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A N
E S S A Y
O N T H E
N A T U R E and Superior U S E
O F
G L O B E S,



In conveying the
First Principles of GEOGRAPHY and ASTRONOMY
To the Minds of Youth;

A L S O

A Candid Examination of the *Construction* and
Use of PLANISPHERES,

W H E R E I N

The *Erroneous Nature*, and many bad Consequences, at-
tending the Use of the *Vulgar Projection* are pointed out:

A N D

The *Nature and Use* of the GLOBULAR PROJECTION,
With many NEW IMPROVEMENTS,

Illustrated by a Solution of Several PROBLEMS,

Explaining the general Principles of GEOGRAPHY and
ASTRONOMY, by Way of Introduction to the more
ready Use of the GLOBES.

*This (Globular) Projection comes nearest of all to the Nature of the
Globe, because the Meridians are therein at equal Distances, the Pa-
rallels also are nearly equidistant: I see no good Reason why our Geo-
graphers do not make use of it.*

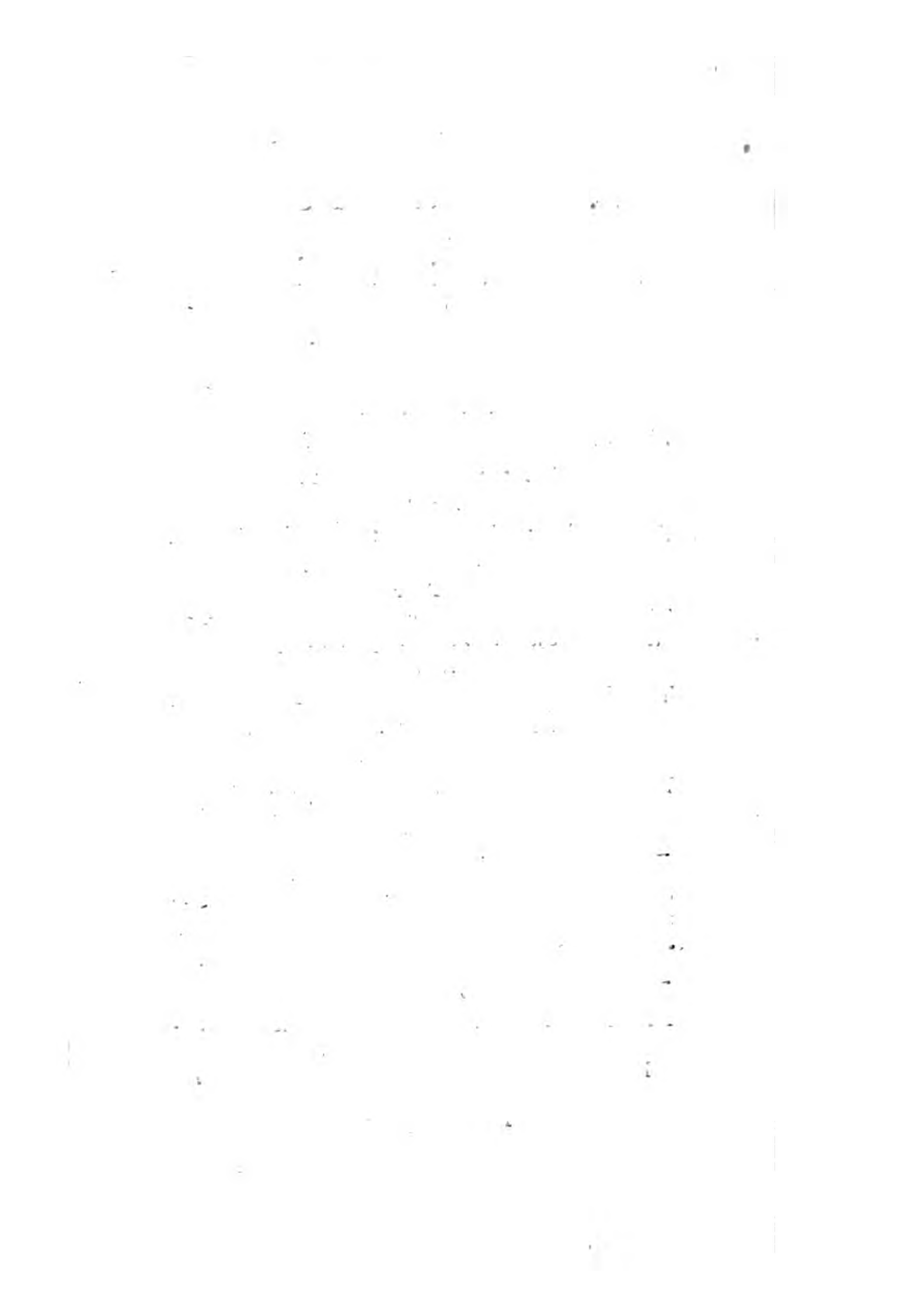
Dr. LONG in his Astronomy, page 155.

By BENJAMIN MARTIN.

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T O

The Ingenious and Ingenuous
Part of the PUBLIC.

GENTLEMEN and LADIES,

I TAKE the Liberty of submitting the following Tract to your Inspection and Judgment; the Size is small, but the Subject great and importing, and in which yourselves are not a little concerned; when the Honour of Science is at Stake, every Member of your Community must be affected by it; and as you have the best and most impartial Judges among you, I cheerfully appeal to them for the Equity of the Cause in which they will find me here engaged. I am the more inclined to do this as I am conscious I have not been actuated by any other Motive than the PUBLIC GOOD; this likewise has been the constant Inducement to all my other literary Undertakings. No Man has been more anxious to make the rugged Paths to Knowledge plain and easy; and the liberal Arts more generally accessible: When I have observed the heavy Lumber of Learning thrown upon you, I have endeavoured to render that Burthen easy and light: When Ignorance has attempted to cast a Veil before your Eyes, and to darken Science by Words without Knowledge, with just Indignation I have endeavoured to take it away, and placed the fair Divinity, with all
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ber native Charms, in the most amiable and advantageous Point of View. In short, for twenty Years past my Views have been all directed to one End, viz. To make the Arts and Sciences as desirable and intelligible to every Genius of your Community as I possibly could. And I have the great Satisfaction to find my Endeavours have been successful, and honoured with your general Acceptance and Application. The manifold Instances of your Goodness and Generosity demand my warmest Expressions of Gratitude; they have happily placed me beyond the reach of Envy and Detraction, and have entailed on me the everlasting Honour of being male-treated by DULNESS and her Votaries. But while Providence preserves my Health and Faculties, my leisure Hours will still be employed to promote and facilitate your Progress in the Studies of the Sciences and useful Arts, which will at the same Time afford the greatest Pleasure to Gentlemen and Ladies,

Your most obedient humble Servant,

BENJAMIN MARTIN.



A N
E S S A Y
O N T H E
Nature and Use of G L O B E S,
Compared with
P L A N I S P H E R E S, M A P S, &c.

