

The arte of navigation, conteyning a compendious description of the sphere, with the makynge of certen instruments and rules for navigations / Translated out of Spanyshe ... by R. Eden.

Contributors

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183 Euston Road
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De Arte Navigationis

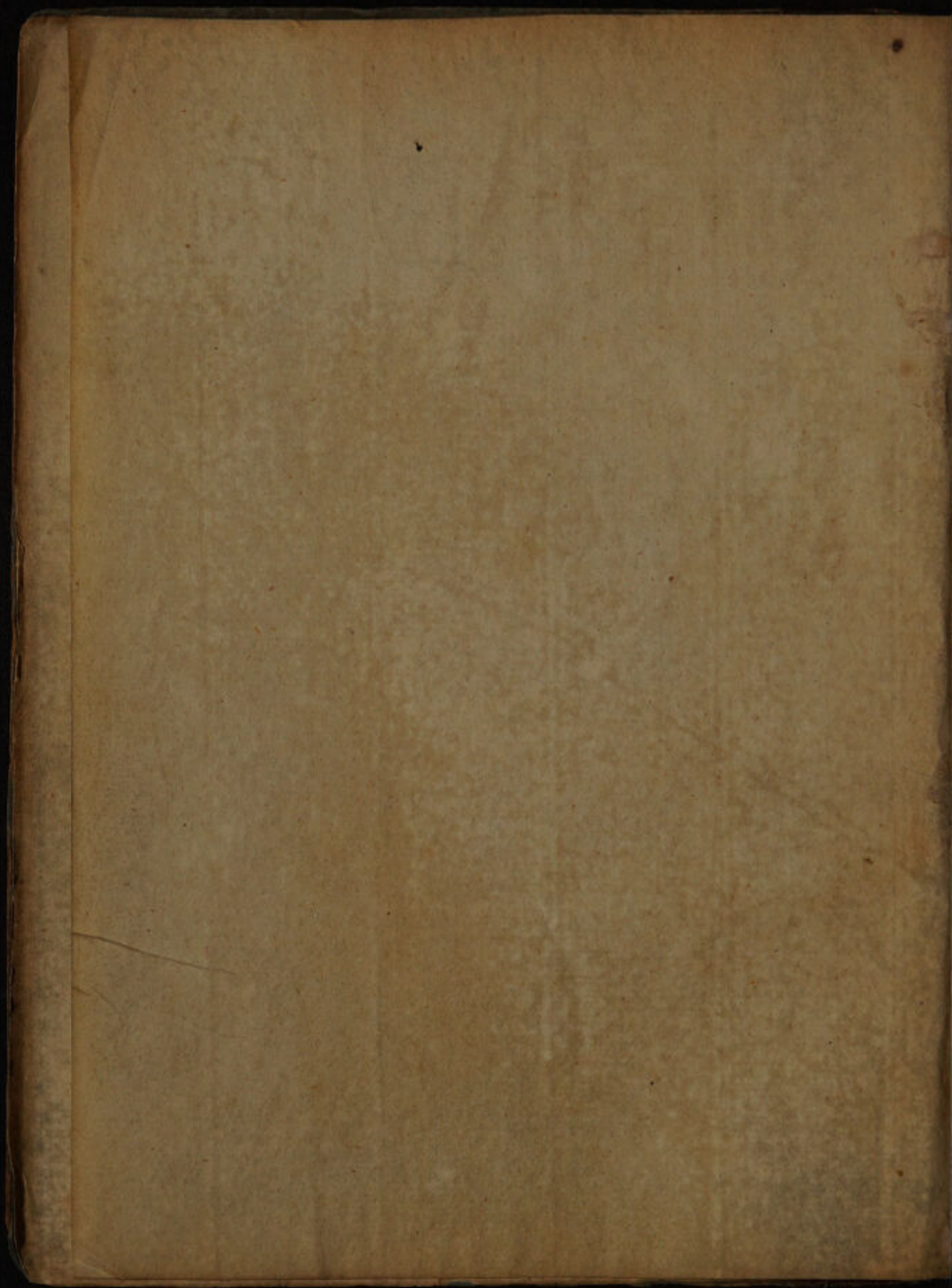
first English translation very scarce

Cortes (M)

The Art of Navigation
London 1561.

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To the ryght worshypfull syr VVyllyam Garrerd

Knyght, and Master Thomas Lodge,

Aldermen of the Citie of London, and Gouer-

nours of the honozable felowshyp or societie,

aswell of certeine of the Nobilitie, as of

Marchauntes aduenturers, for the disco-

uery of Landes, Territories, Flan-

des, and Seignories vnknownen,

and not before their first aduen-

ture or enterpryse by Seas or

Naavigations commonly

frequented:

And to the right worshypfull the Consulles,

Affixentes, and comminaltie of the

same societie, Richarde Eden

wyssheth health and

prosperitie.



That soeuer he was (ryght ho-
nozable and worshypfull) that fyrste
beleued that the frame and coaptacion
of the bodye of man, with the funci-
ons, offices, and duties of the partes
and members of the same, knytte to-
gether in a certen vnitie to a common
ministracion, dyd represent a lyuely

Image and similitude of a perfecte common wealth: I
thynke that he was a man of no bulgare iudgement or
abiecte mynde, but rather of singuler wysdome and pru-
dence in the contemplacion of Diuine and humane thyn-
ges. For he sawe, that as in the small natue seede of
all growyng or lyuing thinges, is conteyned the fourme
that byngeth them to theyr perfection: so in certeyne
small and obscure members of the common wealth, con-
sisteth no small increase to the perfection of the whole.
He sawe lykewyse that herein, as in the bodye of man
representyng the partes and members of the worlde (as
I haue sayde) are dyuers partes of dyuers and sundrye
actions and motions, greatly dyfferyng in fourme, num-
ber, and

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ber, and quantitie, yet all the same to be so knytted together, and so to consent in one vniformitie to the common profyte of the whole, that a greater concord and harmonye can not be imagined, then is proportioned by the friendly unitie of dyuers and contrarie. We saue lyke wyse in the same, such a mutuall compassion of parte to parte, and member to member, by one common sence existent in them all, that no one part or member can feelee yther ioye or payne, but that in maner all the other are parttakers therof more or lesse, yf they be lyuely members, and not wythered or otherwyse vnensate by reason of dead fleshe, which onely by cutting and burning ought to be deuyded from the sounde and whole. But as in man (whom Plato calleth the lesse world) the vigour and agilitie of the immortall soule and mynde, nsuer ceaseth from continuall mouyng, but is ener exercysed in excogitations and inuentions of great thinges (here in resemblyng God, whose caracte it beareth) by prouidence forseeiing, and by intelligence vnderstandyng and deuyng what is to be done, and what to be eschewed, doth immediatly moue & rapse vp the faculties, powers, and members of the body to execute the same: Euen so in the greater worlde, the prouidence of God, and vniuersall counsaile and consent of men, hath elected and appoynted certen principall men, to beare lyke rule and auctoritie in the bodye of the common wealth, as hath the intellectuall soule in the members of our bodye to moue and commaunde the same. To Princes therefore counsaylours, rulers, gouernours and magistrates, as to the most intellectuall and sensitiue partes of the societie of men, hath God and nature geuen preeminence & gouernaunce of the common wealth, that by theyr prouidence, wysdome, and ayde, it may vniuersally florysh, not onely by iuste administration of good lawes, with due correction of malefactours, but also by lyberall rewarding of suche as haue well deserued: and especially by maintenaunce of suche artes and sciences, as the common wealth can not well be without. And to draw
nearer

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neerer to the applyinge of my similitude : I saye, that
whatsoever vertue, whatsoever arte, or the ingenious
industry of men hath to this day inuented, all the same
is to be imputed to the beneuolence and liberalitie of
suche as haue honourablye maintayned and freely re-
warded the trauayles, paynes, and charges of them that
haue spent theiꝝ lyues, goodes, and wyttes (as many
haue done) in the inuentions of necessarye and profyta-
ble artes and sciences. For euē as holosome and tempe-
rate ayre with seasonable wether and fauorable influ-
ence of the heauens and planettes, causeth fruitefulness
on the earth, and contrarywyse, barrenesse by the con-
trarye : Euē so the fauour of Princes and Magistrates
nourisheth, augmenteth, and amplyfeth all artes and
sciences by liberalitie, and extynguisheth the same by
miserable couetousnes and parcimonie. And althoughe
in some men of rare and noble nature, the desyre of ho-
nour and fame onely for vertues sake, and study toward
theiꝝ countrey and common wealth, hath moued them
in maner to theiꝝ owne vndoyng throughe theiꝝ greate
losse and hynderaunce, to sette forth and inuent diuers
thynges for the commoditie of the common wealth and
other, rather then for theiꝝ owne: yet vndoubtedly, who
so wel considereth and indifferently wayeth that I haue
sayde, shall fynde and see by daylye experience, that in
maner onely munificence, liberalitie, and rewarde, or
the hope thereof, geueth spurres to them that attempte
great and vertuous enterpryses, as I coulde more large-
ly proue by so many testimonies of Hystories, both holy
and prophane, that the rehearfall therof shoulde be but
tedious and not greatlye necessarye for my purpose,
especially wytyng vnto your honoures and woꝛshypps,
of whose munificence and liberalitie, I haue had great
experience, bothe in my selfe and others, who by your
ayde and mainteynaunce haue attempted and per-
fourmed many goodly inuentions, viages, navigations
and discoueries of landes & Seas heretofore vnknewen.

¶ Herein

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Wherein, what great charges you haue suffeyned, and howe lyberall and constant you haue ben in furtherynge the same, doth well declare that hyther to you are rather losers than gayners therby. The whiche thyng doubtlesse is the more to your commendation, in that it maye hereby appeare that you haue attempted the same rather for knowledge and vertues sake, then for conetousnes of gaynes: as is furthermore well knowen by your fyrste viages of discouerye attempted to Cathaye by the Northeast seas, vpon certen losse and detriment, for vncerteyne hope eyther of gaynes, or of any such way to be founde, otherwyle then by certen lykely coniectures: not muche vnylike to the shynnyng flowres of Sparchasites, which outwardly appearyng in minerall mountaynes, are signes and token wherby is coniectured what metal is conteyned therein, and whether the same is to be folowed or not. And although it sometyme so chaunce that such signes are fayleable, shewyng more in appareance then they conteyne in substance: yet are not such signes tokens, or shewes to be contemned, but rather earnestly to be folowed, forasmuch as it hath ben often proued and founde by experience, that by folowynge the same, haue ben founde great and riche mynes of metalles: as Georgius Agricola in his booke De rebus metallicis, doth largely declare and proue by manye examples. But to wyte at large what greate thynges haue proceeded of small and obscure begynnynge, and in maner mere coniectures: it woulde so farre exceede the measure of an Epistle or Preface, that it woulde rather increase to the iust quantitie of a booke. For in maner all the late discoueries both of the Spanyardes & Portugales, had they begynnynge of such small coniectures, with vncerteyne hope (as it were preter spem sub spe) vntyll God and good happe, by the constant trauayle and valiaunt mynde of such as fyrst attempted the same, gaue them to enioye that they hoped for. But whatsoeuer they haue obteyned and do enioy, this may I boldly say in your behalf (right honozable and worshipfull) that there hath not lacked in you eyther the lyke or greater promptnesse of mynde, for ward.

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forwardnes in attemptyng, magnificence in expences,
and liberall in rewarde. For besyde the great charges
and losses that you haue ben at otherwyse, what should
I speake of the great gyftes that you haue sente to the
Emperour of Russia: What of your last chargeable vy-
age of discouery among the innumerable Rockes, I-
landes, and moueable mountaynes of Ice in the frozen
sea, by innumerable landes and Ilandes vnknoen to
the Antiques, euen vnder and farre within and beyonde
the circle Arctike, where they thought that no luyng
creature coulde draue breath or liue for extreme colde:
wheras neuerthelesse the same hath ben by you discou-
red euen vnto the myghtye ryuer of Ob, that falleth in-
to the Scythian Ocean, or Oceanus Hyperboreus, not farr
from the mountaynes called Hyperborei, so named be-
cause they are situate almost vnder the North pole, and
thought therfore to be inaccessible. A vyage doubtlesse
of such difficultie and in maner impossibilitie, that con-
sydering the infinite daungours therof (as I haue lear-
ned by thinfoimation of Steuen a Burrough, that was
then the chiefe Pilote of the same vyage) it may seme im-
possible that they shoulde euer haue escaped, excepte the
myghtye hande of God, by the experte skylfulnesse of so
excellent a Pilot, had delyuered them from those daun-
gers. And although in dede (as religion byndeth vs) it
is conuenient in all thynges to geue all honour, glo-
rye and thanks to God, yet are we not thereby restrayned
to be thankfull to such men, as by theyr arte, ingenious-
nes, trauayle, and diligence, haue deserued both iuste
commendation and large rewarde. And therfore refer-
ryng the rewarde to you (ryght honozable and woorthy-
full, to whom it apperteyneth) yf I should not here geue
hym at the leasse suche commendation, as in my iudge-
ment he hath well deserued, I myght seme both to de-
fraude hym of his woorthye desertes, and also to forgette
the frendshyp and good wyll I beare hym, onely for his
vertues and excellencie in his profession. For certeynly
when I consider how indigent and destitute this Realme
is of excellent and expert Pilottes, I can do no lesse of
conscience

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conscience, then in respect of your owne commoditie, yea rather for the commoditie of the Queenes Maiestie and the whole Realme, to exhort you and put you in remembrance (although I may herein seme to put the spurre to a runnyng horse, as saith the Proverbe) so to regard hym and esteeme hym and his saythfull, true, and painefull service towarde you, that he maye thereby be further encouraged, and not discouraged, eyther for lacke of maintenaunce, or other wyse by the iniurious assaults of such his enemies, as onely his vertues and excellencie haue moued to beare hym displeasure, as enuye both euer folowe vertue, as saith the Latin Proverbe, Virtuti comes inuidia. And howe true a sentence this is, is well verified by the saying of a certayne Philosopher (whose name I do not remember) who hearynge one baynely reioyce that he had no enemies, answered that that was a token he hadde done lyttle good: Meanyng thereby (as dayly experience proueth) that yf he had excelled in any vertue, he coulde not haue lacked some enemies. And haupng here touched to speake of enuye, I remember that when I was a yonge scoler, I haue read in the Poet Hesiodus of two kyndes of enuye, whereof the one is called Inuidia, and the other Aemulatio, which is more tollerable then the fyrste, for that it is ioyned with some vertue, and enuyeth that anye shoulde excell hym in any excellent qualitie that he professeth. But forasmuch as this enuy of emulation proceedeth of some singuler vertue of them that are so maliced, they maye herein reioyce, that they shall euer haue a hundreth frendes for one enemy: yea and although they hadde none, yet is vertue a rewarde to it selfe, and to be embraced for it selfe onely, as the Philosophers affirme. What then shall we say to such, as forgettyng this rewarde of vertue, do not onely fauour, but rather hynder the preferment and mayntenaunce of such experte men, more esteemyng certeyne Fysher men that go a trawlyng for fysh in Catches or mongers, and dradgies for Mysters about the sandes, betwene the South furlande

and

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and Wynterton nesse, and the sandes about Temmes mouth, then they do suche excellent Pylotes as are able without any Rutter or Carde of Nauigation, not onely to attempte longe and farre viages, but also to discouer vnknown landes and Ilandes, as haue doone of late yeares many excellent men, to the great honour and enrychying of their Prynce and countrey. But as touching Steuen A Bzrough, the chiefe Pylote of your viages of discouery, it may hereby well appeare y he is neyther malicious nor enuious of his arte & science, in that he desireth y same for the comon profite to be comen to al mē: And for the same intent was the fyrst that moued certen woꝛshypfull of your company, as Syr William Gar- rerd, Maister William Pericke, Maister Blase Sanders, and Maister Edward Castlen, to haue this worke translated into the Englyshe tongue. Who of their own good nature fauourynge al vertuous studies and the professours of the same, did sone incline to his honest request herein: and therewith not only desired me, but also with liberall rewarde entertained me, to take in hande the translation. Whiche being nowe finished as well as my pooze learnynge may perfourme, I desyre your honours and woꝛshippes, to accepte in as good parte as I haue ment herein to gratifie you, and doe suche seruice as my abilitie may suffice. Howe therfore this worke of the art of Nauigation, beyng publyshed in our bulgar tongue, you may be assured to haue more store of skylful Pilotes. Pilotes (I saie) not Pirottes, Rulers, not Rovers, but suche as by their honest behauour and conditions toynded with arte and experience, may doe you honest and true seruice: whiche is not to be looked for of suche as beyng destitute as well of the feare of God as of all moꝛal vertues, superbounde in all notorions byces, accoumpting desperatnesse for boldnesse, rashnesse for hardinesse, impudencie for stoutnesse, and crueltie for manhod. What other thynge (I saie) is to bee looked for of suche, then of suche trees suche fruites, Et mali corui malum ouum. But

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for as muche as these haue no place appointed them in the bodie of our common wealthe, whiche we haue here before compared to the members of the bodie of man: therefore are they no otherwyse to bee esteemed then as excrementes of the bodie, to whom nature hath appointed no place in the same, but labourerth continuallye to cast them forth by diuers wayes, leaste by theyr filthynesse they should infecte the other members, even as the pompe of the shyppe if it be not auoyded, is noyous to the shyppe and all that are therein. But the wyse and honest Pilot, fyrst hauyng before his eyes the feare of God, and puttyng his chief trust in hym, shall secondarely trust to his arte and science, without any suche bayne obseruations as the superstitious Horoscopers (Astrologiers I meane, and not Astronomers) are accustomed to vse in the elections of houres, tymes, and dayes, by constellations and aspectes of the Starres and Planetes, as many fonde menne haue doone, thynkyng thereby to haue escaped suche daungers, as they haue thereby the rather fallen into, throughte contempte of arte and science by folowynge confidence in superstitious Astrologie: which for the vanitie and vncertaintie thereof, the ryght worthy and of singular learnynge in all sciences, Syr Thomas Smyth, in my tyme the floure of the Uniuersitie of Cambridge, and sometyme my Tutor, was accustomed to call Ingeniosissimam arte mentiendi. (That is) the moste ingenious arte of lyeinge. Omitting therefore the superstitious and phantasticall obseruations of the iudicials of Astrologie, it shalbe better and more necessary for all Pilotes that desyre to excelle in theyr profession, to learne and obserue the principles of this booke, whereby they may haue suche knowledge of the Sphere, as may instructe them the makynge and vse of diuers goodly Astronomicall instrumentes perteyninge to the arte of Nauigation, by knowledge of the mouynges of the Sunne and Moone in their Spheres, and the other Planetes and fixe Starres: thereby to attayne to the true knowledge of houres, tymes & tydes, with the variation of the Compasse, and many other goodly naturall obser-

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observations of weathers, tempestes, & calmes, by certain
infaileable signes and tokens of the same, very necessa-
ry to be obserued. And this by the true principles of A-
stronomie and not of Astrologie. And this is the true A-
stronomie wherof the Diuine Philosopher Plato hath
wrytten so diuine a sentence, that I haue thoughte the
same here woorthy to be alleaged, that by the aucthoritie
of so famous an aucthour, we maye knowe what is true
Astronomie, with the vse and commoditie therof. There-
fore in his booke intituled *Timeus vel De Natura*, these
are his wordes. *Rerum autem optimarum cognitionem,
nobis oculi attulerunt. Nam hæc quæ de mundo disputantur,
nunquā inuenta fuissent, si neq; sidera, neque Sol, neq; Cœ-
lū, suspici potuisset. Cognitio vero dici ac noctis, ab oculis or-
ta, fecit vt dimensione quadam, mensum æmorumq; ambitus
metiremur, tempus cognosceremus, ac vniuersæ naturæ ordi-
nē scrutaremur. Quibus ex rebus, philosophiā adepti sumus.*

That is to saye. Our eyes haue brought vnto vs the
knowledge of moste excellent thinges. For what so euer
is disputed of the worlde, had neuer bene inuented, yf
neither the Starres, neither the Sunne, neither heaue,
coule haue bene seene. For the knowledge of the daye &
nyght, takyng beginning at y eyes, caused vs as it were
by certen limites and boundes to measure the circuites
of monethes and yeares, wherby we came to the know-
ledge of tymes and the order of vniuersall nature. And
hereby also we obteyned the knowledge of Philosophie.
etc. And thus by the aucthoritie of Diuine Plato
(whome for hys excellencie Cicero called *Deum Phi-
losophorum* (that is) the God of Philosophers) we maye
vnderstande that the true Astronomie, is the perfecte
knowledge of the miraculous mouinges of y Planetes,
Starres, and heauens (and especially of the Sunne and
Moone) whereby is caused the varietie of times and dy-
uersitie of all naturall thynges, by naturall causes: as
by the qualities of Elementes, as heate, colde, moyste
and drye, whyche are augmented or dymynyshed by the
more or lesse influence of these twoo Luminaries, as
they comme nearer vnto vs at some tymes, or de-

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part further from vs at other tymes, with diuers motions in diuers climates whiche cauleth not onely varietie of tymes in sundry climates, but also the varietie of diuers complexiones, foymes, and dispositions of all creatures vnder the face of heauen, none other accidentall contingent, volutarie or violent cause to the contrarie notwithstanding. And this is it that Plato meaneth by those wordes. *Vt tempus cognoscereimus ac vniuersae naturae ordinem.* &c. That is, to knowe the tymes and vniuersall order of nature. And doubtlesse, who so well considereth the marueilous effectes that are caused, especially by the variable mouing of the Sunne in the Zodiac, must needs acknowledge it to be the chiefe instrument & meane that God useth in the generation, preservation, and alteration of all creatures that are conteyned in the worlde of generation and corruption. And for this consideration, certen of the auncient Philosophers called it the soule of the worlde: Other the eye, and other also the heart of the worlde. Plato also affirmeth that the soule of the worlde is in the Sunne: And that all other liuing thynges, receiue lyfe from thence. And hereof commeth the sayinge of the Philosopher, *Sol & homo generant hominem:* (that is) the Sunne and man, begette man. And therefore (as wyrteth Marcius Ficinus) of all Idolaters they are most tollerable that honour the Sunne for God. The whiche although it bee not, yet vndoubtedlye are his effectes so greate and wonderfull in this inferiour worlde, that it may seme in maner to be Gods Vicegerent, Lieutenant and Viceroy in al the woorkes of nature, excepte where and when it pleaseth hym in any thyng myraculouflye, otherwyle then by the common order and course of nature, to commaunde the contrarie.

And yf it may not be tedious vnto you (ryght honorable and worshipfull) it shalbe a pleasure vnto me, for the better declaracion hereof, to make a bryefe discourse of the marueilous and straunge effectes that are caused by the Sunne: whiche perhappes fewe haue done, otherwyle

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wylse then dispersedly here and there, as occasion hath serued. First therefore let vs consider what it hath done ouer the Equinoctiall line, and vnder both the poles at one instant, yet diuersely and contrarely the one to the other. For so hath the infinite wylsdomme of the greate God of nature, the supreme Architecture of the vniuersall worlde, disposed all thynges in such perfecte order, that to them that are vnder the Equinoctiall, and haue theyr Horizon passyng by the two Poles, the daye is of xii. houres and the nyght as much, and theyr yeare also is deuyded into xii. monethes: But they that dwell iust and perpendicularly vnder our pole, and that haue their Horizon passyng ouer the sayde line, haue the daye of syre monethes. That is to saye: begynnynge from the tenth daye of Marche, when the Sunne commeth ouer the sayde Horizon, vntyll it returne to passe vnder the same at the tenth of September. And contrarywylse one nyght of syre monethes haue th inhabitantes vnder the Pole Antartike: whose yeare (that is to saye, all the course that the Sunne maketh by the. xii. signes of the Zodiac) is accomplished in one daye and one nyght. A thyng doubtlesse mosse wonderfull and marueylous. Lykelwylse, when we haue Sommer, they that are vnder our Pole haue the day of syre monethes, and they of the opposite or contrary Pole, haue theyr nyght of the same length. Agayne, when it is wynter with vs, then vnder our Pole is the nyght of the sayde syre monethes: & vnder the opposite Pole, is the day of the same length. So that as it were course by course, when we haue the night, they haue the day: And contrarywylse, when we haue the day, they haue the nyght. The which although it be so longe and of so great space of tyme, yet is it not continuallye obscured with darkenesse. For the Sunne maketh his course in such order, that the inhabitantes of that parte, lyue not durynge that tyme altogether in darkenesse, as Poles lyue vnder the grounde, but as other creatures that lyue vpon the globe and face of the earth,

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earth, they haue suche lyght as maye suffice to sustayne and mayntayne theyr lyfe. For the bodye of the Sunne declineth no more eyther beneath the Equinoctiall line, eyther aboue the same line (which is the Horizon to both the Poles) then. 23. degrees: That is to saye, no lower or hygher then the Tropikes, whiche are no more then 23. degrees or there about from the sayde Equinoctiall that is the Horizon, as is aforesayde. And yet in these 23. degrees he maketh not his course by the opposite Diameter, but goeth continually rounde about in circuite: so that his beames reuerberatyng heauen, represente suche a maner of lyght, as we haue in Sommer two houres before the Sunne ryse. And this example which we haue taken of the diuersitie of the Horizons of the Equinoctiall and vnder the two Poles, is to demonstrate the marueylous effecte that the Sunne maketh departyng from the .xii. houres of the Equinoctiall (that is to say, from Aries to Libra) and commyng by lyttle and lyttle, illuminatyng the globe of the earth, and so reduceyng the yere of .xii. monethes, into one onely day and one nyght, as is sayde before. Under the infinite varietie of the which course, sometyme with long dayes and sometyme with shorte, all the inhabitantes of the worlde are fourmed and disposed of suche complexion and strength of body, that euery of them are proportionate to the Climate assigned vnto them, be it hotte or colde: And may dwel & abyde there, as in theyr natural place and temperament, not lamentyng or despyng to dwell elswhere, so greate a loue resteth in them to their native situation. But not to departe from the byage whiche the Sunne maketh in one whole yere, as sometyme appoachyng neare vnto vs, and sometyme departyng from vs. I saye that at one selfe same tyme in diuers partes vpon the rounde globe of the earth, it causeth the Spryng, Sommer, Autumne, and Wynter. And neuerthelesse at the same instant and punct of time it maketh day and high noone in one place, and nyght at mydnyght on the opposite part. The which varietie although

The Preface.

though it appeare incomprehensible to the tenderneſſe of our wittes, yet beholdynge the ſame with the eyes of vnderſtandynge, and therewith conſiderynge the vneſtimable mouynge that the Sunne maketh continually, we ſhall fynde it to be true, hauynge reſpecte to the dyuers ſituations of the earth, as it is continuallye illuminate moze or leſſe by the Sunne. And this varietie is made with ſuch a Harmonye and conſonancie, and ſuch a lawe perpetuall and immutable, that yf any poynť or ptecke therof ſhoulde ſayle, it is to be doubted leaſt the elementes ſhould be confounded together, and returne to their fyrſt Chaos.

And to haue ſayde thus muche of the wonderfull effectes of the courſe of the Sunne, it maye ſuffice for an example to proue howe neceſſary a thyng it is, not onely for all Pilottes and Sea men to haue the knowledge hereof, but alſo for all other ſuch as ſhall attempt great and farre viages in vnknown landes and ſtraunge countreyes, as dyd of late maſter Jenkynſon a worthy gentleman, ſette forth by you and mainteyned at your charges, moze lyke an Ambaſſatoure ſente from any Prince or Emperour, then from a companye of marchaunt men. Wherein, what commendation you haue deſerued, to the encrease of your perpetual fame and honour, I referre it to that I haue ſayde befoze. And as touchynge maſter Jenkynſon, what trauayles, paynes, and daungers he hath ſuſteyned, and hardely escaped, and what diligence and art he hath vſed in the ſearching of ſtraunge countreyes, and in the deſcription of thoſe his viages, it were but in vayne for me to wyte much vnto you, vnto whom the ſame is better known then to me. And therfoze to conclud, with rendring iuſt commendations both vnto you and him, I can ſay no moze, but as Plato wyteth in his booke De Legibus. Decens eſt eos ciues laudibus ornare, qui corporis vel animi viribus, res arduas preclarasq; geſſerunt, & legibus libenter paruerunt. That is to ſay: It is decent to commend thoſe Citizens that by theyr induſtry of bodye or mynde, haue done greate aſſayes, and haue wyllyngly obeyed good lawes.

And

The Preface.

And thus effsones desyring your Honours and Wor-
thyppes to accept in good parte whatsoener I haue saide
of good wyll and affection towarde you and your pro-
ceedynges, and with your shielde of Justice and
auctoritie, to defende me agaynste the as-
sautes of such as are enemies to
vertue, and captious of
other mens doinges:

I reste at your
commaun-
dement
to the vttermost of my power, to
do you what seruice
I maye.

()

THE EPISTLE DEDICATO.

rie of Martin Cortes, to the moste mightie
and victorizous Monarch Charles the
Emperour, the fyfte of that
name, kynge of
Spaine. &c.



So greatly were esteemed thynuen-
tours of certain artes and sciences in aun-
cient tyme (as wyrteth S. Augustine in
his bookes De ciuitate dei) that they tooke
them not for mortall men, but honoured
them as immortall Gods. His arryuyng
in Egypt, ordeined common wealthes with iuste gouer-
naunce, gaue them lawes and knowledge of letters: &
taught them also the vse of Plaxe. In consideration
wherof, she was honozed of such as then knewe her, &
reuerenced of them that came after her: In so much,
that they establyshed a capitall penaltie or punishment
of death agaynst all such as eyther in sport or in earnest
affirmed her to be an earthly woman, and not rather a
diuine Goddesse. Ceres being of lyuely wytte & cleare
vnderstandyng, beholdyng in the Cicilians humaine si-
militude and shape to the outwarde apparence, and in-
wardly the fiercenesse of brute beastes: bydeled theyr
customes, and reformed them with newe statutes, tea-
chyng them to tame Oren to beare the yoke, to sowe
wheate for theyr great commoditie, to grynde in the
myll, to kneade in the house, and to bake in the ouen.
In recompence wherof, they made sacrifice vnto her, &
builded many sumptuous temples in honour of her. Sa-
turnus comyng from Creta, gaue lawes vnto the Latines
wherby they myght gouerne them selues, & prescrybed
them maners of lyuyng, teachyng them to tyll and ma-
nure the grounde, and sowe cozne, and to gather rype
fruites in due season. And yf Saturne were profitable
to those nations, and they not unthankfull vnto hym
in that they builded hym alters, celebrated vnto hym
festiuall dayes, and accounted hym in the number of

The first in-
uentours of
artes.

ing.

Ceres.

The Cicils
ans.

Saturne
gaue lawes
to the Lati-
nes.

Tyllage of
the grounde

THE EPISTLE.

The golden
worlde and
reigne of
Saturne.

The worthy
factes of
Charles the
fyrst.

Sicilia.

Spayne re-
formed.

The triumphes
& victo-
ries of Char-
les the fyrst.

the heauenly goddes, namyng him also the father of the
Goddes. And yf (I say) he was to them so profitable, &
that worlde iudged so happy and prosperous for haunyng
so valiaunt a kyng, and so iust a lawe geuer, that it was
therefoze by the mouthes of all men called the golden
worlde and raigne of Saturne: Certes except I greatly
deceauue my selfe, this our tyme is nothyng inferiour to
that. For we knowe certaynly that your Maiestie hath
ben moze profitable to Spaine, then euer was Saturne
to the Latines: And also a moze excellenter lawe giuer
in maner to all Europe, and further to the newe world
lately discouered, then he that gaue lawes but only to a
lyttle cozner of Italy. Wherby I consider that the felici-
tie of your Maiesties tyme hath ben no lyttle commen-
dation to your doynge, in that you haue banyshed vice,
honored vertue, punished offenders, and fauoured inno-
centes: so that the quiet haue thereby lined moze peace-
ably, the vnquiet restrayned, the good exalted, and the
euyl chastysed. In so much that nowe, by reason of iust
ministracion of good order in your Maiesties dominions
they that walke in the nyght go in safetie, whereas we
knowe that in other prouinces, such as walke in the day
go in daunger and peryll. And therfoze in the most hap-
py tyme of your Maiestie, it appeareth that Spayne is
renewed, not onely in therexcellencie of mechanicall or
handy craftes, but also in the knowledge of letters and
discipline of warre: In so much, that she that sumtyme
lacked her selfe, maye nowe abundantly minister to her
neyghbours that haue neede. And wheras to your Im-
pervall Maiestie, it shoulde not suffice to ordeyne lawes,
yf power and armes shoulde fayle to defende & punyshe,
who comparable to your Maiestie enioyeth the one, and
wanteth not the other, haunyng triumphed ouer kynges
and kyngdomes, enlargyng also the name of Spayne in
many vnknownen and barbarous landes and nations:
Greater duetie therfore owe your subiectes vnto you,
then euer dyd the Egyptians to Isis, or the Cicilians to
Ceres, or the Latines to Saturne: forasmuch as they haue
receaued of your Maiestie moze common and profitable
benefites

benefites. It is not long sence your Maiestie hath for-
 bydden and abolsished the vse of Mules, and restored a-
 gayne the exercise of armes so long out of vse, that the
 one with the other hath ben no small profite and com-
 moditie to your subiectes and dominions. For by taking
 awaye the vse of Mules, is so encreased the number of
 horses and horsemen, that such as befoze neyther durst
 nor could in maner lyght by vpo a horse, can now easely
 & apely manege the. So that you seme to haue reuyued
 the dayes of Bellerophon the sonne of kyng Glaucus, and
 lykelwyse the tyme of Saturne, when men had fyrste the
 knowledg how to make horses to abyde the bydle, and
 to byng them by to serue for diuers vses and necessities
 of men. And ryght sure I am, that by reason of suche
 laudable statutes and ordinaunces, in your dominions
 shall sayle neyther horses nor horsemen, as well for the
 court as for the campe. Who knowe in maner howe to
 girde a sword befoze y your maiestie permitted weapons
 and armure to be woꝛne euen in your courte, and that
 elswhere all men might do the lyke: Befoze which time
 dexteritie fayled where courage abounded.ouer and
 besyde the profite & commoditie that hath rylen hereof,
 what honour you haue obteyned by the same is manifest
 by Fraunces the French kyng, who by your Maiestie
 being taken prisoner in the parke of Pawia, was brought
 to Madrid in the yere. 1525. Where seyng many young
 men in maner without beardes, and yet laden with ar-
 mure and weapons, sayde: Oh happye Spayne that
 byngest foozth and nourythest men of warre. In your
 most happy dayes also, the Christian faith is amplified:
 and in maner whole Spayne floꝛyssheth dayly moze and
 moze in sumptuous buildings, & is abundantly enriched
 in treasure brought fro your Indies, farre surmounting
 the riches of Salomon brought fro Ophir. Pea & to say
 the trueth, considering the quanties of gold & siluer which
 haue ben ordinarily brought fro thence to your maiestie,
 this time may rather bee called the golde age, then that
 of Saturne. Not omitting also that by your prosperous
 attēptes, haue ben discovered so many landes & Ilandes
 heretofore so vnknowē to y Cosmographers, Geographers,
 & Histor

Mules.

