



W. W. WARRINGTON'S DISSEMINATION OF THE GOSPEL







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S.T.C. 26021

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THE DESCRIPTION
and vse of the Sphære

Deuided into three principal
Partes :

W H E R E O F

The first intreateth especially of the
circles of the vppermost moueable Sphære,
and of the manifold vses of euey
one of them seuerally:

The second sheweth the plentifull
Vse of the vppermost Sphære, and
of the circles thereof ioynedly:

The third conteyneth the Descrip-
tion of the Orbes whereof the Sphæres
of the sunne and moone haue beene
supposed to be made, with their
motions and vses.

By EDWARD WRIGHT.

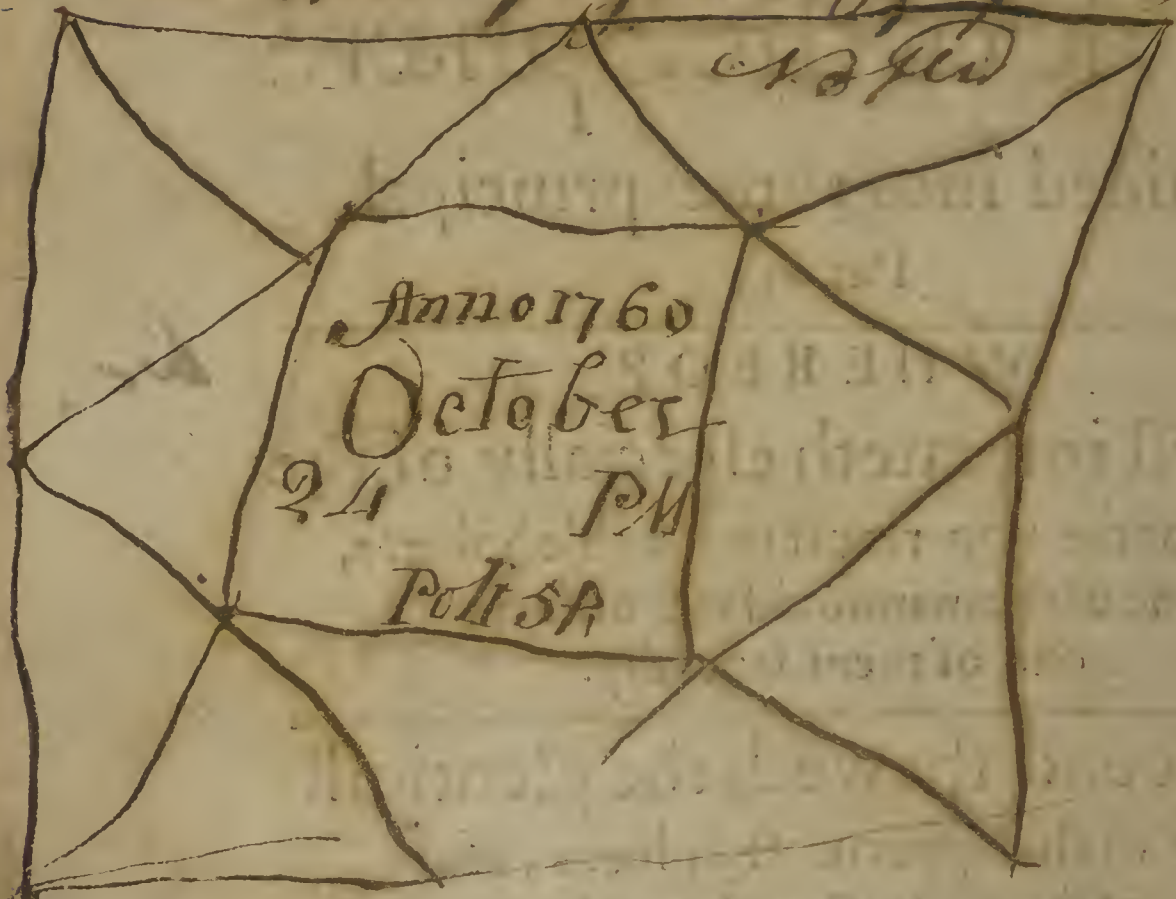
The contents of each Part are more particularly
set downe in the Table.



L O N D O N

Printed for *John Tap*; dwelling at *S. Magnus*
corner. 1613.

Asiologuical fragments
on the figure before



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Of the contents of this booke.

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**O f the circles of the vppermost
Sphære and their seuerall vses.**



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The third Part.

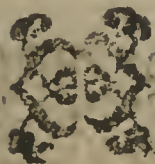
Of the Orbes wherof the Sphæres of the sunne and moone haue beene imagined to be made, and of their motions and vses.

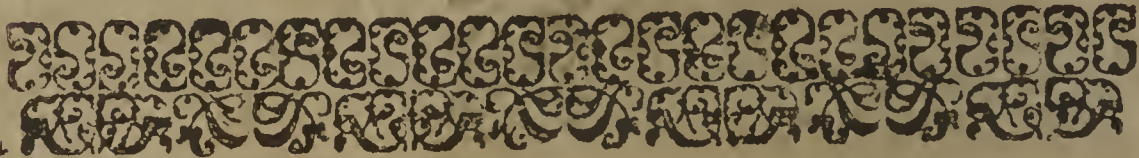
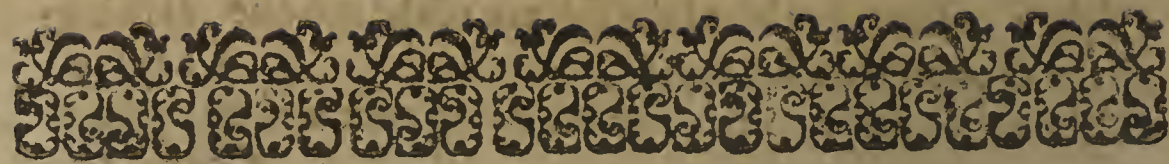


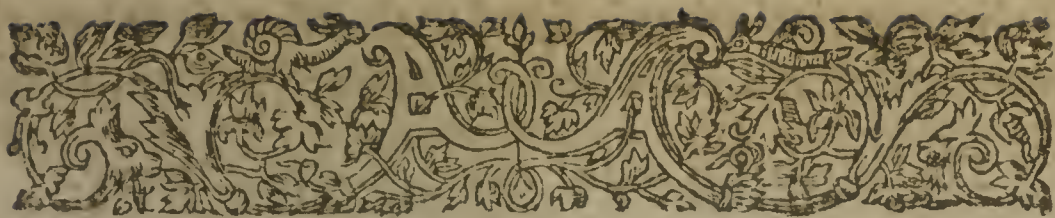
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Of the vse of the Sphære and
Globe. Part 1.

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The Description of the SPHÆRE
and GLOBE, Divided into three
principall parts.

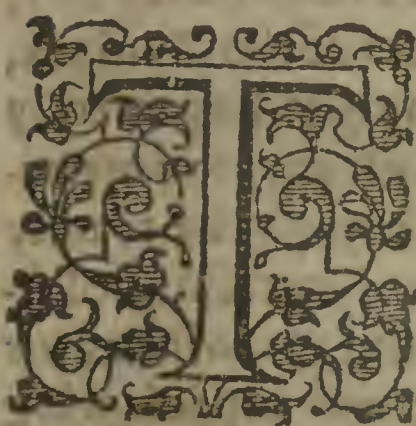
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Wherof this first intreateth specially of the circles
of the vppermost moueable Sphære and of
theyr peculiar vses.

The definition & diuision of this Sphære.

CHAP. I.



THIS SPHÆRE, IS NO-
thing else but a representation
of the Cœlestiall orbes and cir-
cles, that haue bene imagined
for the easier vnderstanding, ex-
pressing, & counting of the mo-
tions and apparences, eyther
common to the whole heauens, or proper to the
Sunne and Moone.

The circles of this Sphære are eyther immouea-
ble, as the two greatest and vtmost circles, the Ho-
rizon and Meridian, (whereto is adioyned the lit-

B

tle

the howre circle that is fixed to the Meridian) or els moueable; as all the rest conteyned within these.

The Description of the Horizon of this Sphere.

C H A P. 2.

TH E greatest and vtmost circle of this sphære that lyeth leuell on all sides from the ground, is called the Horizon, which is deuided into 7. limbs, or borders. The first and vtmost of them conteyneth the 32. points of the compasse, or the windes (as they are at this day deuided and vsed by sea-men) with their latine names adioyned vnto them. The second limb conteyneth the names & diuisions of the 12. windes as they were wont to bee deuided in ould time. The third is deuided into the moneths and dayes of the new Kalendar, first established by Pope Gregory the XIII. & now vsed in many places beyond the seas. In the fourth limbe are set downe the moneths and dayes of the ordinarie Kalendar vsed in England. Next within this, are placed the 12. signes & degrees of the Zodiack, that so the place of the Sunne might be presently knowne for any day of the yeare giuen, or contrariwise that the day of the moneth might be readily found by the place of the Sunne. After this, followeth the sixt limb conteyning the 32. windes or points of the compasse, with letters representing the names now in vse amongst English mariners. The seauenth & last limb next the innermost edge of the Horizon, is deuided into 360. degrees, with figures set to euery tenth degree, beginning from the points of east and west, & ending at north
and

And vse of the Sphære.

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and south, that so the number of any degree of the Horizon might be the easelier knowne: Which circle appeareth most playnly to them that are in a playne Champion cuntry, or vpon the sea, close by the water in a cleare calme day.

The vses of the Horizon.

CHAP. 3.

1. **I**T deuideth the vpper and visible part of the heauens from the nether halfe that is hidden out of our sight.

2. It sheweth partly the difference of a right & oblique Sphære, for when this circle and the æquinoctial, crosse each other at right angles, it is said to be a right Sphære; otherwise when they make oblique angles one with another, it is called an oblique Sphære.

3. In an oblique Sphære this circle seuereth those starres which neuer rise nor sett, but are alwayes eyther aboue or beneath the Horizon, from such starres as rise and set in euery 24 howres. For all the northerly starres that are no further distant from the north pole then the north pole is from the Horizon, do neuer set, but are alwayes aboue the Horizon: And contrariwise, those starres that be about the south pole, no further distant from it then it is from the Horizon, do neuer rise, but are alwayes hidden out of sight vnder the Horizon.

4. In respect of this circle, the Sunne, Moone & starres, or any other part or point of the heauens, are sayd to rise or set: For when they come vp from vnder the Horizon, they are said to rise; otherwise

when they goe from aboue the Horizon downe vnderneath the same, they are sayd to sett.

5. And hereof it commeth that the ascendent, & descendent are found by this circle: for that part of the ecliptick that is at the east part of the Horizon arising, is the Ascendent; & the point opposite to this at the West part of the Horizon, may be called the Descendent.

6. This circle partly sheweth the difference of ascension of any part or point of the heauens.

7. In this circle we reckon how farre the Sunne, the Moone, or any starre, or point of heauen, ariseth from the point of due East.

8. The horizon determineth the time of the artificiall day & night: for we call the time wherin the Sun abideth aboue the Horizon, an artificiall day: And the time that he continueth vnder the Horizon, is the artificiall night.

9. This circle sheweth the reason of the æqualitie of artificiall dayes and nights, in a right Sphære: and of the inæqualitie of them in an oblique Sphære. For in a right Sphære, the Horizon deuideth all the paralels of the Sunne or circles of the naturall dayes, into æquall parts: But in an oblique Sphære, it deuideth them into vnæquall parts.

10. By meanes of this circle, we knowe what starres, and what eclipses, coniunctions, or other aspects of the planets may be seene in our hemisphære at any time.

11. From the horizon is measured the twilight: For in the morning the sunne being vnder the horizon about 18. degrees of the vertical circle, the
twilight

And vse of the Sphære.

twilight beginneth: And when the sunne is so much vnder the horizon at euening, the twilight endeth.

12. This circle is of especiall vse in Geography, for from it we beginne to account the eleuation of the pole, and of the æquinoctiall circle, whereby the latitude of any place is knowne.

13. In Astrologie for erecting a figure, this circle sheweth the beginning of the first and seauenth houses.

The description of the Meridian of this Sphære.

CHAP. 4.

NEXT the horizon, succeeds the Meridian standing vpright on edge, & crossing the horizon at right angles in the points of North and South. This circle is deuided on both sides at the inner edg into 360. degrees; with figures set to euery tenth degree, beginning at the æquinoctiall, & ending at the poles with 90. and beginning also at the poles, & ending at the æquinoctiall with 90. The numbers beginning at the pole, serue to set the sphære readily to any eleuation desired. The other numbers beginning at the æquinoctiall, shew presently the declination of any degree of the zodiack, or of any point assigned in the sphære, One quarter of the Meridian on eyther side thereof from the æquinoctiall to both poles, sheweth the climates, and the quantities of the longest dayes.

The uses of the Meridian.

CHAP. 5.

1. **I**T devideth the world into two halves or hemisphæres: that is, the East and the West hemisphæres. The easterly hemisphære is all that part of the worlde which is on the East side of the Meridian, And the other halfe may be called the West hemisphære.

2. It sheweth the North and south parts of the worlde, for the two interfections of the Meridian with the horizon, shew the very points of North & south. The south point is that which is directly vnder the Sunne at noone: And the point right ouer against this, is called the North point.

3. It devideth the arches of the æquinoctial, & of all his paralels, into two æquall parts both aboue and beneath the horizon.

4. And therefore it devideth the artificial day and night into two æquall parts.

5. And consequently, it sheweth midday & midnight.

6. In an oblique sphære it serueth in stead of a right horizon (that is) an horizon that maketh right angles with the æquinoctiall.

7. Therefore the Astronomers beginne their account of times (which are measured by the æqual motion of the æquinoctial) from the Meridian: the principal of which times, is the naturall day which is vsually begunne from midday, or midnight.

8. This circle sheweth the highest and lowest heights

heights of the sunne and starres, which is most manifest in those starres that are alwayes aboue the horizon. These heights are called the Meridian altitudes of the sunne or stars, which heights are chiefly obserued by Astronomers and Nauigators with great diligence.

9. In this circle, we obserue the distance of the Tropickes, and the greatest obliquity of the Zodiack.

10. In this circle, we obserue and count the latitudes of places, the height of the pole, & of the æquinoctial. For the height of the pole or æquinoctial, is nothing els but the arch of the Meridian conteyned betweene the pole or æquinoctial and the horizon. The height of the pole is alwayes æqual to the latitude of the place. The height of the æquinoctial is æqual to the complement of the latitude, and therefore it being substracted out of 90. there shall remayne the height of the pole.

11. The Meridian sheweth the longitudes of places in Geographic.

12. In the Meridian, are measured the bredth of the zones and Climats.

13. This circle in Astrologie, sheweth the highest & lowest parts of heauen, which are the beginings of two principal howses: that is, the fourth and the tenth howses.

*The description of the howre circle, and poles, of
this Sphere.*

CHAP. 6.

THE little circle fastned to the Meridian, is called the howre circle, which is deuided into 24. æqual parts, signifying and representing vnto vs so many æqual howrs, wherof both the twelfth howrs are fixed iust vpon the Meridian, because when the sunne commeth to the meridian, it is iust twelue a clock: the vpper XII. serueth for the day; and the other XII. beneath serueth for the night.

The index, or the pointer in forme of an arrow, fastned vpon the pinne that commeth through the midst and center of this circle, is made to shew and point out the sayd howres as neede shall require, in the vse of the sphære.

The vse of this howre circle shal be shewed hereafter when we shal speake of the common vse of many circles of the sphære togither. And these two circles (that is, the Meridian and horizon) are called immoueable, because they keep themselves alwaies, and in all places ouer the same parts of the earth; where as all the rest (conteyned within these two) moue round about al togither with one motion in the space of fowre and twentie howres.

This motion (being common to the whole hea- uens) is made about two points or poles, represented in this sphære, by the two wyre pinnes about which the sphære is turned; whereof the one that commeth through the middest of the little circle fastned to the meridian (which we call the howre circle)

And vse of the Sphære.

circle) representeth vnto vs the pole arcticke or the north pole: the other because it is opposite to this, is called the antarctic pole, that is the right opposit, to, or right ouer against the north pole, which is also the south pole.

Of the Aequinoctial circle of this sphære.

CHAB. 7.

THAT circle which compasseth about the midst of the sphære, and is euery where of æquall distance from both poles, is called the æquinoctiall circle, or the æquator; eyther because it is æqually distant from both poles of the world; or els because the sun comming vnder this circle maketh æqualitie of dayes and nights through-out the world.

Why this circle is called the æquinoctial or æquator.

