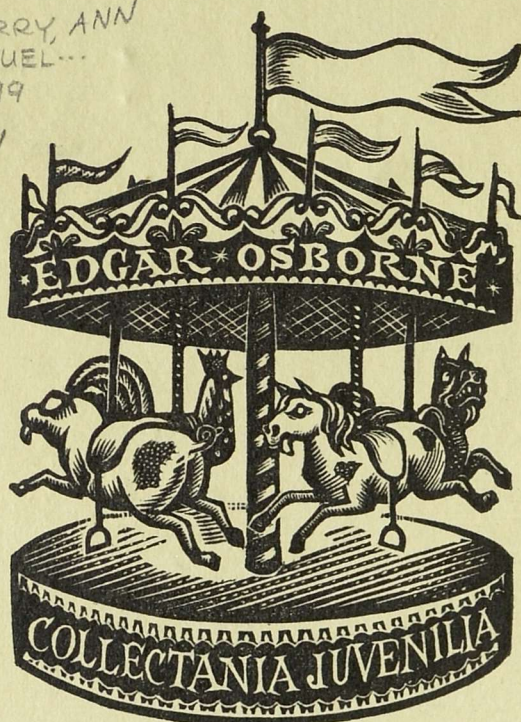


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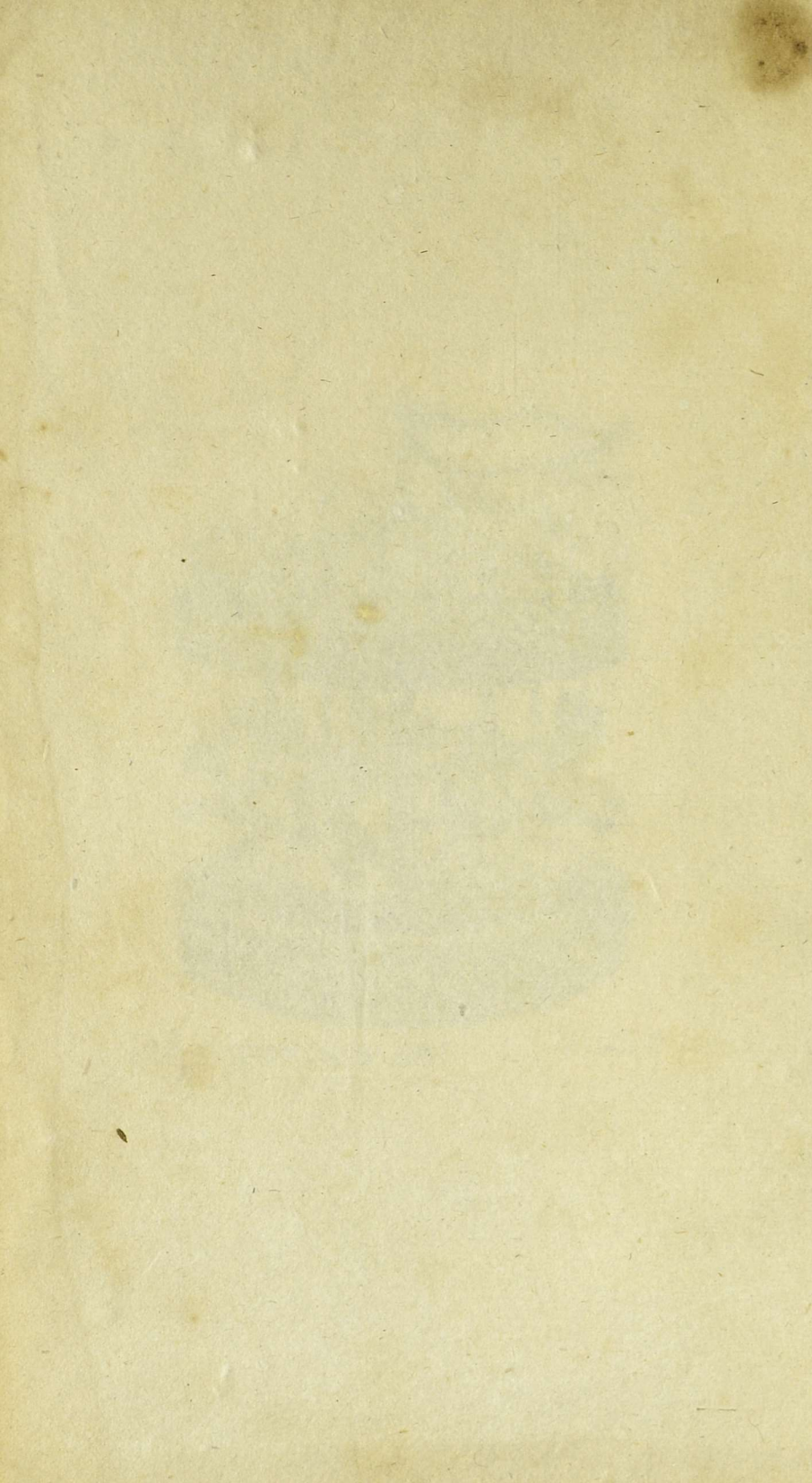


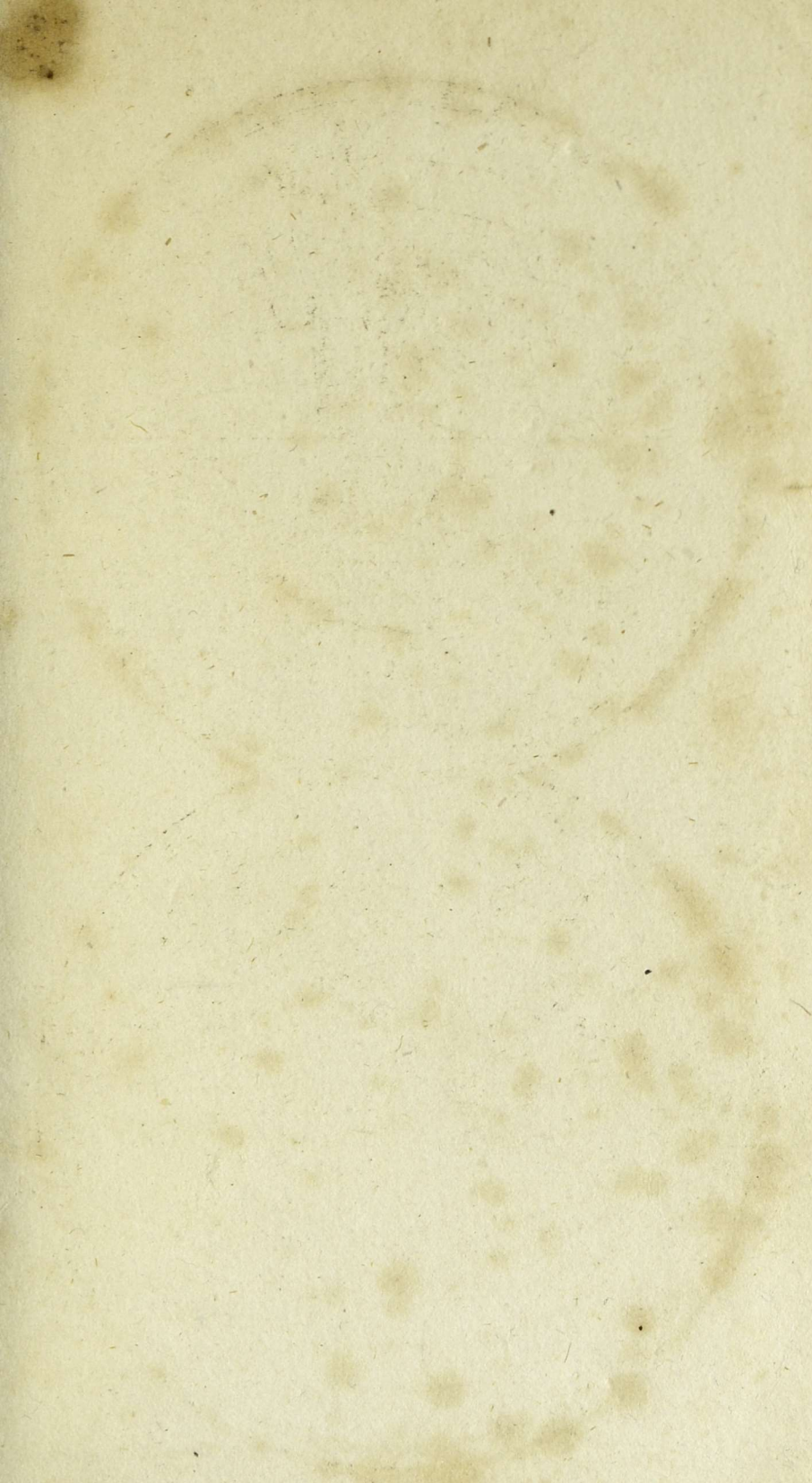
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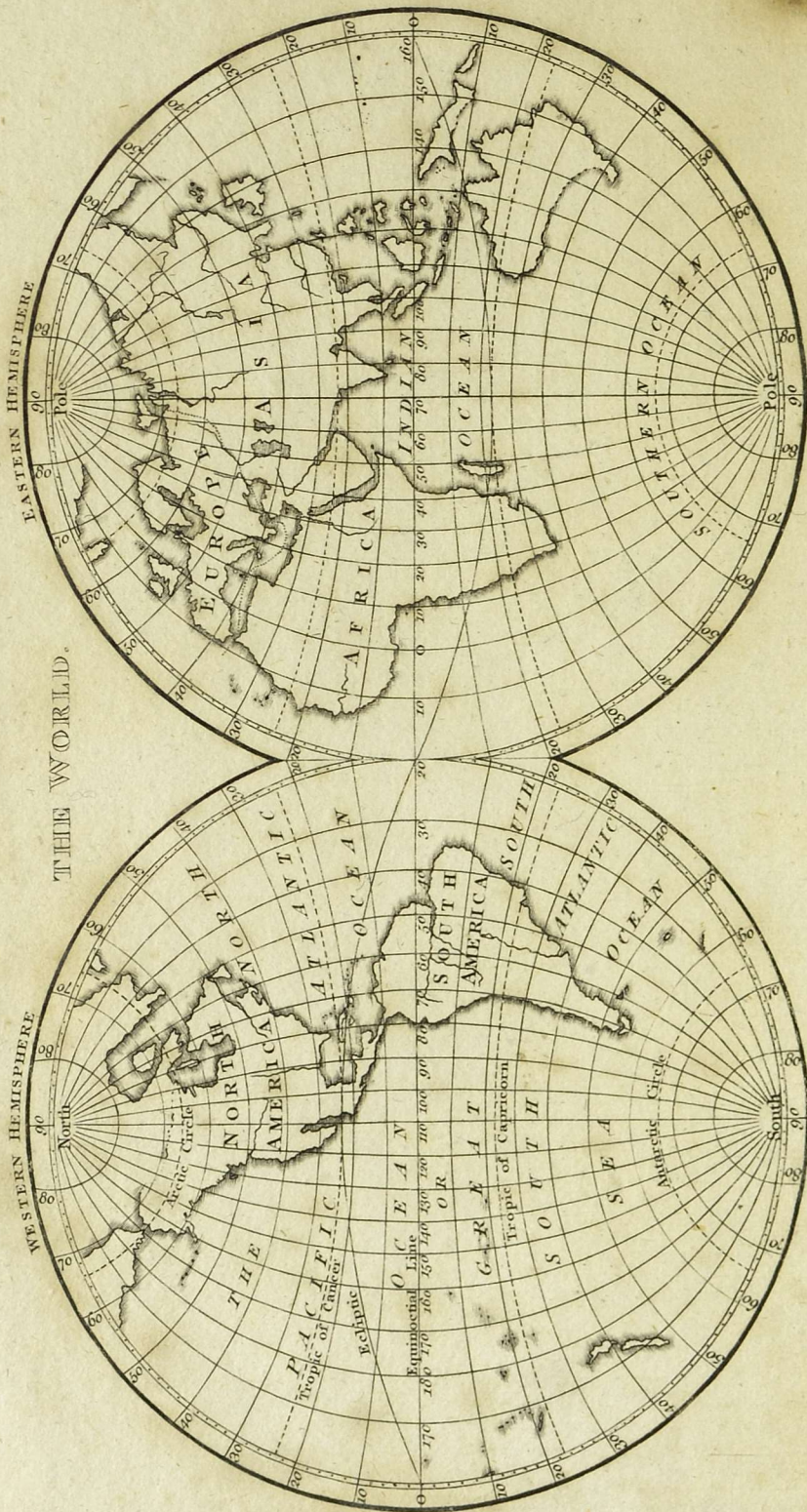
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P R I N T E D F O R C . D I L L Y , I N T H E P O U L T R Y .

1799.

[*Price Four Shillings bound*]

TO HER ROYAL HIGHNESS
THE PRINCESS AMELIA.

WITH the greatest Deference and Respect, I have the honour to present the Sequel to *Mentoria* to your Royal Highness's consideration; if my performance should obtain your approbation, and in any degree prove conducive to your instruction or amusement, my ambition will be amply gratified.

I am perfectly convinced your acquired accomplishments and innate amiable qualities, may justly claim the tribute of Applause; but as Praise is too apt to degenerate into Adulation, I shall pursue the unerring dictates of Simplicity and Truth, and with the most ardent zeal exhort you to persevere in the attainment of Knowledge, in every department of mental cultivation.

Elevated Rank bears no specific weight in the Scale of Merit, unless it is counterpoised by Moral Excellence and Intellectual Treasures; let this considera-

tion excite in your Royal Highness an invariable emulation to Dignify your Illustrious Birth, by the Brilliancy of your intrinsic Virtues.

Accept, Most Gracious Princess, my sincere wishes that you may attain pre-eminence in every ennobling property that can inform the Understanding, or refine the Heart; as the means of effecting this important purpose, diligently explore the wonders of Nature, which will inspire you with implicit reverence for their Primary Source.

These sublime impressions cannot fail to produce in your Royal Highness, that dignity of character and consistency of conduct, which will insure Present Happiness, and entitle you to Future Reward: in the earnest hope that you may enjoy these Blessings to the fullest extent, I remain with the most profound Respect, and perfect Submission,

Your Royal Highness's

Most Devoted and Obedient Servant,

Islington,
25th March, 1759.

Ann Murry.

P R E F A C E.

THE Author presents the following Dialogues on Astronomy and Natural Philosophy to the Public, as the Sequel to *Mentoria*; and flatters herself that they will prove useful to those who favour them with their attention. The subjects she has chosen are of such a sublime nature, and their scientific properties so diffusive and profound, it may be needful to observe, that she has endeavoured to select only those branches that tended to promote the general design of her performance, which was principally to inspire young minds with due reve-

rence for the universal operations of Divine Wisdom, manifest in the various parts of the Creation. In a work of this kind, it is impossible to offer any thing new, or that has not been more ably discussed by persons of superior abilities and refined classical learning; yet it may be productive of great benefit to the rising generation to place these axioms or self-evident truths in such a point of view, as to impress the Juvenile Reader with a just conception of the regular order of the Universe, and the collateral dependence of every atom of which it is composed. The prevalent relaxation in the system of moral rectitude, claims the most energetic exertions to counteract its pernicious consequences; and no remedies can be so efficacious as those that, by early permanent impressions, invigorate the principles on the immutable basis of holy confidence, derived from the emanations of the Supreme Being, which Philosophy unfolds, and renders conformable

formable to our finite powers. It may perhaps be deemed presumptuous in the Author, to attempt a work replete with such abstruse and varied subjects for investigation; she therefore as the means of extenuation, begs leave to plead, that she hopes and trusts her zeal will be accepted, as a substitute for the defects which she is conscious the most candid Critic may discover in the execution of her plan. Astronomy and Natural Philosophy should be considered the native spring of dignified human science, as being the source from which the most sublime and general instructions are obtained, it consequently cannot fail to be essentially beneficial, to convey those fertilizing streams of information into a variety of different channels, and to trace their causes and effects in every object our ideas can compass, from the span-gled Etherial Firmament to the opaque regions of the Earth, and the profound abyss of the Ocean. These researches
unavoid-

unavoidably produce conviction of the Divine Efficient Power and Omnipresence, which in youthful minds, unwarped by prejudice, and unfulled by immorality, infallibly operates as an antidote against the inroads of Vice, and in every age, state, and condition, proves a perpetual incitement to Virtue.

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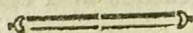
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DIALOGUE

DIALOGUE I.

MONDAY.

On Astronomy, and the Sun, and
Planets.

Mentoria.

I have no doubt, my dear Lady Mary, you recollect that in our conversation on the Sciences, I engaged on some future occasion to expatiate more fully on the subject of Astronomy, on which I wish to fix your attention, and will use my best endeavours to explain the Elements of that sublime study.

Lady Mary. I am rejoiced, Mentoria, you have so speedily fulfilled your kind intention,

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and I shall hope to derive much entertainment, as well as improvement, from your instructions, on a branch of education, of which I have so slight a knowledge.

Ment. You have an idea (though perhaps an imperfect one) of what are usually called the Heavenly Bodies, or luminaries, which appear in the Celestial Hemispheres; I shall therefore proceed briefly to describe the Solar System, which comprehends the Sun, all the Planets, their Satellites, and also the Comets. The Sun, which is the center of this system, continues stationary, that is, always in the same place; but revolves upon his own Axis, in the space of about twenty-five days and an half. The Planets, which are seven in number, constantly move round him in their respective spheres. The names of these Planets, which are ranked according to their several distances from the Sun, are, Mercury, Venus, the Earth, Mars, Jupiter, Saturn, and the Georgium Sidus. Mercury, and Venus, are called Inferior Planets, in consequence of their moving within the Earth's orbit, by which is to be understood, the being nearer to the Sun. Mars, Jupiter, and the Georgium Sidus, are styled superior Planets, because their orbits or
paths

paths are without that of the Earth, which consequently removes them further from the Sun. The term Planet is derived from the Latin word *Planeta*, roving, or wandering, which denotes their quality.

Lady Louisa. I wait with eager expectation to hear your description of the Sun.

Ment. The Sun, which is the source of light and heat, has been ever imagined to be a Globe or spherical body of fire.—Doctor Herschel, in some late observations, appears to be of a different opinion, and asserts, that the Sun is an opaque body, and has hills, and vallies; but as this is a new theory, it may be best to regard it only as such, till the point is proved beyond the possibility of a doubt. The diameter of the Sun is computed to be 893,522 English miles, his distance from the Earth, 95 millions of miles, and his proportion of magnitude compared with the Planet we inhabit, more than a million times as large.

Lady M. I am astonished at your account of the Sun's dimensions: it does not appear of so great a size as you describe.

Ment. Which is to be ascribed to the immense distance the Sun is from the Earth: it is from this cause, that the Moon does not appear small proportioned to her real size,

when compared with the Sun, as she is so much nearer to us, every distant object seeming as a natural consequence less, the farther it is removed from our view.

Lady L. How wonderful it is, that these bodies should appear so bright and perform their courses with such regularity.

Ment. You will cease to be surpris'd at these effects when you consider, that they are under the guidance of Supreme Power and Wisdom; and the further you proceed in your researches, the more you will be convinced, with the Royal Psalmist, that "The Heavens declare the glory of God, and the Firmament sheweth his handy-work."

Lady L. I can clearly discern the brilliancy of the Planets; but have no idea of their form, or substance.

Ment Their figure is that of a sphere, or globe, and their motion consists of revolving, or turning round upon their own Axis, from West to East; they also pursue a regular progressive motion from West to East, through their orbits, and thereby complete their revolving course round the Sun, which is invariably stationed in the center of their system. Their brilliancy they derive from the Sun, as they are

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in themselves dark, or opaque bodies, and by reflection transmit to us the light of that glorious luminary. Dr. Herschel is of opinion, they may be possessed of some inherent light; but this is conjectural, therefore not to be relied on.

Lady M. I cannot comprehend what Orbits mean; pray Mentoria be kind enough to explain their signification.

Ment. Every substance that is round, or spherical, may be termed an Orb, and the space in which that body is destined to move or act, is in effect the Orbit. Thus to render the application familiar to your perception, your eye from its round form, may be considered as an Orb, and the socket which contains it, consequently its Orbit; but in a more enlarged sense, it implies the path or course in which any globular body moves, which often figuratively is termed the sphere of action.

Lady L. I now clearly understand the term Orbit, and beg I may not protract your entertaining instructions respecting the Planets; but hope that you will favor us with some further particulars respecting the Sun; as that is a subject that interests me, in more than a common degree.

Ment. I have already mentioned that the Sun revolves on its own Axis in about twenty-five days, it may be proper to observe, that the Sun has also another motion, which is periodical, and is an elliptical, or nearly circular direction round the common center of all the planetary revolutions; and as this center nearly approaches to the Sun, he may with propriety be regarded as the center of the planetary system.

Lady L. How can it be possibly known, that the Sun revolves on its own Axis?

Ment. By observations respecting the Maculæ or spots, which evidently appear upon his surface.

Lady M. I remember your mentioning the spots on the Sun in some of your former instructions: I wonder who first discovered them.

Ment. Galileo the famous Italian Astronomer, who perceived them about the year 1610. Various opinions have been formed respecting their cause, and quality; the most probable conjecture is, that they are occasioned by an eruption of smoke, or other matter, of an opaque nature from the Sun's surface, whilst many suppose they are volcanoes in the Sun; but these are subjects too occult and profound for human investigation. In contemplating
the

the splendor, beauty, and universal influence of this glorious luminary, as connected with the solar system, we may with Thomson declare, He is the “best Image here below of his Creator.” His beams produce Light, Heat, and every other enlivening property to cheer, invigorate, and perfect the general purposes of existence, in the animal and vegetable world: and to him apparently, we are indebted, (as the instrument of his Divine Creator’s power) for every terrestrial blessing that we enjoy: therefore he is not only an object transcendently entitled to admiration, but also a subject worthy of serious attention; as in the sublime language of Milton, we may also observe, that he is “of this great World, both Eye, and Soul;” “yet must acknowledge God, his greater.”

Lady L. I feel very forcibly the just observations you have made on the Sun; and hope that you will now give me a description of the Planets.

Ment. Mercury, which is nearer to the Sun than any other of the Planets, completes his course round him in the space of about 88 days, or nearly three months, which constitutes his year.

Lady M. Excuse my interrupting you, my
B 4 dear

dear Mentoria; but how is it possible that three months should be a year?

Ment. The word year may be regarded as an indefinite term, as the space of time each Planet takes to complete its course round the Sun, is considered its complete year. The proximity of Mercury to the Sun renders his heat intense, the degrees of which have been computed to be seven times greater than what is experienced in the Torrid Zone, therefore there is every reason to conclude, that the temperature of this Planet, must differ very essentially from that of the Earth, or it could not in the natural course of things long remain in that state, as it has been computed, that the degree of heat Mercury derives from the Sun is 7 times what the Earth receives, which is reckoned sufficient to make water boil. Mercury is but rarely perceived, as he is usually hid in the splendor of the Sun's rays, which prevents the period of his rotation on his own Axis being known. This Planet changes his Phases, by which is to be understood, appearances and positions, in nearly the same manner as the Moon, according to his situation with respect to the Earth and Sun. He never appears quite full, which is occasioned by his

his bright side being only turned directly toward us, when he is so nearly approached to the Sun, as to be obscured by his beams. By these different Phases it is evident he is not endued with native light, which if he possessed would cause him always to preserve a circular or round appearance.

Lady M. How large is Mercury?

Ment. His diameter is 3261 English Miles, and his mean distance from the Sun 36 Millions of Miles; his motion is so rapid in his revolution round the Sun, it is computed at the rate of 95000 Miles in an hour.

Lady L. In these wonderful instances of Divine perfection, it is not possible to express the astonishment they produce.

Ment. Mercury, which is the smallest of the inferior Planets, as I have before mentioned, can be but rarely seen, as the resplendency of the Sun's beams generally renders him invisible; when he is perceptible he has a bright appearance, blended with a light tincture of blue, as the Orbit of this Planet is between the Earth's Orbit and that of the Sun; if it were in the same plane as the Orbit of the Earth, Mercury would frequently be seen to cross the face, or disk of the Sun; but as the planes of

their Orbits are not perfectly coincident, this but seldom happens; when it occurs, it is called a transit of Mercury over the Sun's disk, the Planet then appearing like a black spot on the face of the Sun: the next that will probably be visible, will be on the 7th of May 1799, an event that you will most likely have the pleasure of viewing if the weather is propitious.

Lady M. I shall have great satisfaction in observing the transit, and we are much obliged to you for affording us this information.

Ment. Venus is the next subject of our attention, and the second Planet from the Sun: her diameter is 7699 English miles. Her revolution round the Sun is performed in 224 days, and her mean distance from the Sun is 68 millions of miles; her diurnal rotation on her own Axis, is nearly 23 hours and a half. This Planet when she appears to the West of the Sun, rises before him in the morning, and is consequently denominated the Morning Star; but when she appears to the East of the Sun, she shines after he sets, and from thence is called the Evening Star; in each of these situations, she remains alternately, for nearly 7 months and a half. There is great reason to suppose this Planet has an atmosphere, as certain dark
moveable

moveable spots have been discovered on her disk, and astronomers have perceived mountains on her surface. When viewed through a telescope she is but seldom seen to shine with a full face, her phases varying like those of the Moon, and her enlightened part is invariably toward the Sun.

Lady M. Can Venus be perceived, without the aid of a Telescope?

Ment. She can be clearly seen by the naked eye, on account of her peculiar brightness, which exceeds that of every other Planet; her lustre has a whitish appearance, and is so brilliant she is frequently visible in the day time even when the Sun shines, and she has often been mistaken for a Comet, when she is about 40 degrees removed from the Sun. This Planet as a morning Star, is styled by the Poets, Phosphorus. or Lucifer; and when she shines after the Sun sets, and is hence called the Evening Star, she is denominated Hesperus, or Vesper. The ancients expressed an extraordinary degree of reverence for this Planet, on account of her beauty.

Lady M. With what delight I shall now view the starry firmament, which before I received your instructions on Astronomy, I did

not regard with the attention and admiration it deserved.

Ment. You have hitherto contemplated these glorious Orbs, as mere ostensible objects, without being able to reflect on their importance, magnitude, or distance; and it is by the aid of Science alone, and the labours of persons of profound learning, that you can possibly acquire a competent knowledge of such important truths. The next Planet to Venus is the Earth, whose annual revolution round the Sun is performed in 365 days, five hours and 49 minutes, being rather more than twelve months; her diurnal rotation on her own Axis is completed in about 24 hours, her mean distance from the Sun is computed to be 95,000,000 English miles, and her Diameter 7920 Miles.

Lady L. Pray Mentoria what is the cause that sometimes there are 29 days in the month of February?

Ment. In order to recover the time that the Earth spends in her annual revolution round the Sun, which by the foregoing statement, you will clearly perceive is more than 365 days, it becomes necessary every fourth year to add one day to the month of February, this is called
Bisflexile

Bissextile or Leap year, which consists of 366 days.

Lady L. It appears almost incredible that the Earth should be in constant motion, which must be the case, from the account you give of her rapid progress round the Sun, and her rotation on her own axis.

Ment. In a variety of instances we are required to stretch our belief, when the subjects are above our comprehension; but in the present case, the fact is demonstrated beyond the possibility of a doubt, which is clearly proved, by the vicissitudes of the seasons, the succession of day and night, and a variety of other self-evident means. To convince you of the rapidity of its motion, I shall inform you that the motion of the Earth in its Orbit, is computed at the rate of 68 thousand miles in an hour.

Lady M. I am surprized this rapid motion is not perceptible; I had no idea how fast I was travelling, even when I am asleep.

Ment. Extraordinary as it may appear, it is a certain fact, that the Earth in its revolution on its own axis, moves with a degree of velocity almost incredible to our finite conception; as from the most accurate calculations it appears,

appears, that the inhabitants of London are conveyed by this diurnal rotation 560 miles in the short space of an hour; and at the Equator, it is computed its progress and hourly motion is at the rate of 900 miles.

Lady L. What is the cause of our not perceiving the motion of the Earth?

Ment. The regularity of its progress prevents your feeling the sensible effect of its revolutions; if the slightest obstacle occurred, and the motion consequently became irregular, the whole Globe would perceive its force; but as the Earth is guided in its respective revolutions, by the sustaining hand of an all-wise and gracious Providence, we must cease to wonder at the uniformity, with which it performs its destined courses.

Lady M. I know that the Earth is a sphere, but I wish to be informed of the nature of its surface; as I think the rocks and mountains must rather alter its globular form.

Ment. The form of the Earth is not perfectly round, but rather flattened at the poles, which is what is called a spheroid; the rocks, and mountains, which are the greatest height form but inconsiderable protuberances on so large

large a body, therefore do not affect the bulk in any material degree. When we reflect on the various properties of this habitable Globe, and trace its qualities as a Planet, we are led in the first place to consider the blessings we enjoy, and in the next, to look forward to those which are in store for us in the endless ages of eternity, when the present state of things will be annihilated, and like the baseless fabric of a vision, leave not a wreck behind!

Lady L. I wish to be informed by what means you are convinced of the Rotundity of the Earth.

Ment. The Earth being nearly of a spherical form, as I have before specified, is confirmed by the following clear demonstrations. The first instance I shall produce, is the circumstance of its having been sailed round, which has been often effected by Navigators steering either in an Eastern or Western direction, and by pursuing the same course, returning to the Port from whence they began their voyage. The next proof is, that we may clearly perceive when we are on the sea-shore, and observe a ship sailing from us, the first part we lose sight of is the hull of the vessel, then the lower parts

parts of the masts and rigging, till by degrees the masts disappear, and the whole object vanishes entirely from our view. When a ship approaches near a port, the contrary effect must be produced, the Mariners first perceive steeples of Churches, and other structures of considerable height, and in regular gradation, houses and inferior buildings, and at last the surface of the Earth becomes obvious to their sight. The irregularity of the Earth occasioned by the inequality of its surface, is no argument in disfavour of its spheroid form, as the projections on its surface occasioned by the contrast of the highest hills, or the lowest vallies, it has been computed, bear no greater degree of proportion, than the inconsiderable protuberances that are found on the rind of an orange, which by no means destroy the symmetry of its form. That we have no sensible proof of these extraordinary truths conveyed to us through the medium of our intellectual perceptions, does not prove a contradiction of their existence; our powers of conception are great, but they are finite, and in a variety of other subjects, we are liable to evident deception, occasioned by the limited impressions our visual organs receive: therefore we must

must be thankful as frail beings, that we know enough to be sensible of the Omnipotence of God, and of our entire dependence on his Providence.

Lady L. Pray, Mentoria, receive my most grateful thanks for your reflections on the blessings we enjoy ; and be assured, I will express my sense of them, by the most zealous efforts of gratitude and praise.

Ment. The next Planet above the Earth's Orbit is Mars, whose revolution round the Sun is performed in one year and 322 days ; his Diameter is 5312 English miles, and his mean distance from the Sun 145 million of miles, and his rotation on his axis is in 24 hours and nearly half, which constitutes the length of his day. Mars when seen through a telescope, is observed like the Moon to encrease and decrease, but never appears horned ; it is therefore natural to conclude, he does not shine by his own proper light, and that his orbit includes that of the Earth. This Planet when viewed by the eye unassisted by glasses, appears smaller than Venus and of a redder hue.

Lady M. I am surpris'd at such a distance
the

the length of time can be determined so exactly, as by hours and minutes.

Ment. These nice calculations are effected by mathematical demonstrations, which reduce such profound subjects to the level of our comprehensions, and by clear simple means, convince the most moderate understandings.

The next subject which demands our attention is Jupiter, which is the largest of all the Planets, and in respect to his distance from the Sun, is the next in rank to Mars; his annual revolution round the Sun is performed in the space of 11 years, 314 days, his Diameter is 90,255 English miles; his mean distance from the Sun is 494 millions of miles, and his rotation on his own axis is completed in the short space of 9 hours and 56 minutes, by which means the velocity of his motion is so great, that at his equatorial parts, it is computed to be 25 times greater than that of the Earth, and its rapidity is ascertained at the rate of nearly 26 thousand miles an hour. The portion of light and heat that Jupiter derives from the Sun are proportioned to those received on the Earth, as 37 to 1000; therefore it is peculiarly fortunate for the inhabitants of this Planet, (and it is highly probable there are such) that he is attended

tended by four satellites, or they would be but in a very cheerless dreary state. The quick succession of day and night is another remarkable instance of divine wisdom; as by that means the speedy return of day counterbalances the other disadvantages of situation. In consequence of the Axis of Jupiter being so nearly perpendicular to his Orbit, he perceives no variations of seasons, and this was mercifully ordained, because if the Axis of this Planet had inclined any considerable number of degrees, the same proportion round each pole would have been involved for nearly six years in impenetrable darkness. When viewed through a telescope, Jupiter is found to be surrounded by faint substances, denominated zones, or belts, which are subject to such variations in their appearances, they have been frequently ascribed to clouds. When observed by the naked eye, Jupiter is distinguished for the white quality of his brightness, and in brilliancy exceeds most of the other Planets excepting Venus, which sometimes is superior in lustre. This is the more extraordinary, when we reflect on his immense distance from the Sun, and must be in a great measure ascribed to his vast magnitude; like

like Venus, he is sometimes called a morning, and at other times an evening Star.

Lady M. You frequently mention Diameters, are they in any degree like circumferences?

Ment. As the means of defining a sphere; or Globe, we must consider it as a round solid body, the surface of which is equidistant from a certain point called its center, therefore a line drawn from one side to the other, through the center, is called its Diameter, whilst the circumference would imply the going entirely round that or any other object: it may not be unuseful here to add, that the term magnitude means size, or bigness; altitude the height of any person, or thing; and plenitude fullness, all of which point out the dimensions and quality of the respective subjects, to which they are applied.

Lady L. Whenever I heard the Planets mentioned, I thought that they were considerable in size, and by no means of the consequence you represent; indeed I never paid much attention, when they were the subject of discourse.

Ment. This indifference to things seemingly too deep and abstruse for our comprehension,
is

is one of the principal sources of the ignorance which so frequently prevails, even amongst those who ought to be better informed. On this subject I shall only remark, that on all topics, relative to the œconomy of Nature, and the general state of things, you should ever employ your eyes, and ears, as instruments to convey instruction; as there is scarcely any branch of knowledge that is wholly unintelligible, or that may not in some degree prove a valuable attainment.

Lady. L. I will never neglect any means of receiving improvement; but one does not frequently meet with persons qualified to instruct.

Ment. In that idea you are greatly mistaken, knowledge does not wholly consist in Scholastic learning; but in a great measure is produced by observation and practice. Illiterate persons, and those in the lower classes of life, may afford much useful information, which they have acquired by the regular discharge of their duty, or the prosecution of their respective avocations. Thus a Gardener may improve you in Botany, a Carpenter in Architecture, or a Sailor in the principles of Navigation and Geography, though perhaps they express themselves in incorrect lan-

language, and ambiguous uncouth terms, yet you may safely rely on their assertions, as they are spontaneously the effect of labour and experience, which are the basis of the most essential acquisitions.

Lady M. I will in future listen attentively to every observation I hear ; as I am convinced of the advantages I shall derive by that means.

Ment. The most valuable acquirements are obtained by general, rather than by particular modes of instruction ; as the most useful information usually arises from existing circumstances, which no formal precepts or elaborate lecture could so well effect. Never neglect any means that can enlarge your stock of knowledge, from the weak pretext it can prove of no use ; as experience daily teaches us, that our intellectual powers in the vicissitudes of human life, are called into action by various unforeseen measures, which are to constitute our line of duty. Seek this invaluable treasure with ardour, let not the most humble instruments which impart it be spurned with disdain ; as this would be literally refusing a jewel of inestimable value, because the vehicle which conveyed it was apparently of inferior worth.

Lady L. I will always endeavour to consider

Under the intrinsic merit of every object within my powers of comprehension.

Ment. To speak figuratively on this subject, it is not alone from the Cedar of Lebanon, or the stately Oak we are to gain instruction; as even the most humble shrub is fraught with lessons to impress our minds with a sense of the Deity, though his attributes shine with more resplendent majesty in the various orbs which adorn the Firmament. The subject that now demands our attention is Saturn, which is the next Planet to the orbit of Jupiter, whose annual revolution round the Sun is completed in 29 years, 167 days; his Diameter is 80,012 English miles, and his mean distance from the Sun 906 millions of miles. His rotation on his own Axis has not yet been ascertained. As this Planet is about 9 times and half further from the Sun than the Earth, which is computed to be nearly 900 millions, consequently the light and heat he derives from that luminary, about 90 times less.

Lady M. The number of miles these Planets travel in their respective revolutions, will make me think the short journies we take of no importance.

Ment. I am happy to hear it likely to produce

duce that effect, as it is one of the principal ends of Astronomy to enlarge the ideas, and by a due contemplation of the Supreme Being, in these bright trophies of his skill, to form thereby a just estimate of his divine attributes, and also of our own limited powers. I shall now proceed to inform you, that Saturn has seven Satellites or moons, but the most surprising phænomenon is a kind of ring that encompasses his body, which from the most minute and attentive investigation, has been ascertained to be about twenty-one thousand miles distant from this Planet, and to be nearly thirty thousand miles in breadth.

Lady L. What can be the use of this Ring? I have no doubt it answers some important end.

Ment. There is every cause, philosophically and rationally to suppose, that the Planets are inhabited; and no one can doubt, however near or distant from the Sun they are respectively situated, that the constitution, temperature, and other circumstances of the Beings appropriate to each are so constructed, harmonized, and governed, as to form a perfect system, in every respect according to complete the general laws of the universe. This Ring like every other

atom

atom of created matter, undoubtedly fulfils some wise intention and purpose, and most probably was formed to cheer, and in some degree supply the defect of heat, which must follow as a natural consequence, from Saturn's remote distance from the Sun.

Lady M. How surprising these circumstances are; if it were left to my choice to determine, I should be undecided whether I should prefer Mercury, or Saturn, as the Planet on which I was to exist.

Ment. This like many other instances is graciously ordained by a superior Power: the hand that formed us can best allot our place and station. It is not the degree of light and heat, darkness or cold, which is to be our portion, that is to form our happiness, or misery; our proper bliss depends on the faithful discharge of the duties and parts assigned us, therefore we must think the space we inhabit is the most congenial to our nature, and in our ideas aspire to no higher sphere, than the immortal reward revelation insures, as the consequence of uniform obedience.

Lady L. I am very sorry your account of the Planets is so nearly completed.

Ment. The next and last which I have to
C describe

describe is the Georgium Sidus, discovered the 13th of March 1781, by Dr. Herschel; previous to that event, Saturn was considered as the most remote Planet from the Sun. In consequence of this valuable discovery being made in the present reign, it has the appellation of Georgium Sidus given to it in honour of our most gracious sovereign; it is also frequently called Herschel, to perpetuate the ingenious philosopher's fame who discovered it, and therefore is astronomically characterised by an H. being the initial letter of his name, with a cross, symbolically, to denote it was by Christians this Planet was first explored.

Lady M. I cannot express how much I am obliged to you for giving me so clear an account of the Georgium Sidus; what pleasure it must afford Dr. Herschel when he made this discovery.

Ment. The promulgation of any scientific phænomenon may be considered as one of the most brilliant efforts of human skill, as it gives a degree of preeminence to those who are fortunate enough to discover them, superior to every other rank or station. The Georgium Sidus or Georgian, as he is frequently termed, performs his course round the Sun in 83 years,

121 days, his diameter is 34,217 English miles, and his mean distance from the Sun is 1812 millions of miles. In consequence of his immense distance, the period of his rotation on his own Axis has not been ascertained. Whenever this is the case, we are to ascribe it to the being situated so remote from us; as there is every reason to conclude, that all Planets do revolve on their own Axis; though, in some instances, these rotations cannot be perceived by the inhabitants of the Earth. This Planet has two Satellites, or Moons.

Lady M. The great distance Georgium Sidus is from the Sun, must cause it to be very dreary; as I am now enough of an Astronomer to calculate in some degree by the number of miles, of the respective mean distance from the centre of its system.

