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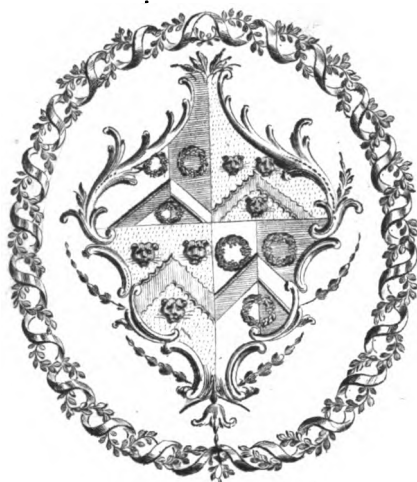
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ASTRO-THEOLOGY
Or a *Demonstration* of the
BEING and ATTRIBUTES
OF
G O D,

From a **SURVEY** of the
HEAVENS.

Illustrated with Copper Plates.

By **W. DERHAM**, Rector of *Upminster* in
Essex, and F. R. S.

The Second Edition, Corrected.



L O N D O N,
Printed for **W. INNYS**, at the *Prince's Arms* in
St. Paul's Church-yard. MDCCXV.

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TO HIS ROYAL HIGHNESS
GEORGE,

Prince of *WALES*, Prince Electoral
of *Brunswick-Lunenbug*, &c.

Duke of *Cornwall* and *Rothsay*, Duke and
Marquess of *Cambridge*, Earl of *Chester*,
Milford Haven, and *Carreck*, Viscount *North-*
Alston, Baron of *Tenchesbury* and *Rensfrew*,
Lord of the Islands, and Steward of *Scot-*
land, and Knight of the most Noble Or-
der of the *Garter*.

GREAT SIR,



OUR Royal
Highness having
done me so great an
Honour, as to take
this Book under your Patro-
nage, with great Humility and
Thankfulness I lay it at your
Feet; not doubting, but that
(whatever my Performance is)
the

*the Subject will be acceptable,
it being a Vindication of the
Existence and Attributes of
that infinite BEING, to whom
your Royal Highness hath, no
less piously than justly, ascribed
your great Royal FATHER's,
and your Family's peaceable
Accession to the Crown and
Dignity of these Realms.*

*THAT the Blessings of the
same most merciful BEING
may be perpetuated to your
Royal Highness and all
Yours, is the hearty Prayer of,*

Most Illustrious SIR,

Your Royal Highness's
most humble obedient

Servant,

W. Derham.



A

Preliminary Discourse, CONCERNING

The Systemes of the Heavens, the Habitability of the Planets, and a Plurality of Worlds: Useful for the reading of the following Book.



Y *Physico-Theology* having met with so quick a Sale as to come to a third Impression before the Year was expired, but especially the solicitations of many Learned men, both known and

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unknown, have given me great encouragement to fulfil my promise, in sending abroad this other Part, relating to the *Heavens*: which should sooner have seen the light, but that I was minded not to interrupt the Reader's patience with many Notes (which I could not well avoid in my *Physico-Theology*, and which my Rough-Draught of this was burthened with) and therefore I threw the greatest part of them into the Text: which necessitated me to transcribe the whole. And when my Hand was in, I new-made some part of it, and added many new Observations of my own, which I have lately made with some very good long Glasses I have in my hands; one of *Campani's* grinding; and others of *English* work, which exceed it; but especially one of *Mr. Huygens's* of about 126 feet, which few for goodness do surpass.

O f

OF these Observations the Reader should have met with many more (and I believe some of my ingenious Friends do expect more) but that I lay under two inconveniences. One the want of an open free Horizon, my Habitation being surrounded much with Trees. The other, and indeed the chief, the want of a long Pole, of 100 or more feet, to raise my long Glass to such an height as to see the Heavenly Bodies above the thick Vapours; which much obscure all Objects near the Horizon; especially when viewed with long and good Glasses. But as I have been at considerable expences already about these matters, and this I am informed would amount to 80 or 90 l. I thought it much too great a burthen for the yearly Income of my Living.

AND therefore if I have not sufficiently answered the expectations of

some of my learned and ingenious Friends, I hope they will excuse me, and believe it to be more my Calamity than Fault that I have done no more; especially among such Planets as have advantageously presented themselves, as *Saturn* particularly hath, whose 5 or more *Satellites* it may be expected I have seen; but I could never reach but three of them, and they only when there were but few Vapours. And as for the Spots in *Mars* and *Venus*, and their Motion round their own Axes, I confess I have not yet had good Views of those Planets, since I have had my furniture of Glasses, by reason of the too great distance of *Mars* from the Earth, and the proximity of *Venus* to the Sun, and of late the cloudy weather, and the small altitude which *Venus* hath above the Horizon. But if I can obtain a sufficient Apparatus, and God is pleased to grant me Life, Health, and

and Leisure, I hope to compensate for my Defects.

BUT however, what is here wanting in my own, is sufficiently made up from the Observations of others. Of which the learned World hath good store since the Invention of the Telescope; which as it hath made ample discoveries of the Works of God, so hath laid open a new, and a far more grand and noble scene of those Works than the World before dreamt of, and afforded us a far more Rational Systeme of the Heavens and the Universe, than was before entertained.

AND forasmuch as I have frequent occasions in my following Book to speak of, and according to, this and some of the other Systemes, it is necessary I should, by way of Preface, give some account of them, to enable such persons to read my Book as are unacquainted with Astronomical matters.

AMONG

AMONG all the various Systemes, I need take notice only of three, the *Ptolemaick*, the *Copernican*, and the *New Systeme*. Of each of which in their Order.

Of the Ptolemaick Systeme.

IN the *Ptolemaick Systeme* the Earth and Waters are supposed to be in the Center of the Universe; next to which is the Element of Air, and next above that is the Element of Fire: next that the Orb of *Mercury*; then that of *Venus*, then that of the *Sun*; and above the *Sun's Orb*, those of *Mars*, *Jupiter* and *Saturn*; and above them all, the *Firmament* or Orb of the *Fixt Stars*; then the *Crystalline Orbs*; and lastly the *Caelum Empyreum*, or *Heaven of Heavens*. All these massy Orbs, and vast Bodies born by them, are, in this Systeme, supposed to move round the terraqueous Globe once in 24 hours;

hours : and besides that, in some other certain periodical times. For the effecting of which Motions, they were forced to contrive such Circles as they called *Eccentricks* and *Epicycles*, crossing and interfering with one another ; which I could not represent in so narrow a compass as *Fig. 1.* is, which is a Scheme of this *Ptolemaick System* ; which is universally maintained by the *Peripatetick Philosophers*.

Of the Copernican System.

THE next System is the *Pythagorean* or *Copernican*, being invented as some imagine by *Pythagoras* himself. But *Diogenes Laertius* (1) expressly saith, That *Pythagoras's* opinion was, That the World was round, containing the Earth in the midst of it. And by *Pliny's* account (2) of *Pythagoras* his Distan-

(1) Lib. 8. in *Pythagorâ*.

(2) *Nat. Hist.* L. 2, c. 21, 22.

ces, and Orders of the Planets, this seems to have been his opinion. But the same Laertius (3) affirms Philolaus the Pythagorean τὴν Γῆν κινεῖσθαι κατὰ Κύκλον, πρῶτον εἰπεῖν. οἱ δὲ, Ἰκάντων Συρακούσιον φασίν; to have been the first that said the Earth was moved in a Circle: but some say Hicetas the Syracusan. So Plutarch in his Life of Numa, speaking of Numa's building The Temple of Vesta, saith, he built it round, and that a continual fire was kept therein in imitation of the figure of the Earth, or rather of the whole World it self, the middle of which the Pythagoreans (not Pythagoras) take to be the Seat of Fire.

THIS Systeme (whoever was the Inventer of it) Copernicus, a Canon of Tourain restored about the beginning of the 15th Century, and was followed therein by many considerable men,

(3) Ibid. in Philolao.

as *Rheticus*, *Mæstlinus*, *Kepler*, *Rothman*, *Bullialdus*, *Lansberge*, *Herigonius*, *Schickard*, *Gassendus*, *Galilæo*, and others. The last of which (by the ill will and instigation of Pope *Urban VIII.* as 'tis supposed) had the misfortune to fall under the censure of, and to have his *Copernican Tenets* condemned by, the Inquisition, and was forced to abjure them. The particulars of which, if the Reader hath a mind to see, he may find them in *Riccioli's Almagest.* (4).

ACCORDING to this Systeme, the *Sun* is supposed to be in the Center, and the Heavens and Earth to revolve round about him according to their several Periods: first *Mercury* in near 88 days; then *Venus* in somewhat above 224 days; then the *Earth*, with its Satellite the *Moon*, in

(4) *Lip. 9. Sect. 4. Cap. 40.*

365 days ; then *Mars* in about 687 days ; then *Jupiter* with his four Moons in about 4333 days ; and lastly, *Saturn* in somewhat above 10759 days, with his 5 or more Moons revolving about him. And beyond or above all these is the *Firmament*, or the Region of the *Fixt Stars*, which are all supposed to be at equal distances from their Center, the Sun.

THIS is the *Copernican System*e, which I have given a Scheme of in *Fig. 2.* And so far as this System relates to the Motion of the Earth, and the Sun resting in the Center, I prefer it to the *Ptolemaick Hypothesis* on these *Five* following accounts.

1. Because it is far more agreeable to Nature, which never goes a round-about way, but always acts by the most compendious, easy and simple methods. And in the *Copernican* way, that is performed by one, or a few easy Revolutions, which, in

the other way, is made the work of the whole Heavens, and of many strange and unnatural Orbs. Thus the Diurnal Motion is accounted for by one Revolution of the Earth, which all the whole Heavens are called in for, in the other way; So for the Periodical Motions of the Planets, their Stations, Retrogradations and Direct Motions, they are all accounted for by one easy, single Motion round the Sun, for which, in the Ptolemaick way, they are forced to invent divers strange, unnatural, interfering *Eccentrics* and *Epicyles*. An Hypothesis so bungling and monstrous, as gave occasion to a certain King to say, *If he had been of God's Council when he made the Heavens, he could have taught him how to have mended his Work.*

2. As the Copernican is far more easy and agreeable to Nature than the Ptolemaick Systeme, so it is far more compleat

pleat, and answerable to the various Phenomena of the Planets; several of which the *Ptolemaick* Hypothesis either very awkwardly solves, or doth not at all come up to. I might instance here in divers particulars relating to *Venus* and *Mercury*, as why the Earth is never between them and the Sun, which the *Ptolemaick* System gives no tolerable account of, and but poor accounts of other of their Phenomena, as also of those of the Moon and the other Planets. I might shew also how incoherent and improper the Motions assigned to the Heavenly Bodies are in the *Ptolemaick* way, as that the Moon should move round once in a Month, the other Planets in such and such Periods as are assigned to them; the Firmament, or Fixt Stars in 25 or 26000 years; the Sphere beyond that in 1700 years; the Tenth Sphere in 3400 years; and the outermost of all, the

Primum

Primum Mobile, which moves all the rest in only 24 hours. Which are Motions so unproportional and disagreeable, that are sufficient to subvert the whole Hypothesis. But it would be endless to enter into a detail of such incoherences and improprieties as the *Ptolemaick* Systeme abounds with.

3. The prodigious and inconceivable Rapidity assign'd by the *Ptolemaicks* to the Heavens, is by the *Copernican* Scheme taken off, and a far more easy and tolerable Motion substituted in its room. For is it not a far more easy Motion for the Earth to revolve round its own Axis in 24 hours, than for so great a number of far more massy, and far distant Globes, to revolve round the Earth in the same space of time? If the Maintainers of the *Ptolemaick* Systeme do object against the Motion of the Earth, that it would make us dizzy,

and shatter our Globe to pieces, what a precipitant, how terrible a Rapidity must that of the Heavens be? What a Velocity must the Sun have to run its course, at the distance of 21 or 22 Semidiameters of the Earth? What a Velocity must that of the Fixt Stars, especially that of the *Primum Mobile* be, at far greater distances than the Sun is?

4. It is an incontestable argument of the *Sun* being the Center of the Planets about him, and not the *Earth*, that their *Motions* and *Distances* respect the *Sun*, and not the *Earth*. For with regard to the *Sun*, the Primary Planets have a very due Motion, in proportion to their several Distances; that is, Their Motions round the *Sun*, are in sesquiplicate Proportion to their Distances from him; but this Proportion doth not hold at all with relation to the *Earth*. But as for the Secondary Planets, round *Saturn*, *Jup*

The Copernican System.

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Jupiter and the *Earth*, it is very certain that they have the same respect to their *Primaries*, as these *Primaries* have to the *Sun*; that is, *The Squares of their Revolutions are as the Cubes of their Distances*. And as it is very certain and visible, that the *Secondary Planets* respect their *Primaries* as their *Centers*, and move round them; so it is in some measure (one would think) no less certain, and beyond doubt, that all the *Primary Planets*, which have the self-same respect to, and Motion with regard to the *Sun*; as those *Secondaries* have to their *Primaries*; that those *Primaries*, I say, do move round him as their *Center*, and not about the *Earth*, to whom they have no such respect.

The last Argument I shall alledge for my preference of the *Copernican* to the *Ptolemaic System*, is from the great *Parity* and *Congruity* observable among all the works of the *Creation*; which

have a manifest harmony, and great agreement with one another.

THUS in our present case, it is manifest to our sight, that every Globe we have any good views of, hath such like Motions, as those are which we ascribe to the Earth. The Sun indeed being in the Center, is as 'twere fixt there, and hath no Periodical Motion: but yet the other Motion round its own Axis, we can manifestly discern. And as for all the Planets which move round about the Sun, they have, as far as 'tis possible for us to see them, such Motions as those we ascribe to the Earth; namely, a Diurnal Rotation round their own Axes, and a Periodical Revolution round the Sun. And if this be manifest in the other Planets, what should hinder its being so in our own? Why should ours be singular? Why not be supposed to be moved as well as the rest, when it is very certain

tain that either it hath those Motions, or the Heavens have so; and it is far more natural and easie for the Earth to perform them, than for the Heavens, as hath been already shewn.

Thus having shewn how far more probable the Copernican Systeme is than the Ptolemaick, so far as it relates to the Motions of the Heavens and Earth, and the Sun being in the Center; it remains (before I proceed into the Third and last Systeme) that I should answer some Objections alledged against this Systeme, partly from Scripture, and partly from Philosophy and Sight.

Those Objections from Scripture are such as seem to assert the Immobility and Rest of the Earth, and the Motion of the Sun and Heavenly Bodies.

Those Texts that are brought to prove the Immobility and Rest of the Earth, are 1. Chron. 16. 30. The World shall be stable, that it be not

moved. The same is said, *Psal. 93. 1.* The World also is establiſhed, that it cannot be moved. And ſo the ſame again, *Pſal. 96. 10.* In *Pſal. 104. 5.* GOD is ſaid to lay the foundations of the Earth, that it ſhould not be moved for ever. And laſtly Solomon, *Eccleſ. 1. 4.* aſſerts that The Earth abideth for ever. Like to which is that of the *Pſalmiſt*, *Pſal. 119. 90.* Thou haſt eſtabliſhed the Earth, and it abideth. Theſe are the principal Texts which ſeem to aſſert the Immobility and Stability of the Earth.

THE principal Texts which mention the Motion of the Sun and Heavenly Bodies, are ſuch as aſcribe Riſing, Setting or Standing ſtill to them. Thus *Gen. 9. 23.* The Sun was riſen upon the Earth, when Lot entered into Zoar. And *Gen. 15. 17.* When the Sun went down, and it was dark, a ſmoaking Furnace, &c. So *Eccleſ. 1. 5.* The Sun ariſeth, and the Sun goeth down, and haſteth to the place where he aroſe.

So

So Psal. 19. 5, 6. the Sun is said to come out of his chamber like a Bridegroom, and to rejoyce as a strong man to run a race. That his going forth is from the end of the Heaven, and his circuit unto the ends of it. Pursuant to which expressions of the Sun's moving, it is said also to stand still, and to go backwards. Thus Josh. 10. 12, 13. Sun, stand thou still upon Gibeon, and thou Moon in the valley of Ajalon. And the Sun stood still, and the Moon stayed. — So the Sun stood still in the midst of Heaven, and hasted not to go down about a whole day. And in 2 King. 20. 10. and Isai. 38. 8. the Sun is said to have returned ten degrees backward in one of the places, and its Shadow to have done so in the other.

THESE are the chief Texts of Scripture, which seem to lie against the Copernican Hypothesis. In answer to which, this may be said in general

ral to them all; That since the design of the holy Writings is not to instruct Men in Philosophical, but Divine matters, therefore it is not necessary to restrain the sense of those Texts to the strict propriety of the Words, but take them to be spoken according to the appearance of things and the vulgar notions and opinions which men have of them, not according to their reality, or Philosophical verity. Thus in divers other instances the holy Scriptures speak; and thus even Philosophers themselves speak. Yea, the Copernicans themselves, although they professedly own, and defend the contrary; yet in vulgar speaking in our present case, say, The Sun riseth, setteth, and moveth, &c. making that to be the act of the Sun in vulgar discourse, which they contend to be in reality performed by the Earth. And if Philosophers, and others did not
thus

thus expresse themselves according to the appearance of things, and mens vulgar apprehensions of them, it would need a Comment, and they must explain themselves every time they speak, in order to their being understood.

HAVING given this general Answer, I shall next consider the particular Texts themselves, and see whether they necessarily infer what they are brought for the Proof of.

AND in the first place, as for the Texts brought to prove the Immobility of the Earth, it is manifest that the *Stability of the World*, mentioned in the three first Texts, doth not relate to the Earth's motion, either Annual or Diurnal, but to the Condition, State and Order of the World inhabiting the Earth, particularly the Peace and Prosperity thereof. One of our own latest, and most learned Commenta-

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tors, the late Bishop Patrick (5) understands the Gospel state to be meant in the first and third of the Texts. And his Paraphrase on that in Psal. 93. 1. is, *He who made the World, will support that excellent order, wherein we are settled; so that it shall not be in the power of man to disturb what he hath established.*

As for what is said in Psal. 104. 5, it is manifest that the Psalmist is there celebrating the Works of Creation, and that there was as fair an occasion of speaking of the Earth's Rest, in relation to its two Motions, as any where. But yet even here also the security and permanency of its State is the thing aimed at. The last most learned Commentator thus Paraphrases on the place (6), *Who hath*

(5) See his *Commentary on Chron.* and his *Paraphrase on Psalms.*

(6) Bishop Patrick's *Paraph.* on Psal. 104. 5.

settled

settled the massy Globe of the Earth, even in the liquid air, upon such firm foundations, that none of those Storms and Tempests, which beat upon it from without, nor any Commotions from within, can ever stir it out of the place he hath fixed for it.

As for the two remaining places in Eccles. and Psal. 119. it is plain enough that their Design is to shew the Vanity and Instability of the things of this World, that they are all more fleeting and uncertain than other matters, even than the Earth it self, on which they have their residence. In Eccles. the wise man (who had undertaken to prove all things herebelow to be Vanity) begins with the State of Man himself, and shews that to be more fickle and transitory than the Earth, on which the various Generations of Men live, and to which their Bodies do all return again. The Generations of men pass away; but the Earth abideth for ever, in the same

same unalterable condition, without such going and coming, as that of the Generations of men have.

IN *Psal.* 119. 90. the Psalmist celebrates God's Faithfulness to all the various and succeeding Generations of the World, which he shews to be as constant and unalterable as the Earth it self, which GOD hath so established, that it abideth through all the several Generations of men, when they at the same time are fleeting and changing.

Thus it appears that all those several Texts which assert the *Stability of the World*, or *Earth*, prove nothing against the *Earth's Motion* in a Philosophical sense ; only express some Moral, Theological Truths.

AND so the same may be said of those other places of Scripture, which mention the Motion of the Sun and other Heavenly Bodies, that say they Rise, Set, and perform the Motions which

which the *Copernicans* ascribe to the Earth. If we should take these Expressions in a philosophical, strict, literal sense, and not as vulgar Expressions, arising from the appearance of things; we shall find that very odd and unreasonable Conclusions may as well be collected from those Scriptures, as the Sun's Motion: as that the Sun hath animal Life, Motion, and Desire, being said to act these things it self, to rise, to set, yea to *haste to the place* of his Rising, or as the Hebrew hath it, to *pant after*, or *eagerly to desire* it (7). So in *Psal. 19.* the elegant *Psalmist* giving a poetical description of this noble and admirable work of GOD, the Sun, saith, GOD hath, in the Heavens, *made a Tabernacle for him*; as if the Sun had an House, a Resting place provided for

(7) *ANV* Anhelavit, inhiavit. vid. *Baxter's* Lexicon.

him

him; from which he comes daily forth with beauty and lustre, as resplendent as that of a Bridegroom, and with the same ardency, joy, and diligence runs his Course, as a Champion doth his Race. And lastly his *Going forth* is said to be *from the end of the Heaven*, and his *Circuit* to reach to the ends thereof; as though the Heavens had two Extremities, or was, as the Ancients fancied the Earth to be, a long large Plane bounded by the Ocean, under which they imagined the Sun betook himself, and was thence said *Tingere se Oceano*, to dip himself into the Ocean when he Set.

AND as in these places of Scripture the Sun is said to *Move*; so in the other places he is said to *stand still*, and to go *backward*. But we shall find that very absurd conclusions would follow the taking those Texts in a strict literal sense. For in *Joshua* the Sun is ordered to *stand still upon Gibeon*;

Gibeon, and the Moon in the valley of Ajalon. But it would be very absurd to take this in a literal sense, and imagine those two great Luminaries were confined to those two places, otherwise than in appearance to the victorious *Israelites*. And if so considerable a part of the transaction be spoken according to its appearance, why not the whole? Why might not this Station as well be an Arrest of the Earth's motion, as of that of the Heavens, if the whole Miracle was not (as some not improbably think) effected by means of some preternatural Refractions, or extraordinary Meteors, &c.

AND so for the Recess of the Sun, or its Shadow in *Hezekiah's* case, that which in appearance seemed to be the action of the Sun, is by divers learned men thought to have been the effect of such like extraordinary Refractions or Meteors, as I mentioned

ned in the last case: of if it was a real Recess; why not of the Earth, rather than the Sun and whole Heavens?

Thus having answered the particular Texts, it doth not appear that the Scriptures oppose the *Copernican System*, but that those passages which seem to do so, are spoken more according as things appear than as really they are. For as St. *Hierom* saith, (8) *Consuetudinis Scripturarum est* — It is the custom of the Scriptures, for the Historian so to relate the opinion men had of many matters, as at that time those matters were by all people taken to be. And in another place (9) *There are many things in the Holy Scriptures, which are spoken according to the opinion of the time in which they were done, and not*

(8) *Hierom. in Matth. c. 13.*

(9) *In Jerem: 28.*

cording to their reality. And this is
 no other than what is very reasona-
 ble, and suitable to the end and de-
 sign of the Holy Scriptures, which,
 as I have said, is rather to instruct
 men in *Divine and Moral Doctrines*,
 than *Philosophical Truths*. And agree-
 ably hereto St. *Augustine* answers this
 very doubt concerning the Motion of
 the Heavens (9). Some of the Brethren
 (saith he) move a Question, whether the
 Heavens stand still or are moved, because,
 say they, if they are moved, how is it a
 Firmament? and if they stand still, how
 do the Stars, which are believed to be fixt
 in them, revolve from East to West, the
 Northern Stars describing lesser Circles
 near the Pole? — To which, saith he, I
 answer, That these things do greatly re-
 quire several subtile and laborious Reasons,
 to discover truly whether the matter be so,

to (9) August. de Genesi ad Literam. L. 2. c. 10.

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or not so. For the entering upon, and discussing of which, I have neither time, neither is it fit it should be done to such as we desire to instruct in the way of Salvation, for the necessary benefit of the holy Church.

HAVING thus answered the Objections from Scripture, I shall in the last place consider those brought from Sense and Philosophy.

THE Objection from Sense is, That we see the Heavenly Bodies actually to move, and therefore ought to believe they do so. But there is no weight at all in this, because whether we our selves, or the Object moveth, it amounts to the same. As is manifest to any one carried in a Boat or Chariot; the Progressive motion of which, produceth the appearance of a Regressive motion in the unmoved Objects we look upon; according to *Virgil's* description

tion of *Aeneas* and his company's leaving their Port (10).

Provehimur portu, terraeque urbesque

recedunt.

i. e. Both Land and Towns receded when we left our port. As for the reason hereof, I shall refer to the Opticians, particularly the famous *Kepler*, who in his *Optices Astronom.* hath designedly handled this point.

THE Objections from *Philosophy* are too numerous to be distinctly answered, especially such as seem very frivolous, particularly those grounded on a supposition of the Verity of the *Aristotelian Philosophy*, as the Immutability and Incorruptibility of the Heavens, &c. For answers to which I shall refer the Reader to *Galileo's System Mund.* But for such Objections as seem to have some reason in

(10) *Aeneid*. L. 2. Car. 72.

them, they are chiefly these, That if the Earth be moved from W. to E. a Bullet shot Westward would have a farther Range, than one shot Eastward; or if shot N. or S. it would miss the mark; or if perpendicularly upright, it would drop to the Westward of the Gun. That a Weight drop'd from the top of a Tower, would not fall down just at the bottom of the Tower, as we see it doth. That Birds flying towards the E. would be hindered in their Flight, but forwarded in flying the contrary way; with much more to the same purpose. But not to enter into a Detail of Answers that might be given from the Laws of Motion, and the Rules of Mechanicks and Mathematicks, I shall only make use of the most ingenious *Galilao's* plain Experiment, which answereth all or most of the Objections (11). Shut, saith

(11) *System. Mund. Dial. 2.*

he,

he, your self up with your friend in the Great Cabin of a Ship, together with a parcel of Gnats and Flies, and other little winged creatures. Procure also a great Tub of Water, and put Fishes therein. Hang also a Bottle of Water up, to empty it self drop by drop into another such Bottle placed underneath with a narrow neck. Whilst the Ship lies still, diligently observe how those little winged creatures fly with the like swiftness towards every part of the Cabin; how the Fishes swim indifferently towards all sides; and how the descending Drops all fall into the Bottle underneath. And if you throw any thing to your Friend, you need use no more force one way than another, provided the Distances be equal. And if you leap, you will reach as far one way as the other. Having observed these particulars whilst the Ship lies still, make the Ship to sail with what Velocity you please, and so long as the Motion is uniform, not fluctuating this way and that way, you shall not per-

ceive there is any alteration in the aforesaid effects; neither can you from them conclude whether the Ship moveth or standeth still. But in leaping, you shall reach as far on the floor as you did before; nor by reason of the Ship's motion, shall you make a longer Leap towards the Poop than the Prow, notwithstanding that whilst you were up in the air, the Floor under your feet had run the contrary way to your Leap. And if you cast any thing to your companion, you need use no more strength to make it reach him, if he should be towards the Prow, and you towards the Poop, than if you stood in a contrary position. The Drops shall all fall into the lower Bottle, and not one towards the Poop, although the Ship shall have run many feet, whilst the Drop was in the air. The Fishes in the Water shall have no more trouble in swimming towards the forepart of the Tub, than towards the hinder part, but shall make towards the Bait with equal Swiftness, on any side of the Tub. And
lastly

lastly the Gnats and Flies shall continue their flight indifferently towards all parts, and never be driven together towards the side of the Cabin next the Prow, as if wearied with following the swift motion of the Ship. And if by burning a few grains of Incense, you make a little Smoak, you shall perceive it to ascend on high, and hang like a Cloud, moving indifferently this way and that, without any inclination to one side more than another. The cause of which correspondence of the Effects, is, that the Ship's motion is common to all things contained in it, and to the Air also: I mean when those things are shut up in the Cabin: but when they are above Deck in the open Air, and not obliged to follow the Ship's course, differences more or less may arise among the forenamed Effects.

Thus Galileo by this one Observation hath answered the most considerable Objections deduced from Philosophy against the Motion of the

Earth. And thus much shall suffice for the Explication and Proof of the *Copernican Systeme*, especially that part of it relating to the *Solar Systeme*. Which things I have more largely than ordinary insisted on, for the satisfaction of many that I am sensible doubt of them, and particularly some of my Friends (and those not unlearned too) who may be apt to read my following Book with prejudice wheresoever I favour the *Copernican Notions*.

Of the New Systeme.

AND now I pass from the Second Systeme to the Third, which is called the *New Systeme*; which extends the Universe to a far more immense compass, than any of the other Systemes do, even to an indefinite Space; and replenishes it with a far more grand Retinue than ever was before ascribed unto it. THIS

THIS *New Systeme* is the same with the *Copernican*, as to the *Systeme* of the Sun and its Planets; as may be seen by the Scheme of it in Fig. 3. But then whereas the *Copernican Hypothesis* supposeth the Firmament of the Fixt Stars to be the Bounds of the Universe, and to be placed at equal Distance from its Center the Sun; the *New Systeme* supposeth there are many other *Systemes* of *Suns* and *Planets*, besides that in which we have our residence: namely, that every Fixt Star is a Sun, and encompassed with a *Systeme* of Planets, both Primary and Secondary, as well as ours.

THESSE several *Systemes* of the Fixt 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 Fixt Stars appear
to

to us of different Magnitudes, the nearest to us large; those farther and farther less and less.

OF those Systemes of the Fixt Stars I have given a rude representation in Fig. 3. together with that of the Sun; which may serve to give an unskilful Reader some conception of the state of the Universe, altho' there be but little likeness in it, for want of room to lay out all the several Systemes in due proportion; which is necessary to a true representation of the matter.

IN this 3d Fig. the Fixt Stars with their Systemes (represented by little Circles about those Stars, which Circles signify the Orbits of their respective Planets) are placed without the limits of the Solar Systeme, and the Solar Systeme is set in the Center of the Universe, and figured as a more grand and magnificent part thereof. And so it may be looked upon by us,
by

by reason of its proximity and relation to us. But whether it be really so, whether it be in the Center of the Universe, and whether among all the noble Train of Fixt Stars, there be no Systeme exceeding ours in its magnificent Retinue of Planets both Primary and Secondary, and other admirable Contrivances, is a difficulty as out of the reach of our Glasses, so consequently above our ability to fathom, although not at all improbable. But be the various Systemes of the Universe as they will as to their Dignity, it is sufficient that in all probability there are many of them, even as many as there are Fixt Stars, which are without number.

THIS *Systeme* of the *Universe*, as it is physically demonstrable, so is what, for the most part, I have followed in the ensuing Book, but not so rigorously and obstinately, as utterly to exclude or oppugne any other Sy-

~~Systeme, because as the Works of G O D~~
are truly great, and sufficiently manifest their excellence and magnificence in any Systeme; so I was willing to shew the same in such Systemes as I had occasion to speak of them in; because I would not offend, and consequently not bar the force of my arguments upon such Readers, as might happen to be wedded to the *Aristotelian Principles*, or prejudiced to the *Ptolemaick*, or any other *Systeme*: not that I had my self any doubts about this *New Systeme*, but think it to be far the most rational and probable of any, for these reasons.

1. Because it is far the most magnificent of any; and worthy of an infinite C R E A T O R: whose *Power* and *Wisdom* as they are without bounds and measure, so may in all probability exert themselves in the Creation of many Systemes, as well as one. And as Myriads of Systemes are

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. But it is very highly probable the matter is so, by reason

2. We see it is really so, as far as it is possible it can be discerned by us, at such immense distances as those *Systemes* of the Fixt Stars are from us. Our Glasses are indeed too weak so to reach those *Systemes*, as to give us any assurance of our seeing the Planets themselves, that encompass any of the Fixt Stars. We cannot say we see them actually moving round their respective Suns or Stars. But this we can discern, *viz.* That the Fixt Stars have the Nature of Suns, as I have made probable in Book 2. Chap. 2. As also that there are something very like unto Planets, which sometimes

appear and disappear in the regions of the Fixt Stars; as I have shewn in my discourse of *New Stars*, Book 2. Chap. 3.

BUT besides what I have said there, I have this farther to add from some late observations I have made since my writing that part of my Book; and that is, That the *Galaxy* being well known to be the fertile place of *New Stars*, the region in which they commonly appear, I am much inclined to be of opinion; that the *Whiteness* there is not caused by the bare Light of the great number of Fixt Stars in that place, as hath commonly been thought, but partly by their Light, and partly (if not chiefly) by the Reflections of their Planets; which stop and reflect, intermix and blend the Light of their respective Stars or Suns, and so cause that Whiteness the *Galaxy* presents us with; which hath rather the colour of the Reflected Light

Light of our Moon, than the Primary Light of our Sun. And that there are Planets enough for this purpose, I suspect, because I have some reasons to imagine that there are many more *New Stars* in the *Milky Way*, (all which I take to be a kind of Planetary Globes) than have ever yet been taken notice of, and that many of those prodigious numbers of Telescopical Stars visible there, are of the numbers of *New Stars* or Planets, and not of *Fixt Stars* only. This Suspicion I have for some time had, but especially lately from my Views of the *New Star* that now begins to disappear in the *Swan's Neck*. Which gave me occasion to inspect some other parts of that Constellation, most parts of which are well replenished with a numerous train of small Stars. Amongst which, sometimes methoughts more have presented themselves through one and the same

same Glass, and sometimes I have mist some I thought I before saw: and sometimes also methoughtes I have seen them nearer to, and sometimes farther off those Stars that did constantly present themselves. But as these things are to my self novel, and what I confess I have rather Suspicions of than Certainty, I shall refer them to the future Observations of my self, and others, for their Confirmation; especially because those Approximations and Recesses of some of the little Stars I spake of, suit not with the Observations of some very eminent Astronomers.

THESE Observations as they will open to us a New, and admirable Scene of the Heavens (if it be as I imagine) so I earnestly recommended the Enquiry into it to such as delight in those matters. For the doing of which, I conceive it may be sufficient, and the easiest course, to make
the

the Observations in some one part of the Milky-Way, as in some part of the *Sun*, as much or a little more than falleth within the Compass of the Telescope you make use of, which was the way I practised, and that part of the Heavens, in which I observed. All the Stars that fall within this Area, an exact Map must be taken of, which will shew when any Variations happen. And for taking in the larger Area of the Heavens, a Glass of 6 or 8 feet is sufficient, and rather better for the purpose than longer Glasses, which take in less, and are more troublesome in using.

HAVING thus represented the State of the *Universe* according to the *New Systeme* of it, the usual Question is, what is the use of so many Planets as we see about the Sun, and so many as are imagined to be about the Fixt Stars? To which the answer is, That they are *Worlds*, or places
c of

of *Habitation*, which is concluded from their being *habitable*, and well provided for *Habitation*. This is pretty manifest in our Solar Planets, from their being opake Bodies as our Earth is, consisting in all probability of Land and Waters, Hills and Valleys, having Atmospheres about them, Moons ministering unto them, and being enlightened, warmed and influenced by the Sun, whose yearly Visits they receive for Seasons, and frequent Returns for Days and Nights. All which particulars are fully treated of in the following Book, and need not therefore to be anticipated here. Only there is one thing, which for want of sufficient Observations, I could not so fully speak of as I would; and that is concerning the *Seas in the Moon*, in Book 5. Ch. 4. Note 1. whose very existence Mr. *Huygens* (11) denies, saying, *Marium vero si-*

(11) *Cosmotheoros*. p. 114.

militudinem illic nullam reperio, &c. i. e.
 In the Moon I find no likeness of Seas,
 although Kepler and most others are of a
 different opinion. For those vast plane
 regions, which are much darker than the
 Mountainous parts, and are commonly ta-
 ken for Seas, and bear the names of O-
 ceans; in those very places viewed with
 a long Telescope, I find little round Cavi-
 ties, with shadows falling within them;
 which cannot agree with the Surface of
 the Sea: as also those very large Fields,
 when carefully viewed, do not present us
 with a Superficies altogether equal. Where-
 fore these cannot be Seas, but are such
 places as consist of a less bright matter
 than that which is in the more hilly parts,
 but in which also there are some places
 brighter than others. Thus the most
 ingenious Mr. Huygens, who then
 proceeds to shew that there are nei-
 ther Rivers, Clouds, Air, or Vapours.
 But that there are Seas, or great
 Collections of Waters, and conse-
 quently

quently Rivers, Clouds, Air and Vapours in the Moon, I shall make out from some of my own Views and Observations; many of which were made with Mr. *Huygens*'s own long Glas before mentioned: through which, and all other long Glasses, instead of imagining the Lunar Spots to be unlike Seas, I have always thought them to look more like Seas, than through short Glasses.

It is true indeed that in those Spots we take to be the Seas, there are such Cavities as Mr. *Huygens* speaks of, or rather Mountains with shaded Cavities in them, as also some parts less dark than others. Thus in the Southerly parts of the *Lunar Euxine* and *Mediterranean*, in the *Sinus Sirbonis*, the *Egyptian*, and divers other Seas, there are several such parts that appear more luminous than others, some having the appearance of Rocks and Islands, some of large Shallows, parti-

particularly towards the Shores, and especially in the Seas bordering on the Continents, such as the great Southern Continent of the *Lunar Egypt* and *Palestine*. But this is no conclusive argument of those parts not being Seas; because they may be Seas having many Islands and Shallows in them. But then in other parts, and even in some parts of these last named, the Spots appear darker, and with but few of those Eminences or Islands, those brighter or shallow parts. Thus the Northerly *Euxine*, and *Mediterranean*, the *Palus Mæotis*, and many other of those Lunar Seas; few of those parts that have the aspect of Islands or Shallows are to be discerned in them, only one here, and another there, at considerable distances from one another.

And in this very manner I doubt not our terraqueous Globe would appear, if viewed at the Moon, or

at some miles aloft. We should there perceive our deep Oceans would be of a darker colour, like the darker Spots of the Moon, and the single Isles of *St. Helena* and *Ascension*, and the more numerous ones of *Ladrones*, *Camarles*, *Azores*, &c. to have the same appearance that the few scattered Islands have in the deeper Lunar Seas: and our Shallow Seas with their numerous Rocks and Islands dispersed about them, especially towards the Continents, would look as those in the Moon do.

THAT a Reader unacquainted with the Geography of the Moon, may apprehend what I have said here and elsewhere, concerning the Parts and Appearances of the Moon, I have represented them in Fig. 10. and 11. In Fig. 10. the Face of the Full Moon is represented, its bright and dark parts, with most of the Names given them

them by *Hevelius*, whose *Lunar Geography* is justly the most followed. In *Fig. 11.* I have represented the appearance of the Moon's Edge on this last Nov. 4. 1714. soon after the Quadrature, for the explication of what is said concerning the Evenness of the Surface of the Lunar Spots in *H. 5. Ch. 4. Note 1.* it may be there observed that the Surfaces of all the Seas appear strait and level, only the top of here and there a Rock or Island presents it self at a small distance. Thus the Surface of the *Hyperborean Sea* between *a* and *b* appears level, although through a Telescope that Sea looks but like a great Lake or Marsh. So do the parts of the *Mediterranean* from *e* to *i*, except when they are interrupted by Rocks or Land, as they are at *b, g* and *d.* At the last of which places, begins a ridge of Hills encompassing the Northern part of the *Mediterranean* which

c 4

makes

makes a pretty shew in the Telescope.

AND now considering how accomplished the Moon, and all the other Planets are for Habitation, how solemn an Apparatus is in them for this service: - and considering also that these Accoutrements relate to their respective Planets only, and in all probability are of little or no use to our Earth; with great reason therefore the Maintainers of the new Systeme conclude those Planets, yea all the Planets of the Sun and of the Fixt Stars also to be *habitable Worlds*; places as accommodated for Habitation, so stocked with proper Inhabitants.