It is deuided at the vtmost edge, on both sides thereof into 360. degrees, with figures set to euery tenth-degree, beginning at the beginning of Aries, and proceeding eastwards, til you be come about to the same point againe.

This circle hath many vses.

1. It is the measure of the first motion. For this only amongst all the circles of the sphære is moued æqually both in a right & oblique sphære; because it alone being perpendicular to the axtree of the world, about which the sphære is æqually turned, is deuided into two halfes by euery horizon in the same points.

2. It is the measure of time; because it measu-
reth the quantitie of the artificial & natural dayes,
of which moneths and yeares are made: It measu-
reth also the quantity of howres and of other times

C

which

which the sunne maketh going vnder the zodiack. And therefore the degrees of the æquinoctial are called *tempora* (that is) times.

3. It sheweth the two æquinoctial points in the ecliptick, cutting the ecliptick in two places, which are the beginnings of Aries and Libra: and the sunne when he commeth to those two points, is æqually distant from both poles of the world, and maketh æquality of dayes and nights in all places; which hapneth in our time about the 10. or 11. day of March, and the 13. or 14. of September.

4. The irregularity of the zodiack, and of all the signes and degrees therof, is measured by this circle. For seeing the most part of the apparences of the first motiõ are referred to the zodiack, which is not turned about his owne poles, but about the poles of the sphere, and therefore must needes be vnæqually turned about; it was needful that this inæquality should be ruled and measured by some other æqual motion.

5. It deuideth the sphere into 2. halves (which they call hemisphæres) that is into the north half or hemisphere, wherein is the north pole, and into the south hemisphere, wherein is the south pole.

6. So it deuideth the zodiack into the north half, and the south half; or into the north signes, & the south signes.

7. From this circle are numbred the declinations of the starres, and of the degrees and partes of the ecliptick, and of any other point of Heauen.

8. And in this circle are counted the right ascen-

cen.

A circle of the ecliptick
 divided into 12 signes
 and 30 degrees
 with the equinoctial
 and the poles of the
 world

censions of the same degrees and starres &c. For the right ascension of any starre or point of the heavens, is nothing els but the arch of the æquinoctial circle conteyned betweene the beginning of Aries and the Meridian; the same starre or point being first brought vnder the Meridian.

9. In the æquinoctiall is counted the ascensional difference and the oblique ascension & descension of any point of heauen. And from the same circle is reckoned the distance of the sunne rising from the true east point. For the oblique ascension or descension is nothing els but the arch of the æquinoctial, conteyned betweene the beginning of Aries, and that point of the æquinoctial eastwards, which ariseth or setteth together with the starre or point that is giuen, in an oblique sphære. And the difference ascensional or descensional is nought els but the arch of the æquator; whereby the right & oblique ascension or descension of a starre, or any other point in heauen do differ each from other. The distance of the sunnes rising frõ the true East point (which in latine is called *amplitudo ortiva*) is the arch of the horizon conteyned betweene the æquinoctial and the parallel of the sunne; or his center when he riseth.

10. In Geographie we count the longitudes of places in this circle; and from it we reckon the latitudes, in the globe of the earth, and in maps, & sea charts. For the longitude of a place is nothing els but the arch of the æquinoctial circle contained betweene two meridians, whereof one goeth by the Canarie Ilands; and the other by the place that is

giuen. And the latitude of a place is the arch of a meridian conteyned betweene the æquinoctial, & the zenith of the place that was giuen.

In dialling this circle is of especial vse. For by meanes of it the spaces of the howres are deuided in all kindes of dialls; horizontal, erect, direct, declining, inclining, reclining, &c.

In Astrologie the twelue houses are set out by the æqual diuisions of this circle into twelue parts, according to the way deuised by *Regiomontanus*, which way is commonly called rational or reasonable. And this circle gouerneth the directions, whereby things to come are artificially foretould.

The description of the zodiack of this sphere.

CHAP. 8.

THe great broad circle that compasseth about the sphere obliquely, comming nearer the pole of the sphere in one place then in another, is called the zodiack.

Round about through the midst of this circle, is drawne the circumference commonly called the ecliptick line, diuiding the whole sphere, and the whole bredth of the zodiack throughout, into two æquall parts.

In this sphere there are represented vnto vs two ecliptick lines. The one may be called the middle, or fixed ecliptick, which keepeth alwayes the same distance or obliquitie from the æquinoctial. The other may be called the true or moueable ecliptick,

be-

because it maketh not alwayes the same angles of interfection with the æquator, but sometimes greater, sometimes lesse. For the greatest obliquity of the zodiack, which not long before *Ptolomees* time was obserued to be 23. degrees and 52. min. in *Copernicus* his time, was hardly found to exceed 23. degrees 28 min. according to his obseruation, and therefore he thought that the difference betweene the greatest and least obliquitie of the zodiack, was 24. minutes: and the middle or meane obliquitie between both these, to be 23. degrees 40 minutes.

The manner of the variation of this obliquitie may in some sort be shewed by this sphære, if we suppose the fixed ecliptick drawne round about through the midst of the zodiack to be 23. degrees 40 minut. distant from the æquinoctial at the beginning of Cancer and Capricorne: and the moueable ecliptick (fastned as it were vpon two poles at the beginning of Aries and Libra, and so hauing alwaies the same points of interfection with the middle ecliptick and æquinoctial) to be moued vp and downe aboue and beneath the middle ecliptick, by the space of 12. minutes at the beginning of Cancer and Capricorne; and this motion to finish his revolution once in 3432 Julian yeares.

The bredth of the zodiack is bounded by the greatest latitudes of the planetes, especially of Venus and Mars, which sometimes hath almost 7. degrees of latitude.

The zodiack is deuided by the æquinoctial into two semicircles.

The one aboue the æquinoctial is called the northerly semicircle the other half beneath the æquinoctial is the southern semicircle of the zodiak.

So long as the sunne moueth vnder the first of these semicircles, the dayes are longer then the nights, otherwise they are shorter.

Each of these semicircles is againe deuided into two parts, and so the whole zodiack into foure quarters: the first from Aries to Cancer may be called the vernal or spring quarter, which in this Sphære is also shewed by the word *Ver* (signifying the spring:) The next from Cancer to Libra, the summer quarter, wherein is written the word *Aestas* signifying the summer. The 3. from Librato Capricorne is the Haruest quarter, wherin you shal finde in this sphære the worde *Autumnus* which signifieth Autumne or Haruest. The fourth and the last from the beginning of Capricorne to Aries is called the winter quarter, which in this sphære is shewed by this worde *Hiems* which signifieth the winter. And these foure quarters of the zodiack are thus called by the names of the quarters of the yeare, because the sunne mouing vnder those quarters of the zodiacke, maketh those foure quarters of the yeare. Euery one of these quarters of the zodiack is againe deuided into three parts, and so the whole compasse of the zodiack into 12. which are called the 12. signes, whereof euery one conteyneth 30. degrees in length from West to East, & is in bredth æqual to the breadth of the zodiack. These signes, &
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the zodiack it self haue theyr beginning from that common meeting, or crossing of the ecliptick, and the æquinoctial, where the ecliptick beginneth to arise aboue the æquinoctial towards the north pole: and they are called by these names; *Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpio, Sagittarie, Capricorne, Aquarie, Pisces.* That is to say, The Ramme, The Bull, The Twinnes, The Crabb, the Lion, the Virgin, the Ballance, the Scorpion, the Shooter, the Goate, the Water-pourer, the Fishes. And they are signified by these characters ♈, ♉, ♊, ♋, ♌, ♍, ♎, ♏, ♐, ♑, ♒, ♓. This diuision of the zodiack into 12. signes and of euery signe into 30. degrees, nature it selfe seemeth to haue shewed by the motions of the sunne and moone. For in what time the sunne moueth once about the whole compasse of the zodiack, the moone maketh 12. revolutions through the same. Therefore as the time of a yeare is deuided into twelue moones, so the zodiacke is deuided into twelue signes: And as euery moneth conteyneth 30. dayes, so euery signe is deuided into 30. parts, which they call degrees, which signifieth as much as steps, because the Sun steppeth, or goeth forwards almost so much as a degree in euery day, from the West Eastwards vnder the Zodiack.

The Zodiack is otherwise also deuided into two semicircles, the one (from Capricorne to Cancer) ascending, because that so long as the sunne or any of the plantes are in that semicircle, they still ascend and rise higher and higher aboue the Horizon. The other semicircle of the zodiack, from Cancer to

Capricorne, is called descending, because the sun or planetes being in that semicircle, come downe euery day lower then other.

The twelue signes are by the Astrologians diuersely diuided, first into chiefe, meane, and common signes. The chief signes (which are also called Cardinall, that is the principal signes) are Aries, Cancer, Libra & Capricorne, because they come next after the principal points of the zodiack that is the two æquinoctiall points at the beginnings of Aries, and Libra; and the two solstitial points of Cancer and Capricorne. The meane signes (which are also called fixed) are Taurus, Leo, Scorpio, and Aquarius. They are called meane, because they are placed betweene the chiefe or principall, and the common signes. They are called fixed signes, because that when the sun is in those signes, we finde a more perfect temperature of the aire, then when he is in the other signes.

The common signes (which are also called double bodied) are Gemini, Virgo, Sagittarie, and Pisces. They are called common, because they take part of the nature of the fixed signes going before them, & of the Cardinall signes following after thẽ. They are called double bodied, by reason of their images, as they are imagined in the eight sphaere, which are compounded of two bodies: For there be two twinnes; and the virgin houldeth an eare of corne in her hand; Sagittarie is made of a man and an horse; and there are two fishes. The placing, and nature of these signes brought in this diuision.

The Astrologians also deuide the twelue signes into

into fowre trigons or triplicities, so called because they are distant the third part of a circle, one from another. The first triplicity containeth Aries, Leo, and Sagittarius; & is called the fiery trigon, or triplicity: The second triplicity conteyneth Taurus, Virgo, and Capricorne; and is called the earthly trigon. The third triplicity conteyneth Gemini Libra and Aquarius; & is called the ayrie trigon. The fourth triplicity conteyning, Cancer, Scorpio, & Pisces; is called the watric trigon. Nature it self is the cause of this diuision of the signes also. For into these trigons of the signes she hath distributed the coniunctions of the three superiour planets: especially the coniunctions of Saturne and Iupiter, which the Astrologians cal great coniunctions. For examples sake, if there be a great coniunction in Aries, the same shal be twenty yeares after in Sagittarie, and other twenty yeares after in Leo; & after as many more yeares, it returneth againe into Aries. The reuolution of one trigon conteyneth almost 200. yeares, after which time the same great coniunctions remoue into the next trigon.

The uses of the zodiack.

CHAP. 9.

1. **T**HE zodiack is the measure of the second motions, as the æquinoctiall is the measure of the first motion.

2. For in this circle we reckon the longitudes, and from it we count the latitudes of al the starres. For the longitude of a starre is nothing els but the arch of the ecliptick conteyned betweene the be-

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ginning of Aries, and the circle of the starres latitude. And the latitude is the Arch of a great circle, drawne by the poles of the ecliptyck, conteyned betweene the starre, and the ecliptick.

3. According to this circle, the whole Heauen, yea the whole world is deuided into twelue signes. Whereof it commeth that because of this circle, aswell the fixed, as the wandring starres which we cal planetes, yea and those starres also that appeare of a suddaine, as blasing starres or comets, and other meteors, are sayd to be in this or that signe; and that three manner of wayes.

First to be in a signe is to be vnder some one of the 12. parts of the ecliptick. Thus the starres which are vnder the ecliptick, but especially the sunne which runneth always vnder it, are sayd to be in the signes.

Secondly because the zodiack hath latitude, those starres are sayd to be in a signe, which although they be beside the Ecliptick, yet are vnder the zodiack, and so any of the other planets, which for the most part wander beside the ecliptick, may be sayd to be in some signe.

Thirdly, if we vnderstand six great circles to be drawne by the beginnings of the twelue signes, and by the poles of the ecliptick; by these circles the whole heauen (or rather the whole world) is deuided into twelue parts, which with a general name are called signes: Thus all the starres aswel fixed as planets and comets, which are without the zodiack in any of these parts, may be sayd to be in some signe.

4. In this circle are noted the degrees of the signes,

signes, with which the starres do rise & set, as well in a right as in an oblique sphære. For because this circle is the chiefest, all celestiall apparences (or at least the most part of them) are referred vnto it, & not vnto the æquinoctiall. But the æquinoctiall measureth the times of their risings and settings.

5. The obliquitie of the ecliptick is the cause of the inæqualitie, as well of naturall dayes in both Sphæres, as of artificiall dayes in an oblique sphære. For seeing it is moued vnæqually because it is moued vpon other poles then his owne, the Sun which is the author, and maker of times mouing vnder it, must needes make vnæquall dayes.

6. The chiefest times are defined by this circle, as the time of a yeare, by the motion of the Sunne; the time of a moneth by the motion of the Moone, through the whole compasse of this circle. Also the 4. quarters of the yeare, Spring, Sommer, Autumne, and Winter, whereto may be added *Plato* his great yeare, which is the time wherin the fixed starres make one reuolution about the axtree and poles of the zodiack, if God would haue the world to last so long.

7. The Eclipticke line sheweth the places, and times of the Eclipses: For the Sunne and Moone, are Eclipsed onely vnder it, or neare vnto it.

8. As the description of the Tropickes dependeth on the obliquitie of the Eclipticke, so the polar circles are described by the poles thereof.

9. Hereof it commeth, that by reason of the

same obliquitie, the zones & climates are set forth and bounded:

10. This circle is of especial vse in Astrologie, for it distinguisheth the points of the 12. howses, and in it the aspects and configurations of the planets are obserued: The chiefest iudgement aswel in casting figures as in reuolutions and directions is taken from this circle.

The description of the two Colures, together with the uses common to them both.

CHAP. 10.

THE two circles crossing each other at right angles in the poles of the Sphære, are called the Colures: whereof the one that passeth by the common meeting of the Ecliptick and æquinoctiall, is called *Colurus æquinoctiorum*, that is the æquinoctial colure, or the colure of æqual dayes & nights. The other passing by the poles of the ecliptyck, and the Solstitial points, is called *Colurus solstitiorum*, or the Solstitiall colure, or colure of the Sunne-standinges.

Vses common to both colures.

1. By meanes of these two colures, all the mouable circles of the materiall sphære are framed together, that so they might be turned about, like as the whole heauens are moued.

2. The poles are fastned in the common meeting of these two circles: and the poles are also shewed by the same common meetings.

3. They

3. They shew the 4. principal points of the Ecliptick; that is, the two æquinoctial, & the two Solstitial points.

4. These circles shew those pointes of the Ecliptick, wherein the sunne is eyther æqually distant from both poles of the sphære, or commeth nearest to cyther of them: In which pointes the Sunne maketh the dayes longest or shortest; or of a meane length betweene both these in an oblique sphære.

5. They deuide the Ecliptick into 4. quarters, in which the sunne maketh fowre quarters of the yeare, the Spring, the Summer, Autumne, and Winter.

6. They deuide the Ecliptick & æquinoctial into such fowre quarters, as in a right sphære doe rise together in æqual time.

Vses of the Eequinoctiall Colure.

CHAP. II.

1. **T**HE section of this circle with the eclipticke, sheweth the æquinoctial points, wherein the æquinoctial & the ecliptick do deuide and croffe each other. In which points the sunne maketh æquality of dayes and nights throughout the whole world: whereof this circle is also called *Colurus Aequinoctiorum*; that, is the colure of æqual dayes and nights, or the æquinoctiall colure.

2. It deuideth the Ecliptick into the north and south halfes.

3. It denieth the signes wherein the sunne maketh the days longer then the nights, from those signes wherein the dayes are made shorter then the nights.

4. It sheweth which halfes of the Ecliptick and æquator, do rise together in æqual time in an oblique sphære.

5. It sheweth the two high sun-standings, in a right sphære, in the time of which sun-standings, the sun passeth by the zenith.

Uses of the Solstitial Colure.

CHAP. 12.