Horses and
horsemen.

Bellerophō.

Wearryng
of weapons
and armure.Fraunces
the French
kyng taken
prisoner.The Christy
an faith in-
larged.The sumptu-
ous buildin-
ges and trea-
sures of
spayne.The Indies
haue of
golde and
siluer.Aetolandes
and Ilandes
discovered.

THE EPISTLE.

Item.
The straigh-
tes of Maga-
lianes.
Rio dela
plata.
The fortun-
ate Ilandes
of Canaries

Religion in
the Indies.

The Spani-
ardes haue
euer trauay-
led into farre
countreys.

The antiqui-
tie of nauig-
ation.
**Argonan-
ti.**
Colchos.

The art of
Nauigation
Thynge
perteyning
to Nauiga-
tion.

& Historiographers that they neuer harde of their names. Which neuerthelesse are nowe so well knowen to your subiectes, that they haue troden them with theyr feete, and measured them by pases. Who befoze this tyme euer harde any mencion of the ryche and large prouince of Peru, or of the strayghtes of Magalians, or of the ryuer of Syluer, called Rio dela Plata. They in tyme past seemed to haue done no small thynge when they hadde knowledge of the fortunate Ilandes, the whiche sence they were conquered by your Maiesties graundefather, haue ben called the Ilandes of Canaria. And yf it is and hath ben muche to discouer and subdue this newe worlde: it is doubtlesse no lesse glozy to your Maiestie, not only to possesse and enioy it, but also that you dayly procure to sende thither Judges to gouerne with lawes, and preachers to instruct in doctrine, to byng those Indians to the knowledge and honouring of the true God. And therfoze considering your Maiesties godly desyre and purpose as touchyng these Nauigations, and the daungers of such as go to discouer this newe worlde (although it be not newe to the Spanyardes to trauayle into farre countreys: forasmuch as in the dayes of Caius Cesar the sonne of Augustus, were founde broken pieces of Spanyshe shippes lost in the goulfe of Arabic, as also Celijs Antipater affirmeth, that certen shippes of Spayne were accustomed to sayle for marchaundysse to the east partes of Ethiopie) in consideration hereof haue I the more wyllingly publyshed these my trauayles for the furtheraunce of all suche as shall hereafter attempt the lyke Nauigations. And here do I not saye that Nauigation is not a thynge of antiquitie. For we reade that in olde tyme, the Argonanti sayled to Colchos, and Danaus brought the firste shippe from Egypte to Grece. But I saye that I am the firste that haue brought the arte of Nauigation into a briefe compendiousnesse, geuing insaylable principles and euident demonstrations, describyng the practyse and speculation of the same, geuyng also true rules to Maryners, & shewyng wayes to Pilotes, by teachyng them the making and vse of instrumentes, to knowe and take the altitude

titude of the sunne, to knowe the tydes ozebbyng and
 flowyng of the sea, howe to order theyr cardes and co-
 passes for Nauigations, geuing them instructions of the
 course of the Sunne & motions of the Moone: teaching
 them furthermoze the makyng of Dyalles both for the
 day and for the nyght, so certen, that in all places they
 shall shewe the true houres without defaute. And haue
 likewise declared the secrete propertie of the lode stone,
 with the maner and causes of the Northeastinge & Nor-
 westing (commonly called the variatio of the compasse)
 with also instrumentes therunto belonging. And that,
 that whiche I shall saye or do, be not accompted to bee
 presumptiouslye done or spoken, I acknowledge that
 whatsoeuer I haue well done or wrytten, it is from a-
 boue by the helpe of the diuine grace, and by the fauoure
 and prosperous fortune of your maiestie. And thus shall
 they that nowe liue, and lyke wise they that shal succede
 vs, se and perceaue, howe much moze the woꝛlde oweth
 and is beholding to your Maiestie, then were the auncient
 Egyptians to their Isis. She gaue them letters to
 reade, but your Maiestie hath geuen rules and orders to
 sayle on the seas. The profite of Isis, was onely for one
 prouince. But the commoditie that ensueth of your do-
 ynges, is vniuersall for all prouinces and nations, and
 for all seas, aswell to go to places discovered, as also to
 discouer landes and regions yet vnknewen. If they of
 auncient tyme had reached that we haue obteyned, the
 Indies had not nowe bene to discouer: neyther should it
 be esteemed a miracle vnto vs as at the tyme when Car-
 thage flozysshed, that one Agnus went forth from the
 baye of Cadiz, and sayled to thende of Arabie. Neyther
 woulde Cornelius Nepos haue wrytten it for so famous a
 thyng, that a certayne man flyinge from kynge Latinus,
 came from the goulfe of Arabie: Whereby it is manifest
 that aswell Nauigation as other artes, doth from day
 to day increase, and by lytle and lytle is come to perfec-
 tion. For in those dayes they had neyther compasse nor
 carde of saylyng whereby to gouerne themselves. They
 lacked the consideration of the starres, vntill the Phen-

The lode
 stone, falsly
 called in
 Englysh the
 Adamant, is
 in Latin cal-
 led
 Magnes.

Charles the
 sixth greater
 then the he-
 roes of olde
 tyme.

Vniuersall
 benefites

Comparatō
 with the an-
 tiques

Plinie.

Nauigati-
 ons of olde
 tyme

The perfec-
 tions of
 artes at this
 day.

THE EPISTLE.

The rudenes of the antiques.

Anguriū.

The North Starre.

The blages of Salomon to Tharsis and Ophir.

The first inuentours of Nauigation

Commodities and difficulties of Nauigation

tians founde the knowledge thereof, and were the fyrste that vnderstode (that to such as shoulde trauaile by sea) it shoulde be necessary to lyfte vp theyr eyes to heauen, and consider the motions therof. They that sayled to the Ilande of Taprobana (which in olde time was called Antitono) carped for theyr vyages luyng byrdes. And when they thought good, let certeyne of them flee: and by the flyght of their wynges, directed the helme and sayles of theyr shippes. They sayled onely thre monethes in the yere. To them therfore it was necessarye to obserue and tarye the tyme vntyll they founde it to serue with a forewynde. They knew not howe to helpe them selues with the bolwe line or syde wynde: neither sawe they the North starre, or sought it, or had any knowledge thereof. And I beleue verely that this was the cause of so long a vyage whiche the shippes of Salomon made, saylyng to Tharsis and Ophir, wherin they spent thre yeres: although in dede that was no short vyage whiche they made, compasyng about India and many other prouinces. And wheras befoze I sayde that Nauigation by lyttle and lyttle came to perfection, I fynde by auncient hystories, that Tiphos fyrst founde the gouernall or rudder, Dedalus the masse and shroudes, and Icarus the sayles. The Thirreni founde the vse of the anker of one graspe or flooke, and Palaminus brought it to perfection, addyng the other. And thus may it manifestly appeare that in these prosperous and fortunat dayes of your maiestie, it hath pleased God to bryng the knowledge of Nauigation to perfection, with this my bryefe discourse as touchyng the same, as well profitable and necessary for them that trauaile by lande as by sea. What can be a better or more charitable dede, then to bryng them into the waye that wander? What can be more difficulte then to guyde a shippe engoulfed, where only water and heauen may be seene. One of the foure most difficult thynges wherof Salomon maketh mention in his Prouerbes, is the vyage of a shippe by the sea. The which Galfrede expoundyng, saith that in humayne thynges, none is more fearefull or more daungerous, then

then to auenture lyfe in a weake & thynne piece of wood,
or for a man to commit him selfe to the rage of furious
wyndes amonge the tempestes of the sea, and there to
hazard that he loueth so well. Oh howe much more
should the same seeme difficult to Salomon, yf at these
dayes he should see that fewe or none of the Pilotes can
scarsely reade, and are scarsely of capacitie to learne.

The igno-
raunce of
Pilotes.

And wheras in the first Chapter of this booke, I haue
made mention, that the gouernall or sterage ought to be
committed to expert men and of good vnderstanding, he
should see that nowe a dayes the ignorant presume to
gouerne other, which were neuer able to rule or gouern
them selues. I moste humblye desyre your maiestie to
receaue in good parte this my poore seruice. Which al-
though it be lyttle, yet being dedicate vnto the greatnes
of your regall person, it shalbe much more then greate.
The profite and commoditie thereof is notozious: and
the benefite that therby may be receaued, is vniuersall.
If therfore when your maiestie shall fynde your selfe re-
leased from greater affayres, it may please you to feede
your eyes with these my traunyles, you shall fynde

The gouer-
nall.

therin many newe, delectable, & wytty thynges:

with also many profitable and certen rules

both to reade and vnderstande. To con-

clude, I estones make humble

petition vnto your Impe-

riall Maiestie, not so

much to consi-

der what I

wryte,

as to respecte thinfent of my wrytyng: and

not the gyfte, but thaffection and

good wyll that remayneth

in me to serue your

Maiestie.

(.)

Q

The first parte of thys Woozke
which entreateth of the composition
of the worlde: And of the vniuersall
principles for the arte of
Navigation.

The first Chapiture of the generall distinction
of creatures.

There differ-
ences of
creatures

Corpozall
creatures,

Man is cal-
led all crea-
tures of the
lesse worlde

Man compa-
red to the
worlde

All that mo-
ueth, is mo-
ued by an o-
ther immo-
uable

The intel-
lect
soule



The infinite god, the begin-
ning and cause of the hole vniuersall,
created thre orders of creatures, differ-
ringe in kynde: That is to say, corpo-
rall, as the Elementes: Spiritual as
Angelles: And compounded of these
two, as man. The corpozal nature is
deuided into bright and shining bodyes, as the starres,
or into darke and thicke bodies, as earth and metalles:
Eytther into Diaphane or transparent bodyes, as ayre
and water. Of these creatures (as sayth S. Gregory)
some haue onely beyng, as stones, some lyue as trees,
and other haue sence, as beastes, other vnderstanding,
as man: who in holy scripture is called al creatures, ac-
cordinge to the sayinge of Chyist to his disciples, where
he sayth: Go and preach the gospell to al creatures. And
therefore not without good cause was man called of the
greke philosophers Microcosmos (that is) the lesse worlde.
In the which we contemplate thynges of no lesse admi-
ration, then in the greate worlde. The similitude be-
twene them both, is that euen as the great worlde, and
the hole Globe or sphere thereof, is moued by the volun-
tarie motion of an intellectuall substance, or an Angell:
euen so is this. For (as Aristotle writeth) what so euer
is moued, is moued by vertue of an other: as man is mo-
ued by the internall or inwarde forme that is within
him: (That is to say) by the intellectuall soule that is pro-
per vnto hym. In lyke maner in the great worlde are
founde dyuers mouable thynges: All whiche are reduced
to one immouable mouer. So in man are founde many
thynges

thynges moued by diuers motions, which are all referred to his intellectuall soule. The great worlde containeth the creatures within it selfe: And consequently is all really, as hauing nothinge without it. Euen so man by knowledge is all, and knoweth all thynges, and nothinge naturally is hid from hym or vnknown to hym. Agayne, in this lesse humayne worlde are two motions, intellectuall, and sensuall. When consequently the great worlde hath two locall motions. The one wherewith the first mouable is moued, & draweth with it all the other spheres from the East to the West, and is called Rationall mouing. The seconde is the mouynge of the other spheres from the West into the East: And is called Irrational mouing. But now leauinge to speake of the lesse worlde, we will procede to speake further of the greater.

Man knoweth
eth part of
all thynges

Two motions
one in man

Primum
mobile.

Rationall
motion.

Irrationall
motion.

The seconde Chapter of the definition of the worlde.

The worlde (as sayth Isodorus) is heauen and earth, and the other woordes of God that are contained therein. It is compounded of thinges visible, and yet vnsearchable. Moyses and S. John the Euangelist, witnesse that it was made by God. The Philosophers called it Mundus à mouendo, because it is in continuall mouinge and neuer in rest. The Grekes called it Cosmos, which signifieth faire or beautiful, and so named it because of the meruailous ornament therof, and diuersitie of Elementes, with the resplendence or shining of the sonne, moone, and starres. And doubtlesse nothinge maye bee sene with the corporall eyes of man more bewtifull then it is. In so muche that the diuine Philosopher Plato, affirmed that eyes were geuen to men to beholde the bewtie therof, and to take pleasure in the contemplation of the heauenly bodies and roundnesse of the worlde, which also for the roundnesse therof, is called sphericall, because that Sphera in the Greeke tongue, signifieth a rounde body.

what is the
worlde.

Or Mundus à Mou
ditie.

that is clea
nes or fayre
nes.

Eyes were
geuen to me
to beholde
the fayrenes
and beautie
of the worlde

The round
nes of the
worlde.

The

The third Chapter of the definition of the Sphere.

Definition
of the Sphere



Heodolius saith that the sphere is a whole and corporal figure vnder one superficial: in the middest wherof is a point or p[ri]cke, from the which all ryght lines drauen directly to the circumference are equall.

The center
of the Sphere

This poyn[t] or p[ri]cke is called the center of the Sphere. Accordyng to Euclide, it is the passage of the circumference of halfe a circle, whiche beyng fixed, the Diameter is turned rounde about, vntyll it returne to his owne proper place. By the center of the Sphere passeth a ryght line, and the extremities or endes therof, touche in the circumference. And this line (imagined) is called the Axis or Criltre of the Sphere, and the endes therof are called the poles. Upō this Axis, is the sphere of the wo[r]lde moued.

The axis &
poles of the
wo[r]lde.

The .iiii. Chapter of the di- uision of the wo[r]lde.

Quinta Es-
sentia,
Aristotle cal-
leth it the .v.
element.



It is to be presupposed that there is difference betwene element and elementate, and the fyfth being, called Quinta Essentia: The quint essence or fyfth substance, is a body of it selfe, differing from all elementes and thinges elemental, aswell in mat- ter as in forme, and no lesse in nature and vertue. And hauing in it selfe no contrarietie, is certainly without corruption. And hereof commeth it that the Philoso- phers called the heauens and heauenly bodyes, the fyfth substance or fyfth essence, by reason of the incorruptibi- litie therof. Element is that wherof any thyng is com- pounded. It is the firste of compositions: & of it selfe is not compounded. Wherby it foloweth, that neither the earth, the ayre, the water, nor the fyre, that are nere vnto vs or about vs, are pure or simple elementes. For these elementes do sometymes myngle them selues one with

The .v. es-
sence is in-
corruptible.

What is e-
lement.

The incor-
ruptible
elementes
are not
pure nor sim-
ple.

with another: and especially where they are nere together and touch one an other. Of these elementes, every part is named by the name of the whole. As every part of fyre, is called fyre, and every parte of earth is called earth, and so of the other. They are called simple bodies in respect of other compounde and mixt bodies. They are diuisible into partes of diuers fourmes: and of the commixtion of them, are made and engendred byuers thinges of sundry kindes. These foure (that is to meane earth, ayre, water, and fyre) although they are named simple but in respect as aforesayde: yet are they the Elementes (that is to say) begynnynge and principles of al other compoundes and mixtes. A pure element can not be sene, forasmuch as that that is pure, lacketh colour: and that hath no colour is not visible. The elementes (as saith Ilodorus) were deuoyded by the hande of God. The Emperiall heauen was replenished with Angels, the aire with byrdes, the sea with fyshe, and the lande with men and other beastes. Elementate, is every body compounded of the foure elementes. Not that they are elementes formally, but virtually in mixt bodies. This knowen, we wyl shewe howe the worlde is deuided into two regions: Celestiall, and Elementall. The region Elementall, which is continually subiecte to alteracions, is deuided into foure elementes: Which are, earth, water, ayre, and fyre. These elementes, the Grekes call Yctogia, for the communion and concoyde that they haue betwene them selues. The heauenly or etherial region (called Quinta Essentia) compasseth and conteyneth the elementall worlde within it.

The elementes are diuisible into partes.

The commixtion of elementes.

Pure & simple elementes can not be sene.

The diuision of elementes.

What is elementate.

Diuision of the worlde into celestiall and elementall.

Quinta Essentia.

The .v. Chapter of the number, order, and propertie of the elementes and heauens.

The order of
elementes

earth.

water.

Ayre.

fyre.

The fourme
of the water

The Ocean
sea.

psal. 107.

Job xxxviii
The will of
god is the
cause of
saues

Nature ab-
horreth emp-
tines

The earth
is not perfect-
ly rounde



The earth (after the Philosopher) is a
pycke or poynt in the myddest, called
the center, to the which they assigne
the lowest place. Pert vnto the earth
and about it, the water occupieth the
seconde place, and the Aier the thirde.
The fyre is hygher then any of the o-
ther elementes. And it is to vnder-
stand that the water hath two superficialis. One, which
is called concaue or hollow. The other, conuer or em-
bowing. You maye compare the inward parte of the
concaue to a dyshe or a bolle, whose outwarde parte is
called conuer. As touchyng the concaue, the water com-
passeth about the earth, leauyng discovered that parte
that serueth for the respiration and lyfe of men, and o-
ther beastes. As concernyng which, some thynke that
the Ocean sea is hygher then the earth: and aske the
question why the sea couereth not the whole earth, and
why the earth is not sonke in the water. To this it may
be a sufficient aunswere, that it hath so pleased the wyl
of God accoꝝdyng to the saying of the Prophete Dauid;
Terminum posuisti quem non transgredietur: Neque con-
uertetur operire terram. That is: Thou hast appoynted
limittes which it shal not passe, neyther shal it retorne
to couer the earth. Besyde the wyl of God whiche is
the chiefe and sufficient cause therof, we say that nature
sayleth not in her necessities. For she sometyme ad-
mitteth a little inconuenience, to auoyde a greater euyl:
as when heauy thinges which naturally should descend,
do not onely not descende, but ryse vp: And as also som-
tymes it chaunceth that fyre descendeth and water arri-
seth to fyll the voyde or emptye place, least any where
should be found voyde or emptye, which nature so great-
ly abhorreth. To this purpose, nature foreseynge the
kyndes of many thynges that coulde not elswhere lyue
then on the earth, neither be conserued within the wa-
ter (as men and other earthly beastes) determined be-
foze to make the earth not perfectly rounde contrary to
the nature therof: wherof it soloweth, that it is not al-
together

together couered of the water. And (as sayth Origen) the earth remayneth discovered of water, that it might bring forth fruites, trees, and plantes. As touching the conuer aforesayde, the water and earth discovered, are conteyned vnder the concavities of the ayre, which is diuided into thre regions, as the lowest, highest, & middlemost. The lowest is hot by reason of the reflection or rebounding of the beames of the sunne striken backe by the earth. The highest also is hot by participation of the fyre and nearenesse therunto. The myddle region is colde, as is manifest by the snowe and hayle engendred in the same. The ayre neare vnto the region of the fyre whiche is pure heate, doth neyther burne nor lighten, because it hath no combustible matter, & so hath it power and not act. It is neare vnto and reacheth the circle of the moone whiche compasseth it about. The heauen or circle of the moone is next vnto the heauen of Mercurie: And Mercurie vnto Venus: Venus vnto the Sunne, the Sunne to Mars: Mars to Jupiter: Jupiter to Saturne which is next and reacheth vnto the heauen of the starres, called the firmament, because that in it are all the starres (except the planets) firme and fixe as a knot in a table. The knowledge of the planetes was had by seven sundry motions they haue amonge themselves, and by their course not vniforme to that of the starres of the eyght heauen, because that sumtymes the planetes appeare vnto vs ioyned together, and sumtymes diuided. The Crystalline heauen, compasseth aboute or conteyneth within it, the heauen of starres. This Crystalline heauen, is transparent & perspicuous as cleare water or glasse that maye bee sene through by reason of the clearnesse and pure substance therof. It is by another name, called the heauen of water, whereof holpe scripture speaketh, saying: *Aqua quæ supra celos sunt*, laudent nomen Domini. That is to say: Let the waters that are aboue the heauens, prayse the name of the Lorde. It was created for the conseruation of corporall thynges, and to temper the heate engendred of the moving of the first moueable, which beinge so great of body that it not onely

Deuision of
the ayre in-
to thre regi-
ons

The highest
ayre is in-
combustible

The order
of the hea-
uens

The firm-
ment

The pla-
nets

The Cry-
stalline hea-
uen

The heauen
of water

psalm. 148
Daniel. 3.

The moue-
ing of the
first moue-
able

only compasseth all the elementes, but also all the inferior heauens is moued so swiftly, that it dayly perfectly moueth all the aforesayde spheres. And least by reason of the great heate therof caused by his swift motion, it shoulde consume inferior thynges: God ordeyned this Crystalline heauen that the coldenes therof myght temper the extreme heate of the other. And this appeareth by Saturne, which beyng the hyghest of all the planettes, shoulde be feruent hotte more then any of the other, because it hath a swyfter course and moueth faster then any of them, and maketh dayly a greater circuite. But forasmuch as it is nearer vnto the sayde Crystalline heauen, the heate therof is tempered by the naturall coldenes of this watery heauen, wherby (as I haue sayd) the feruour therof is qualified and restrayned from the hurte it myght otherwyse doo. This Crystalline heauen reacheth to the fyrste moueable heauen called Primum mobile. And this reacheth to the Imperial heauen which is the twelfth, called Empyreum, by reason of his cleareness and resplendence. This is not moued, and is moste perfecte. The Philosophers had no knowledge hereof. But we beleue by holy Scripture that suche a heauen there is, and the same to be the habitation of Angelles and spirituall creatures. It is also called Cælum cælorū. That is: The heauen of heauens, because it conteyneth and includeth within it all the other heauens. It is of greater clearenesse then all the other heauens, and was created immediatly with the Angelles. In this also remaineth the humanitie of Iesu Christe our God, and in dignitie aboue it. It conteyneth thre holye orders or principallities called Hierarchias. Wherof, the fyrste is called supercelestiall, and hath in it also thre orders: as Seraphins, Cherubins, & Thrones. The second is called Celestiall, and conteyneth Dominations, Principates, & Potestates. The thyrde called Subcelestiall, conteyneth Virtutes, Archangels, and Angels. And to conclude, it hath a boundaunce of all goodnes and perfecte felicitie, with priuation or wante of all euill. This heauen also geueth influence of constancie, stedfastnes,

The coldnes of the Crystalline heauen.

The swyfter course of Saturne.

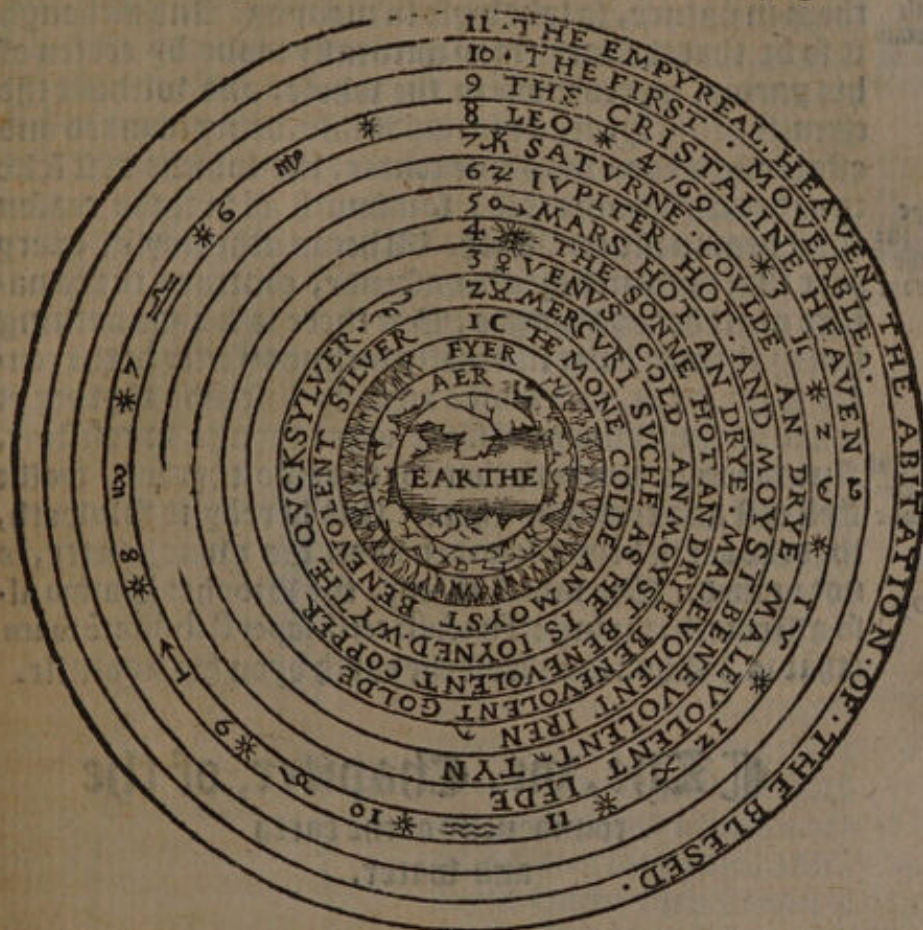
The heauen of the fyrste mouable.

The heauen called Empyreum, is not moued, & is the habitation of angels.

The humanitie of Christ in the Emperyall heauen. The orders of Angels.

The imperial heauen preserueth all the other heauens.

fastnes, and durabilitie to thynges, agaynste the fluxibilitie and inconstancie of the other heauens : the order wherof doth appeare in the demonstration folowynge.



The. vi. Chapter of the immutabilitie or immobilitie of the earth.



The Pithagorians & other ancient naturall Philosophers (as saith Aristotle) were of opinion that the earth dyd moue. Yet not by a ryght forth motion, but circularly about, in the myddest of one place. The whiche errour, both Aristotle hym selfe and the

Opinion
that the
earth mo-
ueth.
Molus in
loco.

The earth
is immou-
ble

All heauye
thynges in-
cline to the
center of the
earth

The earth is
founded vpon
his owne
center

Psal. 103.

the Astronomers do confute and reprove by euident causes and manifest demonstrations: For circular motion is proper to the heauens. And as the earth dyffereth from them in nature, so lyke wyse in mouyng. And although it so be that the earth may naturally moue by certen of his partes, yet to moue in the whole, and without the circuite of his sphere, it is impossible, being founded and established vpon his owne center, the whiche of it selfe is naturally immouable: forasmuch as in it the reason of all heauynesse consisteth. Whereas other wyse, euery part that is moued shoulde ascende, contrary to the nature of all heauy thynges. But there is founde nothing heauy that doth not naturally incline directly to the center of the earth, and wolde actually descende thither yf it had no impediment of some other thyng to resiste it. And when it toucheth there or is come thither, wolde still rest and remayne there. And hereby it foloweth, that the earth beyng founded vpon his owne center, is not moued. The which thyng, the Prophet Dauid also affirmeth, saying: Fundasti terrā super stabilitatē suam. (that is.) Thou foundedst the earth vpon his stabilitie.

The. vii. Chapter, of the roundnesse of the earth and water.

The round-
nes of the
earth

The rising
of the sunne

The Eclipse
of the moone



That the earth is rounde, it appeareth by manifest euidence. For yf it were playne or flatte, the dawnyng of the day or day spryng, shoulde equally & at one tyme appeare to them in the West, as to them in the East. But we see the contrary, that it appeareth first to them that dwell in the East, and afterwarde to them in the West. This is proued by the Eclipse of the Moone, which begynnynge at one instant: they of Ierusalem see it begyn at foure a clocke of the nyght, and we of Andalusia in Spayne, at one a clocke

clocke of the nyght. It foloweth hereby that to them it
nyghteneth three houres soner then vnto vs in Spaine.
And this is caused by the roundnesse of the earth. It is
also aswel knowen to be rounde from the pole Artyke to
the pole Antartike: for by the roundnesse therof, is cau-
sed the equalitie and inequalitye of the dayes & nyghtes.
The same is lykewyse knowen by the raysynge of the
pole aboue our Horizon. And that the superficiall parte

The equalitie
of dayes
& nyghtes.

The earth &
the water as
one rounde
globe.



of the earth and water is al
one rounde and sphericall
globe, is manifest by the
shadow therof, being a cer-
taine darke body reflected
fro the earth in the Eclipse
of the Moone. For by this,
as by playne demonstrati-
on, may we know that the
earth is rounde, as maye
more manifestly appeare by
this figure. It is also pro-
ued y the water is a rounde
bodye, as is sene by experi-
ence. For yf you erecte a
marke vpon the sea banke
of a porte, and a shyppe de-
parte from that porte a cer-
taine space: then standing
in the poupe or sterne of y
shyppe, you shall not see the
marke aforesayde. But yf
you stande in the toppe of
the shyppe, then maye you
see it. Whereas notwith-
standyng (yf that portion of
the bendynge arke of the
earth dyd not hynder the
syght) you should see it bet-
ter beyng in the poupe: for
asmuche as it is nearer to
the mark then is the toppe

The water
is a rounde
bodye.

of the shyppe, as by this demonstratton appeareth.



Howe the
earth is
rounde.

But here some may moue a doubt: saying that on the earth we see many mountaynes, and consequently many greate balleyes and playnes, with many diuersities of sundry other depe & vnequall places, by reason wherof the earth can not truely be called rounde. To this I say, that in two maners the earth is called and vnderstood to be rounde. As after one maner speakyng precisely, it is called rounde as a circle or a sphere whiche we call rounde, because that all ryght lines drawn from the center therof to the circumference, are equall. The other roundnesse is considered without this precisenes: And is such, as not by all his partes is equally dischaunte from his myddest or centre, but hath some partes hygher and some lower: yet not in such quantitie as may destroy the roundnesse of the whole. As if in a bowle there were certayne clyftes or holes, it shoulde not thereby leaue to be rounde, although not perfectly or precisely round. And for this cause saith Auerrois: that although both the heauenly bodyes & the elementes are of rounde forme, yet differ they in this, that the heauenly spheres haue perfecte roundenesse, and the elementes not: As the earth by reason of his mountaynes and vales, the sea by his encreasyng and decreasyng, the Ayre also for his nearenesse to the fyre, and by his contrarietie, doth sometyme do and sometyme suffer (What is to saye) is sometyme actiue and sometime passiue. So that folowynge the one it fleeth the other, by reason wherof, it also lacketh

The ayre is
actiue & passiue,
true, and not
perfectly
rounde.

lacketh perfecte roundnesse. But the fyre, forasmuch as ^{The fyre is} it is neare to the concaue of the circle of the moone, whi- ^{rounde.} che is sphericall, maye therfore be called sphericall or rounde.

The. viii. Chapiter, of the

motion of the heauens and
elementes.



It is not to be forgotten that all the elementes are wholly moueable by local motion, excepte the earth. The water is moued by the motion of the Moone, or tossed by the wyndes. The fyre (as saith Aristotle) is moued circularly by the motion of the daye, and is drawen of the circles that embrace it or compasse it about: As is manifest by the Cometes or blasynge starres, and other fierie exhalations conteyned and engendred in it: Which being caried with this motion, conclude that the fyre moueth in lyke maner. And with this motion is the superior parte of the Ayre violently caried about, as the other impressions therein do shewe. The inferior parte is moued by diuers motions: (That is to meane) laterally, as by experience we see when the wyndes blowe. The Moone with her heauen or sphere, by her proper motio geneth her turne from the Weste to the East in. xxvii. dayes and seven houres, with. xlv. minutes. Venus, Mercury, and the Sunne, in a yere: whiche is the space of thre. C. lrv. dayes, with. v. houres and. xlix. minutes. Mars in two yeres. Jupiter in. vii. yeres. Saturne in. xii. yeres. The. viii. heauen which is the firmament or starry heauen, by his owne proper motion is moued by the. ix. heauen vpon the begynnyng of Aries and Libra, and vpon these two poyntes accompysheth his reuolution in seven thousande yeres.

Howe the
fyre is mo-
ued.

Howe the
ayre is mo-
ued.

The Moone

Venus.

Mercury.

The Sunne

Mars.

The starry

heauen or

firmament.

The Crystal
line heauen.

fy: A moue-
able.

Howe the
fy:st moue-
ble dyalweth
the other hea-
uens.