BUT now the next Question commonly put is what Creatures are they inhabited with? But this is a difficulty not to be resolved without a Revelation, or far better Instruments than the World hath hitherto been acquainted with. But if the Reader should have a mind to amuse himself

self with probable Guesses about the
Burnture of the Planets of our So-
lar System, what Countries 'tis pro-
bable are desert, what Vegetables are
produced, what Minerals and Metals
are afforded, what Animals live there,
what Powers, Faculties and Endow-
ments they have, with much more
to the same purpose; he may find a
pleasant entertainment enough in the
great *Mr. Christian Huygens's Cosmo-*
theoros. To which I shall refer him,
rather than give either him or my self
any farther trouble about these mat-
ters, which are meerly conjectural.
Thus having, for the sake of the
Unskilful Reader, given an account
of the three *Systemes* principally con-
cerned in the following Book, and
having also for the sake of the Doubt-
ing Reader, insisted more largely
than ordinary upon the two last of
those *Systemes*, little remaineth for
the putting an end to this long Pre-
face

face, but to make my Excuse (if it needs any) for assigning the Diameters and Distances of the Heavenly Bodies in English miles, rather than other larger Measures, which would perhaps have come nearer the truth. But this was also for the sake of such as are not very conversant in Astronomical Matters and Dimensions: who can better understand you, when you say, It is so many miles, than so many Degrees, Minutes, or Seconds, or Semidiameters of the Earth or other Planets.

AND now for a Conclusion, I shall only intreat all my Readers to joyn with me in their earnest Prayers, that as this Work is designed for the good of Mankind, particularly for the Conviction of Infidels, for the Promotion of the Fear and Honour of **GOD**, and the cultivating of true Religion, so it may have its desired Effect.

W. Derham.



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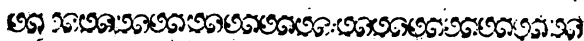
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A
SURVEY
OF THE
HEAVENS.



The Introduction.



THE Psalmist saith, (1)
*The Heavens declare the
Glory of G O D ; and the
Firmament, sheweth, pu-
blickly declareth, tel-
leth forth, or preacheth his Handy-
Work, as the Hebrew Word signifies*

(1) Psal. 19. 1, 2, 3.

(1): that *Day unto Day uttereth Speech, and Night unto Night sheweth, or tells forth, Knowledge.* Which Language of the Heavens is so plain, and their Characters so legible, that all, even the most barbarous Nations, that have no Skill either in Languages or Letters, are able to understand and read what they proclaim. *There is no Speech nor Language where their Voice is not heard: their Line is gone out through all the Earth, and their Words to the End of the World.*

THAT this Observation of the Psalmist is agreeable to Experience, is manifest from the Deductions which all Nations have made from God's Works, particularly from those of the Heavens; namely, that there is a G O D; and that such as

(1) *וַיִּשְׁמַע* significat aliquid verbis efferre, coram nuntiare, annunciare, Conrad. Kircher. Concord. Col. 226. Vol. 2. It is derived from *וַיִּשְׁמַע* Coram, Ante.

have pretended to Atheism, and have deduced God's Works from Chance, &c. are singular and monstrous in their Opinions. Thus saith *Ælian* (1), *There never was any Barbarian that contemned the Deity, nor called in question whether there be any Gods or no? or whether they take care of human Affairs? No Man, neither Indian, nor Celt, nor Egyptian ever entertained any such Thought as Eumerus the Messenian, or Dionysius the Phrygian, or Hippo, or Diagoras, or Socias or Epicurus. So one of Plato's Arguments for the Proof of a God, is (2) The unanimous Consent of all, both Greeks and Barbarians, who confess there are Gods. And Plutarch (3) agreeable to what our Psalmist affirms, tells us whence they collected this Knowledge of a Deity. Men, saith he, began to ac-*

(1) De var. Hist. L. 2. cap. 31.

(2) De Legibus. L. 10.

(3) De Placit. Philos. L. 1. c. 6.

knowledge a God, when they saw the Stars maintain so great a Harmony, and the Days and Nights through all the Year, both in Summer and Winter to observe their stated Risings and Settings. And to pass over a great deal of this kind, that I could cite from divers Heathen Authors, *What*, saith the Stoick in Tully, (1) can be so plain and clear, as when we behold the Heavens, and view the Heavenly Bodies, that we should conclude there is some Deity of a most excellent Mind, by which these things are governed?-----A Present and Almighty God. Which he that doubts of, I do not understand, saith he, why he should not as well doubt whether there be a Sun or no that shines. And then he goes on to prove that this can be no idle Fancie depending on the Caprice

(1) *Quid enim potest esse tam apertum, tamque perspicuum, cum Cælum suspeximus, &c. De Nat. Deor. L. 2 c. 2.*

of Man, but a well grounded, substantial Opinion, bearing the Test of Ages and confirmed by the Length of Time. *For, saith he, Time wears out the Figments of Opinions, but confirms the Judgments of Nature; or such Notions as are grounded upon the true Judgment and Nature of Things. For which reason, saith he, both among our selves, and in other Nations, the Veneration of the Gods, and the Sacredness of Religion augment and improve every Day more and more.*

Thus the *Heavens declare the Glory of God*, even to the Heathen World, so manifestly are they the Handy-Work of God. And that they are his Work, will appear by taking a View of these Seven Particulars.

1. The Magnitude of the Heavens.

2. The great Number of the Heavenly Bodies.

3. Their Distances.

B 3

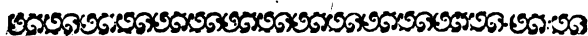
4. Their

4. Their Motions.
5. Their Figures.
6. Their Gravity.
7. Their Light and Heat, and
the admirable Provisions made for
those Benefits.

**BOOK**



BOOK I.



OF THE

MAGNITUDE

OF THE

UNIVERSE, and the *BODIES*
therein contained.



CHAP. I.

*The Ancient and Modern reckonings
compared.*



BEFORE the Invention of the Telescope, the Universe was thought to be confined within far more narrow Bounds than it is since

B. 4

found

found to be, the fixt Stars being imagined to be all placed in the Starry Heavens (which they called the *Firmament*) at equal Distances from the Earth (the Center) like so many golden Nails driven in the Top of some arched Roof, or other circular Concave, encompassing our Eye. These, although far more narrow Bounds, and a more scanty Reckoning than it should be, yet was sufficient to shew who was the Maker of such a stupendous Arch, and so noble a Train as is contained therein.

B u t according to the modern Reckoning (which is far the most rational, and grounded upon better Phænomena) we shall find this Branch of the Creation far more magnificent, and worthy of its infinite C R E A T O R than those former Computations made it.

A n d

AND how grand and magnificent a Structure the Heavens are, will appear by a distinct Consideration of the Magnitude of the Heavenly Bodies themselves; and of the Space in which they are.



C H A P. II.

*The M A G N I T U D E of the
Heavenly Bodies.*

ALTHOUGH we are not able to give a certain Determination of the Magnitude of the Heavenly Bodies, by reason of their vast Distances, yet enough we know, and are sure of concerning their immense Magnitudes, to convince any one that they are the Works of GOD. But to come to Particulars.

T H H

T H E Measure by which we usually gage and compare the Heavenly Bodies, is our Terraqueous Globe; of whose Dimensions and Bulk we can make a pretty good Estimate, having tolerably good and accurate Observations leading us thereto: the Particulars of which I have had Occasion elsewhere to specify (1).

By these Observations it appears that the Diameter of this our Globe is above 79 Hundred Miles; that

(1) *Physico-Theol.* B. 2. ch. 2. In which Place I have made use of Mr. *Picart's* Measure of the Earth. But notwithstanding the Difference be but small, viz. a little above 32 Miles in the whole Diameter of our Globe, yet I shall make use here of our Mr. *Nerwood's* and Mons. *Cassini's* Measures, because they agree to almost a Nicety, and Mr. *Cassini's* were made (by the King's Command) at greater Distances, with the greatest Accuracy. And according to these Measures, the Diameter of the Earth is 7967.7 English Miles, its Surface 199441201 Miles, and its Solid Content 264856000000 Miles.

con-

consequently its Surface is a good deal above 199 Millions of Miles, and its solid Content or Bulk near 265 Thousand Millions of Miles. If therefore we should go no farther from Home than our own Globe, a Mass we here have worthy of an Infinite Creator, a Work proclaiming that great Being that made it.

BUT as vast a Body as this seems to be, it is much less than many, yea most of the Heavenly Bodies that are visible to us, except two or three of the Planets, which seem to be less than our Globe, namely *Mars*, whose Diameter is reckoned to be but 4875 English Miles; and the *Moon*, whose Diameter is but 2175 Miles; and *Mercury*, whose Diameter is 2748 Miles (1); but yet these vast and a-

(1) The Number of Miles which I have here, and all along, assigned to the Diameters of the several Planets are the mean Numbers between Mr. *Flamsteed's* and Mr. *Whiston's* *Astronomizing*

mazing Bodies too. But for the rest, there is good Reason to imagine their Bulk exceeds that of our Terraqueous Globe. Thus the two superiour Planets by far exceed us ; *Saturn* being computed at 93451 Miles in Diameter, and consequently at

astronomical Lectures, and Mr. *Huygens's* in his *Syst. Saturni*. and *Cosmotheor.* which (as Mr. *Whiston* first suggested to me) seem to be nearest the Truth. For whereas the Rays of Light when intercepted by the Edge of a Knife or other Body, are as Sir *Isaac Newton* observes in his *Princip.* L. 1. Prop. 96) somewhat bent, as if attracted from a strait Line by that Body ; and whereas Mr. *Flamsteed's* Measures were taken with a Micrometer that pinches or clasps the opposite Edges of a Planet which would incurvate the Rays one Way ; and Mr. *Huygens's* were taken with the Interposition of a thin tapering Plate covering the Planet as far as the extremity of its Face, which would cause an Incurvation of the Rays the contrary way ; therefore Mr. *Flamsteed's* Measures are as much too little, as Mr. *Huygens's* are too large, and consequently the Mean between them probably nearest the Truth.

427318300000000 Miles in its Bulk; and *Jupiter* at 120653 Miles in Diameter, and 920011200000000 Miles in Bulk. But yet as amazing Masses as these all are, yet they are all far out done by that stupendous Globe of Fire, the *Sun*; which as it is the Fountain of Light and Heat to all the Planets about it, affording them by his benign Rays, and kindly Influence, the great Pleasures and Comforts of Life; so doth it as far surpass them in its Bulk; its apparent Diameter being computed at 822148 English Miles, and its solid Content at 290971000000000000 Miles, supposing the Face we see of the Sun to be its true and real Globe,

THUS stupendous are the Magnitudes of the Globes of this our *Solar System*. But these not all, nor perhaps the most considerable Bodies of the Universe. For the fixt Stars, although in Appearance but so many

ny golden or flaming Spots, yet are, with great probability, supposed to be so many Suns; surrounded with their respective Systemes of Planets, as our Sun is; and no less in Magnitude, if not greater; (some of them at least) than our Sun is, but only diminished in Appearance by their prodigious Distances from us.

IF now we reflect upon the prodigious Masses of those many Heavenly Bodies that present themselves to our View, and many more I shall shew are unseen; what a surprizing Scene do the Heavens afford us of the great CREATOR's Power! a Train of such immense Bodies, that what less than an Almighty Hand could first find Matter sufficient for, and then compose such Magnificent Works! But yet what is the Magnitude of all these Bodies to that immense Space in which they are? Which is the next thing to be considered.

CHAP.

CHAP. III.

Of the IMMENSITY of the Heavens.

IT is necessary that I should give a distinct consideration to the immense Space possesst by the Heavenly Bodies, because it was once imagined to be limited by the narrower Bounds of the *Ptolemaick System*, by that which they called the *Ἀπλανής*, the *Starry Concameration*, or *Firmament* of the fixt Stars, as I have before intimated; but now with far greater Probability and Reason it is extended to an indefinitely larger Space, a Space sufficient, without all doubt, to contain all the noble Variety of Systemes therein, not only our own of the Sun, but all those others I mentioned of the fixt Stars also. But
for

for the better proof, and more easy Apprehension of the Magnitude of this vast expanded Space, let it be considered,


1. **T**HAT some, if not every one, of those vast Globes of the Universe hath a Motion. This is, in some, 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. But in what manner these Motions are performed, whether by the Motion of the Heavenly Bodies round the Earth, or by the Earth round its own Axis, or any other way, it matters not much now to enquire.

2. **I**T is manifest that the Earth is set at such a due Distance from the Heavenly Bodies, and the Heavenly Bodies at such a due Distance from one another, as not to interfere, clash with, or disorder one another,
Nay

May so great is their Distance, so convenient their Situation, that they do not so much as eclipse one another, except such Planets as are called Secondary.

3. It is farther manifest also, That those vast Bodies are so far off, as to appear extreamly small to our Eye, considering their prodigious Magnitudes.

Now for the effecting of this; or any of the other Matters, it is necessary that there be a sufficient Space. And that there is such, and what that Space is, we may make a Judgment of, by considering Particulars according to the best Observations we have of these things.

And to begin nearest Home; the nearest of the Heavenly Bodies to us is the *Moon*, whose Orb is the least of any of the Celestial Globes, but yet she takes up a Space of near 480

thou-

thousand *English* Miles in Breadth (1) to perform her monthly Revolution in. And as for the Earth, if with the Moderns, we suppose it, together with it's Satellite the Moon, to revolve round the Sun; or (which amounts to the same thing) if the Sun revolves round the Earth, this *Magnus Orbis*, as it is usually called, is a Space of above 540 Millions of Miles Circumference (2), or 172

(1) The Moon's *mean Distance* from the Earth according to Sir *Isaac Newton's Princip.* p. 430. is 60 $\frac{1}{2}$ Semidiameters of the Earth, according to which, the Diameter of the Moon's Orbit is 479905 *English* Miles.

(2) Concerning the Distance between the Sun and the Earth, there is a great Disagreement between the former and latter Astronomers, occasion'd by the Disagreement between their Observations of the Sun's *Horizontal Parallax* (which is equal to the Earth's Semidiameter viewed at the Sun) *Tycho* making it 3 minutes, *Kepler* but one, *Bullialdus* 2 minutes, 21 seconds, and *Riccioli* but 28 seconds. Consequently the Distances arising from hence

2

Milli-

Millions of Miles Breadth. And if to that we add the Increment caused by the Sweep of the Moon, or the

are less than those of the latter Astronomers, The very ingenious and accurate *Monf. de La Hire* in his *Tabul. Astron.* thinks the Sun's Horizontal Parallax to be not above 6 Seconds, and his Distance therefore to be 34377 Semidiameters of the Earth. But although his Observations were made since, yet I shall make use of *Monf. Cassini's* Number, being deduced from very ingenious and accurate Observations of the Parallax of *Mars*, and agreeing nearly with the Determination of two great Men, *Mr. Flamsteed* and *Mr. Huygens*, and I may add *Dr. Halley* too, who make it about 10 or 12000 Diameters of the Earth. That great Astronomer assigns a Number between them, in his *Les Elemens de L'Astron.* § 37. That the Sun's Parallax being supposed to be $9\frac{1}{2}$ Seconds, gives the Distance of the Sun from the Earth 21600 Semidiameters of the Earth: which are equal to 86051398 English Miles. And imagining the *Magnus Orbis* to be a Circle (which is an Ellipsis not much differing from a Circle) the double of that Number is the length of its Diameter, viz. 172102795 English Miles.

These Numbers are different from those I have assigned in my *Physico-Theol.* B. I. ch. 4. Note 5. from a Mistake at that time.

Excursion of her Orb beyond the *Magnus Orbis*, we shall have a Space yet broader by near 280 thousand Miles. But as vast a Space as this seems to be, yet it is not such as to cause either the Earth or Moon to clash with any of the other Celestial Globes, as I have said; nay so far from that, that not so much as their Shade approaches any of them. In which case, what ample Orbs must the three Superior Planets have? what a Space is necessary for them and their more numerous Moons to perform their much larger Courses in? And accordingly such Spaces they, and the rest of the Planets are all found to have: *Saturn* an Orb of 1641526386 *English* Miles Diameter; *Jupiter* an Orb of 895134000 mil. *Mars* of 262282910 Miles; *Venus* of 124487114 Miles; and *Mercury* an Orb of 66621000 *English*

English Miles (3) : all of them Spaces so accurately laid out, and Distances so duly proportioned to their Revolutions about the Sun, that abundantly manifest infinite Wisdom to have been concerned in their Appointment, as I intend to shew in proper Place;

BUT now after this Account of this so prodigious a Space as that of our *Solar System* is, what is it to the nearly infinite *Expansum* occupied by the rest of the Heavenly Bodies! Of which we may have a faint Adumbration by considering the Distances which, with the greatest Probability of Observation and Reason, are assigned to the *Fixt Stars*. In order

(3) These Numbers are deduced from the Distance between the Sun and Earth, assigned in the preceeding Note, and Sir *Isaac Newton's* Distances of the Planets from the Sun computed from their Periods in his *Principia*, L. 3. *Phænom.* 4.

to the making an Estimate of which Matter, let it be supposed (which is usually allowed) that the Fixt Stars are so many Suns ; that they are of the same, or nearly the same Magnitude as our Sun is ; and that the Difference of their Magnitudes ariseth from the Difference of their Distances ; if so, then it will follow, That the fixt Stars are each of them as much farther from us than the Sun, as their apparent Diameters are less than that of the Sun (4). And forasmuch as few of them appear otherwise than as Points even through our best Telescopes, therefore how prodigiously farther must they needs be from us than the Sun is, to cause their Appearance to be so very much less than the Sun ? For an Example, let us take one of the fixt Stars supposed to be nearest

(4) Compare the sagacious Dr. *David Gregory's* Demonstration of this in his *Astron.* L. 3. Prop. 56, 60, and 61.

to us, as being the brightest and largest, namely *Syrius*. Now this, by accurate Observations (5) hath been found to be in Appearance 27664 times less than the Sun; and consequently, by the foregoing Rule, it is so many times farther off than the Sun is, which will amount to above 2 Millions of Millions of *English* Miles. And if so, what an immensurable Space is the Firmament, wherein a great Number of Stars lesser and lesser, and consequently (according to the foregoing Supposition) farther and farther off, are seen with our naked Eye, and many more discovered with our Glasses, and still many more and more with better Glasses (6), and in all

(5) See Mr. *Huygens* in *Cosmotheor.* p. 137.

(6) In viewing the Planets with my longer Glasses, especially the Planets of a weaker Light, it often falls out that divers of the Fixt Stars, and some of them very small, present

probability many others that escape the Reach of our utmost Art to descry ; which may consequently be as far distant from those we see, as those are from us.

themselves at the same time within the Glass, notwithstanding its *Area* is not sufficient to contain both *Jupiter* and his most distant *Satellites*. By which means it is sometimes difficult to distinguish between those Fixt Stars and the *Satellites* of the Planets. Thus I have sometimes been ready to fancy that I saw one or more *Satellites* near *Mars*, untill by future Observations I perceived they were only some of the Telescopick fixt Stars lying in the Way of *Mars*. So about *Saturn*, I have only discerned the Likeness of many *Satellites*, but I am not sure I ever saw above three. From whence it is manifest, that in all Parts of the Heavens there are many Stars which present themselves to our Eye through our long Glasses, that are otherwise invisible to us.

C H A P.

CHAP. IV.

Practical Deductions from, and Reflections upon the MAGNITUDE of the Heavens.

HA V I N G set forth the prodigious Magnitude of the Heavenly Space, and of the Bodies therein contained, before we proceed farther, let us pause a little to consider what Influence these Things ought to have upon us.

A N D in short who can behold the Regions above, and consider the Things therein contained, and at the same time not own them to *declare the Glory of God*? Who can view that immensurable Firmament in which those Bodies are, and not acknowledge his Handy-Work? We admire,
as

as justly we may, the vast Bulk of this our own Globe; but when we consider how much it is surpassed by most of the Heavenly Bodies, what a Point it degenerates into, and how little more even it, and what we call its *Great Orb* together also, are, when seen from the Heavens, this gives us a just and noble Idea of the Infinite Creator's Works, such as is worthy of God, and such as may make us slight, not overvalue this little Heap on which we dwell, and cause our Thoughts and Desires to soar among the Heavenly Glories. But for an Application of these Considerations, let us hear *Seneca's* Reflections upon the Matter (7), who on this Account recommends Virtue, not purely *because it is a noble thing in its own Nature, and a great Blessing to be free from Evil, but also because it enlargeth*

(7) Nat. Quæst. L. 1. Præfat.

geth the Mind, and prepares it for the Knowledge of Heavenly things, and makes it fit to associate with God (8).— Then, saith he, the Mind hath the consummate and full good of our human State, when having conquered all Evil, it soars aloft, and wandering among the Stars above, it is able to deride the stately Structures of the Wealthy, and all their Riches. — — — Neither, saith he, can it condemn the Porches and Roofs shining with Ivory, the clip'd Groves, and the pleasant Streams conveyed to their Houses, until it hath wandered throughout the whole World, and from above looking down upon this little Globe, covered in a great measure by the Sea, and, where not so, slovenly, and either burnt up in one part, or frozen in the other, it then saith to it self, Is this that little Point that is divided among so many Nations by Fire

(8) *Qui in consortium D E I veniat.*

and

and Sword? Oh how ridiculous are the Bounds of Mortals, when this River divides this Nation, that Mountain boundeth another, and that Desert another? For as for this World, saith he, It is but a Point in which ye sail, in which ye war, in which ye dispose of Kingdoms. But above, are vast Spaces, into the Possession whereof the Mind is admitted, on Condition it hath brought but little of the Body along with it, that it hath cleansed itself from every filthy thing, and being disengaged from the World hath made itself illustrious, by being expeditious and light, and content with little things. When such a Mind, saith he, hath touched those Celestial Regions, it is then nourished and grows; and, as if delivered from its Bonds, it returns to its original State. And this Argument it hath of its Divinity, that it delights in divine Matters, and is conversant with them, not as things strange, but its own. There it securely beholds
the

the rising and setting Stars, their different Courses, &c. There this curious Spectator discusses every thing, and searches out every thing. And indeed what should it do but pry into those Matters, since he knows they belong to himself. Then he contemns the narrow Bounds of his Habitation in this World. — — And here at last he learns what he hath long enquired after : there he begins to know God (9).

(9) *Illic incipit DEUM nosse.*





BOOK II.



THE
Great NUMBERS
OF THE
Heavenly Bodies:



CHAP. I.

*A General View of the NUMBERS
of the Heavenly Bodies.*

HAVING in the pre-
ceding Book given a
Demonstration of God
from the *Magnitude* of the
Heavenly Bodies, I shall do the same
in

in this from their **Number**; a Number so great, that we cannot view and consider them without Astonishment. Were there no more of them than the Sun, and the Planets (both Primary and Secondary) supposed to move about him, there would be a Number sufficient to manifest an Almighty and Wise CREATOR: But when we view the Heavens, and see ourselves surrounded with so prodigious a Number of illustrious Bodies, of various Magnitudes; when we go to other Parts of this our Globe, from the Northern, suppose to the Southern Pole, and there discover a great Multitude of other Stars, that were never seen in our Hemisphere: when we perceive the Heavens thick beset with them in every Place; and when (as I already hinted) we view the Heavens with our Glasses, and discover many more than our naked Eye could reach; and when we again
view

view them with better and better Instruments, and still discover more and more of those Starry Globes; when particularly we survey what they call the *Milky-Way*, and see the prodigious Number, I may almost say Clusters, of Stars, that fill that Region of the Heavens, and cause that remarkable whiteness there: Hay, when we see such prodigious Numbers of those Heavenly Bodies, which no art of man can number; and when we farther consider, that in all probability, we do not see the half, nay perchance not the thousandth Part of what the Heavens do contain; as we cannot but be struck with Amazement at such a multitude of GOD's glorious Works, so we cannot but own the *great CREATOR* in them; and we are worse than Men, if we do not give him his due Praises.

C H A P.



CHAP. II.

*That the Fixt Stars are Suns encompass-
sed with Systemes of Planets.*

ALTHOUGH the Number of the Erratick and Fixt Heavenly Bodies we see, are sufficient to set forth the Existence and Praises of their great CREATOR, yet there is one thing more that I cannot easily pass over (though it hath only high Probabilities for it) because it gives us a far more noble and agreeable Idea of the Creation, than the World was ever, that we know of, acquainted with before; and that is, That the best and most learned modern Astronomers do generally suppose the great multitude of Fixt Stars we see, or imagine to be in the Uni-
D verse,

verse, to be so many *Suns*, and each of them encompassed with a Systeme of *Planets* like our Sun.

AND that the *Fixt Stars* are *Suns*, or of much the same Nature as our Sun, there is great Reason to conclude,

1. BECAUSE they are Bodies no less immense (as I have said) than the Sun, but only diminished, in appearance, by their prodigious distances from us.

2. BECAUSE they shine by their own native Light, not by any borrowed from the Sun. For so great are their distances from the Sun, and from us also, that it is not possible their Light should be received from the Sun, and reflected to us, as that of the Moon and other Planets is. And withal, so brisk and vivid is their Light, and so very small their apparent Diameters, when divested of their glaring Rays, and made to have

have their true appearance through our Telescopes, that no question is to be made, but that they shine by their own innate Light, as our Sun doth.

AND if the Fixt Stars are so many Suns, certainly they minister to some grand Uses in the Universe, far above what hath usually been attributed unto them. And what more probable Uses, than to perform the Office of so many Suns? that is, to enlighten and warm as many Systemes of Planets; after the manner as our Sun doth the Erraticks encompassing it. And that this is the Use and Office of the Fixt Stars is probable,

1. BECAUSE this is a far more probable and suitable use for so many Suns, so many glorious Bodies, than to say they were made only to enlighten and influence our lesser, and I may say inferior, Globe; which another Moon or two, or one or

two of those very Suns set nearer to us, would have better done, than all the whole train of Heavenly Bodies now doth. But instead of this, many of them, nay perhaps the greatest number of them are at such immense distances (as shall be shewn under the next Head) that they are out of the reach of our naked eye. In which case, what use is it likely such great numbers of such immense, unseen, far distant Bodies can be to our World, when there are so many already of divers Magnitudes of those that fall under View, that (besides other much greater Uses they may do in the Universe) do minister to our comfort here upon Earth in supplying the Absence of the Sun and Moon by Night.

2. FROM the Parity, and constant Uniformity observable in all God's Works, we have great Reason to conclude that every Fixt Star hath

hath a Systeme of Planets, as well as the Sun. For it is certain that the Sun is a Fixt Star to the Fixt Stars, as they are to the Sun. And in this case, if (as the justly renowned Mr. *Christian Huygens* argues) (1) we should imagine our selves to be placed somewhere in the *Heavenly Regions*, as far from the Sun as from the Fixt Stars, we should then perceive no difference between the one or the other. For it would be very unlikely that we should see any of the *Solar Planets*, either by reason of the diminishing of their light, or because their Orbs would sink into the same lucid Point with that of the Sun. Being then so placed, we should imagine all these Stars [both Sun and Fixt Stars] to be much of the same Nature and Kind; and from a view of any one of them nearer to us than the rest, we should make our judgment of them all. And now being;

(1) *Cosmotheoros*, p. 133.

saith he, by the favour of God, admitted so near one of them, namely the Sun, as to see six lesser Globes revolving round about him, and other Secondary ones revolving round some of them: why ought we not to have the same judgment of the rest of those Suns, as of this, and think it altogether probable that this is not the only Star of all the number that is encompassed with such a train, or in any respect excels the rest? Neither also that this Star alone revolves round its own Axis, but rather that all the rest have somewhat of the same kind also. And so that learned Person goes on in the further pursuit of his ingenious Argument.

3. BESIDES those strong probabilities, we have this farther to recommend those imaginations to us, That this account of the Universe is far more magnificent, worthy of, and becoming the infinite CREATOR, than any other of the narrower Schemes,

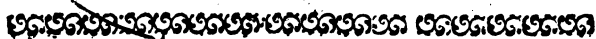
Schemes. For here we have the Works of the Creation, not confined to the more scanty limits of the Orb, or Arch of the Fixt Stars, or even the larger Space of the *Primum Mobile*, which the Ancients fancied were the utmost Bounds of the Universe, but they are extended to a far larger, as well as more probable, even an indefinite, Space; as was set forth in the first Book. Also in this Prospect of the Creation, as the Earth is discarded from being the Center of the Universe, so neither do we make the Uses and Offices of all the glorious Bodies of the Universe to center therein, nay in Man alone, according to the old vulgar Opinion, that *all things were made for Man* (2). But in this our Scheme we have a far more extensive, grand, and noble View of

(2) See *Physico-Theol.* B. 2. c. 6. N. 3.

God's Works: a far greater number of them; not those alone that former Ages saw, but multitudes of others that the Telescope hath discovered since; and all these far more orderly placed throughout the Heavens, and at duer and more agreeable distances, and made to serve to much more noble and proper ends: for here we have not one Systeme of Sun and Planets alone, and one only habitable Globe, but myriads of Systemes, and more of habitable Worlds (3), and some even in our own Solar Systeme, as well as those of the Fixt Stars. And consequently if in the Sun and its Planets, altho' viewed only here upon the Earth at a great Distance, we find enough to entertain our Eye, to captivate our Understanding, to excite our Admi-

(3) See the Preface.

ration and Praises of the infinite CREATOR and Contriver of them; what an Augmentation of these Glories shall we find in great multitudes of them! in all those Systemes of the Fixt Stars throughout the Universe, that I have spoken of, and shall have occasion to mention again in the next Chapter.



CHAP. III.

Of NEW Stars.

BESIDES the Planets of our Solar Systeme, and the wonderful number of Fixt Stars, there are some others, which are called *New Stars*, which sometimes appear and disappear in divers Parts of the Heavens, and will deserve a place here.

SON

SOME of these New Stars have been taken notice of as early as *Hipparchus's* time, who seeing such a Star, and doubting whether it often happened, and whether the Stars we take to be Fixt were so or no; he therefore (as *Pliny* tells us) (1) set upon numbering the Stars for posterity; a difficult Task, he saith, even for a God: and by proper Instruments he marshalled them in such order, that their Places and Magnitudes might be known: by which means it might be easily found, not only whether they decayed and perished, or were again renewed; but also whether any of them changed their places, or had any Motion, as also whether they increased or decreased. Thus *Pliny*.

SINCE which time many other such New Stars have been taken Notice of by others. To pass by the

(1) *Plin. Nat. Hist. L. 2. c. 26.*

New Stars in *Hadrian's*, *Valentinian's*, *Honorius's* and *Otto's* times, and name only such as have been more lately taken notice of by men of good Judgment in these matters; such were those New Stars observ'd by *Tycho Brahe*, *David Fabricius*, *Janson*, *Bayer*, *Kepler*, *Marius*, *Byrgius*, *Holwarda*, *Hevelius*, *Montanari*, *Bullialdus*, *Cassini*, our *Mr. Flamsteed*, and some others (2); to which may be added a New Star that appears at this very time I am writing, in the Neck of the *Swan*; the same in all probability that hath been seen before by

(2) For a Catalogue of these and other New Stars, the Constellations in which they appeared, and other matters relating to them, I shall refer to *Riccioli's Almagest*. Lib. 8. Sect. 2. cap. 1. *Hevelii Prodrum*. in his Description of the Comet in 1665. p. 433. the *Appendix to Mercator's Astron.* and *Mr. Lowthorp's Abridg.* Vol. 1. p. 247.

Mr.

Mr. *Kirch* (3) in 1687, and 1688, and perhaps by *Bayer* long before, as also *Hevelius* and others.

OF these *New Stars*, there is reason to imagine there may be many, by reason they are not confined to any one part of the Heavens, but appear and disappear in divers Constellations, and divers parts of those Constellations, as in *Cassiopeia*, the *Swan*, the *Great Bear*, *Andromeda*, *Eridanus*, the *Whale*, the *Ship*, and divers other parts of the Heavens.

(3) In the *Miscellanea Berolinensia*, p. 210. Mr. *Kirch* saith, he, for some time, sought this Star in vain, but at last on $\frac{1}{2}$ Aug. 1687. he found it with the help of an 8 Foot Tube, but very small, but that it grew bigger and bigger, so as on Oct. 23. to be seen with the naked Eye, until having arrived to its greatest Magnitude, it again became less and less, and at last invisible even in a Telescope: By frequent Observations he discovered its Motion to be very regular, and its Period to be 404 $\frac{1}{2}$ days.

WHAT

W H A T these *New Stars* are, is hard to determine: *Meteors* they cannot be, because they are of a long continuance, and much too far off, for Bodies that emit so little light as *Meteors* do, to be seen by us. And as for other Opinions about them, they are too many, and too frivolous (some of them) to be named (4), except one or two of the most probable. Among which, one is of some that think they may be such Stars as have one side darker than the other (as one of *Saturn's Satellites* is supposed to have) and so appear only when the bright side is turned towards us, and disappear as the darker takes place. Some think they may be *Fixt Stars* that expire in Light and Vapours (5),

(4) If the Reader hath a mind to see a variety of these Opinions, he may find them largely enough handled in *Riccioli's Almagest. ubi supra* c. 17.

(5) This is what Sir *Isaac Newton* surmises in his *Princip. L. 3. Prop. 42.*

and

and are again rekindled, and recruited by the Access of Comets. Others take them to be Comets themselves. But if I may be admitted to speak my own opinion, I rather take them to be *Erraticks* of some kind or other, and that for these Reasons :

1. FROM some of them seeming to change their Places, and appearing sometimes farther off, and sometimes nearer unto other Stars : as I have said in the Preface, *pag.* 48.

2. FROM that Increase and Decrease of their Light and Magnitudes which is constantly observed in them : they being at first obscure, and hardly discernable, but by degrees growing brighter and brighter, till some of them equal the light of *Venus* ; and others the light of the Fixt Stars, of the First, Second, and Third Magnitudes : and then again as gradually grow less and less till they utterly disappear.

3. FROM

3. FROM their Periodical motion and return after a certain time. This indeed hath not been so carefully and judiciously taken notice of as it deserves, or so as to bring their Periods under certain determinations; but yet in some of *Hevelius's* and *Cassini's* observations, it hath been discovered that some of the same Stars have returned, as particularly that in the *Whale's Neck*, and that which now appears in the *Swan's Neck*, which, as I just before in Note 3. said, hath a Period of 404 $\frac{1}{2}$ days, according to Mr. *Kirch's* observations.

THESE are my reasons for suspecting those *New Stars* to be *Erraticks*, rather than *Fixt Stars* either recruited, or having dark and light sides.

BUT the grand difficulty is, what kind of *Erraticks* they are, whether *Wandering Suns*, or *Planets* (like ours)
of

of other Systemes? That they should be *Wandering Suns*, is somewhat odd to assert : and of what use they should be, is hard to imagine, since there is nothing of this kind in the Universe, that we know of, that may assist our imagination.

AND as to the latter opinion, I confess I have been much enclined to suspect that they might be Planets revolving round such Suns as cast a much fiercer, and more vigorous Light than our Sun doth ; and that these their Planets might be more dense than ours, and have Surfaces more strongly reflecting light, and perhaps be much larger too. But notwithstanding that *Planetary Reflected Light* may be sent to very great distances by these means, yet without extravagant Suppositions of this nature, it may be doubted whether it would reach us, so far off as the Fixt Stars are. And besides this, another

another doubt is, That altho' there are divers Stars near those New Stars, of greater Magnitudes than any of the New Stars are, which I ever yet have had the fortune to see, yet I can scarce think them big enough, to conclude them to be the Suns about which those New Stars (if Planets) move. And therefore being uncertain what to determine in so intricate a matter, I shall leave it to future better Observations (which the late long dark Weather hath hindered me in the prosecution of) which I hope may afford us so good light, as may lead us into a much greater knowledge of those rare Phænomena.

B u t whatever those New Stars are, they are a farther Demonstration of G O D's Power and Glory : and that there are many more of the grand Works of the Creation than what our Eyes behold at all, or that we have only now and then a glimpse

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of. But if (as to me it seems very probable) they are Planets of other Systemes, some of those Erraticks revolving round some of the Fixt Stars, then do they lay open a still more glorious Scene of G O D's Works, and give us such a representation of the state of the Universe, that the World never dreamt of before, and that even Angels themselves may be amazed at the sight of.

**B O O K**



BOOK III.



The DUE SITUATION OF THE Heavenly Bodies:



CHAP. I.

*Of the due, as well as great, DISTANCE
of the Heavenly Bodies.*



HAVE before taken notice of the immense Distance of the Heavenly Bodies, that it is such as makes those vast Bodies, the Fixt Stars (no less in all probability, as I said

saïd, than the Sun it self) to degenerate into so many Points, yea to escape our eye ; nay more than this, that it causeth even our own *Great Orb* which our Earth describes about the Sun, to sink into almost a Point, or at least a Circle of but a few Seconds Diameter. I shall therefore say no more on that matter. But that which I shall speak of in this Book, is the due proportion of the Distances of the Heavenly Bodies, that they are not set at random, like a Work of Chance, but placed regularly and in due order, according to the best methods of Proportion and Contrivance. Which will be manifest from the following Chapters, which will shew that the Distance is such, that none of the Globes interfere with one another : but instead of that, are in due and the most nice, commodious Proportion.

CHAP.



CHAP. II.

*That none of the GLOBES of the
Universe interfere.*

HAD the Universe been the Work of Chance, or any thing but a wise Architect, there would have been a great many blunders and inconveniencies in the Situation of such a prodigious number of immense Globes as the Universe doth contain. Some would have been too near, some too far off, some would have met with, knock'd and stop'd one the other, and some would have so interfered as to have incommoded the other some way or other. But instead of this, every Globe throughout the whole Creation is, as far as it is possible for us to observe,

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set

set at such a due Distance, as not only to avoid all violent Concourses, but also so as not to eclipse or shade one the other, wherever it may be prejudicial, or indeed not useful and convenient, or so as to hinder one anothers kindly Influences, or to prejudice one another by noxious ones. This is very manifest in our own Systeme of the Sun; and because we see it not otherwise, we may conclude it to be so in all; unless we should make some exception for what is suspected (and indeed only suspected) of *Comets*, which in their approaches towards the Earth, are imagined to cause Diseases, Famines, and other such like Judgments of God. But this is only Surmise, and what befalls the world at other times without the visible approach of any Comet. But however, supposing that as Comets move in Orbs very different from those of the other Heavenly Bodies,

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so their Effects and Influences may be as different; yet this may be, and no doubt is (because it may be proved) with the concurrence, and by the appointment of the Divine Providence; who, as Governour of the World, might make such noxious Globes for the Executioners of his Justice, to affright and chastize sinful men at their approaches to the Earth, (and as some have imagined) to be the place of their Habitation and Torment after death. But supposing it to be so, yet herein is a kind Providence manifested, That their Returns to the earth are but seldom, and their Stays short, and that they take up many years in passing the rest of their Orbs.

AND now whether we consider the due Situation of the greatest part of the Heavenly Bodies, whereby neither they, nor their influences do interfere; or the more unusual Posi-

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tion and Motion of Comets, still it appears that a wise and careful Architect was the Contriver and Orderer of it all: especially if we joyn what follows in the next Chapter.



C H A P. III.

*Of the nice Proportions of the Distances
of the Heavenly Bodies.*

AS it is one great demonstration of the ingenuity and skill of an Architect to give due Proportions to his Work; so we find this to be abundantly manifest in all the Bodies of the Universe that fall under our cognizance: among which we may discern a curious Order, and that due and nice Proportions are strictly observed in their Situation.