1. **T**HE common meetings of this circle with the ecliptick, shew the solstitial or tropical points; in which points the sunne seemeth to stand, and then returneth back againe: for which cause this circle is called the Colure of the sun-standings. These points are called tropical (which is as much to say as turne-points, or points of returne) because that when the sunne going alwayes vnder the Ecliptick commeth to these points, which are furthest distant from the æquinoctiall circle, it returneth againe towards the same circle. But they were called Solstitial or Sun-standing points, because that whilest the Sunne is about those points, the difference of the sunnes returning is (for certayne dayes) insensible. Hereof the sunne is said to make his station, or to stand, when he commeth to eyther of those points. They that dwell without
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the tropicks, haue two sunnestandings, that is the summer sunstanding, or high sunstanding (when the sun in summer time is at the highest, & next vnto our zenith being in the beginning of Cancer) and the winterly, or low sunstanding, when the sun in winter time is lowest in the Meridian, and furthest from our zenith. But they that dwell within the tropickes (by a certayne similitude taken from our sunstandings, wherein the sunne is eyther highest or lowest) are sayd to haue fowre sunstandings; that is two high sunstandings, when the sunne passeth by their zenith (the highest point in the heauens) which hapneth twice euery yeare in two places, æqually distant from the beginnings of Cancer and Capricorne: and two low sunstandings, when the sunne is in the beginning of Cancer, and Capricorne.

2. In this circle by the arch conteyned between the æquator and Ecliptick, we measure the greatest declination of the sunne, or obliquity of the ecliptick, which in *Ptolemees* time was 23. degr. 51. min. and one third part of a minute. But euer since that time it hath beene found by obseruation to decrease; so as in this our age, it is no more then 23. degrees and one half, or little more: Notwithstanding *Copernicus* thought that the greatest obliquity was 23. degr. 28. minutes.

3. It sheweth the places of the Eclipticke, in which the sunne (comming nearest to our Zenith) maketh the artificial day longest; or going furthest from the same point, maketh the same shortest.

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4. It divideth the zodiack into two halves, the one ascending, and the other descending.

5. Hereby also the signes are distinguished, which doe rise rightly, and which rise obliquely in an oblique Sphære. For the descending half riseth rightly, and the ascending halfe riseth obliquely.

6. So the points of the ecliptick are shewed by this circle, wherein the greatest difference of right & oblique ascensions happeneth. It distinguisheth those signes in which when the sunne moueth, the artificial dayes are increased and the nightes decrease; from those signes wherein the dayes are diminished, and the nights increase.

7. In this circle are the bredths of the zones bounded; for the obliquity of the eliptick doubled, sheweth the bredth of the torride or burnt zone: the distance of the poles of the ecliptick, and of the poles of the æquator, shew the bredth of the cold or frozen zones; and the other two arches remaining, shew the bredthes of the temperate zones.

The Description of the two Tropicks.

CHAP. 13.

THe two smaller circles æquidistant in all places from the æquinoctial, & comming vnder these solstitial points of the eliptick on both sides, are called the tropicks, that is circles of returne.

And they are so called, because that when the sunne commeth to them, it beginneth to returne
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back againe towards the æquinoctial circle. Or els they may be so called, because they are described by the turning about of the Tropical points of Cancer and Capricorne. They are also called solstitial circles; that is circles of the sunstandings; because that by reason of the insensible alteration of the declination of the ecliptick, for some space both before, and after the tropical points, the sunne (in respect of his Meridian altitudes, or in respect of the motion he hath towards the north or south, by reason of the obliquity of the Ecliptick) seemeth to stand (as it were) for certaine dayes in those places.

There be two tropicks, the tropick of Cancer, & the tropick of Capricorne.

The tropick of Cancer, toucheth the Ecliptick in the beginning of Cancer, which is the most northerly point of the Ecliptick: or it is the tropick described in the first moueable sphære, by the summer solstitial point.

This circle is called the tropick of Cancer, because it toucheth the ecliptick in the beginning of Cancer.

It is also called the summer Tropick, and the tropick of the summer sunstanding, because that when the sunne commeth to it, the summer beginneth. It is called the north tropick, because it is in the north part of the world: and the circle of the high sunnestanding, because the sunne coming to it, is highest in the meridian, and next vnto our zenith which dwell in the north part of the world, without the Tropicks. The Tropick of Capricorne is the Tropick which toucheth the Ecliptick in the

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first point of Capricorne. It is called the tropick of Capricorne, because it toucheth the Ecliptick in the beginning of Capricorne. It is called the winter tropick and tropick of the winter sunstanding, because the sunne commeth to it in winter.

It is also called the circle of the lowest sunstanding, because that when the Sunne commeth to this Tropicke, it is furthest distant from our zenith, and hath his lowest height in the Meridian.

Uses of the Tropickes.

CHAP. 14.

1. **T**He tropicks shew the tropical, or solstitiall points of the Ecliptick: that is, the points wherein the sun seemeth to stand, & beginneth to returne back againe.
2. They bound out the greatest declinations of the sun, which in our time is about 23. degrees and an halfe.
3. Therefore they do also bound out the obliquity of the Ecliptick, for they are the boundes of the sunnes way, beyond which the sun goeth not at any tyme.
4. The sun comming to eyther of these circles, is eyther nearest, or furthest distant from our vertical point.
5. In an oblique sphaere, they measure out the shortest, and longest artificiall day and night.
6. The tropicks (aswell in heauen as in earth,

conteyne betwixt them the Torride zone, & separate it from the temperate.

The Polar Circles.

CHAP. 15.

THe two smallest circles that are next about the poles of the sphære, are called the polar circles.

They are drawne by the poles of the Ecliptick, and are euery where æquidistant from the æquinoctial, and from the poles of the sphære.

They are called polar circles, either because they are neare the poles of the sphære, or els because they are described by the motion of the poles of the ecliptick.

And therefore there be two polar circles, that is, so many as there are poles of the Ecliptick: the Polar circle Arctick, and the Polar Antartick.

The arctick polar circle, is that which passeth by the North pole of the ecliptick, or which is described by the North pole of the Ecliptick being caried about with the motion of the first mouable sphære.

The antarctick polar circle, is that which goeth by the South pole of the ecliptick, being described with the first motion by the antarctick pole of the Ecliptick.

The distance of these polar circles from the poles of the sphære, is æqual to the distãce of the tropicks from the æquinoctiall, which in our time is about 23. degr. and an half: for so much as is the obliquity of the zodiack (wherto the distance of the tropicks from the æquinoctial is alwayes æqual) so much are

the poles of the ecliptick distant from the poles of the world.

Uses of the Polar Circles.

CHAP. 16.

1. **T**He polar circles shew the poles of the zodiac, and shew theyr distance from the poles of the æquinoctiall.

2. The temperate zones are bounded by these polar circles; for the arctick circle boundeth the North side of the North temperate zone; and the antarctick circle boundeth out the South side of the South temperate zone.

3. The polar circles separate the temperate zones, from the cold zones, which they compass round about, and inclose within them.

Therefore the 4. lesser circles, that is the two polar circles, and the tropickes, deuide heauen & earth, into five zones.

Of the Zones.

CH. 17.

A Zone is a space of heauen, or earth, conteyned betweene two of the smaller Circles; or inclosed within the compasse of eyther polar circle.

They are called zones (that is as much to say as girdles) because they compass about heauen, or earth like a girdle.

The zones are deuided by auncient writers into

two

two kindes; that is into temperate, & vntemperate zones.

A temperate zone is the space of heauen or earth, conteyned betweene eyther of the tropicks, & the next polar circle.

There be two temperate zones; the one North, the other South.

The North temperate zone is conteyned betweene the tropicke of Cancer, & the arctick polar circle.

The south temperate zone is that which is conteyned betweene the tropick of Capricorne, & the antarctick polar circle.

They are called temperate zones, because they haue a better temperature of the ayre for the most part, and more meet for habitation, then the vntemperate zones. The bredth of eyther temperate zone is alwayes æqual to the complement of the distance of the tropicks, & therefore in this age is about 43 degrees, that is 2580. english miles.

There be two kinde of vntemperate zones, the one exceeding in heat, the other in could, for the most part.

The hot vntemperate zone, (called also the Torride; that is, the burnt or broyled zone) is that space of heauen or earth, which is conteyned betweene the tropicks.

It is called the burnt zone, because that by reason of the sunnes continual going ouer that zone, and casting his beams directly downe thereupon, it is scorched with ouermuch heat, & is not so meete to be inhabited as the temperate zones.

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The bredth of this zone is alwayes æqual to the obliquitie of the zodiack, or greatest declination of the sun, doubled; which in our time is about 47. degrees, that is 2820. english miles.

The could or frozen zones, are the spaces of heauen or earth, conteyned within the polar circles.

There be two could zones, the one North, conteyned within the compasse of the Arctick circle: the other south, conteyned within the compasse of the antarctik polar circle.

These zones exceed in could, because they want the sight of the sun for a great part of the yeare, & when the sunne appeareth vnto them, his beams fall so obliquely vpon them, that they can (in al likely hood) receyue but smal heat thereby for the most part.

The bredth of these zones is measured from the poles of the world to the polar circles, and therefore must alwaies be so much as the polar circles are distant from the poles: that is, in our age about 23. degrees and an half, which make 1410. English miles.



The difference of shadowes that the sunne
maketh in these zones.

CHAP. 18.

They that dwell in the torride zone, doe cast
theyr shadowes which the sunne maketh at
noone (which we may therefore call theyr noone
shadowes) both towards the North, & towards
the South: towards the North, when the sunne is
betwixt theyr zenith and the south point of the
Horizon; and towards the South, where the sun is
betweene theyr zenith and the North.

For seeing the zenith of them that dwell in that
zone is betweene the tropicks, the Sun must needs
be sometime North-wards from their zenith, and
so make a south shadowe: and sometime South-
wards, and then make a north shadow. For which
cause they that inhabite this zone are called *Am-
phiscij*; that is, such as cast theyr noone shadowes
on both sides.

But they that dwell in the temperate zones,
are called *Heterosij*; that is, such as cast theyr
shadowes at noone, one way onely. For they
that dwell in the North temperate zone, haue
the sunne allwayes at noone from theyr zenith
South-wardes, and therefore must needes all-
wayes cast theyr noone shadowes North-
wardes. Whereas contrariwyle they that inha-
bit the south temperate zone, hauing the sunne
at noone alwayes north-wardes from theyr zenith,
must

must needes haue their shadowes at noone, al-
wayes towards the south.

And they that are in the could zones, are cal-
led *Periscij*; that is, such as cast theyr shadowes
round about them. For seeing the sunne conti-
nueth euery yeare for certayne dayes together,
alwayes aboue theyr Horizon, and therefore mo-
ueth round about them without setting: it
must needes be that theyr shadowes
also are caried round about them,
falling towards al parts of the
world in the space of
24. howres.

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The second Part.

Of the uses of the vppermost
 SPHAERE, and of the circles
 thereof ioyntly.

To rectifie the sphere; that is, to sett the sphere
 to the latitude of that place for
 which you would vse it.

PROP. I.

FIRST finde by obseruation, or
 otherwise the height of the
 pole, or latitude of that place
 for which you would rectify the
 sphere: Then (by turning about
 the Meridian of the sphere, lift
 vp or put downe the north pole
 of the sphere (about which the
 howre circle is fastned) til the arch of the Meridian
 from the north part of the Horizon vpwards vnto
 the pole, be iust so many degrees as the eleuation

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of the pole or latitude of the place was founde to be : for so haue you the sphaere duely rectified.

As for example, the latitude of the City of London is 51. degrees and 32. minutes, therefore if you lift vp the North pole of the sphaere, aboue the North part of the Horizon, so many degrees & minutes you shal haue your sphaere rectified for that place.

To know the place of the Sunne (that is, the point of the Ecliptick in which the center of the Sunne is) any time by this Sphaere.

Looke the day of the moneth (for which you desire to know the place of the sunne) in the Horizon, and see what signe and degree of the zodiack vpon the Horizon answereth therto; for there haue you the place of the sunne.

Take for example the 25. of December: looke this day therefore in the Horizon, and you shal find answerable thereto 13. degrees, and about 40. min. of Capricorne, which is the place of the sunne at that time.

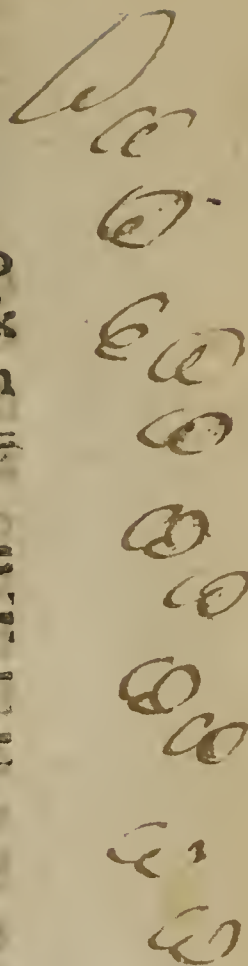
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To know the declination of the Sunne, or of any point of the Eclipticke.

PROP. 3.

Bring the point whose declination you desire to know, vnto the Meridian of the Sphære; & look what number of degrees & minutes of the meridian is conteyned betweene that point and the æquinoctial, for so much is the declination.

As if you would know the declination of the 10. degree of Taurus, bring that degree to the Meridian & you shall finde the arch of the meridian betweene that degree & the æquinoctial, to be 14. degrees and about 51. min.



To know the right ascension of the sunne or of any point of the zodiack.

PROP. 4.

Bring that point (as before) to the Meridian, & see then how many degrees and minutes of the æquinoctial are conteyned betweene the beginning of Aries and the Meridian: for that is the right ascension of that point. So you shall finde the right ascension of the 10. degr. of Taurus to be 37. degr. 35 min: for if you bring that degree of Taurus to the Meridian, you shall finde so many degrees and min. betweene the beginning of Aries, and the meridian.

*To know the oblique ascension of the Sunne or of
any starre or point in the zodiack.*

PROP. 5.

SETT the sphære to the eleuation of the place for which you desire to know the oblique ascension; then bring the sunne, starre, or point whose oblique ascension you would know, vnto the east semicircle of the Horizon, and looke how many degrees and minutes of the æquinoctial circle, are conteyned betweene the East point of the Horizon, and the beginning of Aries; for so much is the oblique ascension desired: As for exāple, if you set the sphære to the latitude of London 51. deg. 32. min. and then bring the 10. degree of Taurus to the East part of the Horizon, you shal finde about 19. degrees & an half of the æquinoctial, at the same East part of the Horizon; which is the oblique ascension of that degree of Taurus, for the latitude of the cittie of London.

To finde the differrence of Ascension.

PROP. 6.

COMPARE the right and oblique ascensions of the sunne, (or of any point of the zodiack) together, and subtract the lesse from the greater, for the remainder shal be the difference of ascension. As for example, the right ascension of the 10. degr. of Taurus, being found by the 4. prop. to be 37. degree 35. min. and the oblique ascension of the same degr.

degree at London, by the 5. Prop. 19. degree 30. min. by subtraction of the lesse out of the greater, the difference shalbe found to be 18. degr. and 5. min. which is the difference of ascension sought for.

*To finde at what time the Sunne riseth
or setteth.*

PROP. 7.

REduce the difference of Ascension into howres and minutes (taking for euery 15. degrees 1. howre, and for euery one degree that remayneth 4. minutes, and for euery minute of a degree 4. seconds) for these howres, minuts & seconds, being added to 6. howres, if the sunne be in any of the South signes; or subtracted, if he be in the North signes, sheweth the tyme of the sun-rising. And contrariwyse, the same howres and minutes subtracted from six howres when the sunne is in the South - signes, or added when he is in the North signes, sheweth the time of the sun-setting.

As for example the Sunne being in the 10. deg. of *Taurus* (which happeneth about the 20. or 21. day of April) I would know at what howre & minute the Sunne riseth, and setteth at London: Having therefore found by the former proposition the difference of ascension to be 18. degr. and 5. minutes. I take for 15. degrees therof one howre, & for the three degr. remaying, 12. minutes of an howre, & for the 5. minutes, 20 seconds of an howre. Which howre, minutes and seconds being subtracted out

of 6. howres, because the sunne is in a North signe, there remayneth the time of the sunnes rising at 4 a clock 47. minutes, 40 seconds. And adding the same howre, min. and seconds to 6 howres, you haue the time of the sun setting that day at 7. a clock 12 min. & 20 seconds.

*To finde the length of the artificiall day
or night.*

PROP. 8.

The artificiall day, is the time conteyned between the sunne-rising and the sunne-setting: and the artificiall night is the time betweene sun-setting & sun-rising. The length of both these is found after this manner: hauing found the difference of ascension, and reduced it into howres and minutes (as in the former proposition) double those howres & minutes, and add them to 12 howres if the sunne be in the North signes, or subtract them from 12. howres if the sunne be in the south signes, for so shal you haue the length of the day: But (contrariwyse) subtract the same howres & minutes (being doubled) from 12. howres, the sun being in the north signes; and add them to 12. howres when he is in the south-signes; so haue you the length of the night.

Or els, double the time of the sun setting, so haue you the length of the day. And double the time of the sunne-rising, so haue you the length of the night.