Ment. The light and heat which this Planet derives from the Sun, is about the 360th part of what is received at the Earth; as his distance from the Sun is computed to be about 19 times that of the Globe we inhabit. As the means of giving you a notion of the climate of the Georgium Sidus, you must endeavour to divide, and subdivide the proportions of light and heat this Planet receives, when compared with the Earth;

which will enable you to form a precise idea, how small a portion of the genial rays of the Sun is allotted to these newly discovered regions. Yet, let us not hence hastily conclude that Providence has not dispensed his blessings with his accustomed liberality ; but rather let us rest assured, this, like every other Planet, and every other part of the Creation, is constructed with unerring skill. The dimensions of the Georgium Sidus are 82 times as large when compared with those of the Earth. Therefore, when we consider the great magnitude, and the stupendous distance this Planet is from the Sun, with what wonder and admiration must we reflect on the power of that Supreme Being who can sustain this, and the other Planetary Orbs, with such order and rapidity, through the regions of the liquid air ! The Planets already specified, are called the primary Planets ; besides which, there are fourteen called secondary Planets, or Satellites, each of which revolves round the primary Planets that are the centre of their motion, as the primary Planets revolve round the Sun. These will be the subject of my future consideration, I shall therefore only subjoin a few observations, and conclude this Lecture. As it is my wish to render

my

Signs of the PLANETS.	Names of the PLANETS.	Diameters, in English Miles.	Periods, in Years and Days.	Mean Distance from the Sun, in Mil. of Miles.
☉	Sun.....	*8935 ²²	—	—
☿	Mercury...	3261	0 — 88	36
♀	Venus.....	7699	0 — 224	68
⊕	Earth	7920	1 or 365	95
☾	Moon	2161	—	—
♂	Mars.....	5312	1 and 322	145
♃	Jupiter	90255	11 — 314	494
♄	Saturn.....	80012	29 — 167	906
♅	Georgian, } or Georgium }	34217	83 — 121	1812

* The Diameters were taken out of Adams's
Lectures.

my instructions as clear to your comprehension as possible, I have avoided all complex terms, and have endeavoured to express myself in language suited to your tender years. I do not intend to strip Science of its dignity or grace, but rather to administer to you such modified portions as your intellectual powers can easily receive and digest. To assist you effectually in your pursuit of astronomical knowledge, I will furnish you with a regular table of all the marks or characters of the different Planets and principal Stars, with their dimensions, distances, &c. which will enable you at one view, to collect all the various instructions on that point diffused through my conversations on this interesting subject. Let your attention be proportioned to my zeal, and by their mutual compact, your improvement will be established on a solid basis,

DIALOGUE II.

TUESDAY.

On the Secondary Planets, or
Satellites, and Comets.

Mentoria.

I HAVE already informed you that there are fourteen Satellites or Moons, which are classed as secondary Planets; I shall therefore proceed to describe their respective qualities, and rotation through their different Orbits. The Moon may be regarded as the first of these Satellites, as she accompanies the Earth in its annual course through its Orbit or path, and is continually revolving round it in an elliptical rotation from one new Moon to another, which she performs in about 29 days, 12 hours, and 44 mi-

44 minutes ; this is called her synodical revolution, besides which, she has another motion that is termed her siderial, or periodical rotation, that is performed in 27 days, 7 hours and 43 minutes ; being the space of time she takes to revolve from one point of the Heavens, to the same again. The diameter of the Moon is nearly 2161 English miles : her mean distance from the Earth 240,000 miles, and her motion in her Orbit is computed to be at the rate of 2290 miles in an hour. As this Planet's rotation on its Axis is performed in the same space of time as her revolution through her Orbit, it evidently appears, that her day and night together, are of the same length as our lunar months, as it is clearly demonstrated, that the Moon turns but once on her Axis during her progress round the Earth.

Lady Mary. I am rejoiced that you are instructing us on the subject of the Moon, which is an object that I admire more than I can express ; and I feel impatient to be informed why it changes and differs in appearance.

Ment. At the period of the new Moon, she is in that part of her Orbit or path, which is between the Earth and the Sun, therefore the whole of her enlightened Hemisphere is turned

from the Earth, and she is said to be in conjunction with the Sun. I make no doubt you recollect, that the Moon as well as the primary Planets, is a dark or opaque body; therefore, the light she dispenses is received from the Sun, by which means, only that half can be illuminated that is turned towards that brilliant Luminary, and the other half must be deprived of light; consequently, the degrees of light we receive, and the different appearances of the Moon, are occasioned by the various positions with respect to the Sun and Earth, which the face of the Moon at different seasons presents to our view.

Lady Louisa. This I clearly comprehend; but what is the next stage of this beautiful Planet?

Ment. When she has performed one quarter of her course through her Orbit, what we perceive of her enlightened Hemisphere, is of a semicircular form; which we denominate her first quarter. When she has performed half her revolution through her Orbit, the whole of her enlightened Hemisphere is turned towards the Earth, in which position she is in opposition to the Sun, and in that state constitutes what is called

called a full Moon. At this period, the Sun and Moon are in opposite parts of the Heavens: the Moon rising in the East, and setting in the West. When the Moon has passed three quarters of her Orbit, she again resumes a semicircular appearance, and is then said to be in her last quarter; and when her whole revolution is compleated, her enlightened Hemisphere is not visible to us, and another new Moon regularly succeeds. As the means of rendering this matter familiar to your perception, if you hold an ivory ball before a candle in a variety of positions, the effect will be clearly evinced by the proportion of light that will be visible on the illuminated part of its Hemisphere. You must also imagine, that if it were possible for you to view the Earth from the Moon, she would exhibit the same phases, or positions as the inhabitants of the Earth perceive, only in direct contrary means; the one being at full, when the other changes, and in a greater proportion, as the Earth yields 13 times as much light as the Moon, in consequence of her superior magnitude; her bulk being about a fiftieth part of the Earth; and as the axis of the Moon is almost perpendicular to the plane of the Ecliptic, she cannot experience any vicif-

fitude of seasons. Many Authors have imagined she has no atmosphere, but later discoveries confirm the contrary opinion.

Lady L. Pray, my dear Mentoria, describe the various appearances the moon exhibits, as its face often seems to change.

Ment. You have no doubt frequently observed that the Moon appears of different shades and colours. When this Planet is viewed through a telescope, it is clearly demonstrated that these varied tints are produced by the contrast of hills and vallies; the mountainous parts occasioning the light spots. It was till lately universally believed, that the dark spots or shadows were seas; but modern discoveries have proved they are concavities or caverns.

Lady L. I am amazed that these things can be discovered with such clear proofs.

Ment. The circumstance of there being hills and vallies, which produce the effect already described on the surface of the moon, is also demonstrated by the border or outer regions of the edge appearing indented about the extremity of the illuminated part, when the Moon is either horned or gibbous. Dr. Herschel has ascertained the height of several of these hills or mountains; and has proved that

very

very few of them, in their perpendicular elevation exceed half a mile; in the course of his observations on this Planet, he has also explored several volcanoes, which emit fire, and from the great similitude there appears between her and the Earth, it is a probable conjecture, that she has not only seas and rivers, but also an atmosphere.

Lady L. You have frequently desired I would request the explanation of any word above my comprehension, therefore I beg to be informed what gibbous means?

Ment. It is an astronomical term often used in reference to the enlightened parts of the Moon, while she is moving from the full to the first quarter, and from the last quarter to the full again; as at those periods the dark part appears horned and falcated, and the light one protuberant, convex or gibbous; as the means of fully explaining this matter, I will inform you that the word falcated, implies crooked, and is applied to express when the moon or any other planet appears crooked or in the form of a sickle.

Lady M. Pray, my dear Mentoria, explain to me why the Moon rises at different times.

Ment. The enlightened part from the new

to the full Moon is turned towards the west, as the Sun is westward of it; but on the contrary from the full to the new Moon, it is turned to the east, as the Sun at that period is eastward of it.

Lady L. Does not the Moon sometimes appear larger than at others?

Ment. The full Moon which happens directly before the Autumnal Equinox, in her dimensions appears larger at the time of her rising than usual, and for several successive evenings rises nearly at the same period, immediately after the full; this is by many called the Harvest Moon.

Lady M. Have I not heard also of a Hunter's Moon?

Ment. It sometimes happens that the same circumstances occur, as I have just described in the succeeding Moon, though not in so great a degree; this is what is often denominated the Hunter's Moon. These extraordinary variations proceed from the Moon's peculiar situation with respect to the Earth at those periods, which would be too abstruse for me to endeavour to explain in terms suited to your comprehension.

Lady L. I have been particularly attentive

to

to your remarks on the Moon, which I shall now admire more than ever; I always imagined it had no other use than to afford us light.

Ment. The great Creator of the universe wisely ordains, that his works should coincide to proclaim his divine attributes, and also serve the subordinate purpose of beneficial effects to the various beings he has formed. In contemplating the universe, or at least those parts which our finite ideas can comprise into one system, we shall clearly perceive mutual advantages are the grand outline of the general economy of nature: thus Philosophy teaches us, as inhabitants of a planetary orb, that our Earth transmits light to the Moon in the same manner as we derive it from her. The proportion of light the Moon affords to us, it has been computed is ninety thousand times less than day light, which is insufficient to make any sensible effect of heat; but the light the Earth yields to the Moon is calculated to be 13 times as much, which I have before observed.

Lady L. I cannot possibly express, how much I admire the serenity of a Moon-light night.

Ment. The calm delight that the lunar splendor affords, has furnished Poets with materials

terials for the most beautiful descriptions ; every object beheld through this meliorated medium, acquires additional grace, and its benign effects may be traced by the influence they have on the human mind. The light which the Moon in its brightest state reflects from the Sun, is of that mild quality, to concentrate the imagination, whilst more vivid rays would tend to disturb, and extend its range to objects, not so well suited to the purposes of serious consideration, or devout contemplation. The Moon is to the works of nature, what modesty, or diffidence, is in its effects on the moral world ; by the diffusion of their gentle beams, the hemisphere of the Heavens, and of human life, are seen through a veil, which invariably adds a superlative degree of Grace to their Beauty.

Lady M. I am extremely sorry that you have closed your account of the Moon ; as it is a very interesting subject.

Ment. It is rendered peculiarly deserving of attention, as being the constant attendant on the Earth, which induced me to expatiate so fully on its qualities ; but I must now proceed to consider the other Satellites, and inform you that Jupiter has four Moons, these Orbs
are

are all of a spherical form, and derive their light from the Sun. Saturn has seven Satellites or Moons, and Georgium Sidus two; these Orbs, or secondary Planets, no doubt were created for the gracious purpose of general benefit to the primary Planets which are the center of their motion, and unquestionably tend to complete the regularity and order of the solar system. I have already mentioned the luminous or bright ring, which encompasses Saturn at a very considerable distance from his body, in which space, the fixed stars may sometimes be clearly perceived. By a late discovery made by Dr. Herschel, it is clearly proved, that this ring is divided into an interior and exterior circle, which are separated from each other by a space of one thousand miles. These Satellites, and Saturn's ring, can only be seen by the aid of a telescope, by which means also, several parallel faint stripes may be observed on the body of Jupiter, that are usually denominated belts.

Lady L. What ingenious things telescopes are, how clever those persons must have been who invented them.

Ment. This like many other valuable discoveries was effected apparently by chance.

The

The telescope is reported to have been invented by Roger Bacon in the 13th century ; but from the bigotry and ignorance of that æra, it gained no repute, and was wholly neglected, till a fortunate circumstance convinced the learned of its great utility, by the following means. The children of a spectacle-maker at Middleburg in Holland, whilst they were playing in their father's shop, made him observe, that when they held two spectacle glasses at some distance from each other, they saw the weathercock on the Church steeple appear much larger than usual, and apparently very near to them, but reverted. The father convinced of this effect, placed two glasses upon a board, set upright, in two brass circles, which he could fix at what distance he pleased. In consequence of this discovery many resorted to his shop, among whom were Zachariah Janson, and James Metias, workmen of the same town, who improved on the plan first suggested, by adding a tube to connect the glasses, which by sliding in grooves, they could extend to any length. Thus much for the mechanism ; but for the scientific advantages, we are indebted to Galileo, Astronomer in the 16th Century to the grand duke of Tuscany, who
only

only having heard this valuable discovery mentioned, had so clear an idea of the importance of this instrument, he constructed one on a very large scale, by placing glasses in the long pipes of an organ, by which means he first perceived the *Maculæ* or spots on the Sun, and its revolution on its Axis; he next observed the four Moons of Jupiter, which he called the Stars of Medicis, in honour of his patron. He had also a glimpse of two sides of Saturn, which have been since ascertained to be the ring I have just described. As he was a man of great learning, he published an account of these acquisitions in the science of Astronomy, and gave a clearer idea of the heavenly bodies than had ever been before attained.

Lady L. How much we are obliged to you, my dear Mentoria, for informing us of the extraordinary means by which the telescope was discovered. I am almost induced to envy the persons fortunate enough to be the projectors of such an important invention.

Ment. I am inclined to think it should rather excite your admiration; for if we were minutely to trace all acquisitions of Science, or knowledge, we should be the more clearly convinced these things are permitted by the wise
designs

designs of Providence ; and that the persons who effect them are the mere agents, or instruments to fulfil his benign purposes for the general good ; as, what we call chance, is a fallacious term, and may almost universally be attributed to a higher source.

Lady M. I will in future endeavour to ascribe all good consequences and important events to where it is most justly due, the Omnipotent Ruler and Creator of the Universe ; as every object I contemplate proclaims its natural dependance, and the divine protection it receives.

Ment. Your ingenuous mind may be compared to a mass of snow or wax, as it is as immaculate as the one, and as ductile as the other. Impressions must be received, and from the state of our nature, will be retained ; therefore, their quality becomes an object of the first importance. The most ignorant and prophane are sensible that they exist, and enjoy many blessings ; but it is only the enlightened and devout Christian who can be convinced of the means by which these advantages are obtained, or be acceptably grateful to the supreme First, and general Cause !

Lady L. Pray Mentoria, what will be the next subject on which you will expatiate ?

Ment.

Ment. The only branches of the solar system I have to explain are Comets : They are solid bodies of various sizes which move round the Sun, and cross the Orbits of the Planets in a variety of directions. Their principal distinguishing marks from the Planets, are their long transparent tails, which proceed from their side farthest from the Sun, and have the resemblance of a pale flame. Their revolutions are exceedingly eccentric, and the Orbits or paths in which they move, Ellipses, or long ovals of a surprising magnitude, having the Sun in one of their foci ; in consequence of which, in one period of their rotation, they are so near the Sun as to be in a situation which must render them subject to the influence of the most intense heat, as they sometimes approach much nearer than Mercury to the solar Orbit, at other periods they fly off again to such immense distances from the Sun, they must experience the greatest degrees of cold. That which appeared in the year 1680 came so near to the Sun, its heat, it has been computed, must be consequently 2000 times greater than red hot iron. After which it pursued its course to the remote distance of near eleven thousand millions of miles, which is
calculated

calculated to exceed six times the Orbit of Georgium Sidus.

From these circumstances it is evident that Comets are of a solid and durable substance, capable of bearing the variations of extreme heat and cold without being subject to dissolution from their powerful effects; and are also opaque bodies, as the light they shine with is received from the Sun, like the Planets I have before described.

Lady M. I think I have heard you speak of Comets, and call them blazing stars.

Ment. They are sometimes so denominated because they have long tails of a blazing quality which proceed from them.

Lady L. Pray Mentoria give me some idea of the dimensions of a Comet, and the nature of their tails, which you so frequently mention.

Ment. Comets differ in magnitude, some of them are larger than the Moon, though the greater part are inferior in size to that Planet; but as they but rarely appear, and take an immense circuitous range, neither their periods nor dimensions are precisely ascertained.

Lady L. I cannot understand what you mean by the Comets having the Sun in one of their
their

their Foci, in their periods through their elliptical orbits.

Ment. The term Foci implies the two points of convergency (by which you are to understand the approaching nearer and nearer, tending to one point) in the axis of a curve or lens, therefore Foci is to be considered as the plural of Focus, which signifies concentrating our views or attention to one point or object.

Lady M. Pray Mentoria explain what the Comets' tails are formed of.

Ment. The tail of a Comet is supposed to consist of a great quantity of fume or vapour which proceeds from its body, as it acquires an accumulated degree of heat in its approach to the Sun. Some of these flaming appendages are of a prodigious extent; having been computed to be 80 millions of miles in length. Though the tail is a distinguishing characteristic of Comets, it is asserted some have appeared without them, and in every respect spherical in form like the Planets.

Lady L. What can be the use of Comets?

Ment. Their importance I cannot define, though I may venture to assert, they are of consequence in some degree or means too difficult for me to comprehend or explain. Vari-

ous

ous conjectures in the early ages of the world were formed from their appearance, as being portentive of some national evil or great event. Many suppose the deluge was occasioned by the near approach of a Comet to the Earth; whilst others, with greater probability, imagine they will be the instruments of effecting the general Conflagration revelation teaches us to expect. As if a Comet, in its return from the Sun, should be in immediate contact with the Earth in its Orbit; the latter must be consumed in the unequal conflict. It is generally imagined that there are at least 21 Comets belonging to our system; the periods of only three have been accurately determined, which have been demonstrated to return at intervals of 75, 129, and 575 years. That which appeared in 1680 was the most remarkable, as its greatest distance from the Sun is computed at 11 thousand 200 millions of miles, whilst its least distance from the centre of the Sun is only 490 thousand miles. Its period is calculated 575 years, and in the part of its Orbit which approaches nearest to the Sun, the velocity of its motion is computed to be 880,000 miles in an hour, and the Sun, as seen from it, appears 40,000 times as large as he does to the inhabitants of the Earth.

Lady M.

Lady. M. From the accounts you give of Comets, and their probable tremendous consequences, I shall be greatly alarmed when any appear.

Ment. I shall endeavour to combat, and I trust shall overcome any apprehensions you may experience on that, or any other subject relative to the laws or order of the Universe. As inhabitants of this terraqueous Globe, we are obnoxious to two kinds of danger; the one I shall term individual, or partial; the other, general, or universal evil; neither of which we can avoid; as a variety of circumstances concur to produce such baneful, or fatal effects. These considerations naturally suggest an entire and unconditional reliance on the decrees and dispensations of Providence, and fortify our minds against the dread of any particular misfortune, or trial: In the course of human events it seldom happens, that the affliction we apprehend occurs, or if it does, the goodness of God enables us to sustain the conflict with due resignation to his divine will. It would be as absurd to dread the fatal consequence of a Comet, as to entertain the idea, that the Sun would fly from its Orbit, or the Sea transgress its bounds. The laws of Nature
are

are in the entire disposal of their omnipotent Creator, nor will they deviate from their due course but by his awful fiat ; as they are not guided by the fortuitous effects of chance, but are restrained and directed by unerring wisdom in their respective revolutions and stations. It would be impious and presumptuous to judge of the final effect of things : that terrestrial glory must end, is an article of our religious faith, and the basis of our future hope, which points to Eternity, and the expectation of a superior and more permanent existence. Respecting the means to effect this great purpose, we are not to form opinions from our finite ideas, but rather to conceive, the most awful measures may be used as instruments of executing the avenging decrees of an offended, yet merciful Deity. On this subject I shall only add, many are of opinion that the general conflagration which is scripturally denounced to destroy the Earth, will probably be produced by an eruption of the volcanoes that are in various of its parts ; which theory they support on the argument, that every body possesses inherently the principles or seeds of its own dissolution. I have expatiated more fully on this subject, as I would wish you to be forcibly impressed with every sacred

cred and divine presage, yet to be neither painfully solicitous concerning the period, or the means of their respective fulfilments, nor weakly indifferent concerning a transit that must consign you to endless misery, or supreme bliss; which latter, you will certainly attain if you trust in God, and regulate your conduct by the precepts of the Christian Religion, and the bright example of its Divine Author.

D

DIALOGUE

DIALOGUE III.

W E D N E S D A Y.

On Astronomy, the fixed Stars,
and the Zodiac.

Mentoria.

IN consequence of my having finished my account of the solar system, I shall now endeavour to claim your attention whilst I describe the fixed Stars, which are distinguished from the Planets by their constant twinkling, or what is scientifically called their scintillation.

Lady. Louisa. Why are they called fixed Stars?

Ment. Because they never relatively change their situation, but always preserve the same distance

distance from each other, notwithstanding the Earth in its revolution, causes an evident motion in the Heavens. It is imagined these Stars are all distinct Suns placed at immense distances in the Universe, each of which shines by its native light, and forms the centre of a system, round which, Planets revolve with the same regularity as in our solar system, but at too remote a distance to be perceptible to us. As these Planetary Orbs derive light only from their respective Suns, that cannot be transmitted at so immense a distance; which is so great, that even Sirius, or what is usually called the Dog Star, never seems to vary in its size, though in one period of the Earth's revolution it is 195 millions of miles nearer to it than it is in the opposite part of its Orbit. These fixed Stars are ranked in six different classes to ascertain their respective magnitude and distance, according to the degree they are to us apparent. The number that can be perceived in the visible Hemisphere without the aid of a telescope, scarcely exceeds one thousand; but by the assistance of optic glasses, those that may be seen are incalculable. And in proportion as these visual auxiliaries improve, the celestial regions are explored with greater accuracy, and new discoveries con-

frequently made respecting the number and qualities of the heavenly bodies. By various astronomical observations it has been proved, that Sirius, which is nearer to the Earth than any of the fixed Stars, is computed to be distant more than two millions of millions of miles. And it is calculated that if a cannon ball were to fly from thence at the amazing rate of 400 miles in an hour, it would not reach the Planet we inhabit in 570,000 Years.

Lady Mary. I am surprised that you describe the fixed Stars as Suns, I always thought there was but one luminary that bears that appellation, or was of equal consequence.

Ment. Qualities and properties, not terms, are what we are to regard in scientific disquisitions; in this instance I do not require implicit belief till I have established sufficient authority of the probability and rationality of my assertions. A variety of opinions might perplex your ideas, and confuse your judgment: I shall therefore only produce Doctor Herschel's sentiments on this subject. He thinks it will scarcely admit of a doubt, that the fixed Stars are distinct Suns; or their immense distance would perfectly exclude them from our view, if the light they emitted were not of a solar quality.

quality. He also carries this analogy still farther, by proving that many, (and most probably all) of the fixed Stars turn on their Axis, and have spots or maculæ on their surface which vary in lustre and appearance. The Stars which he particularly specifies for these solar characteristic marks, are called Lyracephei, Antinoi, and Ceti, with many others he does not particularly enumerate. From these observations it is evident our Sun and solar system make but a small part of the Universe. As it is highly probable there are millions of Suns, attended by planetary Orbs, inhabited by myriads of rational beings; all tending to the glory of their great Creator, and uniting to fulfil the general purposes ordained by Divine Wisdom.

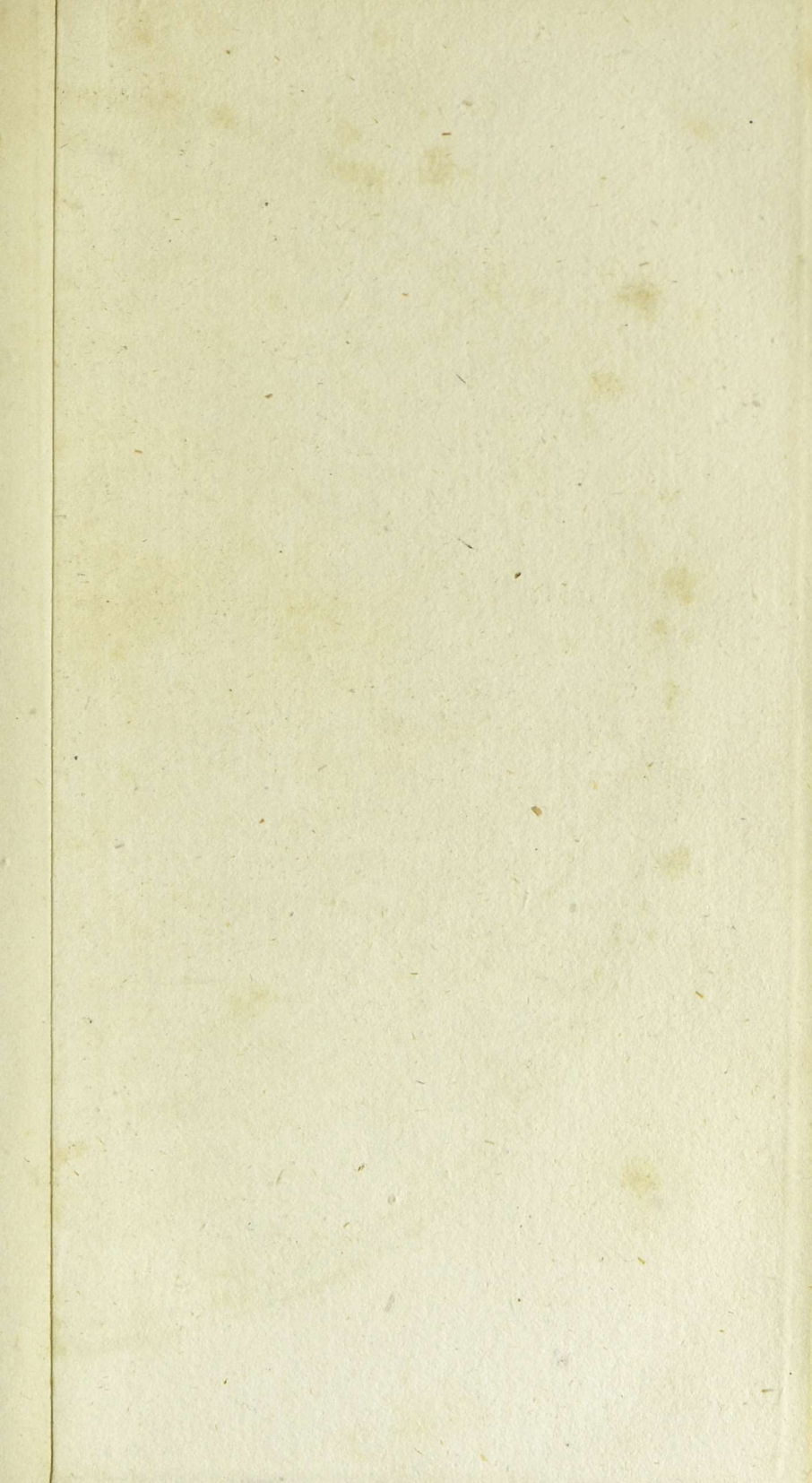
Lady L. I am quite convinced by the proofs you have given, that the Earth comparatively makes but a small part in the general mass of the Universe.

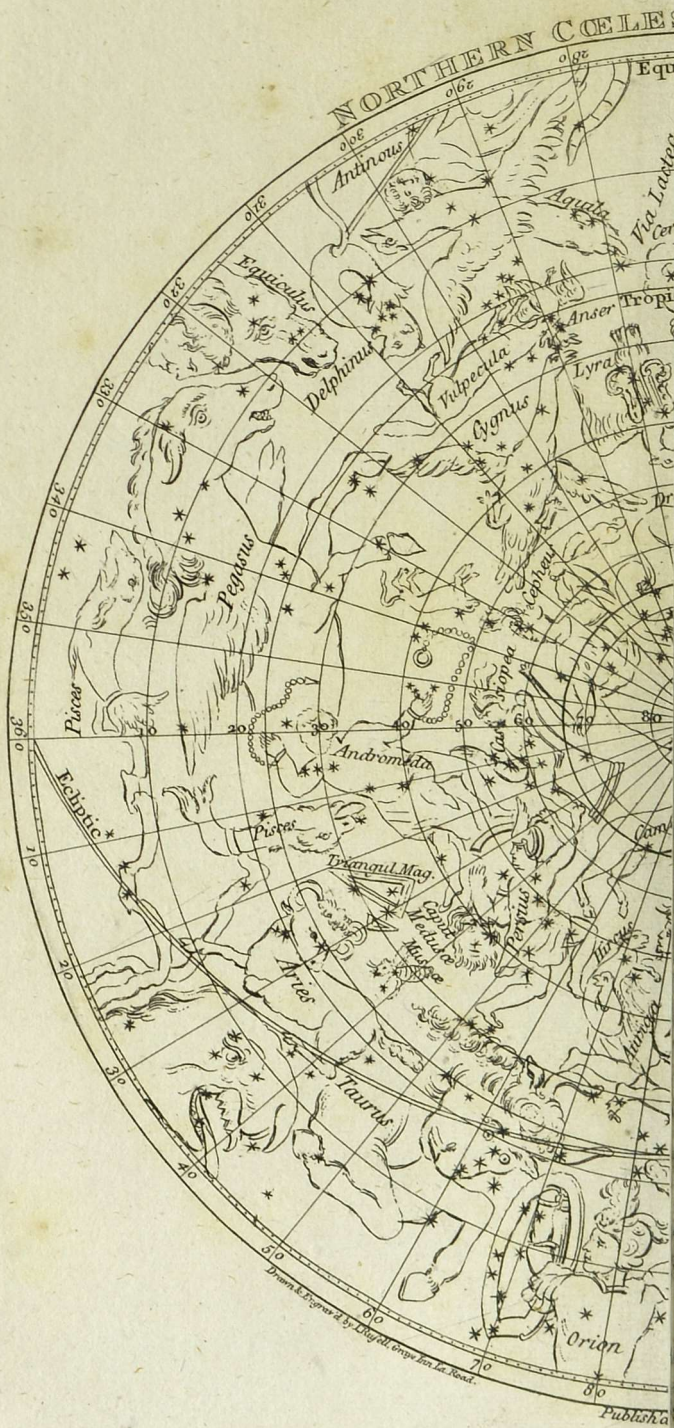
Ment. In ascertaining our real importance in the Arcana of Nature, we must imagine an expanse of boundless space, and reflect that if our solar system were annihilated, it would bear no greater degree of proportion of defection in the whole Creation, than if a drop of water

were taken from the immense reservoir of the ocean.

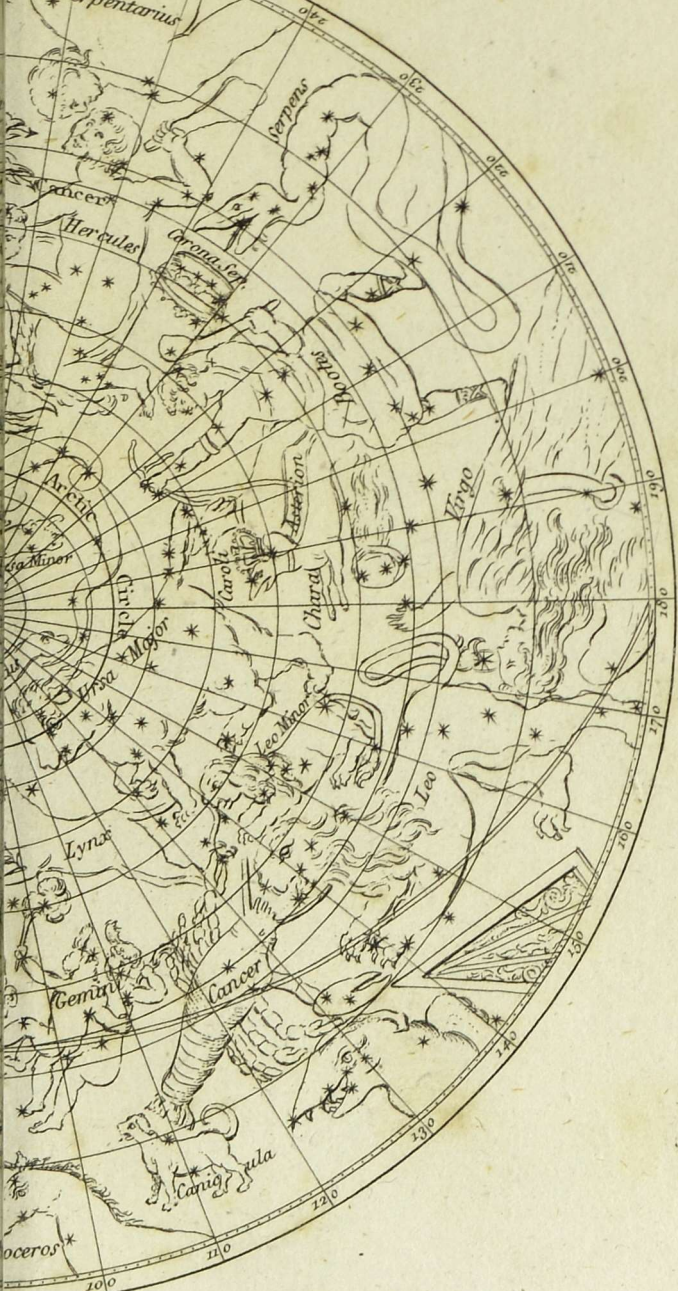
Lady L. Have I not heard of the galaxy, or milky way ; pray what does it mean ? I have an idea it is an astronomical term.

Ment. The galaxy, or milky way, derives its name from the white appearance such an immense number of stars occasions, which unite in illuminating that part of the heavens in which they are situated. Dr. Herschel imagines this broad circle is an extensive stratum of stars, as he has discovered many thousands in it, some appearing double, others treble ; not that they are so in reality, but are stars at different distances, which produce that effect by being seen in the direction of nearly a right line. As the means of rendering my instructions more explicit, I shall subjoin a copper-plate, which will clearly describe the three distinct regions of the Northern and Southern Celestial Hemispheres, and the Zodiac. The ancients expressed these fixed stars by certain imaginary symbolic figures of beasts, birds, fishes, and other animals, which are called Constellations. The number of these stars, including those which have been added in consequence of latter discoveries in the Northern Hemisphere, is 36,
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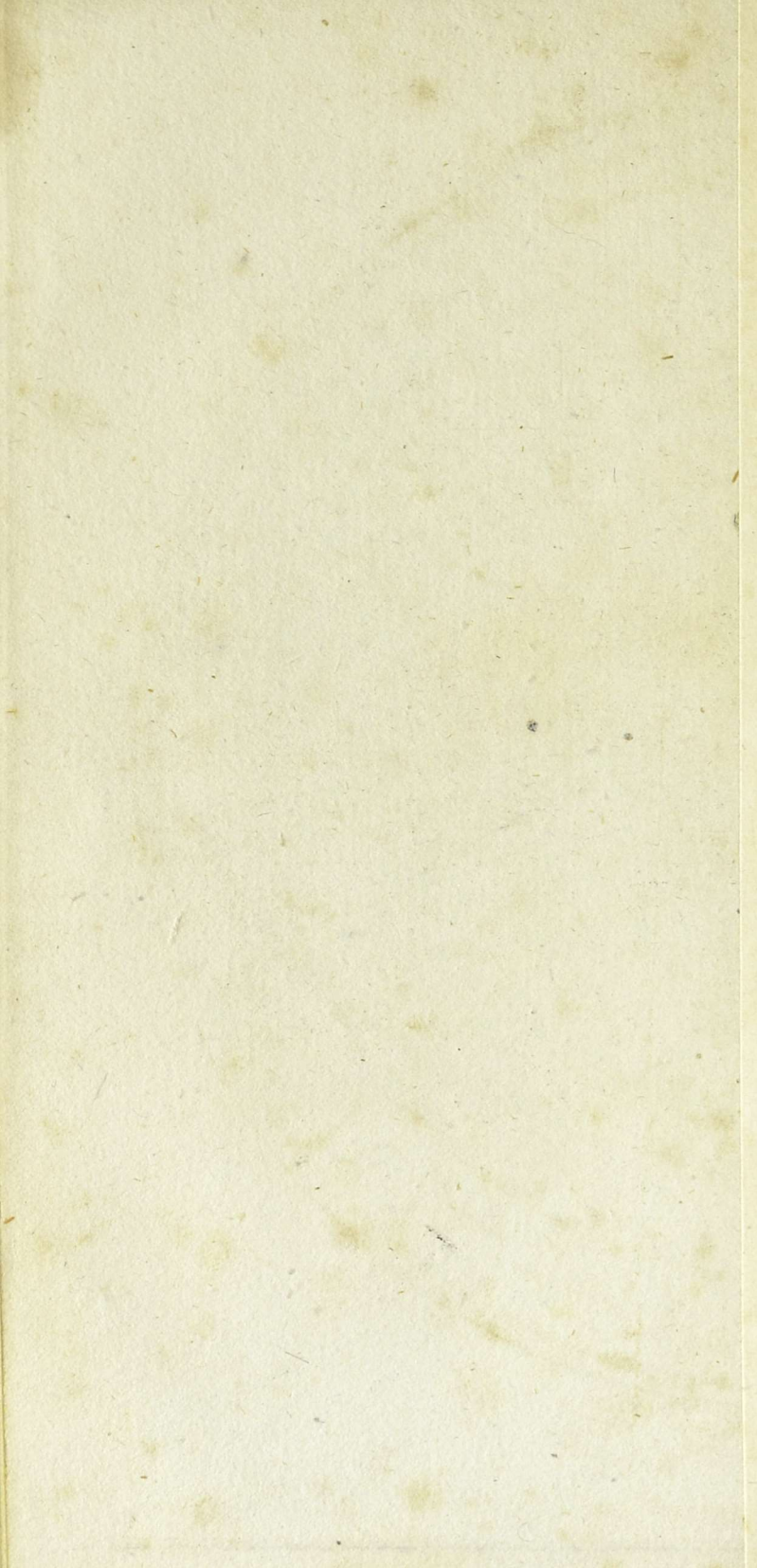


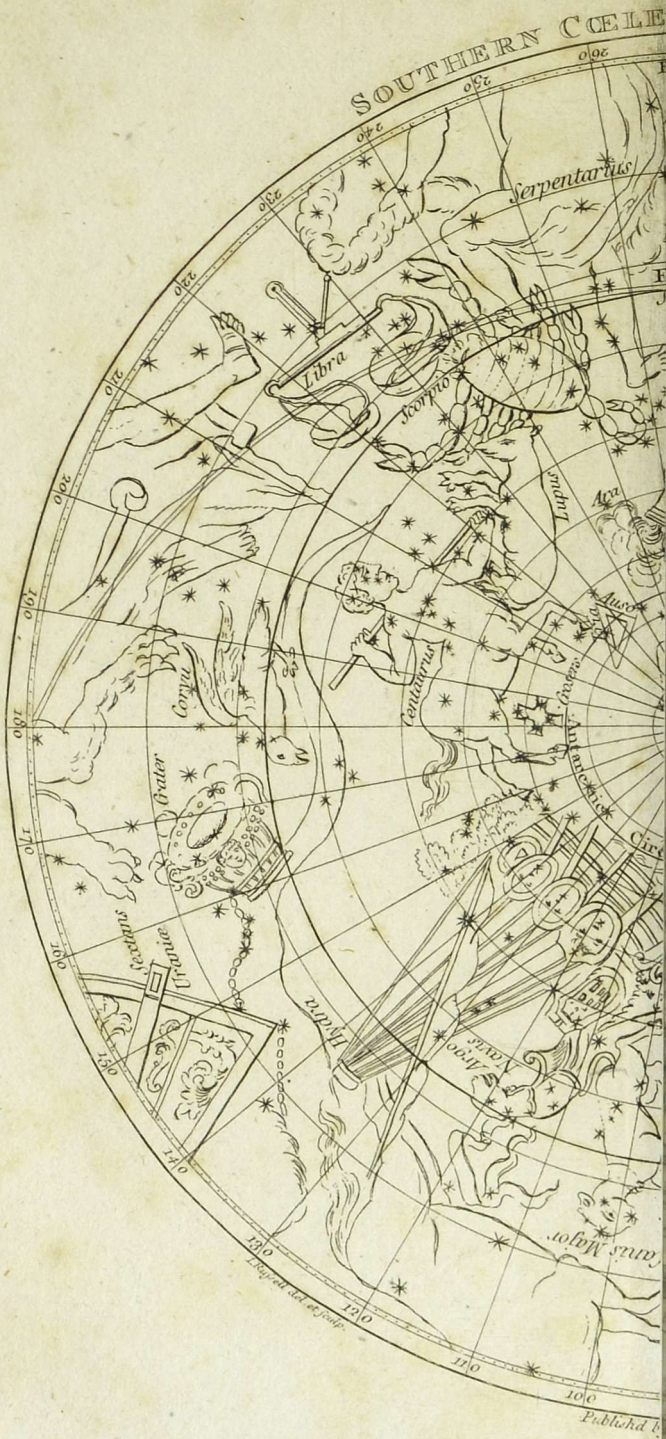


AL HEMISPHERE.



March 1, 1799.





AL HEMISPHERE



in the Southern 32, and in the Zodiac 12. Some stars that are not comprehended in any Constellation, are termed unformed stars; others Nebulæ, that have a cloudy appearance; and those that cannot be seen without optic glasses, are called Telescopic Stars. By the invention of John Bayer, a German, about the year 1600, the letters of the Greek alphabet are used to express the stars in each Constellation, according to their regular gradation; though some of the principal fixed stars have distinct names assigned them, of which you shall have a list.

Lady M. I shall endeavour to acquire a thorough knowledge of these appellations, and shall pursue the method you so often have recommended, of writing them in a little book, which will prevent their escaping my memory.