THE Misapplication of the prime
T Part of our Time, I mean that
which is spent in the Education
of Youth, is a Matter of the most
serious and interesting kind; the
Seed time of Life is our Youth, and the
Harvest of Humanity depends upon it.
Whatever we sow in our younger Days, we
reap in our future adolescent State; and it
is a well known Maxim with all Planters,
that *as the Twig is bent, the Tree will grow.*
In the Culture, therefore, and Plantation of
human Life, the greatest Care, Precaution,
Prudence, and Art in this most important
Species of Husbandry, should be used; for
when the Harvest proves not to our wishes,
it must be imputed to the want of Provi-
dence, Industry, or Skill in the Husband-
man, whether he be the Parent or Tutor of
Youth. The Soil, generally speaking, is
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naturally good, and invites us to a chearful Cultivation; and the most barren is capable of great Improvement; we have nothing to charge on beneficent Nature, if the Trees of our own planting do not produce the Fruits we expect, the Blame falls not on the Tree, but ourselves; for what reasonable Man can expect *to gather Grapes from Thorns, or Figs from Thistles?*

As our Nurseries of Youth are Schools of Education, they have always been thought of the greatest Consequence to the Dignity of the human Character, and the well-being of Mankind, and of course have been first in the Thoughts of all who have the Honour and Felicity of their Species at Heart. On this Account the most ample Instructions, Advice, and Assistance have been supplied in every Age for their Conduct and prosperous Success: But as nothing arrives to Perfection at once, and nothing appears more gradual than the Progress of the Sciences, particularly those of Geography and Navigation, it becomes constantly necessary to supply our Seminaries with the earliest Intelligence of the Improvements made in those Sciences. Now the *true Figure of the Earth* being a modern Discovery, and as yet but very little known in our public Schools, and several learned Men have with great Reason shewn how far the Principles of Geography and Navigation are affected
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by it, and of course ought to be new modelled and regulated according to it, I have taken the Liberty to offer them my Service in that Respect, and have laid before them a genuine Account of this important Discovery, and supplied them with large and new Sea-Charts, and Tables of meridional Parts, for the Practice of Navigation, constructed on these new Principles; as also a large Specimen of a new and just Method of making Geographical Maps and coasting Charts; and have good Reason to hope my Labour in this Affair will be acceptable to all those who are pleased with the Advancement of Science, and endeavour the Improvement and Perfection of the Studies of Youth *. And indeed the greatest Encouragement to this Undertaking has been the good Success which has attended many of my former Essays, by the kind Reception they have met with from the Public.

My present Design regards those young Gentlemen and Ladies who have a Taste for *Geography*, and are willing to attain the first Principles thereof in the most natural and easy Manner. Now the first Steps that Art supplies for advancing in this Science are GLOBES, or their Projections *in Plano*, usually called *Hemispheres*, *Planispheres*, or *Maps*, general or particular.

* See my *New Principles of GEOGRAPHY and NAVIGATION*, just published.

It is no Wonder that the Science of *Geography* has always been held in the highest Regard, and looked upon as the most essential and polite Part of Education. For as nothing less is the Object thereof than the *terraqueous Globe* which Providence has assigned for the Habitation of the human Race, and the Scene of all their Actions, what can more deserve their Notice and claim their first Regard and Knowledge than their native Earth? What can be more necessary than to look about them and survey the various Scenery where they are destined to act their future Parts of Life? What more becoming a rational Being, than to know where he is, and how he stands related to and connected with others of his Species on different and distant Parts of the World? When we consider the Magnitude, Figure, and Dimensions of the Earth; the Divisions thereof into Land and Water; the various Forms and Phænomena of each; the Distribution of Land into original Nations, Countries, and Kingdoms; and each Nation particularized by different Languages, Complexions, Manners, Customs, Governments and Commerce; I say when all this and much more is considered, it must be looked upon as a strange kind of Indolence and Supineness in a Man not to have the Curiosity of enquiring into and satisfying himself in regard to such Notions, Characters, and Subjects

jects as not only naturally give Pleasure to the Mind, but are intimately related to our very Nature, Situation, and Fortune in Life; that distinguish Man from the prone and irrational Animal; that elevate and class us above the rude and unthinking Vulgar; and constitute that Part of Erudition, which above all others characterizes the *Gentleman* and the *Scholar*. But as the *Eulogium* of *Geography* has been oftentimes the Subject of abler Pens, and as it is a Science every one knows full well the Conveniency and Necessity of, I shall desist from enlarging on this Head, and proceed to observe the best Method by which this useful Part of Knowledge may be instilled into the Minds of Youth; which I shall venture to affirm is by Means of the *Terrestrial* and *Celestial Globes*, and I think that is evident beyond Dispute, for the following Reasons.

First, The essential Property of a Globe, which is its *Figure* or *Form*, is that which alone would give it the Preference to all other Means or Methods for conveying the natural and genuine Ideas of Geographical Science to the Minds of Youth; they are first taught that the Earth we live upon is of a *round or spherical Figure*, and therefore it becomes necessary to facilitate that Idea, by presenting to their View a Model of the Earth in Miniature, that is, a *real Globe*. To form a just Notion of a Thing, we must first frame
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to the Senses the true Resemblance of it, consequently nothing less than an *artificial terrestrial Globe* can give the Mind a true Conception of the form or Figure of the real *Globe of the Earth*. To talk of a *Globe in Plano* would be just as good Sense and Logic, as to say there is *Light in Darknes*; for as Darknes is only the *Privation of Light*, so a Plane is only the *Privation of Sphericity or Convexity*; therefore no Projection *in Plano* can give any proper Idea of the very first Principle of this excellent Science. The same is true with regard to the *Heavens*, the Appearance of which is precisely a *Spherical Figure*, and of Course can be represented only by the Convex Surface of a *Celestial Globe*. The Globe, therefore, in this fundamental Point, stands unrivalled by any Contrivance whatsoever.

Secondly, The next Principle in *Geography*, and the first in *Astronomy*, is the *Motion of the Earth upon its Axis*: This is a Matter of the highest Consequence, as upon it depend the most considerable *Phænomena* of the visible World; and it must be confessed that no human Invention but that of a *Globe* can any how represent this, or communicate an Idea thereof to the Mind which is adequately done by the Rotation of the *terrestrial Globe* about its Axis; and the apparent Motion of the Heavens is as naturally and perfectly represented by that of the *Celestial*

lestial Globe. In this Case, therefore, the Globes can have no Competitor.

Thirdly; As many *imaginary Circles*, great and small, are necessarily required in the Science of Geography, for conveying clear and distinct Ideas of the Divisions of the Earth's Surface, Situations of Places, Solutions of Problems, &c. These can by no means be truly and naturally drawn but on the Surface of a real Globe: Here they have their proper Form and true Position, and real Intersections, such as they have (or must be understood to have) on the Surface of the Globe of the Earth; but nothing of this Kind can be expected *in Plano*: For in projecting these Circles, their Forms and Positions are variously altered, and in many, their Nature quite changed, or a *Circle* becomes a *Right Line*. The Shifts, therefore, that we make with *Planispheres* are very imperfect and unnatural, and can give no correct Notions of this Science.