As the time of the sun-rising being found by the former proposition to be 4 howres 48 minutes after midnight at London, the sunne being in the 10 degr. of *Taurus*, by doubling the time of the sun-rising, the length of the night shal be found to be 9 howres and 36 minutes. And doubling the time of the sun-setting, that is 7 howres, twelue minutes, you haue the length of the day 14. howres, & 24. minutes.

To know the time of the sunne-rising and sun-setting otherwise by the Sphære.

THIS place of the figure being found by the 2. proposition, bring the same to the Meridian, and withall set the point of the index of the howre circle, to the 12 howre in the same circle: Then bring the place of the sunne to the Horizon east-wardes; and the point of the howre index shall shew you in the howre circle, the time of the sun-rising. But if you bring the place of the Sun to the horizon west-wards, the point of the index wil shew in the howre circle the time of the sunne-setting.

As for example, the sunne being in the 10 degr. of *Taurus*, bring the same degree to the Meridian, and bring the point of the howre index also to the meridian: then (the Sphære being set to the latitude of London) bring the same 10 degr. of *Taurus* to the east part of the horizon, for then the howre index will shew you in the howre circle, that the sunne

sunne

sunne riseth at 4 of the clock and 48 minutes.

And bringing the same degree to the West semicircle of the Horizon, the same Index will shew the time of the Sun-setting to be 7 howres and 12. min. after noone.

*To finde the length of the artificiall day or night
otherwise by the Sphere.*

PROP. IO.

BRing the place of the sun (being found as before to the East semicircle of the Horizon: sett the howre index to 12 a clock in the howre circle: turne about the sphere from the East, Westwards, till the place of the sun come to the Horizon, & mark how many howres the index hath runne ouer vpon the howre circle in the meane time, for so much is the length of the day.

And to finde the length of the night: Bring the place of the sunne to the West semicircle of the Horizon, and set the index to 12 a clock as before; Then turning forwards the sphere from East Westwarde til the place of the sunne come to the East semicircle of the Horizon; see how many howres the index passeth ouer in the howre circle, for so many howres long is the night.

As for example; supposing the sunne to be as before in the 10 degr. of *Taurus*, bring the same degree to the East part of the Horizon, and the point of the index to the meridian; then turning about the sphere, till the same degree come to the West part of the horizon; you shall finde that in the
meane

meane time, the point of the Index shall passe ouer 14 howres and 24 min. which is the length of the day. Likewise, if you bring the same 10 degree of *TAURUS* to the west part of the horizon, and the index to the meridian, and turne about the sphære, til that degree come to the east semicirle of the horizon, the number of howres that the index runneth ouer in the meane time vpon the howre circle, shall be founde to be nine degrees, and 36. minutes.

*To know the meridian altitude, or the height of
the Sunne at noone for any time and
place (whose latitude
is knowne)*

P R O P . II .

SET the sphære to the latitude of the place where you desire to know the sunnes height at noone: bring the place of the sunne (being found as before by the 2 Prop.) to the meridian, then see how many degrees of the meridian, are conteyned betweene the horizon, and the place of the sun, for so much is the height of the Sunne at noone.

In like sorte it may be knowne how much the sunne is vnder the horizon at midnight, after this manner: Bring the place of the sunne in the zodiack to the meridian vnder the horizon, and see how many degrees of the meridian, are conteyned betweene the vpper side of the horizon, and the place of the sunne downwards: and so shal you haue that you sought for.

G

Or

Or els if you cannot well come to the Meridian vnder the horizon : Bring that point of the ecliptick which is opposite to the place of the sun, vnto the Meridian aboue the horizon ; for the arch of the meridian , or the number of degrees and minutes of the meridian , betweene that point and the horizon sheweth how much the sunne is vnder the horizon at midnight.

After this manner, the sunne being in the 10. of *Taurus*, you shall finde that his Meridian altitude at London is fifty three degrees, and about one halfe.

As also that he is vnder the horizon at midnight about 23 degrees and a halfe at London.

*To know how high the Sunne is aboue the
Horizon at any time of the day.*

PROP. 12.

BRing the place of the sun (found by the 2 Prop.) to the Meridian : set the howre index to 12. a clock vpon the howre circle : turne the sphaere about till the index come to the howre at which you desire to know the height of the sunne aboue the horizon ; take the distance of the place of the sun from the horizon with a large payre of compasses : then set both feet of the compasses in the ecliptick , and looke how many degrees are conteyned betweene them, for so much is the height of the sun.

Thus may you find by the Sphaere, that when the sunne is in the tenth degree, of *Taurus*, his height at 10. of the clock in the fore-noone (the
Sphaere

Sphære being duely rectified by the first propo-
sition) shall be about 45. degrees and an halfe at
London.

40

To finde the howre of the day by the height of
the sunne; the place of the sunne,
& the height of the pole
being giuen.

40

40

40

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40

Set the pole arctick of the Sphære to his eleua-
tion for that place where you desire to know the
howre of the day: bring the place of the sunne in
the zodiack to the meridian, and the howre index
to 12. a clock of the howre circle: take so many de-
grees of the ecliptick betweene the feet of your
compasses, as the height of the sunne amounteth
vnto.

Then set one foot of your compasses in the place
of the Sunne, and turne the sphære about, East-
wards, if it be in the fore-noone, or West-wards, if
in the after noone, till you can but only touch the
horizon with the other foote of your compasses; for
then the index pointeth out the howre of the day
in the howre circle.

As suppose you obserue the height of the sun
being in the 10 degr. of *Taurus*, and finde him to be
30 degr. high in the fore-noone: you shal finde (fol-
lowing the directions præscribed in this propo-
sition) that it shall then be about 8. of the clock in
the morning.

To finde the amplitude or breadth of the sunnes rising, or setting: that is how farre he riseth or setteth from the point of true East, or West at any time.

PROP. 14.

THe pole of the Sphere being set to his elevation, and the place of the sunne to the East semicircle of the horizon: see how many degrees of the horizon, are conteyned betweene the place of the sun, & the true East point, for so you shall haue the bredth of the sunnes rising.

Thus the sunne being in the 10. degr. of *Taurus*, you shal finde by the sphære, that (for the latitude of London) he riseth about 23 degr. and an halfe North-wards, from the true East point, and that he setteth as many degrees towards the North, from the true West point.

To finde the place of the sunne: his declination and the quarter of the yeare being first knowne.

PROP. 15.

THe quarter of the yeare being knowne, bring the quarter of the Ecliptick that is aunswerable thereto, vnder the Meridian; and turne the sphære to or fro, till there be so many degrees & minutes of the Meridian, conteyned betweene the ecliptick and the æquator, as the declination commeth to:
then

then looke what degree of the Ecliptick is vnder the Meridian, for that is the place of the Sunne.

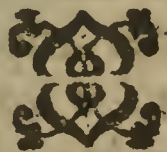
As suppose the declination of the sun in some day of the spring time of the yeare be found to be 14 degr. 51. min. (turning therefore the sphære to and fro, till some part of the spring quarter of the Ecliptick, come right vnder that degree & minute of declination in the Meridian) you may finde that the sunne is then in the tenth degree of *Taurus*.

To finde what day of the moneth it is, by knowledge of the Sunnes declination.

PROP. 16.

THe place of the sunne being found by his declination (as is already shewed) seeke the place of the sunne in the horizon of the sphære, & looke what day is aunswereable thereto, for that is the day of the moneth which was sought for.

As the place of the sunne being found by his declination (as is shewed in the former proposition) to be in the 10. degree of *Taurus*, the day of the moneth shall thus be found to be the 21. of April.



*The day of the moneth being knowne, to finde at
what time the day breaketh.*

PROP. 17.

FInde the place of the sunne (by the 2. prop.) & bring it to the Meridian, then bring the howre index to 12. a clock vpon the howre circle.

Finde out also the point of the Ecliptick that is right ouer against the place of the sunne: then take betweene the feet of your compasses 17 degr. of the ecliptick, and setting one foote of the compasses in the point opposite to the place of the sunn, turne the Sphære West-wards, til you can but only touch the horizon with the other foote, for then the index sheweth in the howre circle at what time the day breaketh.

So the 21. of April, the sun being in the 10 degr. of *Taurus*, you shal finde that the day breaketh about halfe an howre past two of the clocke in the morning.

*To finde how long the twylyght
continueth:*

PROP. 18.

FInde out by the former Prop. at what time the day breaketh, and learne also at what time the sunne riseth by the 7. or 9. prop.

Then subtract the lesser from the greater, and there shall remayne the length of the twylyght.

Or els thus: hauing brought the point that is
oppo.

opposite to the place of the sunne to be 17 degrees about the horizon West-wards, in such sorte as is shewed in the former proposition; and keeping the sphære in that position, bring about the point of the howre index vnto 12 a clock vpon the howre circle; then turne the sphære West-wards vntil the degree or point of the ecliptick that is opposite to the place of the sunne come to the Horizon: and see how many howres the point of the index hath run ouer in the meane time vpon the hower-circle: for so many howres continueth the twylight.

By eyther of these wayes, the sunne being in the 10. deg. of *Taurus*, you shal finde that the twylight (that is the time from the breake of the day till Sun rise) is about 2. howres and 20 minutes.

To finde how much the declination of the sunne must alter at any time of the yeare, to make the day an howre longer or shorter.

PROP. 19.

BRing the place of the sunne (found by the secōd Prop.) to the East semicircle of the horizon, & marke what degree or point of the horizon it falleth vpon; bring one of the Colures to the same degree or point, and there make a prick in that colure; and (houlding the sphære immoueable,) marke withall what degree of the æquinoctiall, or of eyther of the tropicks is then at the horizon: Then turne the sphære 7 degr. and an halfe forwards, towards the West, if the dayes shorten: but contrari-
wise

wise if the dayes lengthen; & houlding the sphære there immoueable, make another prick in the colure at the horizon: for the distance of these two pricks in the colure taken with the compasses and brought to the ecliptick, or æquinoctial, sheweth how much the sunnes declination must alter to make the day an howre longer, if the dayes increase; or shorter, if they decrease.

After this manner you shall finde that the sun being in the 10. degree of *Taurus*, his declination must increase about 5 degrees, (or little more) to make the day an howre longer; but when the sunne is in the 20 degr. of *Pisces*, his declination, or rather his meridian altitude, must increase about 6 degr. to make the day an howre longer: and when he is in the beginning of *Capricorne*, his declination decreaseeth scarce 5 degrees to make the day an howre longer.

*To finde how many dayes it is ere the day lengthen
or shorten an howre.*

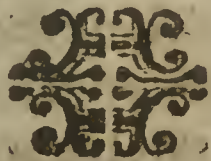
PROP. 20.

BRing the foresayd pricks (made in the colure by the former proposition) vnto the meridian, and there make two markes iustly aunswereable vnto those pricks in the colure: turne about the sphære till the ecliptick line come iust vnder one of those markes, & there make a prick in the ecliptick: then againe turne the sphære til the ecliptick come iust vnder the other marke made in the meridian, and there make another prick in the ecliptick: (But here

here it is to be noted, that wheras the ecliptick may be brought vnder that marke whether way soeuer you turne the Sphære, it must (I say be noted that the sphære must be turned that way which may soonest bring the ecliptick vnder that marke. (Lastly, finde out amongst the signes and degrees described vpon the Horizon, the like arch to this, that is conteyned betweene these prickes in the ecliptick: For the number of dayes answerable to this arch in the horizon, is the time wherein the day groweth an howre longer or shorter.

Thus shal you finde, that when the sunne is in the beginning of Aries, it will be about 18. dayes after, ere the day be one howre longer. But when the sunne is in the beginning of Capricorne, you shall finde that it will be almost twice so much, that is neare 34. dayes before the day will be an howre longer.

Hereby therefore the error of them manifestly appeareth, which think that in euery 15. dayes the day is lengthned or shortned an howre, wheras indeede the lengthning or shortning of the dayes, keepeth no such rule. For when the sunne is about the æquinoctial points, the dayes lengthen or shorten very fast: but when he is neere the tropical points, they grow longer or shorter very flowely.



To make an horizontal Diall by the
Sphere.

PROP. 21.

SEt the sphære to the elevation of the place for which you would make the Diall turne about the sphære, til the solstitial colure be 15 degrees (measured in the æquinoctial) from the meridian; and where the colure crosseth the horizon, there make a prick; then turne the colure yet 15 degr. further, that is 30 degr. from the meridian; and where the colure crosseth the horizon, there make an other prick: againe turne the colure forwards yet 15 deg. more, (that is 45 degrees from the Meridian) and at the common meeting of the colure and horizon, make the third prick in the horizon; and so proceed with the rest, till you haue made so many pricks on that side of the horizon as there are howres in half the longest day. Then looke how many degrees the first, second, third, fourth pricks, &c. are from the Meridian, for so many degrees must the howre lines of 11 a clock and one a clock; of 10. and 2, of 9. and 3. of 8. and 4. &c. be from the 12. a clock line in the horizontal diall.

After this manner in an horizontal diall made for the latitude of London, (which is 51 degr. and 32 minutes) you shal finde the distaunces of all the rest of the howre lines from the 12. a clock line as followeth: Betwixt twelue and 11. and 12. and 1. are conteyned 12 degrees almost: Betweene 12. and 10. and 12. and 2. there are conteyned 24 degr. and

an

an halfe: Betweene 12. and 9. and 12. and 3. 38 deg.
Betweene 12 and 8, and 12. & 4. 53 degr. Betweene
12. and 7. and 12. and 5. 70 degr. and an halfe.

Betweene 12 and 6. both before and after noone,
90 degr. The other howre-spaces before 6. in the
morning, and after 6 in the evening, are æqual to
the hower-spaces after 6 in the morning, & before
6 in the after noone.

How to make a direct mural diall by the Sphære.

P R O P. 22.

S Et the pole arctick of the Sphære so much vn-
der the Horizon as is the complement of the
poles eleuation: the Horizon therefore being thus
set as it were to the zenith of the sphære, and so re-
presenting the verticall circle of East and West
(that is the plaine superficies of a direct mural dial)
you shall finde the distaunces of all howre lines,
(both before and after noone) from the 12 a clock
line, in such sorte as you did before for the Hori-
zontal dial.

So you shal finde the distaunces of the howre
lines in an erect direct mural dial made for the lati-
tude of London to be as followeth: Betweene the
twelue a clock line and the lines of 11 and 1, 9 degr.
and about one third part of a degree: Betweene 12.
and 10. and 12. and 2, 19 degrees and one quarter;
Betweene 12 and 9, and 12 and 3, 32 degr. or little
more: Betweene 12 and 8, and 12 and 4, 48 degrees:
betweene 12 and 7, and 12 and 5, 67 degr. or little

more: betweene 12 and 6. both before and after
noone 90. degrees.

*How to make any direct inclining, or direct recli-
ning diall by the Sphere.*

P R O P . 23.

REckon from the æquinoctial vpwards in the
Meridian, so many degrees as the height of the
pole commeth to at that place where you would
make your diall; for there is the verticall point or
zenith of that place: from this zenith reckon south-
wards in the meridian, the inclination of south dials
and the reclination of North dials; but contrary-
wise, reckon from the zenith North-wards the in-
clination of North dials and the reclination of
South Dials. Then bring that degree of the meri-
dian where this reckoning endeth to the Horizon,
for so the Horizon representeth vnto you the plaine
or the flat superficies of the dial which you would
make. Therefore you shal finde how many degrees
euery one of the howre lines should be distant from
the 12. a clock line, in such sort as you did before
in making the Horizontal dial.

Thus in a South direct dial inclining 30 deg. or
in a North direct reclining 30 degr. made for the
latitude or eleuation of the pole at London, you
may finde the distances of the eleuen a clock line &
of the one a clock line, from the 12 a clock line, to
be about 14. degrees.

And vse of the Sphere.

1760

But the howre lines of 10. in the forenoone and of 2 in the afternoone, are distant from the 12 a clock line 28 degr. and on half; From 12 to 9. and to 3, you shal finde 43 degr. From 12 to 8 in the fore noone, and 4 in the after noone, you shall haue 58 degr. & an halfe: also from 12 to 7, and to 5. shal be about 74 degr. And from 12 to 6 in the morning, & 6. after noone 90 degrees.