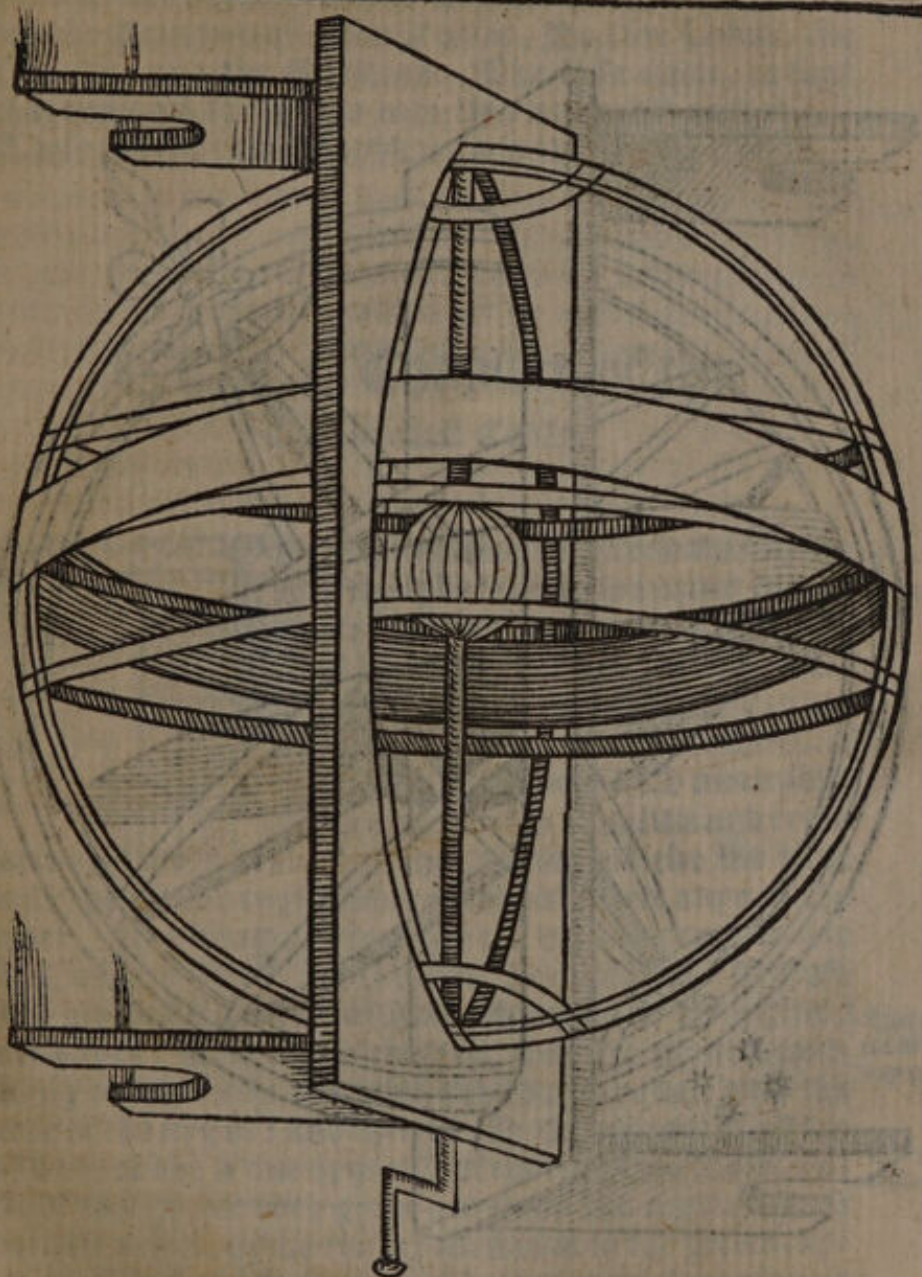
This motion is called *Motus crepidationis*, (that is to say) the tremblyng motion, or motion of accesse and recesse. The ninth heauen endeth his motion from the West to the East in. xlix. thousande yeaeres. And by this motion moueth the eyght heauen. The. x. heauen called *Primum mobile* is moued from the East to the West: And in. xiiii. houres (which is a naturall daye) perfourmeth one reuolution, & with the myghtye force and swyftnes of his motion, caryeth with hym all the other inferiour heauens, and maketh them to geue the same turne in. xiiii. houres, wheras neuerthelesse they cease not in the meane tyme to kepe the course of theyr owne proper motion: as (for example) if an Ant or Dismer shoulde go about the wheele of a myll, contrary to the mouyng of the wheele: befoze the Ant in goyng styl forwarde shoulde come agayne to the poynt from whence she fy:st departed (which is once about or one turne) the wheele shoulde in that space make many turnes.

The. ix. Chapiter, of the diuision of the Sphere into formall partes.

The right &
crooked or
oblique
Sphere.



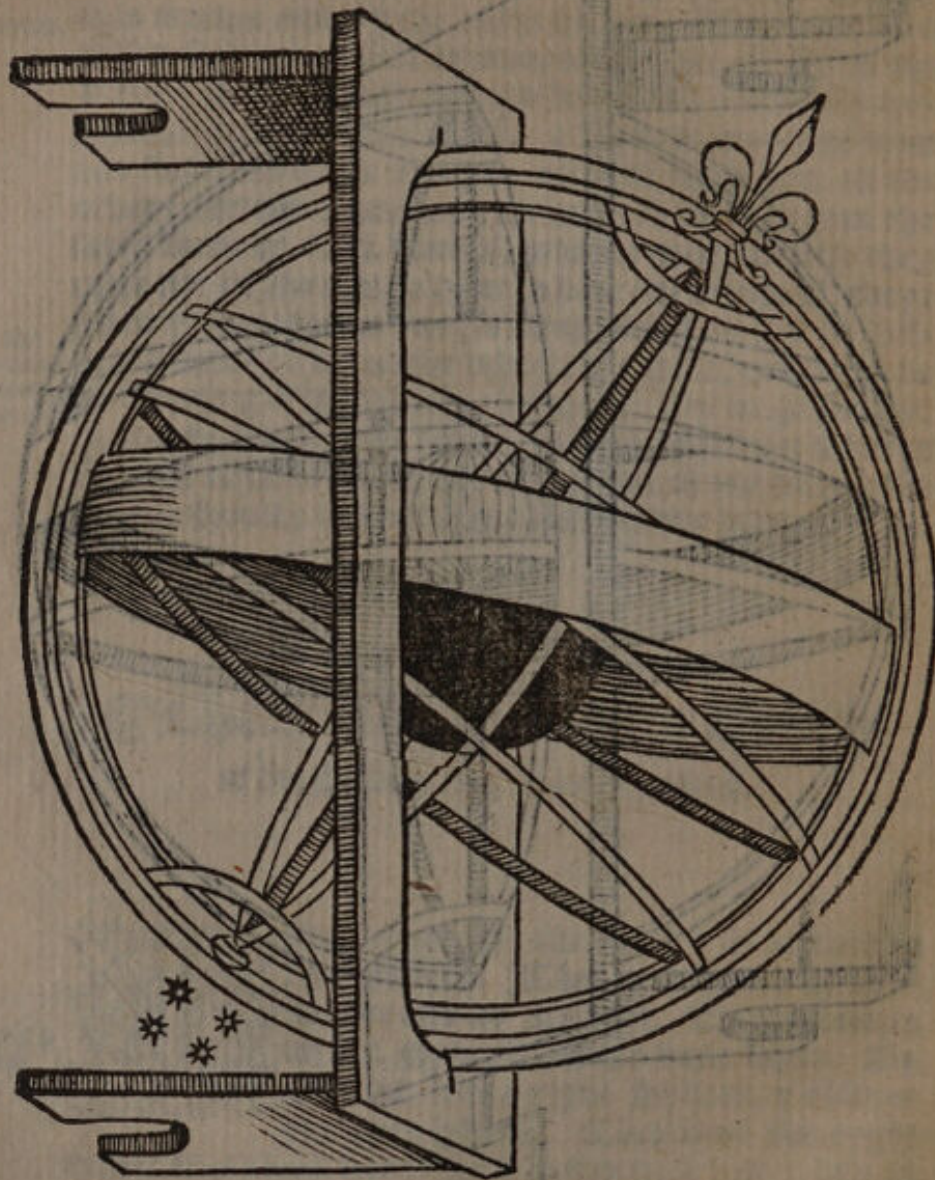
The Sphere of the worlde is diuided in two maners. (What is to saye:) by substance and by accident. By substance into. x. Spheres, as we haue sayde. By accident, into a ryght Sphere, & oblique or crooked sphere. They haue the ryght sphere that dwell vnder the Equinoctiall line: and is called ryght, because to the the poles are equally in the Horizon, as appeareth by this figure folowyng.



They haue the oblique Sphere that dwel eyther on this
 syde or the other syde of the Equinoctiall : vnto whom
 B iii is

The oblique
 or crooked
 sphere,

is euer one of the poles about the Horizō, and the other
bnder it, as appeareth in this figure.



The. 2. Cyl-
cles of the
Sphere.

The sphere is compounded of. x. circles imagined. And
(as saith Iohn de sacrobosco in his booke of the sphere) fire
of

of them are greater, and foure lesse. The greater circle, is that which deuideth the sphere into two equall partes, and hath his center with the center of it. These are the Equinoctiall, the Zodiac, the two Coluri, the Horizon, and the Meridian. The lesse circle, is that that deuideth the sphere into two vnequall partes. These are the two Tropicke, and two Polar circles.

The .x. Chapter, of the

Equinoctiall Circle.



The Equinoctiall is a circle that deuideth the sphere into two equal partes and is by every part equally distant from both the Poles. It is the greatest circle among the other, and is described in the sphere by the motion of the Primum mobile or first moueable.

The Equinoctiall.

This circle for his equalitie and regularitie, is more noble then the Zodiac whiche we haue described in the eyght sphere, and also then anye of the other. It is imagined to gyde the worlde round about by East and West. It is called Equinoctiall, because this worde Equinoctium signifieth equalitie of nyghtes and dayes: wherof the cause is, that the Sunne coming to this circle, the arke of the day is equall with the arke of the nyght: and then is the Equinoctiall. It is also called the Zone or gyde of the first moueable. For even as a gyde doth gyde a man by the myddeste, so doth this circle gyde the myddeste of both the Poles, vpon the which the first moueable is moued. One of these imagined on our parte of the Sphere, is called polus Arcticus, because is is neare vnto certaine starres which the Astronomers call Arcturus, which is the great beare.

The equalitie of the day & nyght

The first moueable.

The pole arcticus.

Septentris:
on.The hoꝛne
North starrPole Antar-
tyke.The crosse
neare vnto
the pole
Antartyke.

It is called Septentrionall or Septentris, because that round about it are moued the senen starrs, which make the lesse Beare commonly called Bozina, (that is) the hoꝛne. The principall and chiefe of these, is the North starr, which is neuer sene to vs although the nyght be neuer so cleare: And (as the Poet Homer saith) doth moue lyttle or nothyng, because of his lyttle distaunce from the Pole. The other Pole is imagined on the other contrary part, and is called Polus Antarcticus of the woꝛde Ante, which signifieth agaynste, contrary, or opposite, because it is on the contrary parte from the pole Artyke. It is also called the South pole, because that from that part of heauen cometh the wynde commonly called the South, and is lyketwys called Meridional because it is ryght South from vs. This is neuer sene to vs. They that dwell vnder the Equinoctiall, or come nearer vnto this pole Antartyke, haue for a signe or marke to knowe it foure starrs in foume of a crosse. And when the greatest of these is lowest in the foote of the crosse, they say it is. xxx. degrees aboue the pole. And as we can not see theyꝝ Pole from hence, so can they not see our Pole from thence.

The. xvi. Chapter of the Zodiacke Circle.

Zodiack



The Zodiack is defined to decline or bende it selfe from the Equinoctiall. It is a great circle which deuideth the Sphere in two equall partes, cutting the Equinoctial by oblique or crooked angles: So that beyng thus cutte or deuyded by it into equall partes, one parte thereof declyneth towarde the South, and the other towarde the North. This circle is called the Zodiack of this woꝛde Zon, whiche in the Greke tongue signifieth lyfe, because that accoꝛdyng to the mouynge of the planettes vnder it, is the lyfe of
inferiour

inferiour creatures : **Z** is so named of Zodion whiche signifieth a lyping beaste. And is therfore deuyded into xii. equall partes, wherof euery part is called a signe, and euery signe hath an especiall name of some beast, in respecte of some p^{ro}pertie agreable to the same : **o**z for the order and disposition of the fyrte starres in those partes somewhat representyng the similitudes of suche beastes, it is called **Zodiack**. The Latins called this circle Signifer (that is) the signe bearer, because it carryeth these signes in it, **o**z is deuyded into them. Aristotle called it an oblique **o**z crooked circle, affirmyng that accordyng to the comming nere **o**z departing of the Sunne from the oblique circle, are caused generations and corruptions in inferiour thynges. The. xii. partes into the whiche this circle is deuyded, are called the. xii. signes. That parte which declyneth to the North, conteyneth. vi. signes Septentrionall, and the other that declineth to the South conteyneth other fyre called Meridionall. Furthermoze, it is to consyder that the **Zodiack** may be deuyded in two maners. One by longitude **o**z length into the. xii. signes aforesayde, and euery signe is deuyded into. xxx. degrees, which make. CCC. lx. degrees. Lyke wyse euery degree is deuyded into lx. minutes, and euery minute into. lx. secundes, and euery secunde into. lx. terces, and so to tenne. The other deuision of the **Zodiack** is by latytude **o**z breadth. By latitude it is deuyded into. xii. degrees, and in it we imagine a line that deuydeth his latitude by the myddest hauyng. vi. degrees on euerye parte **o**z syde. And this line which diuideth into two equall partes the breadth **o**z latitude of the **Zodiack**, is called the **Ecliptyke** line, because that when the Sunne and Moone are directly vnder this line, eyther ioyned together by coniunctiō, **o**z deuyded by opposition, then is the Eclipse of the Sunne **o**z of the Moone. Under this **Zodiack** the seven planets are moued. The Sunne also passeth by the myddeste of the sayde **Zodiack** by the ecliptyke line, not inclynynge moze to the one part of it, then to the other. But the other planettes do sometyme go towarde the North, and other

The twelve
signes of
the zodiack.

Howe the
sunne is
cause of ge-
neration &
corruption.

Deuision of
the. xii. sig-
nes.

Deuision of
signes into
degrees.

Deuision of
the zodiack
by latytude.

The Eclips-
tyke lyne

The mouing
of the sunne
& the other
planets in
the zodiack.

What the
xii. signes
are.

The sign-
es of beas-
tes & other
thynges
imagined
in heauen
besyde the
xii. signes.

other whyles toward the south, & sumtymes also thwart
or traaverse the Ecliptyke. It is lyke wyse to be noted,
that these signes whereof we haue spoken, are not the
constellations or starres that make those figures which
the auncient Astronomers dyd appropriate to certayne
beastes and other thynges. For these figures are mo-
ued accordyng to the motion of the eyght sphere, and
passe from one signe of the Zodiac to an other. As we se
that the starre called Oculus Tauri, (that is) the Bulles
eye, is in two degrees of Gemini. And the two starres
that are the head of Gemini, are in. xlii. & . xvi. degrees
of Cancer. And Spica virginis (that is) the spyke of the
Virgin, is in. xvi. degrees of Libra. And the harte of
Scorpio in two degrees of Sagittarius. And by this or-
der do they passe from one signe to an other: so that we
may not vnderstande the signes by these starres, but for
the. xii. partes of the arke of the Zodiac, takyng the be-
gynnyng of the Equinoctiall of Aries. The names of
these signes with theyr carates and qualities, are descri-
bed in this table here folowynge.

Nũbers	Names	Charates	Qualities	Nũb.	names	Char	Qualities.
1	Aries.	♈	hot & dry.	7	Libra.	♎	hot & moist.
2	Taur.	♉	cold & dry	8	Scorp.	♏	cold & moist
3	Gemi.	♊	hot & moist	9	Sagit.	♐	hotte & dry.
4	Cancer	♋	cold & moist	10	Capri.	♑	colde & dry.
5	Leo.	♌	hot & drye.	11	Aqua.	♒	hot & moist.
6	Virgo.	♍	cold & dry.	12	Pisces.	♓	cold & moist

The. xii. Chapter of the Circles called Coluri.



Here are two Circles in the Sphere, cal-
led Coluri, so named of the Greke worde
Colon, which signifieth a member: And
of Vros, whiche signifieth a wyde Ore.
The tayle of this beaste, maketh a semy-
circle

circle or halfe circle, not perfecte. And as this beaſt mo-
ueth his tayle laterally or ſyde wayes, and not by longi-
tude: euen ſo do the Colure moue to vs, and are rutte in
ryght ſphercall angles vppon the Poles of the worlde.

The one paſſeth by the Poles of the worlde and by the
Equinoctials, and is called the Equinoctiall Colure:

The Equi-
noctiall Co-
lure.

The other lyke wiſe paſſeth by the Poles of the worlde,
and alſo by the Poles of the Zodiac, and by the Solſtici-
als, and is called the Colure Solſticiall, called Solſtiti-

The Solſti-
cial Colure.

um, as Solis ſtatio (that is) the ſtanding or ſtaying of the

Sunne: becauſe that when the Sunne commeth to this
poynt, it declineth no more, but returneth towarde the

Equinoctiall. Theſe circles deuyde alſo well the Equinocti-
tiall as the Zodiac into foure equall partes by the poyntes

The greateſt
declination
of the zodiac

of the Equinoctials and Solſticials. In the Colure Solſticiall
are the greateſt declinations of the Zodiac:

which are two arkes of this Colure, contained betwene
the Equinoctiall and the Zodiac. And theſe arkes are

equall to the other two of the ſame Colure, included be-
twene the Poles of the worlde and the poles of the Zo-

diall.

The xlii. Chapter of the Meridian Circle.

The Meridian, is one of the great cir-
cles, imagined to trauerſe the ſphere
by the poles of the worlde, cuttinge
the ſame in two equall partes by the
Zenith or verticall poynt. It is called
Meridian for this effeate: that wherſo-
euer a man becometh, and at what
ſoeuer tyme of the yeare, when the

Definition
of the Meri-
dian circle.

Sunne (by the mouyng of the fyrſt moueable) ſhal come
to his Meridian: to hym ſhall it be hygh noone at myd-
day, and is therfore alſo called the circle of the mydday.

The myds
day or none

It is

Diuers Meri-
dians.

It is also to be noted, that there are as manye Meridi-
ans or Meridian lines, as are differences or habitacions
by longitude: so that they that dwell in the East, haue
other Meridians then they that dwell in the West. And
hereby is iudged the distance from one citie to an other,
and from one region to an other: So that the interposi-
tion of the arke of the Equinoctial betwene the Meridi-
an of one citie, and the Meridian of the other, is called
the difference of longitude from one region to an other,
and from one citie to an other, as we wyll further de-
clare hereafter.

The. xiiii. Chapter of the Horizontall Circle.

Definition
of the Horiz-
zon



Hemispheri-
of the Horizon

Diuers Ho-
rizons

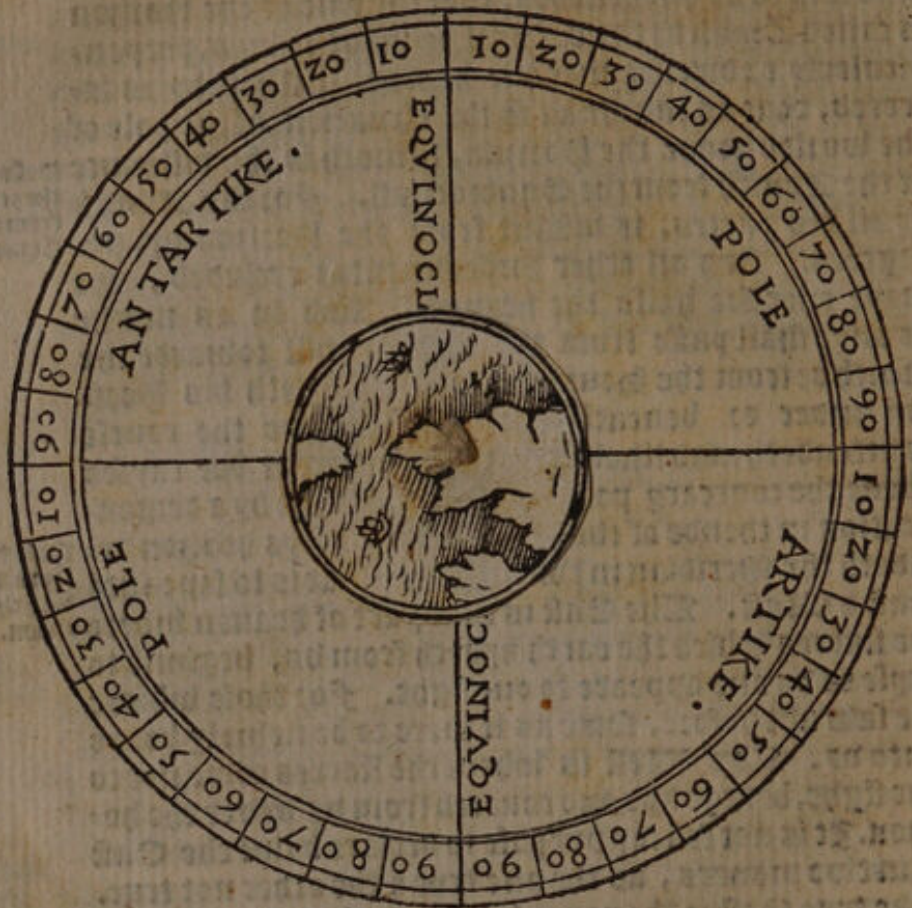
The ryght
and oblique
Horizon

The Horizon (after the Astronomers) is a circle that deuidenth the hemisphe-
re or halfe circle superiour from the
halfe circle inferiour: Or that deuy-
deth that part of heauen which we see
from the parte we see not, as the pro-
fessers of perspective affirme, and is
also called *h* Hemisphery (that is) the
half sphere, as the word signifieth in the Greke tongue,
and therfore eyther of these halfes is called Hemispheriū
This Horizon is moueable to them that moue. And
hereof it commeth, that howe many places are vpon the
earth and the circumference therof: it is possible there
should be so many Horizons. The Astronomers deuide
the Horizon into ryght & oblique or crooked. The ryght
Horizon, is to them whose Zenith or verticall poynt is
directly in the Equinoctiall: And this ryght Horizon
passeth by the Poles of the worlde, and deuidenth the
Equinoctiall in ryght and sphericall angles. The other
oblique or declined Horizon haue they vnto whom the
Pole of the world doth ryse aboue their Horizon. This
Horizon is also called oblique, because it deuidenth the E-
quinoctiall in vnequall and oblique or crooked angles.
Also

Also it is to be vnderstoode, that the pole of the Horizon is called Zenith or the vertical poynt of heauen, perpendicularly or directly ouer our headde. Whereby is inferred, that as muche as is the eleuation of the pole of the worlde aboue the Horizon, so much is the distaunce of the Zenith from the Equinoctiall. For the Zenith by all his partes, is distant from the Horizon by, 90. Distance of the Zenith from the Equinoctial degrees. And all other impedimentes excluded, we maye euer see halfe the heauen. And in as muche as anye shall passe from the Equinoctiall towarde the North or from the South, so muche falleth his Horizon vnder or beneath the pole towarde the course he intendeth, and likewise as muche shall it bee rayled aboue the contrary pole, as shall appeare by a demonstration in the ende of this Chapiture. Thys horizon diuideth the Meridian in two partes. That is to say: into East & West. The East is that part of heauen where the starres which the earth hydeth from vs, beginne to aryse to vs and appeare to our sight. For those whiche we saw not before, seme as it were to be newly bozne vnto vs. The West is where the starres come not to our sight, beinge hyd and couered from vs vnder the horizon. It is not fro my purpose to declare howe the East is in two maners, as the one true & the other not true. The true East is the poynt where the sunne ryseth, the Equinoctiall beyng in the Horizon: Lyke wyse is the West in two maners, one true and the other not. The true West is the part where the sunne falleth or goeth downe at the time of the Equinoctial. The vntue East is variable accordynge as the sunne ryseth dayly in dyuers poyntes of the Horizon. And so consequente is iudged of the West or Decident.

Howe the Horizon diuideth the Meridian.

The true & vntue east and west.



**The .xv. Chapter of the foure
lesse Circles.**

The lesse
circles.

Having intreated of the .vi. byggeste Circles, it
remayneth to speake of the foure lesse Circles.
A lesse Circle (as we haue sayde befoze) is that
whose superficiall deuydeth the Sphere into vnequall
partes

equall partes, not passyng by the centre therof. And of these, two are named Tropykes, so named of Tropo, the Greke worde which signifieth conuersion: because the Sunne commyng to any of these Tropykes, is conuerted, and turneth towarde the Equinotial. These Tropykes are describ'd by the motion of the fyrst moueable with the points of the Solstitials. The one with the begynnynge of Cancer, and this is called the Tropyke of Cancer or Estiuall or sommer Tropyke. The other is describ'd with the begynnynge of Capricorne, and is called the Tropyke of Capricorne, or Hiemall or wynter Tropyke. These two Tropykes and the Polare circles (wherof I wyll saye moze hereafter) are called Paraleles: So named for that they are equally deuyded by theyr circumferences one from an other, and aswell fro the Equinotiall. The Polar circles are describ'd in this maner: so that as the Zodiack declineth from the Equinotiall, so do the poles of the zodiacke decline from the poles of the worlde. And as the eyght sphere is moued at the motion of the fyrst moueable, so shall the Zodiacke moue, which is part of this sphere. And the Zodiack beyng moued, his poles shall lyke wyse moue about the poles of the worlde. And as the poles of the Zodiack are distant from the poles of the worlde. xxiij. degrees and a halfe (whiche is as much as the greatest declination) they shall describ'e certeyne circles deuyded from the poles of the worlde, in the selfe same. xxiij. degrees and a halfe. These Polare circles take theyr name or domination of that pole of the worlde that is mozte nere vnto them: And therfoze is the one called Artyke, and the other Antartyke.

Tropykes

Paraleles

The Polare circles

The poles of the zodiacke & poles of the worlde

The greatest declination of the sunne

Pole Artyke and Antartyke

The .xvi. Chapter of the

fyue Zones.

The

The .x. part.

The sphere
deuided in
to .v. zones



zones habi-
table and
unhabitable

The diuision
of the earth
according
to the fyue
zones of hea-
uen

An error of
Ptolome &
the Astrono-
mers

He auncient Astronomers deuyded the sphere into. v. Zones. The fyrste from the pole Artyke to the circle Artyke. The seconde from the circle Artyke to the Tropyke of Cancer. The thyrde from the Tropyke of Cancer to the Tropyke of Capricorne. The fourth from the Tropyke of Capricorne to the circle Antartyke. The fyfth from the circle Antartyke to the pole Antartyke. Of these. v. Zones they had certayne knowledge that the two of the poles were unhabitable for extreme colde: and also that the burnt zone called Torrida zona whereby the Sunne passeth by the myddest of them, shoulde be unhabitable for extreme heate. That from the Tropyke of Capricorne vnto the circle Antartyke, they called deserte, because they knewe not that it was inhabited. And this our Zone, that is, from the Tropyke of Cancer to the circle Artyke, they called inhabyted or habitable. And to haue moze perfecte knowledge hereof: It is to imagine that the earth is deuided proportionally into. v. regions or portions, which aunswere directly to the sayde fyue Zones, as saith the Poete Duide in this verse.
Totidemq; plagę, tellure pramuntur. That is. And so many regions are on the earth beneath.
Euery of these regions or portions of the earth, is situate vnder one of the. v. Zones aforesayde. But wheras certen men of auctoritie haue moued the question, whether the earth vnder the Zone frō the Tropyke of Cancer to the circle Antartyke, is desert or no: Ptolomie & the Astronomers affirme that it is vnpeopled. But Aristotle, Duide in the seconde of his Metamorphoses, Plinie also, and Ihon de Sacro bosco affirme the contrarpy: As for the moze certentie therof, we knowe by the experience of suche as go and come daylye from those partes. Mozeouer then this, we know that that land is not only well replenished with people of good corporature, & of whyte colour, but y same to be also very ryche in gold. For they that sayle to the East Indies, touch in y cape of Buena

Buena speranza or Caput bonæ Spei, which is in this zone.

Like wylse the lande of Brasile, and the confines of Rio de la Plata, with al the coaste vnto the straighes of Magalians, euen vnto the. liiii. degrees of the South parte.

This land was discovered by Magalians, in y^e yeare. 1520

or. 1521. Wherby that is nowe well knownen by sight,

wherof Ptolomie had no knowledge by hearesaye. The burnt zone (cauled Torrida zona) they also discribed to be

unhabitable by reason of the great heate therof, as Aristotel, Pline, and in maner all other ancient autours as firme: wherof the Poet Virgil writeth thus.

Quinque tenent Cœlum zonæ: quarum vna corrusco

Semper sole rubens: et torrida semper ab igne.

Whiche in the englishe tonge, is thus muche to saye in effect.

In zones fiue the heauens contained be,

Wherof the one with burning sunne is red,

Scorching so the earth subiect to his degree,

That for the heate therof it is vnhabited.

Like wylse Ouide in his Metamorphoseos, toucheth the same, saying.

Quarum quæ media est, & torrida semper ab igne &c.

Yet that the burnt zone is inhabited and well replenished with people that liue there, we knowe so certainly

by the number of them that daily passe to and fro the Indies of your maiestie discovered in your most happy daies

that to say any thing to the contrary it should bee a manifest errour.

And therefore is it greatly to bee marueyled, that certayne wylse menne haue affyrmed these

partes to be unhabitable: where as neuerthelesse they

had knowledge of Arabia Fœlix, Aethiopia, Taprobana,

and diuers other Regions situate vnder the burnt zone.

Plinie writeth that a shippe came from the Sea of Persia

by the Ocean rounde about Ethiope, and came to the

pillers of Hercules: whiche is nowe the citie of Cadiz,

where at this present I wryte this brieft treatyse.

They of Guinea, Calicut, Gatigara, and Malaca, liue all vnder

the burnt zone: and many of the liue very long. And

that, that part is inhabited, S. Isidore saith that Paradise

The land of Brasile.

The straighes of Magalians.

The west Indies.

People of long life vnder the zone.

terrestriall is a place situate in the East, very neare vnto the circle of the Moone: moste temperate, and full of al pleasure and delite. And doubtlesse many thinges ought to perswade vs, that vnder the burnt zone, the earth is furnished with al thynges pertyning to the life of mā. First for that in that region or portion of the earth, is in maner continuall equinoctiall: and the coldnesse of the nyght doth sufficiently temper the heate of the daie. Secondly, bycause Saturne, Mercury, and the Moone, whiche are colde and moyst Planetes, are of great force in regions vnder that Zone & passe directly ouer them. Againe, they y inhabite vnder that zone haue two summers & two wynters in the yeare. Wherby is cōcluded that y aunciet autours erred, not only in affirmyng this zone to be vnhabitable by reason of y great heate thereof, but in lyke maner erred in affirming the zone that is betwene the circle Articke & the pole Articke, to be also vnhabited by reason of great colde. The contrarie wherof we may well affirme, knowyng as we knowe, that Islande, with parte of Gothlande, Norwaye, Russia, and diuers other landes are inhabited and well peopled.

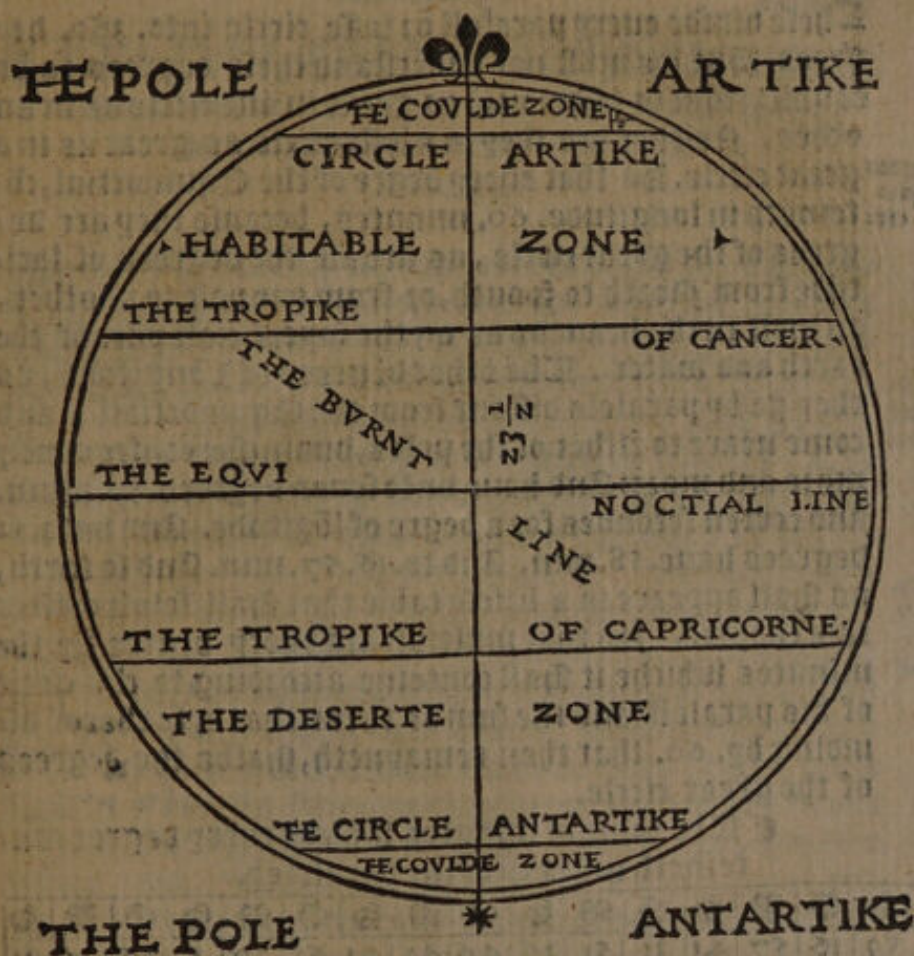
**This is the figure and demonstration
whiche foloweth.**

The

Colde and
moist planetes,
temper
the heate of
the burnt zone.

Colde regions
habitable.

Islande.
Gothlande.
Norwaye.
Russia.



The. xvii. Chapter of longitude and latitude: and of the proportion whiche the lesse circles haue to the great Circle.

The Sphere is deuided in Latitude by degrees in this maner: So that from the Equinoctiall to either of the poles, is. 90. degrees. And in longitude by the Equinoctiall, it is deuided into three hundredeth and three score, as is sayde in the diuision of the Zodiack. And from these degrees, passe certain great circles (called Meridians) to the poles of the world.