Fourthly; The Appearance of the several Parts of the Earth's Surface, both of Land and Water, is perfect and natural on the *Globe*; continuous and together as they ought to be seen, and represented to the tender Minds of Youth; but this is impossible in *Planispheres*, because one half of the Globe must be disjoined and separated from the other in the Projection, and those Parts which are contiguous on the Globe and viewed

in their natural Position, are here dissevered and thrown at the Distance of the two Hemispheres from each other. An Imperfection that nothing but Necessity can tolerate or justify. And the Case is much worse still in regard to the starry Firmament, which only the Surface of the *celestial Globe* should be suffered to represent by the judicious Teacher of Geography.

Fifthly; The *true Form* and *Dimension* of Places can only be naturally and easily represented on the *Terrestrial Globe*, For on the common Sort of Planispheres they are miserably distorted and misrepresented indeed, as is well known to any Person but ever so little acquainted with the Nature of Projections. On the Globe every thing is shewn in just Proportion of Magnitude and Form; but on *Planispheres* nothing is so; but oftentimes the reverse is observed: A small Island or Country on one Part of the Map shall appear equal, or exceed one much larger than itself in another. Hence our Ideas are liable to be vitiated, which is the first Thing to be guarded against by the Tutors of Youth in all Sciences whatever, and more especially in this.

Sixthly; The *Distance* and *Bearing* of Places is quite natural and easy to be observed and measured on the *Terrestrial Globe* by means of the Quadrant of Altitude: They are here represented as they really

really are on the Globes of the Earth itself; but on Planispheres nothing of this Kind is to be expected; but on the contrary, equal Distances are there represented always, and every where unequal, and the whole is one false Idea. On the Globe, the Distance, Position, or Bearing of any two Places are instantly seen, and known as they really are in themselves. The Globe, therefore, can only give a true Idea of these geographical Principles to the Minds of Youth.

Seventhly; With respect to the mutual *Position of the Globe of the Earth and its Inhabitants*, nothing can represent that Matter with any Degree of Ease, Truth, and Propriety but the *Terrestrial Globe* itself; the Elevation of the Pole above the Horizon rectifies it instantly for the Inhabitants of a given Latitude; and it then exhibits a just Representation of their own Situation on the Surface of the real Globe of the Earth relatively to the Horizon, and the Heavens about them. To attempt this in Planispheres is making a flat Piece of Work of it truly; and the Ideas accruing from thence to young People must be as awkward and imperfect as the Operation itself; and therefore as far as possible to be avoided.

Eighthly; The *General Meridian* and *Horizon* of a Globe fit that Instrument for exhibiting in the most natural and lively Manner the *Rising, Culminating, and Setting* of
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the *Sun, Moon, Planets, and Stars*, for every Day of the Year; the *Length of Day and Night*, and the Division of each into *Hours* by means of the *Horary Circle and Index*, is so exact an Imitation of Nature itself, (not to say an Improvement of it,) that no one can rightly consider it without Wonder; and must in vain expect any thing like it from Planispheres.

Ninthly; By means of the Celestial Globe, the true Face of the Heavens for any given Day and Hour of the Night, or the visible Hemisphere of the Planets and Stars may be represented to the Eye in so just and exact a Manner, that each Star in the Heavens may be seen to correspond to its Representative on the Globe; the Pole-Star, the Milky-Way, the Constellations, all tallying in regard to those Positions so nicely with those in the Heavens as almost exceeds Expectation. But to attempt any thing of this kind in Planispheres would only argue a great Degree of Ignorance of their Nature and Use.

Eleventhly; If the *Terrestrial Globe* be rectified and placed in the Sun-beams in a proper Manner, which is very easy to be done, it will then duly represent the real Case of the Globe of the Earth with respect to the illumined and dark Part, and shew where it is Day and Night; the Season of the Year will be naturally seen; which
Pole

Pole is in the light, and which in the dark Hemisphere. All which great Phænomena are, if not impossible, yet so very imperfect and unfeasible on Planispheres, that it is to no Purpose to mention them on this Account.

Twelfthly; By a proper Apparatus the Globe may be so constructed, as not only to revolve on its Axis, but also that the *Poles of the World* shall revolve about the *Poles of the Ecliptic*, by which means the Phænomena of the Platonic Year, the slow apparent Motion of the Stars forwards; the Precession of Equinoxes or Regress of the Equinoctial Points, the different Inclination of the Earth's Axis in different Ages of the World; the shifting of the Seasons, and Festivals in Process of Time through the whole Calendar, and many such like important Particulars are adequately and properly accounted for; but which no intelligent Person would pretend to explain from Planispheres.

To the above-mentioned Advantages of Globes, we might add many others, *viz.* the natural Representation of a *Ship's Way*, and all the *Cases of sailing*; an easy Illustration of the *Doctrine of Eclipses*; the *Rationale of Dialling*; the *Phænomena of the Harvest-Moon*; the *Solution of all the Cases of Spherical Triangles* and astronomical Problems, &c. &c. &c. all which are naturally and properly shewn and solved on a Globe, but so unnaturally and ineffectually essayed on Planispheres,

that I believe no skilful Professor of those Sciences will ever think it worth their Notice. One very material Advantage of Globes I had almost forgot to mention, *viz. That the Surface of a Globe is twice as large as the Surface of the Planispheres, into which it is projected, if the Diameters of each are the same; or any Country is twice as large on a Globe of 18 Inches diameter, as on a Map or Planisphere of the same Extent; and therefore a Map of 18 Inches answers but to a Globe of about 12 Inches in Point of Use or Accuracy.*

Such, therefore, is the distinguishing Preheminence of Globes; this recommended them in every Age to the Admiration of the wisest Part of Mankind, and induced them to recommend them in the strongest Terms to the Study and Practice of others; and this will ever continue to be the Case. The intrinsic Worth and Value of any Invention will support it, and *genuine Science* will continue as long as *Truth* and *Nature* have being.

As the whole DESIGN of GLOBES is to facilitate our Notions of geographical and astronomical Science; it is all we ought to expect; it is the Nature and Manner of the Thing to be communicated and represented, not the Degree of Accuracy with which it may be done, that is the Thing proposed. If I am to exhibit to the Mind a clear, just, and natural Idea of the Form, Division, and

and Magnitude of the Earth ; the rising, setting, &c. of the heavenly Bodies ; the Nature of the Seasons, Eclipses, &c. I take the Globe ; but if great Accuracy be required or the Quantity must be expressed in Minutes of *Motion* or *Time* it is another Affair ; my Pupil must first be instructed in the Arts of Computation, and then referred to astronomical Tables to answer such Design. If the Globe will shew him the Nature of an Eclipse, it is enough ; it would be ridiculous to expect from it, the true Time of its Beginning, Middle, or End : If it shews the rising and setting of the Sun, in the most natural Manner possible, to Half or Quarter of a Degree or Hour of Time, 'tis as much as any reasonable Man expects ; and no Professor of Geography who knows what he is about will pretend to more.