Likewise in a South direct reclining, or North direct inclining 20 degr. for the eleuation of London; the spaces betweene 12 & 11 & 12 & 1, shal be about 5 deg. or little lesse: Betweene 12 & 10, & 12. & 2, about 10 deg. & 2 third parts. From 12 to 9 in the forenoone, & 3 in the afternoone, is almost: Frō 12 to 8, & 4, 29 degr. or little more. From the 12. a clock line, to the line of 7 a clock in the forenoone, & 5 in the afternoone, 50 degr. or thereabouts. Frō 12 to 6 both before & after noone, 90 deg. as in the former kindes of dials. In al which it is to be noted, that there is alwayes the same distance between the howre lines of 5 & 6, & 4 & 6 that there is between 7 and 6 and 8. & 6 in the forenoone, and betweene 5 & 6, & 4 & 6 & 7 & 6, & 8, & 6. in the after noone. So as the distances of al the howre lines from the 12 a clock line being found from 6 in the morning, till 6 at night, the distances of the other howre lines before 6 in the morning, and after 6 at night shall easely be had.

H 3 To

To know at what time the moone, or any other of the planetes or fixed starres, that are within the breadth of the zodiack; rise, or set, or come to the meridian; as also with what degree of the ecliptick they rise or set or midde heauen, together with their declinations, and their right and oblique ascensions, and descensions; and their breadths or amplitudes of rising, or setting.

PROP. 24.

FInde the place of the moone, or any other of the planetes, both in longitude and latitude, by the Ephemerides: and finde the place (that is, the longitude and latitude) of any of the fixed starres in the zodiack by some table of the fixed starres; or otherwise; and marke the same place of the moone, planete or starre, in the zodiack of the sphere: and hauing set the sphere to the latitude of the place, bring the place of the sunne (found by the 2. proposition) to the meridian, and the howre-index to 12 a clock vpon the howre-circle; then turne the Sphere till the place of the moone, planet or starre marked in the zodiack, come to the east semicircle of the horizon; for then the index sheweth the time when the moone, or that planet or fixed starre, riseth.

Also the number of degrees in the Horizon, conteyned betweene the point of the moones, planetes, or starres, rising, and the point of true East, shew

sheweth the bredth, widenes or amplitude of rising; And you may at the same instant see, what degr. of the ecliptick riseth with any of them, and what the oblique ascension of any of them is: For if you tell how many degrees of the æquinoctial are conteyned betweene the beginning of Aries and the Horizon, proceeding East-wards, or according to the order of the signes: you shall haue the oblique ascension of the moone, planete, or starre that you sought for.

But bring the same place of the moone, planete or starre to the meridian, and the index sheweth in the howre circle at what time they come to the meridian: where you may also see, first what degree of the zodiack middeth heauen (that is, commeth to the meridian) with any of them; secondly you may see how much the declination of any of them is; for count how many degrees of the meridian are conteyned betweene the æquinoctial and the place of the moone, planete, or fixed starre, and so much is the declination. Thirdly you may there see what the right ascension of any of them is: for the place of any of them being brought to the meridian and there stayed, reckon East-wards how many degrees of the æquinoctial are conteyned betweene the beginning of Aries and the Meridian, so haue you the right ascensio: Lastly bring the place of the moone, planete, or starre, to the West semicircle of the Horizon; for then the index sheweth the time of theyr setting; and the number of the degrees of the Horizon betweene the point where any of them setteth, and the æquinoctial, or true West point where

(where the æquinoctial, and Horizon crosse each other) is the amplitude or bredth of the setting of any of them, shewing how much they set from the true West point.

You may there also see what degree, eyther of the ecliptick, or of the æquinoctial, setteth with any of them: and consequently you may know the oblique descension of any of them, by reckoning how many degr. of the æquinoctial there are from the beginning of Aries Eastwards, till you come about to the West part of the Horizon.

Take for example the great starre called the Bulles eye, whose place in longitude is about the 4. deg. of Taurus, and his latitude about 5 degr. and an half Southwards.

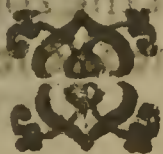
Following therefore the directions præscribed in this proposition, you shal find that vpon the first day of April this present yeare 1600. the same starre riseth here at London about half an howre past 7. of the clock in the morning, and setteth about a quarter of an howre past 10 at night, and commeth to the meridian about 3 a clock afternoone: Also you shal find that it riseth with the 15 degree of Gemini, and setteth with the last deg. of Taurus, and commeth to the meridian, or middeth heauen, with the 5. deg. of Gemini: Thirdly you shal find his declinatio to be about 15 deg. & 2 third parts, his right ascension 63 degr. and a quarter, his oblique ascension 43 degr. and his oblique descension about 84. deg. and an half: and lastly his amplitude or bredth of rising, or setting about 25 degr. & an halfe from the true East & West points towards the North.

To know how long the moone or any of the planets
or fixed starres do shine or continue
about the Horizon.

PROP. 25.

THe Sphære being set to the latitude of the
place, and the place of the moone, planete, or
fixed starre, being found, & marked in the zodiack,
both in longitude, and latitude, (as in the former
prop.) bring the place of the moone, planete, or star
to the East semicircle of the Horizon, and the in-
dex of howres to 12. a clock: Then turne about the
Sphære West-wards, till the same place of the
Moone, or of the same planete, or starre, come to
the West semicircle of the Horizon, and marke
withall how many howres the index runneth ouer
in the meane time vpon the howre circle, for so
many howres continueth the moone, planete, or
starre about the Horizon.

Thus shall you finde that the foresayd starre
(called The Bulles eye) continueth, or shineth a-
bout the horizon at London, about 14. howres &
3. quarters.



To finde which of the planetes or fixed starres are
aboue or vnder the Horizon at any
time of the day or night.

PROP. 26.

THe places of the planetes or fixed starres being
marked in the zodiack of the Sphere, as in the
former propositions, and the place of the sunne
brought to the Meridian, and then the index to 12
a clock; turne the sphere til the index come to that
howre vpon the howre circle at which you desire to
know what planetes are aboue or vnder the Hori-
zon, and then hold stil the sphere, and marke what
planetes or starres are aboue, or vnder the horizon
in the sphere, for the same planetes or starres are
aboue or vnder the horizon in the heauens.

As for example: the 1. of April 1600. at 9. of
the clock at night, you may by this proposition
finde, that the most part of the fixed starres, that
are in the constellations of *Taurus*, *Gemini*, *Cancer*,
Leo, *Virgo*, and *Libra*, together with the three su-
perior planetes, *Saturne*, *Iupiter* & *Mars*, are at
that howre to be seene aboue the Horizon; & that
the rest of the planetes and fixed starres, that are
within the compasse of the zodiack, are vnder the
horizon, and cannot then be seene.

To finde in what time any signe or part of the
ecliptick riseth or setteth.

PROP. 27.

BRing the beginning of the signe, or part of the
ecliptick, to the East semicircle of the horizon,
if you would knowe in how long time it riseth, or to
the west part of the horizon, if you would know in
what time it setteth; then set the index to 12 a clock
and turne forwardes the sphere, til the whole signe
or part of the zodiack be risen, or set: For then the
index sheweth vpon the howre circle in how long
time, that signe or part of the zodiack riseth or
setteth.

Thus you may finde (for example) that the
whole signe of Aries here at London riseth in one
howre or somewhat lesse, and setteth in two howres
& three quarters, or something more: And that the
whole quarter of the zodiack, from the beginning
of Aries to the beginning of Cancer, riseth in lesse
then 4 howres, but setteth in more then 8 howres.

To finde the howre of the night by any of the planettes
or fixed starres in the zodiack, that
appeare aboue the Horizon.

PROP. 28.

THe place (that is to say the longitude & latitude)
of any planete, or fixed starre in the zodiack,
I 2 that

that is about the horizon, being first found, and marked in the zodiack of the sphere; bring the place of the sunne (found by the 2 proposition) to the meridian, & the index to 12 a clock vpon the howre circle: Then hauing found the height of the starre, or planete by obseruation, and the sphere also being set to the latitude of the place of obseruatiō, take betweene the feet of your compasses, so many degrees of the ecliptick, or æquinoctiall, as the height of the planete, or starre obserued, cometh to; and setting one foote of your compasses in the place of the planete, or fixed starre that you obserued in the zodiack, turne the sphere forwards, or backwards, till you can but onely touch the horizon with the other foote: for then the index in the howre circle, shall shew you the howre of the night.

Suppose (for example) I should obserue the height of the foresayd Bulles eye, and should finde the same to be 29. degrees the first day of March at euening: finding therefore the place of that starre in the zodiack of the Sphere, and bringing it (with help of the compasses) to the height obserued (hauing first set the place of the sunne and howre-index both together to the meridian) the index of the howres will shewe, that when that starre hath that height of 29 degrees, it is about 9 of the clock at night.

PROP. 28.

To
of any planete, or fixed starre in the zodiack
that

To know at any time of the yeare, what starres in the zodiack, arise, or sett, Cosmically, Achronically, or Heliacally.

PROP. 14.

Such starres as rise together with the sunne, are sayd to rise cosmically: and such starres as sett when the sunne riseth, are said to set cosmically; But those starres which set together with the sunne, set achronically; and those starres that rise when the sunne setteth, are sayd to rise achronically. Lastly those starres that rise a little before the sunne, rise heliacally: and those that set a little after the sunne, set heliacally.

All which may thus be found: Bring the place of the sunne to the East semicircle of the Horizon: for the starres that are then a litle aboue the horizon rise heliacally: but those that are in the horizon in the East, rise cosmically; and they that are in the West semicircle of the horizon set cosmically: But bring the place of the sunne to the West semicircle of the horizon, for those starres that are at the West part of the horizon at the same time, set achronically; but those that are then in the East semicircle of the horizon, rise achronically: & they which are a little aboue the West semicircle of the horizon set heliacally.

Thus you may know that vpon the six or seuen & twentieth day of May (in our latitude of London) the Bulles eye riseth cosmically, and the starres in Serpentarius his right foote, set cosmically, you may

may see also that the same day the starre in the Bulls South horne setteth achronycally : and the northermost starre in Serpentarius his right foote, riseth achronycally : and lastly you may finde that about the same time the Pleiades & the starre in the Bulles north horne, rise heliacally, & that the same starre also, and the former Twinnes feete set heliacally.

To finde the fowre principall or Cardinall points of Heauen (as the astrologians call them) at any time.

PROP. 30.

THese fowre cardinal points are nothing els but 4 points of the ecliptick, whereof one is at the East part of the horizon, ascending, and is therefore called the ascendent: another is at the vpper part of the meridian aboue the horizon, and is called the midst of heauen, and the hart of heauen: the third is at the West part of the horizon descending, and may be therefore called the descendent: the fourth point is that which is at the nether part of the meridian vnder the horizon. Which fowre points are the beginnings of the first, tenth, seauenth, and fowrth howses. Therefore to finde these points at any time by the sphære, bring the place of the sun (being found for that time by the 2 proposition) to the meridian, and the index to 12 a clocke: then turne the sphære till the index come to that howre at which you desire to know those fowre points, & there hould the sphære that it moue not: and looke withall,

withall, what points of the ecliptick are at the East and West semicircle of the horizon; and at the vpper and nether parts of the Meridian: for those be the fowre principall or Cardinall pointes you sought for.

Take for example the time of the Sunnes entrance into Aries this present yeare 1600. which was vpon the tenth day of March about eight of the clock in the morning, or little after with vs heere at London. Having therefore brought the beginning of Aries together with the howre index to the meridian, and then turned back the whole sphære till the index come to 8 of the clock vpon the howre circle: you shall finde the ascendent at that time, to be the 27 degree of Taurus; the midest or hart of heauen, the 27 of Capricorne: the descendent, the 27 deg. of Scorpio; and the lowest part of heauen, the 27 deg. of Cancer.

To finde out the bredth of any climate; that is, how much the pole must be eleuated, or depressed, to make the longest day half an howre longer or shorter.

P R O P. 31.

Lift vp, or put downe the pole of the Sphære, till you finde that there are 7 deg. and an half of the tropick of Cancer, more or lesse aboue the horizon, then there were before; and mark withal how much the pole of the sphære is raysed, or let fall in the
meane

meane time, more then it was before; for so much is the bredth of that climate.

As for example: having set the sphaere to our latitude of London of 51. deg. and an halfe, with the point of your compasses, houlding and guiding some point of the tropick of Cancer right vnder the horizon; then lifting vp the pole till you finde 7. degrees and an halfe more about the horizon then were before, you shal finde the pole eleuated about 2 deg. and an halfe more then it was before.

Likewise, if you put downe the pole till there be 7 degrees and an halfe of the tropicke of Cancer, fewer about the horizon then was before; you shal finde the eleuation of the pole to be about 3 degrees lesse then before.

The reason of the inaequalitite of naturall dayes; that is, why the space of 24 howres, is longer at one time of the yeare then at another time.

P R O P. 32.

THe reason hereof is shewed partly by the inaequalitie of the differences of right ascensions answerable to æqual arcks of the zodiacke, and partly by the vnæqual apparent motion of the sun. For the first: the differences of right ascensions answerable to the parts of the cliptick, about the tropicall points of Cancer and Capricorne, are much greater then about the æquinoctial points of Aries and Libra.

In

In so much that whereas the difference of right ascension answerable to one signe, or 30 degrees taken about those tropicall points, is more then 32 deg. and an halfe; about the æquinoctial points it is little more then 27 deg. and an halfe; as it may appeare by the Sphære. So as you may hereby gather, that the difference of ascension answerable to one degree, which about the beginning of Capricorne is one deg. and about six minutes; about the beginning of Aries, or Libra, is only 55 minutes. Secondly the apparent motion of the sunne is much swifter about his *Perigæum*, in the signe of Capricorne, then about his *Apogæum* in Cancer, or in other parts of the zodiack: so that whereas the sun being in Capricorne moueth 61 minutes and something more in a day: in Aries or Libra he moueth but 59 minutes or very little more in the same time. Therefore seeing the natural day is nothing els, but the time wherein the sunne moueth from the Meridian about, til it returne againe to the same part of the meridian; it must needs be that alwayes in one natural day, there is made one whole reuolution of the æquinoctial circle, and so much more as is the difference of right ascension answerable to the apparent motion of the sunne in the meane time; which differences of ascension because they be vnæquall, for the two causes before alleaged; the natural dayes must needs also be vnæquall; the motion of the æquinoctiall circle about his owne center being (as it hath beene alwayes supposed to be) æqual, that is mouing alwayes an æquall space in æqual time.

K

Which

Which by this example may most playnely appeare: The Sunne being in Capricorne moueth 61. minutes in a natural day: the difference of ascension agreeable thereto is 67. minutes, or something more. Therefore at that time, in the space of one natural day, the æquinoctiall circle must make one full reuolution, and 67 minutes more. But when the sun is in Aries, mouing onely 59 minutes in a day, and the difference of right ascension answerable thereto, scarce 54 minutes more then one reuolution of the æquinoctiall circle; there shal passe onely 54. minutes more in a natural day; so as here the æquinoctiall circle moueth not about so much in one day as before by 13. minutes. Seeing then that 15. degrees or little more of the æquinoctial circle doe passe the meridian in euery howre, & consequently one degree of the æquinoctiall passeth the Meridian in fowre minutes of an howre, and one minute of a degree in fowre seconds of an howre; therefore 13 minutes of the æquinoctiall shall passe the meridian in 52 seconds: that is almost in one minute of an howre: Whereby it manifestly appeareth that the natural day, that is to say the space of 24 howres, which is the time wherein the sunne moueth from the noone-stead to the same noone-stead againe, is in our age greater almost by one minute of an howre, when the sunne is in Capricorne, then when he is in Aries or Libra.

To finde by the Sphære how much the naturall
 dayes are longer at one time of the
 yeare then at another:

PROP. 33.