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How the Fixt Stars are situated in respect to one another, is impossible for us to determine at such prodigious Distances as they are from us; but they look to us, who can have no regular prospect of their positions, as if placed without any Order: like as we should judge of an Army of orderly, well disciplined Soldiers, at a distance, which would appear to us in a confused manner, until we came near and had a regular prospect of them, which we should then find to stand well in rank and file. So doubtless, if we could have an advantagious prospect of the Fixt Stars, we should find them very commodiously and well set in the Firmament in regard of one another. And this we have great reason to conclude from the Rules of Parity, from that constant Harmony, and Similitude observable among all the works of the Creation, which fall
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under our cognizance: particularly this is evident in this Region of the Universe, to which we belong, and which we have a better Prospect of, and can survey with our Instruments, I mean the Systeme of the Sun. In this we find every Body placed in good order, and at due distance according even to the nicest Rules of Proportion.

FOR the eviſtion of this matter, let us (according to the moſt received and rational Hypotheſis) ſuppoſe the Sun placed in the Center, to influence all his Planets with Light and Heat. Then follow the ſeveral Planets, ſurrounding him, not one here, and another there, at all adventures, in a rude manner, like a Work of *Chance*, but at due Diſtances from the Sun; at proper Diſtances from one another; and in ſuch well adjusted proportion of their Velocities and Gravities, as makes the Squares of
of

of their Revolutions in proportion to the Cubes of their Distances. And this is what is discernable in the whole Solar Systeme, not only in the Primary Planets that revolve round the Sun, but in the Secondary Planets also that revolve round them. Thus it manifestly is in the Five *Moons* that accompany *Saturn*, and the Four accompanying *Jupiter*. And if the great CREATOR and Contriver of the Universe hath thus wisely modelled, and cautiously methodized this part, this Systeme of it where we live, and behold the thing, no great doubt can be made but that he hath done the same in the other Systemes thereof also; that every Systeme is set at a due Distance from one the other, and every Body in each Systeme at its due Distance also from their Sun, or Fixt Star.

AND now who can reflect upon these things, and not perceive and ad-

admire the hand that acteth in them, the Contrivance and Power of an infinite Workman! For where we have such manifest strokes of wise order, counsel, and management, of the observance of Mathematical Proportions, can we conclude there was any thing less than Reason, Judgment, and Mathematical Skill in the case? or that this could be effected by any other Power, but that of an Intelligent Being, who had Wisdom and Power sufficient for such a Work: according to the reasoning of the Stoick in Cicero, who pleads thus (1): *If thou shouldst see a large and fair House, thou couldst not be brought to imagine that House was built by the Mice and Weesles, although thou shouldst not see the Master thereof: so (saith he) wouldst thou not think thy self very plainly to play*

(1) Cic. de Nat. Deor. L. 2. c. 6.

the fool, if thou shouldst imagine so orderly a frame of the World, so great a variety and beauty of Heavenly things, so prodigious a quantity and magnitude of Sea and Land, to be thy House, thy Workmanship, and not that of the immortal Gods! And so when we see such good order, such due proportions in this Region of the Universe, and have good reason to conclude the same may be throughout the whole, can we, without great violence to Reason, imagine this to be any other than the Work of GOD?





BOOK IV.

OF THE
MOTIONS
OF THE
HEAVENS.

CHAP. I.

*That the bare MOTION of the Heavens
and Earth are a Demonstration of God.*

IN treating concerning
the Motion of the Hea-
venly Bodies, it will
be necessary to take in
that of the Earth too,
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it being not easy to speak of one without the other. And here there are two things that are manifest Demonstrations of the presence and management of GOD, namely, That such Bodies should move at all: and that their Motion is so regular.

1. **THAT** all those vast Globes of the Universe should have a Motion, must of necessity be from some Being that had Power enough to put them in motion. For as *Laëtantius* well argues, (1) *There is indeed a power in the Stars* (and the like may be said of the rest of the Globes) *of performing their Motions, but that is the Power of God who made and governs all things, not of the Stars themselves that are moved.* For it is impossible for such lifeless, dull, unweildy Bodies to move themselves, but what Motion

(1) *Laëtant. L. 2. c. 5.*

they have; they must receive from something else able to move them.

Now this some will say may be effected by the *Vortices* surrounding the Sun, the Earth, or other Primary Mover (2); or from a Vectorial Power, or Emanations of the Sun, (3); or other the like Primary Movers carrying about and pushing on such Bodies as move about 'em. But allowing that it is possible it might be so, yet still we must recur to some *First Mover*, some *Primary Agent*, who was able to set that principal Mover into Motion: and then the case amounts to much the same, and the Argument hath the same force, whether we attribute the Motion of one, or all the several Globes to the Power of GOD. For in our Solar Sy-

(2) This was *Cartes* his Notion, and of others long before him.

(3) This was *Kepler's* Scheme.

steme,

steme, for instance, if it should be thought, that the Six Primary Planets revolving round the Sun, received their motion from his Revolution round his own Axis; yet let us think (as Plato argues (4)) how it is possible for so prodigious a Mass to be carried round for so long a time, by any natural cause? For which reason (saith he) I asserť God to be the Cause, and that it is impossible it should be otherwise. Thus Plato: and his Argument is undoubtedly good, since, as Aristotle argues (5), Every thing that is moved, must of necessity be moved by some other thing; and that thing must be moved by something that is moved either by another, or not by another thing. If it be moved by that which is moved by another, we must of necessity, saith he, come to some Prime Mover, that is not moved by another. For it is impossible that what moveth,

(4) Plato in Epistotii.

(5) Aristot. Physic. L. 8. c. 5.

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and is moved by another, should proceed in Infinitum.

AND now therefore, if in our Solar System, we should imagine the Moon to be wheeled about our Earth, by the Motion and Vectorial Power of the Earth; and the Moons about Saturn and Jupiter by the Motion and Vectorial Power of those Planets; and all the Primary Planets to be turned round about the Sun by the Power of the Sun, yet at last we must find out a Mover of the Sun it self, and those other Primaries: a Cause of sufficient Power to wheel about those prodigious Masses, of such vast Bulks, as have before been assigned to them, and which, besides their own Weight, are, according to the former Hypotheses, clogged and encumbered with the *Inertia* of all those Planets, whether Primary or Secondary, or both, which they drive round. And if this
was

was the case, what Power can be found sufficient for this Work, but but that of the same infinite Hand that at first gave them Being!

AND so for all the rest of the Moving Bodies of the Universe, such as Comets, the New Stars before spoken of (6), and the slow Motion of the Firmament, or Fixt Stars in 25920 (7) Years. This latter I shall say no more of, because it may not arise from any motion of the Firmament it self, but from some other

(6) Book II. ch. 3.

(7) *Ptolemy* made this Motion to be one degree in 100 years. But others since make it to be more. *Mr. Street*, in his *Caroline Tables*, makes it 1 gr. 20': *Hewelitts* 1 gr. 24': 46". 50": but *Mr. Flamsteed* agrees *Riccioli's* numbers to come nearest the truth, viz. 1 gr. 23'. 20". in 100 years; or 50" in a year. According to which rate the Motion (called the *Platonic year*) is accomplished in 25920 years.

(8) *Sir Isaac Newton* demonstrates how this may arise from the Sphæroidal Figure of the Earth, *Princip. L. 3 prop. 21. & L. 1. prop. 66.*

cause (8). But for Comets what Power but that of the Almighty could give them such prodigious Projections as their Trajectories or Orbs are found to have? Orbs that run into such amazingly long Ellipses, that 'tis wonderful how their Projectile Force should carry them to such immense Distances, and their Gravity at the same time bring them back, and retain them in their Orbs.

AND so for the New Stars, which I have said are so many Signals of Planetary Systemes dispersed here and there all over the Universe, they are all of them so many manifestations and demonstrations of an infinite Being that hath imparted motion unto them: and they are a sign also that there are other Globes, besides the Sun and its Planets, which are mo-

Corol. 20. See the matter also more easily demonstrated in Dr. Gregory's *Astron. Lib. I. Prop. 64*
ving

ving Bodies, even that all the Globes in the Universe are such, and consequently so many Proofs of an *Almighty first Mover.*

THUS the bare Motions of the Earth, and of the Heavens are so many arguments of a Divine Power therein concerned. But we shall moreover find an infinitely Wise, as well as Almighty Power, herein transacting, by what follows in the next Chapter.

C H A P. II.

The great REGULARITY of the Motions of every Globe.

HAVING in the preceding Chapter shewn that the giving Motion to such immense, lifeless Globes, is the work of God, we

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shall

shall find much greater demonstrations thereof, if we consider that these Motions are not at random, in inconvenient Lines and Orbs, but such, as shew wise Design and Counsel. I shall here specify but two Examples, because I shall have occasion to say more of this matter hereafter. One is, That all the Planets should (when their Motions were impress'd upon them) have their Directions or Tendencies given, not in Lines tending from the Center to the Circumference, or very Obliquely, but Perpendicular to the Radii. The other is, That the Motions and Orbits of the Planets should not interfere with one another, but tend one and the same way, from West to East, and lie in Planes but little inclin'd to one another, or when inclin'd, that it should be very beneficially so, as I shall

shall hereafter shew. These and many other Instances, and in a word, that every Planet should have as many, and various Motions, and those as regular, and well contrived and ordered, as the World and its Inhabitants have occasion for, what could all this be but the Work of a wise and kind, as well as omnipotent CREATOR, and ORDERER of the World's Affairs? a Work which is as plain a Signal of GOD, as that of a Clock, or other Machine is of Man. Thus Tully's Stoick (1) argues our present case from the Shepherd at *Actium*, when from the top of an Hill he happened first to see a Ship sailing in the Sea, he was for a while in great amazement and sur-

(1) De Nat. Deor. L. 2. c. 35.

prize to see such a moving Inanimate Body, and could not imagine of what a Nature it was possible it should be, until he perceived, by some tokens, that it was made and managed by Man. So, saith he, the Philosophers ought to have done, if haply they had any doubts at the first view of the World: afterwards when they should behold its determined and equal Motions, and all things managed by established orders, and with immutable constancy; they ought then to understand that there is not only some Inhabiter in this heavenly, this divine House, but also some Ruler, and Moderator, and in a manner, Architect of so great a Work, so noble a Performance. This Conclusion is so natural, so cogent, that any thing but stupid prejudiced Blockheads (as those Philosophers were) would have naturally and easily made it. But now, saith the

the Stoick (2), they seem to me not so much as to have any suspicion of the wonderfulness of the things of the Heavens or the Earth. And great reason the Stoick had for his surmise. For so manifest a Demonstration of a Deity are the Motions of the Heavens and Earth, that if men do not see them, it is a sign of great stupidity; and if they will not see, and be convinced by them, it is as plain a sign of their prejudice and perverseness; as will farther appear by considering what an incomparable provision is made for the World's good, by the particular Motions which are given to the Earth and Heavens, namely the *Diurnal* and *Periodical* Motions.

(2) *Ibid.* c. 36.

C H A P.

CHAP. III.

*Of the Diurnal MOTION of all the
several Globes.*

AS to the *Diurnal Motion*, there is great probability that our Earth, and all the Heavenly Bodies have a Rotation round their several Axes; not all performed indeed in the same space, or length of time, but some in longer, some in shorter times; each Time making what we call a *Day* in those several Globes, equivalent, although not equal, to the circumvolution of our Earth in 24 hours.

This diurnal Rotation is visible in many of the Heavenly Globes, and highly probable in our own. In the *Sun* it is very manifest from the equable

ble Motion of its Spots, which sometimes appear on its Disk, and have been observed formerly by *Galilao* (1), *Scheiner* (2), *Tardè* (3), *Malapertius*, *Hevelius* (4) and our Country men

(1) *Galileus* tells us in the III. Dialogue of his *System. Mund.* that he was the first that discovered *Spots on the Sun*, in the year 1610, which he shewed the next year to divers great persons in *Rome*. That *Scheiner* sent him two Letters by *Vellserus* under the feigned name of *Apelles*, to desire his opinion of them: that he concluded them to be alterable, contrary to the received Opinion then, of the *Heavens inalterability*, that they were contiguous to the Sun, and that their path over the Sun, sometimes in a Curve, sometimes a strait line, argued the Annual Motion of the Earth about the Sun, and not of the Sun about the Earth; with more to the same purpose, which may be seen in the sagacious Author, in his 1. and 3. Dialogue.

(2) Vid. *Scheiner's Rosa Ursina*.

(3) V. *Tardè's Astra Borbonia*, who took 'em to be small Stars interposing themselves between the Sun and us. Of the same opinion also was *Malapertius*, who gave them the name of *Sydera Austriaca*.

(4) See *Hevelius's* opinion of them at large in his *Selenography*, ch. 5. and in the Appendix

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Mr. *Gascoigne* and Mr. *Crabtree* (5); and since them by Mr. *Boyl*, Dr. *Hook*, Dr. *Halley*, Mr. *Flamsteed*, and others in *England*, and by Messieurs *Cassini*, *Picart*, and others abroad (6); and of late by my self and others too. These Spots have manifestly a Motion, and the same Motion too, as that of a Globe moving round upon its Poles; for we may perceive them

(5) In their Letters (now in my hands) there is an Ingenious Controversie between those two great Men, Mr. *Gascoigne*, the Inventor of the Micrometer, and Mr. *Crabtree*, concerning the *Solar Spots* that appeared about the year 1640. which Mr. *Gascoigne* imagined to be great numbers of small Planets revolving round the Sun, at a small distance from him. Mr. *Crabtree's* answer and opinion may be seen in his Letter which is published with my own observations about the *Solar Spots* from 1753 to 1754 in the *Philos. Trans.* No. 338.

(6) The Observations of those great Men (which are dispersed about in *Phil. Trans.*) may be seen at one view in Mr. *Louisborge's* Abridgement, Vol. 1. p. 274.

to be perpetually shifting their places from the Eastern to the Western Limb of the Sun; and in thus doing, their daily Stages and Motion exactly correspond to the Motion of a Globe; that is, those Stages are shorter, and the motion of the Spots seemingly slower towards the Sun's Limb, but near the Center of the Disk, larger and swifter; and all in exact proportion to a double Line of Sines, or a Line of Sines on each Semidiameter of the Disk.

And farther yet, these Solar Spots, as they manifestly demonstrate the Sun to be a moving Globe, turning round once in somewhat above 25 days, so they manifest themselves to be something adhering unto, or nigh the Sun's globous body, by means of the different appearance they have in the different parts and positions of the Sun: as in the middle of the Disk, if they are round,

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towards the Limb they become more and more oval or long, just as such a like Spot on a common Globe would appear when it is turned to the side from us.

And lastly, another thing observable in and from these Spots is, that they describe various Paths or Lines over the Sun, sometimes straight, sometimes curved towards one Pole of the Sun, sometimes towards the other, exactly corresponding to the different Positions of the Earth in respect of the Sun throughout all parts of the year.

Thus in that vast Mass of the Sun we have manifestly such a diurnal Motion as I spake of, or Circumvolution round its Axis; a Motion constant and regular, and doubtless of as great use to some office or other, in some part or other of the Universe, as the Motions of the Earth are to the Inhabitants thereof: and a Motion

on therefore this is demonstrating the concurrence of the Almighty.

NEITHER is it the Sun alone that undergoes a Diurnal rotation, but most, if not all the Erraticks about him. *Saturn* indeed is at so great a distance from us, that we have not been able to perceive whether or no he hath such a Rotation; but as the other Planets have it, and there is full as much occasion for it in *Saturn* as in them, so there is no great doubt to be made, but that he hath such a like Diurnal Motion, accomodated as well to his state, as it is in the Earth and the rest of the Planets.

So *Jupiter* is discovered to have manifestly a Motion round upon its Axis from East to West, in the space of 9 h. 56', as *Monf. Cassini* (7) by

(7) See his Observations in the *Memoirs de Mathem. & de Physique* for Jan. 1692.

many

many repeated Observations in the year 1665, and other following years first found from the Spots observable on it ; of which there are two kinds, which I my self have often seen as well as others before me, a short account of which (although it be a Digression) may not be unacceptable to many Readers. One kind of those *Jovial Spots* is only the Shadow cast upon the Planet by the *Satellites* intercepting the Light of the Sun, when they are interposed between the *Sun* and *Jupiter* : the other are such as are really in the body of that Planet, after the manner of those we see in the Moon, but not permanent as they are. And by the motion of these latter Spots it is manifest, not only that *Jupiter* revolves round in the time mentioned, but that it is a moving Globe also, by reason (as was said of the Sun) those Spots move swifter, and in larger Stages towards the

the middle, than towards the Limb of *Jupiter's* Disk. Also such Spots as are round about the middle, appearing long or oval towards the Limb or edge of the Disk; as was before observed of the Sun's Spots.

As to *Mars* and *Venus*, they are both discovered to have Spots, or parts lighter and darker, as well as *Jupiter*, and to have a motion also as he hath. Of those Spots in *Mars*, *Dr. Hook* had divers views in the year 1665, which he hath given us Figures of (8): and from thence concluded that Planet had a Motion, although he could not determine in what time it was performed. But *Mr. Huygens* expressly saith (9) it is performed in the space of 24 h. 40'. But for the motion of *Venus*, *Monf. Cassini* could perceive the Spots to change their place,

(8) See *Philos. Transf.* No. 11, 14.

(9) *Cosmotheor.* p. 24.

and that the Planet had a Motion, although he could not make out what it was (10).

Thus are the Primary Planets discovered to have a *Diurnal Rotation*, or somewhat very like it at least, all except *Saturn*, as I said, and *Mercury*, and our own Globe. And as to these we have very little, or no reason to imagine but that they move as well as the rest; only we cannot perceive it in *Mercury*, by reason of its proximity to the Sun, and that its Elongations are never so great, nor so long, as to enable us to have any good and sufficient Views of him with our Telescopes.

And as for our own Globe, it is very visible that either that moves round in 24 hours, or that the Sun

(10) Mr. *Cassini's* Observations dispersed in the *Phil. Transf.* may be seen at one view in Mr. *Lowthorp's* Abridg. Vol. 1. p. 383, &c 425.

and

and all the Heavens move round it in the same time. And which of these two is the most agreeable to the usual course and methods of Nature, which performs all its works in the most compendious facile way, let every one judge. And is it not far the most compendious, ready and easy way that the Terraqueous Globe should wheel about in 24 hours, than that so many vast Bodies of the Heavens should be turned about it in that time? Is it not as possible, yea as probable, that our lesser *Globe* should be so turned about as those more massy Globes of the *Sun*, *Saturn*, and *Jupiter* are about their Axes? But I shall not enter into a detail of the Arguments for the Earth's Motion, and the Objections made against it, because I have done this in the Preface.

Thus having taken a prospect of the *Diurnal Motions* of the great Globes of the Universe, that fall best

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under the cognizance of our Instruments, and found that many, and probably all of them have a Rotation round in a determinate time; if to this we add the *Convenience* and prodigious *Use* of this Motion to the several respective Globes, we shall find that an infinitely *Wise* and *Kind*, as well as *Omnipotent Being* was the *Orderer* thereof. For were those Globes always to stand still, especially the Erraticks that owe their Light and Heat to the Sun, in this case, one half of them would be dazelled and parched with everlasting Day, whilst the other would be involved in everlasting Night and Darknes. And what the consequences would be, we may best judge from what would befall our own Globe, without the kindly Alternations of Day and Night: and that is, that it, at least a great part of it, would scarce be habitable, it would neither agree to the
state

state of Man, or any other Animals; nor to that of Vegetables, or indeed any other Creature. For one half of the Globe would be burning up, at least too much drying, and exhausted with the Beams of the Sun, whilst the other would be immersed in and deadened with too long Night. And in such a case how could the great Works of Nature, so serviceable to the World, be performed? How, for instance, could the Vapours be raised to supply the Earth with cooling Clouds and fertil Showers? How could the Winds be excited to fan the Atmosphere with their pleasant and healthful Gales? How could the Tides be produced, which by their constant agitations keep the Waters sweet and clean, and prevent their poisoning the World?

AND as the Course and Functions of Nature would be thus affected, so would the State of the Creatures

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be no less. For how could those of the Vegetable Kingdom be animated and excited by the kindly Heat of the Day, and then again tempered and invigorated by the no less kindly Dews, and Influences of the Night? How could Men and all other Animals dispatch their Business, gather their Food, and perform all the various labours and offices of the day, and then recruit and repose themselves with rest, sleep, and due Perspiration, and whatever else may be owing to the salutiferous influences of the Night, and absence of the Sun?

THESE and ten thousand as great Inconveniences as these, would be the certain events of the want of this Diurnal Motion of our Globe. And as the rest of the Globes have their Shares in the like Motion, so we may very reasonably imagine that it is no less useful and beneficial to them than

than it is to us, and that the Inconveniences of the want of it would be as great.



CHAP. IV.

*Of the Annual or Periodical MOTION
of the Primary Planets.*

BESIDES the Motion treated of in the preceding Chapter, there is another which is as clear a manifestation of the great CREATOR as that, namely the *Periodical* or *Annual*, which is visible in some of the great Globes, and probable in many others. Among the Fixt Stars it is highly probable something of this Nature is : as appears from those New Stars which I have before taken notice of, which, as I have said, sometimes become visible to us, namely

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when they are in that part of their Orbits which are nearest to our Earth; and then again disappear, namely when they, in their periodick Motion, are in those parts of their Orbits farther off from the Earth. But these Systemes being out of the reach of our best Glasses, I shall pass them by, especially because in our own Solar Systeme we have abundantly enough to entertain us in this Demonstration of G O D.

FOR it is very visible, without the help of the Telescope, that every Planet of the Solar Systeme hath this *Periodick Motion* I am speaking of. For it is manifest that either the Sun, and the Planets move about the Earth, the one in the space of a year, and the rest in other times; or that the Earth and the other Planets move about the Sun in such times. But let us (as I have all along done) suppose the latter, that the Sun is fixt in the
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Center, without any other but its Diurnal rotation in $25\frac{1}{4}$ days: in this case, we shall have the several Primary Planets revolving round the Sun in an excellent and due order, by the exactest Rules of such a noble Structure, such an admirable Oeconomy, and that is in *Times* (as I said) in *square proportion to the Cubes of their Distances*. So that we see *Mercury* to perform its Period in near 88 days: *Venus* (the next in order to the Sun) its Period in somewhat above 224 days: then the *Earth* with its companion the *Moon* in $365\frac{1}{4}$ days: then *Mars* in about 687 days: next him *Jupiter* in about 4333 days: and lastly *Saturn* in somewhat above 10759 days.

To this so strict an order of the *Periods* of those Planets, we may add the consideration of the different *Paths* of their *Periodical* and *Diurnal motion*: that they lie not in a very different Plane,

90 *Benefit of the two Motions.* Book IV.

Plane, as quite across, or the like ; nor exactly in the same Plane, but a little crossing one another; the Diurnal Course lying in, or parallel to the Equator ; but the other in the broad path of the Zodiack at an inclination of $23\frac{1}{2}$ degrees.

AND a glorious contrivance this is for the good of our Globe, and doubtless no less for all the rest that sympathize in the like motion. For was the Earth's Periodick motion to be always in the same Plane with that of the Diurnal, we might indeed be sometimes nearer to, and sometimes farther from the Sun; but at the same time miss of those kindly increases of Day and Night, together with such useful directions of the Sun-beams, which the advances of the Earth to one or other of the Poles cause (1): which two things

(1) There are two Causes of the great difference between the Winter and Summer, Heat and Cold. One is the shorter or longer

are

continuance of the Sun above the Horizon : in Summer long, which increaseth the Heat, as much as it lengthens the Day : in Winter short, which diminishes the Heat as it shortens the Day ; and augments the Cold, as it lengthens the Night. The other cause is the Oblique or Perpendicular direction of the Sun's rays, the Oblique being weaker than the Perpendicular ; as is evident from *Galileo's* experiment, in his *Systema Mundi*. Dial. 1. by holding a Paper turned up at right angles, or a Book half open; over against an illuminated white Wall ; where it may be observed that the side opposite to the Wall, which the Rays strike perpendicularly, is far more light and white than the other side, on which the Rays fall obliquely. The same it is in the Incidence of the Sun's Rays on any Plane, namely the Rays are so much stronger, and the Plane the more warmed and enlightened, as the Rays are more or less perpendicular ; and that on two accounts. 1. Because the Perpendicular Rays strike with greater force than the Oblique: As in Fig. 4. the Rays RR strike the Plane AP more forceably than the Plane OB . The Action or Force of which Percussion is (like that of all other Impulses) as the Sine of the Angle of Incidence. So the Force of the Rays RR upon the Oblique Plane OB , is as the Sine only of ROB , whereas their Force upon AP is as the whole Sine of 90 degrees, or Angle ROP . 2. Another Reason is, That a greater number or quantity of Rays fall within the compass or Area of any Plane in

are the real causes of our Seasons of Summer and Winter, Spring and Au-

a Perpendicular than Oblique direction. This will be manifest from the bare inspection of Fig. 4. Where it may be observed that all the Rays between $R R$ and $O p$ fall on the Plane $A P$; but only about one half of them would fall upon an Oblique Plane of the same length, if it was $O b$: or (which is the same thing) near as many Rays would fall off $O b$, turned up to $O b$, as fall upon it. Also it may be observed farther, that as the Line $O R$ is longer than $O p$ so are the Spaces between the Rays larger in $O B$ than $O p$; and consequently fewer Rays fall on $O B$ for its length, than on $O p$ for its length, or the Rays are denser, or more compact in $O p$ than $O B$. And when they are so, they are so much the stronger, as is evident from the collecting and condensing the Sun's rays by a Burning-glass.

What the particular Power of the Sun's rays is in all Directions, Quantities, and Impulses, falls under Mathematical calculation; but I need not trouble the Reader with it, but shall refer to the ingenious Dr. *Wolffius*, Mathematical Professor of *Hall's*, *Elementa Aerometriae*. And as for the proportional degree of the Sun's heat in all Latitudes, and all its Altitudes, our most acute *Savilian* Professor, Dr. *Halley*, hath given us a neat and clear method for computing it in *Philos. Transact.* No. 203.

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tumn, and not our being nearer unto, or farther from the Sun. For those benefits (we at least that inhabit towards the Northern Pole) have at the contrary Season, when we have most need of them, viz. the Sun's proximity, in Winter; its greater distance from us in Summer; as is manifest from the increment of its apparent Diameter in Winter to $32'.47''$, and the decrement thereof in Summer to $31'.40''$. (2).

(2) Monsieur de la Hire in his *Tabul. Astron.* makes the Sun's Semidiameters, to be Dec. $30.16'22''$ and Jun. $30.15'49''$. But Mr. Flamsteed in his *Lunar Tables* added to Mr. Horrox's *Posthumous Works* makes the greatest to be $16'.23''$, the least $15'.50''$. and the French Academics $16'.23''$. and $15'.50''$. V. *Recueil d'Observ. Les Elemens d'Astron.* p. 22.

Besides the alteration of the Sun's apparent Diameter, its swifter motion in Winter about the Solstice by about a 15th part, is an argument of its being then nearer the Earth. From whence it comes to pass that from the Vernal to the Autumnal Æquinox, there are

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AND now for a Conclusion of this chapter concerning the Periodick Motions of the Primary Planets, we may take up the Argument of *Hugo de S. Victore* (3), Who commandeth the Sun to descend through the Winter Signs? And who again causeth him to ascend through the Summer Signs? Who leads him from East to West? And who again brings him back from the West to East? All these things are very wonderful, but to God alone possible.

about 8 days more than from the Autumnal to the Vernal.

(3). *Quis solem per hyberna descendere signa precipit? Quis rursus per aestiva signa ascendere facit? Quis eum ab Oriente in Occidentem ducit? Quis iterum ab Occidente in Orientem reprobis? Hæc cuncta sunt mirabilia, sed soli Deo possible.* Didascal. L. 7. c. 8.

C H A P.



CHAP. V.

Of the Periodical Motion of the Secondary Planets.

HAVING considered the Periods of the *Primary Planets*; let us next cast our eye upon those of their *Secondaries*. And among these we shall find the same compleat order and harmony as among the last. Thus *Saturn's* five Moons, and *Jupiter's* four, and our own about the *Earth*, have each of them their determinate times, some longer, some shorter intervals of time, in the same due proportion, as I spake of among the *Primaries*.

BESIDES which, there is another thing very considerable in this Periodical Motion of those Secondary
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Planets, and that is, that it is mixt with a kind of *cochleous* Direction towards one or other Pole of the Primary Planet; by which means every *Satellite* by gentle degrees changeth its Latitude, and makes its visits towards each Pole of its *Primary*. This is well known among the *Circumjovials* for instance, that they all have a slow and gradual progress, first towards one, then back again towards the other Pole of *Jupiter*: and that each *Satellite* hath its Latitude greater and greater according as it is farther or farther from *Jupiter's* Body. Accordingly the Latitude of each *Circumjovial*, assigned by the diligent and sagacious *Cassini* (4), after 12 years observations, are these, The greatest Latitude of the *First*,

(4) *Les Hypoth. & les Tables des Satel. de Jupiter*, § 4. in the *French* Academist's large Collection.

Chap. 5. *Latitude of Jupiter's Moons.* 97

Or *Nearest*, exceeds not a third part of *Jupiter's* Semidiameter: that of the *Second*, surpasseth but a little of a quarter of its Diameter: that of the *Third* a little exceeds three quarters of the Diameter: and that of the *Fourth*, or *Outermost* goes beyond *Jupiter's* Poles by a third part of the Semidiameter. All which mutations, he saith, are performed in the space of 12 years. Thus the famous *Cassini*. But I have my self observed a greater variation in the *Third Satellite*, that it advanced near to, if not even with the very Limb, or Pole of *Jupiter*, and that its Stay in *Jupiter's* Shadow, or the Duration of its Eclipse at that time, was less than is commonly assigned unto it, as it is reasonable to imagine it should be, because the Satellite had only the outside of the Cone of *Jupiter's* Shadow, and consequently a lesser part thereof to pass thorough at that time.

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As to the end and use of this so observable a tendency in the *Secondaries* towards each Pole of their *Primaries*, we may guess at it from what hath been said of the like tendency of the *Primaries* towards the Sun, on which our Seasons do depend: So those *Secondaries* moving in like manner to each Pole, effect some of the grand Works of the divine Providence from Pole to Pole, illuminate all parts of their respective Globes, contract the length of their Nights (as shall be shewn in proper place,) move their Waters, and excite their Tides, and perform other such great Works of Nature as with good reason we attribute to the influx of our Moon here in our own Globe.

AND can such well contrived, such useful Motions, that the World could not subsist without, that Nature could not do its grand Works without, can these be other than the
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Fiat of an infinitely indulgent as well as wise CREATOR! Could this consonancy be so universal, among all the Globes we can bring within our View, could their Periods and Distances be in the same due Proportion all the Universe over, their Motions all so alike, had they not had the same Contriver and Maker! But I shall close this argument with the Reflection of the most ingenious Mr. Molyneux (5), who speaking of the sesquiplicate proportion of both the Primary and Secondary Planets, thus concludes. And from hence may we justly fall into the deepest admiration, that one and the same Law of Motion should be observed in Bodies so vastly distant from each other, and which seem to have no dependence or correspondence with each other. This doth most evidently demonstrate that they were

(5) *Dioptr. Nov. Par. 2. c. 6. Sect. 12.*

all at first put into Motion by one and the same unerring Hand, even the infinite Power and Wisdom of God, who hath fixed this Order among them all, and hath established a Law which they cannot transgress. Chance or dull Matter could never produce such an Harmonious Regularity in the Motion of Bodies so vastly distant: this plainly shews a Design and Intention in the First Mover. And with submission to the Reverend and Learned Divines, I am apt to think, that one Argument drawn from the Order, Beauty and Design of things is more forcible against Atheism, than multitudes of Notional Proofs, &c. Thus Mr. Molyneaux. But we shall find farther Evidences of this Supreme Management in these matters from what follows in the next Chapter.

C H A P.

CHAP. VI.

*The Constancy and Regularity of all the
Motions of the Earth and Heavens.*

THAT the Earth and Heavens move at all, but especially that they have such particular and beneficial Motions, appears, from the preceding Chapters, to be the work of God. And the concurrence of the same infinite Hand is as manifest in the Perpetuity, Constancy, and Regularity of those Motions. For without this *Almighty Guide and Manager*, how is it possible that all those vast and unweildy Masses should continue their beneficial Motions throughout all ages? should perform their useful Stages without any the least intermission, interruption or disorder that we know of? What

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Motion, what Contrivance, what piece of Clockwork was there ever under the whole Heavens, that ever came up to such a perfection, and that had not some stops, or some deviations, and many imperfections? But yet none was ever so stupid as to conclude such a Machine (though never so imperfect) was made by any other than some Rational Being, some Artist that had skill enough for such a Work. As he in Cicero (1) argues from his friend Posidonius's piece of Watch-work, that shewed the motions of the Sun, Moon and five Erraticks; that if it had been carried among the Scythians or Britains, *Quis in illâ barbarie dubitet, quin ea Sphæra sit perfecta Ratione?* with more to the same purpose: no man even in that state of Barbarity would make any doubt whether it was the

(1) De Nat. Deor. L. 2. c. 34.

Chap. 6. Regularity of the Motions. 163

workmanship of Reason or no (2). And is there less Reason to imagine those Motions I have been treating of to be other than the work of God, which are infinitely more constant and regular than those of Man! Or to use the last mentioned *Stoick's* argument, can it be thought that *Archimedes* was able to do more in imitating the Motions of the Heavens (in his Sphere) than Nature in effecting them?

AND now to reflect upon the whole, and so conclude what hath been said concerning these several Motions: We may all along perceive in them such manifest signals of a divine hand, that they all seem, as 'twere, to conspire in the demonstration of their infinite CREATOR and ORDERER. For besides what in all probability is in other parts of

(2) See the place cited at large in my *Physico-Theology*, p. 2.

the Universe, we have a whole *Syſteme* of our own manifeſtly proclaiming the Workmanſhip of its *Maker*. For we have not thoſe vaſt and unwieldy *Maſſes* of the Sun, and its Planets, dropt here and there at random, and moving about the great *Expansum*, in uncertain Paths, and at fortuitous Rates and Measures, but in the compleateſt manner, and according to the ſtricteſt rules of Order and Harmony; ſo as to answer the great ends of their Creation, and the divine Providence, to diſpatch the noble Offices of the ſeveral Globes; to perform the great Works of Nature in them; to comfort and cheriſh every thing reſiding on them, by thoſe uſeful changes of Day and Night, and the ſeveral Seasons of the Year.

THESE things are ſo evident to the Reason of all men, that Tully might well make his *Stoick* to alledge this

Chap. 6. Tully's Proof of a God. 105

this as one of his principal arguments for the proof of a Deity (3); *The fourth cause*, saith he, and that even the chief, is the *Equality of the Motion*, and the *Revolution of the Heavens*; the distinction, utility, beauty and order of the *Sun, Moon, and all the Stars*: the bare view alone of which things is sufficient to demonstrate them to be no works of Chance. As if any one should come into an house, the *Gymnasium*, or *Forum*; when he should see the order, manner and management of every thing, he could never judge these things to be done without an *Efficient*, but must imagine there was some Being presiding over them, and whose orders they obeyed. So much more in so great *Motions*, such *Vicissitudes*, and the *Orders of so many, and great things*; — — a man cannot but conclude, that such great acts of Nature are gover-

(3) De Nat. Deor. L. 2. c. 5.

ned by some Mind, some Intelligent Being.

AND so again afterwards (Chap. 21.) when, among other things, he had been speaking of the motions of the Planets, he thus argues, *I cannot possibly understand, saith he, how all this constancy can be among the Stars; this so great agreement of times through all eternity, among such various courses (how this can be) without some Mind, Reason and Counsel.* And a little after this, speaking of the Fixt Stars, he saith, *But the perennial, and perpetual Courses of those Stars, together with their admirable, and incredible constancy declare a Divine Power and Mind to be in them.* And this he takes to be so plain a case, that he that could not discern it, he thinks, could discern nothing. And then he thus concludes, *In the Heavens then, there is neither any Chance, nor any temerity, nor errour, or vanity: but on the contrary, there*

there is all order, cruth or exactness, reason, and constancy. And such things as are void of these are counterfeit, false, and full of error. — — — He therefore that thinks the admirable celestial order, and incredible constancy, on which the conservation and good of all things depends, to be void of a Mind, he himself deserves to be accounted devoid of a Mind. Thus with great Force and reason Tully's Stoick rightly infers the presence and concurrence of a Divine Being and Power from the Motions of the Heavens: only not being aware who that Being was, he erroneously imagines the Heavenly Bodies themselves to have Divinity, and puts them therefore into the number of the Gods.





BOOK V.
OF THE
F I G U R E
Of the several
GLOBES of the Universe.



C H A P. I.
*The consonancy of all the GLOBES in
their Spherical Figure.*

HAVING in the preceding
Book manifested the *Motions* of the Earth and
Heavens to be the Con-
trivance and Work of G O D, I shall
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enquire in this, whether their *Figure* be of the same kind, suited to the Motions, and in a word, to the whole state and convenience of the several Globes?

Now as to the *Figure*; it is observeable in the first place, that there is a great Consent therein among all the Globes that fall under our view, and that is that they are all Spherical, or nearly so, namely Sphaeroidal (1). Thus all the Fixt Stars, so far as we are able to behold them either with our naked eye, or our Glasses. Thus the Sun, and thus all its Planets, and thus the Secondaries, or Moons accompanying Saturn, Jupiter, and our Earth. And although Venus, Mercury, and our Moon have Phases, and appear sometimes Falcated, sometimes Gibbous, and sometimes more or less round;

(1) See *Physico-Theol.* B. 2. ch. 1. Note 1. and

and even *Mars* too, in its Quadratures, becomes Gibbose; yet at such times as these Planets shew their full Phases, they are found to be spherical, and only lose this figure by virtue of their position to the Sun, to whom they owe their Light. And this sphericity, or roundity is manifest in our *Moon*, yea and in *Venus* too; in whose greatest Falcations the dark part of their Globes may be perceived, exhibiting themselves under the appearance of a dull, and rusty colour.

AND as this Spherical Figure holds in every of the Globes at a distance from us, so we may reasonably imagine our own Globe to be consonant to the rest. But indeed we have great reason to conclude it to be so from the Curvity of its Shadow in its Eclipses of the Moon; from the discovery of New Constellations in the Heavens, as we change
our

our Hemisphere, and make approaches towards either Pole: from the Surface of the Sea, which appears to be of this figure, by our gradually discerning far distant Objects, Mountains, Towers, Sails of Ships, &c. the parts of which are more and more seen, as we approach nearer and nearer to them: with other arguments to the same purpose, which I need not enumerate in a case now generally owned to be true.

C H A P. II.

Of the Inequalities, or Hills and Vales observable in the Earth and Moon.

HA V I N G in the preceding chapter demonstrated the several Globes of the Universe to be Spherical, it is not to be understood that

that these Globes are strictly so, but an allowance is perhaps to be made for the difference between their Equatorial and Polar Diameters, before spoken of: but especially for those little and inconsiderable excrescences of the Hills, very manifestly discernable in the Moon (1), as well

(1) Every one that hath viewed the Moon with but an ordinary Glass, especially when she is not round, may easily perceive considerable Unevennesses; that some parts are manifestly higher, and others lower. About the Quarters, divers bright golden Spots may be seen in the shaded part, at some distance from the enlightened part; and these may be perceived to grow larger and brighter, as the Shady part turns more and more towards the Sun; till at last you may see all the intermediate Vallies between those Spots, and the other enlightened parts. Also in divers parts of the Moon, especially such as border on the shaded part, there may be observed to be certain Holes or Pits, black, dark, or shady, when the parts encompassing them are luminous and bright. And this darkness, as if under some Mountain, lies always on the side next the Sun, and gradually goes off, as the

as in our own Globe; which I call little and inconsiderable, especially those in the Earth, because they are so in proportion to the Earth's Diameter; as will appear by coming to particulars. The Diameter of the Terraqueous Globe I have shewn in

Hole, Pit, or Valley turns more and more towards the Sun, till at last the whole Valley is enlightened, and looks like a depressed ground in the body of the Moon. All which things are manifest signals that the Moon's surface is not even and smooth, but like that of the Earth, full of Hills and Valleys.