Diodorus Siculus tells us, the Invention and Use of *Globes* was first discovered by *Atlas*, King of *Libya* in ancient Times ; others attribute the Invention to *Thales*, and that it was afterwards perfected by *Crates*, *Archimedes* and *Proclus*, but principally by *Ptolomy* ; they were very uncouth in their primitive State, and even in the Time so late as *Gemma Frisius*, and *Gerardus Mercator*, as appears by those published at *London*, *Anno* 1593, and by *Bleau*, the *French King's* Geographer, which are still in being. And I judge it quite needless to say that *Globes* are now well known

known to have received their last Perfection in Point of Elegance and Beauty, as well as Correctness and Use by the peculiar Skill and Ingenuity of the late Mr. *John Senex*, F. R. S.

Thus much for GLOBES. Let us now turn our Thoughts on *Planispheres*, which tho' vastly inferior to Globes, yet are of some Use in the Study of Geography, For by Reason of their easy Construction they come cheap, and may be purchased by almost any one, and especially by many ingenious Persons whose Fortunes will not command a Pair of Globes. 'Tis true they will not answer the Purposes of this Science in the best Manner, but still they are better than nothing at all. Projections of the Sphere will serve as a general Introduction to the Uses of the Globe, by preparing the Minds of Youth with some Notions of the *Circles* of the *Sphere*, Divisions of the Earth into *Zones* and *Climates*; the *Latitude* and *Longitude* of Places; and the Solutions of many entertaining *geographical* and *astronomical* Problems, but in a Manner that is rather artificial than natural, however it will bring us as near the Truth as is necessary; and if the *Medal of Gold* be not in our Power, we must be content with its *Impression*.

But with respect to *Planispheres*, there are different Kinds, as the Globe is projected on the Plane of the *Meridian*, *Horizon*, *Equator*,
Eclip-

Ecliptic, &c. according to the Rules I have formerly given in my *Young Trigonometer's Guide*, Vol. II. The first of these, *viz.*, that of the *Meridian* is of principal Use for geographical Purposes, and which at present we shall consider and explain.

This Projection is either *Orthographical* or *Stereographical*. The *Orthographic Projection* is made by parallel Rays, or the Circles of the Sphere are referred to a Plane by the Eye at an infinite Distance ; but as this Projection is useful only in *Astronomy*, and there principally in *Solar Eclipses*, I shall say no more of it here.

The *Stereographic Projection* on the Plane of the Meridian is of two Forms ; one resulting from the Eye being supposed on the Surface of the Globe in the Pole of the primitive ; and the other from the Position of the Eye at some Distance from the Globe in the Axis passing through the Poles of the primitive Circle or Meridian,

The first is the *Common Stereographic Projection*, on which all our *Maps* or *Planispheres* have been made from the Beginning ; as the Contrivance is arbitrary, and without Reason, so the Construction is unnatural and dissimilar throughout ; and consequently the Uses of it (in conveying the first Notions of Geography to the Minds of Youth) cannot but be looked upon as preposterous, fallacious and absurd: For the *Meridians* as well

well as *Parallels* are here projected at unequal Distances in every Part, therefore the Representations of the Land and Water must be very unjust, and their true Forms and Proportions utterly destroyed and lost *. How it was possible for such a vicious and distorted Construction of Maps to maintain its Ground so long in the World is to me an unaccountable Thing. I have ever reflected on it as the greatest *Opprobrium* to the Science of Geography, and have endeavoured all in my Power to expunge it, by placing another (more worthy the Regard of the Public) in the Room of it †. Of which we shall treat by and by.

To give an Instance of the *Enormity* of this Projection, I need only observe that 5 Degrees on the outside are equal to nearly 10 in the Middle, and consequently the Surface of any Country is four Times as large in the first Case, as in the last.

But, as though the Projection was not bad enough in itself, it has been made still worse for the Use of *English Students*, by not making the *first Meridian* pass through LONDON. This has been the general Fault of all the Map and Globe-Makers till lately. When a Map of the World is proposed to

† These were my Sentiments of it twenty Years ago, when I gave the Rules of this Projection in Vol. II. of my *Young Trigonometer's Guide*, Page 55, 56.

‡ See Vol. II. Page 482. of my *Philosophia Britannica*.

be made for any particular Nation, the *First Meridian* ought to pass through the capital City of that Country; to render it of easy and general Use; no Man skilled in Geography will doubt of this Truth; nor will any but those who have no Understanding in this Science chuse a Map of the World on such an unnatural and injudicious Construction. As this vulgar Projection is so faulty, it is no Wonder that several Attempts have been made to mend it from Time to Time, but with little Success, and in some Cases the *Remedy has been worse than the Disease*. The Point aimed at has been to imitate, or rather to mimic the *Rectification of Globes* for any Latitude indifferently; but former Success has shewn how little Merit there is in such a Performance, and whatever may be expected from it, there is still the least Hopes when it is applied to the common Stereographic Projection, or *Vulgar Planisphere*.

The first which I find endeavouring to *rectify the Planisphere* (as it may be called) for any Latitude, was *Gemma Frisius*, in what he calls his *Astrolabium Catholicum*, but this was chiefly intended for astronomical Purposes. After him Mr. *Blagrave* published his *Mathematical Jewel*, in which he proposes to improve the Projection for geographical Uses, by the Addition of what he calls the *Reet* and *Label*, or the *Lattice* and *Index*; but as he left it unfinished, it was afterwards

reassumed and compleated by Mr. *Palmer*, in the Year 1658, under the Title of the *Catholique Planisphere*, that is, in the modern Stile, the UNIVERSAL PLANISPHERE.

This Improvement (as they called it) consisted in the additional Apparatus of vertical or *azimuth Circles* and the *Almicanterbs* or Parallels to the Horizon; these he directed to be cut out of a Brass Plate, and then applied it moveable on the Center, over the Face of the subjacent Map, which he called the *Mater*. On the same Center he also adapted a Label or Index with Divisions, to render the whole more compleat.

But the great Expence and Trouble joined with the natural Imperfection of the Instrument after all, induced Mr. *Palmer* to wish for and think of some better Expedient for this Purpose than his *Brass Rect*. Accordingly, he directs it to be made of *Pastboard*, in which the Circles may be cut out with Ease; or else of *clear Lantborn Horn*, on which the said Circles might be drawn, if the Map be not too large; or lastly, says he, "If we had a *transparent Metal* much Labour might have been saved." It was impossible for him here not to think of *Glass*, but either its Brittleness or the Difficulty of drawing the Circles, and applying it on a Center, discouraged him from mentioning it for this Purpose.