Ment. The Polar Star is the least star in the tail of Ursa Minor, or the Lesser Bear; on account of its proximity to the North Pole, its apparent situation with respect to the earth scarcely varies through the complete period of her annual revolution, which causes this star to serve as an unerring guide to mariners. There are two stars in the Constellation of Ursa Ma-

jor, or the Greater Bear, which are called Pointers, as they evidently point to the Polar Star. Sirius, or the Dog Star, rises and sets with the sun during part of the months of July and August, which space of time constitutes what are usually called Dog Days.

Lady L. By what means can I distinguish the planets from the fixed stars?

Ment. There are two invariable rules which serve to ascertain their distinct qualities, every fixed star twinkles; but a planet has not the least degree of scintillation, they are also always in motion from one part of the heavens to the other, and are visible earliest in the evening, and latest in the morning: whilst the fixed stars constantly preserve the same distances from each other.

Lady M. What occasions the twinkling of the stars, which you mention?

Ment. This effect is produced from the agitated state of the body of air or atmosphere, through the medium of which we view the stars; as the particles, by being in continual motion, cause a twinkling appearance in any distant luminous body: and you must recollect the fixed stars shine with inherent native light,
and

and that the planets are of an opaque, or dark quality.

Lady L. You observe that the number of stars which can be seen without a telescope, scarcely exceed a thousand, which surprises me greatly ; as when it is a fine night, they appear to me innumerable.

Ment. The cause of their appearing so much more numerous than they are in reality, is occasioned by their constant twinkling, and the confused manner in which we view them with our natural organs of sight.

Lady M. By what means do the Planets appear like stars ?

Ment. This resemblance arises from the following circumstances. In whatever part of the universe we are, our situation seems to be the centre of a concave sphere, from which remote objects appear at equal distances from us ; thus clearly to exemplify this subject, if it were possible for you to be removed to the Planet Venus, our Earth would seem to be a star to your view ; but if you could be transported to a Planet of another system, our Sun would appear as a Star, and its planetary Orbs would be invisible.

Lady M. Pray inform me what you mean by Constellations?

Ment. The word Constellation literally signifies a cluster or assemblage of Stars: the ancients, in their progressive improvements in Astronomy, calculated several Stars which they divided into distinct companies, or Constellations; these they expressed by typical figures, according as their fertile imaginations supposed in their combined form they represented any particular object, or had reference to some important consequence.

Lady L. At what period did they make these ingenious discoveries?

Ment. It is not in my power accurately to determine that point; however it is very certain, that the ancients in the first ages of the world, had some knowledge of Astronomy; as the Constellations Orion and Pleiades are mentioned in the book of Job: and it is generally supposed that book was written by Moses, during his residence with Jethro, in the land of Midian, above 1500 years before the Christian Era.

Lady L. I cannot imagine why such names should be given to the heavenly bodies, as they bear no resemblance to animals.

Ment.

Ment. It may perhaps be in my power to throw some light on that subject, by endeavouring to explain the invention of the Zodiac, by which is implied a circle of animals, as that term is derived from the Greek. The Zodiac you are to regard as an imaginary circle, belt, or zone in the heavens, that the Ecliptic divides into two equal parts, which is terminated on either side, by a circle parallel to it, at eight degrees distance, in which space or track the Planets perform their revolutions. I shall now proceed to inform you of the probable means which suggested these astronomical arrangements: in the first state of things we must consider the human race as being placed in a climate and condition subjecting them to few wants, for even the supply of which they could not have recourse to any foreign aid. Thus circumstanced, the first object of importance for them to effect, was the mensuration of time, which could only be ascertained by the motions of the heavenly bodies; the Moon was the primary object of their attention, as by its changes, and periodical returns, they could regulate their affairs with the most exact precision, though totally unskilled in what is usually called Science; and the greatest utility of these disco-

veries was, the enabling persons at remote distances to assemble, for the purposes of divine worship. As their observations were simply the effect of ocular demonstration, they reckoned the New Moon from the period they perceived the Crescent in the firmament; for which purpose they met in deserts, and on high places, as the means of having a clear and extensive view of the horizon; and when they discovered the Crescent, they celebrated the Neomenia, or sacrifice of the New Moon, followed by a feast, of which the assembled families partook; the food having been previously consecrated to the Supreme Being. When any extraordinary event occurred, they also instituted an annual festival, which was added to the Neomenia, and celebrated with great solemnity. Thus you will perceive that the lunar revolutions formed the first system of religious rites, and the equal distribution of time; but as twelve of those were not sufficient to complete the regular returns of the seasons, it became necessary for the ancients to observe the particular stars under which the Sun appeared to them to pass every month, which they divided into twelve equal parts; and as they had no mathematical instruments, they had recourse to the ingenious expedient

expedient of having two copper vessels, one of which they filled with water, and by the peculiar construction of these utensils, the water ran from one into the other ; therefore by accurately observing how many times this operation was performed between the interval of each Star's appearance, and the exact mensuration of the quantity of water which alternately filled the vessels, they acquired to a certainty the regular process of the heavenly bodies, which were their only guides in the regulation of their sacred and civil concerns.

Lady L. In what part of the world were the observations first made, which you have enumerated ?

Ment. In Chaldea, or Babylon, which you will find clearly explained in my Sacred History, with maps to shew you the exact situation of the regions inhabited by the patriarchal tribes. It may be proper to remind you, that in the primitive state of things, the occupations of the human race were principally of the pastoral kind ; tending of flocks, herding of cattle, and attention to agriculture, even in its most laborious branches, were not then regarded as degrading : necessity suggested the importance of these pursuits, and custom and habit reconciled

conciled those who were highest in station to the general adoption of a plan in which their wealth and happiness were comprised. This course of life afforded the ancients many opportunities of making observations on the heavenly bodies, as the nature of the climate, and the quality of their avocations, caused them chiefly to reside in tents, which being moveable habitations, answered their purpose better than fixed dwellings, as they could conveniently change their situations for those that produced the best pasturage for their cattle, which required constant attendance, and by that means enabled them to watch the revolutions of the Stars during their nocturnal attendance on their flocks. As knowledge of every kind is progressive in its operations, the Egyptians who were the most learned people at that early period, having observed the four natural divisions of the year, perceived that the Sun in each of these divisions appeared to be placed successively under distinct Stars; they consequently divided each of the four seasons into three Cantons of different Stars, and the whole year into twelve houses, or stations of the Sun, to which they gave the name of different animals, to denote the quality of the pursuits which were transacted in each particular

lar

lar period; and as they were very partial to symbolic signs, to express any known object, they had recourse to that method to signify their different tendency and uses; consequently this evidently appears to have been the origin of what is commonly called the Zodiac.

Lady M. I am extremely obliged to you for explaining the first discovery of such an important and interesting part of Astronomy.

Ment. I shall in the next place briefly endeavour to describe why the ancients represented many of these Constellations, or signs, by names and figures, the greater part of which are of the animal kind. As in the early ages of the world, the riches of its inhabitants consisted in the abundance of their herds and flocks, they naturally appropriated to each of the Stars that appeared to them in regular rotation, appellations which had an immediate reference to the production of those creatures, which conducted to their subsistence, and constituted their wealth. The spring Constellations prove this assertion beyond a doubt; the first in order is Aries, or the Ram, as at that season, the month of March, their lambs were brought forth. This Constellation was therefore so named, as the means of teaching them to expect that advantageous

tageous event, when that particular Star was observed; in like manner Taurus, the Bull, in April, was to signify that at that period their cows produced calves; the next Constellation Gemini, or the Twins, in May, was a type or similitude of the fecundity of their Goats, which usually had two kids at a birth.

Lady L. How clearly this appears. I am much entertained by the information you have so kindly imparted.

Ment. I am now come to the summer Constellations, Cancer, or the Crab, which appears in the month of June, was so denominated, as a type that the Sun appeared when he had gained that point in the heavens, to recede or have a retrograde motion, which they expressed by the figure of a Crab, as that animal crawls backwards: this is what is called the Summer Solstice, when the Sun is apparently at his greatest height, and the days consequently the longest in the Northern Hemisphere.

Lady L. What apt similitudes the ancients had recourse to, as means to express the affinity and resemblance that different objects bore to their state and condition.

Ment. The remaining summer signs next present themselves for our consideration. Leo

the Lion, which appears in the month of July, was so called to denote the heat of the weather at that season; which was typified by the fury and rage of a Lion. We next find Virgo or the Virgin, in the month of August, which was the emblem of their harvest, it having been the practice from the earliest periods for gleaners (who were usually females) to collect all the corn that was left on the ground by the Reapers.

Lady L. I shall be sorry when you have finished your account of the Constellations. I had no idea they were so interesting.

Ment. The autumnal Constellations are the next branch to be considered. Libra or the balance in September, is a literal type of the equality of the days and nights at that season, usually called the autumnal equinox; which could not be better expressed than by the representation of a pair of scales. The next is Scorpio or the scorpion; which appears in October, and is so called to denote the baneful diseases which in those regions often raged with violence at that season, which were aptly compared to the sting of a scorpion. Sagittarius or the archer, that makes its appearance in November, was a token to pursue the avocation of hunting, which was
necessary

necessary in a country at that time so thinly inhabited, effectually to clear the desarts and forests of wild beasts and noxious animals before the approach of winter.

Lady M. The wise application the ancients made of these advantages does them great credit.

Ment. The first of the winter Constellations is called Capricornus or the goat, which appears in December, and derives its name to exemplify the declension of the Sun at this period, which is what is commonly called the winter solstice, when the days are at the shortest pitch in the Northern Hemisphere; therefore its appellation is remarkably appropriate, as it is the peculiar quality of the goat to climb the highest precipices; therefore the ancients chose this similitude to exemplify the knowledge they had attained that the Sun would for the space of six months gradually advance till it had gained its highest elevated situation. Aquarius or the water bearer, in January, is a lively type of the succession of rain, snow and hail which frequently characterizes that season; and lastly, the Constellation Pisces or the fishes, in February, equally denoted that the fish as a natural consequence, at that period when their native element is more abundant, is from that effect in the greatest degree of perfection: thus
you

you will perceive that the ancients who had no almanacks, and not even an alphabet, were enabled by these symbols to regulate the division of time, ascertain their annual pursuits and expectations with as much precision as we, who by the aid of science can keep regular accounts and transmit our ideas and sentiments to distant regions: but we must cease to wonder when we reflect that the Heavens were to them an index on which all useful necessary information was legibly inscribed.

Lady L. My dear Mentoria, my admiration of these clever people is lost in adoration of the Supreme Being, who wisely ordained these discoveries to be made.

Ment. The world would have been a mere machine of chaos or confusion, had not the goodness of God inspired his frail creatures with the means of reducing his diffused blessings to a general state of order, a lesson that is forcibly inculcated by the observation of the celestial luminaries, which are uniform in their course, and manifest the wisdom and omnipotence of their great Creator.

Lady L. I am surprised to hear you mention the Sun as a body that changes its situation; I recollect your informing me it was stationary in the centre of the solar system.

Ment.

Ment. The Earth's revolution as a Planet, and also on its own axis, were circumstances that were discovered long after the division of the year adopted by the Chaldeans and Egyptians. In the first ages of the world there is no doubt the inhabitants imagined the Earth was a plane or flat surface, and that the Sun constantly moved its position and resumed its course, which produced to them the succession of day and night, and the vicissitudes of the seasons: this was a very natural conclusion, as the mere suggestions of perception could not convince any person unenlightened by science, that the Earth is in constant motion, and that its progress round the Sun is rapid beyond our finite comprehension. It may perhaps in some measure conduce to your amusement, and tend to your improvement if I trace the regular gradations which operated to bring Astronomy to its present state of perfection. Industry and experience are the grounds of the most useful knowledge, the one is a spur to action, the other a guide to valuable achievements.

Lady L. I promise myself much pleasure in hearing your account of the progress of so interesting and sublime a science.

Ment.

Ment. Thales the Milesian about 580 years before the Christian *Æra*, was the first philosopher who taught Astronomy in Europe; he had gained such a degree of perfection in the science, he calculated eclipses of the Sun and Moon, and discovered the rotundity of the Earth. Pythagoras a Greek Philosopher distinguished himself about 50 years after, who, no doubt, from the observations Thales had made, had a clear idea of the revolutions of the celestial bodies, which suggested to him the probability that the Earth was in motion, and that the Sun remained stationary: as this opinion was contrary to the general belief or perception, this new system gained no great progress, nor was ever much esteemed by the ancients. As the means of reconciling this contrariety of sentiments on so important a branch of philosophy, the most learned men at that period endeavoured to establish an intermediate system; therefore Ptolemy an Egyptian philosopher, who flourished above 138 years before Christ, formed a system which he constructed on a plan to reconcile the contending parties. His opinions tended to confirm that the Earth was fixed immoveably in the centre of the Universe; that the seven Planets (considering the Moon as one of the primaries) were placed

placed near to it; above them he asserted was the firmament of fixed Stars and chrystaline Orbs, then the Primum Mobile, by which you are to understand the first principle of motion; and lastly, the Coelum Emperium or Heaven of Heavens. All these immense Orbs he imagined moved round the Earth once in 24 hours; as the means of accounting for these revolutions, he conceived a number of circles called eccentrics and epicycles crossing or intersecting one another, consequently perpetually interfering in their progress; this system was universally received from the time of Ptolemy to the revival of learning in the sixteenth century. It is uncertain by whom artificial globes were invented, yet it is clearly known that Hipparchus, and Archemides, about 200 years before the Christian Æra, by their respective improvements in Geometry and other branches of the Mathematics, rendered the use of the spheres to be relied on, by making them correspond with the aspect of the Heavens, and the motion of the Stars.

Lady M. I cannot express how much I esteem myself obliged by the instructions you give us; I hope essentially to profit by so much useful information.

Ment.

Ment. Notwithstanding the Europeans were in some degree emerged from the abyſs of total ignorance ; yet ſcience or what we rank as knowledge was but in the dawn of its luſtre ; prejudices prevailed, which gradually abated as bigotry declined and the errors of religious faith were vanquiſhed by the firm eſtabliſhment and happy effects of the reformation. Previous to that event learning was chiefly poſſeſſed by the heathen Philoſophers, who advanced certain ingenious opinions and moral precepts in their ſchools ; and in times not quite ſo remote, by Monks and Friars, whoſe intereſt it was to keep the community in a ſtate of profound ignorance ; as when once the human mind became enlightened, their dominion was at an end.

Lady L. How thankful we ought to be that we live in an age ſo conſpicuous for the attainment of every deſirable acquiſition.

Ment. I muſt now proceed to inform you that Copernicus, a native of Poland, who was of an enterpriſing eccentric genius, about the period Anno Domini 1530 ventured to adopt the Pythagorean or true ſyſtem of the Univerſe : this doctrine, however juſt in its principles, had been ſo little attended to, that the Philoſopher who was the inſtrument of its reſtoration

was

considered by the generality of persons, as the inventor or founder of the system, which from thence obtained the name of the Copernican philosophy. The religious feuds and the combined selfish views of the professors of Christianity at that period, greatly tended to check the establishment of a theory which has since been found to have been formed on a rational basis. The controversy which arose from some persons embracing and others rejecting the systems I have enumerated, gave rise to many absurd opinions respecting the œconomy of the Planetary Orbs : In this state of disputation, Tycho Brahe, a Dane of noble extraction, being convinced of the defects of the Ptolemaic system, but averse from acknowledging the motion of the Earth, attempted about the year 1586 to establish a new theory of his own fabrication, which was still more complex and inconsistent than the one formed by Ptolemy. The principal opinions he advanced were, that the Moon had a monthly motion round the Earth as the centre of its Orbit : the Sun he considered as the centre of the Orbits of Mercury, Venus, Mars, Jupiter and Saturn. The Sun he supposed with all these Planets revolved round the Earth in a year, and even once in the short
space

space of twenty-four hours; this system, notwithstanding its palpable errors, met with many advocates, and Longomontanus so far improved and refined upon its tenets, as to admit of the diurnal motion of the Earth, though he denied its annual revolution. This we must allow was one essential point gained, and was undoubtedly the infant state of that philosophical perfection which was attained in the 17th century, in which science may have been said to have gained its meridional height. About the year 1610 Galileo a Florentine, whom I have previously mentioned as being the means of first applying telescopes to astronomical purposes, discovered new arguments to prove the motion of the Earth, which tended to confirm those before advanced; but as these opinions were under the influence of Papal authority, thought inconsistent with the religious principles he professed, Galileo was compelled to renounce these rational ideas, as they were considered a heresy or offence against the Church, though in effect only like every other branch of knowledge militating against its usurping oppressive ministers or priests. In this struggle, or scientific conflict, it remained for one superior genius to complete what so many had endeavoured in vain to compass with

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permanent

permanent effect, and this honour was reserved for Sir Isaac Newton, who flourished about the end of the 17th century. This eminent philosopher was a native of Great Britain, and was as much esteemed for his private virtues, as admired for his distinguished eminence in the most profound and occult branches of science: as he was a good man in the most comprehensive sense of the word, and a zealous sincere christian, his researches all tended and co-operated to display his reverence for the Supreme Being, whose works which shine with superior glory in the Heavens, he traced with accuracy, and defined with a degree of precision which have rendered his fame immortal. It is to the labours of this renowned Philosopher we are indebted for obtaining just conceptions of the various properties and motions of the celestial bodies, and also for the discovery of the principles of the general law of Nature which regulates their respective revolutions. This law is termed Gravity or Attraction, and is the same by which any body falls to the ground when disengaged from what supported it. The universal gravitation of matter to its common centre is a general principle, and may be traced in regular gradation as to its effect, from the Planetary system to the most incon-

inconsiderable object on the terrestrial globe : as every particle gravitates or tends to its central point, which is produced by the powers of Attraction. It has been clearly demonstrated that the natural effects of Attraction and Gravitation keep the sea in its due bounds, and also the various bodies which cover the surface of the Earth from flying into the air ; it has the same operation on every part of the universe, confines the Planets in their proper Orbits, and preserves the whole fabric of Nature from disorder and confusion. I have expatiated very fully on the advantages we have derived from Sir Isaac Newton's valuable discoveries, and cannot adopt any better means for concluding his deserved eulogium, than by citing Pope's concise epitaph, which in a small compass implies the superior lustre of his genius and fame.

Nature, and Nature's laws, lay hid in Night ;
God said, let Newton be, and all was Light !

Lady M. I admire the account you have given of Sir Isaac Newton, and am much obliged to you for quoting the epitaph, which so fully expresses the great effects his genius produced. I suppose when first these philosophers

talked of the Earth moving, they were thought absurd, and very few believed them.

Ment. In all instances, when the human mind is converted from chaotic ignorance, the first effort must require strong conviction to efface the influence of prejudice and fixed habits of thinking; yet when facts are clearly deduced, and opinions embraced, on the evidence of reason, rays of knowledge diffuse their light and become objects of admiration and belief. Persons whose minds are uninformed, are not always credulous, and apt to receive new opinions; suspicion and ignorance go hand in hand, which are material obstacles to essential improvement and the general diffusion of knowledge. I remember in the course of my reading to have met with a remarkable proof to this effect, in the following instance.

To the best of my recollection, an ambassador was sent from a Northern Potentate, to a Prince in some torrid region, who naturally enquired for an account of the country he came from. When the ambassador described the sea as frozen, and the ground covered with snow, which he represented as a beautiful white substance, the ignorant Prince dismissed him, and sent him back with this message, that he
could

could not think of forming any treaty with a nation whose minister was such a notorious liar. Another fact may also be produced of a similar tendency. When St. Paul was pleading his cause before king Agrippa; whilst he was discoursing on the resurrection of the body, Festus called out with a loud voice, "Paul thou art beside thyself, much learning doth make thee mad"! Thus we perceive in both the instances I have specified, ignorance proved a bar to conviction.

Lady M. Yet I can hardly blame the Prince, as the country he lived in presented no such objects, as the ambassador described; and I imagine Festus, as he was not a Christian, did not believe in the Resurrection.

Ment. The evidence or belief of circumstances beyond our comprehension, in religious subjects, is produced by what is theologically called Faith, which is indispensibly required in all matters concerning the promises of God, and the facts that are related in holy writ. In circumstances of lesser importance, we should ever give credit to respectable testimonies; as our ideas must be very contracted, if we only believe what we see, or what we hear, which comprehends what is usually called ocular and

auricular demonstration, or proof. Philosophy clears the path of profound ignorance, by planting knowledge in the various departments of Science and other general vehicles of instruction; and Revelation removes every doubt, and affords every hope a reasonable being can form. Even the Resurrection of the Body, which was a stumbling block to Festus, who was a Heathen, is a beacon of hope to a devout Christian; nor can the intellectual powers doubt, which perceive vegetation renewed, though apparently in the indissoluble bands of death, but that in a future state their own existence will bloom, through the endless ages of eternity.

Lady L. I am greatly obliged to you for placing these observations in a point of view to impress on my mind a due sense of their importance; as knowledge is such a valuable acquisition, I am surprised any persons remain in a state of ignorance.

Ment. A variety of circumstances conspire to check the zeal for attaining this treasure; in the first place there are many who do not possess the means, and others neglect those opportunities which are afforded them. Perseverance is a necessary ingredient in compassing this desirable end, yet but few comparatively have resolution

solution to apply closely to any particular study, and those who are surrounded by objects to excite useful enquiry, are often too supine, to turn them to due advantage. How many with extensive Gardens, stored with native and exotic Plants, neglect the study of Botany? How many with Libraries amply furnished with the productions of the best authors, read only trash, the offspring of some flippant writer? How many, surrounded by all the beauties of Nature, despise their simple yet majestic charms, and devote their time and attention to all the delusive fripperies of Art? These much to be lamented truths, are the primary source of depraved or uncultivated intellects; as the soil or quality of the understanding is of such a nature, that if we neglect to adorn it with fruits and flowers, it will spontaneously be over-run with noxious and baneful weeds.

Lady M. It should inspire us with gratitude, that we receive an Education that inculcates all important branches of knowledge.

Ment. The learning you should be zealous to acquire, consists of that genuine kind of information that will bear the test of critical investigation. There is a species of superficial knowledge, that may be compared to tinsel,

which is glaring in effect, without possessing any real lustre, and when put in competition with sterling gold, bears no proportion in intrinsic value. Let your pursuits be well directed, and your application uniform; as wisdom is not to be acquired by flights of fancy, but must be fought with ardour, and cherished by reflection.

DIALOGUE

NORTHERN CONSTELLATIONS.

CONSTELLATIONS.	ENGLISH NAMES.	PRINCIPAL STARS.
Urfa Major, or Helice....	The Greater Bear ...	Dubhe, in neck. Aliath, and Benenatch, in tail. Alcor, small one in tail.
Urfa Minor.....	The Lesser Bear.....	Cynofura, (the Polar Star) in tail. Kochab, in neck.
Draco.....	The Dragon.....	Ras Tabin, in head.
Cepheus.....[and Chara]	.....	Alderamin, in left shoulder.
Canes Venatici (Asterion),	The Hounds	.....
Boötes.....	.....	Arcturus, in coat. Ceginus, in right shoulder. Mirach, in belt.
Mons Menalus	.....	.....
Coma Berenices.....	Berenice's Hair	.....
Cor Caroli.....	Charles's Heart	.....
Corona Borealis.....	The Northern Crown	Alphacca, or Lucida Coronæ.
Hercules, or Engonafi.....	.....	Ras Al Giethi, in head. Rutilicum, in left shoulder. Marfic, in club. Maafym,
Cerberus	.....	in right arm.
Lyra, or Vultur Cadens.	The Lyre.....	Lucida Lyrae.
Cygnus.....	The Swan.....	Deneb Adigege, in tail. Agilfage, Albirco, in beak.
Vulpecula.....	The Fox	.....
Anser.....	The Goose	.....
Lacerta Stellio.....	The Lizard	.....
Cassiopeia.....	.....	Shader, in breast.
Camelopardus.....	The Camelopard	.....
Serpens, or Ophiuchi....	The Serpent	.....
Serpentarius, or Ophiuchus	.....	Ras Al Hague, in Head. Yed, in right hand.
Scutum Sobieski.....	Sobieski's Shield	.....
Aquila, or Vultur Volans	The Eagle.....	Alcair, or Atair, in neck.
Antinous, or Ganymedes	.....	.....
Delphinus.....	The Dolphin	.....
Equulus.....	The Little Horse	.....
Sagitta.....	The Arrow	.....
Andromeda.....	.....	Caput Andromedæ, in head. Migar, in belt. Almaak, in right foot. [in fide.
Perseus.....	.....	Caput Medusæ, (Medusa's Head) a Cluster. Algol, in Caput Medusæ. Algenib,
Pegasus.....	.....	Enif, in nose. Marhab, in shoulder. Scheat Alpheus, in left leg.
Auriga.....	The Charioteer.....	Capella, in the Goat. Hædi, the Kids.
Lynx	.....	.....
Leo Minor.....	The Lesser Lion	.....
Triangulum.....	The Triangle	.....
Triangulum Minus.....	The Little Triangle	.....
Musca.....	The Fly	.....

CONSTELLATIONS IN THE ZODIAC.

CONSTELLATIONS.	Signs.	ENGLISH NAMES.	PRINCIPAL STARS.
Aries.....	♈	The Ram	.....
Taurus.....	♉	The Bull.....	Pleiades, a cluster in the neck. Hyades, cluster in face. [eye) one of the Hyades.
Gemini.....	♊	The Twins.....	Castor and Pollux, in the head of the Twins. Aldebaran, (the Bull's
Cancer.....	♋	The Crab.....	Præsepe, in back.
Leo.....	♌	The Lion.....	Regulus, or Cor Leonis, heart. Deneb Al Affad, in tail.
Virgo.....	♍	The Virgin.....	Vindemiatrix, in right shoulder. Spica Virginis, wheat in right hand.
Libra.....	♎	The Balance.....	Zuberefchemali, in right scale. Zuberelgenusi, in left scale.
Scorpio.....	♏	The Scorpion.....	Antares, or Cor Scorpii, heart. Lefath, in tail.
Sagittarius.....	♐	The Archer.....	Nebulosa, in nose.
Capricornus.....	♑	The Goat.....	Deneb Al Gedi, in tail.
Aquarius.....	♒	The Water-Bearer...	Scheat, in leg. Fomalhaut, last in the water.
Pisces.....	♓	The Fishes.....	Nodus Celestis, the knot of the ribbon.

These are the Signs of the Zodiac. The six first are called the Northern Signs, and the six last the Southern.

SOUTHERN CONSTELLATIONS.

CONSTELLATIONS.	ENGLISH NAMES.	PRINCIPAL STARS.
Cetus.....	The Whale.....	Menhar, in mouth. Batan Ketus, in fide. Deneb Ketus, in tail.
Eridanus.....	.....	Achernar.
Phoenix	.....	.....
Toucan	.....	.....
Orion.....	.....	Rigel, in right foot. Bellatrix, in right shoulder. Betelgeuse, in left shoulder.
Monoceros.....	The Unicorn	.....
Canis Minor.....	The Lesser Dog.....	Procyon, in fide.
Apus	.....	.....
Hydra.....	.....	Alphard, or Cor Hydræ, heart.
Sextans Uranie	.....	.....
Crater.....	The Cup.....	Alches, in stand.
Corvus.....	The Raven.....	Algorab, in right wing.
Centaurus.....	The Centaur	.....
Lupus.....	The Wolf	.....
Ara.....	The Altar [gle	.....
Triangulum Australis....	The Southern Trian-	.....
Pavo.....	The Peacock	.....
Corona Australis.....	The Southern Crown	.....
Grus.....	The Crane	.....
Piscis Australis.....	The Southern Fish	.....
Lepus.....	The Hare	.....
Columba Noachi.....	Noah's Dove	.....
Robur Caroli.....	Charles's oak (Crossiers	.....
Crux.....	The Cross, sometimes	.....
Argo Navis.....	The Ship Argo.....	Canopus.
Canis Major.....	The Greater Dog ...	Sirius, (the Dog-Star) in mouth. Ifis, in right ear.
Apis.....	The Bee	.....
Hirundo.....	The Swallow	.....
Indus.....	The Indian	.....
Camelion	.....	.....
Piscis Volans.....	The Flying Fish	.....
Xiphias.....	The Sword Fish	.....

DIALOGUE IV.

THURSDAY.

On the Succession of Day and
Night, and the Vicissitudes
of the Seasons.

Lady Mary:

WHAT will now be the subject of your instructions, my dear Mentoria? I was so well pleased with your observations on the fixed Stars and the Zodiac, I anticipate much entertainment from the next object you are inclined to explain.

Mentoria. It appears necessary to make some remarks on the regular succession of Day and Night, the vicissitudes of the Seasons, Eclipses,

and Tides, as they are immediately connected with the foregoing observations on the Solar System; though I shall be less copious on those subjects, as by my former instructions, I flatter myself with the hope, you are tolerably well informed respecting those interesting particulars. The revolution of the Earth on its own Axis, produces what is usually called its diurnal motion, which it performs in the space of 24 hours. In the course of this revolving rotation, whilst that part of the Globe we inhabit is turned toward the Sun, we are consequently cheered by his beams, which constitutes our day; in like manner, when the Earth is turned from the Sun, we are involved in darkness, which makes our night, whilst the other Hemisphere enjoys day: thus you will perceive that they are both alternatively enlightened.

Lady Louisa. I clearly comprehend what occasions the regular rotation of day and night; but wish to know by what means morning, and evening, are produced.

Ment. In consequence of the Sun's great magnitude and distance, the rays of light he emits, fall in a parallel direction on the Earth, which invariably illuminates one of her Hemispheres, therefore whilst any place on the Globe
continues

continues in the darkened part, it is night in those regions, but as soon as that place, by the diurnal rotation of the Earth from West to East, approaches to the verge of the enlightened Hemisphere, what is usually called day-break or Morning, appears. In the Earth's rotation on her own Axis also, when the meridian of that place is brought beneath or under the Sun, it is then said to be Noon there and at every other place of the same meridian; in regular progression as this place advances in the Earth's revolution, it again reaches the boundaries of the darkened Hemisphere, which produces the dusky shades of Evening, and in uniform gradation, the return of Night.

Lady L. In our lectures on Geography, I recollect some of the circumstances you have just recited.

Ment. Astronomy may be considered as the counterpart of Geography; as merely being acquainted with the form of the Earth, and the situation of different countries, would be a very imperfect kind of knowledge. When you hear on what part of the Globe any particular place is situated, you become interested, and wish to be informed, whether it is hot or cold, and what allotment of light, and other

comforts, the inhabitants enjoy: these can never be accurately ascertained, unless you are in some degree instructed in Astronomy, which would enable you to calculate what influence the light and heat of the Sun have over it, and give you a clear idea of its temperature, length of day, and natural productions. For example, we will suppose an ignorant person to be in company, and that Greenland, and Guinea, should be the subject of conversation, he would form no conception whether the inhabitants were scorched by heat, or frozen by cold; whilst the well-informed would have a perfect knowledge of the opposite qualities of each respective region.

Lady L. By what means could this knowledge be attained?

Ment. They would recollect that Greenland is in the frigid, and Guinea in the torrid zone. That the former from its remote Northern situation must be intensely cold; and that the latter by being situated between the tropics, where the influence of the Sun is so great, consequently is subject to intense heat. They would also know that beyond the arctic circle, the inhabitants of those regions in Summer, have a progressive portion of day-light, from one month

month to six, and in Winter the same portion of darkness or night. They would also be sensible, that those who reside in the torrid zone, have not days of any considerable length, as the days and nights are uniformly equal in those countries that are situated immediately under the Equinoctial line, and that from that space to the arctic circle, which is the boundary of the Northern frigid zone, there are 24 climates, each of which increase by half an hour in the length of each day, which may be easily calculated with certain precision, and it may be proper to observe the same effects at contrary periods occur, in the Southern frigid zone.

Lady M. I should not wish to live in Guinea, or Greenland.

Ment. Undoubtedly a station between those two extremes is more agreeable; yet I make no doubt, each party are satisfied with their allotment. In the torrid zone Providence has amply supplied the inhabitants with an abundant portion of blessings, to conduce to their comfort, which in a great measure are spontaneous. In some places gold is found in such plenty in the beds of the rivers, it is not necessary to work the mines, which produce that valuable metal.

Lady

Lady L. I think it would be very desirable to live where there is such abundance of gold.

Ment. In an uncivilized country, gold is of itself of no intrinsic value to the native possessors; as it obtains its consequence and worth by being the medium to procure us the necessities and conveniences of life, which is evident, as in some of the countries where this metal abounds in its genuine state, the ignorant primitive inhabitants were rejoiced to exchange it for glass beads, and other ornaments, and implements of no comparative degree of value. The importance of a possession, depends on the circumstances of our condition; thus to a Savage, who is not skilled in mechanics, an iron hatchet is a more valuable acquisition, than an ingot of gold.

Lady M. I perceive this very forcibly, and do not envy these people their possessions; yet I think they are better provided for than the Greenlanders; as I have often read of the hardships they undergo,

Ment. The great Creator of the universe, has dispensed a degree of provision for all the inhabitants of the Earth, suited to the peculiar state of each region; it is true, each district
does

does not appear to possess an equal portion of those things we consider as essential to happiness; yet the estimation of blessings depends more on the force of habit, than their intrinsic quality. The Greenlanders as inhabitants of the frigid zone, have but few resources in the article of food. Fish, Seals, Sea-towl, and Rein Deer, form the chief of their subsistence, and their train oil which we could not eat, is esteemed a luxurious addition to their simple repasts.

Lady M. Why are Whales found more frequently in the Northern, than any other Seas?

Ment. They are not peculiar to the Northern frigid zone, as many are found also in the Southern; Providence has wisely ordained that the fish which inhabit the Seas, in the frozen zones, are furnished with a very large portion of fat, or blubber, which by a due preparation, is converted into oil, being thus liberally endued with this unctuous substance, enables Whales, Seals, &c. &c. to subsist where the ocean is frozen, as fat renders animals that are clothed with it in a very great degree not very susceptible of cold: thus you see in this, as in every other instance, the wise Creator of the universe
has

has fitted each creature to its allotted station. I must now close this long digression, and proceed to give you some account of the variations of the Seasons.

Lady M. I expect much entertainment from that subject, and will not interrupt you, except to request you will accept my best thanks for the improvement you have already imparted.

Ment. The seasons which consist of the regular succession of Spring, Summer, Autumn, and Winter, are produced by the Earth's annual motion round the Sun, which not being in the plane of the equator, but in an Orbit inclined to it in an angle of 23 degrees and half, as the Earth turns from West to East. The Spring is the season of the year first to be considered, at this period, in this situation of the Earth, the equator is opposed to the Sun, and in consequence of his always enlightening a Hemisphere or half the surface of the globe, his light by being now equally divided, reaches to both the Poles: therefore from the diurnal revolution of the Earth, the days and nights are equal at all parts.

Lady

Lady M. I recollect your informing me that the sign Aries or the Ram was the vernal or spring equinox.

Men. When the Sun enters the opposite sign Libra or the balance, it produces the same effects respecting the equality of the days and nights, and is hence called the autumnal equinox.

Lady L. I will remember to observe these circumstances when the proper period arrives.

Ment. We must now examine the properties of Summer; in order to give you a clear idea of this season I must observe when the Earth has advanced in its Orbit through Libra, Scorpio, and Sagittarius when it arrives at the first degree of Capricorn, the North Pole is turned to the Sun, and the tropic of Cancer is opposite to him; and as the inclination of the Earth's Axis is 23 degrees and an half, just so far the rays of the Sun reach beyond the North Pole, and in the same degree are defective at the South Pole; consequently the whole of the Arctic circle is enlightened and the Antarctic circle deprived of light: from which it will clearly appear to you that in the Northern Hemisphere it is the longest day which constitutes Summer, and in the Southern half of the
Globe

Globe the shortest day, or Winter ; but under the Equator the days and nights are uniformly equal, consisting of twelve hours each, which comprehends the twenty-four hours that is the period of the Earth's rotation on her own Axis.

Lady M. I had not before a clear notion that when it is our Summer the inhabitants of the contrary Hemisphere have Winter.

Ment. This is a natural consequence, as at the period the Earth is proceeding from the sign Libra or the balance, the North Pole is approaching towards the Sun, whilst the Southern Pole recedes from him ; therefore the length of the day is increasing in the Northern Hemisphere and declining in the Southern. In the space of three months the scene will be wholly changed, for as the Sun will then be over the Equator, both Poles will again be enlightened by his rays, and the day and night consequently equal in every part of the Globe. The Sun at this season will be rising to the South and setting to the North ; this is what is called Autumn.

Lady L. The situation of the Sun and Earth which produces the equality of days and nights in the period you have been describing, I
suppose

suppose is what is called the Autumnal Equinox.

Ment. Undoubtedly, and as the Earth advances towards Winter, the South Poles will be turned to the Sun, and the North Pole from him; therefore when the Earth is in the sign Cancer it is Summer in the regions to the south of the Equator at the period when it is our Winter: this you will perceive is occasioned by the Sun's being over the tropic of Capricorn, which is as many degrees south of the Equator as the tropic of Capricorn is to the north of it when the Sun was in our Summer; at this period the Antarctic circle is enlightened and the Arctic obscured in darkness, but under the Equator the days and nights are equal. The Sun continues above the horizon of the south Pole till the vernal Equinox, when he will again rise to the north Pole, and with unceasing regularity fulfil the rotation of the successive seasons.

Lady M. I cannot express how much I admire the variety that we experience in the different effects of the seasons, as they change in annual regularity and order.

Ment. If the Axis of the Earth were perpendicular to the plane of the Earth's Orbit,
the

the days would be invariably of the same length and we should have no diversity of seasons.

Lady M. That would be very agreeable, I should like always to have the seasons like spring or autumn, and the days never shorter: pray what would produce that effect?

Ment. The Sun being over the Equator, which must at all times enlighten both Poles of the Earth, and would make the days and nights constantly equal, as their variation is produced by the inclination of the Earth's Axis and its preserving its parallelism, by which term you are to understand, the Earth keeping its Axis in its natural revolution round the Sun in a position always parallel to itself, which it nearly does. When the Sun is in the first point of Aries, the Earth must be in the beginning of Libra, as that is the opposite sign.

Lady L. How much I pity the inhabitants of the frigid zone, because in winter they have so great a portion of darkness.

Ment. This apparent evil is mitigated by the kind hand of Providence, as even under the Poles when the Sun is not visible to them, they are but a short time involved in absolute darkness; as the twilight continues till the sun is 18 degrees below the horizon, and his greatest depression

depression is but 23 degrees and an half, equal to the inclination of the Earth's Axis. The Moon also is above the horizon of the Poles for about the space of a fortnight, being half her period North and the other South of the Equator; therefore as the Moon at full is in the sign opposite to the Sun, the tropical full Moon must be 24 hours above the horizon at the Polar circles.

Lady M. I cannot sufficiently admire the goodness of God in dispensing such alleviating mercies to the inhabitants of such unfavourable climes.

Ment. These beneficent effects may be traced in every instance: the Sun, which continues longer above the horizon in Summer than in Winter, enlivens our pursuits: but as a counterbalance for the comparatively short portions of his rays that we enjoy in Winter, the Moon at that season continues longer visible to us than in Summer when we stand less in need of her assistance. You will perhaps scarcely believe that in the height of our Summer, we are farther from the Sun than in Winter.

Lady L. How can that possibly be? I must not doubt your assertions, though I cannot imagine

gine as a fact what appears so inconsistent with the evidence of reason.

Ment. This seeming paradox is produced by the days being shorter at that period and the Sun's rays falling in a very oblique direction on the Earth, which are more diffused than they are in Summer when he remains longer above the horizon, and by being higher, transmits his rays in a more distinct manner, by which means the Earth acquires and retains so great a portion of heat that it cannot be subdued or extinguished during the space of a short night, which is occasioned by the Sun being more nearly in a vertical position, and his beams consequently of a denser or thicker quality and not so much weakened by refraction as when they are emitted in a more indirect course as they are in Winter.

Lady. M. I cannot comprehend how this can be proved.

Ment. By observations on the Sun's diameter, which it has been demonstrated is on the shortest day 32 deg. 48 min. and on the longest day 31 deg. 30 min. which ascertains beyond the possibility of a doubt, the proportion of proximity with respect to the Earth.

Lady

Lady L. What portion of the Globe is supposed to feel the heat of the Sun in the greatest degree?

Ment. When the Earth is nearest to the Sun, it is Summer in the Southern Hemisphere; therefore it is reasonable to imagine, the inhabitants of those regions experience a greater degree of heat, than those which are situated in the same degree of latitude in the opposite Hemisphere; to counterbalance this circumstance, their Summer is shorter than ours, by the space of eight days; it is also colder near the Poles in the Southern, than the Northern Hemisphere, which is occasioned by there being more land, which naturally retains the heat, whilst on the contrary the intense cold near both the Poles, in a great measure proceeds from the fields of ice in the Ocean, which even the rays of the Sun in Summer do not wholly dissolve, by the most powerful influence of their genial heat.