Which opinion, although now well grounded, on ocular demonstration, was as old or older than *Plutarch's* days, who in his Book *de Facie in orbe Lunæ*, at the beginning, cites it as *Clearchus's* opinion Εἰκόνας ἢ ποτενύς ὅραται ἐπὶ τῇ σελήνῃ τῆς ὑψηλῆς θαλάσσης——i. e. That what is called the Face of the Moon are the Images and Appearances of a great Sea in the Moon. And about the middle of that Tract, τὸ δὲ πρῶτον ὁρᾷται ὡς ὅτι——i. e. As to that Face which appears in the Moon: as our Earth hath certain large Bays; so we conceive the Moon is overspread with large hollows and ruptures, containing Water, or a thick dark Air, into

my *Physico-Theology* (2) to be about 7935 English miles: but that of the Hills is no more than a few miles. Snowdon in Caernarvonshire (the highest Mountain in all our Island) is but 1247 yards (3); the *Alps* themselves

which the Sun beams are not able to enter, and so no Reflection is made by them.

As to other matters in which the Earth and Moon seem to agree, as in Seas, and great collections of Waters, an Atmosphere, &c. I shall pass them by here as improper for this place.

(2) Book 2. Ch. 2. Note

(3) In the Journal of the late ingenious Richard Towneley, Esq; of Towneley in Lancashire, I find this Note upon Sept. 6. 1682. *This day Mr. Adams called here who is taking a Survey, &c. He told us that with repeated trials he had found Snowdon-hill 1320 yards higher than the High-water mark, and that the Quicksilver stood at the bottom at 29 Inches; at the top at 25.96: So that 1320 gave 3.04. Then follows this Note, viz. Mr. Adams coming since tells me, that the Height of Snowdon was but 1247 yards, which gave 3.04.*

The reason of this difference of 73 yards, in the height of Snowdon I take to be, that the first measure was made by Mr. Adams himself,

but

but about two English Miles (4): nay the very Pike of *Tenariffe*, one of the highest Ridges throughout the Globe (unless we except the high Mountains of Peru called by *Jos. Acosta* (5) *Periacaca*; or that near *St. Martha* (6); or those called the *Andes* (7); this Ridge (I say) is compu-

the latter by Mr. *Caswell* with Mr. *Adam's* Instruments: and probably the former is the Height above the Sea: the latter only above some plane.

(4) Mr. *Nich. Fatio* told me that he had measured the Height of the *Montagne Mauditi*, which is one of the highest Ridges of the *Alps*, and that he found it to be 2000 French Toises above the *Lake of Geneva*, which is equal to 12816 English Feet, or 2.42 miles.

(5) *Acosta* saith the *Alps* seemed to these Mountains he travelled over, but as ordinary Houses to lofty Towers. See my *Phys. Theol.* B. 1, ch. 1. Note 2.

(6) Capt. *Dampier* saith that he is of opinion that the Hill near *St. Martha* is higher than the Pike of *Tenariffe*. Voyage round the World, p. 24.

(7) Of the *Andes* of *Chili* and *Peru*, Capt. *Dampier* saith, These are the highest Mountains I

ted to be but between 3 and 4 miles perpendicularly above the Sea (8). All which Eminences compared with the Diameter or Semidiameter of the Earth is no more than as a particle of Dust is to a large Globe, on which it resteth.

AND so likewise for the Mountains visible in the Moon, although some of them are of that height (9), as to

ever saw, far surpassing the Pike of Tenariffe, or Santa Martha, and I believe any Mountains in the world. Ibid. p. 95.

(8) See Dr. Hooke's account of the Pike of Tenariffe from his Friend Mr. G. T. who went to the top of it; at the end of his *Lectures concerning Springs* p. 42.

(9) By Riccioli's Measures the Height of what he calls Mount Sinai, or St. Katharine's Hill, is 9 Bononian miles, and that of Xaverius 12, but according to his corrections, the former is but $8\frac{1}{4}$ miles, the latter 11 $\frac{1}{2}$. Which at the rate of 6020 English feet in a Bononian mile, is about 13 and 9 English miles; an height so great, considering how much the Moon is less than the Earth, that I cannot but think that diligent person was mistaken in his measures, and that the computa-
reflect

Chap. 2. of the Earth and Moon. 117

tions of *Hévelius* are much the best: who as he was as able as any man, and made more accurate and diligent observations of the Moon's Face than most men ever did, so was more likely to come nearest the truth. And by his reckoning, the highest Hills in the Moon are but about $\frac{1}{2}$ of a *German* mile, and some of them but $\frac{1}{3}$ ths, and some not above an *Italian* mile. And considering the Bulk of the Moon to that of the Earth, these are great Eminences for the Moon.

And as the *Lunar Mountains* are of prodigious Heights, so many of them are of great Extent. *Hévelius* reckons the *Lunar Taurus* to reach to 170 *German* miles; *Mount Sepher* 150; and the *Lunar Apennine* above 100 *German* miles.

The Way how to measure the Height of the Mountains of the Moon is not difficult, nor uncertain: which is, by observing the distance between the distant golden Spots, at their first appearance (which are the tops of Hills) and the enlightened part of the Moon. Which Distance may be computed by miles, or any other equal parts, into which we can imagine the Moon's Diameter divided. Thus in Fig. 5. *A R B* is a part of the Moon's Circumference, one part of which *A R* is enlightened, the other part *R B* is in darkness. *H* is a Mountain, whose top *H* is touched by the Sun-beams, shining from *S* the Sun to *R*, and reaching to *H*. Now supposing the Semidiameter of the Moon, *RC*, to be 274 *German* miles, according to *Hévelius*, the length of the side *RH* or Distance

reflect the Light of the Sun from their lofty Tops some days before ever it reacheth the Vallies beneath them; yee on the Moon's Limb we can discern nothing of them: but so far from that, that, on the contrary, the Edge through our best Glasses, looks like an even, smooth, and uninterrupted Circle (10)

stance between the Top of the Hill, and the edge of the enlightened part) will be found also to be a 10th, 20th or other part of that Semidiameter or Diameter; or some certain number of miles. And then we have the two sides RC , 274 miles, and RH , and the right Angle included between them; by which, both the other Angles, and the Side CH , may be found by a common Case of Right angled Triangles. Out of which side CH , deducting the Moon's Semidiameter 274, there remaineth the Height of the Mountain Hi . Consult here *Hevel. Selenogr.* ch. 8. *Galileus Nunc. Sider.* p. 14. *Riccioli Almagest.* L. 4. c. 8. Schol.

(10) The Edge of the Moon which I here mean is that next the Sun; on which I could never perceive with my best Glasses any the least sign of a Mountain, but all to be exactly level and smooth. Only indeed there are some certain transient roughnesses and uneven-

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ALTHOUGH then vast Mountains, when seen near at hand, seem to be very considerable excrescences of our Globe, yet since they are little, when compared to the Globe it self, we

nesses on the Limb caused by Vapours especially when the Moon is near the Horizon, and in windy, and some other weather. At which times the motion of the Air and Vapours makes a pretty Crispation and Rouling like Waves on the Moon's Limb, which have the appearance of moving Mountains and Valleys. But on the opposite side, if the least portion of the Darkened part of the Moon, extends beyond the Enlightened part, Mountains may very manifestly be discerned, exactly resembling ours on the Earth. A few hours before and after the Full, I have with pleasure seen the appearance of considerable Mountains and Bays. One of which Views, I have given in Fig. 6. which is the Moon's appearance, soon after the Full, on Sep. 12. 1714.

These alone I conceive are the Mountains which the excellent *Hevelius* speaks of in several places of his *Selenography*, particularly in his Answer to *Bettinus*, and other *Peripateticks*, in Ch. 6. p. 143. who denied that Mountains could be in the Moon, as well as many other things discovered now by the Telescope.

may look upon our own, and all the rest of the Globes as if they were perfect Sphaeres, or at least Sphaeroids. And finding them to be such, let us next enquire what reason there is to imagine this their Form to have been the great CREATOR's Work.



CHAP. III.

The Universality and Uniformity of the Figure of the several Globes of the Universe is a sign of their being the Work of GOD, not of Chance or Necessity.

WHEN we see divers Pieces of curious Device and Workmanship to bear the same marks of Art, to have the same masterly Strokes of Painting, Clock-work, Architecture, &c. we conclude with great

great reason such Pieces were made by the same skilful Hand. So when we see the same commodious Spherical Figure to be imparted to the Earth, and all the Heavenly Bodies, we have as good reason to conclude them to be Pieces of the same Hand, Contrivances and Works of the same skilful Architect. For if the Universe had been a work of *Chance*, all the several Globes would have been of several Forms, one of this, another of a quite different Figure: one square, another multangular, another long, and another of another shape. Or if all the several Globes had been a work of *Necessity*, and their Figure had been owing to the natural tendency, or Gravity of Matter, viz. that the Self Attracting power of Matter did make all the Solids and Fluids of all the several Globes, as naturally run into a globose form, as a drop of Quicksilver doth: yet still

we

we may demand; How came Matter by this so commodious a Power? What made it affect so proper a Form but the infinite CREATOR's *Fiat?*

BUT not to contest that Point, but granting Gravity to be congenial and coeval with Matter, without enquiring how it came by that power, and allowing that every Globe of the Universe had its Form from the Self-attracting power of its Matter, yet still we have undeniable marks of *Final Causes*, of wise *Order*, and an over-ruling *Power* in the case. For let us imagin our Terraqueous Globe in its Chaotick state; all its Matter, every particle of it divided, and floating about, and ready by its self-attraction to run together into its natural form, that of a Globe. In this hurly burly, this jumble of unguided Nature made by Attraction only, a confused globose Mass can
be

be supposed to be formed ; but without any order, without that convenient lodgment of its parts, as the necessities of an habitable World require. But instead of any such signs of disorder, or of Nature's acting with an unguided Power, we have the clean contrary ; all the Signals of a wise Contrivance, and excellent Art ; as will appear in the following Chapter.



CHAP. IV.

The Terraqueous and other Globes appear to be the work of GOD from the wise disposition of their parts.

AS the Earth, and all the other Globes would have been of various Forms, if they had been made by Chance : or would have been

been confus'd Masses, if made by Necessity, according to the last chapter: so in this I shall shew them to be the Work of a *Wise* and a *kind Agent*, from the commodious structure and disposition of their parts, so far as we have any knowledge of them. Thus the *Moon* hath great appearances of being no less commodiously than the *Earth* divided into Hills and Valleys (as I have set forth in the 2d Chapter;) into Dry-lands, and great Collections of Waters (1),

(1) That there are Seas, or great Collections of Waters in the Moon is highly probable from the *Moon's Spots*, which plainly seem to be Water on these two accounts, 1. Because those Spots appear to be in strait and level long Planes, when viewed about the Moon's Quarters, or at such times as one half of them are enlightened, the other half in darkness. In this case, when we do not look directly upon those Planes or see them wholly enlightened, but view them in a manner sideways, their Surfaces look as the Sea doth when we view it from the Shore, viz. a large level

and

Plane: only we may now and then discern a bright shining part standing a little out of the large Levels; which are, no doubt, certain Rocks or Islands in the midst of those Seas: 2. The Darknes of those Spots more than other parts of the Moon is an argument they are Water, or some such like Fluid, which imbibes the Sun's Rays more than harder Bodies, and doth not therefore so vigorously reflect them as they do. Accordingly about the Moon's Quarters, when those Spots, as I said, have the appearance of long Planes, we may observe their edge to be a kind of hazy border, which grows darker and darker, as the Rays are more and more absorbed.

But indeed hard Bodies, if they have smooth surfaces, although they reflect strongly to one place, yet in other places they are less visible. Thus a Looking-glass, a Diamond, &c. reflect vigorously the Sun's rays towards one part, so as to dazzle the eyes; but in other parts they appear of a dark, blackish hue. Which by the bye, is the reason why Jewellers grind their Diamonds with many sides and angles, that their lustre may appear many ways. So Silver (as *Galileo* observes, Dial. 1.) when boiled only in *Argol* and *Salt* appears as white as Snow; but wherever it is burnished, it becomes obscure. And so he tells us rightly enough the Moon would become invisible to us, if its surface was not rough, but sleek and smooth. See also *Hervellii Selenogr.* ch. 6. p. 151.

(2) That

and to be encompassed with an Atmosphere as we are (2). So Jupiter although at so great a distance from us, hath manifestly, we see, his lighter and darker parts; his Belts and Spots darker than the rest of his Disk. These Mr. Cassini (who longer viewed this Planet than any body else) takes to be Canals containing some fluid matter, or Water, that more weakly reflects the Sun's rays than the other parts of the Planet do, and that they have some resemblance with what happens here upon Earth. (3) For if, saith he, one from on high in the Heavens should see the Earth in some particular situations, the Sea which encompasseth the Earth would appear very

(2) That there is an Atmosphere about the Moon, see Book 7. ch. 3. Note 1.

(3) *Nouvelles Decouvertes de Jupiter; par M. Cassini in the Memoires de Mathem. & de Physique for January, 1692.*

like

like the great Southern Belt that encircleth the whole globe of Jupiter: the Mediterranean Sea would make an appearance not unlike those Belts which are interrupted or broken, which we see in this Planet: the other Seas would make those great black Spots which never alter at all: the Continents and Isles would seem like those bright Spots that are also permanent: the Snows would make those glittering Sparkles [Brillants] that from time to time disappear: the Flux and Reflux of the Ocean, and those great Inundations that happen sometimes here, would occasion other Spots to appear and disappear: the Moon would resemble one of Jupiter's Satellites: in fine, the Clouds of our Atmosphere would resemble those broken interrupted Belts, and those transitory Spots, which often change their size and figure, and have motions of different velocities.

Thus that ingenious and curious Observer. According to whose not
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improbable opinion, this Planet *Jupiter* hath all its parts orderly placed, as it is here upon earth.

AND so for the rest of the Planets, whose Faces exhibit different appearances of brighter and darker parts, as *Mars* and *Venus* particularly do (4), it is highly probable that these may be such a distribution, such an allotment of Parts, as those in *Jupiter*, and which are more plainly visible in our own Globe.

WHICH brings me to speak particularly of our own Globe, of which we have a nearer View, and can plainly see the footsteps of Divine Providence in the wise and orderly disposition of all its parts; which are so distributed, so placed, as may best minister to the several uses and conveniences of an habitable World.

(4) See Book 4. chap. 3.

C.4. *All parts of the World well plac'd.* 29

Thus for instance, the two grand parts, the Solids, and the Fluids of the Terraqueous Globe, instead of being jumbled into one Mass, are admirably parted, and as nicely laid in proper places. The *Earth* deposited in useful *Strata*; some for the service of the Vegetable kingdom; some for the generation and nourishment of Minerals and Metals; some for that of Stones and Fossils; and some for the sweetening and conveyance of the Waters. And here it is remarkable, and an argument of a wise design and appointment; That all those several *Strata* or Beds are lodged at proper and convenient depths and distances from the Surface; that for Vegetables, the uppermost, for every man to cultivate; and this divided into various Soils and Moulds for all the varieties of Trees and Plants; those *Strata* that contain the Minerals, Metals, and Fossiles, at

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such

such depths, as to be out of the way, when they may encumber or hurt us, but may be come at by us, when we have occasion for them: and as for those *Strata* that convey the Sweet waters (5) it is very remarkable, that they are so universal; in all, or most parts of the World; that they consist of such proper pervious matter; that they remain so distinct from, and unmixed with the other *Strata*, and that they lie at such due depths, as either to break out in Fountains, or to be dug into, for Wells. But I shall not enlarge on these matters, having spoken of them elsewhere.

AND as this so commodious a distribution of the *Earth*, so that of the *Waters* is a manifest demonstration of the concern of a wise Agent, although we should ascribe all that is

(5) See *Physico-Theol.* Book 3. ch. 2.

possible

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possible to the necessities of Nature in the formation of the World. For the Waters, if we observe them well, are accurately dispersed, and lodged about the world for the proper offices thereof; in Seas, in Lakes, in Rivers, in Fountains, to satisfy the Thirst of Animals, to afford them some part of their Food, and to minister abundant supplies of Vapours for the Clouds, the Rains, and Winds: which Supplies must either have failed, or have been too abundant, or have been attended with some or other great inconvenience, without such a commodious intermixture of the Land and Waters.

THIS Συμμετρῶν, this orderly gathering together of the Waters, is implied in Moses's relation of this branch of the Creation, *Gen. 1. 9. And God said, Let the Waters under the heaven be gathered together unto one place.* Where the word *מִן* denotes

a regular and orderly gathering of the *Waters*, as if their Allotment had been made, their Receptracles had been marked out by a Rule, or a Plumb-line, by the CREATOR's *Fiat*.

Thus it is demonstratively plain, that the Earth and Waters were laid by a wise Hand ; and therefore whatever concern *Nature* might have in giving a Sphærical Figure to our Globe, yet was the CREATOR the principal *Agent*, the grand *Manager* of the matter.



C H A P



CHAP. V.

The Convenience and Necessity of a Spherical Figure to the Good of the Globes is an argument they were the work of G O D.

BESIDES the orderly and commodious placing the Parts of the several Globes spoken of in the last Chapter, there are still other reasons to ascribe the Sphericity of our own and the other Globes to a *wise Agent*. For besides that this Figure is the most agreeable to a World, as being the most capacious ; and the most agreeable to a Mass in motion ; as being at a due distance from the center of Motion and Gravity : so without this figure there could have been no such comfortable, and agreeable alternations of Day and
K 3 Night

Night, of Heat and Cold, as now there are, but some parts must have been for too long a time skreened from the kindly approaches of the Sun and Moon, and consequently have lain undertoo long and uncomfortable a Darknes, and been chilled with miserable Cold. And as to our own Globe, the Winds could not have given those kindly and salutiferous agitations to the air as they do, but they must have been too much retarded, if not wholly stop'd by the exorbitant angles, and jettings out of other figures. And lastly, the Waters which I shewed to be well intermixed with Dry-Land, would have had intolerable Confluences ; one part too much, another none at all, no Vapours, no Fountains, no Rivers : so that instead of an habitable, well stocked world, far the greatest part would have been either a Desert, or an unnecessary Confluence of Water.

Thus

Thus having made it evident, that particularly our own Globe received its Figure by the direction of the infinitely wise *Architect* of all things: we have reason, had we none besides, to conclude the same of all the rest of the Globes of the Universe, inasmuch as they agree with ours in other things as well as in their Figure, so far as we have any knowledge of Them, and their State. Thus the Planets of the Solar Systeme have their Light from the Sun as well as we; they turn round on their own Axes, and revolve round the Sun, and consequently have their Days and Nights, their Summers and Winters as well as we; they have their Hills and Valleys as I said, their Land and Waters, by all the Signs that may be, as well as we; and therefore agreeing with our Globe in so many of those very things wherein their Figure is concerned, had we none of those Reasons I

have already mentioned, there would however be great reason to presume the same thing of them as of our Earth, *viz.* That they received their Figure from the same wise CREATOR, and that (were we near enough to behold them) they have as manifest Signals of it as we.

**BOOK**



BOOK VI.



OF THE
Attraction or *Gravity*
OF THE
Terraqueous, and the other Globes.



CHAP. I.

The Usefulness of Attraction in the production and preservation of the Figure of the Earth, and the Descent of Heavy Bodies.



HAVING in the two last Books treated of the Motions and Figure of the Globes, I shall in this consider their *Gravity* or *Attraction*, which

which according to the modern Philosophy (which hath great reason and probability on its side) hath a great agency in both these matters, both in effecting and preserving the Figure of the Globes, and governing their Motion.

As to the agency of the natural Attraction of Matter in the production and preservation of a spherical figure, as that of the several Globes is, besides what hath been before supposed, it may be collected from the spherical figure which most Fluids take, when there is no obstacle to hinder their doing so. Thus I have said *Quicksilver* manifestly doth, especially in small drops or quantities; in which case their own self attracting power is equal to, or exceeds that of the earth: so doth Lead and other Metals when in fluxion (1); so doth Water, Oyl, and

(1) This is very manifest from the making of *Shot*. The way of doing which, is by running in

in short all Liquids, which run nearly into a spherical form, when hung on a small surface, as at the point of a Pin; or into an hemispherical figure, on a broader surface; their Self-Attraction causing the former, as that of the Earth and the Surface on which they lye doth the latter. These Phenomena have indeed been ascribed to divers Causes, most of them improbable enough, except the Pressure of the incumbent Air: but this is manifestly not the true Cause, by reason the case is the very same in the *Air-Pump* (when the Pressure is taken off) as in the free

ming the melted Lead through a Ladle full of holes into cold water. In doing which they take care their Lead be not too hot, because the globules would then fly to pieces; nor too cold, because it would then be long and have tails; but in a due temper it turns round. They put *Orpiment* into their Lead, when they melt and prepare it for Shot.

Air:

Air; and therefore some other Cause is to be found: and what more probable, or so probable as this of *Gravity* or *Attraction*, which manifestly exerts itself in some, and is highly probable in all material things? (2) In the Earth it self there is manifestly such a thing as *Gravity*, which might as well be the Natural Cause of the Sphericity of our Globe, as it is in that of lesser Masses, but then, as I demonstrated in the last Book, it is also evident, that an over-ruling Power, and a wise Providence not only gave Matter this *Gravitating* power, but guided and managed it in the formation of the World.

AND now upon supposition that *Gravity* had any thing to do in the

(2) For the Proof of this I shall refer to Sir Isaac Newton's *Opticks*, Quest. 23. and in his *Principia* in many places, particularly L. 3. Prop. 5, 6, 7.

production of this Spherical Figure I am speaking of; the same it must have also in the conservation of that Figure. For the same Power it exerted at first, it retains still; which is as necessary still to the preventing and obviating all extravagant Excursions, and Deviations from that figure, which may happen through extraordinary Commotions and Convulsions in any of the Globes; such as Earthquakes are, and other such like furious Concussions and Emotions that sometimes befall our own Globe.

BUT leaving these conjectural matters, let us come to a more evident benefit of *Gravity*, and that is the natural tendency of all bodies to the center of the Globe: This is very manifest in our own Globe. For whatsoever the Decays are among earthly things, howsoever their Forms are changed, yet their *Matter* remaineth entire, and returneth again to its
grand.

grand Parent the Earth: or to put it in Solomon's words, *Eccl. 1. 4. One generation passeth away, and another generation cometh: but the earth abideth for ever.*

AND an admirable provision this is for the perpetuity of the Globe, and to continue the State and Habitability thereof throughout all ages, which would otherwise waſt and decay, or run into the moſt irreparable and pernicious diſorders.



CHAP. II.

The Guard which Gravity affords against the Centrifugal Force of the ſeveral Globes.

UPON a ſuppoſition that every of the Globes revolves round its own Axis (which I have ſuf-

sufficiently proved in the Fourth Book) we shall find, besides the Benefits already specified, another very great use of Gravity to the Good, yea the very Existence, of our own and the other Globes, and that is the preservation of their Integrity against the *Centrifugal force* of this their Revolution, or Diurnal motion. For without such a Band, as Gravity, to keep their parts together, the whirling about of those Globes would shatter them into pieces, and dissipate them abroad into the circumambient space. Thus must it needs befall our own Globe, which whirls about at the rate of above 1000 miles an hour (1), and is composed of Earth and Water, materials of much too loose a

(1) The Diameter of the Earth being 7967.7 miles, according to B. 1. Ch. 2. Note 1. the Ambit thereof is 25031.4 miles, which being divided into 24 hours makes the Revolution to be at the rate of 1043 miles an hour.

texture to prevent the dissipation which the Centrifugal force of such a Rotation must necessarily occasion about the Æquatorial parts, a Rotation that would as easily throw off the parts of the Earth, especially the Waters, as the whirling round of a Wheel or a Globe, would the loose Dust and Water lodged thereon. But by reason the *Gravitating Power* exceeds the *Centrifugal* as 2174 exceeds 7,54064 (2) that is above 288 times, therefore all parts lye quiet and secure in their respective places, and enjoy all the benefits, which I shewed do accompany this Motion without any disturbance from it.

Thus is our own Globe guarded by its *Gravity* against the *centrifugal force* of its *Rotation*. But this is far

(2) This is the proportion or nearly so, of the *Gravitating* to the *Centrifugal Force* of the Earth under the Equator, as may be computed from Sir *J. Newton's Princip.* L. 3. Prop. 19.

more

more remarkable in some of the other Globes. Thus particularly in the Sun, whose Orbit is 2582873 miles, and whirls round once in about $25\frac{1}{2}$ days, doth consequently revolve at the rate of 4262 miles an hour (3), above four times as fast as the Earth; which in a little time would endanger its dissipation, without such a provision as Gravity is.

B u t what is this to the Centrifugal force of *Jupiter*? whose Bulk far exceeds our terraqueous Ball, and whose Rotation is performed in less than half the time. But from a computation of particulars we shall better estimate the Matter. The Diameter

(3) The Sun's Diameter being 822148 miles, the numbers here assigned will naturally follow.

As to the Sun's *Gravity* or *Attractive Power* it is (by the calculation of my Friend, the acute and learned Dr. *Halley*) to the Sun's *Centrifugal Force*, as 47000 to 1: The method for finding which see in Note 5.

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of *Jupiter* being 120653 miles, its Circumference is 379045 miles: which revolving round in less than Ten hours, is at the rate of 38159 (4) miles an hour under its *Æquator*. And if the Density of every Planet be proportional to its Distance from the Sun, as is now with great reason imagined, that is, if those Planets nearest the Sun, as *Mercury* and *Venus*, are proportionably denser than those more remote, as *Jupiter* and *Saturn*; then is the Globe of *Jupiter* of a laxer texture than ours is, and in so much the greater danger therefore of being

(4) *Jupiter's* Ambit being 379045 miles, and his Revolution 9 h. 56' or 596 minutes; the Revolution in an hour is by the Logarithms thus.

596 minutes
379045 miles
:: 60 minutes

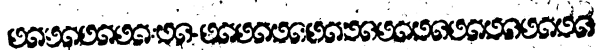
2.7754463
5.5286912
1.7781513
7.3568425

38159 miles

4.5815962
whirl'd

whirl'd to pieces by so rapid a motion as that Planet manifestly hath, were not its parts kept close together and sedate by such a Band as Gravity (5) is.

(5) The Proportion of *Jupiter's* or any other Planet's, or the Sun's Gravity to their Centrifugal force may be computed from the most sagacious Sir *Is. Newton's Princip. L. 3 Prop. 8 & 19*. But the before commended *Savilian Professor* suggested to me this easier and quicker Rule, for such Planets as have Satellites, viz. The Proportion of the Centrifugal to the Centripetal force, or Gravity of any Planet at its Surface, is compounded of the Ratio which the Cube of the Semidiameter of the Planet hath to the Cube of the Distance of any of its Satellites from the Center of that Planet; and the Ratio which the Square of the Satellites Periodick time hath to the Square of the Periodick Time of the Planet's Revolution. Thus for instance, the distance of *Jupiter's* Outermost Satellite being 253 Semidiameters of *Jupiter*; and it's Period 16 days, 16 hours, 22 minutes or 24022 minutes, and *Jupiter's* Revolution 596 minutes; we shall find the Gravity in *Jupiter's* Surface to be to his Centrifugal Force in his Equator, as 1 to 9.96.



C H A P. III.

*Of the Power and Usefulness of Gravity
to retain the Planets in their Orbits.*

FOR a Conclusion of this sixth Book, I shall take notice of one more remarkable benefit of Gravity, which is grounded upon the supposition of the truth of the *Newtonian Philosophy*; which hath so good Grounds, and great Reason, I might say Demonstrations, on it's side, particularly in this matter, that admitting of it here, we shall discover a another admirable work of the Creation, and that is, the preventing the Evagation of the Planets, and the accurate Retaining them within the due Bounds of their Orbits. That this is done by Gravity, and that Gravity

Gravity and Motion solve, in the most compleat manner, all the Phænomena of the Planetary Motions both Primary and Secondary, is abundantly made out by the wonderful Sagacity of the great Sir *Isaac Newton*; as may be seen in his *Principia*.

B u t before I come to the particular agency of Gravity, it will be necessary to premise something concerning its Nature, and some of its Properties, viz. That Gravity is not terminated at the Surface, but reaches to the very Center, and is extended to immense distances all round the Centers of all the Globes: By which means the celestial Bodies are enabled to have Systems of lesser Globes revolving about them. For had the force of Gravity determined at, or near the Surface (as it might have done, if intended only for the Conservation of the Globes) in this case, all the Bodies that were put

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in Motion, and that were to pass at some distance from them, would move on in a strait, not curved line, and be lost in the great Abyss of Space. But the allwise CREATOR hath, in his first Production of Matter, bestow'd upon it such a Property, as that every Particle thereof hath a Tendency towards every other Particle. From whence it comes to pass that every Body hath a *Gravitating Power* according to the solid Content or real Quantity of its Matter, and not according to its Superficies, or Extension.

AND this *Gravity* of all Bodies is observed, manifestly to decrease in proportion of the square of their Distances reciprocally; that is, at twice their distance the Force is but one fourth of what it was at a single distance; and but a ninth at thrice the distance, &c.

T H A T

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T H A T this is so, is abundantly proved by the last commended Author ; who by establishing this one Principle in Philosophy, hath fully explain'd the Systeme of the World, so far as relates to us, and to all the rest of the Planets, that regard the Sun as a Center, both Primary and Secondary.

W H A T the Cause of Gravity is, *Sir Isaac Newton* doth not pretend to assign, his design being not to engage himself in framing *Hypotheses*, but to explain the *Phænomena* by *Experiments* only, and to raise his noble Superstructure upon them. And therefore, although the matters of Fact, and the Final Causes are evident, I will not venture to say how it comes to pass, that Bodies act at such immense distances upon one another ; but chuse rather to acquiesce in adoring the Wisdom and Power of the GREAT AUTHOR

of all things, who hath inspirited the Materials, of which the World consists, with such an active quality, as serves not only to preserve the Globes themselves intire, but to enable them to revolve about their luminous Center (from whence they have their Light and Heat) in Orbs that are the most commodious, and also fixt and permanent.

HAVING thus premised what was necessary for the understanding the Nature and Properties of Gravity, I shall proceed to consider its agency in the Planetary Motions. And here we have divers things, which plainly demonstrate these Motions to be no matters of Chance, but the Works of an infinitely Kind, as well as Omnipotent and Allwise Agent.

I have already in Book 4. Ch. 2. taken notice of the Motion of the Planets being made not in Lines
tend-

tending from the Center to the Circumference, or very obliquely thereto, but across, or nearly perpendicular to the *Radii*. Also that the Motions and Orbits of the Planets do not tend contrary ways, or much interfere with one another. That therefore which I shall speak of here, concerning the Planetary Motions being the Work of God, will be only so far as Gravity is therein concerned. And

1. It was a very notable provision to prevent the Evagation of the Planets, and to keep them within their due and proper Bounds, to bridle and detain them with Gravity, as with so many Reins and Bridles. For as the natural tendency of all Imprest Motion is in Strait Lines, so when Motion was given to the Planets, this Motion (altho' as I said it was artificially made, perpendicularly to the *Radii*, yet) would carry them

them quite away in their Tangents, so that they would never return again. But being thus detain'd by Gravity, another admirable provision is that,

2. They are moved in Orbs : Which Orbs are formed of a Motion compounded of this Rectilinear Impulse impress'd upon the Planets, and the tendency of their Gravity to their Centers. In which Motion a 3d thing very remarkable is, That the Impulse or Velocity which is imparted by the *First Mover* to every Planet, and the Gravity of each Planet, are so nearly equal to what is required to make a Body describe a Circle, that the Orbits of the Planets are not very Eccentric, but nearly Circular. As is particularly remarkable in *Venus*, and the *Earth*; and more especially in the whole Systeme of *Jupiter's* *Satellites*. And an admirable Work this is. For should the Velocity of any Planet be double to what

what would make it move in a Circle, that Planet would go away in *infinitum*, without ever returning again in any Orb whatsoever. Or should one half of the Velocity be taken away, the Planet would descend obliquely towards the Sun, until it became four times nearer the Sun than before; and then ascend again to its former place, describing a very eccentric Orb. And by ascending and descending alternately, it would be heated sixteen times more at one time than another. Which uneven Heat would make the Planet unfit for Habitation. And the same thing would happen, if the determination of its motion should be altered, so as to become very oblique to the *Radius* drawn from the Planet to the Sun. But these things being accurately adjusted, and contempered, make the whole Systeme to be a work of incomparable Convenience and Beauty;

Beauty ; a Work the best contrived for the benefit of the World's Inhabitants, and to set forth the Curiosity and Skill of the infinite Workman.

It is manifest therefore that the Systeme of the Planets is not to be reckon'd a matter of *Chance*, or a thing owing to a *Necessity of Nature*, but the Work of a kind and wise Agent. And that this is so will be farther manifest from the case of *Comets*, whose Motions, Directions and Orbs being utterly different from those of the Planets, demonstrate the *Planetary Systeme* to have been modelled by *Counsel*, and not by a *Necessity of Nature*, or left to *Chance*. For as for the Motion of Comets, it is so far from being always the same way, that they move sometimes contrary to one another. And as for their Planes and Directions, they lie every way. And as for their Orbs, they are

are exceedingly eccentric. And by the bye, this Eccentricity is an admirable Contrivance of the CREATOR, to prevent the Comets from disturbing either the Planets, or one another, by their mutual Attractions. For by this means, they have a large and sufficient room to revolve in; and by ascending to very great heights above the Systeme of the Planets, and spending almost all their time in the remote regions of the Universe, at vast distances both from the Planets, and from one another, they do not incommode either the Planets, or themselves; as otherwise they would have done, should they have moved in the same Plane with the Planets. For had they done so, they would have been apt sometimes to have come too near the Planets, and have disturbed their Motions, and perhaps have dash'd upon them also. But all these circumstances are

are so well adjusted, and so wisely regulated by the Divine Providence, that the Systeme could not have been better contrived, either for convenience or beauty.

And now upon this highly probable, it may say Physically certain, Theory of Gravity acting in the Motion of the Globes, we have another exquisite Nicety in the Works of the Creation, that justly deserves the greatest admiration and praise. That among so many immense, moving Masses, they should all observe their due Bounds, keep the most proper Paths appointed for their convenience and good, and at all times answer the great Ends to which they minister in the Creation. Particularly that the ~~habitable~~ Globes should always remain at such due Distances, and move in such proper Orbits, as are best for them. And that the Comets too should at the same time pass

pass in paths utterly different, but yet such in all probability, as may render them also of very great use to some or other parts of the World; whether we look upon them as Places of Torment (as hath been said) or Bodies appointed for the Refreshment and Recruit of the Sun, or any of his Planets, as Sir *Is. Newton* conjectureth in his *Princip. Lib. 3. Prop. 41 & 42.*

AND now from the consideration of what I have shewn in this sixth Book to be either highly probable, or very certain concerning *Gravity*, we have another manifest demonstration of the infinite *CREATOR's* Wisdom and Care, and another cogent argument to excite the highest Veneration and Praise in his Creatures.

