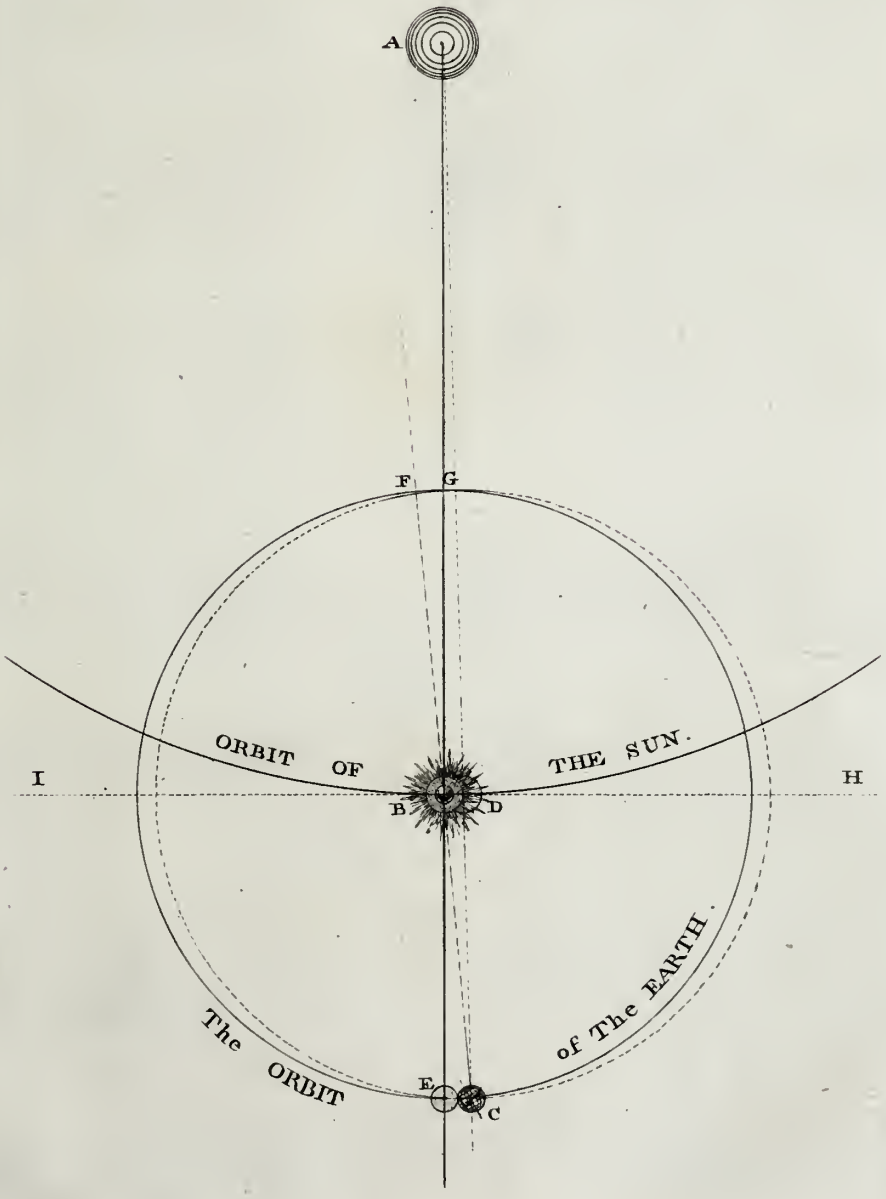


PLATE XXII.