C. ii.

These

The diuision
of the sphere
by longitude
and latitude.

The degrees
of the equis
noctall circ
cle.

The table of minutes whiche euery degree con-
teineth in euery of the paraleles.

1	59	59	16	57	41	31	51	26	46	41	41	61	29	5	76	14	31
2	59	58	17	57	23	32	50	53	47	40	55	62	28	10	77	13	30
3	59	55	18	57	4	33	50	19	48	40	9	63	27	14	78	12	29
4	59	51	19	56	44	34	49	45	49	39	22	64	26	18	79	11	27
5	59	46	20	56	23	35	49	9	50	38	34	65	25	21	80	10	25
6	59	40	21	56	1	36	48	32	51	37	46	66	24	24	81	9	23
7	59	33	22	55	38	37	47	55	52	36	56	67	23	27	82	8	21
8	59	25	23	55	14	38	47	17	53	35	7	68	22	29	83	7	19
9	59	16	24	54	49	39	46	38	54	35	16	69	21	30	84	6	16
10	59	5	25	54	23	40	45	58	55	34	25	70	20	31	85	5	14
11	58	54	26	53	56	41	45	17	56	33	33	71	19	32	86	4	11
12	58	41	27	53	28	42	44	35	57	32	41	72	18	32	87	3	8
13	58	28	28	52	59	43	43	53	58	31	48	73	17	33	88	2	5
14	58	13	29	52	29	44	43	10	59	30	54	74	16	32	89	1	3
15	57	57	30	51	58	45	42	26	60	30	0	75	15	32	90	0	0

The. xviij. Chapter of the circuite or
 compasse of the earth and water, according to the
 opinions of the ancient and later
 Authors.

IT may here appeare to make for our purpose to declare how the ancient wyters counted the degrees of the earth and water. First the Latines counted by myles. *Miles.* The Grekes by furlonges. *Furlonges.* The Spanyardes and Frenchemen by leagues. *Leagues.* The Egyptians by signes or markes: and the Persians by saguas. But they all agree that foure graines of barlye make a synger: foure fingers a hande: foure handes a foote: fyue feete a geometrical pase (for two simple pases make fyue feete) Also. 125. Geometricall pases, make a furlong. viij. furlonges one myle, whiche is a thousand pases: And thre myles one league. In Germanie they make leagues of moze feete: and in some places moze then in other. In Fraunce they count. xv. leagues to one degree. The Spanyardes counte. xvi. leagues and two terces: and. xvij. and a halfe for a degree of the great circle. This difference that one league is bigger then an other, may come hereof, that one barlye corne is bigger then an other. But to our purpose, let vs gyue to euery league, thre thousand pases, and to euery pase fyue foote, and so shall euery league haue fyue thousand foote. In the cardes of the sea that haue their degrees of. xvi. leagues and two terces, we say that of these, the roundnes of the lande and the water conteineth sixe thousand leagues. And in the cardes that haue. xvij. leagues & a halfe for a degree, of these we say that it conteineth sixe thousand and thre hundred leagues. And who so desireth to knowe how much is the Diameter of the earth and water, may knowe it by multiplying the circumference by seuen: So that diuiding the summe that riseth therof by twenty and two, the parte that riseth of that calculatio, shalbe the Diameter: and the halfe therof shalbe the semidiameter.

Miles.
Furlonges.
Leagues.

Graine.
Fynger.
foote.
Pase.

The degrees
of the Sea
cardes.

The Diam-
eter of the
earth & wa-
ter.

The. xix. Chapter of the seven Climates.

Division of
the earth and
water by cli-
mates.



Diversity of
things
in diuers cli-
mates.

What is a
climate.

Difference
of dayes.

The spaces
the seven cli-
mates.

The quanti-
tie of the les-
ser circles.

The auncient autours diuided the su-
perficiall of the earth and water from
the Equinoctiall towarde the part of
the North, into seven climates, with
eyght lynes equally diuided from the
Equinoctiall. In these climates are
dyuers condicions and customes of
men, and dyuersities of beastes and
other naturall thynges. And for y^e the parte of the world
whiche they counted habitable, is comprehended vnder
the. 180. degrees of longitude: and. 37. degrees and. 45.
minutes of latitude, we force not to assigne the climates
in this maner: but compassyng about the whole vniuers,
fall lande and sea, diuiding the paralelle circles. A climate
or climat, is a space of lande in the whiche the greatest
daye maketh difference of halfe an houre. So that in se-
uen climates, shalbe the difference of thre houres and a
halfe. The greatest daye is from the begynnyng of the
first climate. xii. houres and. 45. minutes. And in the
ende of the seventh climate, the greatest daye shalbe of.
xvi. houres and fyue minutes. These climates do not be-
gynne in the Equinoctiall. But the begynning of the
first climate, is distant from it. xii. degrees and. 45. mi-
nutes: And the ende of the seventh climate, is distante.
50. degrees and. xxx. minutes. So that the space whiche
the seuen climates do occupie, shalbe. 37. degrees and. 45.
minutes. In lyke maner is to bee vnderstoode, that
the longitude of the first climate, is greater then the lo-
gitude of the seconde: and that of the seconde then that
of the thirde: and so of the reste. For the lesse circles in
howe muche they are nearer to the Equinoctiall, in so
muche are they greater. And in howe muche nearer to
the pole, so much shal they be the lesse, bicause the sphere
is narrower and narrower towarde the pole, and conti-
nually wareth straighter at the concourse of the Meri-
dians.

dians. In lyke manner shall you vnderstande, that greater is the breadth of the fyrst climate then of the seconde: and the seconde then the thyrde, and lyke wyse of the other. For in howe muche the moze from the Equinoctiall you come neare to the pole, so muche the moze is the sphere oblique or crooked, and consequently the daye encrease more. By reason wherof, in lesse space is found thyncrease of halfe an houre, in whiche the climate maketh difference and doth varie. Whiche thynge shalbe moze manifest to hym that beholdeth the latitude of the all, as may appeare by the Table here following: In whiche you may se the houres whiche the greatest days conteyneth of every climate in his begynning, myddest, and ende: with also the eleuations of the pole, or distaunces from the Equinoctiall: and also the degrees of latitude whiche every climate conteyneth.

The latitude
of climates.

Climates.	Beginning		Myddest		Ende		Beginning		Myddest		Ende		Latitude.	
	Ho.	M	Ho.	M	Ho.	M	Ho.	M	Ho.	M	Ho.	M	Ho.	M
First.	12	45	13	0	13	15	12	45	10	40	20	30	7	40
Seconde.	13	15	13	30	13	45	20	30	24	15	27	30	7	0
Thirde.	13	45	14	0	14	15	27	30	30	45	33	40	6	10
Fourth.	14	15	14	30	14	45	33	40	36	24	39	40	5	20
Fifth.	14	45	15	0	15	15	39	40	41	20	43	30	4	30
Sixth.	15	15	15	30	15	45	43	30	45	40	47	15	3	45
Seuenth.	15	45	16	0	16	15	47	15	48	40	50	30	3	15

The first climat, is called Diameroes. Meroe is a citie of Aphaike vnder the burnt Zone on this syde the Equinoctiall. xvi. degrees.

Diameroes.

The second is called Diasyena. Syena is a citie in the confines of Ethiopia: where there is a well that sheweth the Sommer solstitial: bicause that place is vnder the circle of the Tropike of Cancer, and the Sunne semeth to stande directly ouer that place at midday of y^e Solstitial. Wherby the well is then very cleare, and hath in it no shadowe at all: as the Poet Lucan maketh mention in Farsalia, where he saith.

Diasyena

Vmbras nusquam flectentes.

That is to say: shadowes no where reflecting.

C. liii.

The

Dia Alex
andros.

Dia Rho
dos.

Knights of
the Rhodes.

The Rhodes
taken by the
Turke.

Dia Ro
mes.

Dia Bori
sthenes.

Dia Rifeos

The ryuer
Tanais.

Stollerine.

The West
discovery of four
climates.

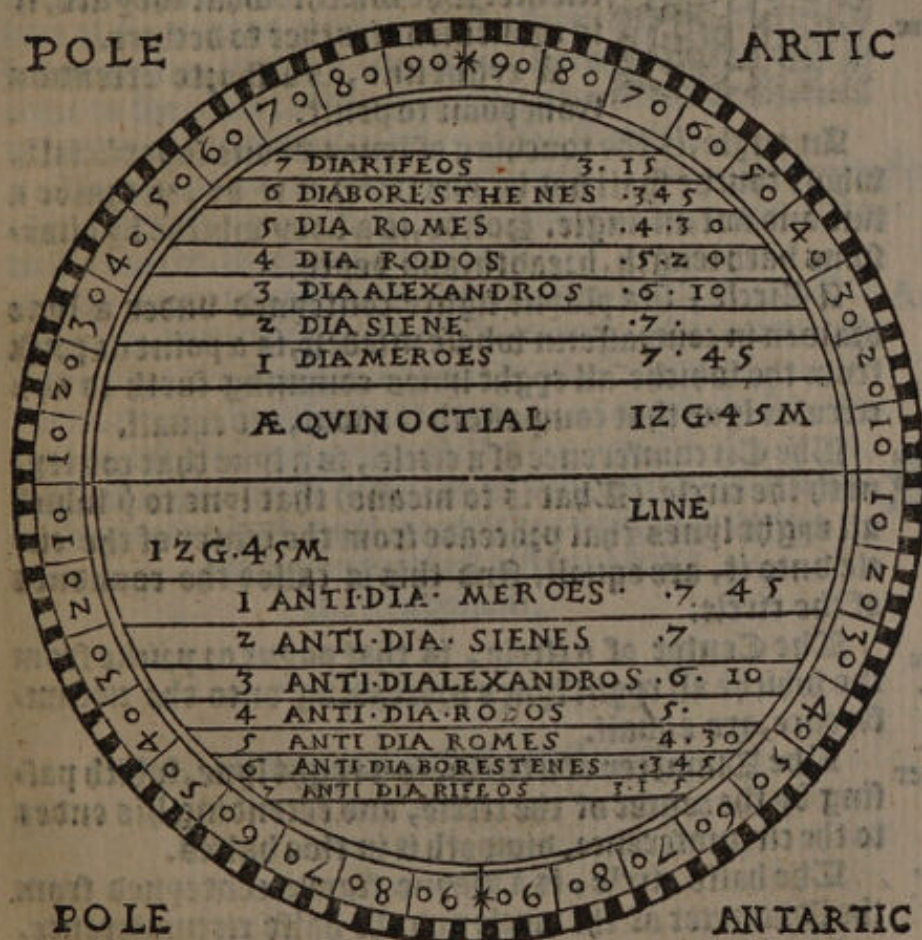
The third is Dia Alexandros. Alexandria is a famous citie in Aphrike, buylded by great Alexander: and is the chief citie or Metropolis of Egypt. The fourth is Dia Rhodes. Rhodes is an Island of Asia the lesse, where were sumtyme the knightes of the Rhodes, called the knightes of the order of S. John, or knightes of Jerusalem. Who were driven from thence when the Island and citie was taken by Soltan Suliman the great Turke, in the yeare 1522: Philippe Vlerio frenche man, being then graund maister of the Rhodes. Within this fourth climate, is the citie of Jerusalem within the holy lande called Palestina and also a great part of Spayne, with many other prouinces.

The fift is Dia Romes, Rome is the most famous citie of Italie, and most notorius of all Europe. Sumtyme the head of the world, dominatrix of nations, and now the see of the byshop of Rome.

The sirt is Dia Boristhenes. Boristhenes is a great ryuer of Scithia: the fourth arme of the ryuer Istro. It fauleth into the sea Euxinum. And where as all other ryuers of Scithia are troubled, this is cleare and faire. Also holisom to be dronke, and full of fysh.

The seuenth and last climat, is called Dia Rifeos. The mountaines called Rifei, are famous in the parte of Europe cauled Parmatia: and are continually couered with snowe. Out of these, springeth the ryuer Tanais, well knowen in the world by fame. When it is wrytte with ph. it is the name of certen mountaines of Archadia. And here ought we not to be ignorant, that wheras the aun-
cient autours assigned only seven climates, they myght haue made many more. And for that they iudged the part of the pole Antartike not to be inhabited, they assigned no climates therto. Stollerine added the right climate, counting from thende of the seuenth climate vnto 57. degrees: and other added moze. In like maner describing Meridionall or South climates, we caule them by the selfe same names as we did the aforesayd Septentrionall or North climates: sauing that it is necessary to put befoze every of them this Greke preposition Anti, whiche

whiche in the Latin tongue signifieth Contra, or Contra-
rium (that is) contrarie or against. So that as we named
the first North climat Dia Meroes, we must to the first of
the south, adde this worde Anti: & so shall the first south
climate be named Anti Diameroes: The seconde Antidia
syene, and so furth of the other, as is scene in the figure
here folowpng.



The. xx. Chapter of certen pzin- ciples that ought to be knowen for this science.



In treating of the Sphere, we haue spoken of Circles, Circumferences, Centers, Diameters, Lines, with such other wordes appropriate to this science. The whiche: what they are, it is conuenient further to declare.

A ryght line, is a shorthe extention from point to point.

A ryght line

An angle.

An angle, is the touching of lynes in one superficial, whose touche shall not be direct: for if it be, it shall be a line and not an angle. Solide, is a body whiche by dimensions hath length, breadth, and depth.

Solide.

A Circle.

A Circle, is a playne figure conteyned vnder a lyne drawn in compasse: in whose middelt, is a point or prick from the whiche all ryght lynes comming furth to the circular lyne that compasseth it about, are equall.

The circumference of a Circle.

The Circumference of a circle, is a lyne that conteyneth the circle. (That is to meane) that lyne to which all ryght lynes that procede from the center of the circle vnto it, are equall. And this is called the roundnes of the circle.

The center of a circle.

The Center of a circle, is that poynnt or pricke from the whiche all ryght lynes proceeding vnto the circumference, are equall.

Diameter

The Diameter of a circle, is a ryght lyne, which passing by the center of the circle, and extending his endes to the circumference, diuideth it in two halfes.

Semicircle.
Zenith.

The halfe circle, is a playne figure conteyned from the Diameter of the circle and the halfe circumference.

Zenith is a point or pricke imagined in heauen directly ouer the top of any thyng. As if we should imagen a ryght lyne to passe by the center of the earth, extended from thence directly to heauen, and passing through the feete and head of a man standing vpryght, so that the extremities or endes of this lyne should reache vnto & touche the the

the the circumference of heauen: then the imagined point
 o2 p2icke of heauen where the ende of the lyne toucheth,
 is called Zenith, o2 poynt of the head, o2 vertical point.
 The same is to be vnderstode of a citie o2 any other thing
 when we speake of y^e zenith therof. Eccentricke, is a circle
 which hath his center distant o2 diuided fro the center
 of the worlde: and is discribed in the heauen of the sunne
 imagining a lyne from the center of the Eccentrike to
 the center of y^e Sunne: And is moued one whole reuolu-
 tion at the proper motion of the Sunne. In the other
 heauens, imagining a lyne from the center of his Eccen-
 trike to the center of his Epicycle: & is moued a whole re-
 uolution at the proper motion of the Epicycle.

Eccētricke

The Epicycle, is a circle o2 litle rouel first in the depth
 of the Eccentrike: In whiche the Planet fixed and nere
 to his center, is moued circularly.

Epicycle

The Auge, is a poynt in the circumference of the Ec-
 centrike, very neare to the firmament. O2 it may bee
 sayde, that the Auge is a poynt furthest distant from the
 earth. Aux in the Greke tongue, is as much to saye as
 the largest lōgitude, o2 greatest eleuation fro the earth.

Auge

The Opposite of Auge, is an other poynt in the cir-
 cumference of the Eccentricke: nearest vnto the
 earth, and furthest disaunt from
 the firmament.

Opposite of
Auge.

Here endeth the first part.

THE SECONDE PARTE

intreatyng of the Motions of the Sunne,
and the Moone: And of the effectes
caused thereby.

The first Chapter of the course of the Sunne in the Zodiac: And of the effectes caused by the same.



The sunne
is the guide
in navigatiō

The moving
of the sunne
vnder the 30
diack.

Equinoctial.

The summer
Tropike.

Declination
of the sunne.

We haue briefly spoken of
the Sunne and of the other heauens.
But for as muche as the Sunne must
be our marke, gyde, and gouernour in
nauigation, whereof we intende to
gyue perfect instructions, it shal be ne-
cessary especially and precisely to de-
clare the course and motions therof. Therfore (as we
haue sayd) the Sunne is moued vnder the Zodiac, and
vpon his poles by the line Eclipticke, passing by the .xii.
signes, beginning in the first degree of Aries, where he
maketh the Equinoctial, when the dayes and nyghtes ar
equall to all. And passeth by this signe to vs that are
on the North parte: wherby the length of the dayes are
encreased with vs, and the length of the nyght are shor-
tened. Then entreth he into Taurus. And passing by it,
entreth into Gemini. Then passing by it and enterynge
into the first degree of Cancer, he toucheth in the Summer
or estiuall Tropike: and then are the dayes longest with
vs, and the nyghtes shortest. Then declineth he no fur-
ther from the Equinoctiall: but returnyng towarde it,
passeth by this signe, shortenynge the dayes to vs & leng-
thening the nyghtes. From this signe of Cancer, it en-
tereth into Leo: and passeth by it into Virgo. And by it
entereth into the first degree of Libra in the Equinoctiall:
and there maketh the other Equinoctiall, when to all,
the nyght is equall with the daye. And passing by this
signe, goeth declining from the Equinoctiall towarde
the

the pole antartike: increasynge the nyghtes to vs & shor-
tenyng the dayes: and so entreth into Scorpio: and from
thence into Sagittarius. And passynge by it, entreth into
the fyrst degree of Capricorne to the Hyemal or wynter
tropicke. And then are the longest nyghtes vnto vs, and
the shorrest dayes. From hence he retourneth towarde
the Equinoctiall, shorthenyng vnto vs the nyghtes and
lengthenyng the dayes. He passeth by this signe of Ca-
pricorne and entreth into Aquarius. And passing by it,
entreth into Pisces. And passing from thence, retour-
neth to his fyrst poynt of the equinoctial of Aries where
he began. Hereby it foloweth, that as the Sunne goeth
the half of the zodiack on this part of the equinoctiall, &
the other halfe on the other parte of it, & in these halfes
hath diuers declinations, is caused the increasynge or de-
creasynge of the dayes and nyghtes to one more and to
an other lesse, accordyng as euery one with his Horizon
discouereth of hys course of the Sunne by hys litle or much
that he is departed or distaunt from the equinoctiall, or
as the pole is rayfed aboue his Horizon. So that, when
as to them that are on this parte of the equinoctiall, is
the longest daye and the shorrest nyght: euen so to them
on the other part, is the longest nyght and shorrest day.
And contrariwise, when vnto vs is the shorrest day, vn-
to them is the longest. Whiche shall further appeare by
evident demonstration in the last chapter of the thyrde
parte.

The wynter
tropike.

The cause of
increasing &
decreasinge
of the dayes
and nyghtes

The discrete reader shall here note that the Sunne is
moued regularly in the center of his sphere: whose cen-
ter is without the center of the worlde towarde the part
of Cancer. Wherby the sunne passing in his Septen-
trionall signes, is more distant from the earth: and hath
more to go then in the south signes. And for this cause it
tarieth nyne dayes more on the part of the Auge then on
his opposite. And hereby it foloweth that by reason of
the obliquitie or crookednesse of the zodiack, certen dayes
of wynter with their nyghtes, are longer then certayne
other of somer with their nyghtes.

The moving
of the sunne
in the center
of his sphere

The

The. ii. Chapter of the true place of the Sunne in the Zodiack.

To finde the true place of the sunne,



The equatio of the yeare,

The true place of the Sunne, is a point or prick in the Zodiack, which is thus founde: That drawing a ryght lyne from the center of the worlde to the center of the Sunne, and carying the same continually ryght furth vnto the Zodiack where this line sheweth or toucheth, that is the true place of the

Sunne. This place is founde in thzee maners. One waye by a table. An other waye by an instrument: And the thyrde waye by a certaine rule to be borne in memorie. To fynde the true place of the sunne by a table, seke in the table folowynge, the moneth that you are in, in the fronte or head of the table: And the dayes of the moneth, on the left syde of the table. Then directly against the dayes, vnder the title of the monethes, you shall fynde two numbers whiche are the degrees and minutes of the signe whiche you shall fyrst fynde named ouer the head or aboue the sayde numbers. Then to the degrees and

minutes whiche you shall fynde, you shall adde the equation that is directly of the yeare in the whiche you are, or seeke to knowe. And this shall you seeke in the table of equations whiche is after this. And that whiche doth amount or arise therof, shall be the true place of the sunne. And here is to be noted, that in the comon yeares, (whiche are they that haue not the bisextile or leape yeares,) from the ende of Februarie vntill the ende of the yeare (I saye of December), shall euer one degree be diminished or taken away. And the degrees and minutes that shall remaine, is the true place of the sunne. Howe to

knowe this by an instrument and by measure, shall be sayde in the sequent Chapter.

The Table of the true place

Mo- neths.	January		February		Marche.		Aprill.		Maye.		June.	
Sig- nes.	Capric.		Aquarius		Pisces.		Aries.		Taurus.		Gemini.	
Dates	☿	♈	☿	♈	☿	♈	☿	♈	☿	♈	☿	♈
1	20	22	21	53	20	55	21	24	20	21	19	55
2	21	24	22	54	21	55	22	22	21	18	20	52
3	22	25	23	54	22	54	23	21	22	16	21	49
4	23	26	24	55	23	54	24	19	23	13	22	46
5	24	27	25	55	24	53	25	17	24	11	23	43
6	25	28	26	56	25	53	26	16	25	8	24	40
7	26	30	27	56	26	52	27	14	26	6	25	37
8	27	31	28	56	27	52	28	12	27	3	26	34
9	28	32	29	57	28	51	29	10	28	0	27	31
10	29	33	0	57	29	50	0	8	28	58	28	28
11	0	35	1	57	0	49	1	6	29	55	29	25
12	1	36	2	58	1	48	2	4	0	52	0	22
13	2	37	3	58	2	47	3	2	1	50	1	19
14	3	38	4	58	3	46	4	0	2	47	2	16
15	4	39	5	58	4	45	4	58	3	44	3	13
16	5	40	6	58	5	44	5	56	4	41	4	10
17	6	41	7	58	6	43	6	54	5	38	5	7
18	7	42	8	58	7	42	7	52	6	36	6	4
19	8	43	9	58	8	41	8	49	7	33	7	1
20	9	44	10	58	9	39	9	47	8	30	7	58
21	10	45	11	58	10	38	10	45	9	27	8	55
22	11	46	12	58	11	37	11	43	10	24	9	52
23	12	47	13	57	12	36	12	40	11	21	10	49
24	13	48	14	57	13	34	13	38	12	18	11	46
25	14	48	15	57	14	33	14	36	13	15	12	43
26	15	49	16	56	15	32	15	33	14	12	13	40
27	16	50	17	56	16	30	16	31	15	10	14	37
28	17	51	18	56	17	29	17	28	16	7	15	34
29	18	51	19	56	18	28	18	26	17	4	16	31
30	19	52			19	27	19	23	18	1	17	29
31	20	52			20	25			18	58		

Of the Sunne.

Mo- neths.	June.		August.		September.		October.		November.		December.	
Sig- nes.	Cancer.		Leo.		Virgo.		Libra.		Scorpio.		Sagitta.	
Dates	☾	☿	☾	☿	☾	☿	☾	☿	☾	☿	☾	☿
1	18	26	18	2	18	4	17	39	18	49	19	24
2	19	23	19	0	19	2	18	39	19	50	20	26
3	20	20	19	58	20	1	19	38	20	51	21	27
4	21	17	20	55	21	0	20	38	21	52	22	29
5	22	14	21	53	21	58	21	38	22	53	23	30
6	23	11	22	51	22	57	22	38	23	54	24	31
7	24	8	23	48	23	56	23	38	24	55	25	33
8	25	5	24	46	24	55	24	38	25	56	26	34
9	26	2	25	44	25	54	25	39	26	57	27	36
10	27	0	26	42	26	53	26	39	27	58	28	37
11	27	57	27	40	27	52	27	39	28	59	29	39
12	28	54	28	38	28	51	28	39	0	0	0	40
13	29	51	29	36	29	50	29	39	1	1	1	42
14	0	48	0	34	0	49	0	39	2	3	2	43
15	1	46	1	32	1	48	1	40	3	4	3	45
16	2	43	2	30	2	47	2	40	4	5	4	46
17	3	40	3	28	3	46	3	40	5	6	5	48
18	4	38	4	26	4	45	4	41	6	8	6	49
19	5	35	5	24	5	45	5	41	7	9	7	51
20	6	32	6	22	6	44	6	42	8	10	8	52
21	7	30	7	21	7	44	7	42	9	11	9	54
22	8	27	8	19	8	43	8	43	10	13	10	55
23	9	25	9	17	9	42	9	43	11	14	11	57
24	10	22	10	16	10	42	10	44	12	15	12	58
25	11	20	11	14	11	41	11	45	13	16	13	59
26	12	17	12	13	12	41	12	45	14	18	15	1
27	13	15	13	11	13	41	13	46	15	19	16	2
28	14	12	14	10	14	40	14	47	16	20	17	3
29	15	10	15	8	15	40	15	47	17	22	18	5
30	16	07	16	7	16	39	16	48	18	23	19	6
31	17	5	17	5			17	49			20	7

The Table of the Equations of the Sunne.

The peres of our loz		The equatio to be added.		The peres.		The E- quation.		The peres of our loz		The equatio to be added.	
15	16	15	16	15	16	15	16	15	16	15	16
1545	1	0	1581	1	16	1617	1	32	1653	1	43
1546		45	1582	1	1	1618	1	17	1654	1	33
1547		30	1583		46	1619	1	2	1655	1	18
1548		15	1584		32	1620		47	1656	1	3
1549	1	2	1585	1	18	1621	1	33	1657	1	49
1550		47	1586	1	3	1622	1	18	1658	1	34
1551		32	1587		48	1623	1	3	1659	1	19
1552		18	1588		33	1624		49	1660	1	4
1553	1	4	1589	1	19	1625	1	35	1661	1	51
1554		49	1590	1	4	1626	1	20	1662	1	36
1555		34	1591		49	1627	1	5	1663	1	21
1556		19	1592		35	1628		51	1664	1	7
1557	1	05	1593	1	21	1629	1	37	1665	1	53
1558		50	1594	1	6	1630	1	22	1666	1	38
1559		35	1595		51	1631	1	7	1667	1	23
1560		21	1596		37	1632		53	1668	1	9
1561	1	7	1597	1	23	1633	1	38	1669	1	55
1562		52	1598	1	3	1634	1	23	1670	1	40
1563		37	1599		53	1635	1	8	1671	1	25
1564		23	1600		39	1636		54	1672	1	10
1565	1	9	1601	1	25	1637	1	40	1673	1	56
1566		54	1602	1	10	1638	1	25	1674	1	41
1567		39	1603		55	1639	1	10	1675	1	26
1568		25	1604		40	1640		56	1676	1	12
1569	1	11	1605	1	26	1641	1	42	1677	1	58
1570		56	1606	1	11	1642	1	27	1678	1	43
1571		41	1607		56	1643	1	12	1679	1	28
1572		26	1608		42	1644		58	1680	1	13
1573	1	12	1609	1	28	1645	1	44	1681	2	0
1574		57	1610	1	13	1646	1	29	1682	1	45
1575		42	1611		58	1647	1	14	1683	1	30
1576		28	1612		44	1648	1	0	1684	1	15
1577	1	14	1613	1	30	1649	1	45	1685	2	2
1578		59	1614	1	15	1650	1	31	1686	1	47
1579		44	1615	1	10	1651	1	16	1687	1	32
1580		29	1616		46	1652	1	2	1688	1	18

This Table of the Equation of the Sunne, serueth from the yeare of. 1545. where it hath his roote or beginning, vntyl. 1680. And in the yeare of. 1681. it shall returne to the roote, adding therunto one degree more. As for example. In the yeare of. 1681. adde one degree vppon the other degree that the roote hath, and so shall the yeare of. 1681. haue two degrees of equation. And the yeare of. 1682. shall haue one degree and. 45. minutes: which is to adde one degree vpon. 45. minutes that had the yere of. 1546. &c. And hauyng passed other. 136. yeares, you shall returne to the roote, addyng two degrees.

The thyrde Chapiter of the declination of the Sunne.

What is the
Declination
of the Sunne



The declination of the Sunne, is the arcke of the greater circle, which passeth by the Poles of the world, included betwene the Equinoctiall and the Zodiac. And here is to be noted, that whatsoeuer foure poyntes or prickes shall be equally distaunt frō the Equinoctials, haue equall declinations.

Wherof it foloweth, that the foure quarters of the Zodiacke haue equall declinations. And to auoyde prolixitie, I wyll adde hereunto a table of the declinations of onely one quarter of the Zodiac: so that all hauyng one self same maner of declinations, it may serue for al, and the order of it is this. The signes whose declination increaseth, are in the head or fronte of the Table, and the degrees of these signes descende by the left syde therof. And the signes whose declination decreaseth, are in the foote of the Table, and the degrees of these signes, ryse by the ryght syde of the same. The disposition of the Table being vnderstode: then to knowe what declination the Sunne hath in euerye degree of the Zodiac, you ought to knowe the true place of the Sunne (as in the Chapiter past is declared) for the day of the declination whiche you desyre to knowe. And the signe whiche

Sig- nes.	♈	♉	♊	♋	♌	♍	Sig- nes.
	♈	♉	♊	♋	♌	♍	
0	0		11	30	20	12	30
1	0	24	11	51	20	25	29
2	0	48	12	12	20	37	28
3	1	12	12	33	20	49	27
4	1	36	12	53	21	0	26
5	2	0	13	13	21	11	25
6	2	23	13	33	21	22	24
7	2	47	13	53	21	32	23
8	3	11	14	13	21	42	22
9	3	35	14	32	21	51	21
10	3	58	14	51	22	0	20
11	4	22	15	10	22	9	19
12	4	45	15	23	22	17	18
13	5	9	15	47	22	25	17
14	5	32	16	5	22	32	16
15	5	55	16	23	22	39	15
16	6	19	16	40	22	46	14
17	6	42	16	57	22	52	13
18	7	5	17	14	22	57	12
19	7	28	17	31	23	3	11
20	7	50	17	47	23	8	10
21	8	13	18	3	23	12	9
22	8	35	18	19	23	15	8
23	8	58	18	34	23	19	7
24	9	20	18	49	23	22	6
25	9	42	19	4	23	24	5
26	10	4	19	18	23	26	4
27	10	26	19	32	23	28	3
28	10	47	19	46	23	29	2
29	11	9	19	59	23	30	1
30	11	30	20	12	23	30	0
Sig- nes.	♈	♉	♊	♋	♌	♍	Sig- nes.

whiche the Sunne shall be founde in that day, shall you seke in the front or foote of the table. And yf it be in the front, you shall seke the number of the degrees on the left syde. And if it shall bee at the foote of the table, you shall seke it on the right syde. Then aboue or vnder the signe in the front of that degree of the sayde signe, you shall finde two nūbers: wher of the fyrst is of degrees, and the seconde of minutes: and those degrees & minutes of declination bathe the Sunne that daye. And this is vnderstode without hauyng respect to the odd minutes aboue the degree, whiche the true place of the Sunne hath.

And yf you desire to verifie this more pprecysely, note the declination of that degree, & of the degree following:

lopyng: and take the lesse from the moze. Then of the reste take suche parte as are the minutes that it hadde of. 60. And this parte of minutes muste be added to the fyrst equation of it, and be lesse then the seconde, or must be taken from it, if it shalbe greater: and that then ryseth therof, shalbe the p[re]cise declination for that signe, degree and minute. As for example.

In the yere. 1546. the tenth daye of September, the Sunne shalbe in. 26. G. 38. M. of Virgo: and to the. 26. G. p[re]cise, shall correspond. 1. G. 36. M. of declination. And to verifie the declination that cometh to. 38. minutes, which is moze of the. 26. G. you muste marke the difference that is fro the declination of 26. G. (which is one G. 36. M.) to the declination of. 27. G. which is 1. G. 12. M. The difference is. 24. M. Of these you must take such part as is. 38. of. 60. which are almoste twoo terces. When two terces of. 24. are. 16. which muste be taken of one. G. 36. M. which corresponde to the. 26. G. of Virgo: because the declinations go decreasyng, and remayneth. 1. G. 20. M. And if the declinations increase, you must adde thereto, as you take away when they decrease.

¶ An other example for this yere of. 1561.

Example for the yere. 1561. the. xx. of Apryl
I find the true place of the Sunne at none in. 9. degrees 54. minutes of Taurus: When in the Table of signes present I seke for the ninth degree of Taurus, to which doth aunswere for the declination. 14. degrees. 32. minutes: and to the next degree folowing, doth aunswere. 14. degrees. 51. minutes. When take the lesser out of the moze: so resteth. 19. minutes. When frame a rule of. 3. & say: yf. 60. minutes geue. 54. minutes (which. 54. minutes doth rest befoze of the. 9. degree of Taurus) how many doth. 19. minutes geue: which. 19. minutes are the diuersitie of the ninth and tenth degrees of Taurus. So I find that. 19. minutes, geueth. 17. minutes & 6. secundes which. 17. mi. & 6. secundes, I adde to the. 14. degrees. 32. minutes which answereth to the. 9. degrees of Taurus:
And

And that commeth to. 14. degrees. 49. minutes, and, 6. secondes, which is the true declination for the. 20. daye of Apryll. Anno. 1561.

It is also to be noted that I adde these. 17. minutes and 6. secondes, because the declination doth encrease: for if it decreased, it were to be taken out so much, and the rest is the declination. So is the declination for the. 20. of Apryll in the yeare. 1561. 14. degrees. 49. minutes, and. 6. secondes.