FOR this purpose it will be best to take a good
 number of dayes together; as for example, take
 the whole moneth of December, and the whole
 moneth of March: both which moneths consist of
 the same number of 31 naturall dayes: finde the place
 of the sunne for the beginning, and ending of both
 moneths, which you may finde by the second pro-
 position to be for the beginning of March this pre-
 sent yeare 1600, about 20 degrees and thirteen
 minutes of Pisces; and for the ending about 26.
 degr. 48 minutes of Aries: Also for the beginning
 of December the same yeare 18 deg. 46 minutes of
 Sagittarie; and for the ending, twenty degrees 24.
 minutes of Capricorne: Then seeke out the right
 ascensions of the same places of the sunne for the
 beginnings and endings of both those moneths by
 the 4 proposition, and the differences of ascension
 answerable to the motion of the sunne in each
 moneth, by the sixt proposition; which you may
 finde by the Sphære to be about 33 degrees, 24 mi-
 nutes for December, and 28 degrees 39 minutes for
 March. Lastly finde out the difference of these dif-
 ferences of ascension by subtracting the lesser out
 of the greater; which in this exāple is 4 degrees 45
 minutes; which resolued into minutes of an howre,
 by taking for euery degree 4 minutes of an howre,

and for every fifteen minutes of a degree, one minute of an howre; shall amount to 19 minutes of an howre, that is a quarter of an howre and fower minutes. And so much is the moneth of December longer then the moneth of March; Notwithstanding both of

them consist of the same

number of 31 natu-

rall dayes

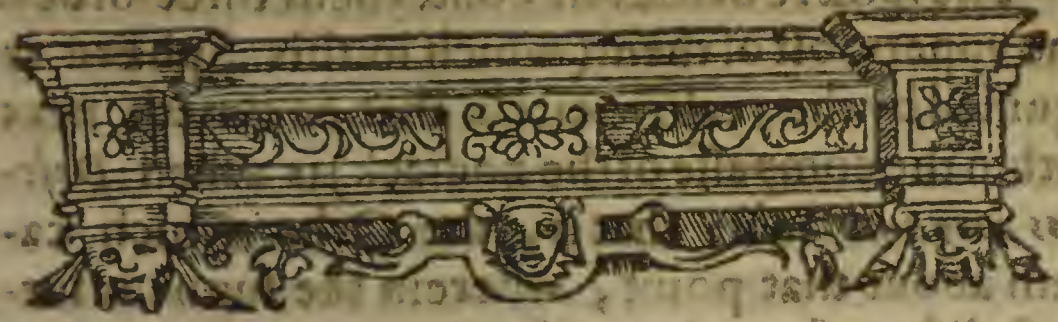
the whole month of March: but which month consist of the same number of 31 natural dayes: and ending of their proper, which you may finde by the second proposition to be for the beginning of March this pre-



and which
beginning
of December
beginning
of the right
the time for
the months by
the proposition and the distance of declination
answerable to the motion of the time in each
month, by the proposition which you may
finde by the 2d proposition about degrees, 24 mi-
nutes for December and 28 degrees 20 minutes for
March: I say the same distance of declination

THE

of the center which in this example is a degree
minutes which related into minutes of an howre
by taking for every degree minutes of an howre



The third Part.

Of the Orbes wherof the Sphæres
of the Sunne and Moone haue been
imagined to be made, and of
theyr motions & yles.

Of the Orbes wherof the Sphere of
the sunne is made.

CHAP. I.



VIN the Sphære or Orbe contay-
ning all the circles that we haue he-
therto spoken of, and representing vn-
to vs the *Primum mobile*; that is, the
first & highest moueable heauen, that
hath beene imagined by the Astronomers, to shew
the reason of that dayly motion, which appeareth
to be in all the heauens, and of all the apparences
that follow therevpon, are included the sphæres &
Orbes of the sunne and moone.

The Sphære of the sun conteyneth three orbes: The vppermost of them (which in this Sphære is signified by the yealow circle that commeth next within the compasse of the zodiack) is called *Deferens apogæum Solis*; that is, the Orbe which carrieth about that point, wherein the sunne is furthest distant from the earth.

Next within this Orbe is placed the eccentricke carying about the body of the Sunne; which in this Sphære is represented by the grene coloured circle that commeth next vnder the *Deferens Apogæum*.

Againe, within this Eccentricke is included the third Orbe of the Sphære of the sun called *Deferens Perigæum Solis*; that is, the Orbe carying about that point wherein the sunne is nearest to the earth. This is the nethermost of the three Orbes of the sunne, and in this sphære is represented vnto you by the yealow coloured circle next vnder the sunnes Eccentricke.

Of the vppermost and nethermost Orbes of the Sphære of the Sunne, more particularly.

CHAP. 2.

IN the vppermost and nethermost of these three Orbes, there be 4 points especially to be considered: That is, the points where they be narrowest and where they be broadest, and where they are of a meane bredth betwixt the narrowest and broadest. For at the narrowest part of the vppermost Orbe, where

And use of the Sphere.

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where you may see written *Aux solis*, and the broadest part of the nethermost Orbe, is the place of the sunnes *Apogäum*; so that whensoever the sunne commeth there, he is furthest distant from the earth. As you may easely trye, if (with a payre of compasses, or otherwyse) you take the distance betwixt the earth and the sunne being brought about to that place, and compare the same with the distances that the sunne hath from the earth in other places. This point is called *Aux Solis*, and *longitudo longior*, that is, the point of the sunnes furthest distaunce from the earth. But vnder the broadest part of the vppermost and vttermost Orbe, where you see printed *PERIGÆVM*, and right aboue the narrowest part of the nethermost Orbe, is the place where the sun commeth nearest to the earth, as you may easely finde (with your compasses, or otherwyse) in like sort as before was shewed. The point where the sun commeth nearest to the earth, is called *oppositum Augis*, and *longitudo propior*, that is, the point opposite to the *Apogäum*, and the nearest distance. And at those parts of this Orbe, which are in the middest betweene the former; the sunne hath a meane distance from the earth: a meane (I say) betweene the least, and greatest distance. The very point wherein this meane or middle distance hapneth, is shewed by the points that are iust in the midst betweene the short lines AB, and IK, which are drawne ouerthwart on eyther side of this Orbe. These points are called *longitudines mediae*; that is, the meane distances of the sunne, because the sunn comming to these points, hath a meane distaunce

be-

betweene the least and the greatest. About these points also, the true motion of the sunne, is as it were in a meane betweene the slowest, which hapneth the sunne being about the *Apogaeum*; and the swiftest, which hapneth about his *Perigaeum*.

Moreover the lines A, and K, shew the places wherein there is the greatest *Prosthapheresis*, or equation of the sun: that is, the greatest difference betweene the true, and middle, or meane place of the sunne.

Lastly the distaunce betweene the lines I, and K, or A & B, shew how much the eccentricitie of the sunnes eccentric is, that is how farre the center of the eccentric, is distant from the center of earth.

To finde how much the sunne is nearer or further from the earth, at one time then at another.

CHAP. 3.

By meanes of this circle, you may easily finde with your compasses, how much the sunne is nearer to, or further from the earth at one time, then at another: for hauing set one foote of the compasses vpon the vtmost edge of the *Deferens Apogaeum*, vnder the place of the sunne in the zodiack, found by the second proposition stretch out the other foote, to the innermost edge of the same Orbe; for then, if you set one foote of your compasses, vpon the vtmost edge of this Orbe, at the *Apogaeum*, the other foote turned inwards, towards the center of the Sphere,

Sphære, will shew you how much the sunne is nearer to the earth, at that time, then when he is in his *Apogæum*: for so much as that foote reacheth within the inner edge of the Orbe, so much is the sunne nearer. Likewise if you set one foot of your compasses, vpon the vttermost edge of this orbe, at the *Perigæum*, and turne the other foote towardes the center of the sphære, so much at this foote of the compasse, is from the inner edge of the *Deferens Perigæum*, so much is the sunne further distant from the earth, at that time, then when he is in his *Perigæum*.

Of the situation and motion of the vppermost, and nethermost Orbes of the Sunne.

CHAP. 4.

THE vppermost, and nethermost of these three Orbes, called *Deferens Apogæum*, and *Perigæum solis*, do alwayes answer each to other, in such sort that the broadest part of the one, is alwayes against the narrowest part of the other: And therefore both of them are moued together, with one motion about the axtree and poles of the ecliptick, making one reuolution vnder the zodiack, in the space of 17000. yeares almost. For in *Ptolemee* his time (that is about the yeare of our Lord 134.) the place of the Sunnes *Apogæum*, was about the middost of the 6 deg. of *Gemini*; as it may appeare by the 4. Chapter of the 3. booke of his *Almagest*. But in our time we finde that it cannot exceede the 7 degr. of *Cancer*, although after the account of *Copernicus*, &

of the Prutenick tables, it should be in the 9 degr. of *Cancer*. So as, if the rest of the motion of the sunnes *Apogæum*, that is to come hereafter, be proportionable to that is past, the whole reuolution thereof shall be finished in 16990. yeares vnder the zodiack. For in 1463. yeares betwixt *Ptolemee* his time and ours, it hath moued about 31 degr. therefore it shall moue 360. degr. (that is, the compassse of the whole circle) in 16990. yeares.

Which number of yeares being deuided by 360. it shall appeare that the *Apogæum* of the sunne moueth one degr. in little more then 47 yeares, whereby the yearely motion thereof may be found to be little more then one minute and a quarter.

How to finde the place of the sunnes Aux or Apogæum: and of the vses of the two foresaid Orbes of the Sunne.

CHAP. 5.

T Herefore the place of the sunnes *Apogæum*, being founde for the yeare 1600. to be about 7 degr. in *Cancer*, the place thereof for any other yeare before or after, may easely be found in our age, onely by subtracting, or adding for euery fowre yeares 5 minutes, & for euery single yeare 1 minute and a quarter, Although indede we neede not stand so præcisely neyther vpon quarters of minutes, neither yet vpon whole minutes, in the place of the sunnes *Apogæum*, which cannot be by any art so exactly found, but that the diligentest man that is, may erre many minutes therein.

Take

Take for example the yeare of our Lord 1558. (in which our gracious Queene *Elizabeth* beganne her happie reigne, which is now 42. yeares since) taking therefore for euery 4 yeares 5 minutes, that is for 40. yeares 50. minutes, and for the two yeares remaying 2 minutes and one halfe; that is in all 52. minutes and an halfe, and subtracting the same out of 7 deg. of *Cancer*, there shall remaine the place of the sunnes *Apogæum* at the beginning of her Ma^{ties}, reigne, in 6. degr. and about 8 min. of *Cancer*.

The vses of these two Orbes are these.

1. First to make the sphære of the sunne concentricall; for these Orbes be so framed together, that the narrowest part of the one, aunswereth alwayes to the broadest part of the other: it commeth to passe by this meanes, that both the out-side, and in-side of the Sphære of the sunne, haue alwayes the same center, that the world it self hath.

2. The second vse is to shew the reason, and manner of the motion of the sunnes *Apogæum* and *Perigæum*.

*Of the eccentric of the Sunne, and how it hath
beene proued that the Sunne is moued
in an eccentrical Orbe.*

CHAP. 6.

THe Orbe conteyned betweene the two former, and carying about the body of the sun it selfe, is called the eccentric of the sunne; because it hath another center, then the center of the world.

The especiall reason, that moued the skilfull in this celestiall science, to make this Orbe (wherein the body of the sunne is carryed) eccentricall, was because they found the apparent motion of the sunne vnder the ecliptick line to be vnæquall, that is swifter in the southerly signes: and slower in the northerly.

For *Hipparchus*, and *Ptolemee* found in their times, that the sunne continued in the Northerne semicircle of the ecliptick, from *Aries* to *Libra*, 187. dayes: and in the other half of the zodiack, that is Southward from *Libra* to *Aries*, 178. dayes and a quarter onely. But in our time by diligent obseruation it is found, that the time of the sunnes continuance in the first of those semicircles from *Aries* to *Libra*, is 186 dayes 14 howres and an half: and consequently in the other semicircle, from *Libra* to *Aries*, 178 dayes 15 howres and an half. Taking it therefore for a ground, according to the doctrine of *Aristotle*, that the motion of the celestiall bodies is circular and æqual; it must needs follow, that a greater part of the circle described by the proper motion of the sunne, must be conteyned vnder the northerly semicircle of the ecliptick, then vnder the Southerly: and consequently that the circle or orbe that caryeth about the body of the sunne vnder the ecliptick, hath another center then the center of the ecliptick.

2. An other reason to proue that the sunne is carryed in an accentricall circle, is the vnæquall apparent bignes of the sunnes diameter, the Sunne being of the same height aboue the horizon & the
ayre

ayre alike affected, and alike cleare; so as if there were any refraction by reason of the thicknes of the ayre, it must needs be the same in both places. For in sommer, when the sunne is at, or neare his *Apogæum*, his apparent diameter hath beene found by exquisite obseruation to be 13 minutes 48 seconds. But in winter being about his *Perigæum* 33. min. 54. seconds, as it may appeare in *Copernicus* his reuolutions 4 booke 21 Chapter.

Therefore seeing euery visible object appeareth greater when it is neare, and lesse when it is further remoued from vs, it is manifest that the sunne appearing greater in winter, then in sommer, must needes be nearer to the earth in winter, then in sommer.

The reason of which appaunce is most easely shewed, by supposing the sunne to be moued, in an eccentricall Orbe.

3. A third reason may be the vnæquall greatnesse and continuance of the eclipses of the moone, euen at those times when she hath had the same latitude, or distaunce from the ecliptick, and the same distance from the center of the earth: which argueth that the conicall sharp pointed shadow of the earth, in the place where the moone in time of the eclipse passeth through that shadow, at the same distance from the earth, is som times greater, and som times lesser: wherof ther. cā no cause be shewed more reasonable then this, that the sunne is sometimes further distant from the earth, and then maketh the shadow greater, and sometimes nearer, & so maketh it lesser. Whereby it is also manifestly

proved, that the sun is moued about another center then the center of the earth, and therefor that the circle or Orbe, wherein the sunne is moued, is an Eccentricke.

Of the vses of the Sunnes eccentricall Orbe.

CHAP. 7.

T Herefore the vses of the sunnes eccentricke may be these:

1. First to shew the reason of that apparent inequality, which seemeth to be in the motion of the sunne: for although the sunne moue æqually in his owne Orbe, and about his owne center; yet to them that are at the center of the world, or vpon the earth, he shall seeme to moue vnæqually; that is, swiftly when he is in that part of his eccentricke which is nearest vnto the earth; and slowly when he is farthest from the earth. And therefore in sommer, when the sunne is about his *Apogæum*, and in his greatest distaunce from the earth, he seemeth to moue little about 57 minutes in one day. But in winter, being about his *Perigæum*, and nearest vnto the earth, he seemeth to moue more then 61 minutes: whereas notwithstanding he moueth æqually in his Eccentricke, euery day about nine and fifty minutes and 8 seconds; and so finisheth his reuolution in 365. dayes, and six howres almost.

2. The second vse of the sunnes Excentricke, may be to shew the reason why the sun appeareth greater at one time then at another; for the sunne being in those parts of the eccentricke that are nearest vnto vs, seemeth greatest, & when he is in those parts

parts of his eccentric that are furthest from vs, he appeareth to be least.

3. And lastly the inequality of the sunnes distance from the earth, caused by his eccentric, is one especiall cause of the inequality of the Eclipses, both of the sunne and Moone.

The definitions of certaine Astronomical wordes of this art, for the better understanding of the Theorick of the sunne.

CHAP. 8.

1. **W**Hat the *Aux* or *Apogæum* of the sunne is, it hath beene partly shewed already: that namely it is that part, or rather point of the Orbe carying the sunnes *Apogæum*, wherein the said Orbe is thinnest, or narrowest: Or it is that point of the eccentric which is furthest distant from the earth, and is alwayes shewed by a right line vnderstood to be drawn from the center of the world, by the center of the eccentric, vnto the Orbe carying the sunnes *Apogæum*. Which line is therefore called the line of the sun his *Aux* or the line of the sunnes *Apogæum*.

2. The motion of the *Aux*, or of the *Apogæum* of the sunne (which is also called the sunnes *Aux* in the second signification) is nothing els but the arch of the Ecliptick, conteyned betwene the beginning of Aries, and the line of the suns *Apogæum*, drawne forth to the zodiack; where this line also sheweth the place of the sunnes *Apogæum*.

3. The middle or meane place of the sunne in the

the zodiack, is shewed by a line drawne from the center of the world vnto the zodiack, æquidistant from the center of the Eccentricke, and of the sunne.

4 This line is therefore called the line of the meane or middle place of the sun.

5 The middle or meane motion of the sunne is the arch of the ecliptick betweene the beginning of Aries, and the middle place of the sun.

6 The true place of the sunne is shewed by a streight line drawne from the center of the earth by the center of the sunne vnto the zodiack, which line is therefor called the line of the true place of the sun.

7 The true motion of the sun is the arke of the eclipticke from the beginning of Aries, vnto the true place of the sun.

8 The argument of the sun (as the *Alphonsines* terme it) or the motion of the Sunnes Anomalie, (as *Copernicus* calleth it) is the arke of the ecliptick conteyned betweene the place of the sunnes *Apogæum* and the middle place of the sunne according to the order and succession of the signes. This arch is called the argument, or motion of the sunnes Anomalie, or irregularitie, because that by it is alwayes found how much the suns true motion which (is vnæqual & irregular) differeth from his middle motion; which difference they call the suns æquation, or prostaphæresis.

9 The æquation, or prostaphæresis of the sun is nothing els but the arch of the ecliptick conteyned betweene the true, & middle places of the sun.