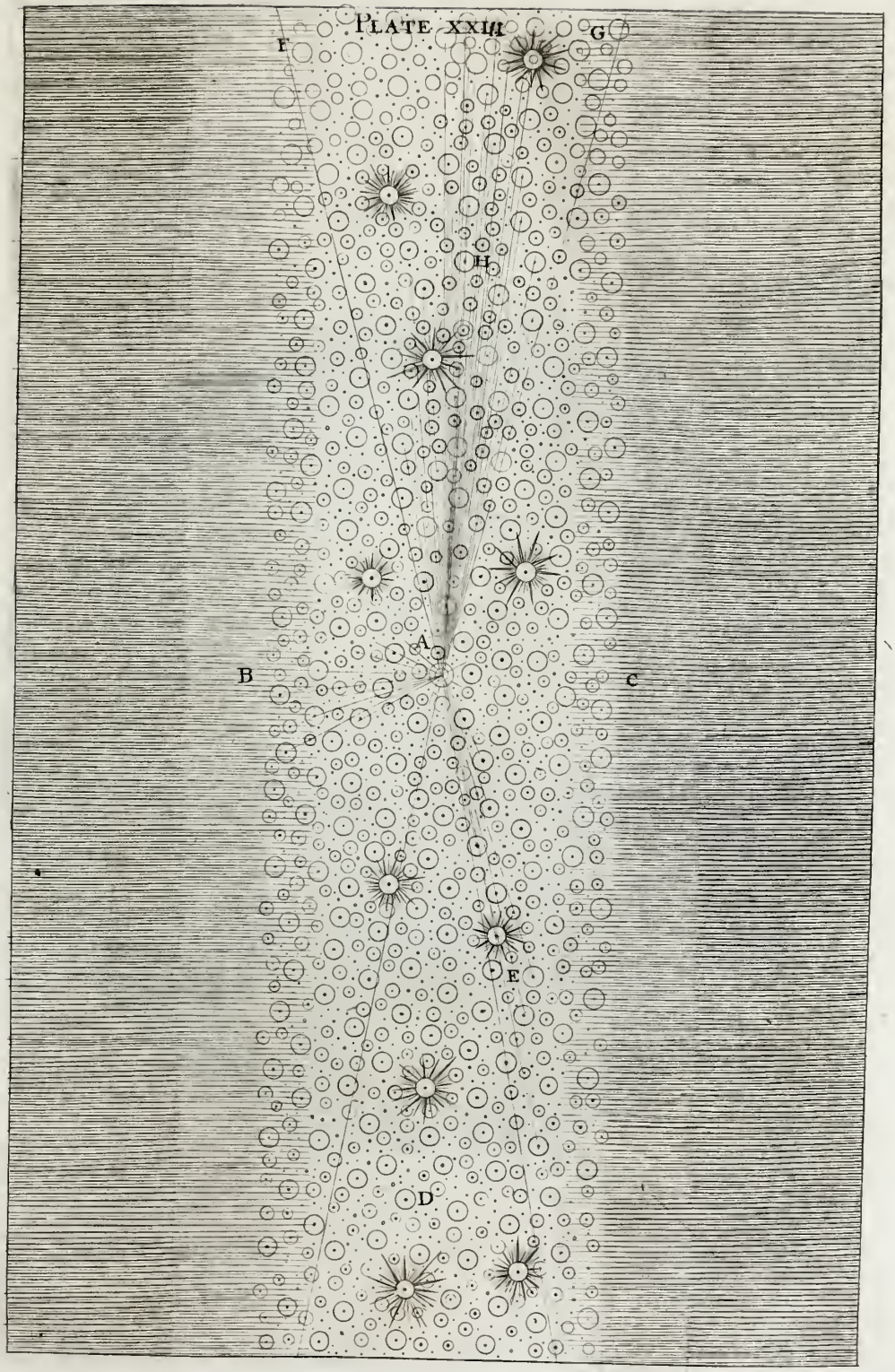


PLATE XXIII
F
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PLATE XXIV.