BOOK



BOOK VII.

~~~~~

Of the Provision made for  
***LIGHT and HEAT***  
throughout the Universe.

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CHAP. I.

*Of the Light and Heat of the Fixt Stars
and Sun.*



A *Light and Heat* are
two of the most use-
ful things in the Un-
verse, so the infinitely
wise and kind CRE-
ATOR hath made an excellent pro-
vision

vision for these things, in all probability for every Globe throughout the Universe, but particularly for those of our own Systeme. For it is very manifest that every Globe we see doth shine with its own native, or with borrowed Light. Even all those immense Bodies at the greatest distance from us, the Fixt Stars, which I have before said are probably so many Suns, it is Light they manifestly dart as far as to our so distant Globe, as well as what they emit for the enlightening, warming, and cherishing their own respective Planets.

B u t I shall forbear to launch out into those conjectural matters, and shall come nearer home into our own Systeme, where we have enough to entertain our Eye, to captivate our Thoughts, and to excite our highest admiration of these magnificent Works of God; whether we survey the great Fountain it self of our Light and Heat,

the Sun ; its due Position, and its wonderful use to its Planets ; and the incomparable provisions that are made to supply its absence and greater distances from them.

AND in the first place, as to the *Sun* it self ; what Power is there that the most extravagant Phancy can imagine to it self, that could ever be able to make so prodigious a mass of Fire as the Sun is, but only the *power of God's Almighty Hand* ! a Body of so immense a Bulk as I have shewn it is, and of such an excessive Heat, that no greater a number of its Rays than what fall within the compass of a two or three inch Burning-Glass shall actually burn ; and what fall within the compass of not many feet, shall far exceed the strongest culinary Fire in the Earth ; as is manifest from its almost instantaneous burning, and vitrifying the most obdurate combustible bodies, such as not only
green

green wood, and white bodies, but also Stones, Bricks, Metals, yea Gold it self (the hardest of all metals to be wrought upon by fire) which yet is melted down in a few minutes (1).

Thus the *infinite Power and Wisdom of GOD* appear in the appointment and make of that immense Body of Fire, the Sun; a mass wonderful, and worthy of its Maker, whether we consider its immensity, its ex-

(1) The famous *Burning-Concave* at *Lyons* of 30 Inches Diameter, and others in *France* and *Germany* of greater breadths, have been celebrated for their Feats in burning, calcining and vitrifying both metallick and other Bodies. But I question whether any of them have come up to the Burning Instrument contrived by, and made for *Sir I. Newton*, and by him presented to the *Royal Society*. It consists of 7 Concave foiled Glasses, each of them 12 inches diameter: which are all so placed as to have their *Foci* concur in one point. By which means the Heat is so increased, as in a surprizing manner to perform the Feats here mentioned, and many others surpassing them.

cessive Heat, or its absolute necessity and great use to us; and all the rest of its Systeme. But we shall find yet farther evidences of the great CREATOR's work in the following Chapter.

CHAP. II.

Of the due Position and Distance of the Sun and its Planets.

AS the infinite Power and Wisdom of God appear in the appointment and make of the Sun, according to the preceding Chapter; so in this I shall demonstrate the same from the due Position of the Sun among his Planets, and his due Distance from each of them.

NOW here we may take it for granted that the Sun is the Fountain
of

of the Light and Heat of all the Planets, not only of the Earth, but of the other Planets too, that move either about the Sun, or the Earth, but whether the Sun be placed in the Center of its Systeme, or the Earth be so, is of no great consequence here to enquire. But I have all along supposed the former to be the most probable Hypothesis, and it seems to be still more so from the consideration we are now upon, concerning the community of its Light and Heat to all the Planets. For since it is manifest that what Light and Heat the Planets have, they receive from the Sun, it is far more likely that this their Fountain of Light and Heat is placed in the common center of them, and that they move round about it, rather than it about them.

But be it so or not so, it is however very certain that all the Planets are placed at such a due and proper

Distance from the Sun, that they receive the beneficial Rays thereof in a due manner and proportion. There is no great reason to doubt of this among the Planets that are at greater or lesser distances from the Sun than we, because we find so noble and solemn an Apparatus answerable to their distances from the Sun, which I intend to speak of hereafter. But as for our own terraqueous Globe we have sufficient signals of the great care and counsel that have been used in the due *Position* and *Distance* thereof from the Sun. For as to its *Position* to the Sun, I have heretofore shewn, that by the Inclination of its Axis, and its Diurnal and Periodical Revolutions, all parts have a due share of Light and Heat. And as for its *Distance*, it is such as not only prevents the danger of its interfering with the other Globes, as I have formerly observed, but also it is duly adjusted to

to the Density of the Earth and Waters, and to the Make and Temper of our Bodies, and of all other things here below. Had we been much nearer the Sun, our World would have been burnt up and wasted, the Waters in the first place would have all been turned into vapours, and dried up; Vegetation have soon ceased, and all things would have soon been wasted, if not burnt and consumed. Or had we been not at so very great a distance, but only a little nearer the Sun, as suppose a few thousands of miles, still the Heat would be as the square of the distance (1); and consequently too great, if not for the Polar, yet for the *Æquatorial* parts. And on the contrary, had we been set at a greater distance from the Sun, so would the Sun's Heat have been

(1) *Newton. Princip. P. 466.*

abated in proportion to the square of that distance. And in this case, if the distance had been very great, we and all things must have been perpetually frozen up; or if it had been not so great, the world would have suffered by cold, the Polar at least, if the Equatorial parts should escape.

AND in this case, when our Globe should thus be parched up with everlasting Heat, or be everlastingly frozen with excessive Cold; instead of an habitable, pleasant, and comfortable World, it must become a Desert, a place of irksomeness, misery, and everlasting punishment. But the great CREATOR having so wisely and indulgently ordered the distance between the Earth and Sun, the Sun's Light and Heat are incomparably accommodated to the state and temper of all things here below, and our World is well fitted for habitation, well provided with every thing that may
mini-

minister to the support, the comfort and pleasure of its Inhabitants. By those indulgent Rays all things are enlightened, and we and all the rest of the Animal Kingdom are enabled to dispatch our business, to seek and provide our Food, and to pass from place to place, as our occasions of pleasure lead us. By its cherishing Beams all things are warmed and comforted, Vapours in some measure made to rise for the forming of Clouds and Rain; Trees and Plants are enabled thereby to put on their verdure and gaiety, and to yield us the benefit and pleasure of their Grain and Fruit. By the presence of this great fountain of Light and Heat, we and even Nature too is awake and excited; and by its absence grows torpid and dull: its absence by Night disposes us to rest and sleep; and even Vegetables too shut up their Flowers

ers then (2) and in a manner betake themselves to rest: and its absence in Winter how doth it change the whole face of Nature, divest Vegetables of their gay attire, force Animals to places of shelter and safeguard, and give an aspect of melancholy and horror to all things!

Thus it is manifest how wisely and indulgently the great CREATOR hath provided for the good of our Planet, by so critically adjusting its Position to, and its Distance from the Sun, to the state and temper of it and all things thereon. And although the rest of the Planets encompassing the Sun are some of them nearer to, some of them farther from it, yet there is no great question to be made but the same wise Contriver hath made as good a provision for

(2) See my *Physico-Theol.* B. 10. Not. 14.

them

them as for us, either by contempering their Density to their Distance from the Sun, or by some other the wisest and best course; as we have very just reason to suspect from that grand and solemn apparatus I spake of, of Secondary Planets. Which leads me to consider the Provisions made for the supply of the Sun's absence, and greater distance.

~~considered, or even those in the distance~~

~~of the Sun, or even those in the distance~~

~~of the Sun, or even those in the distance~~

~~of the Sun, or even those in the distance~~

The Necessity of Light, and the Provision for it by the Atmosphere.

~~of the Sun, or even those in the distance~~

BEFORE I come to the other Planets, it will be convenient to consider how the Sun's absence is supplied here upon the Earth, as also probably how it is supplied in her concomitant the Moon.

A N D

AND first as to the Earth. Of such absolute necessity is *Light* (not to mention *Heat*) that our World could not well be in the least utterly without it, because during utter, absolute *Darkness* (besides the great inconveniences it might bring to *Vegetables*, *Minerals*, and every other such like part of the *Creation*, besides this I say) it would certainly put *Animals* under an utter incapacity of performing their most necessary business, and acting in that office which the divine *Providence* hath appointed them, although of greatest use to themselves or the rest of the World. Men, for instance, whose business and occasions oftentimes necessitate them to borrow a part of the Night; and other *Animals*, whose Safety or Temper, or Constitution of Parts (as of their Eye, or some other parts) confine them to their Dens, and places of retirement and rest by Day, and

and are therefore in course compelled to seek their food, and wander about on their most necessary occasions of life by Night, all these, I say, would at once be cut off from one of the grand benefits of life, from acting that part they bear in the Creation, during such time as they should be put into absolute Darkness. But to prevent this, the infinitely wise Contriver of the World hath made divers admirable provisions both in our own, and the other Planets too. One provision which he hath made in our own Globe, and I may add that of the Moon also, is by encompassing both with an Atmosphere (1),

(1) Mr. *Huygens* in his *Cosmotheor.* p. 115. concludes the Moon to have no Air or Atmosphere because we see its Limb so clearly and accurately defined, and because he thought there are no Seas or Rivers in the Moon. But he was mistaken both in his Conclusion and part of his Premises. For in the Solar Eclipse

which

which, among other grand uses, ministers very much to the propagation of Light, partly by reflecting the Rays of Light to our Eye, and partly refracting them so as to make them visible and useful to us, when otherwise they would not appear. Hence that Whiteness (2) and Brightness observable in the air by day; and hence the Twy-light, when the Sun is hidden under the Horizon. The like to which is observable in the Moon also, in that secondary, rusty light which is seen in her Eclipses, and before and after her Quarters.

May 1. 1706. which in Switzerland was Total, they could manifestly perceive the Moon's Atmosphere, as may be seen in the Accounts given in *Philos. Transf.* No. 306.

(2) See *Physico-Theol.* B. 1. Ch. 1. Note 12.

C H A P.

CHAP. IV.

The great usefulness of the Moon, and the mutual beneficial Returns which the Globes make to one another,

HAVING shewn the absolute necessity of Light, and the supply thereof by the Atmospheres; let us next speak of the principal provision made for that, and for supplying the Sun's absence, and that is by the *Moon* and *Stars*, which as *Moses* saith (1) *rule the Night*, as the greater *Light*, the *Sun*, doth *rule the Day*. What influences these celestial Bodies may have here below in the bodies of Men and other Ani-

(1) *Gen. i. 16.*

mals,

mals, or among Vegetables, Fossils, or in any of the grand works of Nature, is hard to determine, although vainly pretended unto by the judicial Astrologers: but yet some things there are whose Periods and Crises so strictly observe the Courses of the Sun, especially of the Moon, that, on the other hand, it is hard to deny the influences of these Bodies here below. The Tides particularly have all along so constantly observed the Courses of the Moon, that in all ages they have been suspected to be caused and governed by that Planet: and if the stories of *Pliny* (2), *Aristotle*, and others of the Ancients be true, it is by her influence that the bodies of Oysters and other Shellfish are increased and diminished; that the mass of man's Blood is so

(2) *Plin. Nat. Hist. l. 2. c. 41, 98, 99, 101.*

also; that the Humours are resolved and attracted, that the Dead bodies of Beasts are corrupted, that all Animals expire at the time of Ebb, particularly man; that the Sea purgeth it self of filth every Full-moon, which gave occasion to the fable of the Sun's having his Stable about *Messina* and *Milazzo*; and divers other such like conceits which those Authors name, too many and too improbable to deserve to be reckoned up in this place.

B u T whatever influences the Moon may have upon things here below, whatever her concern may be in any transaction of Nature, or any other office of the Creation, it is however very certain that her *Light*, *Eclipses*, *Monthly Revolutions*, and *Latitude* or *Vagations* towards our Poles, are of great use to us.

B y her *Light*, to which I may add that of the *Stars*, we and the rest of

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the Creatures are able to protract our day at pleasure, to go hither and thither as our occasions call, and to dispatch many of our affairs by Night, or to betake our selves to Repose and Rest, to which, according to Pliny (3), the Moon doth naturally incline us.

As to the *Eclipses*, whether of the *Sun* or *Moon*, they have their excellent uses too. The Astronomer applies them to considerable services in his way; and the Geographer makes them no less useful in his; the Chronologer is enabled by them to amend his accounts of time, even of the most ancient days, and so down through all ages; and the Mariner too can make them serviceable to his

(3) *Ferunt Lunæ fœmineum ac molle Sidus, atque nocturnum, solvere humorem, & trahere, non auferre. Id manifestum esse quod ——— Somno sopitis torporem contractum in caput revocet. Plin. L. 2. c. 101.*

purpose,

purpose, to discover his Longitude, to correct his Account at Sea, and thereby make himself more secure and safe in the untrodden paths of the Deep.

So for the *Monthly Revolutions* of the *Moon*, besides the uses they have in the daily Variations of the Tides, and perhaps causing some such Revolutions too in the Humours and Bodies of Animals, and in the works of Nature, besides this I say, they are manifestly of excellent use in the Divisions of Time, in measuring out our Months, as the Sun doth our Days and Years, according to that appointment of the Creator, Gen. 1. 14. *And God said, let there be Lights in the Firmament of the Heaven, to divide the Day from the Night; and let them be for Signs, and for Seasons, and for Days and Years.*

AND lastly as to the *Lunar Latitude*, or Progresses towards our Poles,

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besides the use hereof to the preventing the too frequent Eclipses of the Sun and Moon, those Vagations are of great use to the Polar parts of the World, in affording them a longer, as also a stronger and better light, than if the Rays fell more oblique: which must needs be a very great comfort, and of wonderful service to the Inhabitants of those forlorn parts, in their long and tedious Nights of some days, yea some months length: to Men, to enable them to dispatch such of their Affairs as are of perpetual and constant necessity; and to other Animals of the Air, Land, or Waters, to enable them with greater ease and pleasure to get their Food, and pass where their pleasure leads them.

Thus the great CREATOR hath made the Moon to be of admirable use to our Earth. And so wisely hath he contrived his Works, that

Chap. 4 *Earth and Moon-mutual helps.* 181

that they are mutually serviceable to one another, so that what good services one doth, the other as readily returneth again. Thus as the Moon is a Moon to us, so the Earth is with great reason concluded by the Philosophers to be a Moon to the Moon; not indeed a Secondary Planet moving periodically about her, but such a Planet, as reflects the Light of the Sun to her, and perhaps makes such like returns of Influx as I said the Earth receives from her. For it is not to be doubted, if the Earth reflects light, and gravitates to the Moon, as well as the Moon to the Earth (which is highly probable) but that there is a mutual intercourse and return of their Influences, and good Offices. And this is still more probable from the likeness discernable between the Earth and the Moon, which is a strong presumption that the Moon may have the same occasions for the

Earth, as the Earth for her. For that she is an opake body, and that her surface is covered in some measure with Hills and Valleys, is manifest beyond all doubt to our Eye (4) as I before said: and that she hath an Atmosphere is what hath been not long since (5) discovered: and that there are large Oceans and Collections of Water is what I have before made probable (6). And therefore agreeing thus in Constitution and Make, their Occasions for, and Influences upon each other are in all probability mutual, and much the same.

AND after this manner the infinitely *wise Contriver* of the Universe, seems to have transacted throughout that immense space, by making all the several Globes useful to one

(4) See Book 5. Chap. 2. Note 1.

(5) See before Chap. 3. Note 1:

(6) Book 5. Ch. 4. Not. 1. as also the Preface

another. Thus all the Planets of our Solar Systeme are of considerable use to us, all of them reflect Light unto us, and some of them a Light so bright and strong, as particularly *Venus* and *Jupiter*, that they are a good supply of the Moon's absence in the night as well as the Sun's. Nay the very *Secondaries* (which I shall shew are of greatest use to their Primary Planets,) have their uses too amongst us; not only as being evident demonstrations of the great Works of God, but also in ministering to the discovery of the Longitude of the most distant Places upon the Earth. So for the *Fixt Stars* which I have before shewn to be probably so many Suns ministering to as many Systemes of Planets; it is certain they are of great use to us in supplying the absence of the Sun and Moon by night. And there is no great doubt to be made, but that the like Returns are

made to them and their Systemes by our Sun. So that here we have an admirable Oeconomy observable throughout all the visible regions of the Universe, in the mutual Assistan-
ces and Returns which one Globe af-
fords the other even at the greatest Distance.



CHAP. V.

*Of the Moons, or Secondary Planets in ge-
neral, which are observed about some
of the Primary Planets.*

HAVING taken a view of the
methods which are used for
the accommodating the Earth with
Light and Heat, let us cast our Eye
to the rest of our Solar Systeme, and
examine whether any thing of the like
kind be to be found there. And
here

here we shall find a no less admirable scene of the great *CREATOR's* Care and Wisdom, than we discovered in the Earth and Moon. In *Mars* indeed, we can discern a great similitude with the Earth in its Opacity and Spots, but we have not yet been able to perceive any attendance of Moons, as in the other superiour Planets; not so much probably because there are none, but because they are small, or they reflect a weak light, and are at a great distance from us. And as for *Venus* and *Mercury*, there may be no occasion for any Attendants, by reason of their proximity to the Sun. But in the two highest, or more distant Planets, *Jupiter* and *Saturn*, we have a very noble and entertaining scene of the *CREATOR's Glory*. For whereas those two Planets are at a much greater distance than any of the other Planets, from their Fountain of Light
and

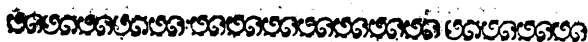
and Heat, the Sun; and as consequently their Heat and Light are abated in proportion to the square of their Distances; so to make them amends they are surrounded with a more grand Retinue of Secondary Planets, or Moons; *Jupiter* with four, *Saturn* with five, as 'tis imagined, and probably more (1).

(1) Mr. *Huygens* in his *Cosmotheoros* p. 99. gives this account of the discovery of the Satellites of *Jupiter* and *Saturn*, That it is well known the discovery of the *Circumjovials* is owing to *Galilæo*; that the brightest, and outermost *Circumsaturnial* he happened to see with a 12 foot Glass in the year 1655; that the rest are owing to *Cassini*, who first saw them with a Glass of *Campani*'s grinding of 36 feet, and afterwards with one of as many feet above 100. That the 3d and 5th *Cassini* shewed him in 1672, and afterwards often. That *Cassini* acquainted him by Letter afterwards with his discovery of the First and Second in 1684. That those two last are not easily discovered, and he cannot say he ever saw them. That beside these, he suspects there may be one or more yet concealed. Of which see chap. 7. following.

AND

AND an admirable remedy this is, not only for the great distance of these two Planets from the Sun, but also for the tardity of their periodick motion in their respective Orbits. For whereas *Saturn* revolves round the Sun but once in near thirty years, and *Jupiter* but once in near 12, it comes to pass that the places near the two Poles of those Planets have a Night of near 15 years in *Saturn*, and 6 in *Jupiter*, supposing their Axes inclined to the Planes of their Orbits, as it is in our own Globe. But supposing (as it is imagined) that their Axes are not so much inclined, and that their Days and Nights, their Winters and Summers are nearly equal; in this respect the case would be worse than in the long Nights in the other case: but in both cases the Polar parts of both those Planets would be dismal regions of darkness, when so long detained from the
kindly

kindly visits of the Sun. But an admirable remedy is found, and a glorious scene of the great CREATOR's Works appears therein, as will be manifest by considering particulars in each of those two Superiour Planets.



CHAP. VI.

Of Jupiter's Moons, Days and Seasons.

IN speaking concerning the superior Planets in particular, I shall begin with *Jupiter*. The Distance of this Planet from the Sun, is reckoned to be 343 millions of miles farther from the Sun than we are; and by that means the Sun's Light and Heat are 27 times less there than with us, and its apparent Diameter five

five times less (1). And considering how vast a Globe *Jupiter* is, having its superficies 100 times, yea (according to Mr. *Huygens's* computations) 400 times bigger, than that of the Earth; in this case, what vast tracts of that Globe must needs lie in profound darkness and desolation, had no remedy been provided! But there are divers provided. One is by the frequent Rotations of *Jupiter* round his own Axis; which being performed in less than 10 hours, it comes to pass that what is wanting in the strength and degree of Light and Heat, is compensated by the frequent Returns thereof.

The other Remedy is by the Increase of the number of *Moons* about

(1) *Gregorii Astron. L. 6. Prop. 5.* Mr. *Huygens* makes the Light and Heat but 25 times less and the apparent Diameter 5 times. *Cosmorb.* p. 103.

Jupiter, who is attended (as I said) with four, as we, who are nearer the Sun, are with one. Concerning which, these four things are remarkable.

1. Their Bulk, which in all probability is not in any of them less than our Earth, as the most ingenious Mr. *Huygens* concludes (2) from their shade upon *Jupiter's* disk. By which means partly it is that

2. They reflect so strong, brisk and vivid a light, as appears very illustrious and entertaining even to us at so great a distance from it : which cannot but be very pleasing and comfortable to that Planet : besides the no less beneficial and friendly Influences therewith conveyed at the same time.

(2) *Cosmotheor.* p. 101.

3. Their

3. Their due Distances from *Jupiter*, and from one another; and their agreeable periodick Revolutions which I have formerly observed (3) to be in the most exact mathematical proportions. By the first of these, those Satellites escape all disagreeable Concourses and violent Oppositions, and, in the most kindly manner, send their Influx to the Planet they wait upon: and by the latter, they are perpetually carrying about their Light and other benefits from place to place. For by the motion of the Innermost round once in less than two days; of the next in about 3¹ days; of the Third in somewhat above a week; and of the Outermost in near 17 days: by these means, I say, it happens very seldom that any part of *Jupiter* is at any time without the presence and at-

(3) Book 4. Chap. 4.

ten-

attendance of one or more of those Satellites; but one is visiting one part, whilst another is attending another, and another another part, and *Jupiter* himself making speedy Returns and Revolutions all the while.

4. The last thing remarkable is the Latitudes of *Jupiter's* Moons, or their progresses to his Poles, which are in a due proportion to their Distances and Periods. The diligent and ingenious *Cassini* hath determined (4) the greatest Latitude of the Innermost not to exceed a 3d part of *Jupiter's* Semidiameter; that of the next about a quarter of his Diameter; that of the Third about three quarters of his Diameter (but I have my self observed it to be very nearly or altogether parallel with *Jupiter's* Poles)

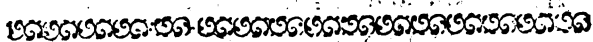
(4) *Cassini's Les Hypoth. & Tab. des Sat. de Jupit. Sect. 4.* among the Tracts of the *Messieurs de l'Acad. Roy. des Sciences.* /

and

and that of the Fourth or Outermost to go beyond the Poles of *Jupiter* a third part of his Semidiameter. * By which means this Satellite escapes the Eclipses of *Jupiter's* shadow for the space of two years.

AND as the Latitudes of these Satellites differ according to their Distances and Periods; so another remarkable thing therein, is, that they shift their Latitudes in longer or shorter times, agreeable to their greater or lesser Latitudes; some making their progresses towards *Jupiter's* Poles one way, whilst some are wandering the other way, and some staying there a longer time, and some a lesser and lesser time. By which quadruple variety of Latitudes, and perpetual changes of it, it comes to pass, that those large tracts towards the Polar parts of that vast Planet, have their share in the light and kindly services
of

of the four Moons, and are seldom or never deprived of them.



CHAP. VII.

Of Saturn's Moons, Ring, Days and Seasons.

HAVING seen the admirable provision made for the remedying *Jupiter's* great distance from the Sun; let us in the last place take a view of *Saturn*, which is above 200 millions of *English* miles farther from the Sun than *Jupiter*, and near 700 millions of miles farther than is our Earth. And here our Glasses, as imperfect as they are, have discovered so surprizing an Apparatus, that must needs strike every one that views it with wonder and amazement.

For

FOR, in the first place, instead of four Satellites or Moons, as *Jupiter* hath, *Saturn* is supposed to have five, and probably more. Three of these I my self have seen with Mr. *Huygens's* 126 foot Glass; but for want of a Pole of sufficient height to mount the Glass high enough, I am not sure I have seen any more. And besides those Five which others have seen, there is great reason to conclude there is a *Sixth* lying between the two Outermost, there being a larger space between them than is in proportion to what is found amongst the rest. And it is not improbable but that there are others also lying beyond the Fifth or Outermost, but become invisible at so great a distance from us, by means of some obscurity, such as is observeable in the Outermost it self, which is never to be seen by us, but in the western part of its Orbit, as

Mr. *Huygens* well observes (1).

THESE Satellites we may reasonably conclude to be of a prodigious bulk for the reflecting of Light, and for their other miniftrations to *Saturn*, because otherwise they could not be seen at so great a distance as the Earth; and particularly one of them (2) is of that magnitude, and its

(1) The reason why *Saturn's* fifth Satellite appears not on the Eastern, but Western part of its Orbit, Mr. *Huygens* very sagaciously (like himself) conjectures to be, because this Satellite, as the Moon doth to the Earth, always turns one and the same Side to *Saturn*, and because this Satellite hath, he imagines, only one part of its surface clear, and the greatest part obscure, and not able to reflect sufficient light to us, therefore all the time that obscure part is turned towards us (which is whilst the Satellite is in the Eastern part of its Orbit) it disappears: but in the Western part it appears, because the bright side lies towards us. *Cosmotheor.* p. 118.

(2) It is the fourth Satellite, or Outermost but one (called from its first Discoverer, the *Hugenian Satellite*) that is so visible.

Light

Light so brisk and vivid, that it appears very illustrious through our longer Glasses, and may be discerned with our shorter.

As to the *Distances*, the *Periods*, and *Latitudes* of those Satellites, they being consentaneous to what I have already taken notice of in *Jupiter*, I shall not insist upon them, but pass to another provision made for the great distance of that Planet; which is a thing so singular to *Saturn*, so unusual in all the rest of the Creation, and so amazing, that it is an evident and noble demonstration of the great *CREATOR's* Art and Care; and that is, *Saturn's Ring*. Concerning which, these things are observeable.

1. The prodigious size of it, its great breadth, and vast compass. This we may make a judgment of, by comparing it with *Saturn* himself. And supposing the Diameter of *Saturn* to be as is before determined, 9345

Q 3

English

English miles, the Diameter of his Ring will be 210265 such miles, and its breadth about 29200 (3), an amazing Arch to an Eye placed in that Planet.

2. The due and convenient Distance of it from *Saturn* it self; not closely adhering to it, because that would annoy a large portion of *Saturn's* globe, by depriving it of the Sun's rays, but environing it about the distance of its breadth; by which means the Sun's Light and Heat are permitted to enter between the Planet and its Ring, whilst other Rays are at the same time reflected upon the Planet by the Ring.

(3) Mr. *Huygens* in his *Systema Saturn.* p. 47. and *Cosmotheor.* p. 109. determines the Diameter of *Saturn's* Ring to the Diameter of *Saturn*, to be as 9 to 4; and the Breadth of the Ring, and Distance of the Ring from *Saturn's* body, to be nearly equal, and accordingly these numbers are defined here.

3. The

3. The thickness of the Ring, which is hardly, if at all perceivable by us; which is as great a benefit, as its edgling shade would be an annoyance, was the Ring thick.

4. Its smoothness and aptitude to reflect Light and Heat (4) is a wonderful convenience in it. Was it full of Mountains and Valleys, and I may add Waters too, as in our earth, and probably the Moon likewise, the Reflections would be too weak to render the Ring visible unto us, at so great a distance as we are; but perceiving its Light to be so lively and strong, as to render both it self and *Saturn* very illustrious, it is a demonstration of the aptitude of its structure, and smoothness for the reflection of Light and Heat to the Planet it serves.

(4) See *Hugen. Syst. Saturn.* p 70.

5. As the Periodical Revolutions of the Earth are an excellent and providential contrivance for those useful and necessary mutations we have of the Seasons of the year, so no doubt but the same benefits accrue to those Revolutions which Saturn hath about the Sun. It is visible that as Saturn changes its place in its Orbit, so its Ring receives a variety of aspects (5), not only with respect to us, but to the Sun. Thus in one part of the Orbit it appears with a (6) larger Ellipsis, so as to exhibit

(5) Every 14 or 15 years Saturn's Ring hath the same Face; appearing at one time with large open *Ansæ*, at another time with no Ring at all. Which Appearances it obtaineth by gentle progresses from the one to the other Face. As, if the *Ansæ* are at the largest, they gradually diminish, until no *Ansæ*, or *Aper- tures* are to be seen in the Ring, and at last no Ring at all also.

(6) This Mr. Huggens shews is when Saturn is 20° degrees in *Gemini* and *Sagittary*. This

a large space between it and Saturn: in another part, with a lesser, and so with a lesser Ellipsis, and sometimes as only a slender strait line, and sometimes it is not visible at all (7): also sometimes one side of the Ring is enlightened, and reflects light towards

was the appearance it had in the beginning of 1708. Of which I have given a Representation in Fig. 7.

(7) Mr. *Huygens* shews that for about six months before and after Saturn's being in 20° degrees of *Virgo* and *Pisces*, the Ring is not visible, but Saturn appears round. *Syst. Saturn.* p. 59, 74, &c. And accordingly at this very time there is no appearance of the Ring, only a small narrow List or Belt crosseth the middle of Saturn's Disk, of a colour somewhat different from the rest of Saturn's Face, and in the place where the Ring should be. This appearance of Saturn is represented in Fig. 8. which is the appearance he had through a very good 34 foot Glass, at the latter end of *Octob.* and beginning of *Nov.* this present year 1714. But a little before this, viz. on *Sept.* 26. I could through an 126 Glass, discern the narrow ends of the Ring on each side Saturn. A representation of which I have given in Fig. 9.

one

one part of *Saturn*, sometimes the other enlightens another part; and there is no doubt but that as our *Earth* has its Seasons according to its position to the *Sun* in its periodical motion in its Orbit; so *Saturn* throughout his Period, hath his Seasons according unto his position to the *Sun*, and the various Reflections of the Ring upon the several parts of his Globe (8).

THESE five things observeable in *Saturn's* Ring we have pretty good assurance of from our Views through good Glasses. But there is a

(8) There is very great reason to imagine this doth certainly happen in *Saturn*, because as Mr. *Huygens* observes, *Saturn* appears sometimes more splendid than at other times. *Ita semper* (saith he) *quo propius versus Cancræ & Capricorni signa accesserit, eo majorem, aut certe splendidiorem, etiam absque telescopio appariturum, quippe Annuli ellipsi semper se latius pandente.* *Hugen. Syst. Saturn. p. 56.*

6. Thing

6. Thing I shall add as only conjectural, and that is, A supposition that the Axis of *Saturn* (9) is inclined (and that pretty much also) to the plane of its Ring, or the Plane of its Orbit at least, and that he hath a Diurnal Rotation in some certain short space of time. For without these two conveniences, very large tracts of *Saturn* would suffer extreamly for want of the Sun. For if *Saturn* hath no other motion but that round the Sun in its orb, one part must be excluded from the Sun's Visits for 15 years, whilst the other partakes all the while of them; and one Hemisphere will enjoy the benefit of the Ring, whilst the other is eclipsed by it: and in this case the Ring would

(9 Mr. *Huygens* determines the Inclination of *Saturn's* Axis to the Plane of his Orbit to be 31 gr. as that of the Earth is 23 degrees. *Cosmotheor.* p. 108.

be

be nearly as prejudicial to the eclipsed part, as it is useful to the enlightened. But supposing *Saturn* to move round in the same, or a shorter time than *Jupiter*, and in a path pretty much inclined to the Ring, all parts then of that vast Planet will have their frequent returns of Day and Night, of Heat and Cold. And since this is what is discernable in the other Planets, and it is not less necessary for the benefit and comfort of this, we may reasonably conclude the thing to be probable, although not discernable at *Saturn's* great distance from us.



C H A P.

CHAP. VIII.

The Conclusion.

THUS I have taken a View of the provision made for those two grand and universal Necessaries, Light and Heat; things, in all probability, no less necessary for the other Globes, than for our own; and things which not only Animals cannot subsist without, but what all things here below stand in need of as well as they. When therefore we actually see and feel those indulgent provisions, those amazing acts of the great CREATOR; when we have views of their extent into Myriads of other the most distant Globes; when (to go no farther) we see in our own Systeme of the Sun,

1 such

such a prodigious mass of Fire placed in the Center, to scatter away the Darkness, and to warm and cherish us by Day; and such a noble Retinue of Moons and Stars attending and assisting us by Night; when we see this *indulgence*, this *care* of the CREATOR extended to all the other Planets, and that, according to their several distances, they have a proportionate provision of the greater number of Moons, and Saturn a stupendous Ring besides, to supply the decrease of Light and Heat; who can be otherwise than amazed at such Providential, such Useful, such well Contrived, such Stately *Works* of GOD! Who can view their Glories, and partake of their beneficial Influences, and at the same time not adore the *Wisdom*, and praise the *Kindness* of their CONTRIVER and MAKER! But above all, should there be any found among Rational Beings so stupid,

stupid, so vile, so insatuated with their Vices, as to deny these *Works* to GOD, and ascribe them to a *Necessity of Nature*, or indeed a meer *Nothing*, namely *Chance*! But such there are to be met with among our selves, and some such the Prophet tells us of, *Isai. 5. 11, 12.* men that had so debauched themselves with drink, and enervated their minds by pleasures, that *they regarded not the work of the LORD, neither considered the operation of his hands.* Such persons having led their lives in such a manner, as to wish there was no GOD to call them to account, would then persuade themselves there is none; and therefore, stupidly ascribe those manifest demonstrations of the infinite *Power and Wisdom of GOD*, to a meer *Nothing*, rather than to their great Author. But may we not with as good reason, imagine a lighted Candle, a well made Culinary
1
Fire,

Fire, a flaming Beacon, or Lighthouse, to be the work of *Chance* and not of *Man*, as those Glories of the Heavens not to be the *Works* of *GOD*? For it is very certain that as much Wisdom, Art, and Power, worthy of God, is shewn in the Lights of the Heavens; as there is in those upon Earth, worthy of Man, which none can doubt were contrived and made by Man. And if from these mean contrivances and works of Man we conclude them to be the Works of Man; why not the grand, the amazing Works of the Heavens, surpassing all the Wit and Power of Man, why not these, I say, the Works of some Being as much superior to Man? According to the argument of *Chrysippus* which shall conclude this Book. *If there be any Being that can effect those things, which Man, although endowed with Reason, is not able to effect; that Being is*
et c.

certainly greater, and stronger, and wiser than Man. But Man is not able to make the Heavens; therefore the Being that did make them, excels Man in Art, Counsel, Prudence, and Power.



P

BOOK

and every way full of Magnificence; all that now remains is, to endeavour to make these Views and Considerations useful to our selves. Which I shall do in the following Chapters.

CHAP. I.

The Existence of GOD, collected by the Heathens from the Works of the Heavens.

THE first and most ready and natural Deduction we can make from such a glorious Scene of Workmanship, as is before represented, is to consider, *Who the Great Workman was?*

THAT the Author of all this glorious Scene of things was *GOD*, is such a Conclusion, that even the most

P 1

igno-

ignorant and barbarous part of mankind have been able to make, from the manifest signals visible therein; Signals so plain and conclusive, that Tully's Stoick. (1) cites it as Aristotle's opinion, That if there were such a sort of people, that had always lived under the Earth, in good and splendid Habitations, adorned with Imagery and Pictures, and furnished with all things that those accounted happy abound with: and supposing that these People had never at any time gone out upon the earth, but only by report had heard there was such a thing as a Deity, and a Power of the Gods; and that at a certain time afterwards, the earth should open, and this people get out from their hidden mansions into the places we inhabit: when on the sudden they should see the Earth, the Seas, and the Heavens, perceive the magnitude of the

(1) De Nat. Deor. L. 2. c. 37.

Clouds,

Clouds, and the force of the Winds, behold the Sun, and its grandeur and beauty; and know its power in making the Day, by diffusing his light throughout the whole Heavens; and when the Night had overspread the earth with darkness, they should discern the whole Heavens bespread and adorned with Stars, and see the variety of the Moon's Phases in her Increase and Decrease, together with the Risings and Settings, and the stated and immutable Courses of all these throughout all eternity; this people, when they should see all these things, would infallibly imagine that there are Gods, and that those grand Works were the Works of the Gods. Thus have we the opinion and conclusions of two eminent Heavens together, Aristotle and Tully's Stoick.

AND if the Heavens so plainly declare the Glory of God; and the Firmament sheweth his handy work (2); if

(2) Psal. 19. 1, &c.

those Characters, those Impresses of the Divine Hand are so legible, that their line is gone out through all the earth, and their words to the end of the World, so that there is no Language, Tongue, or Speech where their voice is not heard; nay if these things are such, that even a subterraneous People would, at first sight, conclude them to be GOD's Work, how daring and impudent, how unworthy of a rational Being is it, to deny these works to GOD, and ascribe them to any thing, yea a meer Nothing, as Chance is, rather than GOD? Tully's Stoick last mentioned denieth him to be a Man, who should do this. His words (3) are, *Who would say he is a man, who when he should behold the Motions of the Heavens to be so certain, and the Orders of the Stars so established, and all things*

(3) Cicero ibid. cap. 38.

so well connected and adapted together, and deny that Reason was here, and say these things were made by Chance, which are managed with such profound counsel, that with all our wit we are not able to fathom them? What! saith he, when we see a thing moved by some certain device, as a Sphere, the Hours and many things besides; we make no doubt but that these are the works of Reason. And so when we see the noble train of the Heavens moved and wheeled about with an admirable pace, and in the most constant manner making those anniversary changes so necessary to the good and preservation of all things; do we doubt whether these things are done by Reason, yea, by some more excellent and divine Reason? For, saith he, setting aside the subtilties of Disputation, we may actually behold with our eyes, in some measure, the beauty of those things which we assert are ordered by the

DIVINE PROVIDENCE.

And then he enters into a long detail

of Particulars of this kind, too many to be named here.

Thus Cicero, throughout whose Works so many passages of this nature occur, that it would be endless to cite them: and therefore one that shews what his opinion was of the sense of Mankind in the matter shall close what he saith, and that is in his book *de Legibus* (4), where he saith, *Among all the tribes of Animals, none but Man hath any sense of a God; and among mankind, there is no Nation so savage and barbarous, which although ignorant of what God it ought to have, yet well knows it ought to have one.*

AND after the same manner Seneca (5), who instanceth in two things, to shew the deference we are apt to give to the general presumption and consent of mankind. One is in the

(4) L. i. c. 8.

(5) Epist. 117.

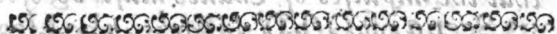
Immortality of the Soul: the other is in the Existence of a Deity; which, saith he, among other arguments we collect from the innate opinion which all men have of the Gods: for there is no Nation in the World so void of Law and Morality, as not to believe but there are some Gods. Nay so positive he is in this matter, that in another place he expressly saith, They lye that say, they believe there is no God. For although by Day they may affirm so to thee, yet by Night they are to themselves conscious of the contrary. Much more could I cite out of this famous Heathen, but one passage relating to the Heavens shall suffice, and that is in his Discourse shewing Why evils befall good men, seeing there is a divine Providence (6). He takes it for granted in this Discourse, that there is such a thing as a **DIVINE**

(6) *Quare bonis viris, &c. c. 1.*

P O W E R and **P R O V I D E N C E** governing the *World*; and he saith, it was needless for him to shew that so great a Work [as the *World*] could not stand without some Ruler; that so regular Motions of the Stars could not be the effects of a fortuitous Force, and that the impulses of Chance must be oftentimes disturbed and justle: that this undisturbed Velocity which bears the weight of so many things in the Earth and Seas, so great a number of heavenly Lights, both very illustrious, and also shining by a manifest disposal, must needs proceed by the direction of some eternal Law: that this can never be the order of stragling Matter; neither is it possible for things fortuitously and rashly combined, to depend upon, and manifest so much art. Divers of which matters he proceeds to instance in.

Thus Cicero and Seneca: to whose evidences I might have added many others, particularly a great deal out of

of Plato (the divine Plato, the Homer of Philosophers, as he is called by the Ancients). But it would be needless as well as tedious, since these two former have given us the sense of Mankind, as well as their own opinion in the matter.



CHAP. II.

GOD's Perfections demonstrated by his WORKS.

AS *GOD's Works* have been shewn to be manifest Demonstrations of his *Existence*; so they are no less of his *Perfections*, particularly of his infinite *Power*, *Wisdom* and *Goodness*; inasmuch as every Workman is known by his Work. A Palace that should have nothing defective in Situation, Beauty, or Convenience

venience, would argue the Architect to have been a man of sagacity, and skilful in Geometry, Arithmetick, Opticks, and all other Mathematical Sciences serving to make a man a compleat Architect, yea to have some Judgment in Physick, and Natural Philosophy too. And so this glorious Scene of *G O D's Works*, the Heavens, plainly demonstrate the Workman's infinite *Wisdom* to contrive, his *Omnipotency* to make, and his infinite *Goodness*, in being so indulgent to all the Creatures, as to contrive and order all his Works for their good. For what less than *Infinite* could effect all those grand things, which I have in this Discourse shewn to be manifest in the Heavens? What *Architect* could build such vast Masses, and such an innumerable company of them too, as I have shewn the Heavens do contain? What *Mathematician* could so exactly adjust their Distances?

What

What *Mechanick* so nicely adapt their Motions, so well contrive their Figures, as in the very best manner may serve to their own conservation and benefit, and the convenience of the other Globes also? What *Naturalist*, What *Philosopher* could impregnate every Globe with a thing of that absolute necessity to its conservation, as that of Gravity is? What *Optician*, what *Chymist* could ever have hit upon such a noble Apparatus for Light and Heat, as the Sun, the Moon, and the Stars are? could amass together such a pile of Fire as the Sun is? could appoint such Lights as the Moon and other Secondaries are? None certainly could do these things but GOD.

CHAP.

of GOD's Relation to us, and the Duties resulting from thence.