This

This arch is called the sunnes æquation, because it maketh the suns middle motion æqual to his true motion, being added to it or subtracted from it, as occasion requireth: for which cause it is more significantly and fitly called *Prosthaphæresis*, that is as much to say, as that which is to be added to or subtracted from the middle motion, that so we might haue the true motion. For so long as the sunne is in the semicircle of his excentrick, descending from his *Apogæum* to his *Perigæum*, so long this *Prosthaphæresis* is to be subtracted from the middle motion: but the sunne being in the other halfe of his excentrick ascending, the *Prosthaphæresis* or æquation of the sun must be added to the middle motion, that so the true motion and place of the sunne may be found. Because that in the first semicircle of the excentricke descending, the middle place of the sunne goeth before the true place, and the middle motion is alwayes greater then the true motion of the sun, and therefore the difference of these two motions, (that is to say, the æquation or *Prosthaphæresis*) must be subtracted; to finde the true motion.

But in the other halfe ascending, it falleth out contrarywise; for the true place of the sunne goeth alwaies before the middle place, and so the true motion is greater then the middle motion, and therefore the æquation must be added to the middle motion for the finding out of the true motion and place of the same.

Of the uppermost Orbe of the Sphere of the moone,
carying the Dragons head and tayle.

C H A P. 9.

NExt within the Orbes of the sun in this Sphære are conteyned the Orbes of the Sphære of the moone: which are five in number.

The vppermost of them (which in this Sphære is next vnder the Orbe that caryeth the Sunnes *Perigæum* and is coloured with red) is called the Caryer of the Dragons head and tayle , or *Deferens nodos* , which is as much to say as the Caryer of the knots, that is of the two interfections , or pointes wherein the rest of the Orbes of the Moone , doe crosse ouer-thwart this Orbe. This Orbe is deuided into fowre ninetyes of degrees , for the easier reckoning of the motion & place of the dragons head or tayle in this sphære. And it is moued about in 18 Iulian yeares 224 dayes 3 howres and 5 minutes almost, from the East West-wards, vnder the Ecliptick. By reason of this motion it commeth to passe, that the eclipses , or rather the places wherein the eclipses of the sunne or moone do happen in the heauens, are remoued continually, more backwards in the zodiack, contrary to the order and succession of the signes.

As for example; the eclipse of the moone hapning this present yeare 1600. the 20 of Ianuarie neare vnto the Dragons tayle about the 9 degree & 40 minutes of *Leo*; the next eclipse that shall happen neare the same interfection of the dragōs tayle,
in the

in the yeare 1601, the 29 of Nouember, shall be in 17 degr. and an half of *Gemini*: And that eclipse which shall be the next yeare after neare the same intersection the 19 of Nouember in the morning, shall be about the 6. degree and 40 minutes of *Gemini* &c.

Al this remouing of the eclipses backwards cometh to passe, by reason of the motion of this Orbe carying the dragons head and tayle, contrary to the course and order of the signes.

This Orbe continueth alwayes right vnder, & euen with the Orbes of the sphaere of the sunne, which abide alwayes in al parts iust vnder the ecliptick line, and hath his center agreeing, and all one with the center of the world, and of the ecliptick: And therefore the poles and axtree, about which this orbe is turned, agree iustly with the axtree of the Ecliptick.

The scituation of the Orbe carying the Dragons head and tayle.

The rest of the Orbes of the moone, that are conteyned within this, haue all theyr playnes agreeing in one, and lying euen one with another. But the one halfe of all their playnes, ariseth aboue the playne of the former orbe, and of the Ecliptick, towards the North pole of the zodiack: and the other half descendeth beneath the playne of the ecliptick, toward the South pole: euen as the one half of the zodiack ariseth aboue the æquinoctiall circle towards the North: and the other half descendeth towards the south. And as the angle of intersection, or obliquitie of the ecliptick with the æquinoctiall circle, is 23 degr. and an half or little more: so the angle of intersection, or obli-

The scituation of the rest of the Orbes.

quity of the playnes of these Orbes of the moone, from the plaine of the Ecliptick, and of the former Orbe carying the Dragons head and tayle, is 5. degrees, or (according to *Tighe Brabe* his obseruation) 5 degr. and a quarter almost sometimes, & sometimes lesse then 5 degr.

That point or interfection of these Orbs with the former, from which they begin to arise about the playne of the ecliptick towards the North, proceeding East-wards, is called the Dragons head; and is signified by this character Ω : and the other point or interfection diametrally opposite vnto this, is called the Dragons tayle, which is also signified by the former character turned vpside downe after this manner, $\var�$.

The two points of these orbes that are furthest distant from the plaine of the ecliptick, are called the bounds or limites of the moones latitude, and they are 90 deg. from the dragons head & tayle, & 5 deg. & a quarter almost from the playne of the Ecliptick, according to the obliquity, or greatest declination of the plaines of these orbes, frō the playn of the ecliptick: Of these two points, that which is in the north side of the ecliptick, is called the north limit, or bound of the moones latitude; and contrariwise, the other point opposit to this on the south side of the Ecliptick, is called the South limite of the moones latitude. And when the moone cometh to eyther of these two points, she hath hir greatest latitude.

Of the Orbes carying the moones Apogæum
and Perigæum.

CHAP. IO.

NExt within the orbe carying the dragons head
and taylor, is containd the orbe called *Deferens*
Apogæum lune which is the point wherein the moon
is furthest distant from the earth.

And vnder this orbe is placed the moones Ec-
centrick, which is also called *Deferens epiciclum Luna*,
that is the orbe carying the moones Epicycle.

Againe within this eccentric of the moone,
is conteyned the least and lowest Orbe, of all that
are in this Sphære, Which they call *Deferens Pe-*
rigæum Luna; that is, the orbe carying the moones
Perigæum, which is the point wherein the moone
commeth nearest to the earth.

The vppermost and nethermost of these three
orbes, that is to say, the orbes carying the moones
Apogæum and *Perigæum* (both which orbes in this
Sphære are coloured with blewe) are alwayes pla-
ced in such sort, that the narrowest part of the one,
is continually answerable to the broadest part of
the other; whereby it commeth to passe, that the
sphære of the moone is made concentricall, that is
to say, to haue the same center with the world:
which also is one especiall vse, why these orbes
were deuised.

Another vse of these Orbes, is to shew the rea-
son of the motion of the moones *Apogæum* and *Pe-*
rigæum: Therefore both these orbes are moued

together with one motion æqually, about the center of the world, in the same time from the East Westwards, in the space of 32 dayes 3 howres & 5 min. almost: So mouing in one day 11 deg. 12 min. and 1 third part almost. The axtree, about which these orbes are moued æqually, passeth through the center of the world and of the ecliptick: but the poles of these orbes differ from the poles of the Ecliptick and of the orbe carying the dragons head and tayle, by the space of 5 degr. and a quarter, or there; abouts which poles are caryed about the pols of the orbe carying the Dragons head and tayle, with the motion of the same orbe, in the space of 19 yeares almost.

Whereby it commeth to passe, that the poles of the orbe carying the *Apogæum* and *Perigæum* of the moone, describe certaine little circles about the poles of the Orbe that caryeth the Dragons head and tayle, euen as the Arcticke, and Antarkticke circle in the ordinary sphære, are described by the motion of the poles of the Eclipticke, caryed about daylie with the motion of the first and highest moueable sphære, in the space of fowre & twenty howres almost.

Of the eccentric of the moone.

CHAP. II.

THe Eccentric of the moone conteyned betweene the two former orbes, and coloured with a sad yealow colour in this sphære, is moued æqually about the center of the same orbes, from
the

the West towards the East, finishing his motion vnder the zodiack, in the space of 27 dayes. and 8. howres almost: and with this motion, it carieth about the moones Epicycle æqually, vnder the zodiack.

Therefore the motion of this orbe, about his owne center, must needes be vnæquall: that is to say, swifter in those parts that are about the *Apogæum*, and slower in the lower parts about the *Perigæum*: Because that greater arches of the eccentric, do aunſwere to æqual arches of the zodiack about the *Apogæum*, then about the *Perigæum* of the Eccentric.

The axtree about which this orbe is moued, is alwayes in all places æquidistant from the axtree of the orbe carying the *Apogæum* of the moone: & the poles of the axtree of the moones eccentricke, are fastned in the orbe carying the moones *Apogæum*, æquidistantly from the poles of the same orbe: therefore these poles together with the whole axtree of the eccentric, are caryed and æqually moued about the poles and axtree of the orbe carying the *Apogæum* from the East, towards the West. With this motion therefore, the poles and center of the eccentric, describe certaine little circles of æqual bignes, about the poles, and center of the Orbe carying the *Apogæum*, from the East West-wards. And therefore also the *Apogæum* of the eccentric, is moued about æqually, vnder the ecliptick, contrary to the order of the signes frō the East West-wards. Whereby it commeth to passe, that both the *Apogæum*, and center of the eccentric, are sometimes vnder

vnder the Ecliptick, that is, when they are vnder the Dragons head or tayle: but for the most part they are beside the plaine of the Ecliptick, either towards the North, or els towards the South.

Hereby also it appeareth, that the plaine of the Ecliptick doth not alwayes deuide the plaine of the eccentric into æquall parts or halfs; but then onely, when the center and *Apogæum* of the Eccentric, is right vnder the Dragons head or tayle; for then onely the playne of the ecliptick deuideth the playne of the Eccentric, by the center thereof; and consequently deuideth it præcisely into two halfs. Otherwyse, if the *Apogæum* of the eccentric, be not vnder the dragōs head or tayle, looke on which side of the plaine of the ecliptick the *Apogæum* is, for on the same side of the Ecliptick is the greater part of the eccentric.

*In what proportion the the moones eccentric,
and orbe, carying her Apogæum
are moued.*

C H A P. 12.

NOW the Eccentric of the moone, & the orbe carying her *Apogæum*, are moued in such sort, that the middle place of the sunne, is alwayes right in the midst betweene the center of the Epicycle carried in the eccentric, and the *Apogæum* of the Eccentric; except it be when the center of the epicycle is in coniunction, or opposition to the middle place of the sunne. For in euery middle coniunction and opposition of the sunne and moone, the center
of

of the epicycle, and the *Apogæum* of the eccentric are vnited together; But in the coniunction they are both conioyned with the middle place of the sun; & in the opposition they are both together opposite to the same. Wherof it followeth, that in the first & last quarters of the moone, the center of hir epicycle is diametrically opposite to the *Apogæum* of her eccentric.

Hereof it commeth to passe, that although the moone haue the same position in her epicycle at the time of the new and full moone, and of the first and last quarters; yet the æquation, or prosthaphæresis of the moones Argument (as they call it) that is the difference betweene the true, and middle places of the moone, is alwayes greater in the first and last quarter, then in the full and new moone. Hereby likewyse it appeareth that in the time contained betweene new moone and new moone (which they cal *mensē synodicū*, that is the moneth coniunctional, or the time from coniunction to coniunction) the center of the epicycle maketh two complete reuolutions, vnder the orbe carying the *Apogæum* of the moones eccentric.

And therefor in euery moneth, the center of the epicycle commeth twice to the *Apogæum* & twice to the *Perigæum* of the eccentric; and so the monthly motion of the center of the Epicycle, describeth an oual figure: the endes whereof are alwayes towards the place of the full & new moone, & the sides towards the places of the first & last quarter.

By this that hath beene spoken, it is also manifest, that if the middle motion of the sunne be, sub-

tracted out of the middle motion of the moone, there remaineth the middle motion of the moones longitude from the sunne, and that if this longitude againe be doubled, you shall haue the motion of the center of the moones Epicycle from the *Apogæum* of her eccentric, which motion they call the center of the moone.

*Of the Epicycle of the moone, and how
it is moued.*

C H A P. 13.

THe little orbe placed in the Eccentric, is called the Epicycle of the moone; in the circumference whereof is also placed the bodye of the moone, represented by the round beade, set into the moones epicycle in this sphære.

The plaine superficies of this epicycle, agreeth euen with the plaine of the eccentric: and the axtree about which it is moued, is perpendicular to the plaine of the eccentric. This Epicycle is moued æqually from his middle *Apogæum*, about his owne center and axtree from the East West-wards, contrary to the motion of the eccentric, carying forwards the body of the moone with this motion 13 deg. and almost 4 min. euery day; and finishing his reuolution in 27 dayes 13 howres and 19 minut. almost.

The middle *Apogæum* of the Epicycle is shewed by a right line, imagined to be drawne, from that point of the little circle (described by the motion of the center of the moones eccentric) which is

oppo-

opposite to the center of the eccentric, by the center of the epicycle vnto the vpper part of the Epicycle.

But the true *Apogæum* of the epicycle, is shewed by a right line, vnderstood to be drawne from the center of the earth, by the center of the Epicycle, vnto the vpper part of the circumference therereof.

By the motion of this epicycle it may easely be conceyued why the moone seemeth to moue sometimes swifter & sometimes slower: For seeing that the vpper part of the Epicycle, moueth contrarye to the motion of the eccentric from the East westwards, when the moone commeth in that part, she must needs seeme to moue more slowly, to them that are at the center of the world.

Why the moone seemeth sometimes to moue swifter; sometimes slower.

But when the moone commeth in the nether part of the Epicycle, the eccentric caryeth the epicycle, and the epicycle carieth the body of the moone both one way; that is, from the west Eastwards, and therefore at that time the moone seemeth to moue more swiftly. According as you may see in the Ephemerides, the diurne motion of the moone to be sometimes little more then 11 degr. and sometimes againe little lesse then 15 deg. The true motion of the moone seemeth then to be swifter, when the moone is in the *Perigæum* of her Epicycle, and the epicycle in the *Perigæum* of the eccentric; because then she is not onely caryed forwards the same way both by her epicycle and eccentric, but she is also at that time nearest vnto vs:

for which cause her motion shall seeme swifter, then when the epicycle is in other parts of the Eccentric.

*The definitions of certaine astronomically wordes
of art, for the better understanding
of the theorick of the Moone.*

CHAP. 14.

1. **T**He line of the moones middle motion, is a line vnderstood to be drawne from the center of the earth, by the center of the moones Epicycle, vnto the zodiack.
2. This line sheweth the middle place of the moone in the zodiack.
3. And the middle motion of the moone, is the arch of the zodiack, from the beginning of Aries, vnto the same line.
4. So likewise the line of the true motion, or of the true place of the moone, is drawne from the center of the world, by the center of the moone, to the zodiack.
5. This line therefore sheweth the true place of the moone in the zodiack.
6. And the true motion of the moone, is the arch of the zodiack, from the beginning of Aries, vnto the true place of the moone.
7. The middle longitude of the moone from the Sunne, is the arch of the zodiack, from the middle place of the Sun eastwards vnto the middle place of moone.
8. And this arch doubled, is called the doubled.

bled longitude of the moone from the Sunne, or the center of the Moone (as the *Alphonsines* call it) which is nothing els but the arch of the zodiacke, betwene the place of the *Apogæum* of the eccentric and the middle place of the moone. It is called the doubled longitude of the moone from the sun, because it is alwayes twice so much, as is the middle longitude of the Moone from the sun.

9. And it is called the center of the moone, because it sheweth the distaunce of the center of the Moones Epicycle from the *Apogæum*.

10 The æquation, or *Prosthaphæresis* of the center, is the arch of the epicycle, betweene the middle & true *Apogæum* of the epicycle.

This æquation or *Prosthaphæresis*, is nothing at all, when the center of the epicycle is in the *Apogæum*, or *Perigæum* of the eccentric. But the epicycle being in any other part of the Eccentricke there is alwayes some æquation of the center; yea in some parts thereof, where it groweth greatest, it is 13 deg. 9 minutes: and so long as the center of the epicycle, is in the half of the eccentric descending from the *Apogæum* to the *Perigæum*, that æquation is to be added to the motion of the epicycles; but in the other halfe of the Eccentric ascending, it must be subtracted; that so the true Argument or Anomalie of the Epicycle may be had.

11 The Argument, or Anomalie of the Moone is nothing els, but the motion of the Moones Epicycle.

12. The true or middle argument, or Anomalie, is the arch of the Epicycle from the true or

middle *Apogæum* of the Epicycle, vnto the center of the body of the moon, reckoned that way, which the epicycle moueth.

13 The æquation of the argument, or *Prosthaphæresis* of the epicycle, is the arch of the zodiack, betweene the middle, & true place of the Moone. This æquation is nothing, when the moone is in the true *Apogæum*, or *Perigæum* of her epicycle. But it is greatest, when the center of the moone cometh to the line, drawne out of the center of the world, and touching the epicycle, when it is in the *Perigæum* of the eccentric.