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It was likewise highly improbable he should not also think of an OILED PAPER, as its Use for Window-lights, Drawing, &c. was very common; but since so judicious and learned a Man is wholly silent upon that Article, we must conclude he had very good Reason for it, convincing him it could by no means be fit for such a Purpose.

However, his Book falling into the Hands of an ingenious Gentleman of my Acquaintance, he resolved to give the OILED PAPER a fair Trial, and accordingly projected the Hemisphere, and applied his *oleaginous Apparatus* upon it, but found his Labour was all in vain, though his Curiosity was thoroughly satisfied without being at any *great Expence* for it. This was done by him *ten Years ago*, and he shewed me his Performance, which he still has by him.

By this short Story the Reader will be convinced there cannot be the least Novelty either in the *Title* or *Invention* of any modern Performance of this Kind: What Merit it may derive from the *Extreme Unction*, they have the best Right to judge who have tried the Experiment; from the Projection itself it can pretend to none at all, as we have shewn. We therefore take our Leave of this obsolete Piece of art, and proceed to examine one of a different Kind; *viz.* that Projection which approaches as near to the Nature and Form of a Globe as any thing

in Plano can do, and is deservedly stiled the **GLOBULAR PROJECTION**, after which we shall specify its Uses, and illustrate the same in a Solution of a great Variety of entertaining Problems by it, and an Apparatus which I have added thereto.

In this *New Projection* the *Meridians* (which are the principal Circles of all) are *equidistant* from each other, as on the Surface of the Globe itself; the *Parallels of Latitude* are nearly so too, but the Position, Form, and Proportion of the several Parts of the Earth's Surface are very little affected by these, and consequently a Map on the globular Projection is the best of all fitted for geographical Uses, and indeed can be exceeded only by the Globe itself.

Dr. LONG in his *Astronomy* (Page 155) speaking of this Projection, says, it was invented by Mr. *de la Hire*, and that it comes *the nearest of all to the Nature of the Globe, because the Meridians are therein set at equal Distances; the Parallels also are nearly equidistant*; the Doctor adds, *I see no good Reason why our Geographers do not make use of it, I fancy if the Doctor had said, the Geographers had all the Reason in the World to make use of it, no one would have thought he had in the least exceeded the Truth,*

Mr. *de la Caille* says, that according to M. *de la Hire*, the Distance of the Eye from the

the Plane of Projection is 1732 such Parts as the Radius of the Table contains 1000 ; but according to M. *Parent* it is distant only 1595 of such Parts. But neither of these Numbers will rightly assign the Distance of the Eye, as I shall demonstrate in another Place. However, the Meridians and Parallels are all circular Arches, and drawn by the common Rules of Geometry. As this is the only RATIONAL and GENUINE PROJECTION of the *terraqeous Globe*, I think it well deserves to be considered how far it is capable of being improved; at present I only propose to do it in the following Particulars; *viz.*

First, The *General* or FIRST MERIDIAN passes through *London*, as it ought to do to make what relates to the Longitude of Places, considered either in Motion or Time, natural in itself and easy in Practice ; especially as this is an Article of the greatest Importance, and neglected in common Planispheres or Maps.

Secondly; The MERIDIANS are drawn through every 15 Degrees of the Equator ; and by this Means represent the Hour-lines most exactly ; and the Intervals being divided in Halves and Quarters, it may be seen by a Glance of the Eye what the Difference of Time is between that of *London* and any other Place. For,

Thirdly; The HOURS for the Morning and Afternoon, are affixed to their respective Circles in each Hemisphere at the Bottom,
on

on the Parallel of 60 Degrees ; and thus perform the common Use of an *Hour-Circle* and *Index*.

Fourthly ; Between the Tropics is placed the Calendar, (as is usual in the *Orthographic Projection*) for readily finding the Sun's Place in the Ecliptic ; which Conveniency is not to be found in common Maps.

Fifthly ; The Horizon of *London* is properly drawn, and divided into Degrees for the Amplitude and Azimuth of the heavenly Bodies ; and the Points of the Compass for the Situation or Bearing of Places and the vertical Circles are drawn through the 8 Cardinal Points.

Sixthly ; The Parallel of 18 Degrees is drawn below the Horizon, to shew at one View all that relates to the *Crepusculum* or Twilight ; its Beginning and End ; when greatest or least ; when there is, or is no dark Night, &c.

Seventhly ; A QUADRANT OF ALTITUDE is added on the Side of each Hemisphere from *London* to the Horizon, by which the Altitude of the Sun or Planets may be nearly estimated for any given Hour of the Day.

Eighthly ; A SCALE of *English Statute Miles* is placed by each Hemisphere that the Distance of any Place from *London* may be seen ; it begins at *London* and extends to 7000 Miles.

Ninthly ; By Means of the HOUR-CIRCLES
and

and HORIZON, the Different Length of Days and Nights; Rising and Setting of the heavenly Bodies; the Vicissitudes of the Seasons, and other Things of this Kind, are rendered evident by Inspection.

Tenthly; These Hemispheres are adapted in Size to serve for *Hand FIRE-SCREENS*; in which Case a moveable Horizon is fitted upon the Handle, by which the Hemispheres may be rectified for any Latitude and so rendered of the most general Use.

Eleventhly; These Hemispheres used as a Print or *Map of the World*, have moreover added (1.) The SOLAR SYSTEM of all the primary Planets, and some Comets. (2.) The System of JUPITER and his four Moons in due Portion of Distance. (3.) The System of SATURN, his five Moons, and Ring in their true Proportion of Magnitude and Distance. (4) A natural View of the Cause of *Solar and Lunar Eclipses*, (5) A Diagram shewing the *Rationale of the Seasons of the Year* by the oblique and parallel Position of the Earth's Axis in its annual Revolution about the Sun.

Twelfthly; The moderate Price as well as the Plainness and Simplicity of every Part will recommend it to all young Students in Geography as a *proper Introduction to the Use of the Globes*; as there is nothing here but what is natural and easy to be understood will occasion no Fatigue to the Mind;

no Pain to the Eyes ; nor offensive *Emanations* to the most delicate System of *olfactory Nerves*.

The USE of the GLOBULAR PROJECTION.

GEOGRAPHICAL DEFINITIONS.

THE Terraqueous Globe consists of *Land* and *Water*. The Land is divided into the following Parts, *viz.*

I. A *Continent* is a large Tract of Land including many Countries and Kingdoms not any where separated by the Sea ; these are four, *Europe, Asia, Africa, and America*.