Lady M. I seem better acquainted with the Zones, than most parts of your instructions on Astronomy.

Ment. This knowledge you have acquired in your geographical lessons, and I make no doubt that you recollect the Globe is divided
into

into five Zones, or Belts, one Torrid, two Temperate, and two Frigid, appellations which clearly denote their respective qualities. The Equator divides the Globe into two Hemispheres or equal parts, the one Northern and the other Southern ; on this circle the degrees of Longitude are marked, by which you are to understand the distance of any particular place, East or West, from the meridional point ascertained on that map or Globe, which cannot in any instance exceed 180 degrees. The meridian divides the Globe into two Hemispheres, Eastern and Western, on which the degrees of Latitude are placed ; by these the distance of any place is found North or South from the Equator, and as there are 90 degrees from the Equator to each Pole, no place can exceed that number, as you will remember the circumference of the Globe is 360 degrees. The Ecliptic is a certain line that runs through the Zodiac, to shew the Sun's annual path in the Heavens, on which are marked those Constellations, called the Signs of the Zodiac.

Lady M. When I consider the different pleasures we enjoy in every Season, I know not which to prefer.

Ment.

Ment. The seasons all abound with sources of delight and admiration. In Spring we behold the works of Nature unfold by gradual degrees, till they attain the highest perfection of beauty. Vegetation, the Animal world, and the general face of things, inspire a contemplative mind with those lively sensations that afford a kind of rational banquet, where the eye is regaled with varied excellence, the ear charmed with melody, and the intellectual powers kept in perpetual pursuit, by the investigation of the progressive renovating changes peculiarly appropriate to this season. Spring with propriety may be said to be the youth of the year, in which bloom is but the harbinger of the more mature perfection which Summer presents; buds and blossoms become fruits and flowers, and the pleasing expectations formed from vernal fructification, are realized; this luxuriant period may be styled Nature's Meridian, as the Earth at this season is at the height of its splendor, Vegetation in the zenith of its glory, and every surrounding object cheered by the vivid rays of the Sun, which diffuse the blessings of plenty, adorned by resplendent beauty. In Autumn we perceive the ample provision which is wisely ordained for the preserva-

tion and sustenance of every species of animals, as Nature at this season pours forth her richest gifts with a liberal hand in the various means she furnishes for our support and happiness. Winter, which appears at the first view to be a dreary comfortless season, serves the purpose of a kind of repose to all the varied works of the Creation, and produces that variety and contrast which constitutes in a combined sense the genuine beauty of the seasons, or rather manifests the infinite wisdom of their omniscient Creator. In frost, snow, or hail, we may trace certain degrees of beauty and utility, and perceive the beneficial purposes for which they were designed ; as the rigour of Winter destroys the pernicious effects which would arise from the exuberance of insects and reptiles that are generated in Summer, and fertilizes the Earth for the approaching productions of Spring : therefore the whole year, as taken in the aggregate, may be regarded as a circle of varied excellence.

Lady L. I never before formed any idea, that each season abounded with so many advantages, as you have enumerated.

Ment. The change of Seasons produces in general no other sensations in the minds of
common

common observers, than the habitual ideas that occur, respecting the change of residence and situation which they often produce ; thus for instance, many prefer Winter, as at that period they visit the metropolis, and are engaged in a constant succession of dissipation and luxurious pursuits : whilst others dread its approach, because they live in retired situations, and are in some degree debarred from social intercourse.

Lady M. I think there is no degree of comparison respecting the preference which ought to be given to the situations you have described : I shall not hesitate to determine in favor of Winter, as at that season I see the most company.

Ment. Society is the balm of life, and rational modes of amusement may be enjoyed without deviation from our prescribed line of duty ; yet how frequently do the pursuits of what is delusively called pleasure, produce the contrary effects of disquietude and repentance. Each season points out to the intelligent mind a certain mode of comfort, peculiarly adapted to its circumstances and quality ; such as in Winter, a cheerful fire, social converse, innocent recreations, consisting of those which can occasion no perturbation of mind, or just cause of

blame or regret. Constant employment is the grand specific against what the French call ennui ; but we must be ever cautious, that the use of our time should be turned to such objects, as may produce individual advantage, or public benefit.

Lady M. I observe you mention that our amusements should be of a nature to produce no uneasiness or unpleasant consequence ; I think there is no danger they ever should.

Ment. Of this there is greater probability than you are aware ; as the pursuit of diversion frequently induces persons to engage in schemes, or enter into plans that are inadequate to their finances, or incompatible with the arrangement their situation in life requires ; games of chance also, or those that depend on any degree of skill, engage young minds with too great a degree of ardour and anxiety ; therefore the object to be won, or lost, should always be of trifling value, as both parties cannot be successful ; and though the victor experiences sensations of triumphant pleasure, the vanquished or persons conquered, are subjected to an equal portion of regret.

Lady L. I must confess that I am always pleased when I win, though I do not care for the money.

Ment.

Ment. This is the genuine sentiment, arising from the simplicity and uncorrupted state of your heart ; but intercourse with the world blunts these fine perceptions, and the hope of gain often degenerates into means and measures, not always according with liberality or strict justice.

Lady M. I will zealously guard against the consequences you so forcibly describe ; and I imagine you will recommend a course of reading as our general pursuit in Winter.

Ment. I am rather inclined to a diversity of avocations, as they exercise the various faculties of the mind ; neither am I averse to what is usually called gaiety, when pursued as a relaxation under certain restrictions, and regulated by the rules which good sense and prudence prescribe. The theatre is a source of amusement and improvement, when the subjects chosen for representation, are of a tendency to inspire noble sentiments, by bright examples ; or to exhibit Vice and Folly in their proper colours. Concerts and musical entertainments are not only agreeable and desirable, but may even be turned to excite devout sensations, or to exhilarate the fancy by lively compositions. Dancing is a wholesome exercise, and source of diversion,

and also tends to add grace and dignity to the deportment. Painting and drawing of every species, are an elegant pleasing employ, and when extended to taking views, or copying from Nature, afford an inexhaustible fund of gratification to a mind replete with refined ideas.

Lady L. By pursuing the plan you recommend, I am convinced time will never appear burdensome to me, even in the depth of Winter.

Ment. It is impossible to enumerate the varied objects of pursuit, as they must arise from the circumstances that surround us. Needle work, of the useful and ornamental kind, should engage a portion of your time and attention, as being more particularly a feminine employ, and productive of utility. Exercise is also a means of distributing time with advantage and pleasure, and may be compassed even in Winter, with benefit and delight. But above all I will point out the advantages arising from the study of the most approved authors, and from the conversation of intelligent, well-bred persons; this is not only the means of passing over time agreeably, but with substantial profit; as knowledge is not only confined to books, but

but may be diffused by various other means ; amongst which, none are more forcible than the admonitions, testimonies, or opinions of those we deservedly revere or esteem.

Lady M. I am perfectly satisfied with our allotment in Winter ; pray, *Mentoria*, point out of what nature our employ should be in Summer.

Ment. In speaking of our pursuits in different times of the year, we use the general term of Summer and Winter, with which we blend Spring and Autumn, and confine ourselves simply to the distinction of heat or cold, long or short days. In Summer every object takes a wide range ; the great portion of day-light we enjoy, and the genial warmth of the Season, conspire to disperse the generality of persons who can pursue their own inclinations. In the higher classes, the greater part retire from the bustle of public or splendid life, and take refuge in the calm retreat of their patrimonial mansions. Others in pursuit of health, or amusement, frequent places on the sea coast ; whilst the general mass, who are engaged in commerce and useful avocations, content themselves with occasional excursions, which can

be pursued without material interruption to the regular course of their business.

Lady L. I am always impatient to get into the country, and if it were in my power to chuse, should like some cottage, or rural spot, where I should be more happy than I can express.

Ment. These ideas are the effect of a youthful imagination, which is apt to figure to itself that wild, or romantic scenes would yield a superior degree of satisfaction ; when in fact they would, when the edge of novelty was worn off, produce vacuity and disgust. It is impossible to define by what measures happiness may be most effectually produced ; as much depends on the turn of mind, and the situation of the parties concerned ; yet we may safely venture to affirm, there is the best chance for attaining this desired end, by active, rather than abstracted means. A cottage allows but a small sphere of action, a pastoral life admits but of few variations, the habits are simple, and by constantly preserving the same uniform tenor, enervate, and cramp a mind inherently fraught with laudable curiosity.

Lady M.

Lady M. I have no doubt you would approve the plan of life pursued by our amiable friends Horatio and Amanda.

Ment. Distinguished merit like theirs claims approbation and applause. Their rank in life is high enough to supply them liberally with all that can be styled the blessings of life; and yet not sufficiently elevated, to involve them in the pernicious and disgraceful habitudes, that degrade too many who fill the first classes in society. In summer they reside at their country seat, in which elegance and convenience unite, their grounds are highly cultivated, their gardens are a Botanical school; agriculture also bears a share in this beautiful arrangement, as the whole estate is a Ferme Ornée. Horatio is a man of science, and neglects no opportunity to adopt every plan that may prove beneficial to society; his flocks and herds are of the finest quality, his horses of the best breed, and regularly trained, and his carriages of the most elegant and convenient construction.

Lady M. How happy Amanda must be in such a situation!

Ment. In those branches which come immediately under her department, every article approaches nearly to perfection. Her aviary

and poultry, form an assemblage of the most rare and beautiful kinds of fowls and birds; her shrubbery and green-house abound with the most curious plants, which she studies with the most minute attention, and by the most scientific rules. Her house displays the purity of her taste, the furniture being in the style of the most elegant simplicity, and many of the decorations most worthy of applause, executed by her own hand. In the whole of this rational system you perceive neither redundancy nor defect, and the most striking harmony is produced by judicious measures, effected by moderate means of expence. Horatio's and Amanda's method of living, is hospitable and liberal; but as it is uniform, kept within due bounds of prudent œconomy, by which mode they perform many signal acts of charity, though their fortune is far from being immense.

Lady L. I am always extremely happy when I pay them a visit; there is a library well stored with books, mathematical instruments of all kinds, and every thing that is curious or ingenious.

Ment. These are rational sources of amusement, and when properly recurred to, produce the happiest effects. Society forms a great part
of

of the comforts of this amiable pair, it consists of all the best families in the neighbourhood, by which I mean those most respectable, not always those of the highest rank ; as Horatio does not approve Lord Sceptic's principles, or Sir Richard Squander's profuse habits : neither does Amanda wish to associate, with dissipated Lady Random, nor contemptible Lady Sordid. The time and attention of these worthy members of society are greatly engaged by the education of their children ; as they do not confine their instructions merely to the hours allotted for their lessons, but are always inculcating some important branches of knowledge from every occurrence, and correcting all the errors they perceive, by the most forcible, yet gentle means.

Lady L. Horatio and Amanda are very kind to their servants, and poor neighbours, especially when they are sick ; and have also established a school for indigent children, who are instructed and clothed at their expence.

Ment. The performance of these essential duties, are the luxuries which I will recommend, as they never cloy ; every evil you mitigate is an exquisite gratification ; to alleviate the pains of sickness, remove the sting of poverty, or plant the seeds of knowledge, by the

application of due remedies and pecuniary relief, places a human character in the brightest point of view : thus you perceive Horatio and Amanda in their Summer residence shed a blessing on all who are within the sphere of their cheering influence. As the means of converting their bright example to your individual benefit, I shall observe, that notwithstanding you cannot wholly adopt their plan, let it impart this useful lesson, that virtue consists in active exertions, and that each season of the year calls us forth to fulfil some important duty ; as even the most minute object teems with instruction, and every dispensation demands the grateful tribute of reverence and admiration !

DIALOGUE

DIALOGUE V.

FRIDAY.

On Eclipses and Tides.

Mentoria.

THE observations I have made on the various qualities of the Solar System would be incomplete, unless I were to enumerate the distinct properties of Eclipses of the Sun and Moon, which you have seen and heard of, but I fear, are ignorant of their natural causes. A Solar Eclipse is produced by the Moon passing between the Earth and the Sun, which hides the light of the Sun from the Earth; this must happen at the New Moon, when the Moon is in conjunction with the Sun. It is called an
annular

annular Eclipse, when the Moon is so situated that its shadow being less than the disk of the Sun, conceals only the centre from our view ; the edge of the Sun appearing to surround it like a bright ring. If the whole of the Sun is obscured, the Eclipse is termed total ; but if only a part is darkened, it is called a partial Eclipse, and as many twelfth-parts as the Moon covers, so many digits are said to be eclipsed.

Lady Louisa. What do you mean by digits ?

Ment. The term digit, signifies the twelfth part of the diameter of either the Sun, or Moon, therefore is used to express the degree, in which either are occulted, or darkened. No solar Eclipses are universally seen throughout the whole hemisphere, which is occasioned by the Sun being then above it, the Moon's disk or face being too small, and too near the Earth, to hide the Sun from its disk. Usually the Moon's dark shadow covers only a space on the Earth's surface about 180 miles broad, when the Sun is at the greatest, and the Moon at the least distance ; though her partial shadow, or penumbra may at that period, cover a circular portion of 4900 miles in diameter within this space, the Sun is in a greater, or less degree

degree eclipsed; as the places are near, or distant from the centre of the penumbra.

Lady Mary. What is the signification of the word penumbra?

Ment. It implies a faint kind of shadow, on the extremity of the perfect, or complete shadow, which renders it difficult to determine where the shadow begins, or ends. By the observations I have made, I hope you clearly understand that Eclipses are a privation of light, which the inhabitants of the Earth derive from the Sun, or Moon. It most frequently happens in solar Eclipses, that the Moon's disk is covered with a faint light, which is ascribed to the reflection of the light from the illuminated parts of the Earth; in total Eclipses of the Sun, what is called the Moon's limb, (by which is meant the exterior border of her disk) appears surrounded by a pale circle of light, that some astronomers imagine indicates a lunar atmosphere of the Sun. When the Moon appears much less than the Sun, she is said to be in apage, and he in perige; the former term implies the greatest possible distance, the latter the nearest situation any Planet is removed from us. The total occultation of the Sun can never exceed four minutes, and more commonly not more

more than two minutes, though at some particular place on the Earth an Eclipse may last for more than two hours. A Solar Eclipse does not happen at the same time in all places where it is seen ; but is visible earliest in the Western parts, and later to the Eastern region, occasioned by the shadow of the Moon, as her motion is from West to East.

Lady L. I wish very much to hear what occasions a Lunar Eclipse.

Ment. An Eclipse of the Moon is produced by the Earth passing between the Sun and the Moon, in consequence of which, the latter is deprived of the solar light ; this only happens at the full Moon, as at that period she is opposite to the Sun ; even in a total Eclipse, the Moon is seldom in a perfect state of occultation, or darkness ; which is occasioned by the Sun's rays being refracted in passing through the atmosphere of the Earth.

Lady M. What is the cause the Sun is not eclipsed every New Moon, and the Moon every time she is at the full ?

Ment. Because the Moon's orbit is inclined to the plane of the Ecliptic, therefore an Eclipse can never happen but when the Moon is either in or near one of the Nodes, which are the
two

two points in which the orbit of the Moon cuts the Ecliptic.

Lady L. Do Eclipses appear in every part of the Globe?

Ment. A Lunar Eclipse is visible in all parts of the Earth, which have the Moon above their horizon, and are every where of the same extent and duration; whilst a solar Eclipse varies its appearance at different places. Eclipses of the Moon always begin on her eastern side, whilst those of the Sun commence on his western.

Lady L. How many Eclipses of the Sun and Moon can there possibly be in one year?

Ment. Seven are the greatest number that can happen in that space of time, and two the least that can occur; the most usual number is four, and there are very rarely more than six, one half of which are generally invisible at any particular place; and no Eclipse of the Moon can last above 5 hours and a half from the period of the Moon's first touching the Earth's penumbra, to its departure from it; but an Eclipse of the Moon by the Earth's shadow probably never exceeds 3 hours and three quarters, and when total, is not more than 1 hour and three quarters. Having thus clearly
specified

specified the interposition of the heavenly bodies which occasion the privation of light, called Eclipses, it only remains for me to remark, that some of the fixed stars are subject to the same consequences ; in particular Aldebaran is frequently obscured by the Moon, when it is behind that Planet, and Jupiter also is in like manner darkened by its brightness being intercepted.

Lady M. I think Eclipses are very extraordinary things ; before their causes were known, I should suppose the inhabitants of the Earth were alarmed at their appearance.

Ment. To have the Sun obscured, or the light of the Moon withheld, for even the shortest space of time, must have excited much astonishment ; but experience in this, as well as in a variety of other instances, supplied the defect of science. The ancients observed these phænomena ; but as they perceived no bad effects, most probably were not apprehensive when they appeared. I recollect a remarkable instance of the sagacious use that Columbus made of the circumstance of knowing from his professional skill, that an Eclipse must at a certain period occur, which serves to shew the very great advantages the learned have over the ignorant.

ignorant and uninformed part of the community.

Lady M. I am greatly obliged to you my dear Mentoria; I remember in your instructions on Geography, you informed us Columbus discovered America.

Ment. In the prosecution of that great undertaking, Columbus experienced much trouble from the factious spirit of the officers and men who engaged with him in that hazardous enterprize. At one time a serious mutiny took place, and as Columbus was at that period but a little distance from land, near one of the West India Islands, he obtained articles of sustenance of every kind from the Indians, his own provisions having been either consumed or spoiled. For some time he was amply supplied by the natives, who bartered their food for the alluring bait of a bit of tin, or a few glass beads, and on those who were of a superior class, he bestowed a small looking-glass, a red cap, or a pair of scissors. This traffic was carried on to the mutual satisfaction of both parties, but unfortunately the mutineers who were on shore, prejudiced the Indians against Columbus, and as in those uncivilized countries they cultivate little more than is necessary for their own use, they began to be apprehensive of experiencing
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a scarcity ; therefore were very remiss in their supply of food, which greatly distressed Columbus, as his men had been grievously afflicted with severe and dangerous disorders, which are peculiarly incident to hot climates ; a circumstance that rendered fresh provisions absolutely necessary, as the most effectual means of establishing their health. In this critical predicament, Columbus had recourse to the following expedient. From astronomical observations, he knew that in the course of three days there would be an Eclipse of the Moon ; he therefore sent an Indian on shore, who was on board his ship, to inform the inhabitants (whom he convened) that he came to acquaint them of an extraordinary circumstance, in which they were all nearly concerned. That Columbus and his people were Christians, and believed in God, who created Heaven and Earth, rewarded the righteous, and punished the wicked ; that this omnipotent Being was incensed against the Indians for having neglected to supply his people with food, and had determined to punish them by pestilence and famine, in token of which, they would that very night see the Moon rise with an angry and bloody aspect, as a presage of the tremendous evils that would accrue.

crue. This prophetic denunciation produced different effects upon the minds of the Indians, some were alarmed, and others treated it with contempt and derision ; but when they perceived the Eclipse of the Moon, which took place in the manner expressly foretold, they were unanimous in expressing their consternation and contrition. The consequence of this internal conviction was productive of the happiest effects ; as they zealously entreated Columbus, with loud cries and lamentations, to intercede with his God on their behalf, as the means of averting the scourge that threatened them ; on which terms they promised in future to supply him amply with every kind of provision he required. Columbus hearkened to their entreaties, yet did not grant their request till the Eclipse began to go off ; when after due deliberation, and the appearance of great condescension on his part, he informed them, they might cease to afflict themselves, as he had prayed to God in their favour, who had graciously forgiven them, on condition they would always be kind and hospitable to Christians, and in proof of this gracious pardon, they would perceive the Moon disperse her angry countenance, and resume her former beauty. When they experienced

enced the fulfilment of this pleasing assurance, they praised the God of the Christians, and regarded Columbus as a person peculiarly favoured by heaven; as notwithstanding they had seen Eclipses, it was beyond the compass of their comprehension, to imagine that any one could foretel their appearance, except by divine inspiration.

Lady L. It was fortunate Columbus thought of such a means to prevent the evils he dreaded; but was it strictly right, that he pretended this natural event was a divine judgment?

Ment. Particular circumstances, and exigent cases, require extraordinary means of redress; and in this instance, on the behalf of Columbus, I shall urge that the happy effects his conduct produced, in a great measure plead his excuse, more especially as it served the beneficial purpose of forcibly impressing on these savage Indians an awful idea of the Supreme Being, which perhaps they would not have acquired by any other means. In defining the character of Columbus, we must acknowledge he possessed very superior merit; his skill in navigation was wonderful at that period, his genius enterprizing, and his presence of mind signal,
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in all the complicated misfortunes his arduous undertaking unavoidably produced.

Lady M. What do you mean by presence of mind, my dear Mentoria?

Ment. That powerful impulse, which directs us to pursue in any emergency, those measures that will prove effectual; as persons involved in intricate and apparently inextricable difficulties, if they were to deliberate, would be lost!

Lady L. I think it was very ungrateful of Columbus's officers and men to shew any inclination to rebel, under so great a commander.

Ment. In enterprizes of vast importance, the projectors have many adverse events to contend with. The greater part of the persons who joined Columbus in the prosecution of the expedition he had planned, were actuated by motives of gain, and were impatient under the delay, which in the natural course of things retarded the object they had in view; consequently the principal obstacles he had to encounter, arose from the avarice, ingratitude, and ignorance of his fellow labourers: thus you will perceive the passions were to him more turbulent in their effects, than the Elements. Human nature is the same in every age and nation, the children
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of Israel murmured against Moses for the dangers and inconvenience they experienced in the desert, in their progress to the Land of Promise; and reproached their wise benign leader, with being the cause of all their sufferings.

Lady L. It must have given Columbus great pleasure, to have the Indians pay him such reverence.

Ment. In a variety of instances, recorded in history, we find that the human race, in a state of profound ignorance, are easily wrought upon by any circumstances which bear a supernatural appearance; this gave rise to the absurd, and I may add impious stories, which were impressed on the multitude in the first ages of the world in Pagan countries; as under the sanction of a pretended divine origin, no one presumed to doubt the validity of any assertion or event. Numa, who governed the Romans after Romulus, was a man of consummate wisdom and prudence; and as he was convinced he could not rule peaceably over his subjects, without some superior aid, he pretended to have an intercourse with the Goddess Egeria, whom he apparently consulted in her grotto, on all subjects and matters of importance; thus by imposing on the minds of his subjects this
feigned

feigned sacred authority, he possessed their entire confidence, and much to his honour it may be added, that he was the first who inspired the Romans with an awful sense of the sacred obligation of an oath, which was undoubtedly the foundation of the credit they afterwards obtained ; as it rendered them just and honourable in all their proceedings.

Lady L. I am much pleased with the instances you have produced of the superior abilities that Numa and Columbus possessed.

Ment. As I have endeavoured to shew you, the advantage persons invested with power derive from the adoption of wise and prudent measures, the result of a highly cultivated good understanding ; as a contrast, I will now point out the contrary effects, by the example of Francis Pizarro, who obtained the conquest of Peru. Various have been the conjectures respecting his origin, some are of opinion he was a nobleman by birth, whilst others (with greater probability) mention, he was the illegitimate son of Gonzalo Pizarro, an officer of Truxillo in Spain, who exposed him as a foundling at the door of a church ; from the circumstance of the cheat being discovered, his father was compelled to support him, who bestowed no

education on him, but employed him in the most servile offices, chiefly in tending his hogs; as this neglected youth advanced in age, he grew weary of this degrading course of life, and as he was of an enterprising spirit, entered on board a ship bound for the West Indies. In this new scene of action, Pizarro so eminently distinguished himself by his bravery, in the wars of Hispaniola and Cuba, that he gained a commission in the Spanish army; after a variety of fortunate events, he became possessed of great riches, and joined with two other adventurers, to undertake the conquest of Peru, in which hazardous attempt he succeeded.

Lady L. I feel quite interested in your account of Pizarro, and am surprised a person so defective in education should achieve such a brilliant victory.

Ment. Personal courage, perseverance, and concurring favourable circumstances, are more effectual in compassing great designs, than mere intellectual possessions, or the genuine effects of regular science; yet when they are added to the other qualities they give an inexpressible degree of consequence to the triumphant Hero: which was manifest in the character of Julius Cæsar, who was an excellent scholar, a gallant

gallant soldier, and in every department, a most accomplished man.

Lady M. Pray Mentoria, now inform us of some striking proofs of Pizarro's ignorance?

Ment. At the time the conquest of Peru was undertaken, there was a contest between two brothers, named Huescar and Atabiliba, for the succession to the Peruvian dominions, on the death of their father. This event proved fortunate for Pizarro, who by artfully seeming to espouse the cause of both these incas, or princes, who were competitors, at length by strata-gem, and a kind of fictitious cause of offence, Pizarro imprisoned Atabiliba, and very soon after Huescar was murdered, which in a great measure secured the victory that was afterwards obtained. Atabiliba was a prince endued with great penetration, and as he earnestly wished to procure his liberty, sought to discover the manners, abilities, and customs of the Spaniards, as the best method of enabling him to offer for his ransom those gifts that would be the most acceptable to them. What appeared the most incomprehensible to him, was, their being able to read and write, which he was at a loss to determine, whether they were natural gifts, or acquired by application and labour. As the

means of obtaining this information, he asked one of the Spanish soldiers, if he could write the name of God upon his thumb nail; the man immediately complied with his request; and the inca went to several of the Spanish captains and soldiers, to enquire of them the signification of the word inscribed on his thumb, and by their reply was convinced they understood its meaning, from which he concluded that the art of writing and reading were natural to the whole Spanish nation. This opinion he was soon convinced was erroneous, as by chance he met Pizarro, and asked him the same question respecting the mark on his nail, which the other Spaniards had so readily interpreted; when he from the consciousness of not being able to write or read, blushed and turned away from him with evident signs of confusion, from not being qualified to give a satisfactory answer. This circumstance convinced Atabiliba, that the accomplishments he so greatly admired were the effect of superior education, and inspired him with contempt for Pizarro, whom he now perceived was of a very low origin, since he was exceeded in knowledge by even soldiers of the most inferior rank.

Lady

Lady M. I am astonished that Pizarro did not learn to read and write when he was a great man, as it is very disgraceful to be so ignorant.

Ment. Knowledge is very difficult to attain, except in the ductile seasons of infancy or youth; the process of acquiring it is slow and progressive, and must be pursued without intermission, which, when persons are advanced to the mature stages of life, is not easy to effect; as a variety of avocations at that period unavoidably engage their attention. Pizarro's time was I make no doubt wholly employed in the pursuit of riches and power, which he obtained to the full extent of the most sanguine ambition: but to counterbalance these advantages he was subjected to the humiliating mortification of his secretary writing his name as a signature, between two strokes which Pizarro drew, a circumstance that made his ignorance universally known.

Lady M. When persons are so high in rank, it is particularly unfortunate when they are so illiterate.

Ment. In commercial countries, it frequently happens that individuals of low birth, by habits of industry, perseverance, or enterprize,

attain in the regular course of things, great riches, and consequently a proportionable degree of power and consequence. When such persons, by the influence of their wealth and connections, become senators, or associate with the higher circles, they betray their own insufficiency in what the liberal minded esteem the most valuable possessions; as their language is incorrect, and their opinions generally contracted and ill founded: thus you will perceive the inefficacy of riches, which may purchase parade, and state, but cannot deserve the tribute of applause or admiration, unless they are accompanied by intrinsic and superior worth.

Lady L. I recollect that Tides are the next subject of your instructions; I have some knowledge of them, as I spent part of last Summer in a beautiful situation on the sea coast.

Ment. The Tides are produced by the Attraction of the Sun and Moon, and are caused by the flux and reflux of the motion of the vast expanse of the ocean, which is in a perpetual state of agitation, as it ebbs and flows alternately, without intermission. This wonderful effect is more particularly occasioned by the Moon, in consequence of her being much nearer to the Earth than the Sun, therefore her
powers

powers of attraction, though inferior, act with greater force, and as a natural consequence, raise the water much higher, which from being a fluid, loses in a great measure its gravitating property.

Lady L. How surprising these circumstances are, and how very few I imagine have a knowledge of their wonderful effects.

Ment. The Moon in passing over any part of the ocean, attracts and raises the water in that particular place, which in the course of about six hours and eleven minutes falls again, and thus invariably rises and falls in little more than the space of twelve hours. The Moon produces the effect of raising the water, not only on that part of the sea over which she is passing, but also on that which is situated in an immediate opposite direction. The effects that the Moon occasions on the water are not perceived till three hours after it has passed the meridian of that place.

Lady L. I imagine the Tides perform their changes with equal uniformity in all parts of the ocean.

Ment. The remarks I have made, more particularly belong to such situations as are open to large oceans; as in seas and channels that are

more confined, many circumstances concur to cause deviations from the rules I have specified ; the effects would be general, if the whole surface of the globe were covered with water ; but the great number of islands and continents interrupt the regular course of Tides in some particular regions.

Lady M. I know that rivers have Tides as well as the ocean, as I have observed them regularly change, when I was at Greenwich.

Ment. All rivers which fall into the sea have a flux and reflux, at some distance from their mouth. I have already explained why the Moon attracts the ocean in a greater degree than the Sun ; the proportion of the attractive powers of the latter, with respect to the Tides, is computed to be four times and a half less than what is produced by the Lunar influence, which effect is caused by the great distance of the Sun from the Earth ; I shall now endeavour to shew you, in what degree the Tides are affected by the concurrent addition of the Sun's force of Attraction. At the time of the new and full Moon, the Sun and Moon, by acting together on the water, raise it to a more considerable height : these elevations are called the Spring Tides ; at the first and last quarters of
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the Moon, the Sun and Moon act in opposition to each other, and the water in consequence, does not rise so high as under the operation of their mutual attraction: these are called Neap Tides.

Lady L. Are not the Tides later every day for a certain space of time?

Ment. Undoubtedly, as the Earth is revolving on its axis 24 hours, the Moon will be advancing in her orbit; therefore the Earth must turn as much more than round its axis, before the same place, which was under her, can come to the same place again with respect to her, as she has advanced in her orbit; during that space of time, which is 50 minutes, this number being divided by 4, gives 12 minutes and a half; so that it will be 6 hours, 12 minutes and a half from high to low water, and the same portion of time from low to high water again, which make in the whole 12 hours, 25 minutes, from the period of high water to its regular return.

Lady L. The Tides I suppose are of great use, as I have observed when I have been near the sea, or River Thames, how many vessels pass in constant succession.

Ment. Important and numerous are the benefits we derive from the regularity of the Tides. Water in a stagnate state becomes foul, and degenerates into putridity, which is productive of the most baneful and fatal effects ; as the effluvia that arises from it, by its noxious qualities corrupts the air, and consequently produces pestilential diseases. Another essential advantage from the flux and reflux of the Tides, is the means they afford for a wide extended commerce ; as by their variations, vessels of all descriptions and dimensions can proceed from the ocean to the centre of the metropolis, by which channel commodities from all parts of the globe are collected in the great emporium of trade, and from thence diffused by different measures, not only for the general accommodation of this kingdom, but also for the supply of foreign marts. I shall conclude this dissertation on Tides, by observing, that the doctrine respecting them was involved in obscurity, till Sir Isaac Newton removed these doubts and mysteries by the clear demonstration of the power of Gravity and Attraction.

Lady L. Pray Mentoria, explain this matter more fully, as I have a general but not a clear idea of its properties ; particularly I wish
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to be informed what the term Gravitation means.

Ment. It signifies the tendency which all bodies have to descend, and the point to which they tend is called the centre of Gravity.

Lady L. This I comprehend, but entreat you will be more explicit on this subject.

Ment. In the Solar system, the Sun is the centre of Gravity ; and the centre of the Earth, and of all the other Planets, is a centre of gravity towards which all bodies placed upon their surface are attracted.

Lady L. By what means are you convinced of this ?

Ment. The Sun from its superior magnitude attracts the Earth, and other Planetary Orbs of its system, which may all properly be said to gravitate, or have a tendency to approach the Sun as their centre. The Earth, by being of larger dimensions than the Moon, attracts her, and she, as a secondary Planet, gravitates towards the Earth. The Planets are attracted by and also gravitate towards each other. When a stone is thrown from the Earth, its weight or gravitating power attracts it to the Earth again ; and by this universal power of Gravitation, we stand upon all parts of the Earth, with our feet

pointing to the centre. The power by which the Planets are attracted towards the Sun, as their centre, is called the Centripetal Force, and that by which they endeavour to fly from it, is termed the Centrifugal Force: thus by the contrary action of these different powers, the Planets are made to move round the Sun, in a circular, or rather in an elliptical Orbit, and it is by the joint action of these opposite forces, that the Planets are retained in their proper Orbits.

Lady M. I wish to know what produces this effect.

Ment. It may be proper to inform you that all motion which is termed simple, is naturally rectilineal, that is, that all bodies, if there were no counteracting power, would move in straight lines, which might be proved in a variety of familiar instances; you will therefore perceive, as the planetary motion is nearly circular, it cannot be called simple, being a compound of the two qualities already specified, which are distinguished by the following terms, the Attractive or Centripetal force, and the Projectile, or Centrifugal force.

Lady L. I am very attentive to these instructions, as they appear to me of great consequence,

sequence, by enabling me to understand the general order of the Planetary system.

Ment. The attraction of the Earth and the resistance of the atmosphere or body of air through which it moves retards its progress or it would continue to move in a straight line with a degree of velocity, equal to that which was first impressed on it. The wise Creator of the universe, has bestowed a force on all the Planets, equal to that of the attractive power of the Sun, that one might not be overpowered by the other, the Attractive or Centripetal force of the Sun, being adequate in proportion to the Projectile, or Centrifugal force of the Planets, which are by Attraction prevented from moving in a straight line, being in a manner driven towards the Sun, and by the Projectile force are hindered from being overcome by the Attractive power, consequently they revolve in circular orbits, though in fact they are rather elliptical in form. All bodies moving in a circle have a natural tendency to fly off in a straight line did not the central force acting against it preserve its circular motion. Before I conclude these remarks upon the general law of Nature, I must mention the remaining branches of Magnetism, Electricity, and what

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is called the Attraction of Cohesion: the two former I shall distinctly consider on some future occasion, but shall briefly inform you that the latter, Attraction of Cohesion, signifies that property that all bodies inherently possess, which tends to unite the different particles of which they are composed, and connects the general system; or they would, uninfluenced by these Attractive powers, be hurled to immense distances, or separated into an infinitude of atoms.

Lady M. Do the rules and consequences you have enumerated respecting the heavenly bodies relate only to the primary Planets, which have the Sun for their centre?

Ment. The secondary Planets are governed by the same laws, in revolving about their Primaries. By the Attractive power of the Sun, joined with the Projectile force of the primary Planets, they are retained in their orbits; so the action of the Primaries, upon their respective secondaries, blended with their projectile force, will preserve them in their proper orbits or spheres; all which, with their Primaries, move round a centre of Gravity, by the universal influence of Attraction.

Lady

Lady L. How very extraordinary it is that the Heavenly Bodies are permitted to move, and are restrained by such wonderful means.

Ment. Every system in the universe is supposed to revolve in like manner round one common centre. In contemplating the order and regularity which prevails in the various works of the Creation, we are led to reflect on the infinite, supreme wisdom, that planned and executed all the wonders which excite our admiration. We ought from hence, also, to derive the useful lesson of an uniform steady performance of the various duties allotted in our sphere of action, as rational Beings; to us, intellectually, God is the centre of all possible perfection, the point to which all our hopes and wishes invariably should tend. Our frailty too often causes us to fly off in a straight direction from our proper orbit, and it is only by the precept, example, and intercession of our blessed Redeemer, that we are enabled to perform our destined course, and ultimately gain the reward of immortal happiness.

DIALOGUE

DIALOGUE VI.

SATURDAY.

On Light and Darknes.

Mentoria.

IN endeavouring to describe the properties and qualities of Light, I shall also point out the essential benefits which arise from its diffusive genial influence, and deduce those reflections which are naturally suggested in so interesting a discussion. Various have been the conjectures and opinions respecting the nature of Light, which is now demonstrated to be a material substance, flowing directly from the Sun. By the term Light, I mean that certain

tain principle by which objects are made perceptible to our visual organs, after a variety of speculations whether these impressions proceeded from those objects or the eye of the person who viewed them; the discoveries of Sir Isaac Newton have tended to remove these doubts, by establishing a doctrine that may be relied on. According to his system, Light consists of a great number of very small particles thrown off from the luminous body, by an opposing or repulsive power, in all directions, and with an immense degree of velocity, from which it is evident, Light is produced by motion, but as all motion will not produce Light, it follows as a natural consequence, that it depends on the quality of bodies, some of which are inherently luminous, and have the property of emitting particles of Light; of this class are the Sun, Stars, and every sort of flame. The velocity with which these particles move is almost incredible, being computed to be at the rate of near two hundred thousand miles in a second of time, that is near a million times greater in proportion than the rapid movement of a cannon-ball, which is calculated by observations on Eclipses; it has also been demonstrated that the progress of Light from the Sun

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to the Earth, is effected in the short space of time of eight minutes and three-quarters, though the distance is 95 millions of miles!

Lady L. My astonishment increases as my knowledge is augmented; how little did I imagine that the Light which is dispensed to us, came by such rapid means.

Ment. The more we know, the more we are convinced there remains to be known than our finite abilities can attain. Persons of profound knowledge may be compared to deep waters, that are clear and genuine in their quality, whilst those that are superficial in their acquirements may be justly said to resemble shallow stagnate pools, which have only a small portion of degenerate loose matter floating on their surface.

Lady L. I hope that similitude will not be verified in me or Lady Mary; my best endeavours shall be used to acquire every branch of valuable information.

Ment. Attention and application will prevent the evil you dread: profit by the advantages you possess; as of all the afflictions incident to human nature those only can be deemed insupportable to which we can attach any self-reproach or blame. As I have already explain-

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ed the velocity of light, I fhall now proceed to inform you that the particles of which it is compofed are aftonifhingly fmall, even beyond human conception; it is computed that from the flame of a candle in a fecond of time there fly out ten thoufand millions of times more particles of light than there are vifible grains of fand in the whole Earth. It is alfo evident that thefe particles of light are emitted or fent forth in ftraight lines, or what is ufually called rectilinear motion, which they invariably preferve unlefs they are turned from their natural courfe by what is termed Inflection, Refraction, Reflection, or finally, Extinction.

Lady M. Pray my dear Mentoria explain thefe terms, as they are above my comprehension?

Ment. Inflection means when light is obftruded in its path, by the attraction of fome other body, whereby the progrefs of the ray is hindered from moving in a ftraight line. Refraction fignifies when the rays of light by paffing in an oblique direction through any body of a different density or thicknefs, do not afterwards move in ftraight lines, but appear broken or bent, and as if they originated from another point. You frequently fee thefe effects,

effects, without knowing their natural cause: thus for instance, a stick when one part is in water and the other in air, seems broken, and that part which is in the water, appears higher than it is in reality. You may also experience the effects of Refraction, by putting a piece of coin, or any other visible thing into a tub or bason, by receding from which, that you can but just see the object, and then by getting a person to fill the tub more than half with water, the money, or whatever you have placed as an experiment, will appear as if it were removed at a greater distance from you. The term Reflection implies, when the rays of light are opposed by some intervening body, which causes them to recede. The last stage of the luminous process, is Extinction, which is occasioned, by the rays of light being stopped in their progress by some body, into which their subtle particles effectually penetrate.

Lady M. What do you mean by a ray of light?

Ment. When a succession of the luminous particles I have just described, follow each other in a right line, they are denominated rays of light. Amidst the various properties of light, none are more extraordinary, than the effect which
Reflection.

Reflection and Refraction occasion, particularly in the production of colours ; this subject I shall more fully consider, in my observations on the Rainbow, which is an assemblage of the most beautiful tints.

Lady L. I promise myself much pleasure from the description of such a fine object.

Ment. From the observations made on the quality of light, it appears evident, that the Sun is its primary source ; therefore it follows as a natural consequence, that from the time of the Sun's rising above our horizon, to his appearing to sink beneath it, we have day, and from his setting to rising again, are involved in darkness, which constitutes night. I cannot mention the Sun rising or setting, without expressing in some degree, the sensations those glorious spectacles exhibit ; there is a peculiar quality in solar splendor which causes the imagination to soar beyond the height or depth of human praise, or admiration. Who can behold the gilded horizon and the Sun's glory reflected in the responsive wide expanse of the ocean, and not be awed into a sublime sense of their Supreme Origin ? When the Sun emits his beams, and exhilarates every surrounding object, to the contemplative mind, it presents
a striking

a striking type of the chearing influence of Divine favour, whilst the remission of his rays should impress us with serious apprehension of being excluded from the participation of resplendent immortal glory, in the realms of blifs.