And the moone being in the first, that is in the Westerly half of the Epicycle, counted from the true *Apogæum* therof, the middle place of the moon goeth before the true place, and the æquation of the argument must therefore be subtracted: but when the moone is in the other latter, and easterly semicircle of the Epicycle, the true place goeth before the middle place, & so that æquation must be added to the moones middle motion, that the true motion and place of the moone may be found.

The reason of the variety of the Moones æquation shewed by this sphere.

CHAP. 15.

THis æquation becommeth lesser or greater, according as the epicycle is further of, or nearer to the center of the world. The least æquations are, when the epicycle is in the *Apogæum* of the eccentric,

trick, & contrarywise, the greatest must happen, the epicycle being in the *Perigæum* of the eccentric.

The difference betweene these greatest, & least æquations, *Ptolemee* and *Copernicus* call the excesse: but *Purbachius*, and the *Alphonsines*, call it the diuersitie of the diameter; because that difference of the æquations, ariseth by reason of the diuerse apparent bignesse of the diameter of the Epicycle, according as it is nearer to vs, or further from vs.

Therefore in the Astronomicall tables, they vse to set downe those æquations only, which happen when the Epicycle is in the *Apogæum* of the eccentric, which are the least æquations, whereto they also adioyne the excesse, or diuersity of diameter, shewing how much those æquations, which happen when the Epicycle is in the *Perigæum* of the Eccentric, exceede those which happen, the epicycle being in the *Apogæum* of the eccentric. Moreover, there are annexed certaine min. which they call *Scrupula*, or *minuta proportionalia*: that is, proportionall minutes: whereby is found, how much of the sayd excesse, is to be added to the foresayd æquations, when the epicycle is in any other part of the eccentric, then in the *Apogæum*: that so the true æquation of the argument, for the same part of the eccentric might at any time be found. For then onely is that whole excesse to be added, when the epicycle is in the *Perigæum* of the eccentric. But if the epicycle be in any other part of the eccentric; then looke what proportion 60 hath to the whole excesse, the same proportion haue the proportionall minutes, answerable to that part of the
eccen-

centrick, wherein the epicycle is, vnto the part proportional of the excesse, which (part proportionall) being added to the æquation before found, shall giue you the true æquation.

The reason of the moones proportionall minutes shewed by this Sphere, and how to finde the same.

CHAP. 16.

THe reason of those proportional minutes, may in some sort be shewed, by those concentric all arches of circles, which you see drawne vpon the moones eccentricall orbe, in this sphære: but indeede all those arches must be vnderstood, to haue alwayes the same center with the world, and not to be moued about together with the eccentric. The vppermost of them is to be drawne by the center of the epicycle being in the *Apogæum* of the eccentric, and the nethermost is drawne by the same center when it is in the *Perigæum* of the eccentric: so as the distaunce of these two arches, or peripheryes, is iust twise so much as the eccentricitie; that is the distaunce of the center of the eccentric, from the center of the world, shewed by the distaunce of the short lines *NO*, or *FF*, vpon the orbe carying the *Apogæum*; or of *PQ*, or *GH*, vpon the caryer of the *Perigæum* of the moone.

The whole distance, betwene these two peripheryes, from the vttermost to the innermost, is vnderstood to be deuided into 60 æqual parts, imagining euery one of these to conteyn 10: as may appeare by the figures set to euery one of them, from the vppermost

most to the nethermost in this order 10 20 30 40 50 60.

Now the interfections of these *Peripheries* with the eccentric (that is, with the vppermost of the two deuidd *peripheries*, which are drawne round about through the midst of the moons eccentricall orbe) do shew what proportionall, min. ansuere to any part of the eccentric, after this manner : In the vppermost of the two forelayd graduated *peripheries*, looke that distance of the center of the moons epicycle from the *Apogæum* of the eccentric, (that is to say) that doubled longitude of the moone as the *Alphonsines* call it) which you desire Then looke which of the concentricall arches before mentioned passeth by the terme, or end of that distãce, or doubled longitude: And thirdly, looke about in the same arch, what number is set therupon for that sheweth you the number of the proportionall minutes, answereable to the situation of the epicycle, at that distaunce from the *Apogæum* of the eccentric.

These proportional min. therefore may be defined to be nothingels, but the sixtyth parts of the diuersities of diameters, of the excesse where with the æquations of the argument, or *prostaphareses* of the Epicycle: are to be augmented, when the epicycyle is any other part of the Eccentric, then in the *Apogæum*.

Otherwyse also, these proportional min. may be defined, to be sixtieth parts of the excesse, wherewith the line drawn from the center of the earth, to the *Apogæum* of the moons eccentric, exceedeth the line drawne from the same center to the *Perigæum* of the eccentric For these sixtieth parts also may not vnfitly be called proportionall minutes, because that alwayes, looke how many of these parts there are left without the circumference of the eccentric, or beyond the center of the

The Epicycle of the Moon
 as it is called in the
 Alphonsines
 and is the same
 as the Epicycle
 of the Moon
 in the Alphonsines
 and is the same
 as the Epicycle
 of the Moon
 in the Alphonsines

epicyclic; so many of the former sixtyeth parts of the diuersity of diameter, or of the excesse of the *prosthapheresis* of the Epicycle, must be added to the æquation of the argument, that the true æquation of the argument may be had, for that position, or situation of the Epicycle, in the eccentric.

The reason of the eclipses of the sunne and moone, shewed by this Sphere. CHAP. 17.

NOW by this sphere, it may easely be conceyued, why there is not an eclipse, in euery coniunction or opposition of the sun & moone. For seeing that the moone hath for the most part a greater apparent latitude, then the visible or apparent conioyned semidiameters of the sun & moone in the coniunction: & because the true latitude of the moone, is also for the most part greater then the apparent semidiameters of the moone and shadow of the earth (at that place where the moone should passe through that shadow) in the opposition, to make an eclipse: it commeth to passe, that in most coniunctions & oppositions of the sun & moone, there is no eclipse. And the reason hereof is this, because that the moone commeth vnder the way of the sun (which we called the ecliptick line) onely twice in a moneth, and those two points (wherein the wayes of the sun & moon crosse each other) onely twice in a synodical month, which two points we called the dragons head & tayle; (wherof we haue also spoken before.) Wherefore, seeing the sun (going but once onely through the compasse of the eliptick in a yeare) can come but once in a yeare to eyther of those points; the moone for the most part, when she commeth to be in opposition, or coniunction with the sun, must needes be so.

be so farre wide from the ecliptick line, or way of the sun, either towards the north or south: that she can neither come betwixt vs and the sunne in the coniunction, nor yet within the compasse of the shadow of the earth in the opposition.

But when the sun commeth neare eyther of those points (which hapneth once in six months) there must needs for the most part be some elipse, eyther of the sunne, or moone, or both.

*Of the diuersitie of the bounds or spaces, within which
an eclipse may happen: and the reason of that
diuersitie.* CHAP. 18.

THe bounds or distaunces from the Dragons head or taile, within which there may happen an eclipse of the moone, are sometimes greater, and sometimes lesse, by reason of the diuerse distances of the sunne, or moone, or both of them, from the earth. For seing the body of the sun is greater then the globe of the whole earth (as it is manifestly demonstrated by *Ptolomee* and *Copernicus*) it must needs be, that the greater distaunce the sunne hath from the earth, the greater shadowe must the earth haue; and the nearer the sunne is to the earth, the lesse shadowe shall the earth haue, at the place of the moones passage through the shadow, at equall distaunces from the earth.

Contrariwylse, the further that the moone is from the earth, the lesse shall the shadowe of the earth be, & the nearer the moon is to the earth, the greater shall the shadowe be, at the place where the moone is to passe through the shadow.

The greatest distaunce therefore from the dragons head or taile, wherein there can at any time happen any

eclipse of the moone, is about 13 degr. And the least distaunce at which it is possible for the moon to auoid an eclipse, is about 10 degr. and one third part of a degree; which hapneth when the moone is in the *Apogaeum* of her epicycle, in her greatest distaunce from the earth, and the sun in his *Perigaeum*, in the time of his greatest eccentricity, for then the sunne commeth nearest to the earth and maketh the least shadow: as contrariwise at the same time of his greatest eccentricitie, being in his *Apogaeum*, he hath his greatest distance frō the earth, and so maketh the earth cast forth hir greatest shadow. At which time, if the moone also chance to be in the *Perigaeum* of hir epicycle, and so in hir nearest distance from the earth, she may be something eclipsed, although she be full 13 deg. or something more from the Dragons head or tayle.

How to finde the place of the Dragons head or tayle for any time. CHAP. 19.

NOW the place, and time of the full moone, being easely knowne, by some almanack, or Prognostication; it shall not be hard, to giue a reasonable neare estimate, and to foretell both the time, and quantitye of the eclipse of the moone, the place of the Dragons head & tayle, being first knowne after this manner.

The place of the dragons head, being first giuen for any time, for euery yeare before the same time, adde to the same place: & for euery yeare after the same time subtract 19 degr. & one third part of a deg & for euery moneth a deg. & an half & a tenth part of a deg. & for euery day 3 min. & the remainder shall shew you the place of the dragons head after the same time: or the same before that time, without any great error.

As for example, the 30 of Iunethis present yeare 1600, suppose you would know the place of the Dragons head: The place therefore of the Dragons head being first giuen, for the beginning of the same yeare, in 0 degr. 45 min, of *Aquarius*: and six moneths onely of that yeare being passed, I take for those six moneths 6 deg. and 6 half deg. that is 9 deg. and six tenth parts of a deg. that is 36 min. the summe of al which is 9 deg. and 36 minutes.

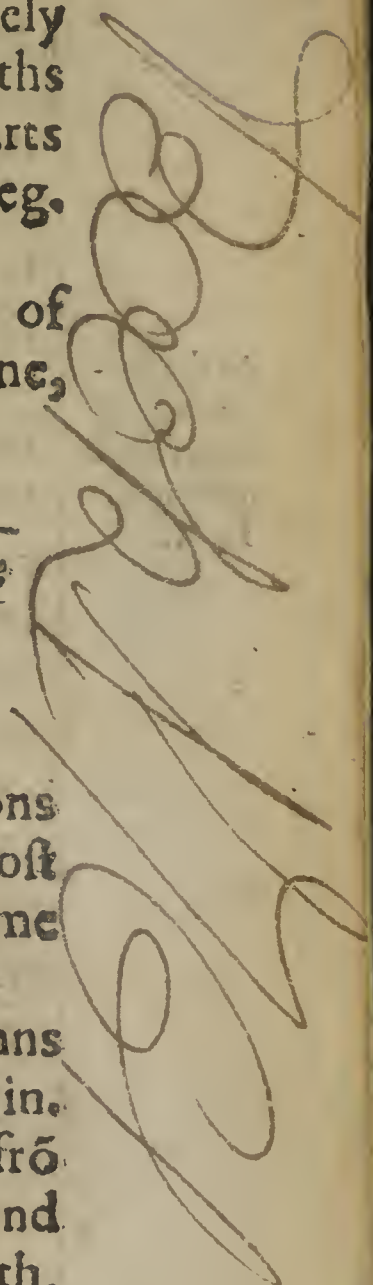
Which being substracted out of 0 deg, 45 min. of *Aquarius*, there remaine 21 deg. 9 min. of *Capricorne*, for the place of the Dragons head at that time.

A table for finding the plase of the dragons head and saile more exactly and the declaration thereof.

CHAP. 20.

BVt if you would haue the place of the Dragons head more exactly, you may finde the same most easely, by meanes of the table following, for any time within the space of these 20 yeares yet to come.

This table conteyneth 3 principal parts, or columns the first part sheweth you in what signe, degr. and min. the dragons head is, at the beginning of any yeare; frō this present yeare 1600 till the yeare 1620. The second part sheweth, how much the Dragons head moueth, in any number of moneths of the yeare: the third part giueth you the motion of the dragons head, in any number of dayes of the moneth.



At the beginning of the yeares of our Lord.

The place of the Dragons head.				Moneths				
Yeare	Sign.	Deg.	Mi.	Complete.	De. Mi.	Day	De. Mi.	
1600	Aquarius	0	45	Januar.	1. 38	1	0.	3
1601	Capricorne	11	21	Februar.	3. 8	2	0.	6
1602	Sagittari.	22	2	March	4. 46	3	0.	10
1603	Sagittari.	2	42	April	6. 22	4	0.	13
1604	Scorpio	13	22	Maye	8. 0	5	0.	16
1605	Libra.	23	59	June	9. 36	6	0.	19
1606	Libra.	4	39	Julie	11. 14	7	0.	22
1607	Virgo	15	19	August.	12. 53	8	0.	25
1608	Leo	25	59	Septemb.	14. 28	9	0.	29
1609	Leo	6	35	October	16. 7	10	0.	32
1610	Cancer	17	15	Novemb.	17. 42	11	0.	35
1611	Gemini	27	55	Decemb.	19. 21	12	0.	38
1612	Gemini	8	35			13	0.	41
1613	Taurus	19	12			14	0.	44
1614	Aries.	29	52			15	0.	48
1615	Aries.	10	32			16	0.	51
1616	P. sces	21	12			17	0.	54
1617	P. sces	1	49			18	0.	57
1618	Aquarius	12	29			19	1.	0
1619	Capricor.	23	9			20	1.	4
1620	Capricor.	3	49			21	1.	7
						22	1.	10
						23	1.	13
						24	1.	16
						25	1.	19
						26	1.	23
						27	1.	26
						28	1.	29
						29	1.	32
						30	1.	35

To finde

To finde the place of the Dragons head or tayle,
by the former table.

CHAP. 21.

FInde out in the former table, the moneth next going before the moneth giuen; finde out also the day of the moneth, Adde together the numbers of degrees and minutes answerable to that moneth and day of the moneth, & subtract the same out of the place of the Dragons head at the beginning of the yeare, adding thereto 30 degr. (that is the whole signe next going before resolued into degr.) if the sunne aforesayd be greater then the number of degr. shewing the place of the dragons head at the beginning of the yeare: so shall you haue the place of the Dragons head for the time giuen And the point of the zodiack opposite to this, is the place of the Dragons taile.

Take for example, the 29. of Nouember 1601. I finde therefore against October (the moneth going next before Nouember) 16 deg. 7 min. & against the 29 day 1 deg. 32 min. the sum of both these added together is 17 deg. 39 min. The place of the dragons head for the beginning of the yeare 1601 is 11 deg. 21 min. of of Capric. which because they be lesse then 17 deg. 39. min. I add vnto them 30 degr. that is the whole signe of Sagittarie, and the summe of both is 41 degrees 12 minutes, out of which subtract 17 degrees 39 minutes and there shall remaine 23 degrees 42 minutes of Sagittarie; the place of the dragons head at that time. And the point of the zodiack which is opposite hereto (that is the 23 deg. 42 min. of Gemini) is the place of the Dragon: tayle.

To know at what time there shall be an eclipse of the
moone.

CHAP. 22.

THe place of the dragons head being thus knowne, finde out the same place vpon the horizon of the sphære, and see what day and moneth answereth thereto: finde out also the place of the full moone, which hapneth next before or after that day, which

W
E
C
M
M

By the former table

which place if it chaunce to be within 11 or 12 degr eyther before or after that point of the zodiack which is opposite to the dragons head, there must needs be for the most part an eclipse of the moone.

Likewyse if you finde what day and moneth is aunswerable to the place of the dragons tayle vpon the horizon of the sphaere if the place of the full moone which happeneth next before or after that day chaunce to be within 11 or 12 degr. of the dragons head, for the most part there shall be an eclipse of the moone.

As for example The 20 day of Ianuarie last this present yeare 1600 the place of the dragons head was fownd (by the former Chap.) to haue beene in 29 deg. 41 min. of Capricorne; where to ther answereth in the horizon the 10 day of Ianuary the place of the full moone hapning next after, vpon the 20 of the same moneth in the morning must needs be in the place opposite to the place of the sunne the same 20 day: Therefore because the sunne that day is in 9 degr. and about on half of Aquarius, therefore the place of the full moone shall be in 9 degr. and about one half of the signe opposite to Aquarius that is of Leo; because it is within lesse then 12 degr. of the dragons tayle (for the dragons tayle is in the 29 deg. 41 min. of Cancer that is in the place opposite to the dragons head, being in the 29 deg. 41 min. of Capricorne) therefore there was at that time an eclipse of the moone: Also because the place of the moone, the same day at noone, was about 12 degr. and on halfe of Leo; that is, about 3 deg. more then at the time of the ful moone eclipsed; it may hereby appeare abating for euery deg. 2 howres, that the midst of the eclipse was about 6 of the klok in the morning.

FINIS.***