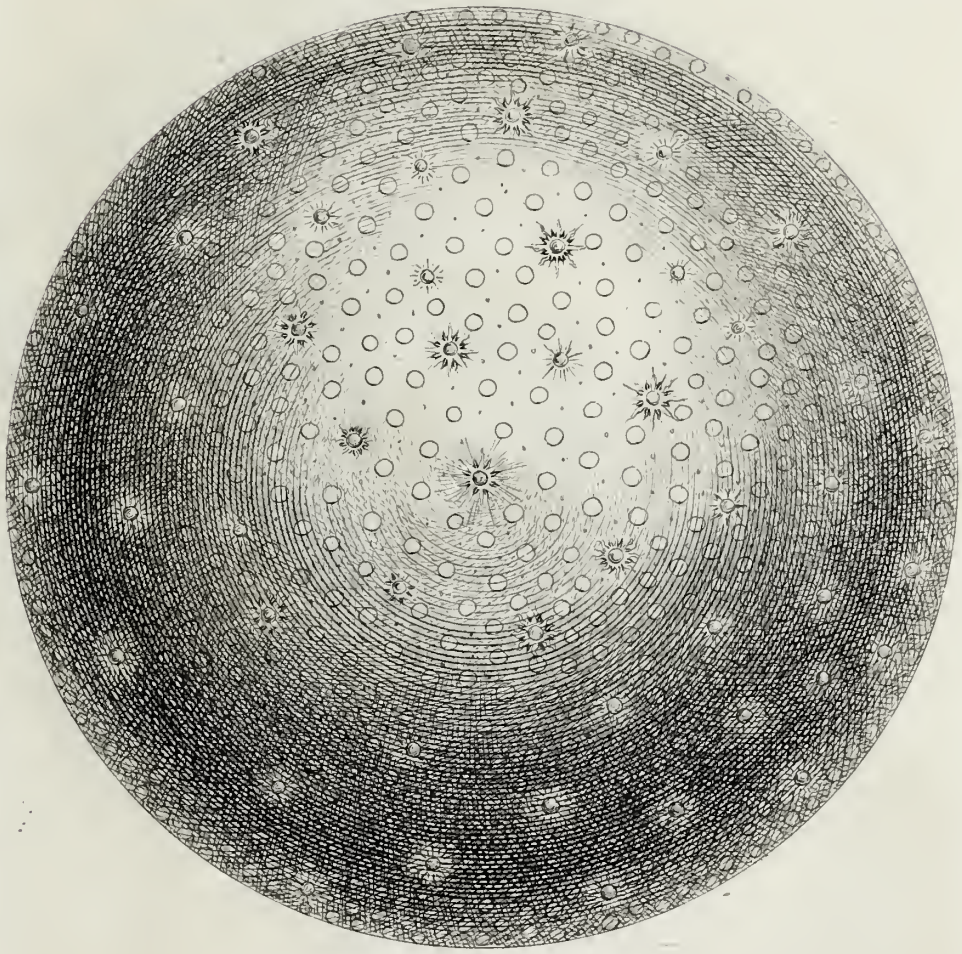


PLATE XXV.