CHAPTER III.

OF GOD'S Relation to us, and the Duties resulting from thence.

IT appearing from the last Chapter how great a Being the CREATOR is, it is time to consider what Relation he stands in to us, and what is due from us to him. His Relation to us is that of CREATOR, and as such, of Conservator, sovereign LORD and Ruler, one that hath an absolute power over us, and all things belonging to us, that can subject us to what Laws he sees fit, and that can reward or punish us as we deserve. And in this case, the least we can do, is to *revere and fear him at all times, to worship and serve him with all our power, to comply with his*

his holy Will sincerely and heartily, and to obey him in all things he hath either forbidden or enjoyned. And considering also how great *Indulgence* and *Love* the CREATOR hath shewed in his Works throughout the Universe, it naturally follows that we ought to be truly *Thankful* to him for his *Mercy* and *Kindness*, and to *Love* him for his *Love* and *Goodness*.

THESE kind of Conclusions are so natural, that the very Heathens have in some measure made them. Thus Cicero's Stoick before cited, (1) *Quid vero? hominum Ratio non, &c.* What? doth not Man's Reason penetrate as far as even the very Heavens? For we alone of all Animals have known the Risings, Settings and Courses of the Stars: by mankind it is that the Day, the Month,

(1) De Nat. Deor. L. 2. c. 61.

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and

and

and Year is determined; that the Eclipses of the Sun and Moon are known, and foretold to all futurity, of which Luminary they are, how great they will be, and when they are to happen. Which thing the mind contemplating, it receives from hence (2) the knowledge of the Gods: from whence arises Piety; to which is joined Justice, and the other Virtues, from which springs that blessed Life which is equal unto, and like that of the Gods themselves, and in no respect yielding to those celestials, except in immortality, which is not necessary to happy living. And in his Book *de Legibus* (3) Cicero brings in his Collocutor saying, *Sit igitur hoc à principio persuasum, &c. i. e.* Let this be what every member of the Commonwealth is fully convinced of from the beginning, That the Gods are Lords

(2) Some read it instead of *Accipit ad cognitionem Deorum*; *Accipit ab his cognitionem Deorum.*

(3) Lib. 2. c. 7.

and

and Governours of all things; that whatsoever things are done, they are managed by their influence, rule and divinity; that they merit a great deal of mankind; and observe what every one is, what he doth, what he admits into his mind, with what mind, what Piety he cultivates Religion; and that they take an account both of the Righteous and Wicked. For, saith he, Minds that are indued with these Principles, will scarce ever depart from that opinion that is useful and true. And a little after (4) one of the Laws arising from hence he saith is, Let men approach the Gods with purity, let them practise Piety: for he that doth otherwise God himself will be the avenger of. This purity and sincerity is so necessary a concomitant of Religion and divine Worship according to Cicero, that he makes it in another place to be that which distinguishes Religion from

(4) Cap. 8.

Superstition (4). Cultus autem Deorum est optimus, &c. But that religion, that worship of the Gods is the best, the purest, the boliest, and fullest of Piety, that we always revere and worship them with a pure upright and undefiled mind and voice. For, saith he, not only the Philosophers, but our Forefathers have distinguished *Superstition* from *Religion*; which he assigns the difference of, and then tells us, That the one hath the name of a *Vice*, the other of *Praise*.

Thus as the Heathens have by the Light of Nature deduced the Existence and Attributes of God from his Works, and particularly those of the Heavens; so have they at the same time collected what the principal Duties are which Men owe to God; so reasonable, so natural, so manifest they are to all mankind.

(5) *De Nat. Deor. L. 2. c. 28.*

CHAP.

CHAP. IV.

*Lactantius his Argument against the
Heathen Gods.*

THE next Inference shall be one
made by the eloquent *Lactan-
tius* (1), *Argumentum illud quo colligunt
universa Cælestia Deos esse, &c.* i. e.
That argument whereby they conclude the
Heavenly bodies to be Gods, proveth the
contrary: For if therefore they think them
to be Gods, because they have such certain
and well contrived rational Courses, they
err. For from hence it appears that they
are not Gods, because they are not able to
wander out of those paths that are pre-
scribed them: whereas if they were Gods,

(1) *Institut. L. 2. c. 5.*

they would go here, and there, and every where without any compulsion, like as animals upon the Earth do, whose wills being free, they wander hither and thither as they list, and go whithersoever their minds carry them.

Thus Lactantius with great reason refutes the Divinity of the *Heavenly Bodies*; which on the contrary are so far from being Gods, and Objects of divine honour and worship, that some of them have been taken to be places of Torment. Thus *Comets* particularly, which must needs have a very unequal and uncomfortable temper of Heat and Cold, by reason of their prodigiously near Approaches to the Sun, and as great Recesses from it. Thus, according to the before commended Sir Isaac Newton's (2) computation, the Comet in 1680 in its Perihelion

(2) Principia p. 466.

Chap. 4. Lactantius's Inference. 229

was above 166 times nearer the Sun than the Earth is; and consequently its Heat was then 28000 times greater than that of Summer: so that a Ball of Iron as big as the Earth, heated by it, would hardly become cool in 50000 years. Such a place therefore if designed for Habitation, may be imagined to be destined rather for a place of Torment than any other living.

BUT above all, the Sun it self, the great Object of Heathen Worship, is by some of our own learned Countreymen supposed to be probably the place of *Hell*. Of which Mr. Swinden hath written a Treatise called, *An Enquiry into the Nature and Place of Hell*.

CHAP. V.

*This Survey of the Heavens teaches us
not to overvalue the World, with Re-
flections of the Heathen Writers there-
upon.*

FROM the consideration of the
prodigious Magnitude and Mul-
titude of the Heavenly bodies, and the
far more noble Furniture and Retinue
which some of them have more than
we, we may learn not to overvalue
this World, not to set our Hearts too
much upon it, or upon any of its
Riches, Honours or Pleasures. For
what is all our Globe but a Point, a
Trifle to the Universe! a Ball not
so much as visible among the greatest
part of the Heavens, namely the
Fixt Stars. And if Magnitude or
Reti-

Retinue may dignify a Planet, *Saturn* and *Jupiter* may claim the preference: or if Proximity to the most magnificent Globe of all the Systeme, to the Fountain of Light and Heat, to the Center, can honour and aggrandize a Planet, then *Mercury* and *Venus* can claim that dignity. If therefore our World be one of the inferior parts of our Systeme, why should we inordinately seek and desire it? But above all, why should we unjustly grasp at it, and be guilty of Theft or Rapine, Lying or Cheating, or any Injustice or Sin for it? Why should we sacrifice our Innocence for it, or part even only with a Good Name for it, which *Solomon* saith (1) *is rather to be chosen than great Riches?* Why should we do this, if we were sure of gaining the whole terraqueous

(1) *Prov.* 22. 1.

Globe, much less do it for a small pittance of it, as the best Empire in the world is? For as our blessed Saviour argues, Matt. 16, 26. *What is a man profited, if he shall gain the whole World, and lose his own Soul? or what shall a Man give in exchange for his Soul?*

BUT passing over the arguments which Christianity suggests, let us see how some of the Heathen Writers descant upon this subject. Pliny (2.) is very pathetical in his Reflections, when he had shewn what little portions of the earth were left for us, and what large tracts were rendred (as he thought) useless, the frigid Zones being frozen up with excessive Cold, the torrid Zones being burnt up (as the opinion then was) with as excessive Heat, and other parts drowned by the Sea, Lakes and Rivers, and others covered with large Woods, Desarts, or barren Mountains: he then exclaims thus, *Hæ totq*

(2.) Nat. Hist. L. 2. c. 68.

portio-

portiones terræ, &c, i. e. These little parcels of land, which are left for our habitation, yea as many have taught, this Point of the world (for no other is the Earth in respect of the Universe) this is the Matter, this the Seat of our Glory: here it is we bear our Honours, here we exercise our Authority, here we covet Riches; here mankind makes a bustle; here we begin our civil wars, and soften the earth with mutual Slaughters. And then having shewn how by fraud and violence men strive to enlarge their estates, saith he, What a little part of those lands doth he enjoy? and when he hath augmented them even to the measure of his Avarice, what a poor pittance is it that his dead body at last possesseth? Thus Pliny. And after the same manner Seneca reflects upon the matter (3), when he shews how Vertue tends to make a man compleatly happy; among other things, by prepa-

(3) Nat. Quest. L. 1. Præf.

ring

ring him for the society of God, by enabling the Mind to soar above the things here below, and to make him laugh at the costly Pavements of the Rich, yea the whole Earth with all its wealth. *Nec enim potest, saith he, ante contemnere porticus, &c. i. e.* A man can never be able to slight the stately Piazzas, the noble Roofs shining with Ivory, the curiously clipped Woods, and the pleasant Rivulets conveyed to the houses, until he hath surveyed the whole world, and spying from above our little globe of Earth, covered in a great measure by the Sea, and where it is not, is far and near squalid, and either parched with heat or frozen with cold, he saith to himself, Is this that Point which by fire and sword is divided among so many nations? O how ridiculous are the bounds of mortals! The Ister bounds the Dacians, the Strymon the Thracians, Euphrates the Parthians, the Danube parteth the Sarmatians and Romans, the Rhene gives

gives bounds to Germany; the Pyrenees to France and Spain; and between Egypt and Ethiopia lie the vast uncultivated sandy Deserts. If any could give human Understanding to Ants, would not they too divide their Molehill into diverse Provinces? And when thou liftest up thyself in thy truly great Province, and shalt see the armed hosts passing here, and lying there, as if some great matter was to be acted, consider that this is no more than the running of Ants in a Molehill. For what difference between them and us, but only the measure of a little body? That is but a point in which thou failest, in which thou wagest war, in which thou disposest of Kingdoms. But above there are vast spaces, to whose possession the Mind is admitted, provided it brings but little of the Body along with it, that it is purged of every vile thing, and that it is humble and free, and content with small matters. And so he goes on to shew that when the Mind is once arrived

to

to those celestial regions, how it is come to its proper habitation ; is delivered from its bonds ; hath this argument of its divinity, that divine things delight and please it, and is conversant with them as its own ; that it can securely behold the Risings and Settings and various courses of the Stars ; that it curiously pries into all those matters, as nearly appertaining to it self: that then it contemns the narrow bounds of its former habitation, it being but a trifling space, of a few days journey, from the utmost limits of *Spain* to the *very Indies* ; whereas the celestial regions afford a path for the wandering of the swiftest Star for 30 years, without any resistance ; in which regions he tells us the Mind arrives to the knowledge of those things at last, which it had before long enquired after, and there it begins to know GOD. Thus *Seneca* ; which shall suffice for this third Inference.

CHAP.

CHAP. VI.

That we should aspire after the Heavenly State.

I Shall deduce only one thing more from my preceding View of the Heavens, and that is to aspire after the Heavenly State, *to seek the things that are above.* We are naturally pleased with new things, we take great pains, undergo dangerous Voyages, to view other Countries: with great delight we hear of new discoveries in the Heavens, and view those glorious Bodies with great pleasure through our Glasses. With what pleasure then, shall departed happy Souls survey the most distant regions of the Universe, and view all those glorious Globes thereof, and their noble Appen-

Appendages with a nearer View. Only let us take especial care to *set our affections on things above*; to be *spiritually, not carnally minded*; and so to run the race which Christ hath set before us, that we may arrive to that Place which he hath prepared for his faithful servants, that he may receive us unto himself, that where he is, we may be also; in whose presence is fulness of joy, and at whose right hand are pleasures for evermore.



F I N I S.

ADDENDUM

To pag. 59. after *accompanying Jupiter.*

— And a most sagacious Contrivance this is, manifesting the Presence and Conduct of the CREATOR, in thus choosing this Proportion I speak of, rather than any other. For should the power of Gravity (for instance) have been so constituted, as to decrease in the Proportion of the Cubes (instead of the Squares) of the Distances reciprocally; although it might be possible to adjust a Velocity, and I may add, a Direction too, so as to make Bodies describe perfect Circles, yet the least Excess or Defect of Velocity, or the least Obliqui-

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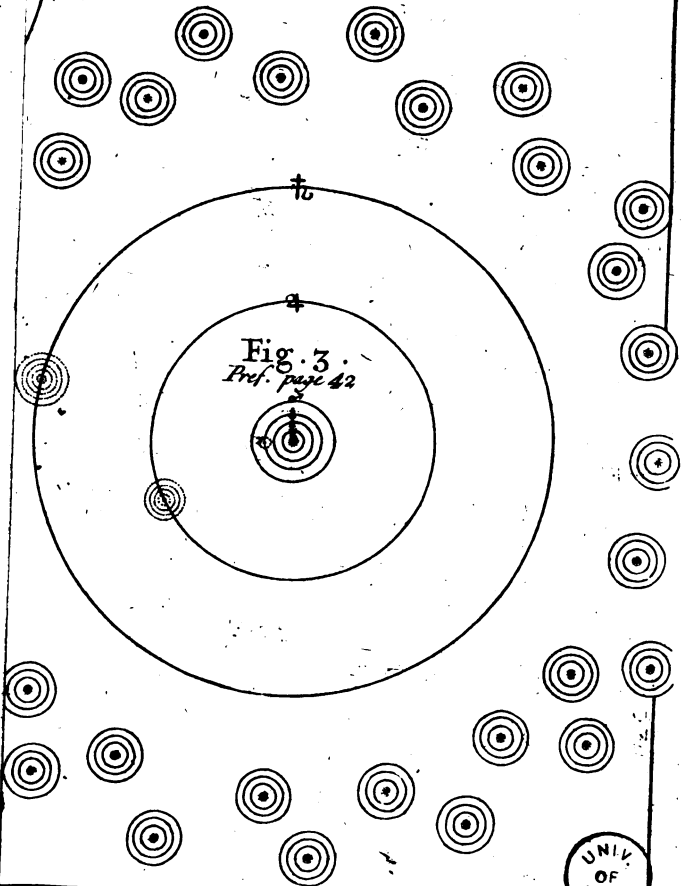
liquity of the Direction, would make them describe Spiral Curves, either ascending in *infinitum*, or else descending to the Center. And supposing the Orbs (in which those Bodies move, and which are supposed, as I said, to be made in proportion of the Cubes) to be perfectly Circular, the least Adventitious Force, even but of an Atom, abating or increasing the Velocity, or changing the Direction, would bring on the afore-said Inconveniences.

And if the great CREATOR,
 &c.



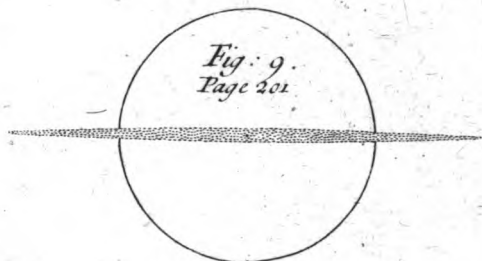
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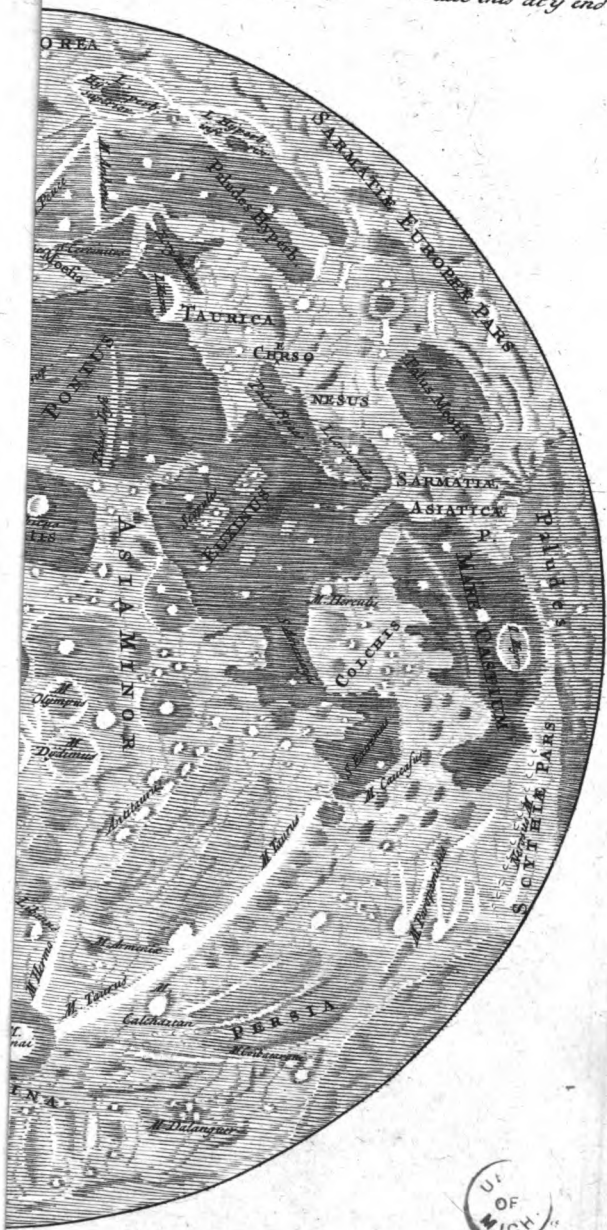
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Page 201*



*Fig: 11.
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CORRIGENDA

PA G. 50. lin. 1. dele. (*as to me it seems very probable*). P. 67. l. 2. dele. *but*. P. 87. l. ult. after *visible to us*, read, *in one part of their Orbits, and again disappears in other parts of them. But these Systems &c.*

on of the World. II. The General Deluge, its Causes and Effects. III. The Dissolution of the World, and future Conflagration. Wherein are largely discussed, the Production and Use of Mountains; the Original of Fountains, of formed Stones, and Sea-Fishes, Bones and Shells found in the Earth; the Effects of particular Floods and Inundations of the Sea; the Eruptions of Vulcanos, the Nature and Causes of Earthquakes. Also an Historical Account of those two late remarkable ones in *Jamaica* and *England*. With Practical Inferences. By *John Ray*, late Fellow of the Royal Society. The third Edition, illustrated with Copper-Plates, and much more enlarged than the former Editions, from the Author's own MSS. 1713. These Four published by *W. Derham*, A. M. Rector of *Upminster* in *Essex*, and F. R. S.

Directions for Studying, I. A General System or Body of Divinity. II. The 39 Articles of Religion. To which is added *St. Jerome's* Epistle to *Nepotianus*.

An Essay on the 39 Articles of Religion; agreed on in 1562, and revised in 1571: Wherein (the Text being first exhibited in *Latin* and *English*, and the minutest Variations of 18 the most Ancient and Authentick Copies carefully noted) an account is given of the Proceedings of Convocation in framing and settling the Text of the Articles; the controverted Clause of the 20th Article is demonstrated to be genuine; and the Case of Subscription to the Articles is considered in Point

Point of Law, History and Conscience. With a Prefatory Epistle to *A. Collins, Esq;* wherein the egregious Falshoods and Calumnies of the Author of *Priestcraft in Perfection*, are exposed. These two by *Tho. Bennet, D.D.* Rector of *St. James in Colchester*.

Philosophical Transactions, Numb. 341. for the Months of *October, November and December, 1714*. Containing, 1. An Account of the Rain which fell every Year at *Upminster in Essex*, for the last 18 Years; with Remarks upon that of the last Year, 1714. By the Rev. *Mr. Derham*. Also a Comparison of what has been observed of the same kind at *Paris* by *M. de la Hire*. 2. *Solutio Generalis Problematis XV. propositi à D. de Moivre, in tractatu de Mensura Sortis inserto Actis Philosophicis Anglicanis No. 329, pro numero quocunque Colutorum.* Per *D. Nicolaum Bernoulli* *Basiliensem;* *J. U. D. & Regiæ Societatis Sodalem*. 3. *Solutio Generalis altera præcedentis Problematis, ope Combinationum & Serierum infinitarum.* Per *D. Abr. de Moivre, Regiæ Soc. Sodalem*. 4. An Account of several extraordinary Meteors or Lights seen in the Sky. By *Dr. Edm. Halley*, Professor of Geometry at *Oxon*. 5. Some Remarks on the Variations of the Magnetical Compass, published in the *Memoirs of the Royal Academy of Sciences*, with regard to the general Chart of those Variations made by *Dr. Halley*. As also concerning the true Geographical Longitude of the *Magellan Straights*. By the same. Continued and published by *Dr. Edm. Halley*, and *Dr. Brook Taylor*, Secretaries to the *Royal Society*. Where may be had all the former Numbers.

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ASTRO-THEOLOGY



BY

EDWARD HIGGINSON.

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Massachusetts Historical Society.

FROM THE BEQUEST

OF

GEORGE EDWARD ELLIS,

Seventh President of the Society.

Received September 13, 1895.

ASTRO-THEOLOGY;

OR,

THE RELIGION OF ASTRONOMY.

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ASTRO-THEOLOGY;

OR,

THE RELIGION OF ASTRONOMY:

Four Lectures,

IN REFERENCE TO THE CONTROVERSY ON THE

"PLURALITY OF WORLDS,"

AS LATELY SUSTAINED BETWEEN SIR DAVID BREWSTER
AND AN ESSAYIST.

BY

EDWARD HIGGINSON,

AUTHOR OF THE "SPIRIT OF THE BIBLE."

LONDON:

E. T. WHITFIELD, 178, STRAND.

1855.

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HACKNEY:
PRINTED BY CHARLES GREEN.

TO THE

Members of the Westgate Congregation, Wakefield.

I FEEL impelled by a sense of fitness, as well as that of duty and affection, to inscribe these Lectures to you, my Christian friends, to whom they were at first presented orally:—to some of you, as earnest and successful votaries of Natural Science; to many, as proficient in Literature and Art; to all, as Rational Christians, in whose free and comprehensive view of your Master's religion, the Gospel is seen to be in beautiful harmony with all the other good gifts of God to His creatures, and with the natural faculties, duties and hopes of His human offspring.

Such as has been, thus far, the unvarying spirit of my most healthy and happy connection with you as your Minister, may it be throughout!

WAKEFIELD, *Feb.* 1855.

P R E F A C E.

It is my daily happiness, as one who holds a rational and free theology, to know and feel that Revealed Religion hails, instead of deprecating, the great discoveries of Science; in other words, that the voice of God in Creation harmonizes with that of His Gospel.

It is also, I grieve to say, my uniform observation, beyond the circle of avowed Unitarian Christians, that Science and Theology are accustomed to look upon each other with a greater or less degree of jealousy and suspicion;—the scientific man seldom daring freely to avow the most religious conclusions he draws from the study of Nature; the theologian dabbling very cautiously in the mere shallows of Science, lest he should plunge unawares into religious heresy.

The revival of the question of a Plurality of Worlds, in the hands of two such men as Sir D. Brewster and his anonymous, but well-known, opponent, has given occasion to both of them to confess the "religious difficulty" to which the passive, creed-bound theology of their respective churches subjects the man of science; while the one of those distinguished men boldly cites his orthodox theology in aid of his negative opinion as to the extent of a living Creation, and the other, holding a Plurality of Worlds too dogmatically for the free and candid spirit of Science, is obliged to strain his orthodoxy in a way that few, probably, will be found fully to approve.

I have read many notices of these two remarkable books of the day, in the periodical Magazines and Reviews, and have been grieved, rather than surprised, to find the same evasion of the scientific difficulty there, as in living society. Not only those organs of periodical literature which avowedly represent the orthodox theology, but also those many scientific and literary ones which dare not encounter theological suspicion, have cautiously left untouched

the all-interesting question which these controvertists have painfully opened, How to reconcile Science and Revelation.

I am one of those who have been so happy as never to have imagined the possibility of their being at variance. Not profoundly scientific, I have ever revered, and to my limited ability and opportunity studied, Science as the expositor of God's own Works. Professedly devoted to Theology, I find its mighty truths accosting me in other records besides the Scriptures; and I find I can understand these venerable books best, and best appreciate their true character, in proportion as I bring an informed mind to their perusal. Most earnestly, therefore, do I desire to tell such of my fellow-students and fellow-christians as will listen to me, how musically those two divine voices sound, whether singly or united, if we but let them tell their own story, announce their own laws, sing their own poetry, and fill us with their own joy and love.

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When I consider Thy heavens, the work of Thy fingers,
The moon and the stars which Thou hast ordained ;
What is Man, that Thou art mindful of him ?
And the Son of Man, that Thou visitest him ?
For Thou hast made him a little lower than the angels,
And hast crowned him with glory and honour.

PSALM viii. 3—5.

LECTURE I.

JEWISH ASTRO-THEOLOGY;

OR,

HOW DEVOUT HEBREWS THOUGHT OF THE SUN, MOON
AND STARS.

THE religious suggestions of the works of Nature are inexhaustible. Around, above, within us, God is everywhere proclaimed to the thoughtful soul. But perhaps no department of Natural Religion is more generally appreciated, than that which traces the perfections of God in the *heavens* above us. Things nearer and more connected with our daily secular use, are so familiarized and made common, it may be, that we too habitually regard them chiefly for their uses, and do not penetrate the mysteries and marvels which really lurk within the constitution and growth of all the living beings

that serve us, and the very corn and fruits that bless us in the bounty of the year. The things nearest of all to us, those of our own conscious faculties and needs,—the traces of divine power, wisdom and love in our own being, not merely in our bodily frame, “curiously and wonderfully” as it is made, but in the spiritual faculties of thought, feeling, sentiment, duty, worship,—are among the later and more advanced studies of the mind, when it has been already trained to thought by reflection upon outward objects. But the bright and majestic heavens, while present to every eye, yet removed by space and mystery from the familiarity of rude thought or low uses, have more constantly, perhaps, than any other part of the Divine works, affected mankind with a deep sense of that Divinity which all things, when duly questioned, declare. Not a child but wonderingly admires the golden sun, the paler moon, the mysterious stars. Not a neglected peasant’s soul, not a heathen’s natural thought of piety, but, when thinking of Deity or aspiring to a future life, involuntarily places the special abode of God and of good spirits after death, among those “bright citadels of light.”

Nor perhaps can the philosophical mind, that ranges through the various realms of modern science, tracing time backwards through its geological ages till progressive Creation stands open before it in the gigantic folios of the earth's stratification, or reading those constant Laws which are recorded in the past as they are seen acting in the present, or enumerating the tribes, classes, species, varieties of each order of organized beings, and tracing their links of connection and analogy with one another,—whether prying into the profound secrets of the minute with the aid of the microscope, or into those of immense distance under the guidance of the telescope;—scarcely will the philosophical mind refuse to confirm the popular judgment of the peculiar *religiousness* of the impressions derived from the study, whether merely popular or more profound, of Astronomy.

The *vastness* of the heavenly bodies, when contemplated in the light of science, is so much increased to the perception of pure reason, above all that undisciplined imagination and adoring wonder had before ascribed to them, that the reflection becomes more and more profound, in which perhaps consists the peculiar religiousness

of astronomical suggestions among those of natural religion in general,—the reflection, namely, How insignificant is Man, in the presence of such mighty works of God! And then that other reflection arises directly upon the traces of the former: How highly Man is endowed and privileged by his Maker! This is the order of the Hebrew Psalmist's thought:

“When I consider Thy heavens, the work of Thy fingers,
The moon and the stars which Thou hast ordained;
What is man, that Thou art mindful of him,
And the son of man, that Thou visitest him!”

Thus far is the first reflection, under which man bows before the starry throne of Omnipotence, feeling himself the least of the Divine works. But the spirit that is in him rises in conscious dignity at the very thought which makes him thus feel his littleness. No other being on this earth can feel, can think, can know, how little or how great it is! The mighty Maker of all has given to man a distinguished place among those works, the mightiest of which is great and glorious only as reflecting His perfections. And from those works so vast and splendid, the mind of man turns to the nearer contemplation of others which display another

and more engaging view of the Divine Maker; that is, as the Giver of Life, and, in life, of Happiness. All tribes of living creatures display, together with the wondrous power, the unbounded goodness, of the mighty Maker. And Man, placed at their head, lord over them by his intellect, and bearing the faint image, while he wields the deputed sovereignty, of God over them all, is now overwhelmed as much by the sense of the Divine favours thus heaped upon him, as he was humbled by the thought of the immensity of those works amid which he stands :

“For Thou hast made him a little lower than the angels,
And hast crowned him with glory and honour.

Thou madest him to have dominion over the works of
Thy hand;

Thou hast put all things under his feet:

All sheep and oxen, yea and the beasts of the field,

The fowl of the air, and the fish of the sea;

And whatsoever passeth through the paths of the sea.

O Jehovah, our Lord, how excellent is Thy name in all
the earth!”

(Ps. viii. 5—9.)

The ancient Hebrews highly appreciated the religion of the heavens. Many of their sacred poems are, like the Psalm above quoted, written

in express celebration of the attributes of God as seen there; and allusions to this class of thoughts dignify and adorn, in the very finest taste, their didactic and moral compositions. Distinguished by their noble belief in One Spiritual God, the Maker of all things, they more truly appreciated the beauty and grandeur of the Divine works than any other nations did, who, idolatrously worshiping the works themselves, missed the higher sentiment which those works are capable of exciting.

It is remarked of the Psalm before us, that the majesty of the heavens seems to be contemplated in it as seen by night, rather than by day. The moon and stars are specified, but not the sun. Perhaps this Psalm was first composed as an evening song of worship. How naturally may it have had its suggestion in the devout author's mind, in that calm period of nature's quiet and man's recovered peace, when the cares of the day are over, its work done, and if man goes forth into the field to meditate, be he king or be he peasant, with but an eye for beauty and a heart for worship (be he David keeping his father's flocks, or David on the throne of Israel), he sympathizes with nature's stillness, while the

evening coolness refreshes and quickens his thoughts, tranquillized and concentrated as they are by the decline of the too glaring light; and while nearer objects around grow dim, the vault above grows more blue, and he sees the stars come forth and the moon walk in her recovered brightness, to the praise of Him who hath set His glory above the heavens.

There is another Psalm (the nineteenth), equally beautiful in poetry and pure in devotion, which is equally suitable, in its turn, to be regarded as king David's morning hymn of praise; when, risen early from sleep, and walking meditatively, perhaps, on his palace roof (the custom of the East being to make the roofs flat, and accessible for purposes both of retirement and of fresh air), he watched the dawn and then the break of day, saw in the roseate hues of the eastern horizon the "tabernacle set for the sun;" from which, "coming forth as a bridegroom out of his chamber, he rejoiceth, as a strong man, to run a race, going forth from end to end of the heavens, where nothing is hid from his heat." Then might the Psalmist have put this silent song of the morning into human thought and words:

"The heavens declare the glory of God,
And the firmament sheweth his handy-work.
Day unto day uttereth speech,
And night unto night sheweth knowledge.
No speech, no language——

(This is the real thought of the poet and worshiper, quite missed in the common version)—

No speech, no language,
Their voice is not heard;
Yet their sound goeth forth through all the earth,
And their words to the end of the world."

Wherever there are eyes to admire and hearts to worship, the glowing picture speaks its own language to them, the silent record is intelligently read.

"How deep the silence, yet how loud the praise!"

In thus recognizing the devout lessons of the glorious heavenly bodies, the Hebrews (it should be superfluous to say, but it is not) had no supernatural knowledge of the science of Astronomy. To them, as to other nations in those early times (and some nations were more given to astronomical observation than the Hebrews), the true theory of the heavens was quite unknown. To them the earth was (as it is still to the child, to the peasant or to the savage) the

one fixed, if not central, part of the creation; round which all those luminous bodies, of such marvellous beauty, but of sizes and at distances quite unsuspected as yet, were supposed daily to revolve, making more complicated movements in the course of the year, and many other movements that were quite inexplicable. To the Jews, as was very natural, the firmament above was a firm, solid, but transparent vault, separating the waters above it from the waters beneath, and the flood-gates of which, when opened wide, could deluge the earth with rain. To them, as to many other ancient nations, there was also a world *beneath* the supposed flat earth, which they called *Sheol*, and which the Greeks called *Hades*,—the “unseen” world,—the mysterious state of the dead. In all these respects, the Hebrews shared the natural knowledge (and the natural ignorance) of mankind in general. Their only specialty of knowledge and belief was of a religious order; and their noble religious belief in One Supreme and Spiritual God, filled this creation with a new spirit of piety and grandeur. So far, but so far only, did it affect their views of natural philosophy. So far, so far only, did it improve their astronomy.

One particular idea, and a striking phrase expressing it, is due to this high theology of the Jews. They were struck, like other nations, with the regularity of the heavenly movements, and the stately magnificence of the marshalled gems of light above them. They had no idea or rational conjecture as to what the stars might be; but they knew they were *the works of God*. They were *as God had made them*. They stood *as He appointed them*. They moved *as He bade them*. They waited upon *His sovereign word*. They fulfilled *His almighty will*. They were His Host,—His attendants, whether as the hosts of an earthly sovereign guard his person and swell his pomp in peace, or as they go forth with him to war. Sun, moon and stars, are the host of the King of kings! Mighty metaphor! Great thought of a pure Theism, struggling for due representation! What poetry so imaginative, while so chaste, as that of great religious thoughts? This, then, was the religious philosophy of the Jews. Of secondary causes and laws of nature, they understood no more than their neighbours; but of the final cause, the deciding and ruling Will, they knew more than philosophy has ever since added, in having learnt

to believe in One Sovereign and Almighty Mind, above nature and its mighty and glorious works.

It must be a matter of surprise and regret to intelligent believers in revealed as well as natural religion, to find the authority of any name truly great in science attempting to uphold irrational expositions of Scripture, where Science and Scripture inevitably come into comparison, and may, by any but broad and comprehensive views of both, be easily set at seeming variance.

Sir David Brewster, in his part of the lately-revived controversy on the "Plurality of Worlds" (into which we shall look further by and by), has committed himself to the strange opinion that the Psalmist, whose words stand at the head of this discourse, was divinely inspired with astronomical knowledge unknown to his age, in order to write those fine words :

"When I consider Thy heavens, the work of Thy fingers,
The moon and the stars which Thou hast ordained ;
What is man, that Thou art mindful of him ?
And the son of man, that Thou visitest him ?"

He thinks this text "a positive argument for a plurality of worlds." He "cannot concur in the opinion of Dr. Chalmers, that a person wholly ignorant of the science of astronomy, and

consequently to whom all the stars are but specks of light in the sky, not more important" (as he is pleased to add, though Dr. Chalmers did not say so) "than the *ignis fatuus* upon a marshy field, could express the surprise and deep emotion of the Hebrew poet." He therefore "cannot doubt that inspiration revealed to him the magnitude, the distances and the final cause of the glorious spheres which fixed his admiration." So then this veteran philosopher, who knows the whole history of astronomical discovery, and has observed how the progressive knowledge of the heavenly bodies has been laboriously gained through centuries of noble discipline alike to the intellect and the character of the sons of science, actually believes that the Hebrew Psalmist was inspired with a knowledge of the magnitudes, the distances and the final cause of those glorious spheres which fixed his admiration! How meanly must he think of the functions of an inspired astronomer, that this Psalmist never communicated such august knowledge to those around him! Natural science, gained by the unaided human faculty, delights to spread itself in free communion between mind and mind; but an *inspired astronomer*, we

are to understand, left the world in total ignorance of the scientific truths which had been imparted to him! Is Inspiration, then, thus niggard and jealous, while Science is so diffusive and generous? O, shame upon those representations of Religion which make it chargeable with such unworthy churlishness!

But this philosopher (and a great physical philosopher he is, though a narrow theologian) discovers yet deeper insight to have belonged to the Psalmist. He assumes also that the Hebrew poet regarded man, not only (as the poet describes him) as "made a little lower than the angels, and crowned with glory and honour," but also as a being "for whose redemption God sent his Son to suffer and to die;" and then (with the help of this strange anachronism of thought) he argues that man, thus regarded, "could not be an object of insignificance in the Psalmist's estimation; and, measured therefore by his high estimate of man, his idea of the heavens, the moon and the stars, *must have been* of the most transcendent kind. Had he been ignorant of astronomy (our philosopher persists), he *never could* have given utterance to the sentiment in the text." And so he concludes that

the Hebrew poet "doubtless viewed these worlds as teeming with life, physical and intellectual, as globes which may have required millions of years for their preparation, exhibiting new forms of being, new powers of mind, new conditions in the past, and new glories in the future."

So then, according to one of the most scientific men of our day, the Hebrew Psalmist was miraculously inspired to know all that sages have been learning through ages since, of the sizes and motions of the heavenly bodies and the geological structure and history of the earth, and all that they have been inferring from the analogies most accessible to us respecting the possible or probable condition of sun, moon and stars, as habitable worlds;—all this (he declares) must have been miraculously infused into the Psalmist's mind, when he gave utterance to his noble song of praise to God for His works!

Now here is a most serious damage done to the credibility of the Scriptures, if it does not also excite a suspicion against the very exalted scientific views of the writer. The true explanation seems to be, that Sir D. Brewster (who is now in his 73rd year) was in early life educated for the ministry of the Kirk of Scotland;

and though he soon gave up the profession of theology for that of science, his early theological impressions appear to have retained their strict accordance with the rigid orthodoxy of Scotland. In the discussion in which he is engaged with an anonymous, but pretty well ascertained, author (also high in the scientific world, if report correctly guesses his name, and high in university honours and preferments as a divine of the Church of England), on this question of a Plurality of Worlds,—or, in other words, the question whether any of the heavenly bodies may reasonably be believed to be inhabited,—it is curious and sadly instructive to notice how “religious difficulties,” confessedly arising out of their mutual orthodoxy, seriously perplex the scientific question on both sides, causing great annoyance and tempting to special-pleading of a most unphilosophical kind on the part of Sir David, and giving room for the suspicion that his opponent has been not a little influenced in his rejection of the plurality of worlds, by feeling such a belief to be incompatible with his orthodox theology. Of this I shall speak more pointedly in its proper place, when we pursue the progress of these great astro-theological

ideas, and endeavour to realize to our religious thought the general evidence on which these curious and interesting, yet abstruse and confessedly doubtful, speculations hang.

For the present, let us return for a few moments to the Hebrew astro-theology, without regard to Sir D. Brewster's imaginative additions,—not asking nor conjecturing what the Psalmist *must* have thought of the stars when he exclaimed, “What is man?” under the prior supposition that he knew how Christ was to die for man,—but remarking simply what he and other pious Hebrews really have expressed themselves as thinking and feeling in reference to the works of God before their eyes. Those thoughts they have expressed at least to the following effect.

I. To the unscientific, yet intelligent and religious-minded beholder of the hosts of heaven (like king David and many other Hebrew psalmists and prophets), the daily and nightly sky appeared as a scene at once of *beauty and grandeur*, impressing them with sentiments of *religious delight and love* towards Him whose hand made all these things.

It is so with us before we learn our first

lessons in scientific astronomy,—before we know whether the heavens move daily round to shew themselves to us, or the earth revolves to let us look at every part of them in turn. And when we have read the history of astronomical thought and discovery, and learnt from Copernicus and Newton the indisputable order of the Solar System, while this sublimest of human knowledge excites our deeper and maturer reverence, the bright and beautiful phenomena themselves still offer to our senses the same impressions as at first, which the associated thought, however, renders proportionately more beautiful and grand to our appreciation. Their beauty and magnificence touch *our* sense of religion, just as *theirs* of olden time, because we see them shining not by their own power to their own praise, but to the praise of Him who “hung those lamps on high.” Ancient Jewish and modern Christian sentiment coincide here :

“These are Thy glorious works, Parent of good,
Almighty! Thine this universal frame
Thus wondrous fair! Thyself how wondrous then,
Unspeakable! who sitt’st above these heavens,
To us invisible, or dimly seen
In these Thy lowliest works; yet these declare
Thy goodness beyond thought, and power divine !”

II. The old Hebrew worshiper was devoutly impressed, much as the modern Christian philosopher is, with the *order* and *permanency* of the Divine works in the heavenly firmament. Order was their believed *moral* law, the law of evidently presiding Will and Purpose, long before the *physical* laws to which the preservation of their order may be in part at least intrusted, were known or thought of. Observation proved it as a fact, long before science was able to account for it. "For ever, O Jehovah," said Hebrew piety, reading by the soul's insight the golden hieroglyphics of the sky,—“For ever, O Jehovah, Thy word is written in the heavens!” “They continue unto this day according to Thine ordinances, for all are Thy servants!” And this perception of order among things so vast and distant, so numberless and so mysterious, naturally became a deep sense of *reverence*. Without any theory or conjecture, as far as we know, respecting the nature of the heavenly bodies,—without the slightest idea (that we can be justified in ascribing to them) approaching to the modern scientific thought of a plurality of habitable worlds,—the old Hebrews read, in the orderly phenomena of the starry heavens,

true lessons of reverential piety. Hear the author of the book of Job expound this moral, as in the name of the Most High himself speaking to mortal man. What is man, indeed, in the presence of these mighty and seemingly everlasting revolutions?

“Canst thou bind the sweet influences of the Pleiades?
Or loose the bands of Orion?
Canst thou bring forth Mazzaroth in his season?
Or canst thou guide Arcturus with his sons?
Knowest thou the ordinances of heaven?
Canst thou set the dominion thereof in the earth?”

When the devout philosopher of modern times contemplates this sublime order of the heavenly bodies as the result of divinely-appointed Laws, the real image still effectually before his thought is not that of the material law which instrumentally produces it, but of the ever-recurring phenomena which are thus produced, the periodical rounds which he has himself seen again and again exactly fulfilled, and which he believes to have been fulfilled with the same exactness through all the ages that have intervened, since the pen of that old Hebrew poet recorded in those fervent words his reverential thought. If he penetrates through the phenomena, it is not

to rest upon a material law, but to rise to the central Will. Science endorses all that the Hebrew poets have sung in praise of the majestic uniformity of Creation.

III. And again : with this lively sense of the beauty and greatness of the starry works of God, and this profound reverence for their majestic order, the Hebrew worshipers united another active sentiment, which it becomes us to feel also ; namely, that of *thankfulness* for the evident subservience of these mighty works of God to the *comfort and happiness* of human life. The most unscientific knows that the sun is designed to shine by day, and the moon and stars to shine by night. He believes they are made for the purpose (as he sees them serve that purpose) of marking out times and seasons and days and years. And in words to this effect the Hebrews of old spoke reverently and thankfully of the blessings conferred upon man's abode by the bright host of heaven.

All such words have a deeper scientific truth than those who first spoke them knew. The growing science of Astronomy has shewn how the celestial phenomena not only mark, but *make*, our times and seasons, and confer their

bounties duly as they roll; while it forbids us to regard many of those uses as limited to the Earth on which we dwell, and lifts our adoring thought to other globes, like ours, yet different, which receive corresponding yet varied influences, as parts of the same great system of Worlds. And, with deep reverence and devotion, Science asks us whether we can doubt that in other worlds besides our own,—how many or how few besides, we may not dare to guess,—there are sentient creatures to receive their Creator's overflowing blessings, and intelligent beings to see and love and worship Him in His gifts.

LECTURE II.
SCIENTIFIC ASTRO-THEOLOGY;
OR,
MODERN PHILOSOPHICAL VIEWS OF THE SOLAR SYSTEM
AND FIXED STARS.

WE have endeavoured to realize the religious lessons of the heavenly bodies, as they shone before the eyes of the devout Hebrews of old; who, long before the times of Astronomical science, looked upon all things as the work of a Supreme Creator, with sentiments of delight and love for the beauty and grandeur that were around them, with profound reverence for the order and permanency of the mighty and mysterious heavens, and with devout gratitude for the beneficent uses fulfilled by them in the changes of day and night and the revolutions of the seasons, with which they were evidently connected.

It needed no scientific ear to hear the heavens telling the glory of God. It required no telescopic vision to see His handy-work as shewn in the firmament. A deeper insight into the religious import of Creation had been given to these Hebrews by their sublime doctrine of One Almighty Maker and Lord of all things, than to the early astronomical observers by their very imperfect means of observation. The profoundest sense of the Divine majesty and bounty, and of man's littleness amid the creation, yet of the near place he occupies in the Divine love and care, dwells in those words in which the Psalmist points the contrast and cherishes the emotion due to the contemplation of the bright heavens above his head: "When I consider the heavens," &c.

Yet, with the advance of Astronomical science, the religious mind has found ever new sources of wonder and devotion. Thought has been strained to its utmost, to grasp the mere facts, as ascertained and expressed in number, size and distance. Imagination has confessed itself unable to realize the suggestions which crowd upon it irresistibly from those facts. Devotion has bowed lower, and felt what Sacred

Mystery means, in things perplexing not by their contradiction but their vastness, when, through the gradual ascent of knowledge, man has found his intelligent conviction leaving intelligent perception far behind, and the noblest efforts of his finite faculties have been baffled by the Infinite that is disclosed to him. O, not in any subtleties of metaphysical thought, not in the daring contradictions of dogmatic creeds, not in any unnatural (or non-natural) meanings ascribed to customary words, is the real idea of Sacred Mystery to be found; but in the Immensity which baffles our conceptions,—in the Complication which, orderly as it is, eludes our effort to trace it through its innumerable ramifications,—in the Secrecy in which causation still hides itself beside the throne of God!

The mysteries of Creation are its marvels still untraced, or only traceable until, sooner or later, we are lost as we approach their infinite source.

The mysteries of Providence are the secret purposes, so far beyond our reach to unravel, for which all the joys and trials, all the temptations and all the discipline of mortal life is sent.

And the mysteries of Scripture are still true to the same sense, as the secrets of the Supreme