II. An *Isthmus* is a narrow Neck of Land joining a *Peninsula* to the *Continent*.

III. A *Peninsula* is a Part of Land almost surrounded by *Water*, and joined to the *Continent* by an *Isthmus*.

IV. An *Island* is a Part of the Globe that is entirely encompassed with *Water*, as *Britain, Madagascar, Borneo, &c.*

V. A *Promontory* is a Head or *Cape* of Land, which projects itself into the *Sea*, as the *Cape of Good Hope, Cape Horn, the Forelands, &c.*

VI. *Mountains*, higher Parts of Land well known.

The Waters of the Globe are divided into the following Parts, *viz.*

I. The *Ocean* is a vast Collection of *Water* that surrounds the *Continents, Islands, &c.*

II. The *Sea* is only a Part of the *Ocean* which lies between, and is nearly environed with *Land*.

III. A

III. A *Gulph* is a smaller Collection of Water communicating with the main Ocean or Sea.

IV. A *Strait* or Channel is that narrow Passage by which Waters of the Sea run into the Gulph.

V. A *Bay* is a large and capacious Inlet of Water, proper for Ships to anchor in, as *Tor-Bay*, &c.

VI. A *Lake* is a deep Collection of Water quite encompassed with Land, as that of *Geneva*.

VII. A *River* is a perpetual Current of Water, proceeding from some Fountain or Lake to the Sea.

The MAGNITUDE *of the* EARTH.

THE Figure of the Earth is nearly that of a Globe; a great Circle of which being divided into 360 Degrees, and each Degree being found to be $69\frac{1}{4}$ of *English* Miles, the Diameter of the Earth will be nearly 7964. The Circumference 25,020 Miles. The square Miles in its Surface will be 199,250,205 very nearly; and the solid Content 264466,789,170 Cubic Miles.

Of the MOTIONS *of the* EARTH.

I. **T**HE *Diurnal Motion* is that about its Axis in 24 Hours, Mean Time, which is at the Rate of $1042\frac{1}{2}$ Miles in an Hour.

E

II. The

II. The *Annual Motion* about the Sun which is at the Rate of 1000 Miles *per Minute*.

III. Its Motion about the *common Center of Gravity* between the Earth and Moon.

IV. The Retrograde Motion of its Axis about the Poles of the Ecliptic, at the Rate of one Degree in 72 Years.

Of CLIMATES.

A CLIMATE is such a Part of the Earth's Surface, contained between the two Parallels which makes one *half Hour's* Difference in the Length of a Day, of which there are 24 on each Side the Equator, to the Polar Circles. Between the Polar Circles and the Poles, there are reckoned six more Climates, wherein the Days increase by one *entire Month*. N. B. The Ancients allowed the Day to increase only $\frac{1}{4}$ of an Hour in a Climate.

Of LATITUDE and LONGITUDE.

I. **L** *Atitude* of a Place is the Distance thereof from the Equator, North or South, and estimated in the Degrees of the general Meridian. It is also equal to the Height of the Pole above the Horizon of the Place.

II. *Longitude* is the Distance of any Place, East or West, reckoned in the Degrees of the
the

the Equator from the first Meridian, which in this Map passes through the City of *London*.

ASTRONOMICAL DEFINITIONS.

I. **T**HE *Longitude* of the Sun or Star is the Distance from the Beginning of the Ecliptic or first Point of Aries, reckoned in Signs and Degrees of the Ecliptic.

II. The *Latitude* of a *Star* is its Distance from the Ecliptic, reckoned in a great Circle, passing through the Poles of the Ecliptic and the Star.

III. The *Declination* of the *Sun* or *Star* is its Distance from the Equinoctial Line, reckoned in Degrees of the Meridian.

IV. The *Equinoctial* is the same Circle in the Heavens as the *Equator* on the Earth; so called because when the Sun is in it, it makes equal Day and Night.

V. *Right Ascension* is that Point of the Equinoctial that comes to the Meridian with the Sun or Star.

VI. *Oblique Ascension* is that Point of the Ecliptic that rises with the Sun or Star.

VII. *Ascensional Difference* is the Number of Degrees between the Right and Oblique Ascension.

VIII. The *Altitude* of the *Sun* or *Star* is its Height above the Horizon measured in Degrees.

IX. The *Quadrant of Altitude* is a thin Slip of Brass the $\frac{1}{4}$ of a Circle, fixed to the general Meridian, over the Place, and moveable to any Part of the Surface of the Globe.

X. The *Azimuth* is the Angle contained between the Quadrant of Altitude and the Meridian, reckoned in Degrees of the Horizon.

XI. The *Amplitude* is an Arch of the Horizon between the Prime Vertical and Quadrant of Altitude, laid over the Sun or Star, it is either north or south as the Sun or Star has north or south Declination.

XII. The *Zenith* is the Point in the Heavens, exactly over the Place of the Spectator, as the Nadir is the Point just opposite to it, and on the Earth it is called the *Antipodes*.

The GREAT CIRCLES of the SPHERE, on the PROJECTION.

I. THE *Equator* Æ Q . divides the Globe into two equal Parts, and is divided into 360 equal Parts or *Degrees of Longitude*.

II. The *Meridian* Æ N Q S . is a Circle dividing the Globe into the Eastern and Western Hemispheres, divided into 360 Parts or *Degrees of Latitude*.

III. The *Horizon* H O . is that great Circle which bounds our Sight or divides the Globe

Globe into the visible or invisible Hemispheres,
 IV. The *Ecliptic* E. C. is a great Circle, representing the Path of the Sun divided into 12 Parts called Signs, and each Sign is divided into 30 Degrees. This Line crosses the Equator in an Angle of 23 Degrees and a half.

V. *Azimuths*. These are Circles which are drawn through the Place of the Spectator Z. to the opposite Point of the *Globe* D. of which that which passes through the East and West Points of the *Horizon* is called the *Prime Vertical*.

The SMALL CIRCLES of the SPHERE.

The principal of these are the following.

I. **T**HE *Tropic of Cancer* E. F. parallel to the *Equator*, and touching the *Ecliptic* in the first Point of *Cancer*.

II. The *Tropic of Capricorn* G. C. parallel to the *Equator* on the South Side, and touching the first Point of *Capricorn*.

III. The *Arctic Circle* a. b. a Parallel $23\frac{1}{2}$ Degrees from the North Pole N.

IV. The *Antarctic Circle* c. d. at the same Distance from the South Pole of the World.

Of the POSITIONS of the SPHERE.

With respect to the Inhabitants of the Earth, the Sphere has three Positions. *viz.*

I. A

I. **A** *Right Sphere*, where all the *Parallels* are at right *Angles* to the *Horizon*, as under the *Equator*.

II. A *Parallel Sphere*, wherein the *Equator* becomes the *Horizon*; as to those who live under the *Poles*,

III. An *Oblique Sphere*, wherein all the *Parallels* of *Latitude* are oblique to the *Horizon*.

Of the FIVE ZONES.

I. **T**HAT Part of the Earth E. F. C. G. which lies between the two *Tropics* is called the *Torrid Zone*, because the *Inhabitants* thereof have twice in the *Year* the *Sun-beams* perpendicular, and at all *Times* nearly so.