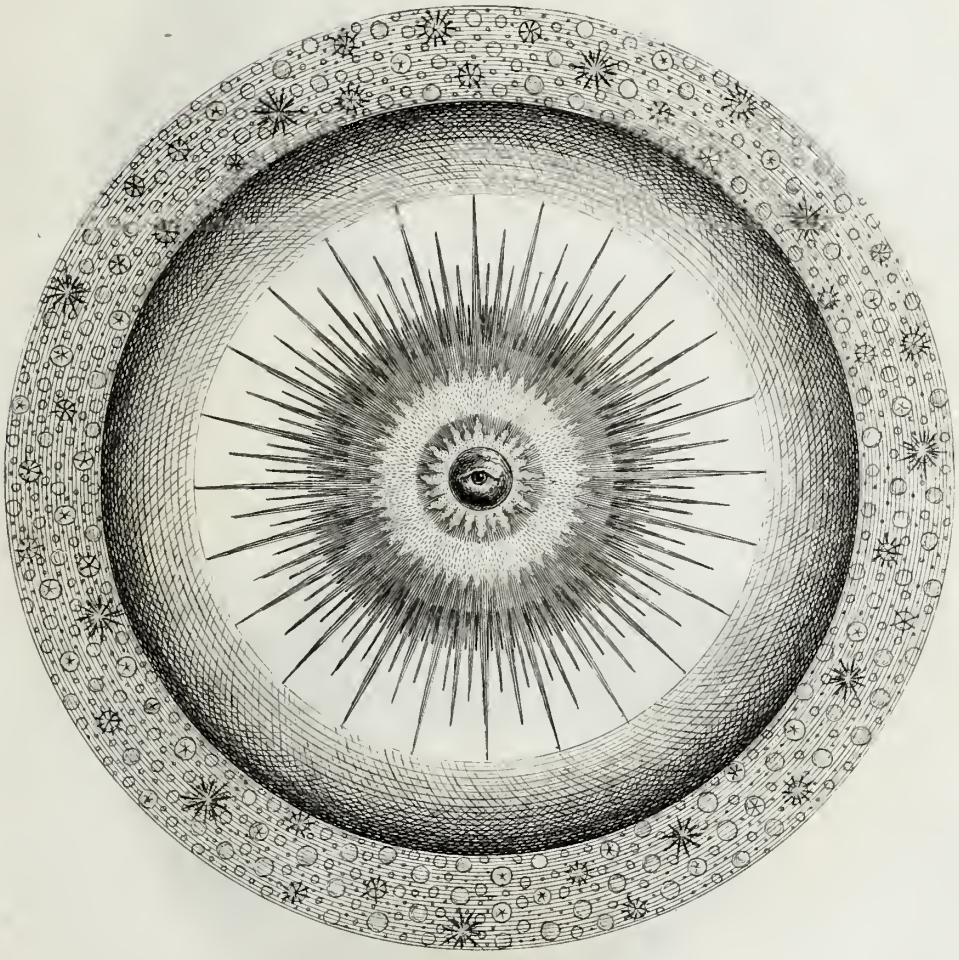
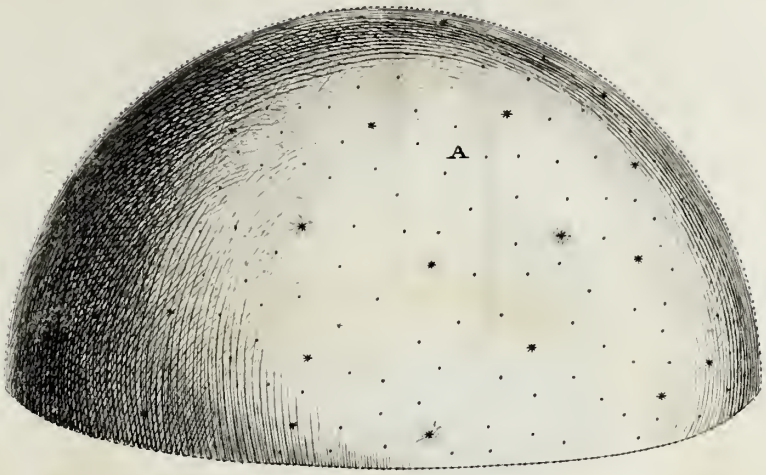


PLATE. XXVI.