The.iiii. Chapter of the entraunce of the Sunne into the. xii. signes. And of the Equinoctials and Solstitials which deuyde the foure tymes of the yeare.



For that is sayde in the Chapter before, it foloweth that the Sunne enterynge into the foure principall signes, causeth the foure tymes of the yeare. For entering into Aries, it chaungeth the tyme to vs from wynter to the springe tyme. And entering into Cancer, it chaungeth the tyme from spring to Sommer: And enterynge into Libra, from Sommer to Autumne. Lyke wyle enterynge into Capricorne, it chaungeth from Autumne to Wynter. So that when to vs that be on the part of the North is Sommer, then is it Wynter to them that are on the South part. Or contrary wyle, beyng Sommer to them on the South, it is wynter to them on the North. The entraunce of the Sunne into these signes, and all other of the Zodiac, hath not ben euer at one selfe same tyme of the yeare. The cause of this is, that the Latine yeare is not equall with the mouyng of the Sunne in the Zodiac: as shalbe sayde in the. v. Chapter, where we wylle entreate of the yeare. In the tyme that Chryste our redeemer was borne, were the Equinoctiales. The one at the. viii. of the kalendes of Apryll, and the other at the. v. of the ka-

The entraunce
of the sunne
into the foure
principall
signes.

The latine
yeare.

The Equi-
noctials in
the yeare of
Christs
birth.

The Solsti-
cials.Foure nota-
ble thyngesTo knowe
more precise-
ly the ente-
raunce of the
sunne into
the foure
principall
signes.

kalendes of October: So that they had the Equinoctiall of the spryng, at the.rrv. of March: and the Equinoctiall of Autumne, at the.rrvii. of September, as wyrteth John Baptist Capuano vpon the seconde Chapter of the sphere of Iohan. de sacro bosco. They iudged then the Solsticials: as that of the Sommer, at the eyght day of the kalendes of July, whiche is the.rrviii. of June.

The other of the wynter, they iudged at the eyght daye of the kalendes of January: whiche is the.rrv. of December. And here wyll I not omit to say howe in those tymes, at these foure dayes (that is to meane, in the two Solsticials and two Equinoctials) were celebrated as byd chaunce foure marueylous thynges in the world. For in the spryng Equinoctiall, which was at the.rrv. of March, the Sonne of God was incarnate: and afterwarde bozne of the Virgin Marye in the Solsticiall of Wynter, which was at the.rrv. of December. In the Equinoctiall of Autumne, which was the.rrvii. of September, was conceaued blessed John Baptist, the cryer and pcursour of Christ: and was bozne in the Sommer Solsticiall, that was the.rrviii. of June. And this is the first moneth whereof S. Luke speaketh in the Gospell. Which thyng also John Chrysostome doth verifye, saying that S. John was bozne when the days began to decrease: and our Lorde when they began to increase. And it may certaynly seme woorthye to be had in memozye, that in the sayde Equinoctiall of the spryng, Christ suffered, Adam was created and losse the estate of innocentie, Abell was slayne, Melchisedech offred breade & wyne, Isaac by Abraham was brought to be sacryficed, John Baptist was beheaded at Macherunta, Peter deliuered out of pryson, Saint James beheaded by Herode, The good theefe enioyed Paradyse, and the bodies of many saintes rose with Chryste. And who so further desyeth more precisely to knowe the entraunce of the Sunne into Aries, and into the other principall signes, shall in the thyrde parte of this woork in the.viii. Chapter, fynde rules which shall bryng hym to the knowledge

ledge therof. But to returne to our tyme, I saye that this present yeare of. 1545. the Sunne entred into the fyrste degree of Aries at the tenth of Marche, at foure of the clocke at after noone. And into the fyrst degree of Taurus the nyth of Apryll. 20. houres, and seven minutes. And into Gemini the. 11. of Maye, two houres, and sixe minutes. Into Cancer, the. 11. of June. 14. houre. 44. minutes. Into Leo the. 13. of July. 3. houre 50. minutes. Into Virgo the. 13. of August. 9. houre. 56. minutes. Into Libra, the. 13. of September. 4. houre. 4. minutes. Into Scorpio, the. 13. of October. 7. houre 13. minutes. Into Sagittarie, the. 12. of Nouember, iuste at noone. Into Capricorne, the. 11. of December, 8. houre. 16. minutes. Into Aquarius, the. 9. of Ianuarie. 2. houre. 1. minute. Into Pisces, the. 8. of Februarie. 1. houre. 30. minutes after myddaye (that is to saye) from noone. 1. houre. 30. minutes. And that we maye in the yeares to come, knowe the daye, houre, and minute, in the which the sunne entereth into euery signe, we wyll folowe this order. Vppon the dayes, houres, and minutes that the sunne entereth into euerye signe this sayde yeare. 1545. we must adde for euery yere siue houres and. 49. minutes, whiche with the. 365. dayes whiche euery yeare conteyneth, shalbe the tyme in the which the sunne accomplysheth his reuolution. And because that in the yeare of the Bisertile or leape yeare, is added to Februarie one day more to his. 28. whiche he hath ons in foure yere from. 6. to. 6. houres, yf we shall take from the computacion that whiche we haue geuen hym, turnynge one daye backwarde (as shalbe in the yeare. 1548.) and vpon that that remayneth shall returne in the yere folowynge of. 1549. to adde fyue houres. 49. minutes, and as much more euery other yeare folowynge shalbe a certayne rule for euer.

To knowe
when the
sunne entereth
into euery
of the. xii
signes.

Leape yeare

And it is to note, that the degrees and minutes which we haue touched before, are properly for the citie of Cadiz. And yf we desyre to applye them for other Cities or places more Eastwarde: then for euerye. xv.

D iiii

degrees

Variation
of houres by
the rapte mo-
uyng of the
Sunne from
East to west

degrees that they are distaunt from Cadiz in longstude, we muste adde one houre. And yf for Cities or places more Westwarde, in lyke maner for every. xv. degrees we must take away one houre, by reason of the course of the Sunne by his rapte mouyng from the East to the West. For it is certayne, that when with vs in Cadiz it is. xii. houres of the clocke: To them that are. xv. degrees Eastwarde from vs, it is one of the clocke: and to them that are from vs. xv. degrees towarde the West, it is. xi. of the clocke.

The entrace
of the sunne
into the. iiii.
principall
signes, cau-
seth the
chaunge of
tyme.

Nowe that we haue rules to knowe the enterance of the Sunne into the. xii. signes, thereby may we also knowe his enterance into the foure Cardinall or principall signes: whiche are they that determine and ende the Equinoctialles and Solstitialles, whereby are caused the foure tymes of the yere. And forasmuch as the generall chaunge of tyme, is by reason of the Sunne, who by his commyng neare, warmeth: by his remaynyng, dryeth: with his departure, cooleth: and by his long taryng away, causeth moystnesse, we wyll shewe the qualities of the principall wyndes, elementes, regions, humours, and agies, in one bryefe table. And then consequently in an other, wyll we describethe the begynnyng, myddest, and ende of the foure tymes of the yere, as well in the monethes as in the heauenly signes.

The Table of the qualities of the Elementes.

Qualities.	Hot & drye	Hot & moist	Cold & moist	Cold & drye
Partes of y yere	Summer.	Springe.	Wynter.	Autumne.
Principal winds	East.	South.	West.	North.
Elementes.	Fyre.	Ayre.	Water.	Earth.
Regions.	East.	South.	West.	North.
4. Humours.	Choler.	Bloud.	Fleame.	Melancholy
4. Agies.	Youth.	Mans state.	Aged.	Age.

The

**The Table of the foure tymes of
the yere.**

Tymes.	Begynnyng.	Myddest.	Ende
Springe.	Marche. Aries	Apryl. Taurus	May. Gemini
Summer	June. Cancer	July. Leo	August. Virg.
Autumne	Septemb. Libra	Octob. Scorpio	Novemb. Sagitt.
Wynter.	Decēber. Capricor.	Januar. Aquar.	Febru. Pisces

The. v Chapter of the Moone,

and of her motions and properties.



In the Chapters past of this seconde part, we haue entreated of the Sunne and of his motions and effectes, as the moste noble and principall luminarie. In this present Chapter we wyll intreate of the Moone which is the seconde luminarie, although in the order of the heauens she is the fyrste, and neareste vnto vs of all other planettes or starres. The Moone therfore is a rounde body, of heauenly substaunce, solide and darke in respecte of the Sunne, hauyng no proper lyght of her owne, but is apte to receaue lyght. She is moued from the West into the East according to the order of the signes, euery daye. 13. degrees, lyttle more or lesse, and sumwhat more then. 10. minutes, by the proper motion of the heauē or sphere vpon the Aris & poles of the Zodiac. I said more or lesse, because y^e ouer and besyde the mouing of her deferent or circle which is moued euery day the aforesaid. 13. degrees & 10. minutes, almost 11. she hath an Epicycle where y^e Moone is fyred. At the motion wherof, sumtymes she is moued more swyftly, and sumtymes more slowly. Neuerthelesse, according to her halfe motion, she maketh her course in. 27. dayes and almost. 8. houres. And hauyng no light of her owne she is lyghtened of the Sunne, as manifestly appeareth hereby, that beyng in coniunction with the Sunne, or neare vnto hym, we see her not lyghtened: because the lyght whiche she then receaueth, is onely by her vppermost or hyghest part wherby she directly beholdeth the Sunne

The sunne and moone are the principall luminaries.

The Epicycle of the moone.

The coniunction of the moone with the sunne.

The moone receaueth her lyght of the sunne.

The aspects
of the moon
to the sunne.

The increas-
ing and op-
position of
the moone.

The bygge-
nes of the
Moone.

The Moone
is neareste
vnto the
earth.

Sunne, forasmuch as he is in the fourth heauen and she in the fyrst. And departyng from the Sunne by her pro-
per mouyng, the Sunne remayneth on the West part. Then towarde that part we begyn to see a lyttle of the part of the Moone lyghtened, and so more and more by little and little as she departeth further from the sunne. And at this tyme she hath her hoznes or coznors toward the East, because the Sunne is in the West. Duryng this tyme also, she is sayde to increase, or that she goeth increasyng vnto the opposition which we see by the part of her, which the Sunne directly beholdeth. And so do we see her altogether lyghtened, and call it the full Moone. Then passing from the opposition, she commeth nearer the Sunne by lyttle and lyttle, beyng darkened and hyd from vs, and lyghtened onely by her hygheste part. And this tyme is called the decreasyng or wane of the Moone. Then also hath she her hoznes toward the West, because the Sunne is in the East: and this vntyll she turne agayne in coniunction with the Sunne, & that we see her not lyghtened at all.

The Moone is lesse then the starres or other planets, except Mercury, and lesse then the earth. And yf anye shall affirme the contrary, saying that it is wrytten in the fyrst of Genesis, that God made two great lyghtes: the greateste to geue lyght to the daye, and the lesse to lyghten the nyght (as Dauid also affirmeth:) To this I aunswere, that the Moone being nearest vnto the earth appeareth vnto vs greater then she shuld do, yf she were further distaunt from vs. And although she be great of lyght (receaued as we haue sayde) and bygge of bodye, yet is she not great in respecte of the other starres. And therfore the wordes of the Genesis aforesayde, maye be vnderstode to be spoken in such maner and phrase as holy scripture often vseth to humble and applye it selfe to the weakenes of our vnderstandynge, and grossenes of our senses.

**The .vi. Chapter of the coniunctions
and oppositions of the Sunne & the Moone.**

The.



The Sunne and the Moone are moued vnder the Zodiac with diuers motions. The Moone with a swifter motion then the Sunne foloweth hym, ouertaketh hym, and goeth before hym, vntyll she place her selfe in Diameter with hym. And when she hath thus overtaken hym, so that they are both in one selfe same degree of the Zodiac: then is the coniunction. Then departynge from hym, and beyng in equall degrees of the signes opposite accordynge to the Diameter, is the opposition. To knowe the tymes of these coniunctions and oppositions, is verye profitable & necessary for Maryners. These tymes may be knowen in two maners. One waye by the Ephimerides or Almanackes, or other tables, or Lunary instrumentes. And by these meanes is knowen precisely the day, houre and minute of the coniunction and opposition. It maye lyke wyse be knowen by the rules of computacio, which are the rules that are knowen by memozye, although not pzeypely as by the bookes aforesayde. And here is to be vnderstode, that from one coniunction to another, accordyng to the halfe mouynges of the Sunne and the Moone, there passeth. 29. dayes. 12. houres, and. 44. minutes. And consequently from coniunction to opposition, and from opposition to coniunction, the halfe therof, which is. 14. dayes. 18. houres, and. 22. minutes. To knowe these coniunctions by rules of computacion, is pzesupposed to knowe the golden number: and by it, the cozcurent or Epacte.

The motion
of the moone.

The coniun-
ction.

The opposi-
tion.

To knowe
the tymes
of oppositi-
ons and con-
iunctions

The golden number, is the number of. 19. yeares. In which tyme, the coniunctions of the Sunne & the Moone make all theyr bareities in the tymes of euer y pere. So that if the coniunction were the. 12. day of Marche in this yeare of. 1545. from this yeare in. 19. yeares folowynge, which shalbe in the yere of. 1564. the coniunction shal retorne to be at the. 12. day of March. It was fyrst called y golden number by the Egyprians, who first found the vse therof & sent it to Rome wrytte in goldē letters. To find this nūber, it is nedeful to know his rotes, which is this

To knowe
the golden
number.

In

The rooten
of the golde
number.

In the yeare that Chyist our Lorde and redeamer was borne (wherby we make this accompt) the golden number was the number of one, which was the yeare of the roote or begynnynge, and the fyrste yeare of the byrth of Chyist, was two of the golde number. So that ioynynge to the yeares of our Lorde one of the roote or beginning and from all take away the .19. then the reste shalbe the golden number. And yf you desyre to make computacion by a nearer roote, take for the roote, the yeare of .1500. when .19. was the golden number: and in the yeare of 1501. dyd begyn one of the golden number, and so consequently euer takynge away the .19.

This present yeare of .1545, we haue .7. of the golden number. And in the yeare of .1546. we shal haue .8. &c.

The concurrent.

The golden number beyng knowen, it is necessary for this computacion of the Moone to knowe the concurrent. The concurrent of euery yeare, is the number of the dayes passed of the coniunction of the Moone at the begynnynge of Marche. And these grow of the difference of the Solar yeare to the Lunar: as the Lunar yeare hath .354. dayes, and the Solar yeare .365: so hauynge euery yeare .11. dayes of difference, which are added euery yeare vntyll they come to the number of .30. and passynge .30. those that do passe are of the concurrent.

The Solar
and Lunar
yeares.

354. 365.
dva add.
11.

To fynde
the number
of the concurrent.

The number of the concurrent of euery yeare, is founde in this maner.

And the better to beare it in memory, you must imagin three places: and these commonlye are assigned on the thumbe. As the fyrste place at the roote of the thumbe, the seconde in the myddle ioynt therof, and the thyrde & last, in the toppe of the thumbe. Then in the fyrst place put .10. in the seconde .20. and in the thyrde .30. Then by the order of these places shalbe coumpted the golden number: As one in the fyrst place, two in the seconde, and three in the thyrde: returnynge foure to the fyrst place, &c. vntyll the golden number of that yeare for the which the concurrent is sought. And the number of that place where the golden number endeth, must be ioyned with the number of the golden number: and that doth amount

amounte thereof, shall bee the concurrent, so that it passe not. 30. But if it passe. 30. then that that is more then. 30. is the concurrent of that yeare.

And here is to be noted, that the yeares for this computation of the Moone, begyn at the first day of Marche, and laste vntill the last daye of February. So that this present yeare of. 1545. by computation of the golden number, we haue seuen: whiche accompted by the sayde places, endeth in the fyrst, whiche is. 10. whiche also ioyned with the golden number of seuen, make. 17. and so muche is the concurrent of this present yeare.

Epact.

Likewyse this number of Epact or concurrent is founde in multiplying the golden number by. 11. and taking out the. 30. then that resteth, is of the Epacte.

The concurrent being thus knowen, then to knowe the dayes of the Moone, it is necessary to knowe thre numbers. The fyrst is the concurrent. The seconde, the number of the moneth in whiche you are, beginnyng at Marche. The thyrde, the dayes past of the same moneth. And ioynyng these thre numbers, if they come not to. 30. so many dayes old is the Moone. And if they be. 30. it is the coniunction. And if they passe. 30. they also that passe are the age of the Moone.

To knowe the dayes of age of the moone.

fixes mueri

This is vnderstode in the monethes that haue. 31. dayes. For in them that haue only. 30. dayes, the coniunction is at the. 29. daye. And they that passe of. 29. are the age of the Moone. As for example: The fyrste daye of August, of the concurrent. 17: Of monethes from March 6. and of dayes of the moneth. 1. make. 24. and so muche is the age of the Moone.

An other example. The tenth of September, of concurrent. 17. of monethes seuen, of dayes tenne, whiche are in all. 34. And because that September hath onely 30. dayes, we must take away. 29. of the. 34. and so resteth foure dayes whiche are the age of the Moone. And in like manner shall we geue to February nyne & twenty dayes of the Moone.

To knowe the dayes of the coniunction.

It foloweth, that the dayes of the Moone beyng knowne, then brekenyng or disrekenyng backwarde, we

We shall knowe the daye when the Coniunction was : As for example. The. xx. of July, the Moone hath. xii. dayes taken from the. xx. Remayneth. viii. Then the eyght day was the coniunction.

The daye of the coniunction is lyke wyse knowen by ioynnyng the monethes (begynnyng in Marche) with the concurrent. And yf they come not to. 30. then at so many dayes of that moneth as lacketh of. 30. shalbe the coniunction. Example.

In August. 6. of the monethes, and. 17. of the concurrent, are. 23. whiche of. 30. lacketh. 7. Then at the seventh daye was the coniunction. And yf they passe. 30. Then takyng them that passe, of the dayes which hadde the moneth next before : in them that remayne was the coniunction. Lyke as the Moone of September of the yere. 1546. we shall count the concurrent. 28. of monethes. 7. which are. 35. Then taking away the. 5. from 30. and one which August hath, remaineth. 25. and so the 25. of August, of the yere to come of. 1546. the Moone shall make coniunction.

¶ The. vii. Chapiter of the declaration
and vse of an Instrument, by the which
is founde the place and declination
of the Sunne, with the
dayes and place of
the Moone.



In the seconde and thyrde Chapiter I haue geuen rules to knowe the true place of the Sunne and his declination. In this Chapiter I wyl describe an Instrument wherby may be knowen the declination & place of the Sunne. And knowyng by the Chapiter past, the dayes of the Moone, shall also be knowen her place in the Zodiac, and howe muche of her is lygh-tened, and what aspect she hath with the Sunne. This Instrument is in square fourme, and hath by the sydes 23. degrees and a halfe : Of the whiche the. 23. & a halfe that

To knowe
the place of
the Moone in
the Zodiac,
and what as-
pectes she
hath with
the Sunne.

that descende from the myddest downewarde, is the declination of the South signes: and the other from the myddeste upwarde, are the declinations of the North signes. Within this quadrature is described a circle, by the circumference wherof are the. xii. signes and theyr degrees, ioyned to the circumference. And further within is the number of them, and then theyr names. Yet further within this, is another circle, where are the. 12. monethes, with theyr numbers and dayes.

The description of the instrument.

Then to the center of this circle are annexed two rundels: wherof the greatestte and loweste is called the rundell of the Sunne. This hath an Index or shewer, in which is paynted y Sunne, & in the circumference of it are the dayes of the Moone. In the other circle, in the circumference thereof, is a rounde hole, representing the Moone: Directly from the which, is an other Index commyng forth of the circumference of this rundell, in which are all the lines of the aspectes which the Moone maketh with the Sunne.

Having described the Instrument, let vs declare the vse therof: which is this.

The vse of the instrument to find the true place of the sunne.

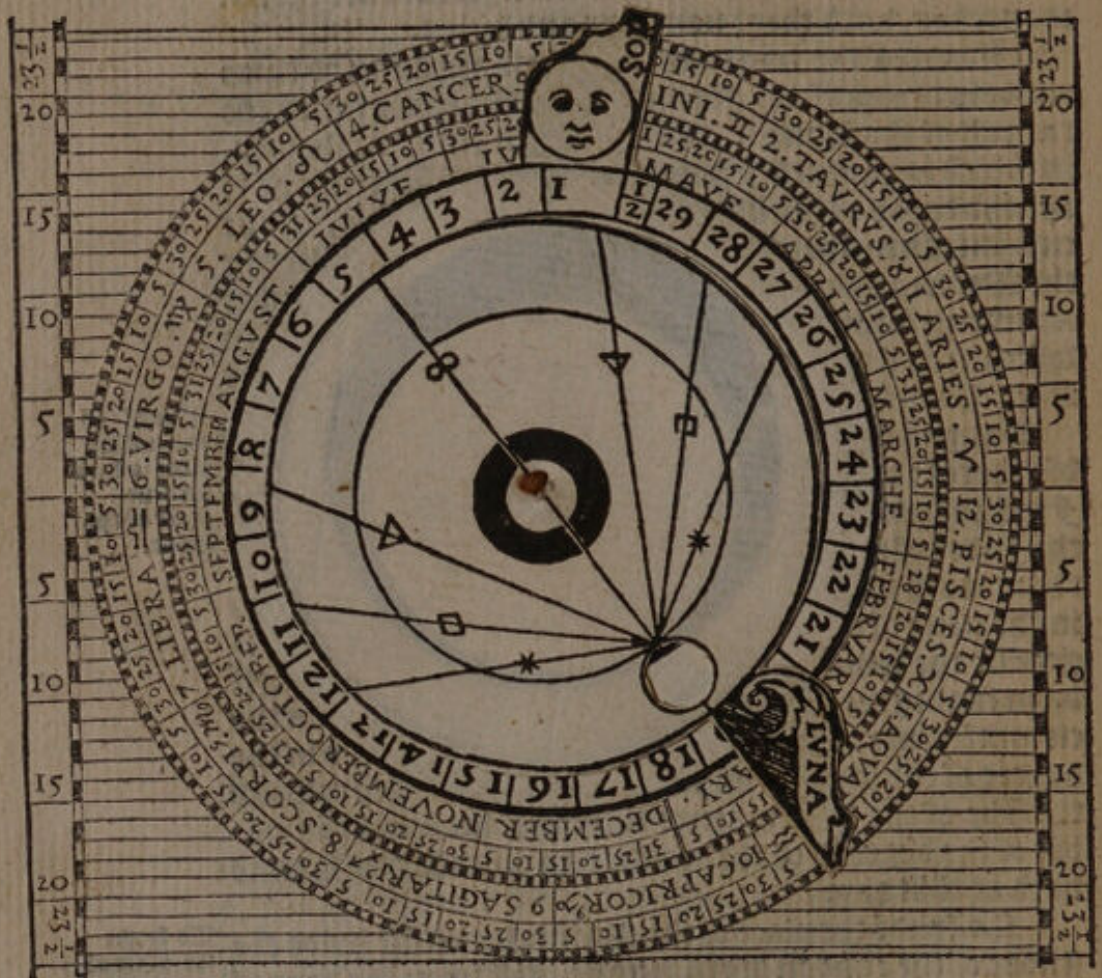
Fyrst to fynde the true place of the Sunne, we must put the Index of the rundell of the Sunne, vpon the daye of the moneth in which we are or desyre to knowe. Then in the circle of the signes, it shal shewe the signe and degree in the which it is. And in lyke maner, resting still vpon the degree, looking in the paralels that touch in the circumference, & proceeding by that that toucheth in the degree of the Sunne, which the Index doth note toward the syde of the Instrument: there shal we fynde the number of the degrees of the declination whiche the Sunne hath at that day.

To fynde the place of the Moone, we muste holde the Index of the rundell of the Sunne, fast vpon the daye of the moneth in the whiche we desyre to knowe the place of the Moone. And accoumptynge in the rundell of the Sunne, the dayes that haue passed from the daye of the coniunction (as I haue sayd in the Chapter before) and where endeth that number of the dayes, yf there we

To fynde the place of the moone.

The 2. part.

We apply the Index of the Moone, it shall shewe in the circle of the signes, the place where she is. And so shall she appeare lyghtened or darkened more or lesse as in heaven. In lyke maner, consideringe the place of the Sunne and the Moone, shalbe seene what aspecte they haue, by the lynes that traaverse the superficiall of the Lunar circle or circle of the Moone.



The aspectes which the planettes haue one to another, or wheréby they beholde one another, are syue.

Five aspectes of the planets.
Coniunctio.

Coniunctio, is when two planettes be vnder one selfe same degree and minute in the Zodiac, whose character is this. $\oslash$

Opposition, is when betwene the place of the planettes is halfe a circle, which are. 180. degrees, and is thus figured. $\odot$

Opposition.

Trinall aspecte, is when betwene the planettes shal be foure signes, which are. 120. degrees, and is figured thus. $\triangle$

Trinall.

Quadruple aspecte, is when one planette is distaunte from another by thre signes, whiche are. 90. degrees, whose character is this. $\square$

Quadruple.

Sextile aspecte, is when two signes are betwene the which are. 60. degrees, and is marked thus. $\ast$

Sextile.

And yf by memory you desyre to knowe the true place of the Sunne, without respecte of the minutes (whiche may sufficiently be done with the Astrolabie) beare in memory these numbers. 10. 9. 10. 10. 11. 12. 13. 14. 13. 14. 13.

To knowe the place of the moone by the rule of memory.

12. Of the which, the fyrst serueth for January: the second for February with theyr signes: and so of the rest.

Then to knowe in what degree the Sunne is, you shall take away the dayes that are applyed to euery moneth, accordynge to the sayde numbers of the dayes for the which you desyre to knowe the true place of the Sunne. And in them that remayne, in so manye degrees is the Sunne of the signe into the whiche it entereth that moneth. And yf the dayes past of the moneth, shalbe lesse then the dayes applyed to the same moneth: you shall toyne. 30. with those dayes past of the moneth, and of the summe that amounteth, you shall take awaye the dayes applyed to the sayde moneth: and the rest shalbe the degrees in whiche the Sunne shalbe of the signe of the moneth past: as for example.

To knowe in what degree the sunne is.

Example.

January.	10.	♊	The. 22. of October, ta-
February.	9.	♋	king awaye. 14. that were
Marche.	10.	♌	applied, remayne. 8. de-
Apryll.	10.	♍	grees of Scorpio, wher the
Maye.	11.	♎	Sunne is. The. 6. of Decē
June.	12.	♏	ber, that that is lesse then
July.	13.	♐	12. which are applied to it,
August.	14.	♑	if we ioyne the. 6. with. 30
September.	13.	♒	they make. 36. and from
October.	14.	♓	them we take awaye the. 12
November.	13.	♐	rest. 24. So in 24. degrees
December.	12.	♏	is the Sunne, of the signe

of the moneth befoze, which is Sagittary.

The. viii. Chapter of the Eclipses

of the Moone and the Sunne.



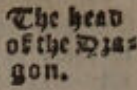
The Eclipses of the Sunne & of the Moone is a thing that causeth great feare and admiration amonge the common and ignorant people. And to them that vnderstand the cause therof, nothyng at al. And therfore haue I thought good to declare the effectes therof.

The eclipse
of the moone

The Eclipse of the Moone, is the interposition of beyng of the earth betwene her and the Sunne. And whereas the Moone hath no proper lyght of her owne, and the earth beyng darke and not transparent, maketh his shadowe on the parte opposite to the Sunne. The Moone by her proper motion doth passe by this shadow and is Eclipsed or darkened eyther in the whole or in part, accorpyng to the portion of her that passeth by the shadowe. Moreouer (as we haue sayde) that onelye the Sunne is moued by the line Ecliptyke, & the earth being in the Center of the world, the point or pricke of the shadowe shalbe vnder the Ecliptik. The Moone at somtymes declineth to one part of the Ecliptyke, & at other tymes to the other, because her Eccentricke so moueth.

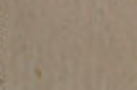
The mo-
uing of the
Sunne in
the Ecliptik

The

The greatest declination or latitude of her Eccentricke is .5. degrees, and cutteth in two partes the Eccentric of the Eclipticke. The one where it trauerfeth to the Eclipticke towarde the North part, which they call the head of the Dragon, and is marked thus. 

The head
of the Dra-
gon.



The other wherby she passeth to the South part, which they call the tayl of the Dragon, & is marked thus.  And the Sunne mouyng by his proper motion, and commynge to the head, then shall the shadow of the earth be in the tayl, because it is the paynte opposite. And yf then the Moone come thither, of her proper motion she passeth by the shadow: and lackyng lyght of the Sunne, is in the Eclipse. And if the Sunne come to the tayl, the shadowe is in the head. And then lyke wyse shall the Moone be Eclipsed yf she passe by the head.

The tayl of
the Dragon.

It is to vnderstande that the Sunne is muche bygger then the earth. And by perspective, the shadow of the earth in how much the further it parteth fro it, becommeth sharper & sharper vntyll it come to a poynt: So that the shadowe of the whole earth, is pyramidallye sharpe. And as the Moone is lesse then the earth, yet (although his shadow goeth sharpenyng) it suffiseth to Eclipse the Moone yf she passe by the myddest thereof.

The sunne
is bygger
then the
earth.

The shadow
of the earth.

The eclipse
of the sunne

The Eclipse of the Sunne, is the interposition of the Moone betwene vs and the Sunne. As yf the Sunne be in the fourth heauen, and the Moone in the fyft, she being a darke bodye, and by her proper motion ouertake the Sunne: then puttynge her selfe betwene hym and vs, she couereth hym in part or in the whole: and this is the Eclipse of the Sunne. As the Sunne also goeth euer vnder the Ecliptike at the tyme that he commeth to the head or tayle of the Dragon, yf then the Moone make coniunction with hym, shalbe the Eclipse of the Sunne, forasmuch as they are both vnder the Ecliptike.

The eclipse
of the sunne
is not vni-
uersall.

The Eclipse of the Sunne can not be vniuersall in the whole earth. I saye vnto all them that maye see the Sunne at the tyme of the Eclipse, as is the Eclipse of the Moone vniuersall. For yf the Moone haue one parte Eclipsed, all that maye see her, shall see her Eclipsed: But the Sunne some may see all wholly eclipsed, and other in parte, or other also not at all eclipsed: and this all at one selfe same tyme. The cause wherof, is the diuersitie of the aspekte, whiche is to see the Moone in the Zodiac out of her place. As yf the Sunne and Moone shoulde make coniunction in the begynnynge of Aries & in the head of the Dragon: they that then shoulde be in the Equinoctiall vnder the Sunne and the Moone, or that the Sunne and the Moone shoulde be in theyr Zenith, they shoulde see the Moone hyde all the Sunne. And they that shoulde be in the North climates, shoulde see that the Moone hydeth or darkeneth only the South parte of the Sunne, and not all. Agayne, they on the South parte, shoulde see the Moone hyde the North part of the Sunne, and not all. And yf at the time of the coniunction, she haue a lyttle passed the head of the Dragon, or lacke a lyttle to come to the tayle, so that shee be in the North latitude: they that then shoulde be in the North Climates, shoulde see the Moone eclipse all the Sunne: and they of the Equinoctiall shoulde see onely the North parte of the Sunne eclipsed, and they of the South shoulde see hym nothyng at all eclipsed. So that
although

So
the sunne is ec-
lipsed in
the whole
or in part.

although the Eclipse of the Sunne shalbe totall or per-
ticuler, it can not be vniuersall in the whole earth.

And note, that for the quantitie of these Eclipses,
the Astronomers deuide into. xii. equall partes, aswell
the Diameter of the Sunne as of the Moone. And these
partes they call fingers, punctes or prickes. And accor-
ding to the punctes of the Diameter of the Moone which
couereth the shadowe of the earth, or the partes of the
Diameter of the Sunne whiche couereth the Moone, so
many fingers or punctes shalbe sayd to be Eclipsed. As
yf. 6. the halfe, yf. 3. a quarter, yf. 4. a terce or thirde
part, yf. 9. thzee quarters, yf. 8.
two terces.

It is also to be noted, that al-
though the Sunne be bygger then
the Moone, yet at some tyme the
Moone seemeth greater then the
Sunne. And this shalbe when the
Sunne is in the Auge of the Eccen-
tricke, and the Moone in the oppo-
site of the Auge of the Epicycle.
And when it so appeareth, he may
be all Eclipsed. Sometyms also
the Moone seemeth lesse. This is
whē the Sunne is in the opposite
of the Auge of the Eccentrycke.
And the moone in the Auge of the
Epicycle. Then althoughe we
should see the center of the Moone
in the center of the Sunne, she
can not hyde hym all wholly, be-
cause the Sunne shall appeare
greater.

Of this that we haue sayde, it
foloweth that all the Eclipses of
the Sunne, muste of necessitie be
in the coniunction. And the Eclip-
ses of the Moone, in the oppositi-
on: Wherby is inferred, that the

To knowe
the quanti-
tie of the E-
clipses.

Why the
Moone see-
meth some-
time bigger
& sometyne
lesse the the
Sunne.



The Sunne
is eclipsed
in coniuncti-
on, and the
Moone in
opposition.

The eclipse
of the sunne
in the death
of Christ.

Howe to see
the eclipses.

Eclipse of the Sunne in the death of Christe our redea-
mer, was not naturall, but miraculous: forasmuch as
then was xv. dayes of the moone, at whiche tyme the
moone is at the full, and farre distant from the Sunne,
and coulde not Eclypse hym. In lyke maner is to be no-
ted, that to see the Eclypses, they of the Sunne must be
in the daye, and they of the Moone in the nyght. And
whether the coniunction be in the nyght, or the opposi-
tion in the day, the Astronomers make none accompt.

The. ix. Chapter of Tyme, and of the definitions therof.

All mouinge
is in tyme.



As muche as hytherto we haue en-
treated of the mouinges of the Sunne
and of the Moone: and howe all mo-
uynge is in tyme (for that nothyng
maye be moued in an instant or out of
tyme) It shalbe conuenient now to
declare what thyng Tyme is, and in-
to what partes it is deuided.