Lady M. From your description of Light, it appears to me very clear, that the Sun, from which it is derived, must be a body of fire; yet you say Dr. Herschel is of a different opinion.

Ment. Some Philosophers have supposed the Sun was a mass of Gold, as that substance can bear fire longer than any other metal. On subjects so far above our comprehension, and that cannot by any possible means be reduced to certain proof, we should be cautious of receiving opinions till there appears almost indubitable grounds for the principles of new theories or speculative systems; those firmly established should be adhered to, till others can be adopted, on a more unquestionable and durable basis; though all persons zealous to make useful discoveries are entitled to applause, and claim our attention. Some ingenious observations have been made on the properties of light and heat, by many
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modern philosophers. Dr. Fordyce asserts that the Sun has probably no inherent heat, and that the Solar rays are not in themselves of a hot quality, but only possess the power of producing heat in other bodies. These sentiments very nearly coincide with those advanced by Dr. Herschel, who is of opinion, from observations he has made on the Sun and Fixed Stars, that they are all most probably inhabited.

Lady M. That would be impossible if the Sun were a body of fire.

Ment. On subjects of such importance we are incompetent judges, therefore must not be hasty in our decisions. For the sake of the argument we will consider the Sun as a spherical body of fire, and yet consistent with our ideas of the omnipotence of the Supreme Being, may acknowledge not only the possibility but the probability of its being inhabited, as that creative power which constructed fishes to live in water, animals on the earth, and birds and insects in the air, might also form beings suited to the only remaining element, fire. Existence is derived from the power of respiration, being congenial to the state and condition of each individual; therefore God could even in this instance deprive fire of its consuming quality, or
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render those who lived in immediate contact with it, not sensible of its force: a remarkable proof of which we find in the miraculous preservation of Shadrach, Meshach, and Abed-nego, who were cast into a fiery furnace by the command of Nebuchadnezzar and were not even scorched by the flames.

Lady L. I am fully convinced that all things are possible with God, and acknowledge my own folly and presumption in an attempt to doubt what he wills to perform.

Ment. Those opinions, which are formed on the immutable foundations of just principles and divine truth, never fail to produce the most lasting conviction. As the means of strengthening these right impressions, I shall add a few remarks on the various dispensations respecting animal life, which experience has proved beyond controversy or doubt. In the first instance, I shall produce the example of the structure of fishes, many of which subsist at the bottom of the ocean. In this situation you would imagine they could not exist, but it is wisely decreed by Providence that most fishes have a bladder or bag of air, which they are enabled to enlarge or contract, and by that means to rise or sink, as best suits their purpose: their gills also act as
a kind

a kind of lungs and admit air, with particles of which water abounds. The next instance I shall specify, are those kind of animals which exist by burrowing in the earth, often far beneath its surface, and in a situation remote from the aperture they have formed for their entrance into their subterranean recess. Another species of extraordinary existence is those classes of animals that are absorbed in a torpid state during the whole winter, and in that interval of somnient repose, take no sustenance, but are alone supported by the peculiar temperature of their blood, and the degree of fat with which they are clothed. These unquestionable facts ought to repress our distrust of Supreme Power, and extend our credulity to the utmost bounds in all matters relative to his Divine appointments and universal influence: therefore if the Sun and Fixed Stars are inhabited, as well as the infinitude of Planetary Orbs which form their systems, there cannot remain a doubt they have a just proportion of all the blessings we enjoy as terrestrial inhabitants, as they are equally dependant on, and supported by an Omnipotent and Omniscient Deity.

Lady M. Your reflections on these subjects I feel very forcibly ; accept, my dear Mentoria,
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my beſt thanks for your zealous endeavours to improve us.

Ment. The nature of the ſubject has cauſed me to digreſs beyond the intent I had originally formed. I muſt therefore now reſume my obſervations on the influence of Light, to which I ſhall oppoſe the contrary effects of its privation.

Lady L. Light is ſo agreeable, I am almoſt inclined to wiſh that we were never deprived of it.

Ment. Like many other bleſſings, the value of it is enhanced by the conſtraſt which Darknefs or Night affords. Light appears to be the ſource of every intellectual enjoyment, whether natural or artificial ; it is the means of enlivening our perceptions and impreſſing permanent ideas of viſible objects which could not be obtained but through that medium. For inſtance, if we were to hear the ſplendor of the Sun's reſplendent beams deſcribed by the moſt eloquent orator, we ſhould form a very imperfect idea of its irradiate glory. If the moſt elaborate pains were taken to expreſs the varied beauties of the creation, nothing but ocular demonſtration could impreſs us with juſt conceptions of the Deity, which muſt be derived from the conviction

tion we have of his infinite attributes in the works of the creation, which combined or separate, are deserved objects of admiration, and just claimants of our gratitude and praise.

Lady L. I clearly perceive the benefit of Light, but cannot so easily discern the advantages of Darknefs.

Ment. Darknefs, or the kind of light which the brightest night affords, seems admirably suited to the purposes of repose. Animal spirits require a suspension of the exertions and avocations to which, in a variety of cases, they are exposed. The ploughman who is employed in the most laborious offices of agriculture, or the philosopher who is engaged in the most profound and ingenious researches, equally stand in need of refreshment from sleep, to which the stillness and darkness of night most beneficially conduce. In Summer vegetation also is cherished by the same salubrious means, dew operating the same on the productions of the Earth, as sleep does on animals of every kind, by shedding a kind of renovating recruit; by which one attains a supply of strength and spirits, the other of freshness and growth.

Lady M. I will never again wish that there was no night, as I find it is attended with such beneficial effects.

Ment. As animals, we may be compared to machines, or wonderful pieces of mechanism, composed of various springs and movements, compacted and constructed with consummate skill ; if these powers were always on the stretch, they would prove but of very short duration. Exercise and rest are the hinges (if I may be allowed the expression) on which our temporal existence depend ; this may be considered mentally as well as corporeally, as intense application cannot be pursued without intermission, any more than the constant motion of the body can be effected without sustaining a material injury. Thus you will perceive it is by the due accordance of Light and shade, exertion and repose, that the whole œconomy or system of Nature is sustained, and our enjoyments rendered substantial and permanent.

Lady L. If Light is so essential to happiness, how miserable those persons must be who are blind !

Ment. I am convinced that is very far from being the case, which I can assert from experience, by examples of some persons with whom
I have

I have been in habits of intimacy. If they are blind from their birth, they are not sensible of the loss they sustain by the privation of sight, and in general they have that defect supplied, by possessing a taste for music, and are endowed with a remarkable just conception of sound, and by touching an object can judge of its quality ; they are also frequently blessed with fine perceptions, which are not dissipated by the succession of external objects, therefore are very often intellectually enlightened in an eminent degree, though in other respects involved in darkness. It is remarkable, that persons who are deprived of sight are uncommonly cheerful ; and when this blindness is the effect of disease in the optic organs at a mature period of life, by the recollection they have of objects, can give their opinion with the most accurate propriety ; and from their ideas in a manner being centred, are intelligent, agreeable companions.

Lady L. In future I will not pity persons who are blind, since I find their situation less melancholy than I imagined.

Ment. That is not the effect I wish to produce, I have only endeavoured to shew you, on the system of the general dispensation of

blessings, that persons deprived of sight, are not destitute of comforts ; though undoubtedly they are objects that excite commiseration, by being not susceptible of the cheering influence of Light, which our visual powers receive in a variety of pleasing forms. In the lower classes of life, where a subsistence is to be gained, they peculiarly demand our pity and assistance ; as persons destitute of sight, notwithstanding by some extraordinary means they may gain a maintenance, those instances are comparatively rare, and in general they have so many obstacles to encounter, and such great difficulties to surmount, they seem to have a superior claim to the most munificent effects of public charity and private pecuniary relief. On this subject I will only add, that it is my earnest wish, when any opportunity offers for you to realize those benevolent lessons I so strenuously inculcate ; that you will pursue the means your sympathetic feelings suggest, by giving liberally to the afflicted, and with heart-felt satisfaction proportion your gifts to the seeming necessities of the object who claims your assistance.

Lady M. I will readily obey your injunctions on this subject, and am certain Lady Louisa will unite with me in relieving the blind,
and

and every other description of afflicted persons, as acts of charity are productive of the highest satisfaction.

Ment. It is worthy of observation that two of the greatest geniuses who have produced harmony of the most exquisite kind, in poetry and music, were both blind; it is almost needless to add, that I mean Milton and Handel, and it is highly probable their imagination would not have soared to such heights of excellence, if their visual organs had been able to contemplate external ostensible objects; so that their misfortunes, perhaps, proved the means of rendering their fame immortal.

Lady M. I shall admire the works of Milton and Handel more than ever, now I have heard they were both afflicted by the loss of sight.

Ment. Excellence of every species demands our applause; but that superior kind which arises from such extraordinary instances of perfection in any Art or Science, as what this great poet and musician attained, is of a nature to excite our admiration to almost an enthusiastic pitch. As these eminent persons are equally distinguished by the sublimity of their respective compositions, they may not unaptly be com-

pared to the Planets, which from being dark, or opaque, transmit the light of the Sun by the powers of reflection; and with justice their bright genius may bear some degree of similitude to that glorious luminary, as their effects are of the most brilliant quality, and must, from their superior lustre, be derived from a Divine source!

DIALOGUE

DIALOGUE VII.

MONDAY.

On Air, the Atmosphere, and
Sound.

Mentoria.

AS I flatter myself with the hope that you have now a just conception of the Celestial Bodies, I shall zealously aim to instruct you in some important branches of Natural Philosophy, as they appear collaterally connected with my Lectures on Astronomy. After having explored the wonders of the Firmament, it becomes in some degree necessary to examine the quality of that thin transparent fluid body, denominated Air, which surrounds the Terra-

queous Globe we inhabit, and covers it to a very considerable height. In the definition of this fluid mass, if we include the constituent parts of air, watery, and other vapours, electric matter, &c. which encompass the whole Earth, and participate of its motions, we call it the Atmosphere, as a general term.

Lady M. I recollect hearing you frequently mention the Atmosphere ; pray, my dear Mentor, be kind enough to explain what it is ?

Ment. The Atmosphere is a body of Air, consisting of aqueous vapour, blended with a mixture of heterogeneous particles, exhaled from all solid and fluid substances on the surface of the Earth : this compound ethereal matter surrounds the Globe, through which the Sun's rays pass before they reach it ; in their progress they do not move in straight lines, except when the Sun is at the zenith, or directly over our heads ; but when they reach our Atmosphere they bend downwards, which produces what is called Crepusculum or Twilight. The rays of light pointing upwards from the Sun before he rises, and after he has set, bend towards the Earth upon reaching the Atmosphere ; and in consequence it begins to be light in the morning when the Sun arrives at 18 degrees below the Eastern

Eastern horizon, and continues to be light in the evening till he has sunk 18 degrees below the Western horizon.

Lady L. What do you mean by the rays of light bending downward?

Ment. This is produced by Refraction, and is caused by their passing in an oblique direction from one medium to another, as from Air into water, or water into Air. As I explained this matter very explicitly in my definition of Light, I shall say no more on that subject at present.

Lady L. Pray Mentoria inform us of all the properties comprised in the Atmosphere.

Ment. It is a thin invisible fluid, more dense or heavy near the Earth, but gradually is of a lighter quality the higher we ascend; therefore at the summit of some high mountains it is scarcely possible to breathe. The Atmosphere serves not only to suspend the clouds, to supply us with wind and rain, but to furnish us with the means of respiration; it also produces the morning and evening twilight, as I have just described. This body of Air, which is termed the Atmosphere, is about 45 miles above the surface of the Earth, therefore the Sun's rays falling upon the higher parts of it before rising, by Reflection causes a faint light,

which increafes till he appears above the horizon, and in the evening it decreafes, till he is 18 degrees below the horizon, when the morning twilight begins, and the evening twilight ends.

Lady M. I never before thought by what means I breathed, or what produced Light, Rain, or Wind.

Ment. It is a common but much to be lamented proof of human frailty, that we frequently enjoy bleffings, without being able phyfically to account for them.

Lady L. What do you mean by the term Phyfically? that expreffion feems to relate to Medicine.

Ment. Its more extenfive fignification implies any thing that can be accounted for by natural caufes, fuch as the various branches of Philofophical inquiry; but all matters beyond the power of human ability to folve or demonstrate, are faid to be Metaphyfical, a term particularly appropriate to Divine fubjects. The Atmosphere is the fource of almoft every terreftrial comfort we enjoy; it is the medium through which we obtain the light of the Sun, the refreshing falubrious breezes of the Air, vegetation, and every relative and combined effect effential

sential to existence. In proportion to the quality of the Atmosphere that surrounds us, we are said to be in a good or bad temperature ; Air is the vital principle of life, and our lungs the organs of respiration, by which such a portion is imbibed as is necessary for the recruit of the animal spirits, and the support of our general stamina.

Lady L. I had no idea of the beneficial consequences of the Atmosphere.

Ment. When you perceive the day appear bright, and the prospect our horizon affords clearly visible, you may then be convinced the Atmosphere enables you to discern these pleasing objects ; as if there were no Atmosphere, the Sun would yield us no light but when our eyes were directed toward him, and the heavens would appear dark, and as full of stars as on a dreary winter's night ; but the Atmosphere, by being strongly illuminated by the Sun, reflects the light back upon us, and causes the whole heavens to shine with so much splendor, that the faint light of the Stars is obscured, and by that means rendered invisible.

Lady M. I am very happy that I am now convinced of the advantages we derive from the body of Air that surrounds the Earth ; I am
thank-

thankful for every fresh branch of knowledge I acquire.

Ment. Learning (which is a perverted term, unless expressive of useful information) is the greatest treasure that you can possess. Riches may diminish, but knowledge cannot fail to increase, provided you use the natural means that we are all endowed with, to acquire this desirable possession. The ignorant pass through life as it were blind-folded; as they observe nothing beyond the common perceptions of their natural sense; therefore wonder on subjects that are plain and simple in their effects; and from their few resources of information, are not sensible of the great advantages that are derived from a highly cultivated understanding, which like the diamond, ever shines with resplendent lustre.

Lady L. I hope you have not finished your account of the different qualities and effects of Air.

Ment. As I have already specified the various advantages we derive from the Atmosphere, as being essentially necessary to existence and the production of vegetation, it may be proper to add those of Sound, Rain, and Dew. Air differs from other fluids in the following instances. It is capable of being compressed into a much
less

less space than what it naturally possesses ; it is of a different thickness or density in every part upward from the surface of the Earth, decreasing in its weight in equal proportions, the higher it rises, and consequently must decrease in density ; it is also of an elastic nature, and the effect of this springy quality is proportionate to the force by which it is compressed ; and the elasticity of the air is increased by heat, and diminished by cold.

Lady L. I have heard persons frequently mention the weight of the Air, but I did not know their cause for so doing.

Ment. Most probably their observations arose from their perception of the dense quality of the surrounding Air, unconnected with the philosophical grounds they had for that assertion. The variations in the weight of the Air, arise in a great degree from the different portions of heat which are in the ethereal fluid near the surface of the Earth ; and also from the changes in the Atmosphere, caused by the vicissitudes of winds and vapours. It is computed there is a pressure of Air equal to 15 pounds avoirdupois weight, upon every square inch ; therefore it is calculated that a human being of full sized dimensions

menfions fufains the aftonifhing burthen of 21,600 pounds.

Lady M. I am amazed they are not crufted by fuch an immense load.

Ment. Great as that preffure is, the divine will and power could increafe it to any degree his providence ordained ; however we may fafely rely that the density of the atmofphere like the revolutions of the Celestial Bodies and every other part of the Universe is directed in its operations by Supreme Wifdom.

Lady L. I fear you have compleated your differtation on Air, which I greatly regret.

Ment. As far as relates to its genuine ftate when not fubject to motion, though there remains a very effential branch for me to difcufs, which comprifes the variations its agitations produce in what are ufually called the wind, which is in effect a ftream of air that proceeds from one region to another. In fome parts of the torrid zone there are regular winds which blow invariably from the fame point, thefe are called trade-winds and are of great utility, as fhips when they attain to a certain degree of latitude and longitude are fure of having prosperous gales : there are alfo fome particular parts between the tropics, where the winds blow periodically

riodically for the space of six months in one course and six months in the contrary direction, those are called monsoons ; these and other respective variations are exemplified on the globe by arrows pointing different ways, which I intreat you will observe with great attention, I therefore will be the more concise in my remarks on that subject. Winds are more uniform in their course on the sea than on the land, which is occasioned by the temperature of the latter being affected by the influence of electricity, volcanoes, exhalations and meteors. It is also observed that the East wind and those which come from the Poles are stronger than the West and those which proceed from the Equator ; whilst on the contrary, the West and South winds are more or less violent than the East or North winds. Winds are more tremendous in their effects in mountainous situations than in plains ; and the higher we go the greater we experience the force of the wind, till we attain the common height of the clouds, which is nearly one quarter of a league perpendicular height, beyond which the sky is generally serene, more particularly in the Summer season, and the wind imperceptible even on the summit of mountains. In continental countries the winds are not only variable but produce extraordinary

nary effects, such as the heat of Summer being experienced on one side of a mountain and the rigour of Winter on the other. During the Summer season in Egypt hot Southern winds are very prevalent, which suspend the breath and raise such a quantity of sand of a quality so fine and subtle it penetrates into every object, and often causes pestilential diseases. The most tremendous effect of wind is what is usually called hurricanes, in which the wind seems to proceed from all directions and produces a whirling kind of irresistible motion that is inexpressibly awful and fatal in its effects; a calm generally precedes these dreadful tempests. Whirlwinds are produced by the conflicts of sudden rarefaction when contrary currents of air meet in the same place. I have been thus particular on this subject as it must frequently occur in common discourse, and you are no doubt informed the four cardinal or chief points the wind blows from are North, South, East and West; therefore the quality of the weather naturally in a great measure depends, from which of those the current of air proceeds. I must now endeavour to give you some idea of the properties of Sound.

Lady.

Lady L. I think that will not be very difficult, as we are all sensible of its effects.

Ment. But I am doubtful whether you know by what cause they are produced. Sound is the natural consequence caused by an agitation of the air, arising from the tremulous motion of the parts of any sonorous body when struck upon, which by occasioning the air around it to vibrate to a certain distance, conveys the Sound to the ear that is within the reach of that vibration: and various experiments which have been made on the air-pump clearly demonstrate that Sound cannot be produced without air, as on the motion of its particles it entirely depends. It is by this elastic force that Sounds are conveyed to the organ of hearing, which is wonderfully constructed not only to receive the impression but to convey it to the brain which is the seat of perception, and from the concurrent operations of these extraordinary instances of divine skill, we are susceptible of a variety of sensations arising from the influence of Sound. In the variations and proportions these act upon our feelings, they are said to be pleasing or painful in their effects, as a certain degree of harmony or coincidence is necessary to render them accordant to our sensitive perceptions. Music

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is unquestionably the most refined and distinguished effect of the property of Sound, and by its influence on the passions, and intellectual powers, may be considered to comprize the general œconomy of the doctrine of Sound.

Lady L. I am extremely delighted with music of every kind, and shall in future pay great attention to the different kinds I hear.

Ment. Music from its general pleasing effects, is a science almost universally admired, and very frequently persons acquire a great degree of perfection in the practical parts; most of whom I make no doubt are ignorant, that the different Sounds produced by different instruments, are occasioned by their peculiar construction, and the natural consequence of the properties of air, which tend to constitute those variations of tones, which are comprehended in the compound term, of Music.

Lady L. It is surprising at what distance one can perceive any noise.

Ment. Sound moves at the rate of 68,520 feet in the space of a minute; or 1142 feet in a second or moment: this computation will enable you in some measure to account for the distant perception of Sound; as the rapidity with which it is conveyed to our auricular organs,

gans, is with a degree of velocity almost beyond the powers of our comprehension: thus you perceive, that even what you hear, comes through a medium, and by a means which cannot fail to excite your wonder and admiration. There yet remains a curious Phænomenon respecting Sounds, which I will briefly explain: you have frequently heard an Echo, this like many natural causes is commonly perceived, though but rarely traced to its original cause. An echo is produced by the vibrating air being obstructed in its passage. The undulating motion of the air, in its progressive course frequently meets with repellant objects, and by striking against them is reflected back to us, and occasions new vibrations, which if the object is in a proper situation, repeats the same word or sound first formed, and this sometimes not only once, but by several distinct repetitions.

Lady L. We are much obliged to you, my dear Mentoria, for giving us a just notion of an echo; there are some places in our park, and gardens, which produce that Phænomenon.

Ment. You will now be convinced this constant effect arises from some permanent obstruc-

obstruction of the current of Sound, which causes it to return to you the very word or tone you uttered. As I have enumerated the general effects of Air, I shall now endeavour to subjoin some apposite reflections on its universal beneficial qualities. Air like every other species of matter, is expanded by an increase of fire, or heat, blended with its particles, in which state it is said to be rarefied. As a proof of its elasticity, the greatest degree of cold is never able to destroy its springy quality, as the particles of which Air are composed are subject, like every other species of matter to the laws of gravitation, they are expanded by a decrease of its general mass or quantity.

Lady L. Pray my dear Mentoria do not conclude your remarks on Air.

Ment. I will extend them so far as to shew you that Air, not only contributes to produce animal, and every other degree of heat necessary to existence, but also what is called combustion, by which you are to understand any body or substance that may be burned or destroyed by conflagration. Air may properly be said to be the fuel of fire, as by combining with combustible matters, the Air is condensed or destroyed by the fire being emitted, which
kept

kept it in a state of elasticity. Every animal is possessed of some means of aspiration or breathing, by which they can acquire as much Air as is proportioned to their construction, and other relative circumstances of existence. The greater part have lungs, and others that have not, have that defect supplied by a kind of bladder, by which such a portion of Air is imbibed, as serves the purpose of supporting animal life; most insects are endued with a kind of tube, which serves as a substitute for lungs, and enables them to gain as much Air as their state and condition requires. It is not alone to the animal part of the Creation, that the dispensing hand of Providence has been so diffusive in its blessings, as vegetables are also furnished with tubes or pipes, by which they receive such a portion of Air, as not only tends to their existence, but their growth; this is not merely effected by the fibrous parts of the roots, but also by those which are situated on the leaves, as Air constitutes an essential part of vegetative preservation.

Lady M. I am almost ashamed, when I reflect, that I have breathed without being sensible of the importance of Air, and have seen all the effects

effects you describe, perfectly unconscious of their important uses, and divine source.

Ment. In your case, there is neither cause for regret, nor reproach. Youth is the period of life, in which information is to be gained; we cannot be wise by intuition, Instruction is the general medium by which you are to obtain knowledge, and observation and experience are the auxiliaries that tend to complete the great end of essential Improvement. Education operates on the mind, as Air does on the body; it expands, it animates, and vitally fertilizes the whole intellectual system.

DIALOGUE

DIALOGUE VIII.

TUESDAY.

On Electricity and Magnetism.

Lady Louisa.

YOU have explained many very surprising things to us; pray my dear Mentoria give me some idea of Electricity?

Ment. Electricity is that peculiar quality which some bodies possess, that after having been rubbed, and by that friction heated to a certain degree, acquire a power of attracting and repelling other bodies, and frequently of emitting sparks of fire. All such bodies as have this inherent quality, and require only a certain degree of friction to excite it, are called Electrics,

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and

and all those which have not this property, and can only receive it by communication with electrified bodies, are denominated Non-Electrics. Thales, the Milesian, was the first who discovered the electrical properties of amber, by attracting light bodies when it was rubbed, about 600 years before the Christian æra; and nearly at the period of 300 years previous to that epocha, Theophrastus observed that the Lyncurium, a substance now called Tourmalin, had the same attractive property. From this period to the 17th century, this branch of Philosophy appears to have been neglected, excepting that Mr. Bose discovered that Jet and Agate were possessed of electric properties. About the year 1600, Dr. Gilbert, by various observations, extended the discoveries respecting the variety of other electric bodies. In the year 1670, Mr. Boyle greatly enlarged and improved the Science of Electricity; but to Sir Isaac Newton, who flourished at the close of the 17th century, we are indebted for many valuable discoveries, who ascertained that the electric attraction and repulsion penetrated through glass. After this period a variety of modern philosophers have made great improvements in this part of Natural Philosophy.

Lady

Lady M. How frequently you mention Thales and Sir Isaac Newton as being the cause of great discoveries in science ; how very superior their merit must have been !

Ment. They were both signally distinguished by their learning and abilities. Thales was one of the seven wise men of Greece, and Sir Isaac Newton one of the most brilliant geniuses that this, or perhaps any other country ever produced. I must now recal your attention to the properties of Electricity, which are to attract or repel all kinds of very light bodies at a sensible distance, when the attracting body is heated by friction, which is in effect nothing more than the attraction of Cohesion, excited by a strong attrition to act with less force in a larger sphere, such as amber, jet, sealing-wax, glass, &c. It will be beyond my purpose to enumerate each substance endued with this property, I shall therefore briefly divide them into the following classes: metals, such as gold, lead, copper, iron, steel. Animal substances, bones, shells, hair, &c. &c. Vegetable substances in infinite variety. Corallines, or marine productions of sponge, coral, &c. &c. Fossils and mineral substances, and, lastly, artificial substances,

namely, china-ware, glass, elastic gum, silk, &c. &c.

Lady L. By what means are these effects produced?

Ment. The electric property in some instances may be proved by the simple process of friction, though its philosophical systematic uses are ascertained by an ingenious apparatus, called a machine. The principal parts of these electrical machines are the Electric, the Moving Engine, and the Prime Conductor; these curious pieces of mechanism consist of globes, spheroids, cylinders, wheels, &c. so constructed as to produce the effect of Electricity. Their various forms and qualities would carry me beyond my present purpose; I shall therefore only mention, that formerly a variety of substances were used as Electrics in these machines; but at present smooth glass globes are very generally adopted.

Lady M. I have heard of many of our friends being electrified; what advantages did they derive from it?

Ment. We are composed of the Elements, Earth, Air, Fire and Water, which are our component or constituent parts.

Lady

Lady L. I cannot comprehend this matter ; pray my dear Mentoria be more explicit on that subject.

Ment. Our corporeal frame is comprised of solids, and fluids ; the solids are evidently Earth, as in the Scriptures we are expressly told, dust we are, and unto dust we shall return. The fluids, which consist of blood, and other juices, have a great proportion of water in their compound ; and it is evident that breath which is the chief principle of existence is derived from Air ; therefore there only remains to prove that we possess also a portion of Fire, as well as of the other Elements blended in our composition, which Electricity demonstrates beyond a doubt.

Lady M. I can scarcely believe we have Fire in our composition.

Ment. This quality is philosophically termed animal heat, by which is to be understood that principle, which is produced by the agitation of the body, and the fire contained in it, which excites the idea of heat in our minds, and in the body thus heated, is merely the effect of motion. Various are the opinions respecting animal heat, though it appears most probable, that the absolute heat, which is separated in respiration, and absorbed by the blood,

is the genuine cause of the portion of this elementary fluid, which is dispersed through our general mass, and almost in every other composition: namely in plants, in most species of trees, the bones, flesh, and blood of animals, which is evident from their combustible quality when dried; also in minerals and a variety of other things. In this instance, there is peculiar cause for gratitude, that this active fluid fire which is incorporated in our frame, is kept in due bounds respecting its operation, by the effects of Divine wisdom. I hope you are now convinced you are composed of the Elements, which is a term expressive of the original simple or unmixed parts of any body, or that to which it is ultimately resolvable.

Lady M. I recollect seeing a lady electrified, and it seemed to be a very ingenious apparatus that was used to produce that effect; in what respect could it prove beneficial to her health, as she was in an invalid state?

Ment. This branch of Philosophy, which is converted to medical purposes with great success, has been brought to a surprising degree of perfection. In paralytic, and other cases that require a stimulus, Electricity often produces the happiest effects; but like all other remedies
powerful

powerful in their operations, they should not be adopted, but by the advice and under the immediate direction of the most skilful practitioners.

Lady M. I heard once of a person receiving such a shock by touching some electric power, that it had nearly proved fatal.

Ment. The consequences of the electric force in many instances have been tremendous : a very melancholy accident happened in 1753 to professor Richman at Petersburg, as he was making experiments on lightning, which he had drawn into his chamber for the purpose of ascertaining its electric qualities ; when dreadful to relate, just as he was going to prove philosophically the proportion of electric fire, a ball of fire issued from the lightning, struck him dead, and consumed and destroyed most of the things in the room.

Lady M. How much the death of such an ingenious man is to be lamented, particularly as he was seeking to gain fresh knowledge.

Ment. Persons who die in such a glorious cause may be considered as martyrs to the general good of mankind. I recollect an instance equally unfortunate, and in many respects similar, in the death of the elder Pliny who lost his

life by his determined resolution to observe the effects of the dreadful eruption of Mount Vesuvius which happened A. D. 79. He was in vain advised to recede from the danger that threatened him, by exploring this tremendous object too nearly. As Pliny had at this awful season a fleet of ships under his command, he ordered the gallies to put to sea, with the hope of rendering service to his friends on the coast, as well as to satisfy his laudable philosophical curiosity. After various difficulties he at length determined to go on shore to his friend Pomponianus at Stabia, in the gulf of Naples, observing when he debarked, "Fortune befriends the brave." In the extremity of distress this eruption caused, by the fire, smoke, and cinders that issued from it, the people were involved in inextricable danger; therefore, whilst on the shore deliberating whether to go on board his ship again, this great man was suffocated, as it was imagined, by some noxious vapour from the eruptive matter.

Lady L. I feel much regret that two such eminent men should have fallen sacrifices to their eager pursuit of science.

Ment. To die is the common lot of human nature, but to expire heroically is the fate only
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of persons of distinguished bravery and magnanimity of soul. A sense of danger will never operate to retard a truly great mind from engaging in any noble enterprize, as Glory is more valuable than life !

Lady M. The melancholy fate of Professor Richman will make me fearful of being electrified, if ever that remedy should be advised for my benefit.

Ment. You might with as much propriety never eat any grapes, as the Grecian poet Anacreon was choked by swallowing that fruit ; and a number of cases might be adduced, that would excite dread on every subject, if those sensations were not counteracted by trust and implicit confidence in Divine protection. To quell your fears on this occasion, I can safely assert that a judicious operator in Electricity, possesses the skill of proportioning the degree of the shock produced by the electric quality, to the circumstances of the case ; and by that means even the eye, which is of a most delicate texture, can receive a slight touch of its force, which is often productive of the greatest advantage. This like many other things is possessed of great utility when properly applied, but destructive when perverted or abused. As a means of entertain-

ment, many ingenious experiments are made that come immediately under the class of Lectures upon Natural and Experimental Philosophy, from which much improvement is derived.

Lady L. I now clearly understand the properties of Electricity, and am greatly obliged to you for the information.

Ment. The next subject I shall discuss is Magnetism, a wonderful phenomenon that is produced by the power of the Magnet or Loadstone, which is a mineral that has the property of attracting and repelling iron.

Lady M. I have heard the Loadstone frequently mentioned; therefore, my dear Mentoria, let me intreat you to be very explicit respecting its qualities.

Ment. The Loadstone, or Magnet, is a kind of ferruginous stone, in weight and colour resembling iron ore, though rather of a harder substance and heavier quality, endued with the powers of attraction. It is supposed to have derived its name from Magnesia, a part of the ancient Lydia, where it is said to have been first found; though many imagine it was so called from a shepherd named Magnes, who first discovered its attractive qualities, by the iron in
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his crook, on Mount Ida. This wonderful production is usually found in iron mines, frequently in large pieces, half iron and half Magnet. The best Loadstones are brought from China and Bengal, which resemble iron in hue; it is also found of various dimensions, and in a great number of different places; those of England, Germany, and Hungary have a strong similitude to unwrought iron.

Lady M. I have seen a Magnet attract a needle, and observed when the Magnet was held up, the needle appeared to be fastened to it, till it was removed by force.

Ment. This extraordinary circumstance was most probably produced by what is called an Artificial Magnet, which is a piece of polished steel impregnated with a magnetic quality. The effect you describe may be produced at any time, if you place a bit of iron near to one end of a Magnet, which will clearly prove its power of attraction. Every Magnet has what are called its North and South Poles, one of which has a repellant force to drive backwards the same piece of iron which the other will attract.

Lady M. By what means was the use of the Loadstone discovered?

Ment. Its attractive powers were known in the early ages of the world. Thales, the Milesian Philosopher, who flourished about 600 years before the Christian æra, surprized at its constant effect, ascribed to it the property of a soul. Aristotle and Pliny have mentioned its magnetic quality : but it was not till the twelfth century that it was discovered invariably to point to the North. The knowledge of these extraordinary properties prepared the way for the grand discovery of turning them to advantage in nautical matters. The only use the ancients made of this mineral substance was, as a remedy for burns and defluxions of the eyes: happily for succeeding generations its more important utility has been ascertained, as in the fourteenth century the mariner's compass was brought into use, and after various improvements has attained its present perfection. To the discovery of the attractive power of the Loadstone, we are indebted for the invention of this useful instrument; as by observing the invariable tendency of a magnetic needle to point to the North, it has proved of the greatest service in determining the course of ships and the variation of the winds.

Lady

Lady M. Pray my dear Mentoria explain the construction of this valuable machine.

Ment. The mariner's compass is of a circular form, and has a kind of dial-plate divided into thirty-two equal parts, by right lines drawn from the centre to the circumference, which are called the points of the compass; the four principal ones, viz. East, West, North, and South, are termed the **Cardinal Points**. Over this dial-plate is suspended a thin piece of iron, which being touched by a magnetic virtue, by that means its two Poles are made to point nearly to the North and South Poles of the World; this is called the Magnetic Needle, and serves the important purpose of directing sailors what course they are to pursue.

Lady L. I cannot yet clearly understand by what means the Loadstone is so useful to navigators.

Ment. The compass may be invariably relied on as their guide, for however the ship may change its situation, the Magnetic Needle before described constantly points to the North, and by observations on the other parts, they are enabled to pursue the course that leads to the object of their destination, and to avoid what would steer them from it.

Lady

Lady M. Who first invented the Mariner's Compass?

Ment. This valuable discovery is usually ascribed to Flavio da Melfi Gioai, a Neapolitan, about the year 1302, in consequence of which, Principato, his native place, bears a Compass for its Arms. Others are of opinion that Marcus Paulus, a Venetian, A. D. 1260, made a journey to China, and brought back this useful invention: those who support this belief, alledge that when first the compass was used, it was on the same construction that is at present adopted by the Chinese, by having the Magnetic Needle floating on a piece of cork, instead of being suspended on a pivot; it is also supposed that the Chinese had some knowledge of the Loadstone's properties 1120 years before the Christian æra, as Chiningus their emperor was a great astronomer, and they assert made this, amongst many valuable discoveries. The French also put in a claim for the honour of this invention, from the circumstance of the Fleur de Lys being generally used as a sign to denote the North on any map or globe. The English form the plea for their share in this distinguishing honour, by the word compass being adopted for the appellation of this useful instrument,

as that word is used by them to express circuit or extent ; and though they cannot aspire to the fame of the invention, they are most likely entitled to the credit of having brought it to perfection, by suspending the box that holds the Magnetic Needle. I have enumerated the most probable sources of the valuable discovery of the Mariner's Compass ; though it is asserted by the French, that they had a prior knowledge of the Magnetic properties, as being of great utility in navigation, from the circumstance of some verses being extant, written in praise of the Marinette, or Mariner's Stone, in the year 1200. At such remote periods it is not possible to ascertain decisively on any controverted point ; it is therefore best to embrace those opinions which are the most generally received.

Lady L. By what means did sailors conduct their ships, before there were any Compasses ?

Ment. Previous to the discovery of the Polar Star and the attractive powers of the Loadstone, navigation was limited within very narrow bounds. The greatest enterprizes that were undertaken, and the principal traffic that was carried on by the ancients, were effected by coasting ; the mariners being afraid to quit the shores and launch into the main ocean, as they were

were possessed of no specific rules to ascertain their respective distances and courses. The Phœnicians were the first who obtained the knowledge of the Polar Star; and they communicated this valuable discovery to the Ionians and other Grecian states, about 600 years before the Christian epocha. This circumstance will convince you that we are indebted to the Phœnicians for the first rudiments or elements of navigation. Tyre and Sidon, the chief cities in the Phœnician districts, were the centre or emporium of trade in those remote times; therefore the hope of extending their commerce made them zealous to adopt every means that could increase its channels, as their wealth and consequence were derived from no other source, their country being inconsiderable in extent, and from their intense application to traffic, its cultivation in a great measure neglected. In a progressive survey of nautical improvements, it appears evident, that from the indefatigable pursuits of the Tyrians and Sidonians, and their constant regard to the direction of the Polar Star, we derived the knowledge of the coasts of the Ocean, and those of the Mediterranean Sea, on the most Eastern part of which Phœnicia was situated. These commercial people extended their
traffic

traffic to Africa and many distant regions in Asia, and settled several colonies in various parts, which served the purpose of establishing a general mart for all valuable commodities.

Lady M. In this instance the Phoenicians appear to have had great merit ; but who were the first who had courage to explore the Ocean, and undertake the valuable discoveries we read of?

Ment. These important effects have been produced by the knowledge we have attained of the Loadstone's wonderful powers. When their properties were fully known, many states availed themselves of the benefits derived from them, and in consequence several important discoveries have been made ; but the most eminent and earliest example we can find, is the great and successful enterprize of Columbus, A. D. 1492, who traversed an expanse of Ocean, unknown but to his great ideas, and by compassing his intrepid undertaking, ascertained an immense extent of continental country, and a great number of islands, which comprize the regions of America, and what are usually called the West Indies, from which many valuable productions and great wealth are obtained. The ancients had a knowledge but of
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a small part of the Globe, all America and the internal regions of Africa were wholly unknown to them: they were ignorant of the flux and reflux of the Sea, and were not convinced the Ocean furrounded the Globe entirely, though it was in some degree suspected; but none ventured to attempt a voyage round the World, till A. D. 1519, when Magellan, a Spaniard, undertook this great enterprize, and discovered the straits in South America, which bear his name. Sir Francis Drake was the first English circumnavigator, who returned from his successful voyage round the Globe in the year 1580.

Lady L. I remember in your Sacred History you mentioned the great services Hiram, king of Tyre, rendered to Solomon, when he erected the Temple.

Ment. He furnished him with timber, consisting of fir and cedar trees, from Mount Lebanon, which he conveyed on floats to Joppa, where they were delivered to Solomon's servants, and from thence brought to Jerusalem; and also provided him with artificers of various kinds, skilled in working gold, silver, and inferior metals, and dying scarlet, crimson, purple, and other colours, for which the Tyrians were

were famed. For these essential services Hiram required to be supplied annually with twenty thousand measures of wheat, and twenty thousand barrels of oil for his household, exclusive of the same quantity of barley, wheat, wine and oil which Solomon was to bestow on the workmen employed in his service. These were the most acceptable compensations Hiram could receive for the benefits he conferred on Solomon, as Phœnicia was but a small tract of country on the sea coast, and agriculture but little attended to, as the inhabitants were absorbed in the acquirement of riches.

Lady M. I nevertheless think it was beneath the dignity of a king, to make a bargain for the supply of his table.

Ment. Solomon, exclusive of that condition, gave Hiram, as a token of gratitude, when the Temple and Queen's Palace were finished, twenty cities in Galilee, which from the nature of the soil displeased Hiram; he therefore refused the proffered gift, and in contempt called the whole land Cabul, which signified dirty or displeasing, thereby intimating no one could walk on it without being up to the ankles in dirt. Solomon afterward rebuilt and improved these

these cities, and planted colonies of Israelites in them.

Lady L. I hope that you have not finished your account of Tyre ; is it now a place of importance ?

Ment. In consequence of the power and eminence it obtained by the great influx of riches, the natural effects of its extensive commerce, the inhabitants were guilty of every species of enormity, which attracted the Divine displeasure, and caused a prophetic presage of their destruction to be announced, and its fulfilment was completed by Nebuchadnezzar, King of Babylon. The great wealth of the Tyrians rendered the conquest of their country a matter of great importance to the Babylonians, who after a siege of thirteen years subdued it, destroyed the city, and put the few remaining inhabitants to the sword, the greater part having fled with their possessions to a new city they had built about half a mile distant from the shore : this event happened 572 years before the Christian æra.

Lady M. I suppose Solomon would not have been able to have erected the Temple, if Hiram had not assisted him in the undertaking.

Ment.