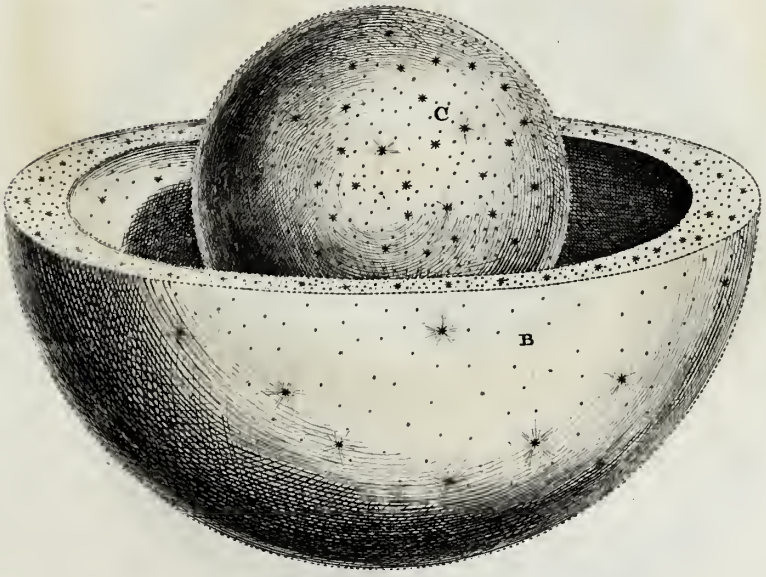
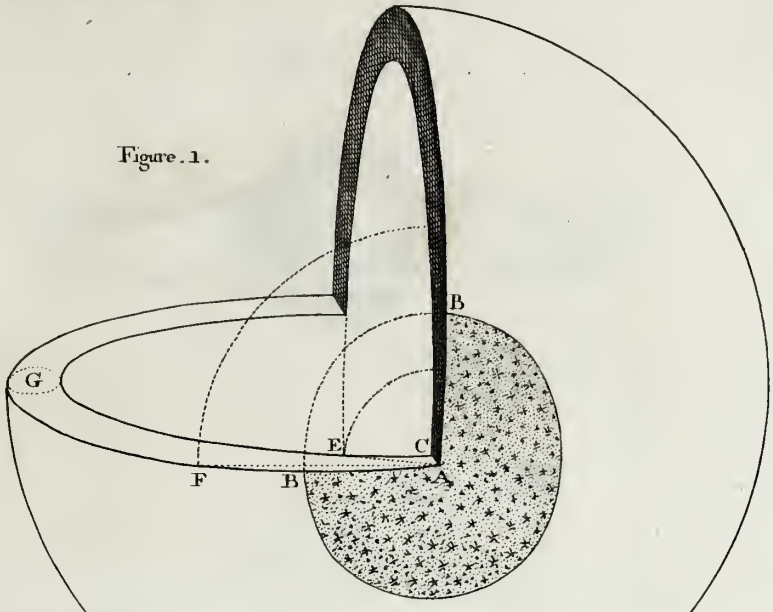


PLATE XXVII.

Figure. 1.



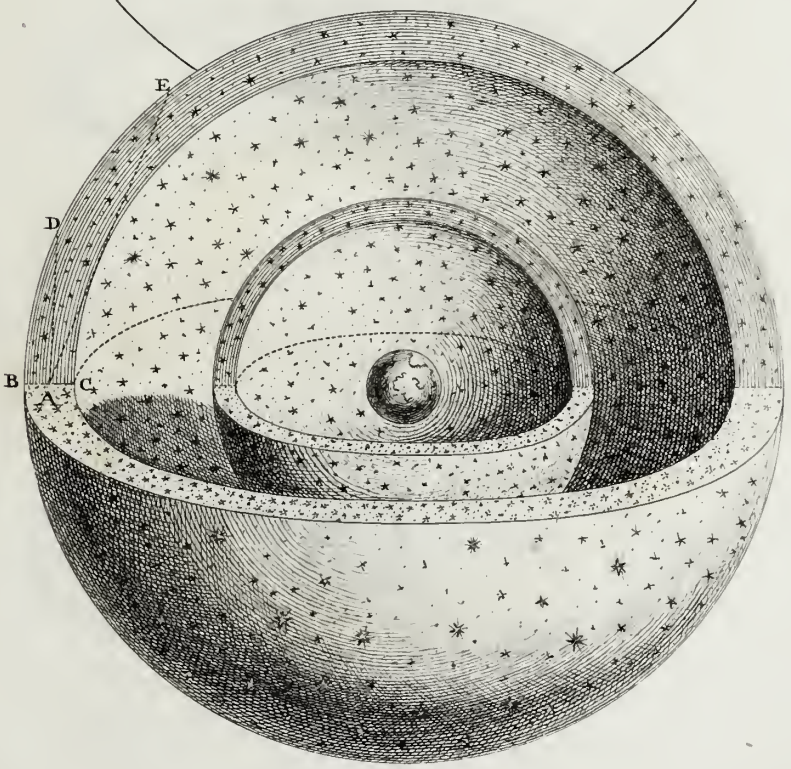


Fig. 2.