II. The *North Temperate Zone*, between the *Tropic* and the *Arctic Circle*.

III. The *South Temperate Zone*, between the *Tropic* and the *Antarctic Circle*.

IV. The *Two Frigid Zones*, within the *Arctic* and *Antarctic Circles*.

Geographical and Astronomical PROBLEMS solved.

On the GLOBULAR PROJECTION.

Problem I. To find the LATITUDE of a PLACE.

IN Order to this, let the *Place* be observed in the *Map*, and carry your *Eye* parallel to the *Equator*, towards the left *Hand Side* of the
the

the Map, if it be in the Eastern *Hemisphere*, or towards the right Hand Side, if in the Western, and you will observe the Degree upon the *Meridian*. Thus *Pekin* in *China* will be found in the Parallel of 40 Degrees in one, and *Cape Horn* about $57\frac{1}{2}$ in the other.

Problem II. To find the LONGITUDE of a PLACE:

HA V I N G observed the Place in the *Map*, carry your Eye down from thence to the *Equator*, and you will easily see the Degree that corresponds to it. Thus the middle Part of *Madagascar* has 45 Degrees East *Longitude* from *London*, and *Jamaica* about $76\frac{1}{2}$ of West *Longitude*.

N. B. By this Method the Difference of *Latitude* and *Longitude* between any two Places becomes easily known.

Problem III. To find the PLACE in the MAP from the LATITUDE and LONGITUDE given.

A C C O R D I N G as the *Longitude* is East or West, you must look for the Place in the Eastern or Western *Hemisphere*.

Thus let the *Longitude* of the Island of *Ceylon* be 80 Degrees East of *London*, and 8 Degrees of North *Latitude*. Then cast your Eye on the given Degree of *Longitude*, and rising up to 8 Degrees of *Latitude*, you will there find the Isle of *Ceylon*.

Problem IV. To find the DISTANCE of any PLACE from LONDON in English Miles.

IN the Eastern Hemisphere on the Right-Hand of London above the Meridian is placed a Scale of 7000 English Miles. Then from any Place observed in the Map, you direct your Eye in a Parallel to the Horizon to that Scale of Miles, where you will see the Number expressing its Distance from London. Thus, *Pekin* will be found 5190 Miles from London.

Problem V. To find how any PLACE bears from LONDON.

THOSE that lie under the *Prime Vertical*, bear due East or West; those that bear North East and South East, or South West and North West will be seen under those Circles in each Hemisphere, and any other Place between being referred to the Horizon, the Point of the Compass will there be seen which shews its bearing from London, in either Hemisphere.

Problem VI. To find those PLACES which have the same LATITUDE and LONGITUDE with the GIVEN PLACE.

Observe the *Latitude* of the given Place and that Parallel of the *Equator* which passes

passes through it, lies over all those Places that have the same *Latitude* in each *Hemisphere*. And the *Meridian* passing through the given Place shews all the Places from Pole to Pole, which have the same *Longitude*.

Problem VII. To find the SUN'S PLACE in the ECLIPTIC for any given Day in the Year.

FIND the given Day in the Calendar by the Side of the Map, carry your Eye parallel to the *Equator*, till you meet with the *Ecliptic*, and where that *Parallel* crosses it will be the Place of the *Sun*. Thus for *May* the 8th, you will observe the *Parallel* crosses the *Ecliptic* in the 18th, Degree of *Taurus*, which is the *Sun's Place* in the *Ecliptic* for the given Day.

Problem VIII. To find the SUN'S DECLINATION for any given Day.

OBserve the Day of the Month in the Calendar on the Right-hand Side of the Eastern, or Left-hand Side of the Western Hemisphere, and by it in the Meridian is the Number of Degrees required. Thus, for Example, against the 8th of *May*, you find $17\frac{1}{2}$ Degrees for the *Sun's Declination*.

Problem IX. To find the SUN'S RIGHT ASCENSION for any given Day.

LET the given Day be the 8th of *May*. when the Sun's Place is in 18 Degrees of *Taurus*, observe in the Equinoctial what Degree is cut by the *Meridian* passing through the Sun's Place, which in this Case will be found to be $45^{\circ} 30'$, which shews the Distance in the Equinoctial from the first Point of *Aries*, or the Beginning of the Equinoctial.

Problem X. To find the SUN'S MERIDIAN ALTITUDE for any Day required.

LET the Day proposed be *May* the 8th, when the Sun's Place is found to be in the 18th Degree of *Taurus*, through the Sun's Place, carry your Eye in a Parallel to the *Horizon*, and it will give you the Number of Degrees on the graduated *Meridian* on the Side of the Map, above the *Horizon* H O, and that will be the Altitude of the Sun for that Day at Noon, as required.

Problem XI. To find the AMPLITUDE of the SUN at RISING or SETTING.

LET it be required to find the *Amplitude* at Sun-set for the 8th Day of *May*, observe the Parallel to the Equator which passeth

passeth thro' the Sun's Place in the 18th Degree of *Taurus*; and where it intersects the Horizon will be the Amplitude required, which in the present Case will be in $27^{\circ} 20'$ from the West towards the North.

Problem XII. To find the Time of SUN-RISING or SETTING on any given Day.

LET the given Day be the 8th of *May*, the Amplitude of the Sun at Setting was found to be $27^{\circ} 20'$, observe what Meridian passes through that Point of the Horizon, and it will give the Hour of its Setting, which will be nearly half an Hour after VII. consequently the Time of its Rising will be half an Hour before V.

Problem XIII. To find the BEGINNING and END of TWILIGHT for any given Day.

AT 18 Degrees below the Horizon in each Hemisphere is drawn the Parallel P L. The *Twilight* begins when the Sun is set in the Horizon, and ends when it comes to the Parallel P L. The Meridian, therefore, which passes through that Point of the said Parallel, will shew the Hour of the Night when the *Twilight* ends, which, in the present Case, will be nearly XI o'Clock.

Problem XIV. To find the AZIMUTH of the SUN at any given Hour of the Day.

LET the *Azimuth* be required for the 8th of *May* at 3 o'Clock in the Afternoon, make a Mark in the 3 o'Clock Meridian, where the Parallel of the Sun's Declination for that Day crosses it; through that Point imagine an *Azimuth* Circle to pass from the Zenith to the Horizon, and it will give the *Azimuth* from the South as required.

Problem XV. To find the ALTITUDE of the SUN above the Horizon at any given Hour of the Day.

LET the given Day and Hour be *May* 8th, at 3 in the Afternoon. Observe in the West Hemisphere where the Hour Circle of III intersects the Parallel of the Sun's Declination for that Day, from thence carry your Eye parallel to the Horizon, and on the Quadrant of *Altitude* by the Side of the Hemisphere, you will observe the Height required, *viz.* about 38 Degrees.

Problem XVI. To find those PLACES to which the SUN is VERTICAL on any given Day,

OBserve in each Hemisphere the Parallel of the Sun's Declination for that Day, for all the Places that lie under that Parallel

Parallel will have the Sun in the Zenith, and this will be twice in each Year at equal Distances from the Solstice, in the North or South Parts of the Torrid Zone.