Ment. No great design can ever be executed without the concurrence of auxiliary co-operation ; gold in the mass, or precious stones in their native state, would not have embellished the sacred edifice ; skill was required to form one, and polish the other ; and these combined qualities could only be obtained by the joint efforts of persons possessing these separate gifts. The erection and decoration of the Temple were not the only advantages Solomon derived from his connection with the Tyrians. As the means of defraying the immense expences he had incurred in the execution of his diffusive plans and improvements, he built a great number of ships at Ezionzeber on the coast of the Red Sea, and when they were finished put them under the conduct of some expert Tyrian mariners, who with his men steered them to Ophir, or the Land of Gold, near a thousand years before the Christian æra.

Lady L. Where is Ophir, or the Land of Gold ? I imagine many persons resort to it.

Ment. Respecting where it was situated, the learned differ in opinion ; the most probable conjecture appears to be, that it was in some part of the East Indies, as those regions abound with the purest gold, silver, precious stones, ivory, ebony,

ebony, and other curious wood, spices, peacocks, monkeys, and a variety of other valuable commodities, which greatly encreased the revenue of Solomon's kingdom : thus the Tyrians proved the means of this monarch establishing a navy, as their skill in navigation qualified them for executing the vast projects Solomon's power and riches enabled him to undertake.

Lady L. I think three years appear a great length of time for the ships to be going from the Red Sea to India, and back again.

Ment. In those early ages voyages were undertaken with extreme caution, and executed with great timidity ; at this period the Phœnicians had no knowledge of the Polar Star, or of the Mariner's Compass, they were consequently obliged to steer in such a safe course, as would prevent their being exposed to the dangers of the wide Ocean, as they possessed no certain means to determine the distance they were from the regions that were the ultimate objects of their destination. This circumstance points out the signal benefits we derive in these more enlightened times, from the perfection attained in the Arts and Sciences, a consideration which should inspire us with gratitude to the
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the great source, from whence these and all other mercies are obtained.

Lady M. I am sorry you have closed your account of the Loadstone, as it has proved very instructive and entertaining to me.

Ment. And on reflection may impart an useful lesson, as I will suggest it is in your power to have its distinguishing properties reflected and exemplified in your own conduct and character, and also in Lady Louisa's.

Lady M. How can that be possible? What resemblance can there be between us who are comparatively so insignificant, and a substance which possesses qualities of such inestimable worth?

Ment. Intrinsic merit can only be appreciated in the certain sphere in which it acts; therefore if you perform the several duties allotted you, there cannot remain a doubt but that you will, like the Loadstone, attract the esteem of all worthy persons, as that mineral operates on iron; and I trust your just principles and discretion will in like manner possess the inclination and repellant power to reject all unworthy pursuits; as the Magnet repulses Iron that is in immediate contact with it, in direct

direct opposition to its attractive properties : thus you will find Virtue is a Mental Magnet, which points as invariably to temporal felicity and eternal reward, as the Loadstone does to the regions of the North Pole ; and to pursue the simile, as the latter conducts mariners to their destined port, the former will steer you to the haven of celestial bliss !

DIALOGUE

DIALOGUE IX.

W E D N E S D A Y.

On Meteors of the Watery kind.

Mentoria.

THAT branch of Natural Philosophy which comprehends the various kinds of Meteors, is divided into the following classes, those of Fiery, Airy, and Watery properties.

Lady L. Of what do these respectively consist?

Ment. Fiery Meteors are formed of vapours ignited, or set on fire, such as Lightning, falling Stars, and other luminous phænomena that

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appear

appear in the air. Airy Meteors, as Wind, Tornadoes, Hurricanes, &c. are the effect of the unequal temperature of the air, arising from the action of heat or cold. Watery Meteors are composed of vapours or particles of water variously modified by heat or cold, namely, Rain, Hail, Snow and Dew. As the means of rendering this subject intelligible to your perceptions, I must explain the different properties of evaporation and exhalation, which in their regular process occasion the production of Meteors.

Lady M. I will be very attentive to these remarks, as those expressions I am wholly unacquainted with.

Ment. They are distinct terms and of a very different tendency. Evaporation implies the action of dispersing or dissipating the moisture or humidity of a body, and Exhalation signifies a dispersion of particles of a dry quality from any mass or substance.

Lady L. Though we so frequently see it rain and experience its benign effects, I am totally ignorant of its natural cause.

Ment. The clouds from whence rain proceeds are produced by the heat of the Sun, whose attractive power draws the damp from
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the Earth, and the water from the rivers and seas: when these vapours unite in the air they form what are termed clouds, which are a compound of water and air; these sometimes disperse again, but when the aqueous particles become superior to those of the air, they break through it and fall in rain, which forms distinct drops by the resistance it meets with from the ætherial body in falling to the Earth.

Lady M. When it rains the drops of water appear round, what causes that effect?

Ment. Their globular appearance is produced by the power of attraction: for as every particle of water of which the drop is formed tends to a centre, every part must be equidistant from that point, which consequently makes it of a spherical form: from the observations I have already made you will perceive that the ascent of vapours consists in a repulsive force between the parts of matter, by which such as were separated from the surface of humid and other bodies, were repelled and driven up into the air in the form of exhalations; I have previously remarked that the density or weight of the air is greatest near the surface of the Earth, and that its dense quality gradually decreases as it ascends; whence it happens differ-

ent effects are produced according to the height of their respective regions, which is occasioned by the various proportions of the gravity or weight of the air.

Lady L. How different the clouds appear, sometimes they are beautiful beyond expression, at others, lowering and tremendous in their aspect.

Ment. This effect is produced by the various proportions of the weight of the air which occasion the clouds to ascend in progressive order, and by reflecting the light of the Sun above and below the horizon, present to our view such a variety of beautiful tints and shades as delight the eye and excite our astonishment: as I have enumerated the general cause of rain as produced by the concurrent effects of Air and Water, I shall now proceed to point out the influence of the Winds in the production of Rain.

Lady L. I have frequently heard persons remark that it was likely we should have rain, as the Wind was Southerly or Westerly.

Ment. They had rational and philosophical grounds for their expectation, because those Winds that blow from the Ocean, as the South or West Winds bring large recruits of vapours to the clouds, and therefore are more likely to produce

duce rain than other winds which proceed from the land or continental regions, like the North or North East Winds which generally operate to disperse the vapours or dissipate the clouds. Having thus explained the nature and properties of Rain as to their physical causes, it only remains for me to delineate the proportions in which they are dispensed, which are the effect of divine goodness ; as, instead of being salubrious, or beneficial, Rain would be productive of floods, and absorb the general mass of animal and vegetable nature in destruction if it came in torrents without due intermission. By the disposing Omniscient Power of the great Creator of the Universe the general means of receiving the blessing of rain consists in gentle showers, or rains, that from their quantity and quality are exactly suited to the important purposes of producing vegetation, and fulfilling other essential requisites to animal existence.

Lady L. I reflect with much concern that I have never formed a proper estimate of this blessing, as I have often murmured when it rained, if by that means I was deprived of walking or going out in an open carriage.

Ment. This regret was occasioned by the strong impulse of your natural feelings impatient under the delay of an expected enjoyment.

and from want of due reflection, ignorant that your disappointment was perhaps an universal blessing ; as rain is the harbinger of plenty, whilst continued drought must inevitably produce pestilence and famine.

Lady M. Pray my dear Mentoria what is Hail, it sometimes falls in tremendous showers ?

Ment. Hail is only the drops of rain congealed into ice, which is occasioned when in their passage through the inferior regions of the air they meet with nitrous particles that in a great measure contribute to freeze or congeal them. In ascertaining the properties of Hail, it is evident it seldom hails but when the air is heavy and the vapours ascend to a great height, which is usually the case in Summer time, when hail-storms are more frequent than in Winter. In the higher regions of the air the cold is more intense, and therefore it is imagined abounds with a superior quantity of Nitre, which causes a more immediate and stronger congealment of the aqueous particles, and forms them into a body of ice of various sizes, their magnitude differing according to the degrees of cold which produced them. These icy substances acquiring considerable weight, descend

descend from those heights to the Earth in the form of a shower of hail.

Lady L. Hail-stones are often of a great size and do much mischief.

Ment. Their size or magnitude is in some degree occasioned by their acquiring a fresh accession of matter in their descent and progress to the Earth. Hail-stones are various in dimensions; it is asserted there have been some in foreign regions as large as a turnip or Seville orange; in our country they have been frequently found one fourth of an inch in diameter: these formidable showers are productive of the most destructive consequences, particularly to vegetation of a delicate texture or infant growth; the form of Hail-stones is not always the same, they are generally conical or oblong.

Lady M. You frequently mention Nitre as a part of the composition of Meteors; I imagined it was a medicine: explain this circumstance to me?

Ment. The Earth is formed of different strata or layers of matter which by the Sun's attractive power is diffused through the body of the atmosphere for the general benefit of the Universe. Thus the Air is impregnated with different qualities, Nitrous, Sulphureous, &c.

which co-operate to produce vegetation, and by their salubrious effects, to prove universally beneficial. Nitre, which is the subject of your inquiry, is a salt extracted out of the Earth, abundantly incorporated with the spirit of the air; it is of great and general use in medicine, as its cooling saline properties are very effectual in the reduction of fevers, and a variety of other cases produced by an exuberance of heat.

Lady L. I am impatient to hear what Snow is composed of; it is a beautiful substance which I greatly admire.

Ment. Snow is produced by the vapours becoming considerably condensed, yet not in so great a degree as to be changed into Water; in this state, by a great degree of coldness in the upper regions of the air, the particles of the condensed vapour are congelated into ice; several of them, by adhering together, compose small fleeces of a white substance, something heavier than the air, which consequently descend in a slow and gentle manner through its medium, being subject by their peculiar light quality to be driven about by the various motions of the wind, which produce what we call drifts of Snow.

Lady

Lady L. When I see the Snow fall, I shall observe it with more pleasure than I did before I knew from what cause it was produced.

Ment. Snow, when philosophically defined, is demonstrated to be the natural effect that saline particles of every quality possess, to collect together and constitute some specific form: this is what is called crystalization; therefore flakes of Snow are only these accumulated bodies, which descend to the Earth when their weight is too great to be sustained by the Air; so that Snow, when analyzed, is evidently nothing more than saline, aqueous particles, congeled by the degrees of cold in the higher regions of the Atmosphere.

Lady M. I am much obliged by your giving me so copious an account of Snow, and entreat the favour you will explain the qualities of Frost.

Ment. The converting a fluid body into a hard solid mass, by the influence and action of cold, is denominated Freezing or Congelation, which terms are appropriate to liquids when transformed into Ice. Various are the opinions respecting the natural causes which produce that effect; it appears highly probable it is occasioned from an abundance of saline, nitrous

particles then abounding in the air, which penetrate into the porous parts of the water, and by that means render them dense in quality. The effect of Congelation is uniformly attended with the emission of heat; Water also diminishes in weight by the process of its frozen state, and evaporates almost as much as when it was in its native fluid form, and in proportion to the degree of cold this evaporation increases. It is also observed that Water that has been boiled is more speedily Congelated than before it has undergone that operation.

Lady L. Frosty weather is very agreeable, when it is not too severe.

Ment. This, like every other Elementary dispensation, abounds with advantages, which on a cursory view, we are not always able to estimate to its due extent. In the œconomy of Nature, the primary object appears to be universal benefit, which is pursued by wise measures, ordained and administered by the great Author of Existence. The effects of Frost, like every other means employed for the advantage of the whole system, though partially or individually they may prove unpleasant or destructive, yet in a compound sense eventually operate beneficially. Thus you who bask in the sun-shine
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of Prosperity walk out on a Frosty day, and enjoy the clearness of the Atmosphere, warmly clad, and fenced against the cold, and on your return, with an appetite encreased by the keenness of the air, sit down to a plentiful and elegant repast, cheared by a blazing fire and enlivening intercourse : reflect, that whilst you enjoy all these blessings, many pine in want for the common comforts and conveniences of life. Numbers who acquire a competent subsistence in the lower ranks of life, by cultivating the Earth, working on the Water, or in other employments influenced by the weather, are by the means of Frost deprived of support, from not being enabled to pursue their respective vocations. How many by this circumstance can obtain neither Food, Raiment, Fire, nor Shelter ? to them the storehouses of plenty seem shut, and if it were not, that the hearts of those who possess abundance, did not melt in proportion as the Earth and Waters freeze, a great and valuable part of the community would perish and be plunged into an abyss of misery. The human race are not the only beings who sustain a trying conflict during this severe yet salutary season ; Beasts of the Field, Birds of the Air, Fishes, except those in Seas or great

Rivers, Reptiles and Insects feel the force of this congelated temperature, as their natural resources of food in a great measure fail by the influence of a long continued Frost: thus there appears an irresistible claim for liberality, when the very Elements conspire to lock up their treasures in impenetrable security. Charity is the mental solar ray which thaws the icy chains of Poverty; Benevolence is the balm which heals the galled wound of an afflicted heart, zealous to acquire the necessaries for support, yet by the rigour of the season deprived of the due means. During this inclement period, various are the appeals for aid, the calls of necessity render the timid bold, and self-preservation (which is one of the first laws in nature) operates to induce the subordinate parts of the creation to urge by their near approach and plaintive tones, the benevolent assistance their destitute state requires; under this influence the Robin-Red-Breast almost becomes an inmate in human habitations, and many other instances might be produced of a similar nature, to enforce the practice of that philanthropy which it is my endeavour to inculcate.

Lady

Lady L. There is so much pleasure in relieving the distressed, I will never neglect any opportunity afforded me.

Ment. I wish your charity to be diffusive, but not indiscriminate ; as judicious benefactors should bestow those gifts which are likely to prove most useful to the objects of their bounty. The circumstances I have been enumerating, whenever they occur, are but so many opportunities to place your virtues in the fairest light : be liberal in your donations, but not ostentatious ; seek the afflicted in their most obscure and concealed recesses ; obey the impulse of your feelings, which will lead you to perform kind services ; but above all, blend sympathy with your alms ; as many when they bestow gifts, by an ungracious look, or an unguarded harsh expression, eclipse the merit of the act, by the rigid, austere mode of its performance.

Lady M. I will ever avoid this unamiable conduct, and in every instance will strive to mitigate the sufferings of the afflicted.

Ment. Philosophy may make you Wise, but it is Christianity alone that can make you Good ; and in its divine precepts the practice of Charity is enforced as an essential quality in
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the formation of a perfect character, by which quality we are to understand not only the giving of alms, but also that general benevolence of heart, that is productive of universal philanthropy or good will.

Lady L. I will endeavour to regulate my conduct by these and every other rule prescribed in the Scriptures.

Ment. An adherence to this resolution will render you respectable and happy, as uniform good conduct is sure of attaining eternal reward. I shall now endeavour to explain the properties of Dew, Hoar Frost, Mists, &c. which will close my remarks on the process of Freezing, or Congelation. When the air is full of vapours, if a breeze arises and checks their solution, they form clouds in the lower regions of the atmosphere which constitute a mist or fog: this effect is usually produced in a cold morning, and is dispersed when the Sun has rarefied the air sufficiently to dissolve the aqueous particles, of which mist of all qualities are composed. From these observations it will appear evident, that what we usually call a Fog, is a Watery Meteor, composed of gross vapours floating near the surface of the Earth, and is produced by the intense cold quality of the air, that prevents

prevents the vapours ascending through it, which by becoming condensed in the lower regions of the atmosphere, either fall in Dews, Hoar Frosts, or drizzling Rain, or continue suspended in the form of Fogs. The dimensions of any object viewed through the medium of a Fog appear magnified, and in fact Fogs are only clouds of vapour formed in the atmosphere near to the surface of the Earth, which render their effects very dangerous to travellers and persons engaged in many particular occupations.

Lady M. I was surprized one day last winter, that our coachman was so much alarmed, when he found the Fog encreased to a very great degree.

Ment. He knew from experience that caution, not skill, would be the only probable means of counteracting its dangerous consequence. The gross particles of which Fog is composed, obscured the perception of visible objects ; therefore he was fully aware, unless he could obtain artificial light to pervade the misty vapour that surrounded him, he might the next instant be immersed in a river, or be hurled into an abyss from which no human means could extricate him ; as what we usually call accident, is frequently natural consequences, which might
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be timely avoided by vigilance and prudent circumsppection.

Lady L. Are not Fogs very unwholesome?

Ment. The gross quality of vapour that forms their constituent parts, is in many instances too powerful and oppressive for delicate organs of respiration to contend with. I shall now proceed to inform you of the qualities of Dew, which is a dense vapour of a moist quality that falls on the Earth, like a kind of drizzling rain. The refreshing nature of this Aqueous Meteor is so well known, and its salubrious effects so generally experienced, I shall only observe, that the Earth in fair dry weather naturally becomes parched by the heat of the Sun, at which period the watery and other less volatile particles, as those of a saline or oily quality are by the attractive power of the Sun, raised into the air, and occupy those regions in the atmosphere that are nearest to the surface of the Earth. Whilst these exhalations are kept in agitation by the solar heat, they are not visible; but when that heat begins to abate, a white dense vapour collects, which continues till by the genial heat of the rising Sun in the morning it is entirely dissipated. The essential difference between Rain and Dew, consists in the following

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ing particulars: that the condensation of the former is produced at a considerable distance from the Earth, and the latter is occasioned by that effect very near to the object on which it falls, which happens from the various operations of cold upon the vapoury air; and what is called the Hoar or white Frost is nothing more than the Dew changed into ice by the influence of extreme cold: black Frost differs only from this in not being attended with a mist or Fog, and by not appearing white.

Lady L. I have frequently perceived the great advantages that plants of every description derive from the Dew falling on them; but I think I recollect taking cold from wetting my feet, by walking on grass which was very damp, in consequence of a great degree of Dew that had fallen after a very hot day.

Ment. This unlucky circumstance is no argument in disfavour of the salutary influence of Dew, the same heat that had parched and nearly withered the flowers and plants, had also opened the pores of your skin; the former were replenished and recruited by the natural supply of Dew, which is congenial to their generic qualities, and in fact operates on vegetation as food and medicine; whilst on the contrary,
your

your temperament received a check which it was happy proved productive of only a slight degree of indisposition, as those effects often prove fatal to the human constitution, which evinces the necessity of avoiding exposing ourselves injudiciously to the sudden transitions of the Elements. Thus much for the general properties of Frost and Dew, which naturally lead me to consider the quality of what is termed Cold, that produces them in their varied effects. On strict investigation, Cold appears to be only a comparative term, and implies nothing more than a less degree of Heat. By various experiments it is proved that many bodies will liquify with one degree of heat, and become fixed or frozen with another; which is the case with Metals, Salts, Oils, and Water; with one degree of warmth the latter will appear in a fluid state, and with a less degree the particles will be found to be fixed or congelated; in like manner the vapours in a warm air are in a fluid state, and when condensed by the cold of the evening and descend, they adhere to the grass, and assume the appearance of pearly drops, which in that state is called Dew; but these particles by the influence of a colder air become fixed, and whilst they are floating in the Atmosphere,

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constitute a rainy fog or frozen mist which when they descend fall on the grass, shrubs, trees, &c. and produce a beautiful effect from the kind of crystalline incrustation this hoar or white frost exhibits.

Lady M. I cannot express how greatly Lady Louisa and myself are obliged by the variety of information with which you store our minds.

Ment. It is my hope and my endeavour to render you rich in Nature's best gifts, extensive knowledge and a just sense of the various obligations of duty; valuable possessions that I would not on your behalf exchange for all the gold and diamonds, that Golconda and Peru produce.

Lady L. I am sorry you appear to have finished your account of the watery Meteors.

Ment. Perhaps this definition may be incomplete, if I do not give you some idea of the properties of Water in its fluid state. This element possesses many extraordinary qualities which would carry me beyond my present purpose, circumstantially to enumerate; I shall therefore only dwell on those particulars that may tend to give you a general sense of its importance,

portance. As fluidity is the effect of the influence of heat, it is asserted on philosophic grounds that ice is the natural state of Water; by the increase of heat Water is rendered elastic and volatile and becomes a vapour, which is again condensed into Water by the superfluous heat being withdrawn. I shall next observe the effect it produces from pressure or force, which varies in proportion as its depth does, without any respect to its breadth; if it were not for this property vessels would be forced against the shore in their sailing process, and navigation consequently impeded in its course. It is also observable that Water always rises to the level of its source, even when conveyed in pipes or other channels: this wonderful effect is occasioned by the pressure of the atmosphere, which by its general influence on all parts of the fluid body impels it from its source to pass through any medium or vehicle till it meets with an equal resistance from the pressure of the atmosphere at the other end or termination: when this pressure of the atmosphere is removed, Water will rise to the height of thirty six feet, which is occasioned by the weight of the body of Air on the Water's source. It is on these principles that Water-works, fountains, and

and even common pumps are constructed. Water contains a certain quantity of air, and from its various changes produces many beneficial effects; in their various vicissitudes we may trace that vapours are raised by the Sun from the expanse of the Ocean by the general operations of evaporation, the effects of which are diffused by the Winds through every region and climate; when their course is interrupted by the summit of Mountains their accumulated matter forms itself into clouds and descends to the surface of the Earth in the quality of Rain, Snow, Dew, &c. The exuberant parts of these exhalations by their tendency to gravitate, bend their course through Brooks and Rivulets till they meet with Rivers, and from thence revert to the Sea, and again are subject to a rotation of the salutary consequences I have previously described.

Lady M. How surprising these circumstances are: I am very happy I am sensible by your kind instructions of their wonderful variations.

Ment. The quantity of subterraneous Waters is incalculable; it is generally imagined that in the space of the Earth's surface more than two thirds of the Globe consist of Seas. The diversity of Mountains, Hills and Vallies
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are an eminent example of the wisdom of God manifested in the creation ; as, if the Earth were perfectly level the Waters would be unavoidably stagnated, and in consequence produce several fatal effects. When we seriously reflect on the beneficial properties of Water in the general system, it excites our gratitude and praise ; but when we extend our enquiry to the individual advantages it produces to the human race and every species of animals as well as every branch of vegetation, we are lost in wonder in the contemplation of these transcendant instances of Divine Mercy. This active fluid conduces very universally to the comfort and existence of animals of every genus ; it is the medium to produce the fruits of the Earth, to dilute food, to allay thirst, and also is the genuine element of a variety of animated beings who could not live in any other sphere : from these considerations it appears evident that Water is an essential blessing without which we could not subsist, as the possession of solids would not operate to the preservation of life unassisted by the happy effects derived from fluidity in the concoction of our food, and many other important purposes. Another advantage may be

be suggested, experienced by the human race, from the various springs of Water that arise in the Earth, endued with medicinal virtues, occasioned by the different stratum of the Earth through which they pass, some being hot or sulphureous, others chalybeate or of an irony or steel quality, and several impregnated with a variety of nitrous and other properties, derived from the mineral particles, of which the mass of Earth is composed.

Lady M. I have been at Bath and Tunbridge, and have tasted the Waters which render those places so much resorted to.

Ment. Health is the greatest blessing that, as human beings, we can enjoy ; its uncertainty and privation convinces us of its value ; yet like many other important possessions, it is frequently lavished by the intemperate sallies of youth, or the depraved effects of passions at a more mature period of life. In pursuit of this treasure, many who are afflicted with diseases go to places distinguished by medicinal springs to seek relief, which they often find ; and I hope are duly sensible of the Source or Fountain which flows with the Streams that recruit impaired strength, and tend to the prolongation of life.

Lady

Lady L. I had no idea of the variety of good effects we experience from Water, which I am afraid many inconsiderate persons do not estimate as they ought : I am conscious I never ascribed to it half the consequence I now perceive it possesses. Pray, *Mentoria*, do not quite close your remarks on it.

Ment. As far as relates to its genuine properties, I believe I have exhausted all the observations necessary for your immediate consideration, therefore shall close my account of Watery Meteors ; but as I ever wish to comply with your requests, I will extend my lecture, by endeavouring in a kind of metaphor to shew you the contrary effects of Frost and Dew, exemplified in the characters of Avaro and Benevolus, that the contrast may produce in your mind some forcible impression respecting the opposite qualities of Avarice and Philanthropy, which bear a strong similitude to the rigidity of Frost and the benign effects of Dew.

Lady M. Forgive me, my dear *Mentoria*, if I betray a degree of impatient anxiety for you to begin these interesting traits of human life, which I have no doubt will have a strong moral tendency.

Ment.

Ment. Avaro was of a low origin, yet by the concurrence of some favourable circumstances, at an early period of life was established in a lucrative employ. His understanding was moderate, and received no degree of cultivation beyond the common rudiments of education, essentially necessary to fulfil the laborious mechanical duties of a commercial vocation. By the joint efforts of perseverance and uniform punctuality in the general routine of business, Avaro succeeded in all the enterprizes he undertook; an increase of wealth was the consequence of his prosperity, and in the course of a very few years he became possessed of considerable property, the natural result of unremitted assiduity. His conduct in his youth had been marked with approbation, as his success was in some degree imputed to his merit, and in his private domestic concerns he adopted a rigid oeconomic plan, which at first attached to him the character of a Prudent Man. As Avaro's sphere of action was circumscribed to the small space of the Royal Exchange, Custom-House, and Bank, his ideas were inadequate to a more excursive range, consequently his imagination respecting happiness never soared beyond a confined situation in one of the most undesirable

parts of the city, which afforded him neither light nor air, in a degree much superior to what might be obtained in a dungeon. Avaro's increase of wealth served no other purpose than to contract his heart, and the rapid accumulations he experienced only tended to make him the more insatiable in pursuit of Riches, and their consequent concomitants, oppression and power. The fardid quality of Avaro's disposition precluded a taste for the convivial pleasures of society, therefore his habits of life were parsimonious and misanthropic. His notions of enjoyment alone consisted in an extention of those possessions, which when sought with unrestrained ardour, are too often gained by means disgraceful to human nature. His rapacity kept pace with the increase of his treasures, and steeled his heart with that kind of Apathy, which might be said to resemble Frost, as it congealed the Fountains of Compassion, and stopped the Current Tide of every benevolent sensation. He was Deaf to the eloquent entreaties of hapless innocence in distress, Blind to the ostensible wants of the hungry and naked, Oppressive to his tenants, Reproachful to the very poor to whom he refused relief; and above all, was Niggardly to himself, as he experienced Want in the midst of
Plenty,

Plenty, lived as an Alien from friendly intercourse, and died unlamented by even his nearest relations!

Lady L. I cannot see for what purpose Avaro was so penurious; pray what became of his vast possessions?

Ment. In defining the character of a Miser, we must consider him as an Agent, employed in amassing riches that will in the end be converted to their proper use. Avarice is one of those perversions of human blessings, that one cannot contemplate without abhorrence, and unquestionably is a disease of the Mind; as an inordinate thirst for Wealth is like the eager desire which delirious persons feel in a raging fever for the attainment of liquids, in a proportion superior to what they can swallow or enjoy. The incitements to this vice are gradual in their progress, and in the first instance originate in the fallacious idea of self-gratification; as the Miser aims at Riches, which according to his principles are the source and end of happiness, unheeding that his Golden Harvest will probably be reaped by an unthankful legal descendant, who will dissipate his Wealth with the same degree of profusion, as he has used of artificial penury, to effect its amassment. This

general consequence Pope thus emphatically expresses.

Who sees pale Mammon pine amidst his store,
Sees but a backward Steward for the Poor ;
This year a Reservoir, to keep and spare ;
The next a Fountain, spouting through his
Heir !

Observations on human life and manners bear evident proof that Gold, when once it has obtained the medium of circulation, like Water, will always rise to the level of its source ; as notwithstanding it may for a season be consigned to the dreary abyss of the Miser's iron chest, by the decrees of an over-ruling Providence contingencies happen that operate as the weight of the atmosphere invariably does on Water, to bring it to its native channel, for the universal benefit of the community.

Lady M. I can clearly perceive a very great similitude between Avaro's character and the qualities of Frost, as both are rendered impenetrable to tender impressions. How essentially Splendidus's conduct differs from the example of the sordid conduct you have just described !

Ment.

Ment. Splendidus does not appear to me to form the strong contrast I wish to exhibit to Avaro's unamiable character; profusion of expence, and apparent magnificence in the general course of life, frequently rather impede than produce generosity and benevolence of mind; as an ostentatious display of riches is often accompanied by selfish principles, meanness of spirit, and corruption of heart; therefore I shall chuse the intermediate qualities which Benevolus possessed, to exemplify the happy effects his uniform conduct produced, which operated like the benignant Dew.

Lady L. My dear Mentoria, how can we express our obligations to you for thus portraying the characters of Virtue and Vice in such strong colours, that they produce in our minds the just sensations of abhorrence and esteem!

Ment. Benevolus was descended from an ancient family, and resided on his paternal estate, which was situated in a Western county, at a considerable distance from the metropolis. In his youth he acquired a competent share of every useful and polite accomplishment, usually attained in the regular course of a liberal education; as his fortune was very large, he did not pursue any profession from lucrative mo-

tives, but as his general plan was as a citizen of the World, to be diffusively useful within his sphere of action, he studied Law to enable him to assert his own rights, and to protect those of others; and also bestowed great attention on the Medical Art, that he might administer relief to his indigent tenants and other distressed objects in the vicinage of his domain. With these laudable inclinations and ample qualifications for their discharge, Benevolus dwelt in the mansion inhabited by his ancestors for many centuries, which he judiciously improved, but preserved every vestige that remained of its venerable antiquity: and as his turn of mind was perfectly domestic, he married a very amiable woman, who coincided in all the good offices Benevolus planned or executed, and in her peculiar department suggested many improvements and salutary measures for the completion of their philanthropic system. As wealth is an essential quality in the performance of munificent acts of charity, Benevolus apportioned a certain part of his income to that laudable purpose, and formed a regular arrangement for his own expenditure, with which he maintained a degree of splendor adequate to support the dignity of
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of his family, yet under such restrictions as to avoid profusion and prodigality. Under the influence of this prudent conduct, Benevolus became the arbiter in all disputes in the circle of his neighbourhood ; the friend and the physician to administer relief to the diseased in body, or afflicted in mind ; and the patron to advance the interest of all who implored or required assistance. The disconsolate Widow and helpless Orphan found the defect of a Husband and Father supplied by Benevolus's judicious bounty ; the Aged experienced in his kindness a staff to lean on for support ; the Infants lisped his praise, and persons of all descriptions and ages resounded his eulogium. To these perfections he also added a distinguished degree of zeal for the advancement and welfare of all public institutions and improvements, to which he largely contributed his pecuniary aid. In the execution of his designs for the general benefit of society, he found employment for the idle ; by his admonitions and example, reclaimed the profligate, and often by his zealous efforts effectually restored those who had flagrantly wandered from the path of duty. This philanthropic turn of mind and genuine purity of heart, was produced by

strict adherence to the principles of Christianity, strengthened by reliance on the decrees of the Supreme Being, which operated to constitute a character that rendered Benevolus an object of universal esteem during his terrestrial probation, and caused his death to be a subject of general regret : as his virtues were of that superior quality, to entitle him to the loudest plaudits of Fame!

Lady L. Benevolus may with great justice be compared to Dew, as he appears to have possessed all those qualities which are the characteristic excellencies of that salutary Meteor.

Ment. The Christian charity which comprehends a general system of moral perfection, and was eminently conspicuous through the varied scenes of Benevolus's warfare upon Earth, bears a literal similitude to the fructifying effect of Dew, which is dispensed to recruit vegetation in its languid drooping state ; as philanthropy enlivens the plants of adversity, and causes them to shoot with blossoms of hope ! I cannot close this account of Watery Meteors without subjoining some observations on the advantages which are obtained by the absorption
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of solar heat produced by the general process of evaporation, which conduces to the gradual change of the temperature that in every progressive season we experience, and largely contributes to prepare the Earth for culture, and produce the benefits derived from fertilization, and the universal harmony of terrestrial blessings.

On Meteor of the fiery kind.

Meteor.

I AM now going to enter on the subject of the most awful and sublime effects of Divine Will, exemplified in Thunder and Lightning. It was generally believed that this tremendous Meteor was the natural effect of Sulphurous, Nitrous, and Acetous, and Acetous or L 5 EUGALID, exhaled in various bodies which ascended into the air, and after various fluctuations by the motions of the wind, were in consequence so much agitated, that by striking against

DIALOGUE X.

THURSDAY.

On Meteors of the Fiery kind.

Mentoria.

I AM now going to enter on the subject of the most awful and sublime effects of Divine skill, exemplified in Thunder and Lightning. It was generally believed that this tremendous Meteor was the natural effect of Sulphureous, Nitrous, Spirituous, Bituminous, and Acetus or acid particles, exhaled from various bodies which ascended into the air, and after various fluctuations by the motions of the wind, were in consequence so much agitated, that by striking against

gainst each other they forced themselves through the clouds, and by their joint action produced the explosion which is termed Thunder, and a flash denominated Lightning, the bituminous and sulphureous occasioning the stream of light, and the nitrous and other qualities the tremendous sound, by repeated efforts or claps of Thunder. Modern philosophical observations have at length demonstrated that Lightning is an Electric fluid, and that some clouds possess a positive, and others a negative state of Electricity, and the greatest flashes are probably produced by the Electric fluid combining in some degree with the vapoury particles of the air. The claps of Thunder which are connected with the flashes of Lightning appear to be occasioned by the filling of the great space made by the progress of the electric matter; as its vibration, which is the source of its sound, commenced at the very instant: which is evident from the echo, or repercussions that are heard before the sound finally reaches the ear. From various experiments on the different properties of the Electric Fire, it is a probable conjecture that these variations are produced by the fermentation of different particles in the atmos-

phere, such as those of a sulphureous and acid quality.

Lady L. The sound of Thunder is so terrific, I tremble when I hear it; and am greatly alarmed when it lightens.

Ment. It may not be in our power to conquer apprehension, when the subject of our dread is fraught with evident signs of portending danger; yet the kind of resignation that is produced by trust in Divine Providence, keeps those sensations within proper bounds. In a tremendous storm of Thunder and Lightning, no rational being can deny that the most fatal consequences may accrue; but as these instances are comparatively rare, we should fortify our minds by a firm reliance on the protection of God, under whose omnipotent direction Bolts of Thunder and Flashes of Lightning pursue their destined course. When beset with instruments of danger, it would be presumptuous to think ourselves secure; yet on the other hand we should zealously guard against those emotions, which when properly defined, are in effect a kind of sinful distrust.

Lady L. I will endeavour to adopt the conduct which you inculcate with so much energy.

Ment.

Ment. It is not sufficient that you avoid being apprehensive, the circumstances of this awful predicament require also that you should express gratitude for the protection you experience during this general convulsion of the Elements ; as objects of greater magnitude and importance are often destroyed, whilst you have escaped the dire effects exhibited in a tremendous storm, which is the entire effect of Divine mercy, not of your superior merit.

Lady M. Pray, my dear Mentoria, favour us with some further particulars of the properties of Thunder and Lightning. What is a Thunder Bolt ?

Ment. It is a substance consisting of a compact undissolved body of ignited matter, which had not time to explode in the air, but is darted with the velocity of light itself, to the objects on the surface of the Earth, and acts with irresistible force ; its fatal effects are manifested by the destruction of trees, buildings, and every other substance (even those of the strongest texture) that obstruct its progress.

Lady L. Lightning is not always destructive ; and does it not frequently appear unattended by alarming symptoms ?

Ment.

Ment. The Electric matter of which Lightning is composed, may be divided into three distinct classes : the first is that in which it simply explodes and flashes, in a degree of force insufficient to be destructive ; the second is when it explodes with greater force, or density, which often operates to strike persons blind, or set various objects on fire ; the third and last stage is that of the Thunder Bolt, which is the most awful state of this wonderful phænomenon. From the observations I have already made, you will perceive that Thunder is probably produced by a sudden kindling of combustible exhalations in the clouds, and Lightning is nothing more than the Fire bursting from those clouds : this opinion is confirmed in a great degree by storms of Thunder and Lightning, being most frequent in sultry weather, when the air is more strongly impregnated with sulphureous and other combustible particles. With all due respect to modern experiments and opinions, from just deference to Sir Isaac Newton's theory of optics, I shall inform you that he defined Lightning in the Heavens as analogous to the flashing of Gunpowder in an unconfined state or condition, and that Thunder produced a similar

milar effect to the report of a Gun, from the powder kindled but confined in the barrel.

Lady M. I recollect seeing Iron conductors put on houses and other buildings, as the means of preventing fatal accidents from Lightning ; how can they operate so beneficially ?

Ment. The Fire of Lightning is Electrical, therefore can be attracted by non-electric bodies, such as Iron, Earth, &c. so that these conductors are intended to prevent general bad effects, by the antidote of a partial attraction.

Lady L. Is not Lightning invariably seen before the Thunder is heard ?

Ment. Undoubtedly, and always in a medium of proportion to the distance of the Thunder clouds ; as Light travels with a greater degree of velocity than Sound.

Lady M. In what respect does Thunder prove beneficial ?

Ment. By altering the state of the air, and by an explosive effort dispersing those particles which might prove of a hurtful tendency, if they remained floating in the atmosphere. Air, like Water in a stagnate state, would be productive of diseases and scarcity, originating from its putrid tendency ; this dire effect is happily counteracted by Winds, Thunder, Light-

Lightning, and other Meteors which operate to purify the regions of the air, and conduce to the general harmony of the seasons.

Lady L. I will forbear in future repining when it Thunders, as I clearly perceive it is attended with general benefit to society.

Ment. In treating of Meteors I must not omit mentioning Falling Stars, which are also vapours kindled in the Air, often very near to the surface of the Earth, and sometimes in the higher regions of the atmosphere: many are of opinion these, like other fiery meteors, are pure Electric matter.

Lady M. In some of your former instructions I remember you mentioned a Meteor called Ignis Fatuus, commonly termed Will with a Wisp, or Jack with a Lantern.

Ment. It was a subject of general belief, that these luminous vapours frequently arose in marshes, and other damp situations, forming a Meteor resembling the flame of a candle, which frequently misled travellers; but at present there are doubts entertained whether these effects were not more the consequence of a deluded imagination, than a circumstance existing in nature. The real quality of this exhalation is defined to be an ignited vapour produced by the decomposition

tion of vegetable substances in low marshy situations, or bogs, that from the inflammable air with which they abound, cause a luminous appearance, and by wafting near the surface of the Earth, create alarm and apprehensive sensations in superstitious uninformed minds, and consequently attach the idea of this phænomenon being the effect of supernatural causes. These Meteors are sometimes seen in different numbers on the same spot, and by intersecting each others paths with great rapidity, they frequently disappear all at once, which is probably occasioned by their meeting with some object in their progress, which obstructs their course.

Lady L. Those must be very weak persons who are frightened when these Meteors appear.

Ment. Prejudices are conveyed by the ignorant, and implicitly received by those who are immediately connected with them, by the relative ties of kindred or friendly association; this medium is the native source of the propagation of error which takes deep root in understandings that are not within the sphere of receiving genuine information.

Lady

Lady L. I have frequently seen the Aurora Borealis, Streamers, or Northern Lights, are they Meteors?

Ment. Without doubt, and of the Fiery kind, as they have a luminous appearance, which is sometimes visible at night in the Northern part of the heavens, and is almost constantly perceptible in the regions near the North Pole; its natural causes have not hitherto been decisively ascertained, though it is almost universally allowed that this Phænomenon is solely produced by Electric light.

Lady M. I fear that you have finished your account of Meteors, which I much regret.

Ment. As I have so fully described those of the Watery and Fiery kinds, there only remains the Airy class to be considered, the properties of which I explained in the regular course of my definition on Air; therefore I shall only add a few general observations respecting the benefits that are derived from the variations of the Winds. In a commercial country like Great Britain, the fluctuations of the Air, which comprehend the various Meteors denominated Winds, are productive of many substantial advantages; as they cannot blow from any point, without waisting to our shores.

shores the productions of the most distant climes.

Lady L. I am convinced of the advantages you have enumerated ; yet I should always like the Wind to be calm.

Ment. Before we seriously form such a wish, we should duly consider the probable consequences of a tranquil state of the air. If there were a general calm, the Winds would undergo but slight variations in the body of the atmosphere, which would produce the most fatal effects ; vessels would be slow in their progress, and the general purposes of trade and navigation considerably impeded. After having thus amply considered the different properties of Watery, Fiery, and Airy Meteors, and their natural causes, there appears no branch remaining that claims attention, except the general qualities of Fire, which I will endeavour to explain.

Lady L. I wish to hear an account of this Element, as it produces many great and wonderful effects.