PLATE XXVIII.

Figure I.

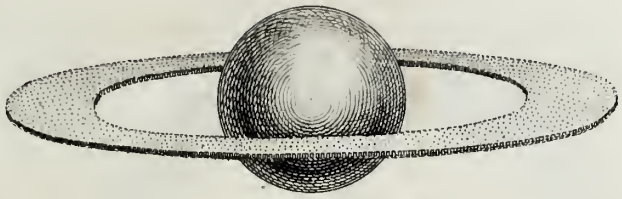


Fig. II.

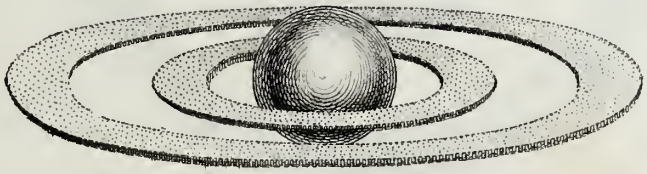


Fig. III.

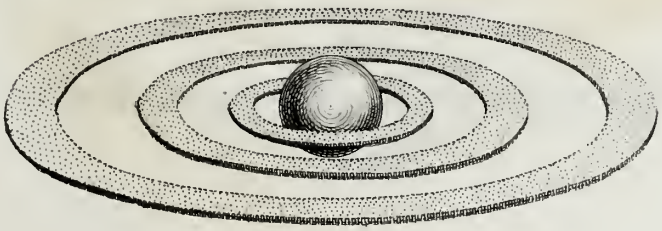


PLATE. XXIX.

Figure I.

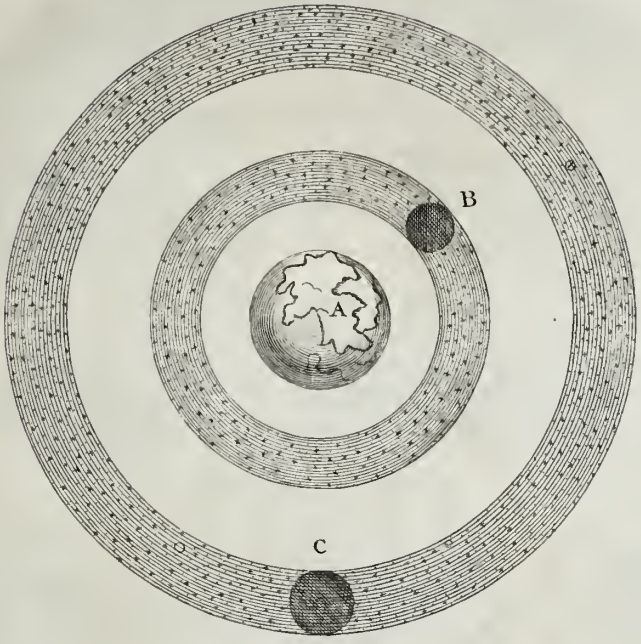
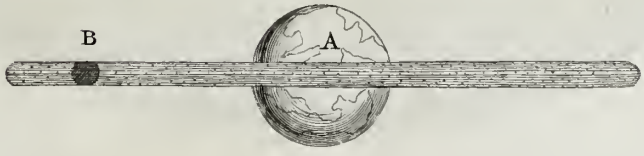


Fig. II.