Problem XVII. To find the HOUR at LONDON when it is NOON at any given Place.

LET the given Place be *Madagascar*; the Meridian which passeth through that Island is 45 Degrees East from *London*, and every 15 Degrees being equal to an Hour, shews that when it is XII o'Clock there, it is IX o'Clock at *London*, as shewn in the Hour Circle in the Parallel of 60 Degrees in the lower Part of the Map, and so for any other Place.

Problem XVIII. When it is XII o'Clock at LONDON, to find the Time at any other Place.

LET the given Place be *Japan* in the Eastern Hemisphere. The Meridian which passes through it is the 9th from *London*, which shews that it is then 9 o'Clock at Night in that Island.

In the Western Hemisphere the Meridian which passes by *Jamaica* is the 5th from *London*, which taken from 12, leaves VII for the Hour of the Morning there.

Pro-

Problem XIX. At any given HOUR of the Day at LONDON, to find all those Places where it is then NOON.

LET the given Hour be 9 o'Clock in the Morning; then observe what Parts of the Earth lie under the 9 o'Clock Hour Circle, for to all them it is at that Time NOON, as in *Madagascar, Arabia, Georgia, Muscovy, &c.*

Problem XX. For a given DAY and HOUR, to find the Place to which the SUN is then VERTICAL.

LET the given Time be *May 8th* at 7 o'Clock in the Morning. Then having found the Sun's Parallel for that Day, observe where the Hour Circle of 7 crosses it, which you will see is near the Coast of *Malabar, Eastward of Goa.* On the same Day the Sun is nearly vertical to *Jamaica,* a little after 5 in the Afternoon.

Problem XXI. To find the SPACE of TIME, during which there is no DARK NIGHT.

IT is evident by Inspection in either Hemisphere, that the Parallel of 20 Degrees North Declination of the Sun, just touches the Parallel P L of *Dark Night,* and therefore when the Sun's Declination exceeds 20 Degrees, there can be no *Dark Night,*

Night, and it is plain from the Calendar on the Side of the Map, that the Time will be from about the 22d of *May* to the 22d of *July* inclusive.

Problem XXII. To find in the NORTH FRIGID ZONE all those Places where the Sun begins to shine constantly without setting from the Equinox to the Summer Solstice.

Observe the Declination of the Sun for any given Day, then all those Places which are the same Number of Degrees distant from the Pole, are those required to be found.

These are the principal Problems that are solvable by the Hemispheres for the Latitude of LONDON; and when they are made into HAND FIRE-SCREENS, an *artificial* or *moveable* HORIZON is adapted to them in the Handle, and then many of those Problems are to be resolved for any other Place as well as *London*.

The SOLAR SYSTEM.

IN the Print between the Hemispheres I have given the young Student a View of the SOLAR SYSTEM, with some of the cometary Orbits, that he might have some Idea of the *Number, Order, and Disposition* of the PRIMARY PLANETS about the central SUN.
But

But as the System of the primary Planets must be very large to represent distinctly the proportional Magnitudes and Distances of the Planets from the Sun, we have here subjoined a Table for that Purpose, shewing the Diameter of each Planet in *English Miles*, also their Distances from the Sun in the same Measure; the Times of their Revolutions in Days, Hours, and Minutes, as here follow.

	Magnitudes	Distances	Period. Times
<i>Mercury</i>	2460	3200000	87 : 23 : 16
<i>Venus</i>	7906	5900000	224 : 16 : 49
<i>The Earth</i>	7960	8000000	365 : 6 : 9
<i>Mars</i>	4444	12300000	686 : 23 : 27
<i>Jupiter</i>	81000	42400000	4332 : 12 : 20
<i>Saturn</i>	68000	77700000	10759 : 6 : 36
<i>Moon</i>	2175	240000	27 : 7 : 43
<i>Sun</i>	822148	About its Axis	25 : 15 : 16

The JOVIAN SYSTEM.

IN the Right-Hand Corner of the Print at the Top, is represented the SYSTEM of JUPITER and his FOUR MOONS or *Satellites*, with their Orbits, in their real Proportion of Distance from JUPITER's Center, measured in Diameters of his Body; which are expressed in Numbers, together with the Times of their Revolutions, as in the following Table.

The

The Times of Revolution of JUPITER'S Sa-
tellites.

	D	H	'
1	1	18	27
2	3	13	13
3	7	3	42
4	16	16	32

The SATURNIAN SYSTEM.

SATURN'S System of 5 Moons, and wonderful *Ring*, is represented in the Left-hand Corner of the Print on the Top; and the Orbits of the Moons are drawn just in the same Proportion of Distance as in the Heavens they are found to have. The periodical Times in which they revolve about their Primary are as follow.

Satelites	D	H	'
1	1	21	18
2	2	17	41
3	4	12	25
4	15	22	41
5	79	7	16

Of SOLAR and LUNAR ECLIPSES.

WHAT relates to *Eclipses* is shewn in a Diagram at the Left hand Corner of the Print on the Bottom: The Eclipse of the Sun is occasioned by the Interposition of the new Moon between the Earth and the Sun; a small Part of the

G dark

dark Shadow falling on the Surface of the Earth *totally* eclipses the Sun from those Parts it passes over, which may extend to about 180 Miles. But there is a large *penumbral Shadow* (dotted in the Print) that covers a large Tract of about 9000 Miles, which causes only a *partial Eclipse* of the Sun, which is greater or less as you are near to or farther from the *dark Shadow*.

On the other Side of the Earth's Orbit, the Full is represented as passing through the Shadow of the Earth, and of Course being eclipsed; as the Diameter of the Shadow is near three Times as large as that of the Moon, a *Lunar Eclipse* if central, may sometimes last four Hours. I have not represented the *penumbral Shadow* of the Earth, as it has but little Effect on the Moon.

Of the SEASONS of the YEAR.

IN the Right-hand Corner at the Bottom is a natural Representation of the annual Motion of the Earth about the Sun, in such Manner that its Axis is always inclined to the Plane of its Motion, and always kept parallel to itself. By this means it is necessary that in one Part of the Orbit the North Pole should be turned towards the Sun, and the South Pole from it; and in the opposite Part of the Orbit the contrary happens. When the North Parts of the Earth are inclined

clined towards the Sun we receive his Beams more directly, in a greater Quantity, through a less Part of the Atmosphere, and in a longer Continuance above the Horizon; which Particulars together make this the hottest and most lightsome Season of the Year, which we call SUMMER; for contrary Reasons, in the opposite Part of the Orbit, it is WINTER with us. In the Parts between, the Seasons are *temperate*, one of which is called the SPRING, and the other opposite to it AUTUMN. Not only the *Seasons* but the *variable Length* of Days and Nights will be easily observed from the same Diagram, and may be pointed out to his Pupil by any intelligent Tutor.

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