What is
tyme.

Tyme (as sayth the Philosopher) is a measure of
mouyng accordyng to first and last, or before and after.
Although by accident (as Armandus hath subtylly defi-
ned) Tyme may be a measure of reste or quietnesse: as
measures of habites are measures of priuations. Or
Tyme may be a measure of the mouing of the first moue-
able called Primum mobile, and cause of generatiō ther-
by, and of corruption by accident. Tyme hath the ly-
mittes that hath the worlde. And as the worlde, so is it
caused of the mouynge of the heauens: and beganne
whan God created the heauens, and shall ende when
the worlde shall haue an ende, as the holye Schooles
of the Diuines teache vs. It is assigned to be within the
heauens: forasmuch as without them, is neyther tyme
nor any naturall place. All the tyme sence God created
the worlde, vntyll it shall haue an ende, is called Seculū
(that is) a worlde, or an age of Tyme. Albeit this word

Howe tyme
is cause of
generation
& corruptiō.

The begyn-
nyng & en-
dyng of
tyme.

The place
of tyme.

Seculū

Seculum in an other sence, may be extended further then the durabilitie or continuance of the worlde. And this in holpe Scripture is called Seculum seculi: that is, the worlde of the worlde: or secula seculorum, whiche is as much to meane, as the worlde & worlde to come: which signifieth eternitie, or everlastyng worlde without end. Lyke wyse also seculum is taken for the space of a hundredeth yeares: whereby in olde tyme certayne playes were called seculares, because they were celebtrate from a hundredeth to a hundredeth yeares. The Pope Paule, the thyrde of that name, commaunded them to be celebtrate in Rome, in the yeare of. 1536. which was the yeare in the whiche the seculum ended, and beganne a newe seculum.

And as in Tyme are dyuers mouynges, so hath it dyuers measures: whereof some are greater and other lesse. The greatest measure of Tyme, is a reuolution of the heauens which is slowly moued. And the pryncipall or chiefe of these, is that that the Sunne maketh: which we call a yeare. The lesse measure, is the mouing of the fyrste moueable, whiche moueth mosse swyftely: and this measure we call a day. And forasmuch as there is variation in the greateste measures, we wyll in the Chapter folowynge entreate of the yeare and of the diuersitie therof.

Diuers mo-
uynges and
measures of
tyme.

The. x. Chapter, of the yeare,

and of the dyuers begynnynge and
rekenynge, or computation
had therof in old tyme.



Here are thre differences of the yeare: as the great yeare (called Annus Magnus) the Solar yeare, and the Lunar yeare. The greate yeare, is the space of tyme in the which all the planets retorne to the place where they had ben sometyme before. As yf they all had ben in the beginning of Aries, & had begunne theyr course from thence, and shoulde agayne all retorne thither: then shoulde be the greate yeare.

Thre differ-
ences of
yeares.

The great
yeare.

The revolu-
tion of the
eight sphere

The solar
yeare.

Howe the
Egyptians
painted the
yeare

The quan-
tity of the
yeare

The yere of
the Hebrewes
The grekes

Julius Ce-
sar

Leape yere

Days of the
yeare.

By the description of other, the great yeare is when the
eyght sphere ioyntly with all the Angles, make one per-
fecte revolution at the moving of the ninth sphere. And
this shalbe in the space of. xlii. thousande yeares.

The Solar yeare, is a revolution of the Sunne, ca-
rried by the proper moving of his heauen vpon the Aris
and Boles of the Zodiac, ending where it began, and
returning an other yeare by the selfe same course, as the
Poet Virgill affirmeth, saying.

Atq; in se sua per vestigia voluitur annus.

That is to saye. The yeare turneth agayne to hym
selfe by his owne steppes.

The Egyptians lackyng the vse of letters, & hauyng
the same consideration, paynted the yeare lyke vnto an
Adder, bytyng her owne tayle. And hereof was a rying
called Annulus, as it were Annus, (that is a yeare) be-
cause a ring turneth rounde in it selfe as doth the yeare.

Of the quantitie of this yeare, were dyuers opinions &
computacions among them of auncient tyme. The Ara-
bians and Persians accompted it regularly by. xii. moones
which are. 354. dayes. Romulus gaue to his yeare. x. mo-
nethes, because that tyme suffised to a woman to bring
foorth her byrth: and also for that during so much time,
it was not lawfull for a wydow to marry after the death
of her husbande. Numa Pompilius added two monethes,
to make it by twelue monethes in. 350. dayes, whiche
was the most auncient yeare of the Hebrewes: according
to the which they accompt at this day. The Grekes and
Egyptians, considering the course of the Sunne, made
the yeare of. 365. dayes. Then by the comaundement
of Iulius Caesar (whose order we nowe obserue) were ad-
ded. 6. houres, to thende to make equall this number of
dayes with the course of the Sunne. And hereof the bi-
sertile or leape yeare had his begynnyng, from foure to
foure yeares. But to say the trueth, they erred: The
one by somewhat to muche, and the other by somewhat
to lyttle.

The yeare conteyneth. 365. dayes. 5. houres, and
49. minutes.

Lyke.

Lykelwylse at the fyrste the yere had dyuers begyn-
nynges. Numa Pompilius beganne it from the Wynter
Solstitiall, because that then the Sunne beginneth to rise
towarde vs, as Ouide affirmeth in these verses.

Beginnyng
of the yere,

Ouide.

Bruma noui prima est, veterisq; nouissima Solis:
Principium capiunt Phebus & annus idem.

Which may thus be Englyshed.

Brume is the fyrst of the newe yere,
And last day of the olde:
The Sunne and yere begynne at once,
As Ouide hath vs tolde.

Bruma, is
the daye of
the Sunne
in wynter,
the wynter
solstitiall &
hottest daye
of the yere

Romulus began it in Marche, at the Equinoctiall of the
sprynge: because that then all thynges reuiue and flo-
ryshe. And by the opinion of the Diuines, it seemeth
good reason to begyn the yere at Marche, because the
worlde was created the. 25. of the kalendes of Apryll,
whiche is the. 18. of the moneth aforesayde. Lykelwylse
God speakynge of this moneth to the people of Israell,
sayde vnto them: This shalbe the fyrst of the monethes
of the yere. The Arabians begynne from the sommer
Solstitiall: whose opinion is, that the Sunne was
made in the signe of Leo. Other begynne the yere in
September, about the Equinoctiall of Autumne, as do
the Jewes, resting in the auctoritie of Genesis where
is wyrtten thus: Lette the earth bryng forth greene
hearbes to haue fruite agreable to theyr kynde. &c. And
because Autumne is a fruitfull tyme, they began from
thence to accompt theyr yere. The Grekes, Persians,
and Egyptians accompted it from October. The Chri-
stians, some from the Incarnation of Christ: other fro
his byrth, and other from the fyrst day of January.

The creatiō
of the worlde
Exod. xii.

where the
Christians
begynne the
yere.

In lyke maner is great diuersitie in begynnyng the
number of yeres, which we call Era, (that is) the date.
The Greekes beganne theyr date from the death of
greate Alexander. The Egyptians from the death of

Diuersitie
in the nomi-
ber of yeres
of the date.

Phabu

Nabuchodonosor. The Persians, from Geldargit. The
Machomet. Arabians or Moores, from the preaching of Machomet,
 who was after the birth of Christ. 626. yeares. Other
The date of also from the Romane Emperours. The Christians be-
the Christi-
ans. gan the accompt of our Saviour Jesu Christ. 500. yerres
 after his birth, as writeth Cardinall Cusanus. And here
 it shall not be from my purpose to shewe howe iustelye
 and ryghtfully was commaunded by Don John kyng of
 Spayne, the fyrste of that name, that in the courtes and
 Parliamentes which he held in segouia, in the yeare of
 1383. leauyng the dates that they had begonne from the
 Emperour Octauian, for tributes & other paymentes
 specified in wrytynges and priuileges: they shoulde no
 more put the date of the Emperour, forasmuche as the
 day in the which the Sunne of Godde became man, and
 was bozne of the blessed virgin, was so excellent a thing
 and mosse woorthie to be hadde in memozy. So that in
 Spayne sence that tyme in all common wrytynges, the
 date is made from the Natiuitie of our Lorde, begyn-
 nyng there the fyrst day of the yeare: and commonly the
 fyrst day of January. Some Astronomers begynne it
 the fyrst of Marche.

We haue in this Chapiter entreated of the greates
 yeare, and of the Solar yeare, with his quantitie, be-
 gynnynge, and date. In the Chapiter folowynge we wyll
 entreate of the Lunar yeare, which we call a moneth.

The. xi. Chapiter of the Moneth, and of his differences.

*The Lunar
 yeare or mo-
 neth.*

*Reuolution
 of the moneth.*



Consideryng the Moneth absolutely with-
 out hauyng respect to the Solar yeare, it
 may be called a yeare, accordyng to the de-
 uision we haue made in the Chapiter of the
 yeare. For it is a reuolution of the hea-
 uen of the Moone, which moueth slowly
 in comparison to the fyrste heauen. And if
 we

We consider the moneth as part of the yeare, then is the name of a Moneth more proper vnto it. For this worde Mens Mensis in Latin, is deriued of Mensura, which signifieth measure. And so, the moneth and yeare referred to tyme, all may be called moneth: Forasmuch as all is the measure of tyme, as we haue touched in the sayde Chapter of the yeare.

The moneth is to be considered in two maners: either as it is parte of the Solar yeare, or is caused by the course of the Moone. The moneth that is parte of the Solar yeare, is that which at this day we vse. And into xii. of these monethes is the yeare deuyded: As Ianuary, February, Marche, Apryll, May, June, July, August, September, October, Nouember, December. They are not all of equall dayes. Apryll, June, September, and Nouember, haue. 30. dayes: All the other haue. 31. except February, which hath. 28. and when the bisertile or leape is, it hath. 29. The names & numbers of these monethes were assigned at the wyll and pleasure of men: And the cause why they haue remayned so long tyme, is the auctoritie of the Emperours, that ordeyned them for the common people, who accepted them by the Roman Church which admitted the vse of them.

The Lunar moneth hath two considerations. The one is the tyme whiche the Moone taryeth from that she cometh forth from one punte of the Zodiac, vntyll she retorne thither by her proper mouyng. And this is called the moneth of peragracion: In which reuolution she spendeth. 27. dayes and almoste. 8. houres. The other consideration, is hauyng respecte to the tyme which the Moone taryeth from that she is in coniunction with the Sunne, vntyll an other coniunction. And this is called the moneth of consecucion, and is more then the moneth of peragracion by. 2. dayes. 4. houres. 44. minutes. For the Sunne and the Moone beyng in coniunction vnder one punte of the Zodiac, and mouyng both by theyr proper mouynges towarde the East, as the mouyng of the Moone is swyfter then the mouyng of the Sunne: she leaueth hym behynde.

And

The deuision
of the
yeare into
xii. monethes

The Lunar
moneth.

The moneth
of peragra-
cion.

The moneth
of consecu-
cion

The mouyng
of the
Sunne and
Moone in
coniunction.

And when she hath ended her moneth of peragratiō, she returneth to the poynte from whence she departed: And not finding the sunne there (because in the meane tyme the Sunne of his proper motion hath gone almost 27. degrees) the Moone passeth from this poynt: and in the sayde. 2. dayes. 4. houres. 44. minutes, ouerta- keth the Sunne. And so commonly hath this moneth of consecution. 29. dayes. 12. houres and. 44. minutes. So that whatsoeuer is sayde of the Lunar moneth, is to be vnderstode of this moneth of consecution, whiche all they vse that accompt by moones: as do the Hebzues, Arabians and Persians.

To knowe
the tides by
the aspectes
of the moone.

The illumi-
nation or
chaunge of
the moone.

Interluni-
um, is the
space of
tyme in the
which ney-
ther the
olde moone
both appere
nor the new
moone is
sene.

The Maryners ought not to neglecte this computacion because it is conuenient for them to knowe the tydes and other effectes caused by the aspectes of the Sunne and the Moone. For theyr aspectes do corresponde to the partes of this moneth, as the coniunction to the begyn- nyng, the opposition to the myddeste, and the quartyle aspecte to the quarter, and so of the other. Lykewyse in this moneth, is considered the illuminatiō of the moone and the dayes that the lyght fayleth her: so that neither by day nor by nyght we may see her for being burnt vnder the beames of the Sunne. The tyme that she is so, is called Interlunium, (that is) the chaunge or hydyng, which is sometyme more, and sometyme lesse. When the coniunction shalbe from the begynnyng of Capri- corne vntyll thende of Gemini, and the Moone hath North latitude, and her mouyng swyfte: then shall the newe Moone soone be sene, and so shall the Interlunium be but lyttle. And when the coniunction shalbe from the begynnyng of Cancer vntyll the ende of Sagittarius, and the Moone hath South latitude, and her mouyng slowe: the longer wyll it be or the newe Moone shewe her selfe to vs. And certen of these causes concurringe and not all, so shall the Interlunium be in a meane betwene both.

The

The .xii. Chapiter, of the weeke.



The weeke is a time of seven dayes, the begynnynge wherof is Sundaye. And so dyd the Iewes count theyr fyrst day sayinge, Prima sabati, Secunda sabati, (that is) the fyrst of the Sabbath, the seconde of the Sabbath. &c. to the syxt of the Sabbath, and then the Sabbath. The Romans that called the

The weeke of the Iewes.

The Remans.

planettes Gods, forasmuche as the Sunne was princypall among them, called theyr fyrst daye, the daye of the Sunne, the seconde of the Moone, the thyrde of Mars, the fourth of Mercury, the fyfth of Jupiter, the syxth of Venus, and the seventh of Saturne. The Chrysstians solemnysynge the Sunday, began theyr accompt from it: As on such a day our Lorde was borne, on such a day he rose, and on such a daye he sent the holy ghooste vpon his Apostles. &c. They also accompt the dayes of the weeke for Ferias.

The Chrysstians.

Ferias, significthe vacant dayes, or somtyme holy or festiual dayes.

The .xiii. Chapiter, of the day and of the nyght.



The day is of two sortes: As the naturall daye, and the artificiall daye. The naturall daye, is the tyme whiche the Sunne pprolongeth or tarieth from the mouyng of the fyrste moueable from that he is in the South vntyll the West, & vnder the earth

The naturall day.

to the East, turnyng agayne to the South or Meridian. And in this tyme hath the Equinoctial geuen one whole turne: and moze such parte of it as correspondeth to the proper mouyng of the Sunne. Or other wyse, the naturall day is a circle described with the center of the Sunne at the mouyng of the fyrst moueable. The Romanes began this naturall daye from mydnyght, and ended it in the mydnyght solowynge. And so do we accompte it for fastyng

The begynnynge of the naturall day

fastyng dayes : & from euenyng to euenyng, in celebra-
tyng of festiuall dayes. The Athenienses began it at the
Sunne sette or goyng downe of the Sunne. The Babi-
lonians at the rysyng of the Sunne. The Vmbrians and
Ethuscus, from the myddaye or noone, and ended it the
next noone solowynge. In this maner do the Astrono-
mers begynne it : And fynde that the day shall euer be-
gynne at one selfe same houre for the equalitie of the Me-
ridians. And yf they had begunne it from the rysyng or
fall of the Sunne, it should not be euer at one selfe same
houre, because the Sunne ryseth and falleth at some-
tymes sooner, and at other tymes later : and so shoulde
the begynnyng of the day be variable. And it is to vn-
derstand, that when we commonly say, at the tenth day
of such a moneth, the same tenth day doth ende the same
day at noone. And the houres that run from that noone,
tyde forwarde, are of the eleuenth daye : and so do the
Astronomers accompt them.

The ende of
the naturall
day.

The artifi-
ciall day.

The nyght

The day artificiall is part of the daye naturall, and
is the tyme that the Sunne tarjeth from that it ryseth
in the East, vntyll it fall in the Weste. And the nyght
is that part that lacketh or sayleth for the naturall day:
whiche is the tyme that the Sunne tarieth from that he
hydeth hym selfe in the Weste, vntyll he returne to ap-
peare in the East. And so the day artificiall & the night,
make one naturall day. And accordynge hereunto, it is
wrytten in the Genesis, that of euenyng and moornyng
was made one daye. Plodorus defininge this artificiall
day, saith that the daye is the presens of the Sunne, or
the beyng of the Sunne aboue the earth : as it is nyght
vnto vs when he is vnder it. Or otherwysse : the nyght
is the shadowe of the earth extended Diametrallye a-
gaynste the Sunne. The quantitie and differences of
these dayes artificiall and theyr nyghtes, and howe they
increase and diminishe, we haue largely declared in the
first Chapter.

CThe

The. xiiii. Chapiter of houres.



There is two differences of the day, as the naturall daye, and artificiall: so is there two differences of houres, as houres naturall which correspond to the naturall daye: and houres artificiall, which corresponde to the artificiall day. Hora or Ora is a Greeke name, and signifieth ende. And so say

Houres naturall and artificiall.

We Ora maris, for the ende or bymme of the sea, or the lyfte or edge of apparell, as saith Isodore in his Etimologies. The houre naturall or equall, is a. 24. parte of the day naturall: And is the tyme of passyng. 15. degrees of the Equinoctiall. These. 24. houres that make one naturall day, the Astronomers accompt from that the sayd day begynneth, which is from the Meridian toward the West: and they come to be the. vi. houres in the ryght Horizon of the sphere: and the. xii. in the Meridian in the angle of mydnyght, and the. xvi. in the ryght Horizon to the East parte: and come to end the. 24. houres in the same Meridian where they began. And this they vse for the computation of the tables of the mouynges of the heauens. The Astronomers vse the same in theyr instrumentes, as in the Astrolabic, and Dyalles Horizontall and verticall, and in all other instrumentes for houres. In Spayne also we vse to accompt these. 24. in two tymes twelue, begynnyng at noone, and endynging at mydnyght: and agayne, begynnyng at mydnight and endyng other twelue at noone. And to distincte the one from the other, they call the one afternoone houres, and the other forenoone houres: And commonly we say syre houres of the moynyng, and sixe of the euenyng. In Italy they accompt them from the fallyng of the Sunne vntill the next fall the daye folowynge.

The houre naturall or equall.

The artificiall or temperall houre, is a twelfth parte of the daye arcke or the nyght arcke.

The houre artificiall or temperall.

They

The day &
nyght deu-
ided into.iiii
partes.

Interpreta-
tion of cer-
teyne places
of the Sol-
pell.

The nyght
deuided in-
to foure
quarters.

Foure wat-
ches of the
nyght.

They are called temperall houres, because they vary in the tymes that the day varyeth. For in the time that the dayes shalbe greate, so shalbe the houres. And when the dayes shalbe shorte, so lyke wyse shall the houres be, and in lyke maner of the nyghtes. So that, as the artificial day great or lytle, is deuided into other. 12. houres, even so the night great or lytle is deuided into other. 12. The auncientes deuided the day into foure partes, & the nyght into other foure: geuing vnto euery quarter part thre houres. At the rysyng of the Sunne, whiche was the fyrst houre of the fyrst quarter, they called the fyrste houre: and thre houres passed, they called the thyrde houre: and fyre houres passed of the day, they called the fyrt houre, which was the mydday or noone tyde. Also the nyynth houre, they named at nyne houres past of the day. And the Sunne sette or going downe of the Sunne they called the Euenyng: as saith the Poet Virgill in this bearse.

Ante diem clauso componet vespere Olimpo.
And accordyng to this computation, is to be vnderstode that writeth Saint Mathew: That the labourers came to the Vineyard at the eleuenth houre: wherby is ment the fift houre, one houre before the Sunne was set. And when we reade in saint John: The ague leste hym the seuenth houre. &c. By this accompt it was one houre after noone when Christe healed the sonne of the Ruler that was diseased in Capharnaum. In lyke maner, by these houres the auncientes diuided the night into foure quarters, geuyng thre houres to euery quarter. And in these foure partes of the nyght were souldyers appoynted to wathe. In the fyrst quarter (which they call Can-
ticinū and we the fyrst sleape) they watched all. In the seconde whiche they called Intempellum, beyng the turne of midnyght, the yong men watched. In the third whiche they called Gallicinium, of the crowng of the Cockes, watched the souldiers of myddle age. In the fourth and last quarter, called Matutinium or Antilucanū (that is the spryng of the day) the old souldiers watched. And thus is vnderstode the fyrst, the seconde, and thirde wathe

watche of the nyght. In like maner ought the mariners to kepe watche and warde, to auoyde aswell the perylls of the Sea, as also the daungers of Rouers: and to diuide the nyght by quarters after the maner of the soldiours, as did also the mariners in olde tyme.

Whome mariners ought to watche.

The.xv.Chapiter of the making and vse of a vniuersall Diall for the daye.



Here as in the Chapiter befoze, wee haue entreated of houres & their differences, we entend here to describe the making of an instrument generall, to knowe the houres of the daye by the beames of the sunne: whiche is doone in this maner. Take a rounde plate of laton, and let it be called the Equinoctiall circle: The circumference wherof, you shall diuide into. 24. equall partes by both the sydes. And from the center to euery of these partes, you shall drawe a ryght lyne: one of the whiche, shalbe a meridian. And in the one part of that, wryte. xii. which shalbe the houre of the mydday or noone. And in the other parte, wryte other. xii. whiche shalbe for mydnyght. In the hyghest part turnyng vpon the center, towarde the ryght hand, wryte one, two, three, foure. &c. In the lower or nether part, you shall counte towarde the left hande, turnynge it vpon the centre: so that the one houre of the one part come vpon the lyne of the one houre of the other part: In lyke maner two vpon two, three vpon three, and so forth of the other. And note that in the lyne of syre at after noone, and at the lyne of syre in the morning, there remaine certen rounde pieces, corners, or endes, after the maner of axis, of the thickenesse of the selfe same plate. Then make a halfe-circle of the same metall, as bygge as the halfe circumference of the plate: and of the thickenesse of a piece of. iiii. rials of plate or sumwhat more, such as the plate it selfe: and of the breadth of halfe a

To knowe the houres of the day by the sunne.

springer if the instrument shalbe greate, or lesse if the instrument shalbe lesse. This halfe circle, shall you graduate or deuyde into. 180. degrees, begynnynge at the one ende, one, two, thre, and so forth vnto. 90. in the myddest. And the lyke shall you doe from the other ende vnto the same. 90. Also you must number them in the breadth of the same halfe cyrcle. And this halfe circle, shall you make fast on the nether parte of the instrument, so that the endes therof may be fxyed in the endes of the Meridian line. Then thzough the center of the plate or Equinoctiall cyrcle, shall passe a rounde style or wyze of the same metall, made fast or sothered in it: so that it ryse or come forth equally frō euery syde of the plate the fourth parte of the Diameter of the same. And this shalbe called the Axis or axiltre of the worlde. The instrument being thus made, you shall place it or set it in a frame hauyng two armes, standardes or arches, so that it hange betwene the sayde arches, borne vp by the rounde pierces or endes of the plate lefte therof at the endes of the lyne of the syre houres afore sayde: In suche sorte that being thus stayed, it may be directly tourned. And in the myddest betwene these twoo armes, beneath in the foote of them, or where they are placed, you shall rayse a prycke or poynt: so that the plate which signifieth the Equinoctiall, being perpendicular, the byzmyne or edge thereof may fall vpon the poynthe or prycke. And consequentye the plate standyng playne or flat, the. 90. degrees of the halfe circle, must shewe or touche the sayd prycke: as shal also thende or extremitie of the Axis of the worlde: And the other ende shall shewe the Zenith or verticall poynt. This instrument must bee so placed that the Meridian lyne be North and South: whiche you shall fynde in this maner. In an open and playne place where the Sunne shyneth for the moste parte of the daye, you shall make a circle with a payze of compasses. In the myddest wherof, you shall set a style or wyze so vpryght that it declyne not or bende not, eyther one waye or an other. And the same no longer then the fourth parte of the Diameter of the circle, Then in the moornyng when the Sunne riseth, the shadowe

The placing
of the instru-
ment.

The finding
of the Meri-
dian lyne.

Shadowe shalbe very longe. And as it ryseth hygher and hygher, so the shadow wareth shorter and shorter. When must you obserue the tyme when the extremitie or ende of the shadowe toucheth in the circumference of the circle. And where it toucheth, you shall make a prycke. Then goeth the shadowe shortening vnto the mydday or noone tyme. And as from thence the Sunne declineth, so doeth the shadowe increase. And when it shall come agayne to the circumference of the circle, you shall make an other prycke. Then shal you part in the myddest, the arke that is betwene the one prycke and the other. And from the myddle prycke, drawe a ryght lyne to the center of the circle: And that shalbe the Meridian lyne, whereupon you shal set the instrument. Furthermoze in the foote of the frame of the instrument, you shal set a compasse or dyall which shal shew the Meridian lyne. This done, vpon the arches of the frame & corners of the syre houres, you shal turne the Equinoctiall so farre that it passe so muche of the halfe circle by the myddle prycke howe many de-

grees the pole is rayled aboue the Horizon of that region or place where you are.

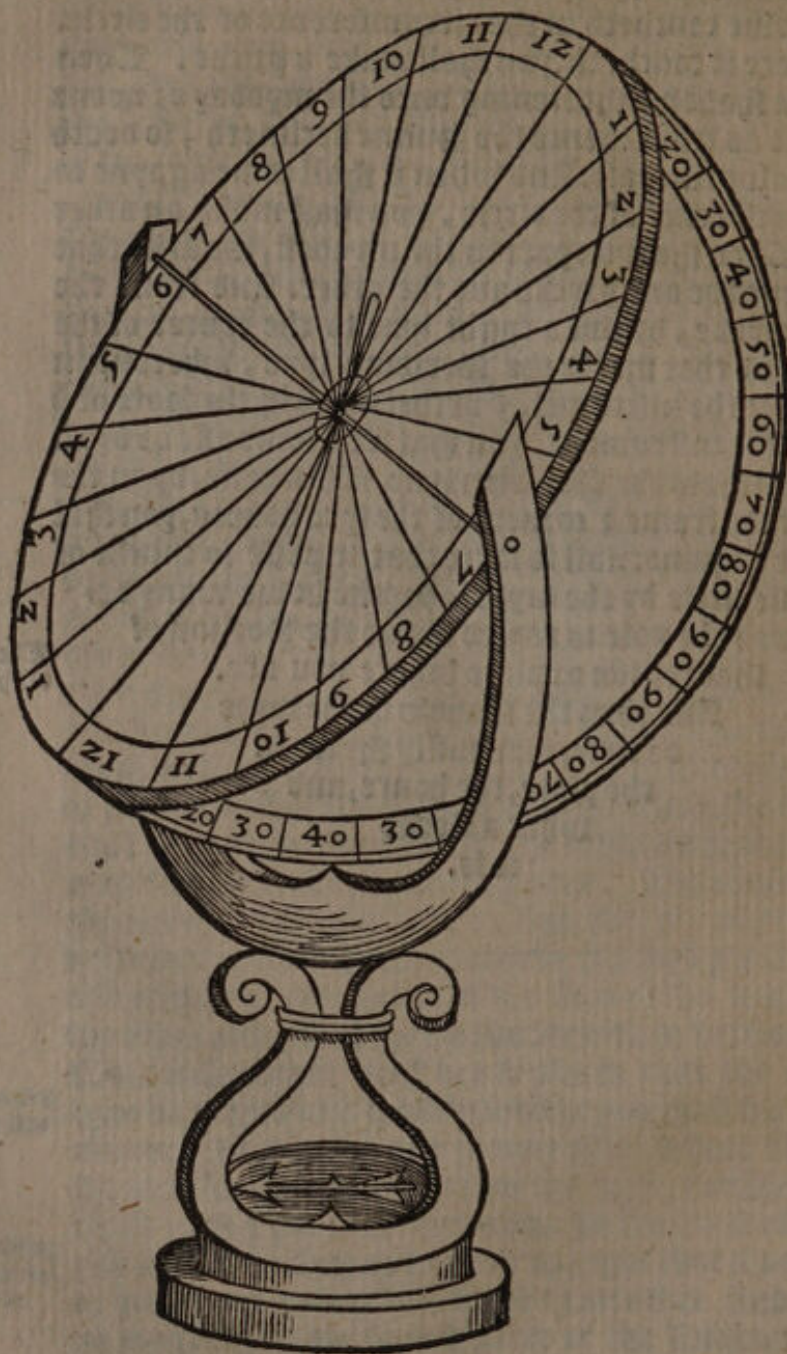
And then the shadow of the wyze or style, shall iustly shewe in the plate, the houre, and what a clocke it is.

The eleuatiō
of the pole.



The .2. part.

Here followeth the Figure of the
Instrument.



The

The. xvi. Chapter of certaine particular dials Murall and Hozizontall.



Among sundrie maners and fashions of
particular Dials, there are two pyn-
cipall. Wherof the one is Orientall, Dials hori-
zontall and
verticall.
whiche is placed in the superficial of
the Hozizon. The other is verticall, &
must be made or set on a wale perpen-
dicular, and directly against the south
or mydday, from the poynt of the true

levant or east, to the true ponent or west, the whiche the East & west
Mariners call East and West. To make any of these
two dials, you must drawe a ryght lyne and call it the
Aris of the poles of the worlde, vpon the whiche, you
shall drawe an halfe circle and deuide it in. 90. equall
partes. And wher the half circle is cut with y lyne of the
Aris, must be accompted by the circumference, the alti-
tude of the pole for the citie or place for the whiche you
intende to make the dial. And in the poynt of the circum-
ference where endeth the altitude of the pole, you shall
make a marke: and wyte there, the altitude of the pole.
And from that poynt drawe a ryght lyne vnto the point
where you began to accompte the altitude of the pole.
Whiche lyne shalbe called the Simidiameter, or half Dia-
meter of the verticall circle. And from the same poynt of
the altitude of the pole, drawe an other ryght lyne to the
other extremitie or ende of the Aris. And this shalbe cal-
led the Semidiameter of the hozizon. And like wyse fro
the same poynt of the altitude of the pole, drawe a right
lyne perpendicular vntill it touche in the Aris. And this
shalbe called the Semidiameter of the Equinoctiall.
Hereby is considered a triangle whiche hath by the sy- The trian-
gell.
des thereof the Semidiameter of the verticall, the Se-
midiameter of the Hozizon, and the Aris of the worlde,
whiche triangle shal serue afterwarde. These three Se-
midiameters, of the verticall, the Equinoctiall, and the
Hozizon, beyng founde, you shall make the Diall in this
maner.

F. iii.

Drawe

The making
of the diall.

Draw a ryght line somewhat long and cal it the line of contingence. This shall you cut with an other lyne in ryght angles after the maner of a T. whiche shalbe the meridian lyne. Then with your compasse, take from the triangle the Semidiameter of the Equinoctiall. And of this bygnes, drawe a circle vpon the meridian lyne: so that the edge or bymme of the circle, touche in the lyne of contingence. Then with a compasse, take the Diameter of the verticall circle, if you wyll make a mural dial: Or the Semidiameter of the Horizon, if you wyl make a Horizontal dial on a playne or flat soyme. Therfore with suche Semidiameter as you desyre, you shal drawe a circle vpon the other parte of the Meridian line, so that the circumference therof touche in the lyne of contingence. Then shall you deuyde the Equinoctiall circle into foure equall partes. And the quarter that is towarde the lyne of contyngece, shall you deuide into syre equall partes. And settynge the ende of the ruler in the center of the Equinoctiall, and vpon every poynte of them that deuyde the syre equall partes, from thense shall you drawe certayne ryght lynes, vntyll they touche in the lyne of contingence. And from these poyntes of the lyne of contyngece, you shall drawe other ryght lynes to the center of the Horizontal circle: which lynes shalbe the determiners of the houres. And neare vnto the Meridian lyne where it toucheth in the lyne of contingence, you shall wypte. 12. And consequentely towarde the East, you shal wypte. 1. 2. 3. 4. 5. 6. And from this syxt houre, you shal drawe a ryght lyne whiche shal passe by the center of the Horizon, and be equally deuided from the lyne of contingence. The one quarter of the Horizon being drawn by the self same and of the same measure and bygnesse, shal you drawe the other, in such sorte, that the same bignesse that is from. xii. to one, the selfe same shall you geue fro the. xii. to the. xi. And the same byggenesse and measure that is from one to two, shall you gyue from. xi. to. x. and so forth of the other.

And note that the Horizontall dyall, after the syxt houre of the euenyng, shall haue the houres of. vii. and viii.

viii. And in climates farre North. ix. also, and more yf
 neede shal requyre. And consequently must haue the hou-
 res of fyue and foure of the moynng. And in climates
 farre North, thre also. And these must be so marked that
 from fyue to seuen, may be the same that is from fyue to
 fyue, and from seuen to eyght, the same that is from four
 to fyue. Also foure and fyue of the moynng, as seuen and
 eyght. The dyall beyng thus drawen in paper or on a ta-
 ble or any other thyng, must be paynted (on a table or in
 stone, or in whatsoeuer you desyre to make the dyall) a
 circle of the same bygnesse as is the circle Horizontall.
 And in that, must be translated the lynes and nombers
 of y^e said circle Horizontal. Then must you make a trian-
 gle of metall of the selfe same bygnesse and fourme that
 is made in the myddle circle. And the syde of this trian-
 gle, (which is called the halfe Diameter of the Horizon)
 must be fyred vpon the meridian lyne of the Horizontall
 dyall: So that the syde of the triangle (which is the axis
 of the worlde) and extremitie or ende therof, may fall in
 the center of the Horizontall dyall, and must stande so
 perpendicular that it declyne neyther to the one part nor
 the other. The dyall beyng thus made, you shall sette it
 vpon a meridian lyne, so that the meridian lyne of the
 dyall may stande or rest vpon it. And so shal the shadow
 of the triangle shewe the houre: And if for this place we
 desyre to knowe it, we must fyre it there. And if for anye
 other place, so setting it we shall haue a certen houre.

So maye we in an instaunt remoue it to an
 other place, and lyke wyse set it there
 to make certen and true demon-
 stration of the houre.