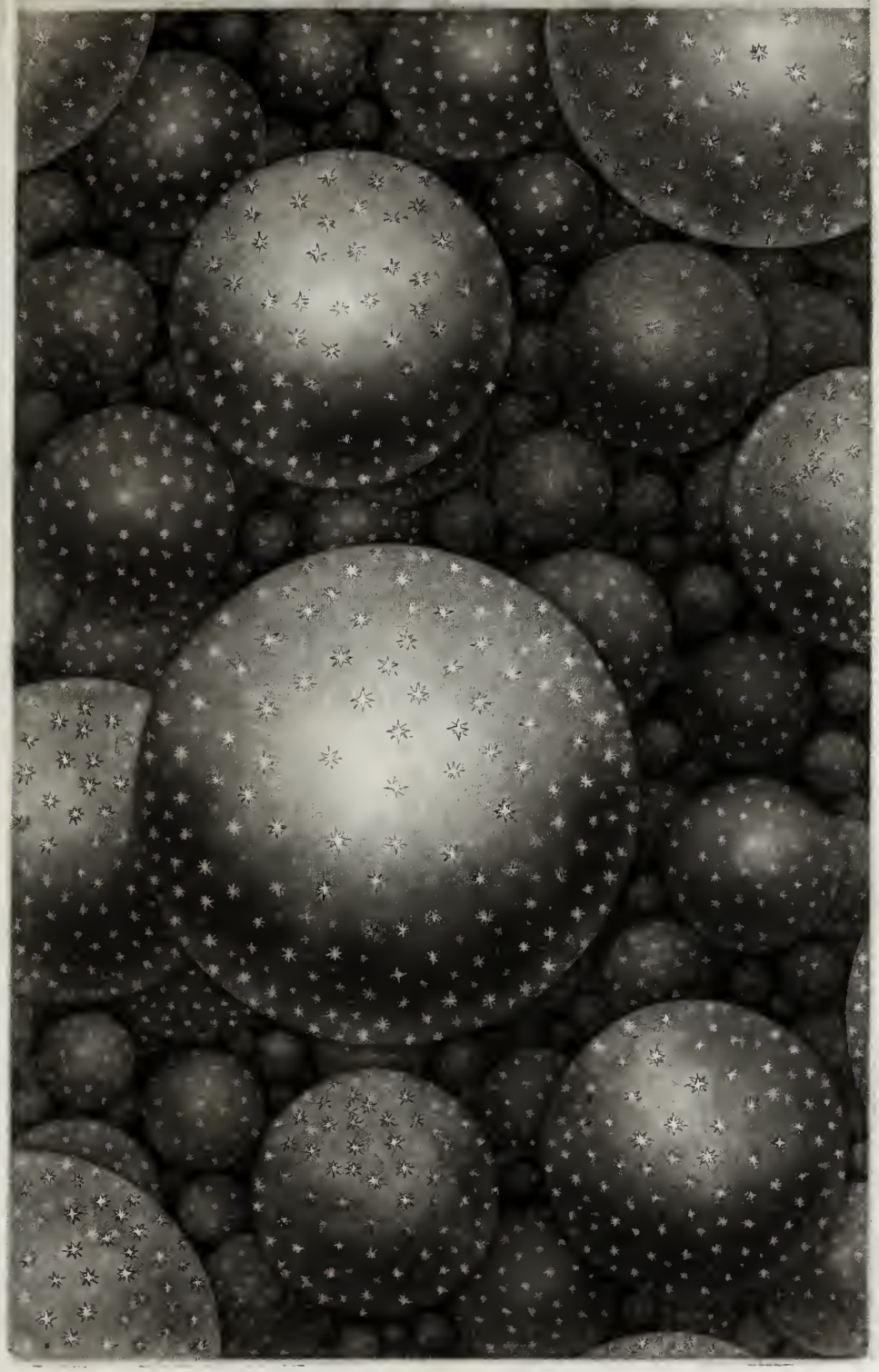


THE

EARTH

PLATE XXX.

PLATE. XXXI.