Ment. The real nature of Fire has been the subject of dispute with naturalists and philosophers ; some maintain the opinion it arises from a violent motion of the parts of any body
or

or substance, whilst others assert it is a fluid possessed of certain qualities distinct from every other : the latter seems to be the system best approved, and most generally received. By the term Fire, I wish you to understand that wonderful subtile agent of nature, which by some invisible cause, expands bodies, and renders them hot to the touch, by the effects of which fluids are rarefied and changed into vapour, and in the end evaporate, or terminate, by being melted into glass. From various experiments it is evident that Fire exists and acts unconnected with matter, independent of every terrestrial substance, neither being produced nor compounded with any thing of which we have any knowledge or perception. The action of Fire is proved by a number of ingenious experiments, as well as by the common consequences we perceive ; and from an investigation of solar light, a certain modification of that quality is most likely the primary cause of heat, expansion, vapour, &c. as it in every respect answers to the characteristic properties of Fire ; and it is thought highly probable that the Electric matter is in effect nothing more than the solar heat absorbed by the Earth, and by thus undergoing some transmutations essentially differing from its
appear-

appearance when acting as Light, therefore the affinity between Fire, Light and Electricity are by many identified as one substance.

Lady M. I am happy to hear some rational account of Fire, as though I daily experience the comforts arising from this element, I am ignorant of their philosophical cause.

Ment. The elementary fluid of Fire is universally dispersed in almost every part of the Creation, and it is generally asserted that Fire or Heat is the only permanent elastic substance in Nature: Air is its natural food, which produces ignition or the kindling quality; for, by uniting with combustible matter such as coals, wood, &c. &c. in infinite variety, the Air is destroyed and the fire that constituted its elasticity is consequently emitted; this effect is demonstrated by combustibles not burning when excluded from Air.

Lady M. I shall now have a clear idea of what causes the Fire to burn which blazes in Winter to infuse warmth into us at that dreary season.

Ment. It is a common but vulgar error to imagine that flame is the quality possessed of a greater degree of heat than the other parts of Fire: its properties have been defined by Sir Isaac

Isaac Newton to be a burning smoke which has not the same degree of intense heat as the combustible body from which it proceeds, only by ascending and diffusing itself, consequently communicates Fire to a greater extent than its original source; this is the cause of the devastation produced by conflagrations, which often rage with such violence as not to be easily extinguished by the strongest efforts of human skill.

Lady L. I have heard of the tremendous consequences of Fire, which I dread when I am in London or any populous situation.

Ment. Fire like the other elements, is beneficial in its operation, yet in its extreme effects proves destructive; in like manner Water may produce inundations, Air hurricanes and tempests, and the Earth a general convulsion of Nature. With gratitude we must reflect that the good we enjoy greatly preponderates in the scale of human allotments when weighed in the balance against the evil which is placed in the opposite medium; in proof of this self evident principle I will endeavour to enumerate the benefits derived from Fire in the general œconomy of the Universe. As inhabitants of this terrestrial Globe we are peculiarly indebted to Providence
for

For the dispensation of Fire; if it were not for the cheering influence of this element nearly half our time would be obscured by the gloomy effects of darkness and the painful sensations of intense cold; our food could not be duly prepared, and consequently not masticated in a degree suited to our powers of digestion. Minerals and metals would be of no essential use, as without Fire they could not go through the various chymical processes which render them eventually of diffusive utility in arts, manufactures and commerce; it is therefore to the general beneficial effects of Fire that we may ascribe most of the blessings we daily enjoy; even gold would not answer the important purpose of procuring the commodities necessary for our existence till purified by Fire; as, by its consequent fusion it is converted into coin and becomes the principal agent of wealth by administering all those qualities on which human accommodation seems to depend. Thus much for the universal influence of Fire which enlivens the general system, and operates to produce comfort to individuals of every rank and class: the Fire that burns in the cottage of a Peasant diffuses warmth with as much ardor as that which blazes in the palace

lace of a Monarch: the taper that illuminates the Mechanic sheds as bright a flame as that which cheers the most renowned Potentate, there being no gradation in the diffusion of this blessing in its genuine quality, all stand in need of its aid to render subsistence replete with enjoyments and permanent; therefore it is wisely ordained its influence should be universal.

Lady M. In Winter I shall now more forcibly be sensible of the advantages of Light and Heat: I will be ingenuous enough to confess I never reflected by what means they were obtained, neither did I gratefully acknowledge the benefits I derived from them.

Ment. If it were possible to transport you to Lapland or Kamtschatka, you would then experience a degree of cold that would excite comparative sensations of regret when you reflected on the more temperate regions you had left; this like other instances requires the experience of contrary effects to render a person duly sensible of imparted blessings. As your wants are liberally supplied, abundance precludes an experimental perception of penury, and in all other cases your prosperity prevents your being exposed to those exigences which bring conviction

to the test ; I shall therefore conclude with expressing my ardent wishes that you may ever possess a due proportion of every elementary blessing, for which I most earnestly exhort you to inwardly feel, and exteriorly demonstrate uniform gratitude, and every other ebullition of moral virtue.

M

DIALOGUE

DIALOGUE XI.

FRIDAY.

On the Phænomena Halo, Parhelion, and Rainbow.

Mentoria.

I Shall request you will bestow great attention on the curious Phænomena I am going to describe, denominated Halo or Crown, Parhelion or Parheliolum, or Mock Sun. These wonderful appearances are caused by the reflection and refraction of Light. The Halo or Crown is frequently visible, consequently excites no sensations of surprise or astonishment ; but the Parhelion from its rare appearance is regarded by
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the common people as a presage of some extraordinary event. The Corona or Halo is a luminous circle surrounding the Sun, Moon, the Planets, and fixed Stars. These circles are sometimes white, and at other times coloured like the Rainbow: it often happens that only one is visible, and at other periods several concentric Coronas make their appearance at the same time. Those which have been observed about Sirius and Jupiter never exceeded three, four, or five degrees in diameter; those which surround the Moon are also sometimes of similar dimensions, but they, as well as those which surround the Sun, differ in magnitude: their diameters also differ very essentially during the time of observation, and the breadth of the coloured and white circles vary very much, viz. from two, three, four, to seven degrees. The colours of these Coronas are also more softened or less vivid than those of the Rainbow, and are arranged in a different manner according to their size. Those which were observed by Sir Isaac Newton in 1692 were classed in the following order, beginning from the interior part: in the first or innermost part were Blue, White and Red; in the middle were Purple, Blue, Green, Yellow and pale Red; in the outermost pale

M 2

Blue

Blue and pale Red: these Coronas are very frequent in Holland. M. Muschenbroeck asserts fifty may be seen in the day time almost every year; but it is very difficult to discern them, except the eye is so situated that not only the body of the Sun but also the neighbouring part of the Heavens can be seen. In North America they are so common that there are usually one or two surrounds the Sun every week, and the same number about the Moon every Month. Halos round the Sun are also very common in Russia; it is asserted that in the year 1758 twenty-six were perceptible from the month of April to September. Descartes has observed it never rains when this Phænomenon appears, from which he concludes it is occasioned by the refraction of the light in the round particles of ice which are then floating in the atmosphere; and though these particles are flat when they fall to the ground, he imagines they must be protuberant in the middle before their descent, and in proportion to that projection he supposes that the diameter of the Halo would vary.

Lady L. I never heard of these things before, and am much surpris'd at their existence in the works of Nature.

Ment. You are perhaps a stranger to the
philosophic

philosophic terms that describe these Phænomena ; though I make no doubt you have frequently seen the Halos which surround the Moon, and have heard people express their expectations of change of weather from a burr appearing round that Planet, which was identically one of the Halos or Coronas I have been describing.

Lady L. Whenever these appear, I shall observe them with great attention, and will inform all my young friends of these extraordinary circumstances.

Ment. Perhaps you may extend your information beyond the limits of youth, as I am fearful too many at a more mature period of life are ignorant of these wonderful instances of curious Phænomena, that you must recollect are only visible in frosty, misty or hazy weather, which causes them to be regarded as the harbingers of rain. There is an artificial mode of representing these Halos or Coronas by placing the flame of a candle in the midst of a steam in cold weather, or else at the distance of some feet on the other side of the window, which will cause the flame to be encompassed by a coloured Halo ; this effect may also be perceived when the window in the room is encrusted with a thin body of ice, through the medium of which

the Moon will appear with a large Halo of several varied tints.

Lady L. I shall be impatient for the kind of weather that you describe as necessary to make this experiment, when I shall with much pleasure bring all your observations on this subject to the proof.

Ment. The next subject to be considered is the Parheliion, Parhelium, or Mock Sun, which appearance is extremely curious. This Meteor is exhibited in the form of a very bright light appearing on one side of the Sun, it is apparently of the same size of the luminary it represents, though not always equally bright nor even of the same shape, and when a number appear at one time, they vary in magnitude, and lustre. In their exterior parts they are tinged with colours like the Rainbow, and many of them have a long fiery tail opposite to the Sun, but of a paler or fainter hue towards the extremity. Parhelia are usually accompanied with Coronas, some of which are white and others tinged with the colours found in the Rainbow: they differ essentially in number and dimensions, but uniformly agree in breadth, which is the same as the apparent diameter of the Sun. A very large circle parallel to the horizon

izon passes through all the Parhelia, which if it were entire would go through the centre of the Sun: frequently there are arcs of lesser circles concentric to this touching those coloured circles which surround the Sun, these are tinged with colours and contain other Parhelia: the order of the colours in these circles resemble those of the Rainbow, but in the interior part with respect to the Sun they are Red, which effect is also observable in many other Coronas. Sometimes the Sun has risen or set with a luminous tail projecting from him of the same breadth with his diameter, and perpendicular to the Horizon.

Lady M. I am amazed at these circumstances; I should be much surpris'd if I were to see this Mock Sun.

Ment. This effect is probably produced from the infinitude of small particles of ice floating in the air, which multiply the image of the Sun either by refracting or breaking his rays, and thus causing him to appear where he is not, or by reflection representing his form, as objects are seen in a looking-glass.

Lady M. I wonder who first observed these Phenomena.

Ment. Appearances of this kind have been mentioned both by ancient and modern Philosophers; Aristotle observes they are only discernible when the Sun is very near the Horizon, though he specifies two that were seen in Bosphorus from morning till evening. Pliny also has recorded the period when this Phenomena appeared in Rome. In more modern times the Parhelia were visible in Rome A. D. 1629, at which time four were distinctly observed; some were also observed 1683. In England and Scotland two have frequently been seen at a time. Parhelia have been discernible for one, two, three and four hours, and in North America where they are frequently visible they are often seen from Sun-rise to Sun-set, when they disappear: it sometimes rains, or there are falls of snow of an oblong form, which is occasioned from the Air in North America abounding with frozen particles in the form of spiculæ, that are perceptible to the naked eye, and are probably the cause of Coronas and Parhelia. Sometimes it happens that the Parhelia appear in a different manner; as when three Suns have been perceived in the same vertical circle, well defined and touching one another; the true Sun was in the middle, the lowest touched

touched the Horizon, and they set one after another; a fourth Parhelion has also appeared directly under the real Sun, but this effect is very uncommon.

Lady M. I am fearful you have closed your account of the Parhelia, which I regret as it is a subject entirely new to me.

Ment. Novelty, which consists in the consideration of subjects unexplored by common observers, is peculiarly attached to the season of youth: every year, nay, every month, week or day develops some branch of knowledge, and by thus extending your information quickens the desire for fresh attainments. Though I have finished my account of the Parhelion or Mock Sun, I must add some remarks on an extraordinary Phænomena that have been observed called *Parasclenæ* or Mock Moons: these wonderful meteors are accompanied by tails and coloured circles like those which are perceived in the Parhelia: an account of several and a particular description of a fine appearance of this kind may be found in the observations of *Muschbroeck*.

Lady L. I shall in time cease to wonder; as every fresh instance of information that I receive increases in surprising causes and effects.

Ment. Astonishment, or what we usually call wonder, is the natural effect of ignorance ; the well informed rarely meet with objects and but very few occurrences or circumstances to excite surprise. The works of Nature are so diffusive, and many of their operations so profound and occult, it is scarcely possible for an individual to attain a complete knowledge of every particular quality or perfection, yet a moderate degree of application will furnish a mind replete with acute perceptions and due reflection with a competent share of learning on most philosophic subjects ; if we avoid perplexing our ideas with intricate theories and abstruse points of science, which often tend to obscure the truth and obstruct the paths of valuable information.

Lady L. I am convinced, my dear Mentoria, you will shield us from this error, as the information you impart cannot fail to enlarge our ideas.

Ment. It is my principal aim to accomplish this desirable purpose, I therefore endeavour to express myself in terms that are upon a level with your conceptions : It is reported that the Ostrich can digest iron, but as I fear your intellectual powers are not of an equal strong texture,

ture, I render your mental sustenance adequate to your concoctive faculties. Technical terms, scientific expressions, and philosophical processes are extremely useful and indispensibly necessary for the propagation of knowledge; yet their general adoption and familiar use would render a female, particularly one of tender years, subject to the reproachful epithet of pedantic, or rank her as a smatterer in learning. From these observations it will appear evident, that I wish your knowledge to be genuine; but your expressions simple, that is, unmixed with an ostentatious display of learning, and uncorrupted by an exuberance of ornament, and an apparent desire to acquire an oppressive degree of superiority.

Lady M. There is little danger of my erring in that point; as when I am in company I have not courage to give my opinion, and I perceive the same sensations in Lady Louisa.

Ment. Courage, or that quality which in the general intercourse with society is in some degree necessary, may with more propriety be termed proper confidence. Too great a portion of timidity, or what we usually call bashfulness, obscures merit, as it prevents the due exercise

of those powers and accomplishments which are an honor to human nature. To this false quality we may ascribe the errors of most young persons in common behaviour, and also the imperfect performance of whatever they undertake to execute in company: as the means of overcoming this evil, from the earliest age, children should be accustomed to sing, dance, and perform all other parts of their education, even though their attainments in those respective branches are incomplete, by which means they acquire an easy unembarrassed manner, that adds great grace and dignity to their general deportment. I have been thus particular on this subject, as I earnestly hope that you will observe the due medium between a bold forward address, and an insignificant sneaking behaviour, as they both will destroy every sensation of respect or consequence.

Lady M. What will be the next subject on which you will be kind enough to expatiate?

Ment. The Rainbow or Iris, which is one of the most beautiful objects that nature exhibits.

Lady L. I always admire the Rainbow, as the colours, though they are brilliantly gay, are
so

to skillfully blended, there appears not the least degree of glare.

Ment. This is evidently the triumph of nature over art, the greatest effort of human taste or fancy could not compact such a variety of tints without producing an effect that would weary the eye and offend a correct taste. An assemblage of varied hues such as the Rainbow presents, if arranged by an artist possessed of superior excellence in his profession, would be considered as a composition incongruous in its arrangement; yet by the plastic power of Nature, all the component parts so well accord they form a regular harmonic effect, the lights and shades are so gradually contrasted, that brilliancy and splendour are produced, and the mind struck with the impression of perfect beauty. Having thus considered the general effects of the Rainbow or Iris, I shall proceed to explain its natural cause.

Lady L. I wish to be informed by what means the Rainbow is produced?

Ment. When a cloud converted into Rain, is exposed to the rays of the Sun, and the eye of the person who views it is between the Sun and the Cloud, the Rainbow is clearly perceptible.

Lady

Lady M. I can clearly distinguish every kind of colour, red, orange, yellow, green, blue, indigo, and violet.

Ment. These beautiful tints are occasioned by the refraction of the rays of light that pass through the Rain, which fills the atmosphere at that period. The uppermost drops reflect the red rays, the next in degree is the orange, and so on in regular gradation, the violet being the last that appears.

Lady L. Are there any particular periods when the Rainbow is discernible?

Ment. The Sun cannot possibly be more than 42 degrees above the horizon when a Rainbow appears; because when it is higher than that point, its axis passes beyond the eye of the spectator. The different dimensions of the Rainbow entirely depend upon the height of the Sun at that period; when the Sun is in the Meridian, the Rainbow appears the least to us, and as he gets gradually lower and lower, the Rainbow increases in height; and when the Sun is in the horizon, the Rainbow attains its greatest dimension, and appears nearly of a semicircular form. The Rainbow always is visible in that part of the heavens apparently opposite to the Sun, from which it appears evident
that

that it is occasioned by the Solar rays falling on the drops of Rain.

Lady L. I recollect frequently perceiving a fainter kind of Rainbow in the sky; by what means is that phænomenon produced?

Ment. This fainter coloured Bow that appears above the Rainbow, is commonly termed a Water Gall, and as the colours are reversed in position and effect, it is undoubtedly a species of reflection from the Rainbow, and as a considerable portion of light is lost in each reflection, the colours in the higher Bow, as a natural consequence, become more diluted or softened than those in the lower, from which they are derived.

Lady M. I am more obliged than I can express, by your explicit description of the Rainbow.

Ment. You must keep in mind that the Rainbow never appears but when it rains, or nearly at that period, and you may simplify its philosophical effects by an easy experiment, as a bubble at the end of a pipe will refract the Sun's light in the same manner as the drops of Rain which form an Iris or Rainbow, in both cases the gradation of colours is uniform. An artificial fountain also will exhibit, in form and colour,

colour, the exact properties of this extraordinary phænomenon; and from the peculiar construction of our visual organs, the dimensions though so near, will appear as far off, and as large in size, as the real Rainbow.

Lady L. I scarcely know any object in Nature more beautiful than the colours of the Rainbow.

Ment. Its form is equally worthy of admiration, as there is something inexpressibly graceful and majestic in the semicircular figure in which this phænomenon generally appears, in the vaulted concave of the Celestial Hemisphere.

Lady M. Is not the Rainbow particularly mentioned in the Bible?

Ment. For a full explanation of this subject, it may be necessary to revert to the account I gave you of the Noahchical dispensation of the Covenant of Grace which God entered into with mankind, immediately after the Flood. The Supreme Being, when he had enjoined certain conditions of obedience, assured Noah of prosperity and his blessing; and in token that the Earth should not again be destroyed by a Deluge, thus declared, " I do set my Bow in the Cloud, and it shall be a Covenant between
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me and the Earth, and it shall come to pass, when I bring a cloud over the Earth, that the bow shall be seen in the cloud, and I will remember my covenant, which is between me, and you, and every living creature of all flesh, and the waters shall no more become a flood to destroy all flesh, and the bow shall be in the cloud, and I will look upon it, that I may remember the everlasting covenant between God and every living creature of all flesh that is upon the Earth. And God said unto Noah, this is the token of the covenant which I have established between me and all flesh that is upon the Earth." Thus graciously did God indemnify the inhabitants of the Earth from experiencing his wrath, by the same means as before had expressed his displeasure: therefore we ought to regard this instance of Divine condescension with the most reverential gratitude.

Lady L. I always thought the Rainbow a very pleasing spectacle, but had no idea of its serious import.

Ment. You will perceive in a variety of other instances, your perceptions have been able only in a very limited degree to appreciate the importance of objects to the extent of their intrinsic worth, or latent tendency. The contemplation

plation of the works of Nature leads in an especial manner to enlarge the conceptions, when we reflect that God is ever present, our actions should be guided by the strictest rules of circumspection; and when we seriously consider his infinite attributes are not confined by space, nor his existence or duration circumscribed by time, our imaginations naturally soar to the boundless ages of eternity. The Firmament, and the various luminaries that adorn it, which are probably distinct worlds, all co-operate to impress the mind with the most sublime and awful sentiments; and in this research our intellectual powers are absorbed in wonder; and when exerted to their greatest stretch, cannot fully comprehend the heights of omnipotent perfection!

DIALOGUE

DIALOGUE XII.

SATURDAY.

On the Terraqueous Globe, various
kinds of Earth, Fossils, and
precious Stones.

Mentoria.

IN the course of my Lectures on Astronomy and Natural Philosophy, I have hitherto only described the Earth as a Planet annually revolving round the Sun, as a part of the Solar system ; I shall therefore now endeavour to enumerate its properties and perfections, as the Terraqueous Globe, which is assigned to us as a temporary abode, in our present probationary state.

Lady

Lady Louisa. I think that will be a subject replete with many interesting and important particulars.

Ment. We must first consider the Earth as a large mass or body, of a Spheroid form, rather flattened at the Poles, and more protuberant at its equatorial parts, the surface of which is divided from one Pole to the other by two bands of Earth, and two of Water, of immense magnitude and dimensions. As navigators have not been able to penetrate to regions at the Poles, from the ice in those seas, the proportion of Earth and Water cannot be precisely ascertained: only from what is discovered, it is generally believed there is more sea than land. As it is my intent that my present instructions should be rather Philosophical than Geographical, I shall not specify the different kingdoms and countries on the Earth, but confine myself to a definition of its constituent parts, and shall affix a Copper-Plate of the Globe, which will enable you to judge of its construction respecting its Terrestrial and Aquatic properties.

Lady Mary. I shall be very attentive to your observations, from which I have no doubt Lady Louisa and myself will reap solid advantage.

Ment.

Ment. I shall first consider the Universal power, energy, or spirit that is to be regarded as the Divine agent or efficient principle by which the whole mass of matter in the Earth is actuated, agitated, or put into constant motion ; this evidently exists, and is demonstrated, by every object in Nature ; as if there were no motion, there could be no heat, of which there is a considerable portion in the Earth, unquestionably proved by the wonderful Phænomena of Hot Springs, Volcanoes, &c.

Lady L. I am amazed at these instances of Divine skill, exemplified even in the Earth, on which I never bestowed a thought.

Ment. The next point to be explained is the Universal Vegetation in the Earth, by which term you are to understand such natural bodies as grow and increase from parts organically formed ; but that have no sensation or life. This effect is not confined alone to plants and trees, but is extended to spars, fossils, minerals, and metals, as Silver discovers as perfect an expansion in branches and leaves as Fern ; and Gold grows in grains of different dimensions : thus it is demonstrated that metals increase in their proper Earth, or Ores, in a regular process of Vegetation.

Lady

Lady L. I could never have imagined that Gold was capable of growth, or increase of bulk.

Ment. The last branch of these wonderful effects is the Universal Plastic Power in Nature, by which is meant that Principle which from the Creation arranged the various forms of Matter into that beautiful systematic order, which is uniformly manifest in the general œconomy of the Earth. To this permanent effect may be ascribed the invariable similarity and characteristic marks that are preserved in every genus and species of animals, plants, and the general productions of nature, which never depart from the leading traits of their genuine character: thus for instance, Earth, Sand, Gravel, Clay, Loam, &c. are unchangeably of the same form or quality. Stones, Flints, Pebbles, Slate, Marble, Marcasites, and Metals, have the same specific properties in every region. Spars, Crystals, and precious Stones are always the same kind of Body: thus the works of Nature are uniform in their operations, and never deviate from the prescribed line of organic distinctions.

Lady M. I shall in future think the Earth a subject of importance, and shall neglect no
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opportunity of observing its extraordinary qualities.

Ment. The solid parts of the Earth are formed of beds or strata of different materials, which lie one upon another in regular order. The first stratum consists of Mold, or common soil, intermixed with a great variety of decayed vegetable and animal matter blended with sandy and stony particles. In different regions the other strata are found to consist of incongruous materials, variously disposed, such as Sand, Gravel, Loam, Clays, Argile, Marl, &c. In some situations the strata are horizontal, in others they are inclined, and veins or fissures of Metals, Coals, and other minerals, frequently penetrate through the different beds or strata to a great depth and divide them: every stratum, either horizontal or inclined, has an equal thickness throughout its whole extent. In this mass of solid matter, the superficial, or that nearest to the surface of the Earth, is the least pure in quality; all substances derived from the sea in form of sediment or sand, and those composed of the combinations of the animal and vegetable productions, and that have been changed by volcanean fires or sublimed by the internal heat of the Globe, are transformed
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in quality, and become vitrifiable, or can be turned into Glass, by the sole action of fire, as all fixed matter, when decomposed in the greatest degree, is reducible ultimately into Glass. You will therefore perceive that the different strata or beds of which the Earth are composed, consist of distinct layers of Sand, Stone, Clay, Shells, Marble, Gravel, Loam, Marl, Chalk, &c. &c. and these beds are invariably parallel to each other, and of the same extent. Chalk affords a striking instance, where Nature deviates from the usual resemblance, between a production and its parent stock, as Flint that is the hardest in texture and blacker in hue than any stony substance, is produced from Chalk, which is of the softest and whitest quality: it is not unuseful here to add the importance of Flint in striking fire with steel; Chalk also is of extensive use, as it can be converted into Lime, Whiting, &c. and is the most remarkable absorbent in nature. Chalky hills afford the best Springs of soft water, and soften those which are of a hard quality: and to conclude my eulogium on Chalk, I shall remark, it is in a variety of cases efficacious as a medicine, and an excellent manure for Land: these useful properties

perties render it so valuable, it may be justly ranked as a celebrated Fossil.

Lady L. I fear you have finished the account of Earth as an element, which I much regret, as I find it very curious and entertaining.

Ment. There are some other species of Earth I will enumerate, as they are of essential utility to us in the general accommodation of life. The first is Fullers Earth, which possesses an extraordinary purifying quality, and is of great use in cleansing cloth from spots of grease; and also is of important service in manufacturing cloths. The next is the Earth from what are called the Soapy Rocks in Cornwall, near the Lizard Point. This substance has the appearance of soap, and produces the same effect to the eye and touch; but is not possessed of its cleansing quality, yet is of great use in manufactories of China, on account of the white, fine, and firm grain of its texture.

Lady M. The extraordinary properties of this Earth, like every other part of the creation, excite my wonder and admiration.

Ment. I will next endeavour to describe a remarkable Fossil called Muscovy Glass, which is the most superior species of Talk that the

Earth produces. The internal parts consist of plates or flakes of a thin transparent substance, very much resembling thin sheets of glass, and transparent in proportion to their thickness; and are often so thin as to float in the air, and by reflection, produce the most brilliant colours in nature: this Fossil is not of a brittle quality, but pliant, elastic, and strong; which render it of great utility in optics, as it is not easily affected by fire or flame. Amber is another Fossil, the qualities of which I will briefly specify, it is supposed to be of a mineral nature, consisting of a kind of bitumen, that was once in a fluid state, hardened by a mineral acid, which is evinced, from the number of extraneous objects observed in it, such as straws, small insects, &c. its native colour is yellow, its substance is transparent, and of a hard compact consistency, admits of a high polish, and is of an inflammable nature. This was the first substance observed to possess an attractive property, which I have already mentioned in my observations on electricity. The next substance the ancients discovered to be of an electric quality, is now called *Tourmalin*, and as the Dutch jewellers found it attracted ashes, they named it *Ashes Tracker*; as electricity is of two kinds, amber possesses one quality, and glass the other,
but

but Tourmalin is endued with both, or rather each sort may be excited in it, the positive degree of electricity being on one side, and the negative on the other, which are put in action alone, by the influence of heat. This Fossil may be properly said to be a jewel or gem, endued with wonderful properties; yet from its small bulk, is not converted to practical uses, but is regarded only as a curious object.

Lady L. I never thought Fossils were so extraordinary in their nature as you describe.

Ment. The most renowned and delicate Fossil the Earth affords, is called Island Crystal, which is celebrated by naturalists and philosophers, for its singular property of a double refraction of light; like other Crystals it is of a pure pellucid quality, and as clear as water, and like them grows from the hardest rock and stone, in form of hexagonal pyramids, with very sharp points. This Crystal is converted to the form of prisms, and by that means produces not only a double reflection of one object, but a multiplicity, which occasion a variety of prismatic colours that are of great use in the science of optics. As I have already described the Magnet or Loadstone, I will not repeat my remarks on that subject.

Lady M. These observations on Fossils are so new to me, I cannot express the pleasure they afford me; but pray my dear Mentoria, what does the word Fossil imply?

Ment. The term Fossil is derived from the latin, and means any substance which is, or may be dug out of the Earth; but is more particularly applied to some peculiar species, that are discovered in the interior part of its substance. One of the most extraordinary of this numerous tribe, is the Asbestos or Amianthus, which possesses the wonderful quality of resisting the force of fire. In form and substance it appears like a common Fossil stone on one side; but on the other, exactly resembles a piece of fine green silk or satin; silky filaments run through the whole length, owing to the firmness of its texture, and the natural polish of its fibres, which when raised up with the point of a needle, appear of a soft silky substance, and as white as cotton. The ancients possessed the art of manufacturing this into fine webs of silk for garments, and the moderns are not ignorant of the means, though its rare quality prevents its common use.

Lady M. How valuable such garments must have been.

Ment.

Ment. This wonderful Fossil is of so rare a quality, a sufficiency of the curious specimen I have described to you cannot be procured; also from its brittle nature it must be interwoven with flax, and when formed into a fine thread, be put into the fire to destroy the flax, and by that means leave a pure Amianthus, Asbestos, or incombustible cloth; this kind of Fossil, which is found in England, is of an inferior quality and no great value; as those of superior excellence, like every other kind of Fossil, are produced in the greatest perfection in hot countries.

Lady L. It is wonderful such extraordinary substances are found in the Earth.

Ment. The ground on which we tread conceals a subterraneous museum of invaluable treasures and curiosities; the deeper we penetrate, the more profound our ideas must be of that Being who created all these extraordinary productions. The next species of Fossils I shall describe is called Mundic, which is a kind of Marcasite, esteemed for its glowing colours that are innate and permanent, and when in an opaque solar microscope, appear not only greatly magnified, but exhibit an inexpressible degree of resplendent beauty.

Lady M. It would give me great pleasure to see the objects you have described, and I hope my dear Mentoria you will be kind enough to contrive some means of affording me this satisfaction.

Ment. I will use my best endeavours to that effect; and shall now proceed to give you some idea of that class of Fossils which are held in the highest estimation, as Jewels, Gems, and Precious Stones. The Crystal is the most common kind, it is devoid of colour, transparent, and of a very hard texture, growing from rocks in a pyramidical form, and sometimes in the shape of a pebble, as the Brazil kind. Agate is ranked in this class, though very common, it is for the most part opaque and variegated with colours in a beautiful irregular manner. Jasper is found in form of a flint or pebble, and when wrought appears a beautiful green, sometimes spotted with white clouds, and is rarely transparent except when it is very thin. The Emerald is green and in forms of pebbles and Crystal, and when polished is of a beautiful lustre. The Cornelian Sardius or Sarda, found in pebble form, when polished is of a whitish flesh colour, or blood-red hue, and frequently variegated and veined with pale red and white. Onyx is a precious stone, semi-transparent, formed in zones about a central
body,

body, which constitute its beauty. The Sardonyx is nearly of the same quality, resembling the Sardius in its flesh colour, and the Onyx in its annular marks and tabulated form. The Topaz is invariably found in an oblong pebble form; by the ancients it was denominated Chrysolite from its golden colour, in which it excels, but varies from a very deep to a pale tinge. Sapphire is a beautiful gem, distinguished by its azure or sky coloured blue appearance. They are sometimes found in columnar crystalline forms, and frequently in the shape of pebbles, and vary in the tinges of their colour, from the palest to the deepest degree. The Ruby is greatly esteemed for its glowing red colour and hard texture. The Carbuncle is only a species of Ruby, but is so denominated as when held up to the Sun it resembles a glowing charcoal. The Beryl is a finer sort of Crystal, generally of a columnar form, but also found in pebbles, it is of a fine bluish green colour, which it never loses. The Jacinth or Hyacinth is a Gem of the pellucid sort, of a red colour with a mixture of yellow; it is of a columnar form, sometimes found in Pebbles and is subject to a great variety of tinges from the Ruby to Amber. The Amethyst is a stone of

a beautiful colour, being a mixture of red and blue, which produces every degree and gradation of a purple hue ; it is found in form of Pebbles and Crystal. The Garnet is a Gem of a deep red colour with a cast of blue, variable in its tinges down to a flesh colour, it is always found in the Pebble form, and does not lose its colour in fire like other Gems.

Lady M. I shall view the brilliant Gems that you have enumerated with additional pleasure ; now you have informed me of their respective properties.

Ment. There yet remains the most resplendent species of Gem or precious stone for me to describe, which is the Adamant or diamond : this Jewel excels every substance in nature by its peculiar hard quality and the power of refracting light ; it is cut and polished by its own substance reduced to fine powder, and its superior brilliancy is produced by its wonderful refracting quality, which greatly exceeds that in Crystal or Glass. It is found in various forms of Crystal and Crystalline pebbles with several irregular sides which often have a native polish ; its dimensions are various, the great Mogul has one that weighs two ounces and a quarter, worth seven hundred, seventy nine thousand,

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two hundred and forty four pounds. The heat of common fire does not affect this Gem ; it is the produce of the East Indies, and other parts of the Torrid Zone, where all the species of the most valuable precious stones are also found.

Lady L. Diamonds are so beautiful in their effect, one cannot see them without admiration, accompanied by a wish to obtain such brilliant ornaments.

Ment. They may morally be considered as a lesson, as well as an external decoration ; their latent brilliancy resembles intrinsic merit and superior abilities, and their resplendent lustre in a polished state, forcibly inculcates the advantages derived from the joint efforts of skill and judicious refinement.

Lady L. Be assured, my dear Mentoria, I will be more zealous to resemble the Diamond in its valuable resplendent qualities, than to possess it literally as an exterior distinction respecting rank or dress.

Ment. There are some other Fossils, not distinguished by brilliancy, which are of great utility in Medicine, Arts, and various occupations. The Lapis Lazuli, of which the finest blue colour, called Ultramarine, is made. The Turquoise Stone, sometimes reckoned amongst

Gems. Bismuth and Zink, much used in soldering Gold and Silver. Antimony, celebrated for its medicinal qualities. Native Cinnabar, which is a kind of Mercurial Ore, from which Mercury is obtained. Sulphur, the most inflammable substance in nature, and of very essential use in Medicine, and for the common purposes of life. Bitumen, of a pitchy sulphureous property. Asphaltos is also of a bituminous quality. Naptha, a liquid Bitumen, very inflammable and difficult to extinguish. Petroleum, a sulphureous oil distilling from the clefts of rocks, and Arsenic, a mineral of a most destructive poisonous quality.

Lady M. I have heard of fatal accidents, by persons taking Arsenic, by accident or design.

Ment. The misapplication of a variety of things proves detrimental, though in many respects they may be useful when skilfully employed. As I have finished my account of Minerals, I shall proceed to inform you the Earth also yields many saline productions, distinguished in the following species of Salts, such as Alum, Sal Ammoniac, Nitre, Borax, Sal Gem, &c. Vitriols of various kinds, blue, green, red, white, &c.

Lady

Lady L. I have frequently heard these things mentioned, but had not the least idea they were taken out of the Earth.

Ment. The interior part of the Globe is an inexhaustible magazine of invaluable treasures: the superficial observer, who does not penetrate beneath its surface, has no knowledge of the riches unexplored by his narrow conceptions; whilst the Philosopher and curious Speculator discern perfection in every atom of the varied compound Terrestrial mass. The Deity may be traced in the most minute object, and his attributes shine with equal resplendence in the common Flint as in the Diamond's blaze! It is a circumstance which should excite our gratitude and praise, that the several varieties of Stone, Coal, and many other articles which are of extensive use, are abundantly diffused, whilst Gems and precious Stones are comparatively rarely found. A diversity of soil is also a remarkable instance of Divine mercy and goodness, as it greatly tends to produce abundance and diffusive blessings. In some districts the Earth is of a light sandy quality, in others of a clayey, chalky, stony, or flinty property, and in many parts gravelly, or of a mixed substance, which conduces to our general accommodation,

and promotes universal vegetation. Some regions abound with quarries of Slate, Limestone, Freestone, and Marble, others with mines or pits of Coal, and a variety of subterranean substances too numerous to be specified, yet too important to pass unregarded by the most unlearned of the human race.

DIALOGUE

DIALOGUE XIII.

M O N D A Y.

On the Terraqueous Globe, Ores,
Metals, Vegetation, and ter-
restrial Beings.

Mentoria.

AS I have no doubt your curiosity is excited by my account of the various kinds of Earth and Fossils, I shall continue our subterranean research and proceed to inform you of the nature of Ores and Metals.

Lady L. I have frequently heard of Metals, and know in some degree what they are, but pray my dear Mentoria what do you mean by Ores?

Ment.

Ment. Ore is a hard Mineral Stone, either Rock or Pebble, which is more or less impregnated with particles of Metal, these when separated from the earthy part, are melted into a solid mass or body of pure Metal: I will endeavour to give you a concise idea of this process. The Miners have stamping mills, which by repeatedly breaking the lumps of mineral ore, at last reduce them to a kind of dust or powder, which is carried by a stream of Water from the mill, over several platforms of Wood, lying one below the other, upon a gradual descent, and consequently upon each platform the powdered mineral adheres, in proportion to the size and weight of its particles, the lowest being as fine as is necessary. Thus pulverized, it is conveyed to what is called the Smelting-house, where it is put into a large furnace, with a proper flux to promote its fusion, and there by the influence of the Fire it is melted, and sinks to the bottom in a fluid state, and the Earthy part all rises to the top by being of a lighter quality. The melted metal is drained off into suitable vessels, where it gradually consolidates by cold into massy substances of metal, such as Blocks, Ingots, &c. &c. I have previously observed the various effects of vegetation in silver ore, which

which appears like branches and leaves in a multiplicity of beautiful forms. Copper Ore is also remarkable for the variety of brilliant tints it exhibits, and it is generally supposed, produces the different hues in the several species of Marcasites or Mundics, Crystals, Precious Stones, &c.

Lady L. These circumstances appear very extraordinary, I cannot forbear expressing my admiration of their beneficial effects; how many kind of Metals are there?

Ment. From those properly called Metallic Ores, only seven, Gold, Silver, Copper, Iron, Tin, Lead, and Mercury, which all agree in the common character or nature of Metal, viz. a hard shining mineral body, fusible by various degrees of heat, principally Fire, subject to its particles being concentered by cold, malleable or ductile under the hammer, or any other weight, and specifically the heaviest of all Bodies.

Lady L. Is not Gold the most valuable Metal?

Ment. It is not only the most valuable, but the purest of all compound bodies; it is proved to be the heaviest by being 19 and a half times more weighty than water; and is more ductile or malleable than any other metal. It is fusible
(that

(that is, can be melted in the Fire), but is more fixed, and loses less in the Fire than any other metallic substance. It is of a yellow colour by reflected Light, and of an azure colour by refracted Light, through the thin leaves thereof; has an obtuse sound, and is only dissolvable in Aqua Regia and Mercury. Gold is sometimes though but rarely found in Ore, often in its native state, but most commonly in small Grains or Dust in the sand of many Rivers on the Gold Coast of Guinea, and many other places.

Lady L. Which is the next Metal that you are to describe, my dear Mentoria?

Ment. Next to Gold, Silver is the most pure, fixed, and ductile Metal. It is of a perfect white colour, and respecting its growth and form, bears a greater degree of similitude to vegetable substances than any other metallic body: it can be dissolved into a pellucid fluid, by Aqua Fortis, and possesses no colour. The next Metal in regular order is Copper, which is peculiarly distinguished by its sound, or sonorous quality. It is of a red, or deep purple colour, but gives a fine blue to a solution of it. It is chiefly found in a very hard stone of a dark colour, running in veins between beds or layers of rocky Earth or Stone; and sometimes in its
pure

pure native form of a perfect malleable quality. It appears to have a vegetative power of shooting into twigs and branches, and very frequently exudes in the mine, in form of blue pointed shining Crystals, in large heads of six or eight inches wide, which have a beautiful appearance.

Lady M. Pray, Mentoria, what are the qualities of Iron?

Ment. Iron is the hardest of all metals, it is fusible by only the greatest degree of heat, but malleable and ductile with a common red hot heat, and may be hammered till it becomes red hot, and is the only body in Nature susceptible of the Magnetic power. It dissolves in Aqua Fortis very easily, and more rapidly than any other metal, but is corroded by the acid in the air, and becomes rusty. When red hot under the hammer, it emits scales or flakes of calcined iron, highly magnetical. Iron is never found pure, but always in Ore, either Pebble or a hard Stone, it may be extracted by the Loadstone from the Ashes of Plants, and in Crystallizing, discovers less of a vegetable form than any other Metal; it is of a whitish glittering colour when broken.

Lady

Lady L. I recollect Tin is the next Metal, according to the rank or order you mentioned them in.

Ment. Tin is the lightest of all Metals, in colour it is as white as Silver, but softer than any other Metal except Lead. It melts with a small degree of heat, is malleable, not very subject to rust, and possesses no sonorous quality. It has the least fixity in fire of any Metal, easily blends with other kinds, all of which it renders brittle except Iron. It is found in Ore of hard stone, and also in opaque Pebbles.

Lady L. I am greatly indebted to you for informing me of the properties of such useful and valuable productions of Nature by which I benefited, but was not sensible of their extraordinary qualities.

Ment. Lead is the next metal I am to describe; it is the heaviest of all metallic substances, except Gold and Mercury. It is the softest of all Metals, consequently melts the soonest, and is very ductile and flexible, and less sonorous than any other kind, and the least fixed by Fire. It is seldom found pure, but in an Ore of a glossy black hue.

Lady

Lady L. I fear you are now come to the last branch of the Metallic Ores, which is Mercury.