F. liii.

Here

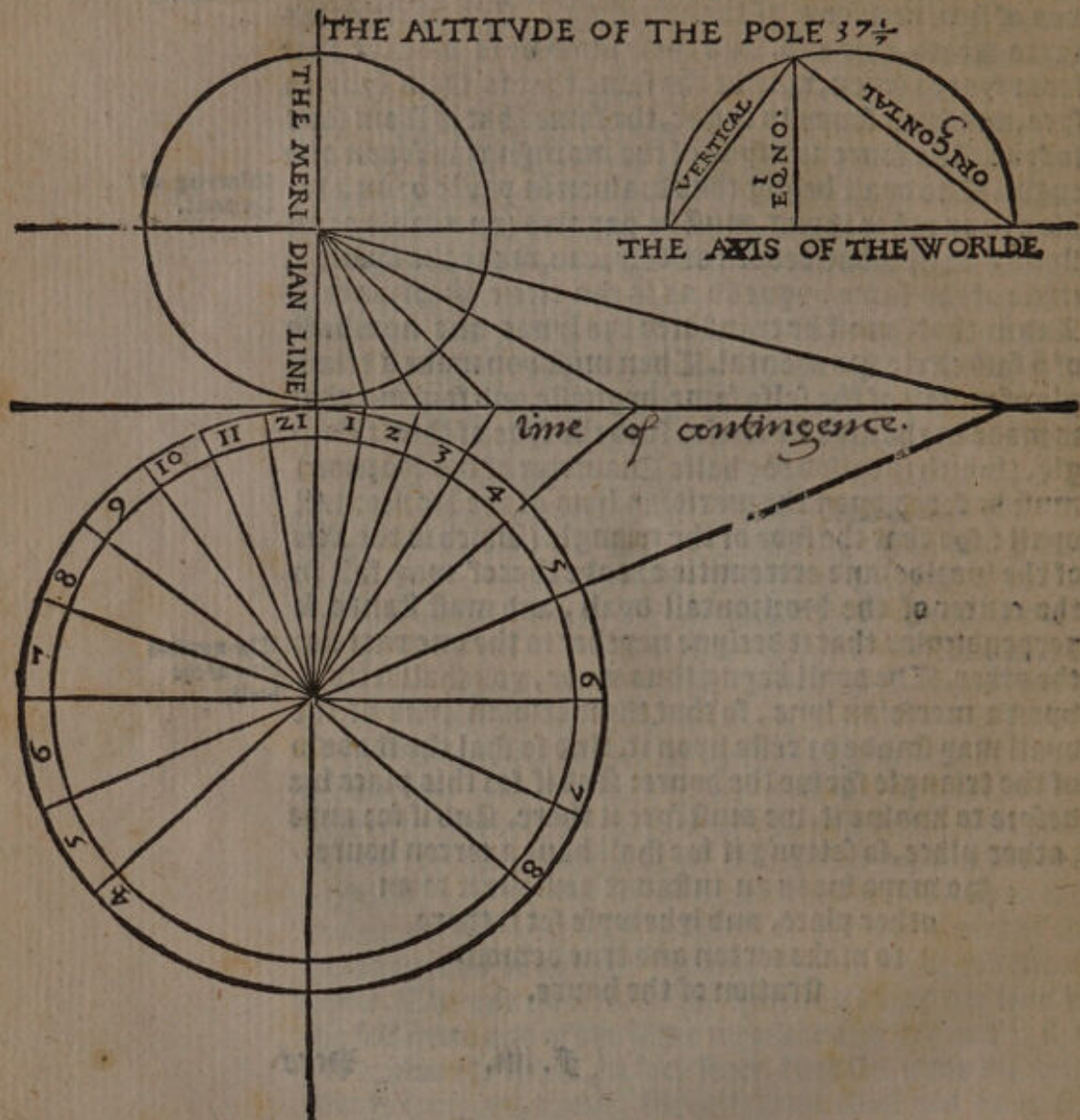
Portes of
 the horizon
 fall diall.

Placing of
 the diall.

The meridi-
 an lyne of the
 diall.

The. 2. part.

Here foloweth the figure of this demonstration.



The mas-
king of the
vertical dial

In lyke maner as is made the Horizontall Dial, must be made the verticall, takynge from the triangle the Semidiameter of the circle verticall.

And note, that for the circle verticall, it shall not be nedeful of moze then sixe houres befoze noone, and other syde

fyre after noone. And the triangle must be firt in the meridian lyne vps the side that is called the Semidiameter of the circle verticall. And if you wyll not make a triangle of metall, but that a wyre of Iron may geue the shadowe, then must you make the sayde triangle of paste or paper. And according to the forme or paterne thereof, make the wyre of Iron, and cause the same to be set in all sortes of dyals as is beforesayde.

The.xvii.Chapiter of the composition and vse of an Instrument general for houres of the nyght.



Here as in the Chapters past, I haue described the maner and forme, to make two dials for the houres of the daye, me semeth that for the more perfection of this worke, it should be conuenient heare to teache the makynge of a diall, to knowe the houres of the nyght by the circle whiche the two starres called the Guardians or the mouthe of the horne, doe describe by the mouyng of the first moueable. But for as muche as it is a common opinion that in the myddest of Apryll, it is mydnyght when the Guardes be in y head, wherof they take the beginning of the yeare: I wyll declare howe it ought to be vnderstode. Certaine it is, that to be mydnyght, is none other thyng, but the Sunne to be by the mouyng of the first mouable, to euery one in that parte of his meridian that is to hym vnder the earth: Euen as is to hym myddaye or noone, when to hym it is in that part of the Meridian that is aboue the earth. And in this present yeare of. 1545. (to be out of doubte hereof) I made experience with a precise Astrolabie: so that the fyrst or formoste Guard starre beyng perpendicularly ouer or aboue the North starre, I founde in the Meridia where the sunne maketh mydnyght, the nyynth degree of Taurus. Wherby it foloweth, that the sunne beyng in this degre which is at the. xix. of Aprill, the same garde starre shalbe perpendicularly ouer the North starre,

f. v.

whiche

The garde
starres.

what is mids
nyght.

Noone or
mydday.

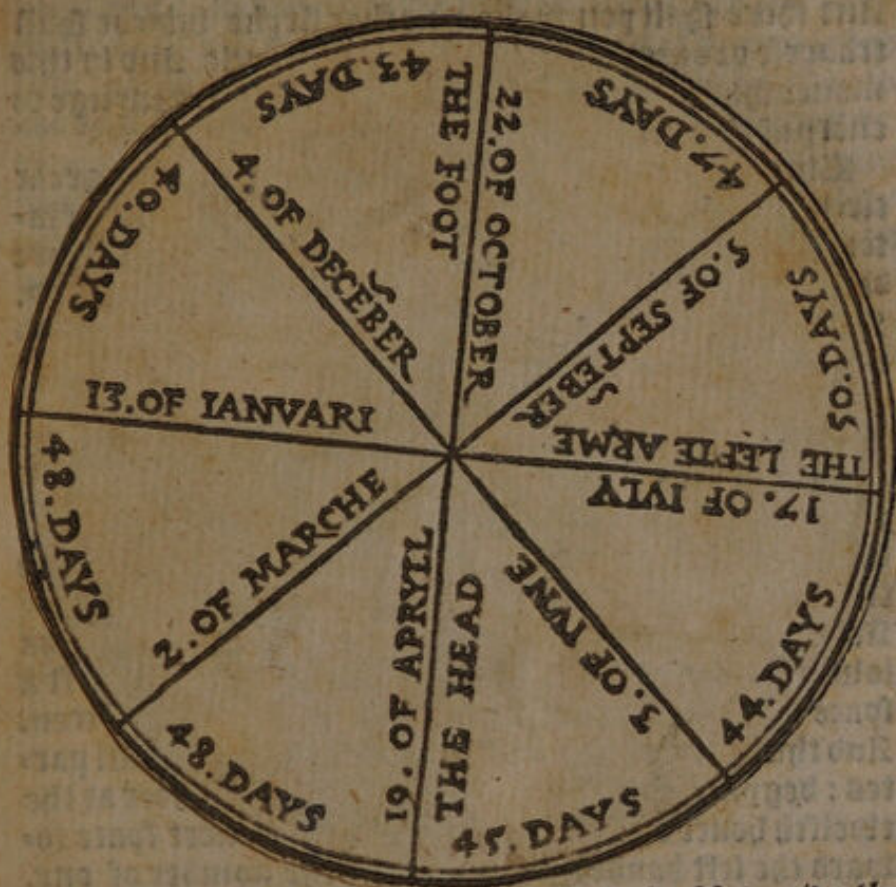
whiche is the lyne of the head. And consequentlye the Sunne beyng in the nyynth degree of Scorpio, whiche is at the. xxi. of October, the guard starre shalbe in the line of the feete. And by this calculation maye be knowen when it shalbe in the ryght arme or the lefte, and in all the other lynes. So that they manifestlye erre that accompte the mydnyght at the. xv. of Apryll, when the fyrst guard starre is in the line of the head: accompting a terce or thyrde parte of an houre soner and moze then they should doe.

An error.

The making
of the instru-
ment.

Having thus given principles for the instrument, you shall proceade in the making thereof as foloweth. In paste, or on a plate of laton, make a circle of the quantitie of a spanne, or of the bignesse that you desyre the instrument or dyall to be. Then make an other circle some what lesse: so farre disaunt from the greater that betwene the one and the other may be a space in the which may be signed or marked the dayes and monethes. Lyke wyse shal you make an other lesse circle, leauing space to set the numbers of the dayes of euery moneth. And vnder this circle, shall you make an other, leauing space to wyte the names of the monethes. Then shall you diuide the fyrst and greatest circle, into eyghte equall partes. So that the. xix. of Apryll may bee in the hyghest or hyppermoste parte of the instrument, whiche is where they say the lyne of the head to be. And the. xxi. of October must be in the nether part. Also the. xiii. of January, in the ryght arme. And in the left arme, the. xvi. of July. And so the other dayes that doe fall to the other lines according as thei aunswere to the ryght ascention of the Sunne, as you may see in this figure.

This



This being thus deuided, you must also deuide the spaces that are betwene the one lyne and the other, into the dayes whiche be numbered in euery space: So that betwene the. xix. of Apryll and the thyrde of June, are 45. dayes. And that space shall you deuide into. 45. partes. And where as the instrument beyng small, it can not in so lyttle space receaue so many partes, you shall deuide it from fyue to fyue partes. And so shall you deuide the other spaces by the numbers that are signed in them. When one daye more before the. x. towarde the left hande, you shall make a stryke, and there shalbe the. xx. of Apryll. And fyue dayes more before, make an other stryke: & there shalbe the. xxv. And yet other fyue dayes more before, (whiche shalbe the. xxx. of Apryll) make an other stryke ouerthwarte vnto the nethermoste circle, & there shall May begynne. And from these dayes shal you begynne to accompte the dayes of May from fyue to fyue. And in the laste space, you shall put fyue, whiche shall make the one and thirty dayes that May hath.

And

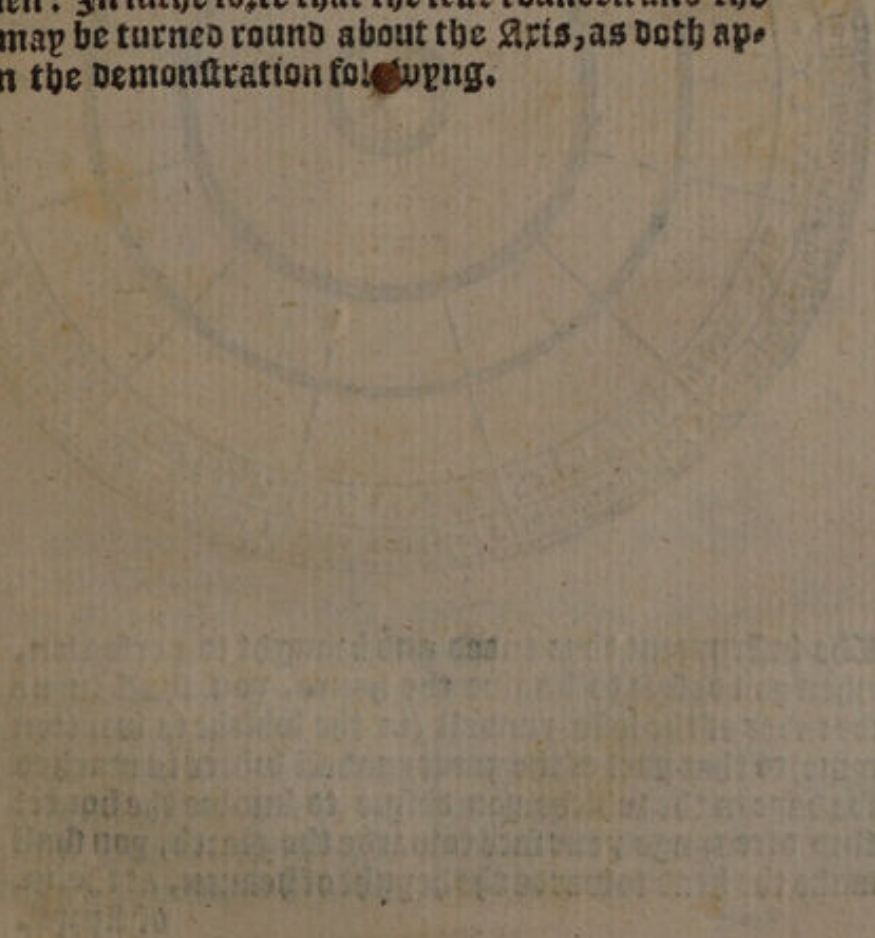
And there shall you make an other stycke whiche shall trauerse or ouerthwarte vnto the lesse circle. And in this maner shall you deuide the other monethes, geuyng to euery of them the number of his dayes.

This being done, vpon the outward part of the great circle, you shall cut rounde the paper, past, or plate of laton: leauyng of the same for a signe or marke, a floure deluce vpon the. xix. of Apryl, for that it must be the head. And lykelwys at the. xxii. of October, may be left a handel to holde it by. Then must you make a rundell of the same paste or laton of the bygnesse of the lesse circle, without the circumference wherof, shalbe left a toothe or inder, in the whiche you shall wyte: tyme. And from the one syde of this inder toward the left hande, you shall drawe a ryght lyne that may passe throughe the center to the circumference. And this shalbe the Meridian lyne. Also to this roundell shall you geue a circle, so muche lower from the circumference, that there may be left a space where the numbers of the dayes may be wytten. And this roundell you shall deuyde into. 24. equall partes: begynning at the meridian lyne of the inder at the twelfth houre of the nyght. Then in the next space toward the left hande, you shall make the number of one. Lykelwys in the seconde space the number of. ii. In the thyrde the number of. iii. and so forth of the residue vnto the other. xii. of the daye, in thopposite or contrary parte of the inder. So consequently proceeding. i. ii. iii. &c. vnto the. xii. of the inder, whiche shalbe the. xxiiii. houres of the naturall day.

The horn of
the. vii. star-
res whiche
make the left
beare.

Furthermoze also you must make an other piece of the same substance of past or metall, in maner of a horne, in forme & order as are in heauen the seuen starres which make the lesse beare. And this of such quantitie that the fyrst or formoste guard starre, may reache withoute the great rundell close to the circumference therof: hauyng the north starre his center with the center of the instrument. And from this starre or center vnto the firste and formoste guard starre, must be a right lyne by the which the horne must be cut neare from the center vnto the dis-
couering

coueryng o: shewyng of the houres. Also from the fyrst
garde to the second, must be two partes of nyne of that
that is from the starre whiche signifieth the North, to
the fyrst garde. Againe, the second & last garde, must be
toward the left hand ouer o: aboue the first, thre quarter
partes of one halfe circle (whiche hath for the Semidia-
meter the two partes of nyne whereof we haue spoken
before) geuen vpon the ryght lyne that goeth from the
North to the fyrst garde. These twoo garde starres,
must be boored throug with holes of the byggenesse of
an aglet of a poynt. And lyke wyse the North starre, with
also the two roundels throug the center: And by that
all thre pieces annered: so that there remaine a hole in
the myddest lyke the holes of the gardes. So that by it,
and by the other of the gardes, may be sene the starres
in heauen: In suche sorte that the lesse roundell and the
horne, may be turned round about the Axis, as doth ap-
peare in the demonstration folowynge.





To find the
houre with
the instrumēt.

The instrument thus ended and brought to perfection,
when you desyre to knowe the houre, you shall turne
the inder of the lesse rundell (in the whiche is wypten
tyme) to that part of the great rundell where is marked
the daye in the whiche you desyre to knowe the houre:
And directynge your face towarde the North, you shall
make the head towarde the heyght of heauen, at the.19.
of Apryll.

of Apryll. And seying in heauen by the hole in the myddest the starre of the North, holdynge the instrument in suche compasse of the face, that by the circumference of the greater rundell may be seene the Guard starres in heauen, you shall turne the horne rounde about, vntyll it fall vpon the Guardes: so that by the two holes of the mouth of the horne, the two Guard starres may be sene, and by the hole in the myddest the North starre, and all thzee with one eye: Then the right line that goeth from the North to the fyrste Guard, shall shewe in the lesse rundell the houre that shalbe.

The.xviii. Chapter of the tyme of the Tydes, or rysyng and fallyng of the sea.



Grete accompte ought Pilottes and Maryners to haue of the Tydes, to take port, enter vpon barres, passe by flattes: and finallye for all maner of Nauigations. For being ignoraunt hereof, great hurt and inconuenience myght chaunce vnto them: as dyd of late to the valient Captayn Don Iohn Gusman Therle of Niebla, in the yeare of. 1436. who was drowned befoze the Citie of Gibraltar, for that the Maryners kept none accompt neyther had consideration of the tydes. By reason wherof, not only he was drowned, but also with hym dyed many woorthye gentlemen and valient capitaynes of Spayne.

The Maryners holde for a certen rule, that the Moone being in the Northeast, or in the Southwest, is full sea: And beyng in the Southeast, or Northwest, to be lowe water. They affirme also, that at the fyrst day of the newe Moone, the Sunne beyng at Northeast and a quarter to the East (that is Northeast and by East) the Moone shalbe Northeast: And then shall be full sea, and thzee houres, and thzee quarters.

And

The Maryners opinion of ebbing & flowing of the sea, or tydes.

Observation of the mone to know the tydes.

Eyght prin-
cipall wyndes

And at the seconde day of the Moone, when the Sunne shalbe at East North-east, the Moone shalbe at North-east, and then shalbe full sea, and foure houres and two quarters. &c. They accompt is, that the Sunne beyng in the North is mydnyght: and being in the North-east they accompt thzee: and in the East, sixe. So that they accompt thzee houres from wynd to wynde, by the. viii. principall wyndes, or lines which the Spanyardes call Rumbos. These wyndes muste be imagined vppon the North, placed in the angle vnder or beneath the earth: and the Sunne and the Moone at the mouing of the first mouable. And they ought not to be imagined in the Horizon, as the compasse sheweth. For speaking by the termes of Astronomie, you muste vnderstande that the Moone touchyng in the circle of houres, at the number of thzee, is euer full sea. And touchyng in the same circle at the number of nine, is euer lowe water. No lesse ought they to obserue iust accompt of the houres by quarters of houres. For, to geue. 32. dayes to the Moone, it shalbe necessary to accompte by the fyftes of houres, as shalbe sayde hereafter.

Here is to be noted, that the Spanyardes thynke (be lyke) that a North-east and South-west Moone, maketh a full sea in al other places as it doth in Spayne. But in that they are greatly deceaued. And therefore the rule that they haue sette forth for the tydes, serueth onely for such places where it floweth North-east and South-west moone a full sea.

The moone
causeth the
the ebbing
& flowyng
of the Ocean
sea

And the better to vnderstande the increasyng and decreasing of the Ocean sea, it shalbe couenient to knowe the cause therof. Wherunto we saye, that the moone is the cause of ebbing and flowyng, or rysyng and falling, increase or decrease of the sea: Not onely by her lyght, but also by her secrete or hyd propertie. The moone compasseth about the earth from the East into the West, vntyll she returne to the place or poynt from whence she departed. And in this course wasteth or spendeth so much more then one naturall daye, in howe muche her proper mouyng is more then the Sunne against the fyft mouable.

The mouing
of the moone

able. So that she maketh her tourne or course about the
 foure quarters of heauen in. xliiii. houres & foure fiftes
 of one houre: whiche are the. xii. degrees that she goeth
 moze then the Sunne. And in this tyme the Ocean in-
 creaseth and decreaseth twyse. So that this increasyng
 and decreasyng, aunswereth directly to the course of the
 Moone. Wherby it foloweth that the Sea increaseth sixe
 houres & one fyfte parte, & decreaseth other syxe houres
 and one fyfte. And if this daye at the. xii. houre was full
 Sea, the lowe water shalbe at the syxe houre and one
 fyfte parte. And at the. xii. houre and two fyfte partes,
 it shal retourne to be full Sea. And at the syxe houre &
 thre fiftes, shalbe lowe water agayne. And at the. xii. &
 foure fiftes of the other daye, shalbe full Sea. So that
 from one daye to an other, the tyde doeth shorten foure
 fyftes of an houre, whiche is the tyme that the Moone
 slacketh or tarieth moze then one natural day, to retour-
 ne to the pointe from whence she departed by the. xii. de-
 grees wherof we haue spoken. Wherby it manifestlye
 appeareth how they beguylde them selues that say that
 the Sea increaseth syxe houres, and decreaseth other six.
 For if it were so, the tydes shoulde euer bee at one selfe
 same tyme and houre. But for as much as there is moze
 then. xliiii. houres by the sayde foure fyfte partes, there-
 by is caused the variation of the tydes: So that yf this
 daye, the tyde be at one of the clocke, to morowe it shalbe
 at one and foure fyfte partes. And the daye folowynge at
 two of the clocke and thre fiftes. &c.

The shorten-
 ing of the
 tyde.

An error.

The varia-
 tion of tides

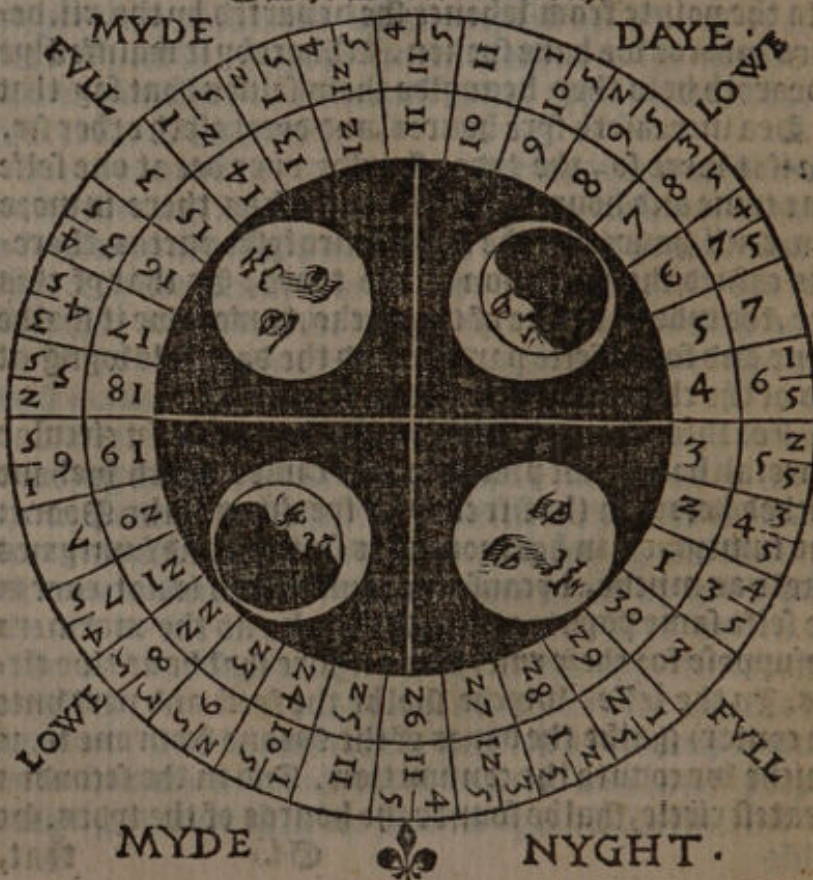
For this accompt, I wyll describe a table in circular
 figure: although not precise for the causes which we haue
 touched before in the fift chapter speaking of the Moone:
 who sumtymes in her mouing is swifte, and sumtymes
 slacketh as much, bycause the coniunction is not euer in
 one selfe same poynte of the Zodiack, as the mariners
 presuppose for their rule. This figure shal haue two cir-
 cles. In the lesse (whiche shalbe the fyrst and next vnto
 the center) shalbe the dayes of the Moone from one to. 30
 whiche we counte the coniunction. And in the seconde &
 greatest circle, shalbe founde the houres of the tydes. So

A table to
 knowe the va-
 riation of the
 tydes.

Gi. that,

that, who so desyret to knowe when the tyde shalbe, where it floweth Southwest and Northeast, let hym at that houre take heade to the dayes of the moone howe many they are: as if she be in the coniunction, or if it be the fyrst or seconde of the moone. &c. And the day beyng knowne, then in the seconde cyrle whiche aunswereth directly to the daye, shal he fynde when shalbe hygh water or full Sea: and consequently the ebbe or lowe water, whiche shalbe fyve houres and one fyfte after the full Sea. And so like wyse may he iudge when shalbe the half tyde. And this aswell at the tyme when it increaseth, (whiche shalbe thre houres and halfe a fyfte parte of an houre before the full Sea) as also when it decreaseth: whiche shalbe the halfe ebbe, thre houres and half the fyfte of one houre after the full Sea.

The Table foloweth.



This increasing and decreasing of the tydes, is not euer in equall quantitie. In the coniunctions and oppositions, they increase and decrease muche: Whiche the Maryners call hyghe spynges tydes. And the greatest increase of all, they call the hyghe spynges. In the quarters of the Moone, (which are at the. 7. and the. 22. of the Moone or neare there about) they increase and decrease but litle: Whiche the Mariners call nepe tydes, lowe ebbes, lowe waters, dead waters, or lowe fluddes.

The. xix. Chapter of certen

signes whiche prognosticate Tempestes or fayre weather.



Good Wylote or Mariner ought not to be ignorant of certen signes or tokens whiche the naturall Wyllosophers describe of tempestes. For as they signifie vnto him, so shal he leane his porte or enter into it. Whiche if he can not, then ought he with patience and hope to tary the time that God hath appoin

ted for hym, who moueth & troubleth the Seas when it pleaseh hym, & appealeth them againe at his pleasure. Lesse hurteth & damageth the stroke which we see coming or soone, then that which hath strikē vs & taken vs carelesse. When the Sunne riseth faire & cleare, it signifieth a fayre daie. But if it shew yealow or deadly, tempest is like to folow. Again, if at the rising of the sunne, his beames shew them selues contracte or gathered together & short, you shal haue raine. If the mistes or cloudes make a circle about the Sunne or Moone, how much the greater that circle shalbe, so much greater shalbe the tempest to come. And if there shalbe two circles, the tempest shal increase the more. And if it chaunce that at the rising of the sunne, the cloudes be turned red, it is a signe of no smal tempest. When the Sunne or the Moone shal haue a circle, loke toward the part where it breaketh, & from thence shal wynd come. If it depart or disperse equally, faire wether shal folow. When the Moone riseth bright & shining with pure colour, you may iudge it faire wether.

Signes of
fayre and
foule wea-
ther.

And if redde, wynde. If black, rayne. When in the newe Moone, the hornes or corners appeare grose or great, it is a token of tempest. And if sharpe, it signifieth sayre weather.

The newe Moone.

This that we haue sayde, is the auctoritie of Plinie & Aristotell, to whome the prudent Mariner shal credit vntill he haue founde other moze certayne, eyther by his owne experience, or by the experience of other wyse men woorthy to bee beleued. And euerye manne oughte to trauaile as muche as in hym is, for the knowledge of these thynges, according as God hath gyuen him vnderstandyng and reason to obteyne the same. And this shall be wysdom, bearyng in memorie the experience of things past, to gouerne presently, and to prouide for thynges to come. The prouidence of God is so great, that depryving brute bestes of reason and vnderstanding, he hath geuen them sense and naturall instincte, whereby they may knowe that, that men do vnderstande by reason.

The sense of bestes in forering tempestes.

Antes.

By this sense and secrete instincte of nature, the Antes or Dissemares, with prouidence and dilligence, laye by in store theyr prouision and egges, when befoze they fele

Swalowes.

Flyshes.

the rayne to come. The Swalowes also when they fele the wynter comyng, passe the Seas. Lyke wyse the Flyshes when they perceyue stormes to come, goe downe to the bottom of the water and hyde them in the mudde of the Sea. And although it may seme besyde my profession to meddle with matters perteynyng to Diuines, yet wyl I not omitte to speake that Christ our Lorde sayeth, as testifieth S. Mathewe. When the Phariseis with the Saduces (to tempte hym) willed hym to shewe them signes from heauen, he answered saying: when it is euening you saye it shalbe sayre weather, because the heauen is redde. And in the moynyng, you say it shalbe tempest when you see that the heauen draweth toward redde. &c. They knewe by that they iudged of heauen, to determen thynges to come: As whether it were euell to take iourney, to enter the Sea, to reape Cozne, to laye it abroad, or to gather it in. I saye that to vnderstand the reason that moued them to haue suche consideration of tyme,

Math. xvi

tyme, (whiche we nowe lykelwyse obserue,) it is necessary to knowe that the redde colour which appeareth in the euenyng, signifieth the drynesse of the ayre: wherby the matter of the grosse vapours which should be conuerted into water, is so muche dried, that it appeareth in maner inflamed, and is therfore redde. And so is it not aptely disposed to be conuerted into water: And is therfore the nearest sygne of sayre weather. The other sygne when the heauen in the moynyng draweth toward rednesse, (yet not redde) sheweth manifestly that rayne shal folowe. Wherof the cause is, that this matter is ingro-
The redde-
nesse of the
euenyng.
A ruddy col-
our.
What is tem-
pest.
Luk. xii

Lykelwyse it is wyrtten by S. Luke: When you see a cloude ryse in the West, you saye rayne shal folowe. And when the wynde bloweth South, you saye it wyl be hotte. &c. To vnderstande this, I saye the cause of this is, that rayne is made or engendred of moyste vapours whiche both may be and are ingroced. Or otherwyse, a cloude is a grosse body of moyst vapours so ingroced. And when the cloude doth so ryse, it shalbe a signe that rayne shal shortly folowe. For that that was ingroced in the cloude, shall sone be resolued into water. To the other reason why they say that when y wynd bloweth South, it wylbe hotte, I saye that that wynde is hotte and drye. Furthermoze is to be considered that y wyndes are sometymes drye, and sometymes moist. Not not by their own

ppertie: but accordyng to the regions by the whiche they passe. We see that in some one Region it rayneth with one wynde: and the selfe same wynde in other places disperseth the cloudes. The Northwest wynde is drye in Spayne. Yet in Libia is it very moyst and rayny. The South wynde in Europe, causeth rayne in moste places. And therfore the Poetes named it the wynde of waters. And this wynde in Palestina or Jure, is drye. The cause of this diuersitie, is, that when that wynde bloweth in Palestina, it passeth by hoate and drye Regions, as by the desertes of Aphrike, and passeth not by any Sea at all. But when it bloweth in these partes of Europe, it must of necessitie passe by and ouer the waters of the Sea Mediteraneum or the Leuant Sea, where it gathereth moisture & causeth rayne. The Leuante or East wynde, in Malaga and Gibraltar, is moyst: And in sheres, De la Frontera, is hoate as hell.

**The. xx. Chapter of the bryght and
shining exhalations that appeare in tempestes: whiche
the Mariners call santelmo
or Corpus sancti.**



Ignorance is the mother of errours. And therfore wyl I not smit to the we the naturall cause hereof, although among certayne simple and ignoraunt people it is accounted for a myracle, that in certayne tempestes on the sea, the Mariners see certayne shynynge & bryght fyres which with great superstition they knele downe vnto and praye vnto, affirming that it is santelmo that appeareth vnto them. And not contented herewith, some sweare that they haue seene droppes of grene ware fall downe. Other affirme that this ware is of suche heate, that if it fall from the top of the shyppe, it doth melte the rosen and pitche of the hatches of the shyp, with suche other folyshe imaginations. And therfore it shalbe good bryefly to speake hereof to stoppe

Some call
these the
teares of saynt
Ellen and
S. Nicolas.

stoppe the mouthes of suche sonde & ignoraunt persones.
 The exhalations or vapours of the grosse fumes or smo-
 kes that ryse from the earth, are constrainned or gathe-
 red together by the coldnesse of the nyght and the ayre: &
 are thickened in the first region of the ayre next vnto the
 earth. This may and is wont to be inflamed or kyndled.
 And if it fynde a body whereunto it may cleave, it aby-
 deth in that vntyll it be consumed. This fyre is cleare &
 shyning, and yet burneth not. The Grekes call it Poly-
 deuces: and the Latines call it Castor & Pollux. It is accu-
 stomed to appeare vpon the shrowdes, and oftentimes
 is sene vpon the pykes of Soldiours in the armies of me-
 of warre, as Plinie wyrteth. And this aswell by reason of
 continuall smoke, as also by the heate of muche people.
 Certayne it is, that smoke is none other thyng then fyre
 disperfed: as flame is an exhalation or euapozation that
 ryseth in maner of a smoke from a grosse or fat body: and
 at the tyme that it ryseth, beyng gathered together, is
 constrainned into flame inuestured with fyre. This re-
 splendence or shyning, is also often tymes sene not on-
 ly in tourneyng by lande, but also in sayling by ryuers.
 And when it appeareth on y lande, it riseth of the smoke
 that is gathered together with the colde ayre of y night:
 and on the bankes of ryuers, this smoke is gathered of
 the exhalations of the water. And consequently beyng
 kyndled, appeareth bryght and shyning. But nowe let
 vs come to the shippes that sayle by the Sea, and to the
 Mariners that are accustomed to tempestes. So them
 therfore I saye, that that lyght or suche other lightes as
 they see, is engendred of the fumes and smokes of theyr
 shyppe with the heate of men couched close and neare to-
 gether in a narowe place. And when a tempest ryseth, y
 sayd smoke is thickened, prest together, and beate down
 by the wyndes, in suche sorte that beyng tossed from one
 syde to an other, it is sette on fyre by mouyng: and ta-
 keth holde sometyme on the shrowdes, and sometyme in
 the top, and somtime also in the poupe or in the foreship.
 So that to see this lyghte, or the same to appeare, is a
 naturall thyng, and not supernaturall.

wanderyng
 fiere engend-
 red of exha-
 lations and
 vapours.