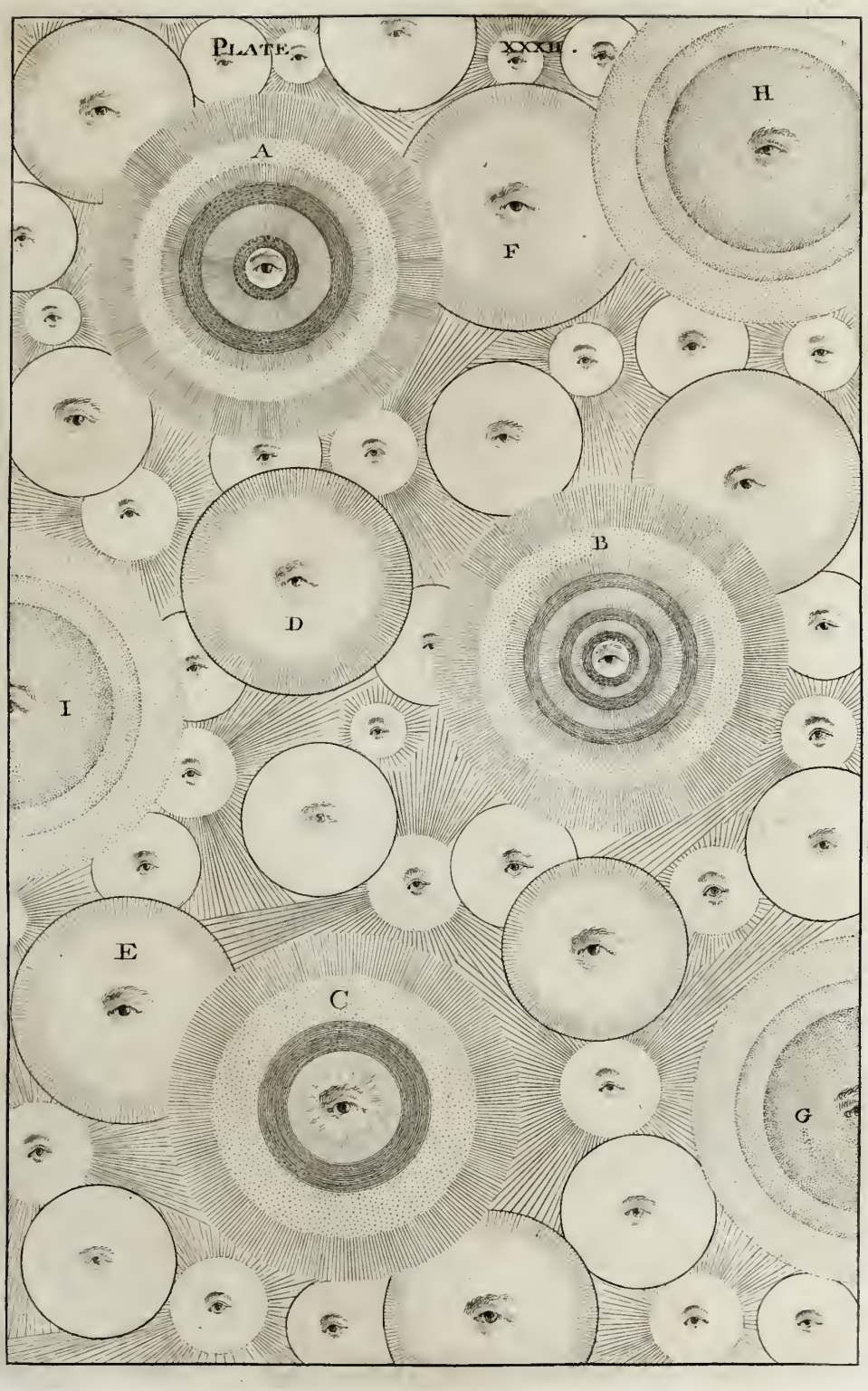


PLATE XXXII.
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T-76