Mind ; for the Scripture shews us many mysteries *revealed*, in its successive disclosures of the Divine Will and human duty and hope ; while not even Revelation has revealed *all* the secrets of life, death and immortality, because to *finite* man such a revelation would be constitutionally impossible.

In fact, close on the borders of our knowledge, whether scientific or directly religious, and whether natural or supernatural, the dark shadows of the unknown still rest, and still would rest, however far those borders might be extended ; or else the dazzling haze of immensity not less effectually defies our mental vision. Such is the real mystery of God, and of His works and ways !

The progress of astronomical discovery has developed this true sense of the mystery of Creation. It has given vastness, before inconceivable, to those bright specks that once seemed but to adorn the blue arch of night ; and, from the known vastness, it has plunged the mind into immensity beyond both knowledge and conception. But it has, meanwhile, irresistibly prompted the inquiry into the possible or probable *uses* of the heavenly bodies, and has suggested to us the grandest thought that there is

in the whole range of Natural Science and Religion, namely, that of a *Plurality of Worlds*.

While this fair Earth upon which we dwell was regarded by its rational inhabitant as the centre of creation,—while its hundreds and thousands of miles, so vast to his experience and reaching far beyond his farthest travels, was practically his measure of conceivable size and distance for everything else,—while he believed that the sun revolved daily from east to west for the earth's sole benefit; and, without the slightest knowledge, thought or belief as to the sizes or distances of sun, moon or stars, was satisfied to regard them as ministering to the beauty, comfort and convenience of man's abode, —so long the human race was, in the eye of human reason and religion, the *ultimate purpose* of the universe. Man, the head of creation on this earth, naturally believed himself the sole created intelligence among God's works; or if, under the inspiration of high religious thought, he believed (as the Hebrews did) in the existence of spiritual or angelic agents higher even than himself, they were not regarded as the inhabitants of the heavenly *orbs*, but rather of the mysterious heavenly *arch* in which those

orbs themselves stood as the attendant host, and their office was supposed to be that of administering the providence of God to His creatures on this earth.

But after the discovery that this world, instead of being the centre of the whole system of things (and that system small, proportionately to that idea), is only one of many planets which revolve, like it, around the sun, illustrating the same great and uniform laws of matter and motion, heat and light, and sharing a similar alternation, varied in detail, of day and night and also of seasonal changes,—it was impossible for religious minds to resist the suggestion of analogical thought whispering to them, If, by these arrangements, this earth is fitted for the residence of man and all the other living and rejoicing creatures that dwell upon it, is it not probable that those similar, but varied, arrangements in other planetary bodies, may subserve corresponding uses for various other orders of living and happy creatures, with intelligent beings at their head also?

The argument from analogy put itself into this form, long before those minuter observations could be made upon the various planetary bodies,

by which the scientific astronomer has been enabled more recently to tell with considerable confidence, at least in many cases, how far their physical circumstances correspond to, or differ from, those of our globe. And it is very possible to generalize somewhat too fast and to infer too confidently, till this truly grand, sublime and religious idea should verge upon the improbable or the absurd. But, on the other hand, the discriminating circumstances revealed through the recent wonderful improvements in the telescope, if they make it more difficult to conceive that certain globes in our system are inhabited by forms of life at all resembling those with which we are familiar, render it more difficult still to doubt it as regards those others which are proved to resemble our globe very nearly in the physical circumstances which specifically adapt it for human residence.

Then another thought, yet more vast, and utterly bewildering from its vastness and from its vagueness, has followed in the astro-theology of later times. From the knowledge that our Sun is the centre of a great system of planetary worlds, it is inferred, with as high probability as the nature of the case admits, that the Fixed

Stars, those specks of light which were but the lamps of the sky to earlier ages, may be so many Suns, like our own in purpose, giving light and heat to planetary systems corresponding to ours, and that some or all the planets which incircle them may be worlds full of life and happiness, as this Earth is.

Reason shrinks indeed, and imagination itself totters, under the mere attempt to realize the facts and but to fancy the suggested inferences. Around our Sun, this Earth revolves at a distance of nearly one hundred millions of miles;—and it would be well to pause a moment and just ask ourselves, whether we *really apprehend* what one million is. A million is as easily said as a hundred or a thousand; but a hundred must be counted ten times over to make a thousand, and that thousand must be a thousand times repeated to make the one million; and then that million must be counted through its thousand-thousands yet ninety-five times over, to make the miles that reach from the Earth to the Sun. At such a distance the Earth revolves round the Sun, travelling above a thousand miles every minute, the attendant Moon revolving monthly round it in its course. Within this annual circle

described by our Earth are two other planets, Venus and Mercury, and without it another, Mars, about half as far again from the Sun,—the two that are nearest to us having a very close similarity to our globe in all those things which specifically fit this world for its specific inhabitants. Beyond, at five times our distance from the Sun, is the magnificent planet Jupiter; at nine times our distance, the mysterious Saturn, girt with his triple ring of light; at eighteen times our distance, there is Uranus; and at twenty-eight times our distance, is Neptune; all these encompassed with Moons,—four, six, eight in number,—carrying out (as if with some view to compensation by increase of number) the analogy of our Earth and its Moon, while other points of practical resemblance diminish rapidly by the mere law of distance. These, with a multitude of small planetary bodies situated between Mars and Jupiter, and some more mysterious bodies still, of unknown constitution and use, the Comets, form our Solar System. And then we are taught that the Fixed Stars are, to all appearance, Suns like ours, shining by unborrowed light,—all of them so distant, that none of them seems in the slightest degree

nearer or more remote, for all the 190 millions of miles that we change our place with respect to them in six months' time;—and, at such distances, how immense must they be in size! Then, for their number! Every improved telescope, looking further into space, has seen them only more numerous than before, and still without any intimation of approaching limit! No bounds to space, and no space unstrewed with suns! And these thousands upon thousands of suns, we can scarcely avoid concluding, are (or it is more reverent, perhaps, to say, may be) each encompassed by a system of worlds, more or less analogous to that to which our Earth belongs! Who can realize the idea? And then, to attempt in thought to give yet further to all those planetary worlds their myriads of living inhabitants! It is too much! too much! And yet, who shall deliberately say that less than this is justified by appearances?

It is, however, quite possible that the zealous advocate of the Plurality of Worlds may overstate his case, presuming to assert more than analogy fairly justifies, and by so doing may excite doubt instead of reverence.

Looking more carefully at the Solar System,

with all the wonderful aids of modern science and art, the philosophical astro-theologian is far from maintaining that *all* the bodies which form that system must be, without exception, habitable worlds. The three bodies within, and the one next without, the Earth's orbit,—Mercury, Venus and Mars,—are those which bear the closest analogy in all respects to the Earth; their periods of day and night being nearly the same as ours, and the inclination of the axis of Mars (the cause of seasons) being almost the same as that of the Earth; while all of them have atmospheres, and in all of them the force of gravitation, and the amount of light and heat communicated from the Sun (without reference to unknown causes of modification which may operate), are such as imagination can reconcile even to the condition of beings similar to those which dwell upon our own planet. But the planets more distant from us in position, differ much more widely in all those important conditions which depend upon distance from the Sun, and in many other conditions also; and this consideration (on the very principle of analogical reasoning, which should notice differences as carefully as resemblances) makes it necessary

that we should speak less confidently, at any rate, as to the *kind* of beings for whose residence we venture to suppose those planets may possibly be adapted, and hold our imagination more free from all the actual forms of being which belong specifically to this Earth. As we could not have conceived of the existence of creatures breathing in the water, if we had seen only those that breathe the air; so we ought neither to deny the existence, nor to attempt to define the organization, of creatures that may be fitted for planetary abodes where we and the other creatures of this Earth could not live. Then, the Sun itself, the centre of motion to the system,—though it is perfectly conceivable that its surface, beneath a radiant atmosphere, may be the abode of suitable life,—yet this body might, if any difficulty be felt on this head, be regarded as uninhabited, without at all impugning the general doctrine of the Plurality of Worlds. A sufficient *use* in the purposes of the system would have been assigned to the Sun, as the centre of motion and the source of light and heat to the rest, though it be not itself regarded as an inhabitable world. The Moon, again, the comparative nearness of which to the Earth

renders the observations made upon it in this respect quite reliable, is found to be destitute of an atmosphere, which the primary planets, generally at least, appear to have; and this, together with other considerations, may seem decisive against the idea of the Moon being inhabited, yet still without impugning the general doctrine. The Moon is the attendant of the Earth; and her functions so important to the Earth in the creation of its ocean tides (and aerial tides also, with great and beneficial influence, no doubt, upon the weather), besides her important use to us as a luminary by night,—these functions are quite sufficient to vindicate creative wisdom and goodness to our most scrutinizing thought, without our endeavouring to believe, against appearances, that the Moon too has its inhabitants. And the same train of reasoning makes it perfectly unnecessary for us to endeavour to assign inhabitants to the Satellites of Jupiter, Saturn, Uranus and Neptune. Again, the Planetoids, as they are called,—the thirty or thirty-one little planets (if another or two be not added to the discovered number while we speak about them),—those little planets which lie next beyond the orbit of Mars, are so peculiar and

exceptional a group among the bodies which circulate round the Sun, that the argument from analogy, instead of peopling them, would hold the question of their habitableness in doubt at the very least. They are, we may say, close together, thirty or more small bodies, some scarcely larger than a mountain, circling round the Sun while crossing each other's orbits, and irresistibly suggesting to the Astronomer's mind the idea either of a world destroyed, or of planetary matter destined possibly to become some time a world! Nor, again, does this belief in a Plurality of Worlds make it necessary that we should believe the Comets to be inhabited. We know far too little about their nature, to believe confidently that they are; and we know many things respecting them which remove them so far from all resemblance to the known habitable world, as to make it seem probable that they are not. While they are subject to the same great laws which guide all the planets round the Sun in elliptical orbits, the ellipse is so slight in all the rest, and so exaggerated in the comets, necessarily involving such extremes of heat and cold, while their substance appears to be so attenuated, that analogy would dispose us to

doubt or deny, rather than to affirm, their habitableness, and to keep in cautious suspense our judgment of the purposes which they may serve in the System.

He then who, to complete a theory of the Plurality of Worlds, dogmatically asserts that all these must be inhabited, invites (and indeed receives) the ridicule of the scientific opponent; who, in his turn, artfully begins the survey with these weakest parts of the case, and after scornfully asking whether the comets and planetoids, and even the nebulæ, can be rationally considered to be the orderly abodes of intelligent beings like man, comes last in order to the worlds most like this, and then doubts the theory just where he might (had he begun there) have believed it probable and felt it to be devout.

And when the same analogy is extended, with such hesitancy as becomes us, to the possible systems of worlds which we suppose may incircle the Fixed Stars,—it does not suggest to us to regard those myriad suns as themselves habitable worlds, so directly as to believe it possible, yea probable, that they may have revolving round them planets analogous to those of our

Solar System, which may receive light and heat and blessing from them, as we do from our Sun.

Such is the outline of the analogical argument from the well-known parts of the Solar System, to the less known, and from the whole, to other Systems in the starry heavens. There should be no temptation to overload or exaggerate this vast argument. At the least, it carries our minds quite beyond all clear conception of size, distance and numbers, in what we are forced to admit at the mere dictate of scientific astronomy, which has actually measured planets and their spaces by the application of the same optical and mathematical principles by which a survey of our own mountains and plains is effected, without contact with every part.

Few men at once scientific and religious, probably, doubt the great inference suggested, of the Plurality of Worlds. It has seemed to be the involuntary conclusion of ever-widening science.

But Religion (or rather, what was thought to be Religion) hesitated long to admit the true theory of the universe, in opposition to the senses of the ignorant, which seemed to tell them that the Earth does stand still, and that

Sun, Moon and Stars do move round it,—and in opposition also to the supposed dictate of the Scriptures, which when they speak (as even a scientific man may now speak) of the Sun as *going forth* and *rising* and *setting*, were stupidly supposed to utter oracles of scientific truth, and were appealed to by the Church and the Inquisition against the genius of Copernicus and Kepler, and even against the telescope of Galileo.

Strange indeed have been the alternations of scientific belief as to the constitution of the Solar System. Pythagoras, five centuries after the days of David and five before the Christian era, acutely guessed the actual order of things, mingling his noble theory with strange but beautiful fancies of geometrical harmonies and music of the spheres. But all this was, by the great astronomer of the second century after Christ, Ptolemy, completely swept away from scientific thought, as though it had never been; the Earth was restored to its popular place as the centre of the universe, and Sun, Moon and Stars were bidden to revolve again about it. It was not till above thirteen centuries more had passed away, that Copernicus, himself a priest,

reproduced the thought, and, amid opposition calling itself religious, again presented the beautiful, simple and majestic truth to the delighted minds of those who were capable of appreciating it and dared to do so. But the religious prejudices of his time still forbade its general reception; and towards the end of the sixteenth century, Tycho Brahe ingeniously, yet one can hardly think sincerely, endeavoured to conciliate religious prejudice by a compromise with scientific truth, permitting Mercury and Venus to revolve round the Sun, but insisting that all the three should, with the more distant planets, revolve daily round the Earth as the centre of the whole system. But Kepler followed hard upon Tycho; and amid priestly interference prohibiting the publication of his books and placing them, with those of Copernicus, in the *Index Purgatorius* of the Church, he established his three great Laws of planetary motion; on his publication of the last and grandest of which, he, with true sublimity, unsurpassed in the devout annals of Science, writes thus to a friend: "The book is written;—to be read either now or by posterity; I care not which. It may well wait a century for a reader, as God has waited

six thousand years for an observer." And Galileo was Kepler's contemporary, and his correspondent; on whose invention of the telescope, and its disclosure of the four moons of Jupiter moving regularly round their primary, the truth of the Pythagorean or Copernican system was demonstrated to men's sight, and (the Inquisition notwithstanding) it was made manifest that the Earth did move, and that Mind was moving too;—that Society was stirred, Science on the advance, Religion reforming fast. And would that Science had thenceforth always known and asserted her own pure religiousness; and that the expounders of Scripture had known a truer reverence for the Works, and a more discriminating one for the Word, of God; so that those perpetual jealousies of the Church against Scientific truth might not have again revived,—as, alas! they have done so often,—disputing the truth of God's own Works, and bringing that of His Revelation also into doubt by the ignorant jealousy of its guardians and expounders!

Yet Science cannot give up her facts, though timid advocates may tamper with them. And happy indeed are they who have so read the revelation of Divine truth in the Bible, as to

catch the devotion of the Hebrew Psalmists and Prophets without consecrating the philosophical errors of their day, and to read the Creation with their souls awake, without ever suspecting that they can thereby dishonour Christianity.

Chronological Note to the foregoing Lecture.

Pythagoras born	B.C. 590
Ptolemy flourished about	A.D. 140
Copernicus born	1473
Tycho Brahe born	1546
Kepler born	1571
Galileo born	1564
Galileo invented telescope	1609
Galileo forced by Inquisition to abjure his science	1633
Des Cartes born	1596
Newton born	1642
Fontinelle (author of "Plurality of Worlds") born	1657
Derham (author of "Astro-theology") born	1657

LECTURE III.

ORTHODOXY AT ISSUE WITH THE CREATION ;

OR,

THE “RELIGIOUS DIFFICULTY” CONFESSED BY SIR DAVID
BREWSTER AND HIS OPPONENT.

WE have learnt, from one of their Psalmists, how the pious Hebrews of old interpreted the religion of the sky,—possessed as they were of little scientific knowledge, unable to conceive the sizes and distances of the heavenly bodies, and of course intirely ignorant of the laws by which their motions are guided ; yet with eyes to discern their beauty, with admiring perception of their order and constancy, and thankful recognition of their evident benefits to mankind ; and, above all, possessing that sublime theology which ascribed Creation and Providence to One Supreme Mind, and led them to look upon all

the starry host as the ministering servants of the Most High God. Those words of the Hebrew Psalmist express therefore the essential thought of the devout, but unscientific, observer, in ages also since his own.

We have carried the thought with us (in the second Lecture) along the path of scientific astronomy; and have found the noblest and truest commentary upon it, not among Churchmen, who have too often made the letter of Scripture untrue by exaggeration or irrational interpretation, but among Mathematicians and Sages, realizing its spirit continually more and more in the widened pages of the sky; in the wonderful insight of Pythagoras, the scientific devotedness of Copernicus, the mathematical genius of Kepler, the sight-convincing telescope of Galileo, the comprehensive and all-harmonizing theory of Newton. These great enlargers of our knowledge have felt that, as their knowledge of the universe advanced, whether in exactness or in extent, it furnished the more solid basis continually for those devout conclusions which, in the minds of the Hebrews, had anticipated the course of scientific astronomy. But—O, the injustice, alike to those bright Hebrew visions

of God amid His works, and to the patient explorers of the Divine works ever since!—we have found the scriptural theologian, at every step, the most bigoted opponent of scientific research, by his narrow idea of a verbal inspiration investing mere popular ignorance with divine authority. We have seen the Church anathematizing the movements of the Solar System, and the Inquisition visiting them with pains and penalties!

These religious difficulties lying in the way of scientific conclusions, were caused—as similar ones still are caused—by mere *ignorance* of the facts of science allying itself to the deeply revered, but thoroughly misunderstood, *letter* of the Scripture. But there is another kind of religious difficulty which now sorely perplexes the astro-theology of the Christian world, arising directly out of its metaphysical *creeds and theories*, quite extraneous though these really are to the Scriptures, yet of co-ordinate authority in most minds. Through a process of reasoning as ingeniously subtle as it seems perverse to those who do not accept it as true, the “orthodox” believer (so called) who has surmounted the vulgar idea that he is forbidden by Scripture

to believe in the motion of the earth, feels himself on the verge of the most awful religious heresy when he admits the great scientific idea of a Plurality of Worlds! This "religious difficulty" (as it is called by one such orthodox believer), this "astronomical objection to religion" (as another calls it), is confessed on the one hand and urged on the other, by the two great scientific disputants who have lately revived that most interesting and ennobling question of scientific religion, the Plurality of Worlds.

I intreat you to view the matter just now in the aspect in which these men think it necessary, as orthodox theologians, to present it, that you may see in what peril Religion itself is placed by the popular theology, according to the avowal of orthodox men themselves.

To those to whom natural religion and revealed are but as harmonious voices hymning the praises of the One Supreme Beneficence, this perplexity appears indeed to be the most perverse and gratuitous of religious difficulties. But to the bulk of those sincere believers in the popular form of Christianity, who have reasoning power enough to trace the connected thoughts, it is a real and most alarming difficulty,—it is

a rock that threatens their Christian faith with shipwreck.

The difficulty is precisely this :

According to the Trinitarian belief, in all its many modifications, the death of Jesus Christ, as the Second Person of a supposed Divine Trinity, was the means of procuring salvation for the human race, or for a certain part of them, who must otherwise have been eternally lost from their Maker's blessing.

Now, on acquiring the sublime views, which Astronomy opens to us, of other worlds more or less resembling our own, and naturally inferred to be (or some of them at least) inhabited by intelligent beings more or less analogous to our own race,—the “orthodox” believer inevitably asks himself, what he is to think of the salvability of those other intelligent beings in other worlds. He cannot simply leave this new glimpse of other habitable worlds to the providential care of Him whose inexhaustible beneficence they seem to proclaim. The Theist of Nature can do that. The Unitarian Christian can do it; and feel the happier for even the vaguest thought thus gained of the diffusiveness of Divine love. But the orthodox Christian cannot. So,

at least, it is declared by these his representatives in the world of Philosophy. His theological system bids him ask, and answer to his own creed's satisfaction, these questions :

Do the intelligent beings who may be supposed to people other worlds, need a Redeemer, to do for them what Christ did for the inhabitants of this world ? Orthodox believers generally (but not universally*) conclude that they do.

If so, How do they find that Redeemer ? is the next question.

Can the Second Person of the Divine Trinity be believed to have made his incarnation and his expiatory sacrifice in each habitable world in succession ? The orthodox believer, it would seem, cannot admit this thought for a moment. I know not exactly why ; but he cannot, he does not.

Can the expiatory sacrifice of Christ then, presented on this earth for mankind 1800 years ago, be conceived to have had a similar influence

* The late Dr. Chalmers thought it possible they might not ; and he is deemed evasive, if not heretical, by Sir D. Brewster, for having admitted such a possibility. *Rational* beings, it is thought, *must* have fallen everywhere.

throughout all the habitable worlds of God's universe? The orthodox believer, who admits a plurality of worlds, is generally driven to this conclusion!

Yet how hard it is for a really scientific man to make this a part of his belief! When, in the wider atmosphere of Science, he has learnt to look at this fair globe on which we dwell, not as the centre of the Universe, but as one small part even of the Solar System, and that System itself as but a small part indeed of the boundless Universe,—it seems like undoing his scientific thought, to come back in the name of his theology to this same Earth as the centre of the most stupendous spiritual influences to the whole creation. This little Earth is arbitrarily selected from among all the planets of all the Solar Systems in the Universe, to become the centre of a Spiritual Force, before which the functions of gravitation itself in the material creation appear insignificant! Such is the orthodox Christian's astro-theology. It is difficult for him to realize to his own belief his own theory, and solemnly to say to himself that he thinks the inhabitants of Venus and Mars were redeemed from sin by Christ's dying at Jerusalem; and

not only so, but that all the habitable planets which he conceives of as probably circling round the Fixed Stars, also recognize this planet Earth (invisible to them, as those planets are to us) as the centre of religious influences the most mysterious but most potent, to them and to the universe. One would almost think such difficulties were strained and imaginary. But no; they are indeed real to the sincere believer in what are called orthodox views of religion, for they are the legitimate consequences of his belief. Astronomy furnishes perhaps the severest scientific test of our Platonic and Middle-age theologies. It brings them face to face with the mighty Universe, and in its wide field reduces them at once to their due proportion in the possible or probable spiritual world, when the Earth itself is seen taking its subordinate place in the stupendous march of the Creation. And then the orthodox Atonement is proved to be a paralogism in astronomy, as palpably as the Athanasian Trinity is an absurdity in arithmetic.

Hear the learned and scientific, and both of them, alas! orthodox, disputants in the matter before us, severally confessing the difficulty which I have endeavoured to describe.

The author of the first book, intituled, "Of the Plurality of Worlds, an Essay," who takes the negative side of the argument (and whom we must scruple to speak of as Dr. Whewell, the Master of Trinity College, Cambridge, only because his name is not actually on the title-page of a book universally ascribed to him and not disowned by him), supposes "a bold advocate of the Plurality of Worlds" to say :

"The only matter which perplexes us, holding this belief on astronomical grounds, is that we do not quite see how to put our theology into due place and form in our system."—P. 216.

Again he describes the difficulty as taking this shape :

"If we believe the astronomers, will not such a belief lead us to doubt the truth of the great scheme of Christianity, which makes the Earth the scene of a special dispensation?"—P. 129.

In the Preface to his second edition, he makes one of the speakers in an imaginary dialogue say :

"There are many persons to whom the assumption of an endless multitude of worlds appears difficult to reconcile with the belief of that which, as the Chris-

tian revelation teaches us, has been done for this our world of Earth.”—P. xiv.

And, in his own person, he says :

“It may be useful if we can shew * * * that astronomy no more reveals to us extra-terrestrial moral agents, than religion reveals to us extra-terrestrial plans of divine government.”—P. 133.

From this last quotation it seems obvious to conclude, that the writer's orthodox theology has, at least, *disposed* him to reject the idea of more worlds than one. His solution of the “astronomical objection against religion,” as he calls it, is found by denying those vast conclusions which astronomers in general are disposed to draw from the discovered immensity and order of creation, and by maintaining for man (as he elsewhere does) “a nature and a place unique and incapable of repetition in the scheme of the universe.”—P. 136.

His opponent, Sir D. Brewster, on the other hand, comes forth in his own name to maintain the majestic doctrine of “More Worlds than One,” as the belief of the Philosopher and the faith of the Christian. But, as a member of the Scotch Kirk, equally strong in prescriptive or-

thodoxy with the most orthodox divine of the University of Cambridge, he too confesses, while he endeavours to solve, the "religious difficulty." He alludes, with very decided disapproval, to the theory of the late Dr. Chalmers in his *Astronomical Discourses*, as having "cut the knot of the difficulty rather than untied it," by "maintaining that the inhabitants of other worlds may not have required a Saviour;" and he thus deals with the difficulty in his own person :

"If we reject, then, the idea that the inhabitants of the planets do not require a Saviour, and maintain the more rational opinion that they stand in the same relation to their Maker as the inhabitants of the earth, we must seek for another solution of the difficulty which has embarrassed both the infidel and the Christian. How can we believe, says the timid Christian, that there can be inhabitants in the planets, when God had but one Son whom he could send to save them? If we can give a satisfactory answer to this question, it may destroy the objections of the infidel, while it relieves the Christian from his anxieties."

His answer to the question then follows :

"When, at the commencement of our era, the great sacrifice was made at Jerusalem, it was by the crucifixion of a man, or an angel, or a God. If our faith

be that of the Arian, or the Socinian, the sceptical and the religious difficulty is at once removed ; a man or an angel may be again provided as a ransom for the inhabitants of the planets. But, if we believe, with the Christian Church,* that the Son of God† was required for the expiation of sin, the difficulty presents itself in its most formidable shape."

Thus the orthodox astronomer expresses his own difficulty, in words which, ungracious as they are towards more rational Christian views than his own, need no exaggeration in order to make them truly grievous to every one who, possessed of a more comprehensive religious faith, sees the difficulty to be gratuitous, perverse and most unnatural. Let us then hear his attempted solution of it ; and suppressing, if we can, the smile of contempt, yield rather the sigh of regret that such a scientific name as Brewster's should be thus coupled with an unscientific theology. He proceeds :

" When our Saviour died, the influence of his death

* Arians and Socinians, then, are not of the Christian Church !

† In the sense just defined, of being " a God who was crucified " !

extended backwards, in the past, to millions who never heard his name, and forwards in the future to millions who will never hear it. Though it radiated but from the holy city, it reached to the remotest lands, and affected every living race in the Old and in the New world." (A description, by the by, which would not be accepted by all orthodox people, and is quite inconsistent with the history of the influence of Christianity as actually spread by the apostles and first preachers in portions only of the Old world.*) "Distance in time and distance in place (he goes on) did not diminish its healing virtue :

‘Though curious to compute,
Archangels failed to cast the mighty sum!’

‘Ungrasped by minds create,’ it was a force which did not vary with any function of the distance. All-powerful over the thief on the Cross, in contact with its divine source, it was in succeeding ages equally powerful over the red Indian in the West and the wild Arab in the East. Their heavenly Father, by

* St. Paul says, "Whosoever shall call upon the name of the Lord shall be saved. How then shall they call on him in whom they have not believed? And how shall they believe in him of whom they have not heard? And how shall they hear without a preacher? And how shall they preach except they be sent?" (Rom. x. 13—15.)

some process of mercy which we understand not, communicated to them its saving power. Emanating from the middle planet of the system" (in what philosophical or conceivable sense the Earth is the middle planet of the system, he does not define), "why may it not have extended to them all? to all the planetary races in the past, when 'the day of their redemption had drawn nigh,' and to planetary races in the future, when 'their fulness of time shall come'?

'When stars and suns are dust beneath His throne,
A thousand worlds so bought were bought too dear.'

Then, after all this magniloquence, he condescendingly proposes "to bring his argument more within the reach of an ordinary understanding." With this view, he makes an illustrative supposition to the effect, that our globe had been broken into two at the beginning of the Christian era, and that its two halves had thenceforth revolved together; in which case he concludes that "both its fragments would have shared in the beneficence of the cross" (the Theologian here again leaving the Philosopher unthought of, who might else have scrupled to admit the supposed survival of the human race through such a catastrophe); and he then asks whether, in like manner, "all the planets, *the*

*worlds made by our Saviour himself,** formed out of the same material element, and basking under the same beneficent sun, may not be equal participators in his heavenly gift?"—P. 138, &c.

Now who shall tell us, in the face of these things, that theological opinions are of no importance; that the day for scriptural controversy is quite passed by; that the absurd dogmas of former generations are dying out, and have only to be let alone in order to be soon quite forgotten? Would that it were so! But we are far from such a point of progress as yet. Those religious dogmas which are the poison of our common human life and its social affections among unscientific zealots, are the perpetual stumbling-stone of science among the wise. Here is a scientific astronomer, high among the highest philosophers of our land, and possessing, moreover, a world-wide celebrity,—one of the eight selected foreign Associate members of the National Institute of France,—who yet writes like a child, or a submissive servant of church creeds,

* Is this Sir D. Brewster's deliberate translation of τὰς δειῶνας ἐποίησεν (Heb. i. 2); or of καινὴ κτίσις (2 Cor. v. 17, and Gal. vi. 15)?

in his attempted reconciliation of his religion with his philosophy. He confesses their apparent repugnance, and few intelligent persons will think that his proposed adjustment of their claims redounds much to the credit either of his theology or of his science.

The truth is, that the realms of scientific thought and those of the distinctive orthodox theology, so called, have *nothing in common*. Scientific men in general, for fear of open collision with the clergy, have agreed to keep their theology in abeyance; and then, without overtly calling in question the popular orthodoxy, they quietly pursue the great ideas of Science, and even imbibe its sublime religious thoughts, without bringing them into conscious juxtaposition with the theology of their churches. And so Revelation suffers from their hands one of two evils. It is either tacitly slighted or more actively doubted by the bulk of scientific men, who intuitively feel that there is no common groundwork of thought between the prevailing creeds of the churches and the revelations of science; while the few who venture to trace any mutual connections between natural science and what are currently assumed to be revealed truths,

present such humiliating disclosures as are here before us. At the same time that the creeds of orthodox churches are thus virtually hostile to the free advance of science, the suppression of theological opinion and inquiry which the ascendancy of those creeds naturally dictates, is not less ruinous to religious simplicity and sincerity. Great need is there that those who so hold revealed truth as to present continually points of contact, and never of collision, with the truths of scientific investigation, should avow on the one hand their free and rational theology, and earnestly trace out on the other hand the great lessons of natural religion which science enables them more and more clearly to read. The separation of the two departments of Religion and Science is ruinous to both. Science, stopping short in the discovery of material substances, forces and laws, through fear of offending religious prejudices, becomes thereby the gross materialistic thing which it is often falsely charged with being in its own nature. And Religion, turning a deaf ear to the sublime discoveries of science, and keeping jealously aloof from contact with the intellectual activity of scientific thought, can never exert its highest

inspiration upon the souls of those whose understandings are closed in its sacred name.

And why is this separation? Why this jealousy between what is called Religion and what is called Science? Should they not be as parts of one and the same pursuit? the varied breathings of One Great Spirit? successive tributes of cumulative truth?—that truth having reference in both instances to the Creator's ways and will and attributes, and being properly religious when traced through the inductions of science, whether physical or mental or moral science,—and properly scientific, in the highest sense, when it has been caught from divine inspiration, in advance of man's natural knowledge of himself, his duties and his destiny. Are they not God's works that the man of science explores, as truly as it is God's word that the divine, too exclusively perhaps, expounds? Is the language any more obsolete to our minds, in which the former are written, than the dead Hebrew and Greek of the latter, which are translatable, nevertheless, into living English? Or is their text more perplexed? Or are their versions more various? Or their readings more uncertain? Does not the Divine Spirit shine forth

in both to the intelligent and religious-hearted reader? Is it not treason to both, to set them for a moment at variance? Does not the analogy which is traceable between Natural religion and Revealed, enrich the one and endear the other from their mutual sources?

So may the bright heavens ever shine upon the pages of the Gospel in the view of our free, comprehensive and blessed faith! So may the Gospel still shew our hearts a Heavenly Father's love in the mighty architecture of those countless worlds!

I ought perhaps to say a few words more specifically in reference to the two books to which I have adverted.

The book which holds the negative argument will strike most persons as decidedly the more clever of the two. It is lively, dashing and bold—may I venture also to say, one-sided and sophistical. The reply by Sir David Brewster is stately, rhetorical often, but heavy, and far less effective than those who hold essentially his side of the argument think it might and ought to have been. Nor is he free from that overstatement of his case, which most seriously of all enfeebles such a case as this, where analogy

is the ground of argument, and the analogy grows fainter with distance till it is lost in doubt. His way of speaking of his opponent, moreover, is such as has been sometimes, but erroneously, regarded as characteristic of theological controversy alone, and is certainly unworthy of Philosophy. Thus, he speaks of him as "exhibiting an amount of knowledge so excessive as occasionally to smother his reason." He ascribes his sentiments "only to some morbid condition of the mental powers, which feeds upon paradox and delights in doing violence to sentiments deeply cherished, and to opinions universally believed." He charges his opponent with employing "dialectics in which a large dose of banter and ridicule is seasoned with a little condiment of science;" and describes his performance as "the most ingenious though shallow piece of sophistry which we have encountered in modern times." And he refers his "theories and speculations to no better a feeling than a love of notoriety." All this is in the worst taste, if not the worst spirit too.

The opponent of a Plurality of Worlds rests the strength of his argument upon the discoveries of geology. It is a strange argument; but thus

he argues:—From the fact now (we may say) proved and accepted, that the Earth went through a variety of formations or states of growth, occupying long ages upon ages, before it became fit to be the abode of man, he argues (or rather he endeavours to reconcile the mind to the idea) that the whole Creation, this one world excepted, may be a similar waste for ever! He says:

“When Geology tells us that the earth, which has been the seat of human life for a few thousand years only, has been the seat of animal life for myriads, it may be millions, of years, she has a right to offer this as an answer to any difficulty which Astronomy, or the readers of astronomical books, may suggest, derived from the consideration that the earth, the seat of human life, is but one globe, of a few thousand miles in diameter, among millions of other globes, at distances millions of times as great.”—P. 194.

To this Sir David Brewster has aptly replied, that if the comparison between time and space be allowed, the ratio of time in the habitable state of the Earth to time in its uninhabitable state is continually changing, and so vitiating the analogy to the assumed proportion between habitable and uninhabitable space. In fact, the analogy itself suggests the very opposite con-

clusion: If this Earth was for ages uninhabitable, yet in process of gradual preparation for its present state,—then, if it could be proved that other planetary bodies are now in its ancient geological state, it would be fair to argue that they are in process of change and growth towards a habitable state. This is the direct argument from analogy.

The philosopher on the negative side seems, indeed, to consider it possible that some of the planets may contain animal life; but “a progressive creature, intellectually considered (he insists) there is not the slightest ground for believing to exist anywhere else” but on this earth. (P. 121.)

Then he most wilfully argues that such a superior being must be not only *like* man in faculties, but *actually and identically* man;—that “man cannot conceive any moral creature who is not man” (p. 126), and so forth. Truly a most wilful restriction of the analogical argument, which he permits, in the same sentence, to fill some, at least, of the planets with plants and animals, without insisting that they must necessarily be *our* plants and *our* animals.

Then he as arbitrarily accepts the nebular

hypothesis for the Solar System, but stoutly denies it beyond (p. 314).

He calls "the Earth's orbit the Temperate zone of the Solar System" (p. 300); and the Earth itself its "domestic hearth" (p. 302);—his very figures of speech suggesting to us that Almighty Goodness may have formed appropriate inhabitants for the Torrid zone of Mercury and the Frigid of Uranus and Neptune (as for the varied zones of this planet Earth)—if rather the constitution of the respective planets themselves may not be the real adjuster and equalizer of temperature. And in the following bold metaphor he would reconcile us to the idea that this Earth is the sole ultimate purpose of the whole Creation :

"Instead of manufacturing a multitude of worlds on patterns more or less similar, He (the Creator) has been employed in one great work, which we cannot call imperfect, since it includes and suggests all that we can conceive of perfection. It may be, that all the other bodies which we can discover in the universe, shew the greatness of this work, and are rolled into forms of symmetry and order, into masses of light and splendour, by the vast whirl which the original creative energy imparted to the luminous

element out of which they were formed. The planets and the stars are the lumps which have flown from the potter's wheel of the Great Worker; the shred coils which in the working sprang from his mighty lathe; the sparks which darted from his awful anvil when the Solar System lay incandescent thereon; the curls of vapour which rose from the great caldron of creation when its elements were separated. If even these superfluous portions of the material are marked with universal traces of regularity and order, this shews that universal rules are his implements, and that order is the first and universal Law of the heavenly work."—Pp. 353, 354.

Had this passage been found in any writer between the days of Pythagoras and Copernicus, or even if it could be conceived to have presented itself earlier still to a Hebrew mind, it would have been deservedly regarded as suggesting a grand poetic thought, and doing homage at once to the then natural idea of the comparative dignity of our Earth in the Creation, and to the dimly-perceived reign of order beyond the Earth. But, produced amid and after the grand discoveries of size and distance with which this age of the world has become acquainted, the idea which it suggests is repudiated at once

by every smith at his anvil and every potter at his wheel, as known and felt by them to be unworthy of their own coarse manual art—how utterly, how degradingly unworthy of that grand Economy of Nature by which human artists and artificers have been hitherto accustomed reverentially to take copy! If the views here propounded be accepted, we must cease at least henceforth to cite the Economy of Nature as delighting to produce the greatest results by the simplest means, and as pursuing a grand and elevated utility even in the “pomp and prodigality” with which it ministers to our sense of beauty and our faculty of worship! No wonder that the writer of the reply should, in the severe spirit of retributory justice, have reproduced the following as the earlier and worthier thoughts of William Whewell in his *Bridgewater Treatise*:

“The earth, the globular body thus covered with life, is not the only globe in the universe. There are circling round our Sun six others, so far as we can judge, *perfectly analogous in their nature*; besides one moon and other bodies analogous to it. *No one* can resist the temptation to conjecture that these globes, some of them much larger than our own, are

not dead and barren; that they are, like ours, occupied with organization, life, intelligence. To conjecture is all that we can do; yet even by the perception of such a possibility, our view of the kingdom of Nature is enlarged and elevated."—Brewster, p. 247; *Bridge-water Treatise*, pp. 269, 270.

And, in a corresponding tone, that *Bridge-water Treatise* speaks of the Fixed Stars:

"Astronomy teaches us, that the Stars which we see have no immediate relation to our system. The obvious supposition is, that they are of the nature and order of our Sun; the minuteness of their apparent magnitude agrees, on this supposition, with the enormous and almost inconceivable distances which, from all the measurements of astronomers, we are led to attribute to them. If then these are Suns, they may, like our Sun, have planets revolving round them; and these may, like our planet, be the seats of vegetable, animal and rational life; we may thus have in the universe worlds, no one knows how many, no one can guess how varied; but, however many, however varied, they are still but so many provinces of the same empire, subject to common rules, governed by a common power."—Brewster, p. 222; *Bridge-water Treatise*, B. iii. Chap. ii. p. 270.

Do we not prefer these first thoughts to the

second? May we not still rest in this truly grand and most devout philosophy, as sustained by the probabilities of analogical argument, reasoning cautiously and hypothetically, not mathematically nor dogmatically, from the great facts of Science?

NOTE TO LECTURE III.

While preparing these Lectures for the press, I meet with the following estimate of the two books in question, in an able article in the *Christian Remembrancer* for Jan. 1855, which confirms the estimate given above. It also painfully illustrates what I have said of the hollow truce or transparent compromise effected, at Cambridge and elsewhere, between orthodox Theology and Science; for the reviewer, with an ingenious affectation of reverence, declines the solution of the religious difficulty, while ridiculing Brewster for his absurd attempt to solve it.

“In the one volume, a very bulky mass of very pompous thought, ingenious argument and elaborate dissertation, is expended in an effort to maintain a paradox and overthrow a popular belief. In the other, a highly discursive style of querulous remonstrance feebly advocates the established conviction,—sometimes by false philosophy,—sometimes by random theory,—sometimes by not indisputable analogy,—and not seldom by mere bombast.”—P. 53.

Of Whewell's book the reviewer further says:

“Like all his other works, it evidences very great

faculties of mind, very comprehensive capacity of intellect, very extensive acquaintance with every branch of physical science; moreover, very clumsy and disorderly notions of logic, and a marvellous inelegance in the use of English.”—P. 60.

Of Brewster’s he speaks as follows :

“He takes up the cudgels against our Essayist, with a spirit worthy of better logic than he knows how to wield. The side he supports is the one we would advocate; but we blush for the forced analogies, the unsound argument, the daring speculation, the inflated diction, by which it is supported.”—P. 78.

“We take leave of Sir D. Brewster’s work, with a very acute feeling of disappointment. We are sorry to find so very famous a man condescend to employ rhodomontade and bad reasoning on so interesting a theme. We are the more sorry, because we feel that *such* an answer to so able (though we trust we have shewn not immaculate) a work as his opponent’s, cannot but weaken the cause which we ourselves incline to support. To Sir David, an advocate of the Plurality of Worlds may well exclaim, ‘Save me from my friends!’ Would that the author of the Essay had been writing on the opposite side!”—P. 80.

LECTURE IV.

SCIENTIFIC ANALOGIES AND THE CHRISTIAN HOPE;

OR,

OTHER WORLDS AND ANOTHER LIFE.

THE great religious impression produced on our minds by Scientific Astronomy, is that of the Immensity of Creation and the Infinite Perfections of the Creator. Under its serene guidance, the world in which we dwell takes its place as a part, and in some respects a subordinate part, of a system amid systems of worlds; and from the known sizes and distances of objects upon the earth (some of which, indeed, almost fill the practical limits of our clear perception of distance or of size), we are taught to imagine, or at least to speak of, sizes and distances thousands and millions of times greater;

and then, again, we are required to multiply the whole Solar System itself by an indefinite number, till millions more or millions less can make no real difference to our overloaded imagination :

“ The unsteady eye,
Restless and dazzled, wanders unconfined
O'er all this field of glories ;—spacious field,
And worthy of the Master,—Him whose hand
With hieroglyphics elder than of Nile
Inscribed the mystic tablet, hung on high
To public gaze, and said : Adore, O Man,
The finger of thy God !”

Yet, however unable our minds may be to realize the facts and their suggestions, it is impossible for us to retreat from these dimly sublime conclusions, because we have reached them through steps of reasoning and calculation which, in their earlier stages, are clear and definite enough, and which have only become less clear and definite as their results have gradually outgrown our power of grasping more. Thus Reason itself baffles Imagination ; and lowly Worship alone can express the mixed knowledge and emotion of the soul in the midst of this discovered Universe. In the presence of such wonderful works, and of the mysterious

Being whose power, intelligence and goodness they proclaim, what indeed is Man, that the Lord of all those worlds is mindful of him; and the son of man, that He visiteth him with choicest blessings, making him little lower than the angels! In the presence of such a Universe, not only Man himself, his works and his interests, range themselves in due subordination and proportion in his own thoughts; but his religious ideas respecting Nature, Providence and Divine Revelation, all chasten themselves into order and harmony. He must cease to ascribe to the Divine Author of this wonderful Universe, any merely partial or local modes of operation, such as he might reverently have believed in while its majestic Laws were unknown to him. This Plurality of Worlds, while it rectifies all our paltry views of physical Philosophy, irresistibly bids us also expand and elevate our theories of Morals and Theology into harmony with that Universe of probable or possible intelligences. Natural Religion, thus dignified by the spirit of Science, forbids any low and narrow views of Christianity to seek acceptance thenceforth in her presence.

And while Astronomy, with its wonder-work-

ing Telescope, has thus *enlarged* our views of Creation beyond our power of clear and definite conception, the Microscope has carried out a similar process in the opposite direction, shewing us an extreme of minuteness not only beyond our natural power of vision, but again beyond our faculty of thought fully to realize, and manifesting the same perfection of structure and organization in the minutest forms which is visible in the largest. And we find it equally impossible to shew, or even to imagine, a limit at either end of the series, beyond which Creation may not extend farther, or within which its operations may not be still more minute, than we have yet discovered or imagined.

Such mystery is in the Divine works! We ourselves, a part of those works, to whom the Creator hath given a spirit of understanding which can discern His operations in them, are soon perplexed and left behind in our attempt to follow them on either hand, in the direction of large or of small, beyond our daily common experiences. But the limits of great and small, it is evident, are in *our* faculty and *our* experience, not in God's creation. We are involuntarily making Him like ourselves, when we begin

to wonder how His creative power can reach wider and wider still, as our telescopes reach farther and farther yet without coming to the crystal bounds of space, or how it can contract itself to yet more and more minute organizations still, defying the research of our most improved microscopes. This is but our human point of view ; for there is, in truth,

“To Him no high, no low ; no great, no small ;
He fills, He bounds, connects and equals all !”

In the discovered Plurality of Worlds, we trace the most instructive *analogies* prevailing through the remotest parts of the universe, and identifying all its worlds as subject to the same grand laws of One Sovereign Mind ; while we also trace such *diversities of condition* resulting, as to impress us with the profoundest sense of the infinite diversity of *orders of being* which the Creator has, in His works best known to us, and must in those less known be conceived to have, endowed with varied life, intelligence and happiness.

In the two planets nearest to our own, the scientific astronomer finds reason to think that all the physical circumstances which are here connected with life and well-being, are *so nearly*

repeated as to warrant his belief that creatures not much unlike ourselves and the other living tenants of this Earth, may also inhabit them. The amount of light and heat received is not so much greater or less as to defy the thought of adaptation in the creatures themselves, when we bear in mind the adaptations of life to climate between our own Equator and Poles. Even the duration of day and night is almost identical with ours. Atmospheres are seen to surround the planets in question. The action of gravitation is not materially different in amount from what we ourselves experience. And the conditions which cause our seasons are repeated almost identically in one instance at any rate.* The

* Venus, compared with the Earth, receives $2\frac{1}{4}$ times more light and heat upon an equal surface; Mars receives somewhat less than one-half.

The revolution of Venus on her axis is computed at something less than $23\frac{1}{2}$ hours; that of Mars is fully ascertained to be something more than $24\frac{1}{2}$.

The action of gravitation on the surface of Venus is almost identical with that experienced on the Earth; on the surface of Mars it is less by one-half.

The inclination of the axis of Mars is 28 deg. 27 min. (that of the Earth being $23\frac{1}{2}$ deg.); that of Venus is not yet ascertained.

astronomer ventures to believe it possible that man himself might live there, and that he would find less difference in the physical circumstances surrounding him, if he could be transferred to that part of another planet which most nearly resembles his own country here, than he often does in passing from one extreme of climate to another on this world of Earth. He ventures to think it probable that such planets may even be inhabited by beings organized much like ourselves.

But when he passes on in thought to the planets more remote in place from our Earth, and differing more and more widely in these the ordinary conditions of life as known to us; when he finds one of them so much nearer to the Sun that he can hardly avoid believing it intensely hotter,* whatever modifying effect he may reasonably reserve for a particular constitution of the body of the planet, or for the special atmosphere surrounding it; and when he finds others, more and more remote from the Sun, whose share of heat can seem but small comparatively,*

* Mercury being three times nearer to the Sun (in round numbers), receives nine times as much light and heat on a given surface as we do; Jupiter, on the other

'however modified it may reasonably be supposed to be by the nature of the material composing such planets, and also by that of their respective atmospheres, and whose diminished share of light is evidently compensated to a small degree, but in no sense equalized, by their attendant moons; when he also finds reason to conclude that these remoter planets are composed of materials very much lighter than the substance of the Earth (the specific gravity of Jupiter, for instance, being compared to that of the heavier kinds of wood, Saturn to lighter wood, and Uranus and Neptune being apparently about the weight of water);—his ideas of the inhabitants that might be suitable for these planets respectively, must be greatly modified and more and more vague continually. Here, while the grand analogy is unbroken, inasmuch as gravitation, light and heat act by universal laws, the intensity varying in a known ratio to distance; that varied distance itself changes the result so greatly, as to forbid us to adhere too closely to the definite forms of life with which we are hand, receives only the $\frac{1}{25}$ th part, Saturn $\frac{1}{81}$, Uranus $\frac{1}{324}$, and Neptune $\frac{1}{764}$, being respectively at 5, 9, 18 and 28 times our distance from the Sun.

familiar on this Earth, in our reverent attempt to people those distant orbs. But then the differences of circumstance, and corresponding differences of organization, under which we see the life-giving agency of the Creator manifested on this Earth, are sufficiently wide, surely, to suggest to the scientific imagination wider diversities of formation still, corresponding to yet wider differences of circumstances. Surely we do not doubt the possibility of countless other forms of life, besides those with which we are actually acquainted! Who that had never seen a fish, would easily conceive that living creatures could exist and breathe immersed in water? Who that had never seen a bird or a winged insect, could readily conceive how creatures might be formed capable of passing through the thin air without touching the ground? And when we trace the infinite diversities of living creatures that inhabit this globe, endlessly varying with climate and locality, but everywhere adapted to the position assigned them in the great Economy of Nature, the profoundest as well as the most religious reflection that suggests itself surely is this,—that the Creator has forms of life suitable to every imaginable difference of

condition. Our Earth itself not only exhibits such varieties through land and sea and air, from the Torrid zone to the Frozen poles; but also, in the fossil remains of extinct species, preserves the types of creatures suitable to an earlier period of our own planet, before it became fit for human occupation. And if the scientific naturalist admiringly traces all these endless varieties of creatures to a few archetypal forms, evincing the severe simplicity of Nature's plan, he should beware of so unscientific an assumption as that of believing that there can be no other types of life in other worlds, besides those which he sees in this. Rather should these seen varieties suggest to him the largest general faith in Creative skill and goodness, and assist him vaguely to imagine that, however different the physical circumstances of other planetary bodies may be from those which prevail in this globe, there may be other orders of creatures, living and rejoicing, and with intelligent beings at their head, all equally appropriate in their physical structure to the different physical circumstances of the worlds in which they respectively live.

And Man himself, the lord of all below,—how various both in physical and spiritual con-

stitution, circumstances and developement, is he! Not another creature in this world is found existing under such various circumstances of climate and other physical influences, or exhibiting such varieties of bodily and mental character, as Man. If one human race, presiding over this planet, is thus diversified in the external forms of Papuan, Negro, Hottentot, Red Indian, Asiatic and European,—and in its mental developements from the hunter in the wilds to the civilized worker and thinker, from the savage idolater to the philosophical Christian,—need we doubt the possibility of other orders of being, analogous in position, yet for that reason diverse in formation from ourselves (though we know not *how* formed), to whom the supremacy may have been respectively assigned in every other habitable world that God hath made?

Such are among the suggestions of the great argument from Analogy, implying endless diversities of operation on the part of the One God, who is in all and through all and above us all. It shews us, actually existing, so much that is wonderful, majestic and benevolent, as to enable us to believe that whatever else is required

throughout the universe, of wise and wonderful and benevolent, is everywhere done.

There is a most weighty and most interesting topic of religious belief and religious affection, which more particularly connects itself with these speculations on the Plurality of Worlds.

Involuntarily and rightly, the thought of the FUTURE LIFE seeks to find for itself a resting-place among those dimly discovered worlds, as

“ Perhaps our future home, from whence the Soul,
Revolving periods past, may oft look back
With recollected tenderness on all
The various busy scenes she left below,
Its deep-laid projects and its strange events,
As on some fond and doting tale that soothed
Her infant hours.”

Does our Astro-theology point out the probable, or possible, locality of the future life of man? Or (short of this) does it help to support or define, in any way, that natural hope and Christian belief?

The true science of the heavenly bodies has long since dispossessed the popular Heaven and Hell of their prescriptive seats above the blue sky and below the dark earth. Our antipodes

(as everybody knows) dwell, like ourselves, upon the opposite surface of the round earth, where the old Greeks, in ignorance of its globular form, placed their Tartarus and Elysian fields. Within the earth, the Geologist cannot find fit space even for the Roman Catholic Limbo, or Purgatory. And the Heaven of ancient Jewish and Gentile belief above the blue firmament, has dissolved into space occupied, at intervals, by suns and systems of worlds. Has Science, then, while thus disproving these definite false beliefs of former ages, given a definite true one in their place? Has it shewn us *where*, or *how*, or *when* that Future Life is?

It has not. It has not told us definitely, what is or will be. But indefinitely, what *may* be, in hundreds and thousands of ways at the Sovereign Will, it has told us and proved to us. It has disclosed orderly worlds so numerous and so vast, reasonably believed to be inhabited or habitable, as to make it an absurdity for any philosophical believer in human immortality to ask doubtingly, *Where* the future life of man *can be*? Can be? If that is the question,—it can be *here*, if God hath so willed. A spiritual life may be well conceived of as tenanting the

self-same abodes in which it erewhile dwelt in the flesh, now unseen by us who remain, though taking earnest and loving interest in us. And here, in the very scenes of its fleshly dwelling, the spirit may be reaping the blessedness or the woe of its previous actions and character, with sharpened perception of the one unalloyed by earth's trials, and of the other no longer disguised by outward indulgence. *Can be?* It *can be* in any planet in the Solar System, if God hath so willed;—in one of those nearest and most like the earth in their physical circumstances, if it hath pleased God to ordain that, in the life to come, we shall be reinvested with bodily limbs and senses closely resembling our present lot;—or it *can be* in any of those least like our own, if it please God to invest our souls with proportionately different organism (we know not how different, nor what it should be like), adapted to we know not how different physical circumstances! The question of *Can be*, is answered from planet to planet through our system: *Here, here! There, there! if but the Sovereign Will commands.* And then, from star to star along the boundless heavens, if the restless soul would travel farther in search

of its possible future, the vaguer answer is still harmoniously echoed further and further back from boundless space: *Where can it not be? Where can it not, if the Almighty Father give the word?*

But, if the question be, *Where is* the future life of man? or, *Where will* it be? * religious Philosophy is not ashamed to say, I know not, nor need I know, since it is, or it will be where the good God chooseth.

Certain difficulties, supposed to be derived from the New Testament Scriptures (but not, I believe, properly chargeable upon them), are commonly felt, indeed, by religious persons both in conceiving the general doctrine of a Future Life, and in connecting it specifically with these scientific views of the starry worlds.

“The resurrection of the body” is one of the articles of the creed of the Church of England: “I believe in the resurrection of the body and the life everlasting.” Now, to many minds, this

* The question between *is* and *will be*, that is between immediate and deferred restoration to life, is a question of consciousness and mental philosophy, rather than of Scripture or Astronomy. The latter can only repeat, that unnumbered worlds exist.

juxtaposition of terms seems little better than a direct contradiction. The bodily life which we now live is, through the divinely-appointed laws of its natural constitution, temporary only ; and a life everlasting seems necessarily to imply a very different state from this bodily one. And how, again, can the astronomer imagine bodily transference from this earth to another planet or another system ?

If we ask those who recite this creed, what they understand by believing in the resurrection of the body, they will generally declare that they believe the identical body which has died will be raised again by the power of God and made immortal, like Christ's glorified body in which he rose from the dead. They think this is the doctrine of Scripture ; and they try to believe it, without asking whether it is credible or not. But Philosophy puts in a serious doubt, and cautions us not too rashly to ascribe to Christianity a doctrine which may prove to be not true. It asks us how it is possible that the same mortal body which has died and been decomposed and scattered, it may be, to the winds, or which (even in the most common case, of Christian burial) has entered into new material

combinations, forming in part the substance of plants and then of animals, and thus partly entering, no doubt, into other human bodies, can be reconstructed of the very same particles which belonged to it before death. Reverently we feel, that Deity itself cannot do inconsistencies. Devoutly we believe, that the Author of the Laws of Nature respects His own enactments. Chemistry declares, in the name of those Divine Laws, that the thing under consideration is impossible. Chemistry tells us, that even during the course of a few years of life, every particle that forms our body is changed and replaced by others. How needless, then, to assert a *bodily* identity after death, which is lost even during life! Not Divine power can be believed to effect things divinely constituted inconsistent. The particles which have belonged to a certain human body at death, and which have since gone into the composition of various plants, animals and other human bodies, cannot be collected together, identically the same particles in each instance, to form the substance of two or three different bodies in the resurrection. Seriously to maintain such a doctrine is only to bring religion into contempt. No philosophical

mind can believe in the re-union of identically the same bodily particles which form the body before death, at a future resurrection of that body to eternal life. And in the name of Philosophy we must hope that Revealed Religion is not responsible for any such doctrine.

Why, indeed, we may well ask, should the Church make it an article of faith? It is nowhere so declared in Scripture. I say, distinctly and very deliberately, I do not find this doctrine of the Resurrection of the Body to be a scriptural doctrine at all.

It is indeed a scriptural fact, quite beyond all doubt, that *Jesus Christ*, having died, rose again, *without having seen corruption*, the same bodily man that he died. But that the human body of Christ lives eternally in a heavenly state may well be doubted; and (which is the real point to be noticed) the case of his resurrection from the dead is miraculous and exceptional, and bears no analogy of manner or form to ours. He "saw not corruption;"—we do. His mortal body rose to human life again the third day;—ours do not. Therefore, the fact of Christ's special resurrection from the dead in the same body in which he died, is far indeed from bear-

ing out the inference that we too shall rise from the dead in the identical bodies in which we die. The comparison does not hold good in any essential point. The one case is no true precedent for the other. Nor is any such overstrained analogy necessary for the Christian faith in Immortality. *Identity of soul* is all that the doctrine of the future life requires; and the soul sees no corruption in the body's mortality.

St. Paul is indeed thought to favour this doctrine when, in that well-known chapter of his first Epistle to the Corinthians which forms part of the Burial Service, he deals with the objections of those who, doubting or denying a future life, asked tauntingly, "*How* are the dead raised up, and with *what body* do they come?" Now a careful reader of that chapter will, I think, soon perceive that Paul does not attempt to give a categorical and dogmatic answer to the question, With what body do they come? He only says in effect: God will give a body as He pleaseth; and man may be satisfied to rely upon the power of Him who has promised that the dead shall live.

In illustration of the reasonableness of this trust, he refers the doubter to one of the com-

monest phenomena of nature,—the growth of the corn which he sows in his field,—to shew him the absurdity of his sceptical *how*. He cannot tell how that corn grows; yet he believes it does, for he sees it. If he saw the “bare grain” for the first time, without ever having seen the plant, he could not possibly tell with what body it would come up. He could not possibly anticipate “first the blade, then the stalk, then the ear, and then the full corn in the ear.” But *God giveth it a body, as it hath pleased Him*. Here is a genuine and deep mystery in one of the commonest occurrences of nature. Then, again, every seed has its own body. Each different kind produces a different kind of plant. Who could anticipate, from looking at the different seeds, the different plants that will grow from them? From strange seeds imported from a distant country, who can conjecture the new varieties of stem and leaf and flower? Or what can all our Physiology and Chemistry even yet say about the processes of vegetable life and developement? Absolutely nothing, as to *how* that body is given to the plant in which it rises to light and beauty before God and man. “So,” says Paul, “is also the

resurrection of the dead,"—equally inexplicable, but equally certain. *God will give a body* there. The seed of mortality will become an immortal growth. We know not how, but we know that God hath boundless power and endless diversities of operation.

Guided by his rich imagination and fervid feeling, the apostle finds further illustrations, popular rather than scientific in form, and yet in their spirit perfectly scientific and profoundly philosophical, when he turns his glance to the heavenly bodies. To him those bright orbs shone with the poetry of true devotion. "There are bodies celestial," he says, "and bodies terrestrial; but the glory of the celestial is one, and the glory of the terrestrial is another. There is one glory of the sun, and another glory of the moon, and another glory of the stars; even one star differeth from another star in glory. *So also* is the resurrection of the dead,"—the difference as striking, and equally appropriate the change,—“from corruption to incorruption, from dishonour to glory, from weakness to power, from an animal body to a spiritual body.” And with this most expressive figure, amounting to a verbal contradiction deliberately and purposely

committed,—the “spiritual body,”—he completes the climax of his thought and feeling, at once rebuking the poor materialistic doubt and instilling a spiritual faith.

Do we not feel, in our own consciousness, that the future life to which it is at once the deepest necessity and the proudest privilege of our nature to cling, is the life of the *Soul*? It is not for our fleshly limbs and senses that we crave immortality; but for our powers of thought and affection, with whatever body they may be endowed, or whether with a body (properly speaking) or not. Even in this life it is often proved to us, by experiences at once sad and holy, that the bodily limbs or organs, with their specific infirmities or defects, are not the conscious Man himself; for in the sad loss of one or more, not affecting the vital functions, his conscious self remains. Even in this life it is often proved that the bodily senses which we possess are not, in their precise number,—no more, no fewer,—required in order to constitute a human being with spiritual faculties ready for developement; when in the deprivation of one or other of these precious inlets of knowledge and impression, the thinking and feeling soul

may still be developed, though with more difficulty to the sufferer, pleading for most special care and help on the part of others. Thus its present being is not absolutely dependent upon each and all the usual limbs, organs and senses of the human frame. Who then shall tell us what different, what more numerous, what more perfect inlets to knowledge and goodness may be given to man when made immortal, or which of his earlier implements of knowledge and action may be superseded?

These things it is not given to us either to know or to conceive in actual detail, while in our present state. A child cannot imagine the faculties, wants, feelings, passions, aspirations of manhood; nor may the mortal imagine those of his immortal state. We can only gain that large faith in the infinite resources of Divine power, wisdom and love, which makes the more minute answer quite unnecessary for our peaceful and sublime trust.

This faith, then, we cultivate and sustain, when in the spirit of Christianity we study the exalted science of the star-lit heavens. In this way only, and only to this extent,—but assuredly to this important extent and in this most

effectual manner,—does the scientific idea of other Worlds sustain and inspire with philosophic argument the Christian promise of a Life to come. And the philosophical thought, like the Christian promise, lights us back wiser and happier to the home scenes of present duty, trial and love, to leave upon them the inspiration of great thoughts and immortal affections.

“For soon the soul, unused to stretch her powers
In flight so daring, drops her weary wing,
And seeks again the known accustomed spot,
Drest up with sun and shade, and lawns and streams,
A mansion fair and spacious for its guest,
And full replete with wonders. Let us here,
Content and grateful, wait the appointed time
And ripen for the skies. The hour will come
When all these splendours bursting on our sight
Shall stand unveiled, and to our ravished sense
Unlock the glories of the world unknown.”

BARBAULD.

SECOND AND CONCLUDING VOLUME.

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"THE LETTER KILLETH; THE SPIRIT MAKETH ALIVE."

VOL. II.,

CONTAINING THE APOCRYPHA AND THE NEW TESTAMENT.

THE reception of the First Volume (on the Old Testament), which was published at the end of 1853, has been highly gratifying to the Author; who, in now announcing his Second Volume as nearly ready for issue, has the pleasure of citing the following testimonies in favour of his First,—some of which are as generous in their approval of his aim and spirit while greatly differing from the critical results brought out in its execution, as others are cordial in their sympathy with both the design and its fulfilment. It will be seen that they proceed from the literary and theological organs of the most opposite parties.

LITERARY GAZETTE, Dec. 24, 1853.

"Although there are various points in this volume from which we withhold our assent, we commend it to the perusal of thoughtful and inquiring minds. The design of the author is to shew the spirit in which the sacred Scriptures ought to be read and interpreted, received and defended. He seeks to promote an intelligent and free-minded, instead of a blind and traditional, belief in the records of Divine Revelation. Between the letter-worship of too many 'bibliolaters' and extreme rationalism, he attempts to indicate 'a middle ground, on which rational Christianity may take its stand, implying the divine origin of Judaism.' Of the tenets and statements of recent critics and objectors, and of the defences and apologies of believers in inspiration, he gives a fair and candid representation. There is no doubt that many theological writers have, by their hostility to natural science, and by their disregard of the principles of natural reason and conscience, given room for attacks on all supernatural revelation. In the acknowledgment and statement of these errors, good service is done to the cause of true philosophy and religion. . . . The analysis of the several books of the Old Testament is ably and eloquently written. A second volume will treat of the Apocrypha and the books of the New Testament."

WESTMINSTER REVIEW, Jan. 1854.

"Mr. Higginson's 'Spirit of the Bible' is an attempt to shape the scientific 'Introduction to the Old Testament' into a form suitable for training, especially in the young, the devout sentiments and convictions. Notwithstanding a modest disclaimer of all learned pretension, a great deal of useful information, critical and historical, is given. In fact, the 'letter' of the Bible is more fully, as well as more successfully, treated than the 'spirit;' and the reader's debt to the volume will be greater on the score of knowledge than of religious impression. The author's theological tendency is rationalistic, without however relinquishing the supernatural doctrine of the Hebrew dispensation. Freely surrendering whatever is repugnant to science or to the moral sense, he holds to the residue as of divine authority, and presumes the truth of the miraculous records till some falsehood can be established against them."

CHRISTIAN REFORMER, Feb. 1854.

"No thinking person can read the Scriptures without remarking that, notwithstanding the commentaries with which

they have been encumbered, they have not received from the learned the critical explanation which is so useful in the case of other ancient authors, and he naturally suspects that much knowledge respecting the books of the Bible has been wilfully kept back. Some of this information Mr. Higginson here puts before us; and he adds the weight of his character as a Christian minister at the head of a highly respectable congregation, to prove his belief that such knowledge, instead of helping scoffers and enemies, will serve the best interests of religion. It is for this frankness and boldness that we feel particularly grateful. In his first chapter, he sets in distinct opposition to the prevalent bibliolatry the rational and enlightened respect which he desires to secure for the Bible.

"Mr. Higginson does not shrink from discussing the history of Abraham's readiness to sacrifice his son, which is certainly one of the chief difficulties with thoughtful believers in the Bible, who refuse to make any allowance for the ignorance of an early age or for Jewish prejudices. Abraham's conduct has been praised in all ages, by Jewish historians, by the apostles Paul and James, and is still praised by Christians, though certainly not without many misgivings. The difficulty is not lessened by supposing that there may be errors in so old a narrative. Even if we thought that it was altogether a feigned story, the praise which Abraham has received for being willing to put his son to death is certainly real. He believed that he had a command from heaven. Mr. Higginson meets the difficulties of the case with a frankness which does him honour.

"On the prophetic office, and on the schools of the prophets, our author writes with equal freedom and acuteness."

INQUIRER, Feb. 25, 1854.

"We hope that this book may be widely read. It contains a great deal of critical information on the Old Testament in a popular form; and we venture to say, that no authors who are so much read are so little understood as the Hebrew prophets."

CHRISTIAN SPECTATOR, May, 1854.

"The object of this work is to catch up and exhibit the scope and religious bearing of the books of the Old Testament. Though written in a popular style, it contains the result of copious and varied reading and careful thought. Mr. Higginson believes the books of the Bible to be simply and only the records of a Divine revelation. As such he treats them throughout this

work....The results are certainly not in accordance with our own views.....Notwithstanding this, Mr. Higginson's work is of value, and much may be learnt from it by most readers. It is written in a remarkably clear, chaste and forcible style, and contains many passages of unusual eloquence and power. As a partially polemical work, its spirit is thoroughly candid and courteous."

PROSPECTIVE REVIEW, May, 1854.

"The volume before us is no unfavourable example of what this abbreviating spirit can effect; for it is, in fact, a very well-filled and well-written compendium of information on that great subject—the Bible—to which it relates. The author's leading design clearly forbade the attempt to indulge at length in the statement or discussion of the minute details of controversy which so plentifully present themselves to the critical student of the Old Testament. The work is essentially popular in its aim, as the title and the declaration of the preface inform us; and we certainly think that, within the moderate compass of a single volume, it presents us with a valuable epitome, which may be read with interest and profit by any intelligent person.

"The want of such a book as this, spoken of by Mr. H. (p. 3), is one which we know has been experienced. For a large and important class of readers, it will be very satisfactorily supplied by the present volume.

"With a free use of intelligent and rational, not to say rationalistic, criticism, he is yet essentially conservative, and we need hardly add reverential, in his discussion of the different points that come before him. The work endeavours to unite a spirit of bold and candid inquiry with a decided adherence to the supernatural explanation of the origin and history of the Hebrew monotheism.

"He has imparted a freshness and an interest to some old subjects, which are often wanting in works of this kind."

(AMERICAN) CHRISTIAN EXAMINER, May, 1854.

"Had this excellent book come to our hands before we had written and printed the article on the Popular Use of the Bible which opens this number of our journal, we should certainly have availed ourselves of its help in the expression of some of the views there set forth. Mr. Higginson's work bears the appropriate motto, 'The Letter killeth, the Spirit maketh alive.' As this volume is exclusively concerned with the Old Testa-

ment, we suppose the author intends to follow it with another devoted to the New Testament. He has undertaken a most serious and exacting task, in which any measure of success is deserving of respectful and grateful commendation. There are two very distinct standards by which even an accomplished biblical scholar may put the contents of the Bible to the test of criticism: first, the standard supplied by his own intellectual and spiritual judgment, his taste, discernment and philosophical theories, his sense of the probabilities and fitnesses of things, and his appreciation of one or another sort of evidence; second, the standard which accepts certain external, historical, traditional arguments as to some extent substitutes for personal investigation, and as having assured to themselves by the allowance of others, an authority which careful inquiry at this late day, and under many disadvantages, cannot fully authenticate. The rule of wisdom doubtless is to adopt both standards, or to interchange their application according as we are dealing with distinct issues in the which one or the other of them is a more appropriate test. But both of these standards are felt by us all to require great caution in their application, nor in fact can they always be distinguished; for intelligence and culture, according to the degree in which they are possessed, will make the subjective standard more or less objective, and the objective standard more or less subjective, to different persons. We think that Mr. Higginson has fairly appreciated and has skilfully availed himself of both these standards of criticism in the book before us. In some very valuable preliminary pages, he presents, in a form suited to persons of average intelligence, such suggestions as are most worthy of being heeded by one who seeks to discern the spirit of the Bible. Without a cumbersome array of learning, he states the essential conditions which require and enable us to discern between the form and incidental accompaniments through which the records of revelation have come to us, and the substantial facts of that revelation. While we might incline to differ with Mr. Higginson as to the soundness of some two or three of his leading principles, and should certainly dissent from him widely in the application which he makes of them in some particular cases, we cannot withhold the expression of very high praise to him for a work that we believe would relieve and instruct the minds of vast numbers who read the Bible under a painful sense of its perplexities.

“ He has brought together much valuable information relating to the constituent portions of the Old Testament; he writes in a cautious and most reverential spirit; he advances a positive

belief in the inspiration of Moses, and in the reality of a revelation made by God through him ; and his aim throughout is not to undermine or discredit, but to assure, to build up and reinvigorate the faith of those to whom the Bible is the most precious of all books. When we consider how easy it is to fail wholly in the carrying out of such a design as Mr. Higginson proposed to himself,—but one element in which was to discriminate between the divine and the human in the contents of one and the same volume,—we are impressed with a high sense of the value of his labours. He has shewn great good judgment in not opening some questions which, though they most importunately invite debate, would have required his whole volume for their discussion. His remarks upon the substantially Mosaic origin of the Pentateuch, upon the spirit of Judaism, upon the poetry of the nation, and upon the moral of Jewish history, shew the action of a sound mind and of a clear discernment."

THE CLERICAL JOURNAL, AND CHURCH AND UNIVERSITY
CHRONICLE, May 8, 1854.

"He writes in a religious and earnest tone ; and although his views differ as widely as possible from those of the Church of England, he is seldom irreverent in his manner of advancing them ; nor is he captious or uncharitable towards any class of believers.

"We shall gain (from this book) a glimpse of a school of religious thought and opinion of which, though important and influential, we in general possess but little knowledge.

"His tone and feeling are 'defensive ; and the eye of his polemic seems not to be directed towards our Church, or towards any body that holds high views of the inspiration of Scripture, but towards those who reject it intirely."

NONCONFORMIST, June 21, 1854.

"A very capital idea is expressed in the purpose and plan of this work, and great ability and considerable learning are displayed in its execution. A similar book, founded on as thorough study of the Bible as this, and written as forcibly and agreeably, but directed by sounder principles of criticism and interpretation, would be a welcome publication to the class of readers described by the author as 'thoughtful and intelligent, but not learned.' But this book is written from a standpoint we believe to be untenable, and in a spirit which would justify us in describing it as a piece of 'sweeping rationalism,' in *our*

sense of the words,—although the author seems to apply such words only to those who ‘presume to deny the *possibility* of a *supernatural* revelation.’

“The aim of the work is ‘to shew the spirit in which the Scriptures require to be read and interpreted, received and defended;’ and ‘to indicate the ground on which rational Christianity may firmly take its stand, implying the Divine origin of Judaism.’ The author thinks there is less novelty in his *ideas* than in their *publication*; he calls them ‘parts of the unwritten faith of common sense.’ Sincerity, maturity, earnestness, we will not deny him, in their promulgation.

“The literary and moral beauty, the social and religious truth of the Old Testament as a whole, receive ample justice in the analysis of the several books. These analyses are admirably clear, full, intelligent and suggestive, if we only accept the author’s standpoint. Though we could not offer this book to any one ignorant of the scholarship of the subjects it embraces, yet thoughtful, well-informed persons, though differing wholly from the writer’s characteristic views, might find valuable helps in it to the comprehension of particular books, to the interpretation of some difficult and obscure passages, and to a moral use of the ancient Scriptures generally.”

THE TEACHERS’ JOURNAL OF SUNDAY-SCHOOL EDUCATION,
August, 1854.

“The only pity is when, from preconceived notions about the sacred nature of any person or any writing, we are inclined to torture language, in order to bring out of it what was not first expressed by it, or what is still worse, to look with complacency upon deeds and words, because they are found in so-called sacred authors, which we should condemn anywhere else. From such an error, so common and detrimental among Protestants who regard all the writings of the Jews to be equally inspired, we know no book so well calculated as the one before us to free the mind, and at the same time to leave on it a justly favourable impression respecting the value even of their least inspiring passages. We could only have wished that the work had been long ago not only written, but placed in the hands of all our intelligent artisans, before their minds had been poisoned by works which have exposed too clearly, but in a one-sided spirit, the monstrous notion that every part of the Bible expressed equally to us the truth, the whole truth, and nothing but the truth. Men have had thus to *unlearn* what as children they took upon trust, and from finding the Bible to contain much

that was revolting to morality and piety, they have, agreeably to the oft-repeated delusion, 'You must take all or none,' thrown aside the volume with a natural aversion.

"This work has long been wanted. We have hitherto been obliged to resort to the Germans for anything at all satisfactory regarding the Jewish literature. Herder has been a favourite. His work on Hebrew poetry has been well translated. His view of the creation is most poetical. . . . But this, though beautiful in itself, and probably a source of experience whence the writer drew his picture of creation, is satisfactory to no critic as a version of Genesis. The point of view taken by Mr. Higginson, in this case as in most others, we prefer. . . .

"It is from the fearless candour of Mr. Higginson, and his full appreciation of all the beauties of Scripture, that we chiefly prize his work. It is all the more valuable on account of the important quotations most suitably given from writers unfortunately not so acceptable [accessible?] as this; Mr. Wellbeloved, Kenrick, Norton and Geddes. We do not know a greater service that can be rendered to the rising generation, than the presentation of the Jewish writings in their purely historical character, as illustrating the gradual progress of humanity in moral and religious views, no less than in scientific knowledge. All the researches of the learned, amidst all their differences, tend to confirm this important fact. It is only in this view that the miscellaneous study of the Jewish writings can benefit us. As a work to edify, we require only 'the beauties of their literature.' But in order to see how God's providence has gradually trained the human race to know Him in the character in which Christ represented Him to us, not a line of the Old Testament is valueless."

JOURNAL OF SACRED LITERATURE, October, 1854.

"Mr. Higginson has produced a very thoughtful book, which cannot be read without profit. We are sorry we cannot see his opinions, expressed above, combined with what we conceive to be true in relation to inspiration. But, as a member of the Unitarian body, we cannot but rejoice to find the writer much in advance of his school. We would recommend his volume as containing a vast amount of correct reasoning, and still more of the expression of pious feeling. The Scriptures are treated with a reverence which can scarcely be exceeded, and we only regret that in certain articles of his creed we cannot sympathize with the learned writer. Only half the design is accomplished in this volume, which is to be followed by another."

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