Ment. The properties of Mercury, or Quick-silver, will require particular explanation ; though a Metal, it is a Fluid Body, therefore you must understand that Fluidity is one state of Metal produced by a certain degree of heat, and fixity or solidity is another, by a degree of cold that our air invariably affords, which is found insufficient to fix Mercury, or convert it into a solid body, even in the frigid regions at the Arctic circle ; though at Petersburg an artificial degree of cold has been made to fix it into a body as hard as Lead, and whiter than Tin when cut, and to render it ductile and malleable, by which is meant a state capable of being beat by a hammer.

Lady M. In your description of Metals I am surpris'd that you have made no mention of Brass, Steel, or Pewter.

Ment. They are not natural, but factitious metals that are made by art. Brass is a compound produced by mixing pulverized Calamine stone with Copper, which by letting it stand a proper time in a wind furnace, is converted into Brass. Steel is not a distinct Metal
from

from Iron, but only so purified and altered by art, as to be of a finer grain and of a harder quality, consequently better suited for making sharp instruments and implements to cut with. Pewter is a compound of several metals and minerals so compounded, as Tin mixed with Lead and Brass, Bismuth, &c. Tin Plates are in reality Iron plates covered with Tin on both sides, and are penetrated so strongly by the Tin, they appear to be such by the whiteness when cut ; but still the Iron retains its magnetic quality. There is also a new mineral, called Platina, which is even heavier than Gold, and in colour resembles that Metal, but is very hard and brittle ; when blended with Gold or Silver it produces a rich compound, superior in quality to Bell Metal, Pinchbeck, or Princes Metal, of which a variety of articles are made. I have been very explicit and diffuse in my remarks on metallic substances, as most species of metals are of essential utility. In the first instance, Gold and Silver, by being converted into current coin, produce the various accommodations of life ; and from the value, by the general consent of all civilized nations intrinsically allowed to them, in a great degree constitute wealth. It is scarcely possible to enumerate the advantages

tages we derive from Copper, Iron, Tin, and Lead, if it were not for the several properties of those metals, we could have no buildings or ships constructed, no useful implements or utensils made for agriculture or domestic purposes, and, in fine, our situation must be reduced to nearly a savage state, respecting the varied comforts and conveniences of social intercourse. From Mercury we receive many benefits we are not in every instance able to trace, as it is used in a variety of means, and produces many good effects philosophically and medicinally, which would be beyond your comprehension and my present purpose to explain. I have dwelt more on these subterranean treasures, as I am convinced very few comparatively have a clear notion of their importance and wonderful qualities, though in other respects what are usually termed well-informed and cultivated by a liberal education; thus many who are deeply skilled in scientific learning are totally ignorant of the productions of Nature, and the general system of the Universe.

Lady L. I am surprized that the generality of persons should be so inattentive to subjects of such importance.

Ment.

Ment. This almost universal consequence arises from the prevailing erroneous habit of confining instruction to particular branches of knowledge, usually called scholastic or classical, which render persons learned respecting words, and ignorant concerning the general structure and properties of things. As I have endeavoured to explain the interior productions of the Earth, I shall now proceed to consider those instances of Divine power exemplified in the varied vegetable substances that grow on its surface. Vegetative Nature differs very essentially from animal existence, as it consists alone in growth, which is commonly called its life. Every Plant properly defined consists of various determinate parts, which have this vegetative power by Nature, of unfolding themselves from a certain fixed point or basis downward into the Earth, and upward into the Air: the descending part is gradually unravelled, protruded, extended, and carried forwards in numberless branches and ramifications through the circumjacent parts of the resisting Earth, Stones, Rocks, &c. to the most filamentary state; and this assemblage of parts is called the Root. The ascending part consists of much greater variety, and in fact constitutes the whole substance of the

Plant

Plant in miniature. The vegetative power in the Earth causes the several parts in the Plantula (or embryo of the plant contained in the seed) to evolve and unfold themselves by imperceptible degrees, till at length they are separated one from the other, and appear above ground in the proper and specific forms in what are called Leaves, Blades, Stalks, Stems, Branches, Flowers, Seeds, &c. which compose the adult, complete Plant.

Lady M. I have frequently sown seeds in the garden, and observed with much pleasure their gradual process of growth.

Ment. Every Seed contains in itself the whole Plant's similitude on a small scale which produced it: this Plantule, or Plantula, is placed in the side of each Seed, consisting of two parts called Lobes; it is included between and connected with both on the side where they join. The œconomy of the circulation of fluids through the body of the Plant, is as incomprehensible as that in the body of animals in general, though its obvious mechanical principle is produced by the natural power of attraction between the particles of matter in bodies. If we attentively examine each particular part of a Plant, they appear to be created for some important

portant purpose or use, the Root for its stability and nourishment from the Earth, the Fibres to contain and convey the Sap, besides which there are a large sort of vessels to contain the proper and specific juice of the Plant, and others to carry air for the degree of respiration necessary to its existence. The outer and inner Bark of Trees serve to defend the Trunk and Boughs from the excesses of heat, cold, and drought, and to convey the Sap or vegetative nourishment for the annual augmentation of the Tree, every species of which may in some degree be said to be an annual Plant, as the Leaf, Flower and Fruit proceeding from the coat that was superinduced over the wood the last year, which never bears any more, but with the old wood serves as a block to sustain the succeeding annual coat or covering. The Leaves serve before the Gemma or Bud is explicated, to defend the Flower and Fruit, which are even then perfectly formed, and afterward to preserve the Branches, Flowers, and Fruit from the intense effects of the Solar heat, and also to prevent the too rapid evaporation of the moisture about the Root. It is worthy of observation, that notwithstanding Plants by culture and manure may be highly improved in quality and dimensions, yet the same

same Plastic Power which operates in every other part of the Creation prevents their exceeding in growth beyond the limits of their original specific form.

Lady L. A Garden affords such a variety of pleasures, it is scarcely possible to suppose any person wholly insensible to their impressive effects.

Ment. Horticulture, or that kind of study which is confined to the cultivation of Gardens, is a pursuit fraught with innumerable sources of delight and improvement; yet Vegetation is so diffusive in its extent, and in every branch even in its wildest state abounds with specimens to excite our wonder and admiration: I shall therefore briefly consider its general effects. In the first instance, the greatest part of the dry land is covered with a kind of carpet of green grass and other herbs, not only most pleasing, but the most salutary to the visual organs, and this is also decked with great variety of Flowers of beautiful colours and forms, possessed of sanative and fragrant odours, conducive to our gratification, and the refreshment of our animal spirits. The Earth is likewise furnished with beautiful Shrubs and stately Trees, affording us not only pleasant and nourishing Fruits, many

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Gums,

Gums, Liquors, as Turpentine, Tar, &c. Drugs, and valuable Medicines; but also Timber and utensils for all kinds of trade and varied occupations conducive to the general convenience of the human race, and the support of subordinate animals. It is graciously ordained by Providence, that vegetables which are designed for animal sustenance are abundantly produced and increased, and many propagated not only by the Seed, but also by the Root producing off-sets, some by creeping under ground, and others above the surface of the Earth. It is a striking proof of Divine mercy, that those kinds of grain which are defined under the general term of Corn, (by which you are to comprehend all that are of a quality to make Bread) such as Wheat, Rye, Barley, and Oats, are very generally diffused; and that Wheat, which is the purest and most salutary kind, flourishes not only in temperate, but in regions of an extreme hot and cold climate, and is also of a remarkable fruitful nature; which even Pliny, who was a Heathen, produced as an argument in favour of the bounty of God dispensed to Man. When we reflect what myriads of beings are supported by herbs, grain, and general vegetation, we are naturally led to acknowledge the wonderful provision

vision that is made for every species and gradation of animal life. The Earth yields an ample store of every requisite to sustain the general œconomy of the Mundane system, every particle of which is subject to the same general laws and properties, as those clearly defined and specified in the regular order of the Universe, Terrestrial as well as Celestial. On a general survey of these blessings, it would be a heinous species of neglect to withhold that tribute of grateful acknowledgment for the benefits which, as inhabitants of the Terraqueous Globe, we enjoy from the combined effects of the varied perfections I have so imperfectly delineated. The Earth is the basis and support of all animals and Plants, and affords them the hard and solid parts of their bodies, yielding us not only food and sustenance, but also raiment. The beings usually called Terrestrial animals, from being inhabitants of the Earth as their congenial Element, are Man, Quadrupeds, Insects, and Reptiles; these are all respectively so judiciously arranged, that the most perfect harmony subsists. Beasts of Prey are confined to deserts and their native dens, by the restraining hand of Providence; whilst those which are docile and domestic, are more generally diffused, and by

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their varied properties conduce either to our sustenance or convenience, some being fit for food, others for the support of burthens and laborious purposes, and many for our essential benefit or amusement. The noble qualities of the Horse, the fidelity of the Dog, the utility of Oxen, Cows, and Sheep, are subjects which must afford rational grounds for admiration. The degree of instinct approaching to rationality, exemplified in the Elephant and Beaver, and the eminent portion of sagacity found in a great variety of other animals, cannot fail to impress a contemplative mind with a just sense of Divine Wisdom, more especially when we reflect that these beings, though superior in strength, are subordinate to the human race, to whom they are under subjection by the decrees of all gracious Providence. I will next consider the nature of Insects, which are so called, as their bodies appear as it were infected or divided into different parts, their eyes are all fixed in their heads, and not moveable as in other animals; every species of winged Insects have but two eyes, but all the different kinds of spiders have some four, many six, and others eight. The Insect Tribe is so numerous, I shall not attempt to enumerate them, but shall only remark

mark they vary very essentially, the same animal being at one time an Insect, the next a mere Reptile, and afterwards neither Insect nor Reptile, and are also Aquatic as well as Terrestrial. The various changes of the Butterfly and Silk-worm are well known; and many remarkable instances might be produced of several transmutations in form and quality, that would be beyond my present purpose to describe. The mechanism of the smallest Insect is a subject of most exquisite symmetry, and frequently of resplendent beauty; and their operations, in their several allotments and stations, extremely curious. The Spider, the Bee, the Silk-worm, and the Ant, afford lessons of ingenuity, industry, and prudent œconomy, worthy of praise, and in many respects of imitation. Spiders are not in reality proper Insects, as they have no feelers, no wings, more eyes, and more legs, and their heads are joined to their bodies; some Insects have two transparent membranous Wings, with small hairs or bristles on the surface, and others have four wings, two large and two small.

Lady M. Pray my dear Mentoria, what is a Reptile?

Ment. Any thing that creeps or crawls along with many small feet, which causes them generally to be called Multipedes, many of this tribe have been denominated Centipedes, as if they had a hundred feet, and many Millepedes, as if they had a thousand; which is not to be understood literally, but as implying, that the animal has a great number of feet; such as Wood-Lice, Caterpillars, most Worms, and all the Lizard kind; for notwithstanding they have but four feet, they move by creeping and crawling along. Snails also have no distinct legs, yet belong to the Reptile class, as their motions consist in gliding on the surface of any substance.

Lady L. Are not Reptiles usually considered as an inferior order of beings?

Ment. They possess many extraordinary qualities, though perhaps not such distinguishing marks of excellence as many other parts of the creation. I will next engage your attention on the Feathered Race, which are the most gay, melodious, and elegant species of animals that exist. If we consider the beauty of their plumage, the exquisite harmony of some of their notes, the wonderful instinct they display in forming their nests, and rearing their young;

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we must allow they are possessed of many eminent qualities, as they delight the eye by their exterior perfections, charm the ear by the most perfect melody, and regale the appetite by the delicious quality of the flesh in many species; and by their great variety, and brilliant colours, enliven the general appearance of nature. Birds that have a carnivorous appetite, are called Birds of Prey, such as the Eagle, Vulture, Kite, Hawk, &c. The feathered tribe are also divided into two kinds, Land and Water Fowl, which clearly distinguishes their proper element. When the formation and plumage of Birds are attentively considered, they appear to be possessed of extraordinary beauty and agility; it is also remarkable, that some can swim, whilst those of lighter bodies, fly to great heights, and many migrate at stated seasons, and return in regular order to their native regions. In these annual excursive flights, these delicate beings must be subject to great exertions and difficulties, and proceed with a degree of regularity which would not disgrace an army of veteran troops.

Lady M. I admire Birds, and take great pleasure in keeping and feeding them.

Ment. Every pursuit that tends to increase your reverence for the Author of Nature, is

laudable, and to a mind unperverted from a just sense of the Divine attributes, every, the most minute object excites grateful sensations. On a moral retrospect of the Terraqueous Globe, we shall find it abounds with varied substantial provision for its numerous inhabitants. The beasts of the field are furnished with pasturage, herbaceous, and farinacious food, Insects and Reptiles are amply supplied with sustenance by the various productions of vegetation. Birds are supported by seeds, fruits, and an infinitude of resources the fields and gardens afford; and as it is the property of most animals to prey on those of an inferior quality, they eat insects and reptiles, whilst many animals of superior strength and magnitude prey on them; this universal property produces a general kind of carnage, as the human race are nourished and supported by the inferior beings, which by the express appointment of their Maker, are created for their use, and submitted to their care and protection.

DIALOGUE

DIALOGUE XIV.

TUESDAY.

On Mountains, Rivers, the Sea,
Submarine Productions, Fishes,
Amphibious Animals, and Zoo-
phytes.

Mentoria.

IN our progressive investigation of the wonderful qualities of the component parts of the Terraqueous Globe, the next that demands our attention is Mountains.

Lady Louisa. I know that Rocks and Mountains are of a great size and stupendous height; but pray *Mentoria* be very explicit respecting their several uses and construction.

Ment. A Mountain, or high hill is a part of the Earth rising to a considerable height above the level of its surface; and a rock is a large mass of stone, rooted in the ground. The origin of Mountains, many suppose, was the natural effect of the Deluge, whilst others maintain they have been produced by explosions, by the means of subterranean fires, and that they have probably great concavities beneath them; since it has been proved that subterranean fires have raged in caverns under the sea. By many, Mountains are rashly considered as excrescences or imperfections, yet in reality they are productive of great benefit to the human race, and many species of animals, by affording shelter from the intense cold of the Northern and Eastern winds, and serve also for the production of a variety of vegetables and minerals, to which no other soil is congenial. These terrestrial protuberances greatly add to the beauty of the scene, by the contrasted variety they produce of hills and vallies; as it is certain if the Earth were an even flat surface, the sea would cover the whole Globe, and hence become only the habitation of fishes and aquatic animals.

Lady Mary. That would be a dreadful situation, I will never in future presume to wish
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any part of the universe different from what is produced by the unerring effects of **D**ivine wisdom.

Ment. This determination will prove an effectual barrier against hasty conjectures, and consequent erroneous opinions; as we may depend that there is not an atom in the whole Volume of Nature, incongruous to the organic construction of the complete system. In proof of this assertion, it is evident the continuity of ridges and chains of lofty mountains, generally being found to run from East to West, consequently prevent the progress of the vapours towards the Poles, without which they would all run from hot countries and leave them destitute of Rain. Mr. Ray remarks, as an argument of the importance of Mountains, that they condense these vapours like Alembic heads (by which you are to understand a vessel used for the purpose of distilling liquids) and so by a kind of external distillation, give origin to Springs and Rivers, and by that means, and by amassing, cooling, and compacting them into Rain, render the torrid regions habitable. Mountainous situations are also the only temperature in which animals of several descriptions can exist.

Lady L. I am now fully convinced of the advantages derived from Mountains, and will never be weak enough to wish the Earth were a perfect level surface.

Ment. To the benefits I have already specified, I must add their importance by the production of Metals and Minerals ; as the mountainous parts of the Earth, though apparently only very large and high Rocks, frequently covered on the outside with verdure and herbage, are interiorly composed of Mines which contain all those productions, to which we annex the idea of intrinsic value. Mountains, by the diversity of the soil, are remarkable for producing the greatest variety of vegetables, and peculiarly those appropriated to medicinal purposes ; they also prove in some degree boundaries and defences to the territories and kingdoms in continental countries.

Lady M. When you are describing Mountains, you sometimes mention Rocks ; in what degree, my dear Mentoria, are they connected?

Ment. All the Earthy substances of which some Mountains are composed, and with which they might once have been covered, have for ages been washed away from their summit, and nothing is left remaining but immense Rocks,
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that no tempest has been able to destroy, which cause the tops of Mountains to be bare and pointed, and occasion those masses of Rocky substances that frequently fall from tremendous precipices. When Hills and Rocks are found formed of a heterogeneous mass of Marine productions in inland situations, such as shells and stalks of Sea-weed, and in other respects of a similar quality with those which stand within low water mark, it is reasonable to suppose they are so many wrecks and monuments of the general devastation the Deluge produced; as a mass incorporated with petrified Sea bodies cannot otherwise be probably accounted for at so remote a distance from their genuine native source.

Lady L. Are there not a great number of Rocks in and near the Sea?

Ment. Undoubtedly, and which frequently produce the most fatal effects to mariners by the calamity usually called shipwreck, occasioned by the vessels dashing against the Rocks. These substances are formed of the common sediment of the Sea, as sand, bones of Fishes, stalks of Sea Weed, empty Shells, and a variety of extraneous marine productions, that are rolled into beds by the constant agitation of the Waters, and thus being blended together, by the violence
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of the flux and reflux of the Sea, are banked up towards the shore, which is the cause of the inclination or dipping of Rocks. No sooner is this stratum laid, than there is a continual accession of the same matter, till the mass has reached a certain height in Water. These loose materials, as soon as vegetation commences, are adhered by a strong cement, and assume the consistency of Stone, and frequently appear like white Marble, capable of a high polish: this definition I hope will give you a clear idea of Rocky substances.

Lady M. I now have a clear notion of Rocks and Mountains, but pray Mentoria describe what Volcanoes are, and by what means produced?

Ment. Burning Mountains, usually called Volcanoes, contain in their interior parts sulphur and bitumen, with other combustible matter, which serve as food to a subterranean fire. The orifice from which the eruptions proceed, are often of great extent, from whence issue flame, streams, or rivers of bitumen, sulphur, melted metal, and clouds of calcined stones, cinders, and enormous masses of Rocks, which are tremendous in their operations, cause Earthquakes, destroy cities, overthrow Mountains,
and

and agitate the Sea. In Europe there are three remarkable Volcanoes, Mount Etna, Mount Vesuvius, and Mount Hecla. In Asia and America there are a great number of burning Mountains that sometimes emit fire and smoke, and also in Africa there are several phænomena of this kind. In continental countries, the Mountains usually form chains, and in Islands are generally more distinct and raised above the Sea in pyramidical or conical forms, and are denominated Peaks; all these prominences are masses of Rocks heaped one upon the other, from some of their summits occasionally emitting burning matter similar to Volcanoes. Precipices that are between Rocks, are caused by the sinking of Rocks, from the effect of air and frost which separates them, and by the joint effort of torrents, they are divided into a variety of cleft forms.

Lady L. I believe the next subject you are to illustrate will be Rivers; I expect they will prove a pleasing contrast to the burning Mountains.

Ment. In defining the properties of Rivers, we shall find they are only Waters descending by their gravity to lower parts of the surface of the Earth, in proper channels, and are entirely
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occasioned by great quantities of Water collected on the tops and sides of Mountains and high lands, from the accumulated vapours of Rain, Snow, Fogs, Dews, and also Clouds, which run through various chinks and apertures into their internal cavities and reservoirs, till they are completely filled. The superfluous Water afterward flows through various channels and recesses to the sides of Mountains, where they form in concavities Pools, Ponds, or Lakes, and also operate as bubbling Springs, many of which are of a perennial, others of an intermitting, and some of a reciprocating quality.

Lady M. I have heard you frequently mention the Head and Mouth of Rivers, what do these terms signify?

Ment. The Head of the River is the source from which it first springs, and the Mouth implies where it empties or discharges itself into some Sea: thus the Nile rises in the Abyssinian Mountains and falls into the Egyptian Sea, a situation immortalized in Fame, by Lord Nelson's brilliant victory.

Lady L. I recollect your shewing me the seven Mouths of the Nile, in the maps of your sacred history. Pray, Mentoria, what are the principal benefits that we derive from Rivers?

Ment.

Ment. They are so diffusive, I cannot possibly reduce them to any specific form or number. In the first instance, their flux and reflux occasioned by the influence of Tides, which I have already explained, are produced by the attractive powers of the Sun and Moon on the Ocean, and prevent that stagnation which would inevitably render the water of a putrid quality, consequently of a destructive tendency. In the next place, Rivers supply water for the general accommodation of life, are indispensibly necessary for Navigation, driving of Mills, working of Engines, and a variety of other important purposes, beyond my ability to specify. Rivers possess many extraordinary qualities; the principal Rivers fall into the Sea; but there are some that lose themselves in the sand, and others that appear to penetrate into the Earth; it is also observable, that in inland situations at a distance from the Sea, they flow in a direct line, but as they are near their Mouths they acquire more of a winding or serpentine course in their progression.

Lady L. Pray, Mentoria, what are Lakes?

Ment. A Lake is a standing pool, or great collection of waters, which differ in quality; some have no connection with any River, and
from

from which no water goes out ; others do receive Rivers, and from which also others run ; and there are some which only receive Rivers. I shall not specify the different Lakes, as I fully explained that branch in my Lecture on Geography.

Lady M. As you have finished your account of Rivers, I suppose the next subject of your instructions will be the Sea.

Ment. Sea is a general term adopted to express the immense body of salt water opposed to that of Rivers, which is of a different quality ; though those vast briny expanses that encompass the Globe, with stricter propriety are denominated the Ocean, the word Sea being with more justice applied to denote a particular part or division of the general mass, often so called from the countries it washes, or from other circumstances, as the Irish Sea, Mediterranean Sea, &c. &c.

Lady L. The Sea is an object that I contemplate with great delight ; therefore I wish to be informed of its dimensions, and most important uses.

Ment. The extent of the superficies of the Sea, compared to that of the Land, is not precisely ascertained, though it is generally supposed

posed to exceed two thirds. As the Waters of the Earth must necessarily rise to the surface thereof, as being specifically of a lighter quality; it was expedient there should be large cavities, as receptacles to contain them, or they would have overspread the superficies of the Globe, and rendered it uninhabitable for terrestrial animals.

Lady M. What would have been the immediate cause of that dreadful effect?

Ment. The centre of the Earth is supposed to be of a magnetic quality, by being the common centre of Gravity, to which all objects on the Terraqueous Globe invariably are attracted; and as it is the nature of Fluids, that they equally yield to equal powers, and the power of attraction being every where equal, at equal distances from the centre, it follows as a natural consequence that the superficial parts of the Water will every where conform themselves to an equi-distant situation from the centre, and by that means constitute the surface of a sphere, as far as they extend.

Lady M. This rationally accounts for what before appeared to me inexplicable; but pray, my dear Mentoria, what is the depth of the Sea?

Ment.

Ment. The depth or profundity of the Ocean in some places is asserted to be unfathomable, and in others variable, some few parts are above a mile deep, but the most common depths are from 60 to 150 fathom; and the profundities are much less in Gulphs and Bays than in Oceans; and in general the depth of the Sea bears a great analogy to the height of mountains on land.

Lady L. I am surprized so many Rivers falling into the Sea, do not cause it to overflow.

Ment. The chief cause why the Sea does not encrease by the means of a vast accession of waters from Rivers, is principally occasioned by the Waters returning from the Sea by subterranean cavities, and aqueducts, through various parts of the Earth; and also from the quantity of vapours raised from the Sea and falling on the land which by that means cause only a circulation, but no increase of Water.

Lady L. It is surprising that the Sea, which frequently appears so tempestuous, does not at those periods inundate the land.

Ment. It can only be ascribed to the omniscient decrees of an over-ruling Providence; that the Sea should compose itself to a level, or
equal

equal superficies, and with the Earth be comprised into a spherical form, and that it should also be defined by strands, shores, and certain limits: as however the Sea may appear to rage, its Divine Creator thus proclaims, “thus far shalt thou go, but no further”! Notwithstanding the Sea does not exceed its bounds in a degree to prove destructive, in some instances several encroachments have been made, of no importance when considered as relatively connected with the general œconomy of the universe. It is a matter of dispute whether those encroachments made by the Sea on the land, or whether the Land or the Water are gaining on each other, in this terraqueous Globe. In Great Britain several encroachments have been remarked; in the time of Augustus, the Isle of Wight was a part of the Island of Britain, so that at that period the Britons crossed over towards it with carts loaded with Tin. In general on the Eastern side, the Sea has gained ground, whilst on the Southern and Western it has increased in some places, and lost in others.

Lady L. What produces the beautiful Waves and different appearances of the Sea?

Ment. The natural effects of the Flux and Reflux of the Sea, by the mutual attraction of the

the Sun and Moon, but principally of the latter, which I have fully described in my explanation of the doctrine of Tides, as produced by the universal power of the Laws of Gravity and Attraction. The Waves, Billows, and Surges which cause such a varied sublime effect, are occasioned by the agitation of so vast a body of Water, by the efforts of the Winds and the joint influence of the Tides: and their diversity of tints and hues is derived from the Solar rays emitting light in peculiar directions. The saltness of Sea Water is on very rational grounds ascribed to Mines and Mountains of Salt dispersed in the depths of the Sea; this saline property is of diffusive utility, as it preserves the great expanse of Water from the effects of putrefaction, by keeping it pure and uncorrupted; it also renders the Water more dense or heavy, and consequently better suited to sustain ships of large burthen, and promotes the purposes of navigation by being less liable to freeze, and thereby prove inaccessible, and also to nourish a variety of beings whose native Element is the Sea, and lastly, to fertilize lands by the salutary effects of its saline vapours, and the qualities that are extracted from its extraneous matter, as manure.

Lady

Lady M. You have given me so clear an account of the Sea, that next Summer, when I go to Weymouth, I shall view it with peculiar pleasure and attention.

Ment. There yet remains many wonderful properties for me to describe, in particular, respecting submarine vegetative productions, which include Plants, Shrubs, and Trees, that grow under the Sea, or on its immediate coasts.

Lady L. I have frequently seen Sea Weeds of varied descriptions, and have had many in my possession.

Ment. The Submarine vegetables are divided into three classes, Plants, Arboresecent Shrubs, or Corallines, and Coral Trees; as the hard substance of which these productions consist is called Coral. The texture and form of these varied objects are so well known, I shall not attempt to describe or enumerate them; they differ very essentially in their origin from the nature of terrestrial Plants, which are germinated from a seed, and derive their nourishment from the Earth by means of their root and fibres, whilst Sea Plants are fixed by a broad basis to the hard surfaces of Stones and Rocks, and appear to receive their nutriment and growth through the general component parts
of

of their bodies, and have no Seeds or Flowers. As these plants are considerably lighter than Sea Water, they are consequently supported by it; and when by accident they are torn from the substance to which they adhere, they swim, and are washed on shore by the surges of the Sea, and by being cast on the Coast, afford improvement to the curious, benefit to those employed in agriculture, and also in glass manufactories, by burning the Sea Weeds for the salt their ashes contain.

Lady M. I never before knew that Coral is a Sea production.

Ment. The specimens you have seen, differ very essentially from the Corallines I have just mentioned. The Coral you admire is a vegetable Spar or Crystal, that the Earth produces, which is nourished by Sea Water; it chiefly grows upon Rocks in various species, forms, sizes, and colours; the most perfect sort of Coral is the red and white, as the black Coral is in fact only a submarine wood. Besides this genuine kind of Coral, there is a spurious species, called Madrepor, of which there are some in Canada of a lively blue hue. The form and growth of Sea Plants are a striking proof of Divine skill, and that the motion of the
Water

Water extends to a considerable depth ; as those Plants which grow at the bottom of the Sea, and at a great distance from its surface, generally are of a flat form, in some degree resembling the construction of a fan, but not with lateral branches like Trees, which formation is peculiarly adapted to enable them to encounter the flux and reflux of the tide, without sustaining any injury as to their figure or duration. In the most profound abysses, of the depths of the Ocean, Mr. Ray thinks it highly probable there are neither Plants nor Fishes, as their remote situation from the external surface would render the portion of air, and the supply of insects as food, inadequate to the purposes of existence ; and from the influence of their aquatic element, Submarine Plants are of a dusky olive colour, but never of a vivid green hue, like terrestrial vegetables ; though many are of the most delicate texture, and possessed of inherent beautiful colours : and to the variety I have already enumerated, the Sponges which are common in use, constitute a distinct order of Submarine Vegetables.

Lady L. Do we not derive several advantages by being inhabitants of an Island ?

P

Ment.

Ment. We are benefitted very essentially by our insular situation ; in the first instance, by the extent of Trade and Commerce, and also by the consequent influx and connection with the most distant regions, which accumulate wealth, and tend to the general civilization of the inhabitants of such a distinguished Isle, blest by local advantages, and protected by lenient laws administered with impartial justice. Notwithstanding you are well informed respecting the principal Islands in the different parts of the Globe, I must add some remarks respecting the New Islands that are sometimes produced by the sudden operation of subterranean Fires, or by the more gradual process of sediments of Water, these are but rare ; but there are many New Islands occasioned by the Mud, Sand, and Earth, which the Rivers or the Sea convey to different parts of the Globe ; the Sea also by retiring from certain Coasts, and by encroaching on others, and thereby covering the lowest part of the surface, by that means produces the same effects ; and it is observable, there are but very few islands in the middle of the Sea, but chiefly near to continental countries, where they were probably formed, either by the retreat or approach of that irresistible body of Water. I shall

I shall now close my account of Islands; I hope you are truly sensible of the individual and general blessings we enjoy, as natives of a land enlightened by Christianity, refined by the progress of Arts and Sciences, and protected by a wise Constitution, which is the basis of Civil and Religious permanent security.

Lady M. It is impossible for me to express my gratitude for the dispensation of the blessings you have enumerated; and I regret the probability of your having completed your account of the Sea.

Ment. Concerning its general properties, I have little more to observe, but as I have endeavoured to explore its most profound recesses and its abundant productions, it is in some degree necessary for me to make some remarks concerning its various Inhabitants. In this research, Fishes are the first class of beings, that present themselves to our view, which may be thus distinguished; first of the cetaceous kind that includes the Whale in all its varieties, the Dolphin, the Grampus, and the Porpoise, which in some degree resemble Quadrupeds in their internal construction and habitudes, and cannot subsist under the water, for any considerable length of time; the next tribe are of the Car-

ilaginous kind, which have cartilages or gristles instead of bones, and are subdivided into the Shark, and Ray kind. The next are the spinous kind of Fishes, or those of the bony kind, which are so numerous, they are sometimes divided into a variety of classes, to denote their several properties, some of which possess a poisonous quality. The last order is Shell Fish, which are thus ranked. First the crustaceous kind, such as the Lobster, Crab, Tortoise and Turtle; next the testaceous species, the shell of which may be considered as its habitation: as these subjects may be traced in infinite variety, as the means of giving you a clear idea of their several generic distinctions, I shall inform you that Aristotle divided them in the following manner. The univalve, or turbinated, which consist of one piece like the shell of a snail; secondly the bivalved, consisting of two pieces united by a kind of hinge, as an Oyster; and lastly the multivalve, consisting of more than two pieces, many of which tribe are formed of a number of parts. All these varied species are found in different depths of the Sea, and are valuable in proportion to their beautiful, or rare properties.

Lady

Lady L. A friend of mine gave me a collection of shells which I greatly esteem, I believe he brought them from the East Indies : Pray Mentoria, are not Pearls produced from some kind of Shell Fish ?

Ment. The most rare and beautiful species of Shells are brought from Eastern regions ; your present will appear doubly valuable, if you not only admire it for the varied exterior elegance of its several specimens, but also reflect that the most minute article has been the abode of some animated being. Pearls, as you rightly imagine, are the production of Shell Fish, many of which are found to contain Pearls, but particularly that species which has obtained the name of the Pearl Oyster ; it has a large strong shell of a whitish hue, exteriorly of a wrinkled rough texture, and in the inside of a silver colour and smooth quality, from which what we call the Mother of Pearl is produced. The Oysters which contain the superior kind of Pearl, are principally found in the Gulph of Ormus, and several parts in the East Indies ; though there are Pearl Fisheries established in various places in the Asian and American seas, and these valuable Oysters are procured by a regular process of diving for them to a considera-

ble depth, which is effected by the efforts of skill, undaunted by imminent danger. Pearls, which are esteemed as an elegant costly ornament, next in degree to precious stones, are nothing more than a preternatural excrescence of the Fish, probably not the effect of disease, but only produced by some extraordinary means from the same matter that constitutes the shell.

Lady L. It is extremely kind of you to give us such a particular account of those things which we so often view, but have never seriously regarded.

Ment. I have endeavoured to describe the several kind of Fishes, which you must strive by some other means to be circumstantially acquainted with. Fish in general may be regarded as inhabitants of the Sea; though some particular species live in fresh Waters, and others migrate annually to Rivers to deposit their spawn, which could not be so safely disposed of in the tempestuous depths of the Ocean. The construction of Fishes is admirably adapted to their peculiar situation; the air-bladder with which they are almost universally endued, enables them to respire in an element apparently uncongenial to that purpose. Their fins, and tail are formed of a texture, to accelerate their progress,

gress, and keep their body in proper equilibrium and due course: and their great fecundity is wisely ordained for the preservation of each species, as they are not only food for Man, but the objects of prey for all superior kinds of Fishes, which make regular depredations on each other, and subsist by that means, and on the insects and plants the Sea produces.

Lady M. Are not Fishes a very wonderful tribe of animated beings?

Ment. Without doubt, and distinguished by several characteristic marks, as well as by great inequalities in their dimensions, some being scaly, others covered with skins of a smooth surface, and many defended by a coat of a hard, yet often of a brittle quality: they are also subject to great variations in size, some being of a large magnitude and others diminutive; and great numbers fit for food, but some particular species of a poisonous nature. Besides Fishes, there is another kind of animals whose proper element is the Sea; such as Seals in their several varieties, the Walrus and the Manati: these creatures all form a distinct class in the scale of beings, by being compounded of heterogenous qualities, which render them, notwithstanding they are animals, nearly allied to the Cetaceous tribe

tribe of Fishes; as the Seal and Walrus have a kind of members resembling four feet, consequently approach nearer to quadrupeds than to Cetaceous Fishes; but the Manati by having only two fore feet, resembles the Cetaceous kind more than quadrupeds. The Seals, and Walrus also, from the peculiar construction of their heart, can subsist either on Water or Land: but the Manati species cannot properly be termed amphibious, as they never entirely leave the water, but only advance their head to the shore to eat grass and herbage: they are sometimes found in Salt Water, but chiefly in Creeks and Rivers near the Sea, but not very far from land.

Lady L. What do you mean by amphibious animals, my dear Mentoria: is the Sea Bear of that quality?

Ment. The Sea Bear, which is often called the White Bear, the Polar Bear, or the Sea Bear, is not of that class, as it only lives occasionally on the fields of ice in the frozen Seas, and at other times on land. The term amphibious is properly applied to such animals as are constructed to breath the air, but pass the greatest part of their time in the Water, as that element affords them the most food, such as the
Frog,

Prog, Otter, Beaver, &c. &c. and likewise to several species of plants as grow either on Land or in the Water, viz. the Alder, Willow, &c. &c.

Lady Mary. I fear you have finished your account of the Sea, its productions and numerous inhabitants; and I anticipate with much concern that your instructions on Natural Philosophy are nearly terminated.

Ment. There yet remains another branch of existence immediately connected with the Sea, called Zoophytes, that are not produced by the usual course, but by dissection; as, if they are divided into several parts, each becomes in due time a perfect animal; such as the Polypus, or Polypes, which according to their varied species have different names. There is also another wonderful genus of Sea animals that appear to be a kind of animated plant, and grow upon the surface of Rocks, Pebbles, Stones, &c. to which they so firmly adhere, it is with difficulty they are separated without essential injury to their texture. They are of various species, forms, sizes, and different colours, one in particular, is called the Sea Anemone, and others resemble young Aloe leaves, and many when

when expanded, appear like Flowers beautifully variegated.

Lady L. How can these productions that resemble flowers, be animals?

Ment. It is evident they are possessed of animal powers, from the motions and actions of their bodies; and they are asserted to be very expert in catching and devouring their prey; such as Crabs, &c. &c. To this wonderful class of beings, the Polypus, the Earth Worm, and all the varieties of the Sea Nettles, properly belong, and very probably also, those that produce Coral, and Sponges.

Lady M. The next time that I am on the Sea coast, I will endeavour to get some of those Animated Plants; as I shall take great pleasure in such curious Phænomena.

Ment. I have considered the Earth, first as a Planetary Orb, performing its annual course round the Sun; secondly, as a Terraqueous Sphere composed of Land and Water; and lastly, as a Congregated Globe, inhabited by myriads of beings endued with powers suited to their state of existence. On a philosophical survey of the operations of Nature, it appears evident, that the Deity in a variety of instances, gradually unfolds his divine attributes in the general

neral system of the Universe. In the animal classes, the gradation is progressive from Man to the Ape; from the Ape to Quadrupeds; from Quadrupeds to Cetaceous Animals; and from those tribes to Birds, Fishes, and Reptiles. By extending this research still further, we may clearly trace the degeneration from Reptiles to Insects; from Insects to Worms; from Worms to Zoophytes; and from Zoophytes to Plants. In each variation the declension is marked by a combination of qualities which have a kind of analogy, and form a regular shade that connects every genus into a system of perfect order, and organic harmony.

Lady M. I had no idea there were such similarities and connections as you have specified; but am now clearly convinced, that every part of the Creation abounds with perfections, which are not sufficiently the object of attention.

Ment. The Universe proclaims its Maker's praise, by the various proofs it exhibits of Divine Excellence; blessings which are diffusively dispensed, though but imperfectly estimated or acknowledged. Our gratitude should be peculiarly excited when we reflect, that in the general scale of Being, the Human Race hold the
first

first class. This superiority arises wholly from their intellectual faculties; as several inferior species exceed them in strength and magnitude, and by the operations of instinct, equal them in ingenuity, and many other valuable qualities; therefore their pre-eminence alone originates from the possession of Reason, and that immortal pure intelligence of Mind that render them capable to judge between Good and Evil, and to contemplate the works of their Creator. The general subordination that may be delineated in all parts of Animated Nature, as necessary to the existence and welfare of every member of each species, inspires a contemplative mind with acquiescent resignation respecting the several stations and allotments in life, which constitute collateral degrees, conforming to those in the Animal Genera, as relative to distinctive qualities. Those properties which exalt Human Nature to its greatest possible degree of perfection, are universally dispensed; such as Reason, and the various operations of Intellect; whilst partial distinctions, as elevated Rank, Riches and Power, are only occasionally bestowed to fulfil the general purposes of order, requisite for the benefit of the Community; as individually, those possessions
neither

neither ensure happiness nor prove an exemption from the various conflicts and vicissitudes of temporal events. On an impartial retrospect of Human Frailty, and a just statement of Divine Mercies and dispensations, those must be considered as inestimable that deliver Mankind from the dominion and penal consequences of Sin, by the perfect atonement of our blessed Redeemer! Let these sublime truths enlighten your minds, and produce humility in its most comprehensive and refined sense, which in the highest station, is not inconsistent with dignity of character; endeavour by your example and precepts, to stem the current of popular error in all matters that operate against the suggestions and decrees of Moral Principles. By your general conduct evince an uniform devout reverence for the Christian Religion, Holy Ordinances, and Sacred things; but above all, as the ultimate criterion of your duty, cherish an entire, unlimited confidence in the Promises of God, and the efficient Protection of his Divine Providence!

F I N I S.

DIRECTIONS TO THE BINDER.

The **GLOBE** to face the Title.

Table of Diameters and Distances of **PLANETS**, to face Page.....28

The **NORTHERN CELESTIAL HEMISPHERE**, and the **SOUTHERN CELESTIAL HEMISPHERE**, to be placed between pages 54 and 55, on a Guard.

List of **CONSTELLATIONS & STARS** to face p. 80

E R R A T A.

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|------|------|------|-----|--|
| Page | 6. | Line | 5. | for <i>is</i> , read <i>in</i> . |
| — | 8. | — | 20. | for <i>bid</i> , read <i>bidden</i> . |
| — | 58. | — | 19. | for <i>Plecades</i> , read <i>Pleiades</i> . |
| — | 66. | — | 27. | for <i>is</i> , read <i>are</i> . |
| — | 70. | — | 17. | for <i>Archemedes</i> , read <i>Archimedes</i> . |
| — | 145. | — | 8. | for <i>is</i> , read <i>are</i> . |
| — | 167. | — | 13. | for <i>requires</i> , read <i>require</i> . |
| — | 244. | — | 9. | for <i>furrounds</i> , read <i>surround</i> . |
| — | 249. | — | 18. | for <i>Parasclena</i> , read <i>Parasclena</i> . |