Castor and
 Pollux.

what is smo-
 ke & flame.

Exhalations
 of the lande
 and water.

Exhalations
 & vapours
 engendred in
 shippes.

A hymne
flye.

A superstiti-
ous opinion
of the Mary-
ners.

A lyfe of the
fryer prea-
chers.

Psalm. lxxvii

Testimonie
of ancient
antiquity.

When capitaine Bezerra was at Corron in the Empe-
rours paue with his companie of soldours, he chaun-
ced to be in a tempest and sawe the sayd fyre of santelmo,
whiche shortly after descended so lowe that the Capi-
taine myght easely come to it. And taking it in his cloke
he founde it to be a lyttle droppe of water. Some haue
thought it to be a certayne flyninge flye called Taros,
which the Sea men sometyme see in a calme in the som-
mer season. And thus Santelmo appeared no moze. The
Captaine remayned astonysed at the mockerie: and the
other perceiued it to be no miracle. The opinton of the
Mariners that affirmed it to be Santelmo, may rse of
saynt Erasmo Byshop of Naples: who (as they saye) not
only in his lyfe tyme but also after his death, was a pa-
trone and helper of Mariners that called vpon hym in
tempestes. His name of Erasmo, they of Naples call
Eremo. And proesse of tyme takyng awaye one. e. by
the figure of syncope, remayned the name of Santermo.
And y Spaniardes who neuer can long kepe any straunge
vocable, call it Santelmo, turnyng. r. into. l. Yet of thys
Santelmo wherof the Mariners speake, ther is neither
scripture that maketh mention, nor authoritie that con-
firmeth it. I heare saye that the Fryers preachers had a
religions man of commendable lyfe and good conuersa-
tion, named Fryer pero Gonzales, borne in Galtzia. And
that in his lyfe tyme our Lorde dyd certayne myzacles
by hym. And that this is he that flyneth & gnyeth light
in tempestes. No doubt but God worketh myzacles in
his sayntes and by his Sayntes as sayeth Dauid. But yf
this seruaunt of God was Pero Gonzales: howe then
shal he be Santelmo? An other difficultie there is as tou-
chyng this lyght. For there are wytynges of moze an-
tiquitie then the lawe of grace and commyng of Chryste
in fleshe, whiche geue testimonie hereof. For the Poet
Virgyl in the seconde of his Aeneidos, wytfeth that this
fyre appeared vpon the head of Iulius Ascanus. And
Titus Liuius in his fyrste booke, affyrmeth that it appea-
red vpon the headde of seruius Tullius, the fyrte kynge
of the Romaines.

Pome

pomponius Atticus saith, that Rome begunne to be builded in the thyrde yeare of the thyrde Olimpiades. That is in the tenth yeare of Ioathan kynge of the Iewes. And from the creation of the worlde. 3201. yeares: and. 729. yeres before Christ our sauour was borne. The kinges of Rome were seuen, and raigned. 244. yeares. Eusebius saith they raigned. 246. Seruius Tullius raigned. 44. yeares. Tarquinus superbus. 25. yeares after hym. So that discountyng these yeares, it shall appeare clearely as I say. And although the yeares were not discounted let them reade Diodorus siculus an auncient wyter, let them reade plutarchus, Aristotle, and other old auctours that haue wytten hereof. And they shall fynde that yf tempestes be neare vnto the sea, these fyres and lightes appeare in them. And appeared not onely to the Gentyles, but at this daye also appeare to the Turkes and Moores in tempestes. When only one lyght appeareth it is taken for an euyl signe. And hereof saide propertius thus.

The buyls
dyng of
Rome.

The Ro-
main kinges

Candida foelici soluit vela toro.

And why it is an euyl signe, this is the cause. That yf the tempest that ryseth be great, it choketh the exhala- tion: although yet by the parte leaste troubled it appeareth. When there are two lyghtes, is signifieth that in the ayre is great abundaunce of grosse humours. And is a token that it is sufficient to consume the matter of the tempest: Or that the tempest begynneth to cease, & the grosse humour hath the masterye. But sometyme it chaunceth that two lyghtes appearyng, there maye be tempest: and one appearyng shall not be so greate. And oftentyme there is tempest without any light at al sene. The blynde Gentyllitie called these Castor and pollux, and placed them in heauen in the signe of Gemini.

One lyght
or fyre is an
euyl signe.

Two lygh-
tes:

Castor and
Pollux.

Nowe remayneth to aunswere to one obiection of the Mariners, who say, that neuer man that hath sene these fyres hath peryshed. To this I saye, that manye may se and haue sene these lightes: of whom some haue ben in peryll and some drowned. Notwithstanding, no man can affirme, that yf the drowned myght speake, they

An error of
the Mary-
ners.

The .2. part.

they would saye that they had seene them. Therfore the
wyse Christian Mariner ought to haue a clear conscien-
ce, and to call for the helpe of almyghtie God, lyftynge vp
his eyes and handes vnto heauen, and saye with the

Psal. lxxlii.

Prophet, Saluum me fac Deus, quoniam in-
trauerunt aquæ vsque ad animam meam.

Haue me oh my God, for waters
haue entred euen vnto
my soule.

¶ Here endeth the seconde parte.

The thyrde parte, entreateth of the composition and vse of Instrumentes: and Rules for the Arte of Nauigation.

The first Chapter of the number, Order, and names of the wyndes.



So greatly esteemed was

Eolus, kyng of the Eolas Ilandes, or Ilandes of Vulcane, for hauing reason and knowledge of the wyndes, that they of auncient tyme called hym the God and Lord of them. With no lesse

why Eolus
was sayned
God of wyndes.

consyderation, the prudent Mariner ought not to be ignoraunt of them, for as muche as the vniuersall benefite and commoditie of Nauigation consisteth therein. And to haue the better knowledge therof, you shall vnderstande that wynde is frute of the ayre, & vapour of the earth. The whiche by reason of his subtiltie, perceth the Ayre, striketh it, and enforceth it. Other saye, that wynde, is Ayre moued or tossed by the vehement influence of vapours of contrary qualitie. It is in Latin called Ventus, because it is vehement and violent. Whose force is so great that it ouerthroweth not onely heapes of stones or rockes, and casteth downe trees: but also disturbeth the Ayre and the earth, and moueth the Seas. There are foure principall wyndes whiche come from the foure cardinall or principal poyntes of the Horizon. We haue sayd that the Meridian circle cutteth the Horizon in two pointes: (that is) in the North & in the South. And the Equinoctiall cutteth it in other two: that is, in the East and the West. And from these foure pointes come these foure wyndes, wherof also the holy scripture maketh mention. These foure wyndes, thei in auncient tyme named in this maner. That that cometh from the East, they called subolanus, whiche we call the Levant or East wynde. That cometh from the South, thei named Auster: whiche we call the Meridian or South wynde. That cometh from the West, they called Fauonius, whiche we call the ponent or West.

what is
wynde.

The foure
principal or
Cardinall of
wyndes.

Like. 1011.

East.

South.

West.

That

North.

**Collaterall
wyndes.**

**Twelve
wyndes.**

**viii. whole
wyndes.**

**Deuision of
the Horizon
by the foure
pryncypall
wyndes.**

**viii. halfe
wyndes.**

That from the North they named septentrio, or Aquilo, or Boreas, which we call North. To euery of these foure wyndes, they adioyned two collaterall wyndes in manner as foloweth. That that is from the East towarde the parte of the North where the Tropicke of Cancer aryseth or cometh forth, they called Vulturius. And that is from thence towarde the part of the South where ryseth the Tropicke of Capricorne, they called Eurus. Also that is from the west towarde the parte of the South, where the Tropicke of Capricorne goeth downe, they call Africus. And that that declineth to the North where the Tropicke of Cancer goeth downe, they call Caurus. The collaterall of the North and of the South, answer to the circumferences of the Polar circles. That that is from the North toward the Leuant or East, they call Aquilo. And that declineth toward the West part, they call Circius. That is from the South towarde the East, Euro Auster. And toward the West Euro Africus. Thus many hath Aristotle in his Metheora. With these xii. wyndes they sayled in olde tyme, and made theyr compasse by them.

The Hydrographers of late dayes, and suche as are traunpled and exercysed in saylyng, agree with the ancientes in the foure pryncypall wyndes: Although they haue chaunged the names, calling the Leuant or Orient, East. The Ponent or Occident, West. The Septentrionall, North: and the Meridionall, South. Betwene these foure wyndes, they deuide euery quarter of the Horizon into two halfes, made of the two nearest in this maner. Betwene the North and the East, taking name of them both, they name the Northeast. Betwene the East and the South, they name the Southeast: And betwene the South and the West, Southwest: betwene West and North, Northwest. These eyght wyndes in nauigation they call whole wyndes.

Betwene these eyght wyndes, they place other. viii. that are called halfe wyndes: whiche also are named of the two that are neareste vnto them. That that is betwene the North & Northeast, they call Northnortheast.

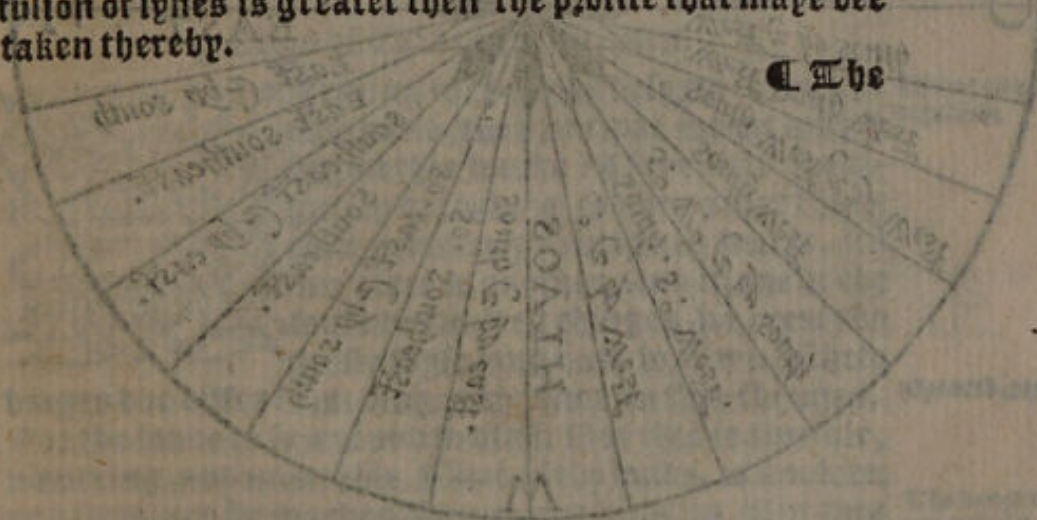
Betwene

Betweene Northeast and East, is Northeast: & so south of the other. Besyde these halfe wyndes, they haue other whiche they call quarter wyndes. These take the name of the wyndes to the whiche they declyne: As if to the quarter from the North towarde the Northeast, they call it North and a quarter towarde the Northeast: that is North and by East. And that that is towarde the North west, they call North and a quarter toward North west. And so of the other as shalbe veryfied in the fygure solo, wyng. Whereof is gathered, that deuidyng the eyghte pyncipall wyndes into halie wyndes, they are. 16. And euery halfe wynde diuided into two quarters, are in all 32. wyndes. Some haue bene so curious, or rather so baynely carefull and to precise, that they haue diuided them into. 64. And in the cardes that they haue, the confusion of lynes is greater then the profite that maye bee taken thereby.

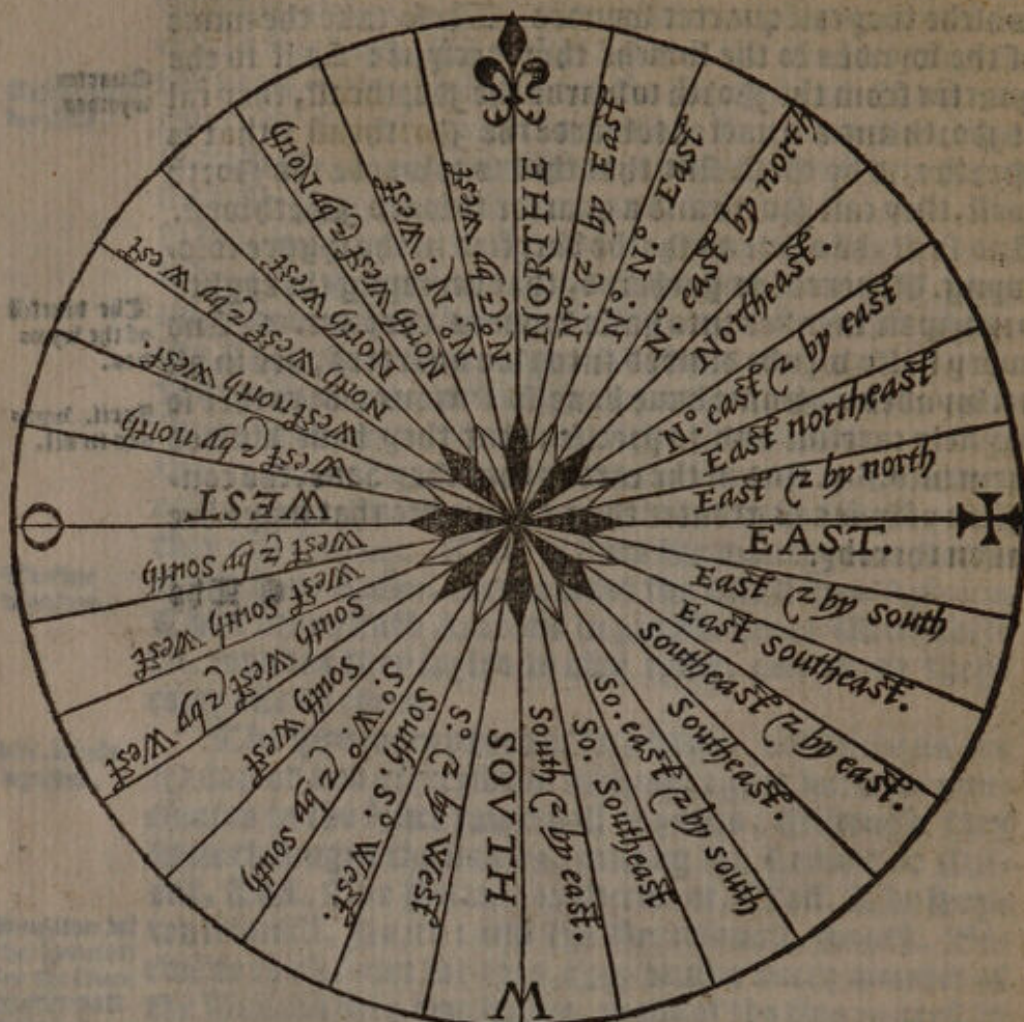
Quarter
wynbeg.

The division
of the loynes
des.

Excise. Wines
Dues in all.



The demonstration of the wyndes



These names do thet vse that saile by the Ocean sea. And it semeth that they had their beginning of the Almaine or Flemyshe tongue. For these nations chieflie, saile in the Ocean. They that saile in the sea Mediterraneum, or Leuant Sea, call them by other names, taking originall of the Tuscan or Italian tongue. Or els that they haue denomination of the partes from whence they come in respect of the Sea Mediterraneum. As the wynde called Graco, because it cometh from Grecia, And Libeico because

The names
of the wynde
des in the
Tuscan tongue.

because it cometh from Libia: And Syroccho because it cometh from Syria. And beginning at the North, these are their names, Tramontana, Græco, Levante, Ponente, Maestro. And that that is betwene Tramontana and Græco, they call Græco Tramontana. And that is betwene Græco & Levante they call Græco Levante. And that is betwene Levante & Syroccho, they call Levante Syroccho. And that is betwene Syroccho and Mezzo Iorno, they call Mezzo Iorno Syroccho. And so of the other: and the like of the quarters. And because they that sayle in the Ocean, are governed by altitudes, we wyll vse the names that they vse, where we intende to entreate of Altitudes. And every man shall vse them as he lysteth, for as muche as the difference is not in the wyndes, but only in their names.

The seconde Chapter of the composition of Cardes for the Sea.



Arriving to the ende desired (which is navigation, the principal intent why I began this worke) I saye that Navigation or saylyng, is none other thing then to journey or viage by water, from one place to another. And is one of the foure difficultest thinges whereof the moste wyse king hath wyrtten. These

What is navigation.

viages doe differ from viages by lande, in thre thynges. For the lande is firme and stedfast. But this is flurible, wauering, and moueable. That of the lande, is knowne and termined by markes, signes, and limittes. But this of the Sea, is vncerten and unknowen. And if in viages by lande, there are hylls, mountaynes, rockes and craggye places, the Sea payeth the same seven fold with tozmentes and tempestes. Therefore these viages beyng so difficulte, it shalbe hard to make the same be vnderstode by wordes or wyrtynge. The best explication or inuention that the wyttes of men haue founde for the manifestyng of this, is to geue the same paynted in a Carde. For the draughte or makynge whereof, it shall bee requisite to knowe twoo thynges. Whereof the one is,

Wounerb. xpx

The dangers and difficultie of navigation.

Making of Cardes for the Sea.

the

The wyndes
or lynes are
called Rum-
bos in the
Spanyshe
tongue.

The mother
compasse of
the Carde.

xxii. lynes
whiche sig-
nifie so ma-
ny wyndes:

the right position of places, or placing of countreys and coastes. The other is the distances that is from one place to an other. And so the Carde shal haue two descriptions. The one that aunswereth to the position, shalbe of the wyndes whiche the Mariners call lynes or poyntes of the compasse. And the other that aunswereth to the distances, shalbe the drawyng and pointing of the coastes of the lande and of the Ilandes compassed with the sea. To paynte the wyndes or lynes, you must take skynnes of parchement or large paper, of such bignes as you will the carde to be. And in it drawe two ryght lynes with blacke inke, whiche in the myddest shal cut or deuide the selues in ryght angles: The one accordyng to the length of the Carde, whiche shalbe East and West: And the other North and South. Upon the poynt where they cut, make a center: and vpon it, gyue a priue or hydde circle whiche may occupie in maner the hole Carde. This circle, some make with leade that it may be easely put out. These two lynes, deuide the circle into foure equal partes. And euery part of these, shal you deuide in the myddest with a pricke or puncte. Then from one punct to an other, drawe a ryght Diametrall lyne with blacke inke: and so shal the circle remayne deuided with foure lines into eight equall partes whiche corresponde to the eight wyndes. In lyke maner shal you deuide euery of these eight into two equall partes. And euery part of these is called a halfe wynde. Then drawe from euery punct to his opposite diametrally a ryght lyne of greene or azure. Like wyse shal you deuide euery halfe wynde in the circle, into two equal partes. And from these punctes whiche deuide the quarters, you shal drawe certayne ryght lynes with reed inke, whiche also shal passe by the center, whiche they call the mother compasse or chiefe compasse of the Carde, being in the myddest thereof. And so shal come furth from the center to the circumference. 32. lines whiche signifie the. 32. wyndes. Besyde these sayd lines, you shal make other equal distant to the, & of the self same colours, in this maner. Fro y pointes of y wyndes & half wyndes y passe by y center, drawe certē ryght lines y passe not

not by the center, but be equallye deuided to those that passe by the center, and of the same colours and equidistance as are they that passe by the center. And as these lines concurre together aswell in the center as in the poyntes of the windes and halfe windes that are in the circumference of the circle, they shall leaue or make there other. 16. compasses, euery one with his. 32. wyndes. And yf y^e carde be very great, because the lynes may not go farre in sunder, yf you wyl make there other. 16. compasses, you muste make them betwene the one and the other of the sy^{de}. 16. poyntes, where the quarters are made with they^r wyndes as we haue sayde. It is the custome for the most parte, to paynt vpon the center of these cōpasses a floure or a rose, with dyuers colours and golde, differencyng the lines, and markyng them with letters and other markes: especiall^y signyng the North with a floure deluce, and the East with a crosse. This, besyde the distinction of the wyndes, serueth also for the garnysshing of the carde. And this for the moste parte is done after that the coaste is drawen. And thus much suffiseth for the draught of the wyndes.

The situation of the places, portes and Ilandes in the Carde, acco^rdyng to they^r proper differences, consisteth in the particuler and true relation of such as haue trauayled them. And therfore for this purpose it shalbe nedefull to haue paterne^s of coastes, portes, & Ilandes, whiche muste be paynted in the Carde: And these of the best and most approued to be true. And not only to haue paterne^s well paynted, but also it shalbe necessarye to knowe the true altitudes of the Pole, of certen principall capes, portes, and famous Cities. This done, they must be translated into certen thynne papers and transparent, that may be seene through: and those of the best and finest that may be had, annoyntyng them with oyle of Line seede, & then drying them at the Sunne. Then take the paterne or Carde that is to be translated: And reach or stretch it forth vpon a table. Then put the transparent paper vpon the one side of the paterne where you wyl begyn. And the paper being made fast vpon the

The places
yng of many
compasses
in the
carde.

The floure
or rose of
the center.

The North.

The situatⁱ
on of the
places, &c.

Translati^o
of the Carde
from one to
another.

paterne with plomettes of leade, or a lyttle ware that may easely be taken of, you shall in the transparent paper marke with a fine penne one East and West, and one North and South, or two, vpon those that are seene by the selfe same paper in the Waterne. And this is called traceyng or translatyng. In lyke maner shall you trace all the coastes, Hauens, Portes, Ilandes, Cities, Capes, and Ryuers, as appeareth in the Waterne, vnto the Rockes that come forth of the water, and the known banks. And because this paper doth not suffice, you shall put thereto another, and moze as neede shall requyre. And begyn the translatiō in one where the other endeth, vntyll you haue translated all that you desyre: Not forgettyng to make in euery one, lines of North & South, East and West, to serue for markes after ward. So that the line of North and South of the one paper may ioyne close and euen with the line of the North and South of the other paper that is ioyned to it by longitude.

And the paterne thus translated into these papers, you muste putte the ruled or lyned paper or papers vpon a playne, smooth, and stedfast table, where you shall stretch them forth, and make them fast with plomets or waightes, or nayle them to the table by the sydes and corners with small nayles. Then vpon the sayde ruled paper, you shall put the paper that is translated from the paterne, in that syde or parte that is correspondent from the paterne to the ruled Carde, so that the lines of East and West, North and South of the translation, may be vpon the lines that aunswere to them in the ruled carde.

This paper thus made faste by the one syde or parte, you shall by the other syde (that it maye remayne in his place) put vnder it another fine paper, smoked or smyrred on the nethermost parte (whiche is that that falleth vpon the ruled Carde) eyther with a lynke or with matches of pitche. These thus ordered and made faste one vpon another, you shall take a stiele bodkyn, or wyze with

Some do
this only
with oyle.

With a smoothe and blunt poynt. that it rase not oꝛ boze
not the paper: and with it shall you drawe, pressing bp:
pon all the translation, and traceyng it with diligence
and discretion, marking euer how much in it is transla-
led from the paterne: sauving the wyndes oꝛ lines which
the Maryners call Rumbos, and so shall remayne all the
impreſſion of the ſmoke in the ruled Carde. Upon the
which with a fine penne you ſhal trace with ynke: which
beynge drye, you ſhall with crumbes of breade make it
cleane from all the ſmoke, and ſo ſhall the coaſt appeare
in the Carde drawen with ynke.

The traſing
of the Carde

This done, then with a ſmall penne ſhall you de-
ſcrybe in the Carde all the places and names of the coaſt
in that part where they are, and as they are ſeene in the
paterne. And fyrſt you muſt deſcrybe in red, the portes,
principall capes, famous Cities, with other notable
thynges: and all the reſidue in blacke. Then ſhall you
drawe oꝛ paynt Cities, ſhyppes, banners, and beaſtes,
and alſo marke the regions and other notable thynges.
Then with colours and golde ſhall you garniſhe and
beautifie the Cities, Compaſſes, ſhyppes, and other
partes of the Carde. Then ſhall you ſet forth the coaſtes
with greene, by the ſhoꝛe oꝛ bankes of the landes, and
make them ſayre to ſyght with a lyttle ſaffron, oꝛ other
wyſe as ſhall ſeme beſte. Lykelwyſe ſhall you deſcribe
certain letters with theyꝝ ſignifications in this ma-
ner.

The payn-
tyng of the
Carde.

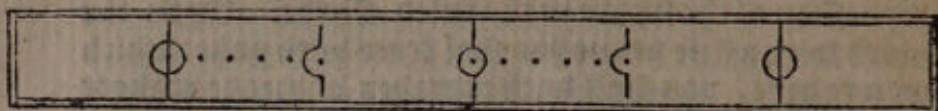
B. for a Bay. C. for a Cape. A. for an Angle. I. oꝛ P.
for an Ilande. M. for a Mountayne. P. for a Port. R.
for a Ryuer.

Then in place where is more roome, oꝛ that is leaſt
occupied, you ſhall drawe two ryght lynes equallye dy-
ſtant: and the one no further from the other then halfe
a ſynger oꝛ lyttle more, and ſo longe, that betwene
theym maye bee marked at the leaſte three hundreth
leagues. And this the Maryners call the truncke oꝛ
ſcale of leagues, & place it oꝛ uſe it in this maner. They
take with the compaſſe a hundreth leagues of the truncke

The ma-
king of the
truncke oꝛ
ſcale of the
leagues.

The 3. part.

of the Carde or paterne that is translated. And they set them iuste betwene the two lines, and this space they part by the halfe, and reste in. 50. And these deuided by the halfe, they reste in. 25. And the, 25. beyng deuided, they reste in. 12. leagues and a halfe. And marke them as appeareth in the demonstration folowynge.



The gradu-
ation of the
Carde.

The Carde beyng thus made, then to graduate it or de-
uide it into degrees, you must drawe three lines, which
make ryght angles with the line of East & West, equi-
distaunte to the line of North and South: and they also
shalbe North and South. These shalbe drawn by the
Ilandes of Afores or Soria, or nearer to Spaine, or wher
the Carde shalbe lesse occupied. And for this purpose,
the one line must be so farre distant from the other, that
in the two spaces which they make, may be marked, in
the one the degrees, and in the other the number of the,
conformable to the graduation of the paterne: as the
numbers of degrees shewe East and West, with the
portes, capes, and coastes in theyr proper altitudes.

And yf the carde haue no graduation, you shall take
in the compasse of the trunke of the leagues, seven spa-
ces of. 12. leagues and a halfe, whiche are. 87. leagues &
a halfe. And these muste be deuided into fve partes,
which come forth at. 17. leagues and a halfe for a part.
And the foure partes taken in the compasse, make foure
degrees: and deuided into foure partes, euery part is a
degree, and is marked thus. $\odot$

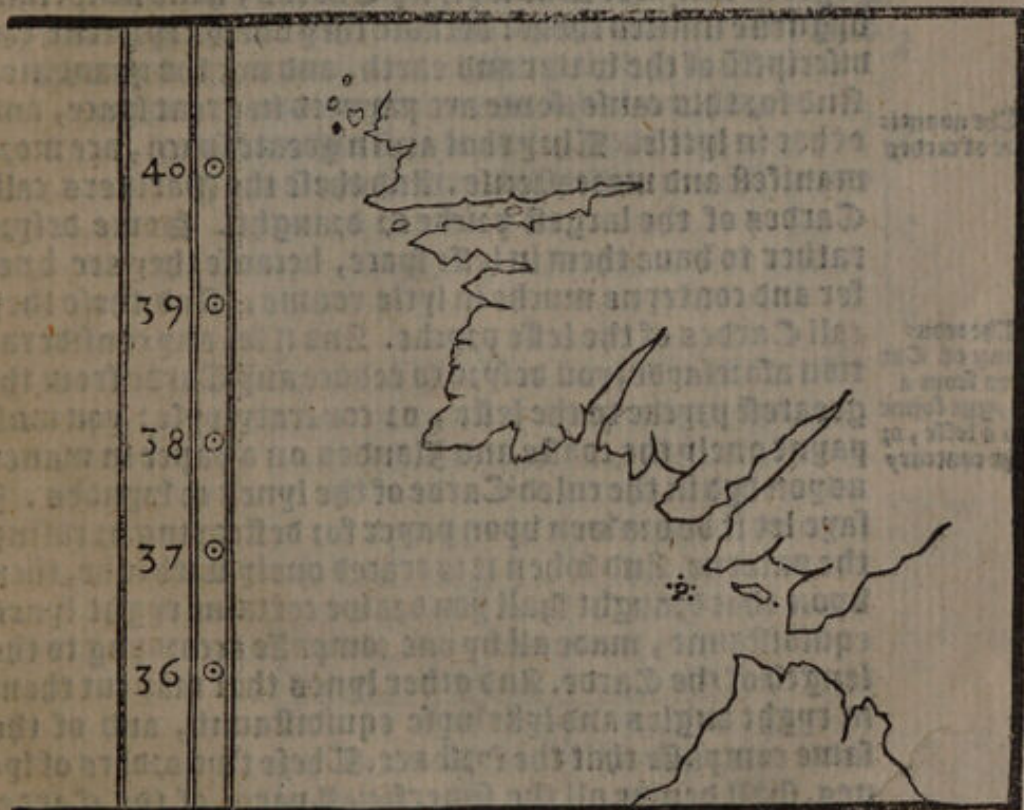
The marke
of a degree.

And yf you wyl make the degrees at. 16. leagues & two
terces or more: you shall geue to euery degree so much
space as the leagues comprehend. This graduation
must be begun from some one cape, whose altitude of the
Pole is wel knowen. And the whole Carde beyng thus
graduate, you must begynne the number of the degrees
from the Equinoctiall line, one, two, thre. &c. toward
the one Pole, and the lyke toward the other: so that
to

to the known Cape maye aunswere the number of his altitude. And so shall you do to the whole Carde. Also the Equinoctiall line shalbe marked in his proper place. And in lyke maner shal you marke the Tropykes accordyng as they are in the Sphere. But forasmuche as in Spayne, Cape Saint Vincent is the pyncipal: they begynne there to make graduation, and number it in. 37. degrees. And from thence towarde the Pole Artyke, the degrees do increase. And from thence towarde the Equinoctiall line they demynyshe: and from that line to the pole Antartyke they increase agayne (as we haue sayde) as is conteyned in the Carde, and as appeareth in this demonstration folowynge.

Cape saint
Vincent.

Increasing
and diminis-
shynge of
the lines.



And yf the paterne haue neyther leagues nor degrees, you must take or knowe the altitudes of two capes that are North and South, and the difference of the degrees

If the paterne haue
neyther
leagues nor
degrees,

¶ iii

that.

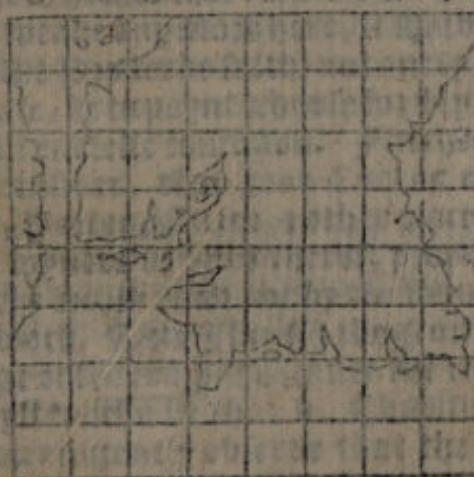
that is from the one cape to the other, by the which degrees they diuide the space of fyrtene leagues and a halfe for a degree. And accordyng to the opinion of the leagues of the roundnesse of the earth, as we haue sayde as touchyng this in the eightenth Chapter of the fyrst parte. In Spayne they vse with the compasse to take the space that is from Cape saynt Vincent, to the myddest of the greatest Ilande of Berlinga, which they accounte thre degrees: So that after fyrtene leagues and a halfe for a degree, they are. 52. leagues and a halfe. And so muche do they put in this space. Other put. 50. leagues accountyng after fyrtene leagues and two terces for a degree. And in this maner they make of leagues degrees, and of degrees leagues. The saylyng Cardes, haue no certain bygnesse limited them: because they onely represent the discriptio of the water and earth, and not the quantitie. And for this cause, some are paynted in great space, and other in lyttle. They that are in greate space, are moze manifest and moze pzeise. And these the Mariners call Cardes of the largest pricke or draught. Some desyre rather to haue them in lesse space, because they are byleser and conteyne muche in lytle rounge. And these they call Cardes of the lesse pricke. And if for any consideration aforesayde, you desyre to reduce any Carde from the greatest pricke to the lesse, or contrarywyle: you must paynt onely the coaste and Ilandes on a paper in maner as you byd in the ruled Carde of the lynes or wyndes. I saye let it be drauen vpon paper for destroying or rasing the paterne. And when it is traced onely with inke, then vpon that draught shall you draue certayne ryght lynes equidistaunt, made all by one compasse accordyng to the length of the Carde. And other lynes that may cut them in ryght angles and lykewyle equidistaunt, and of the same compasse that the fyrst are. These two orders of lynes, shall deuide all the superficiall parte of the Carde into perfect squares or quadzatures. And it is to be noted that the nearer the lynes are ioyned together, and the squares the lesse, so muche the moze perfectly may it be reduced, and moze easely. When shall you take an other paper

The quantitie of cardes

The reducing of Cardes from a bygge forme to a lesse, or the contrary

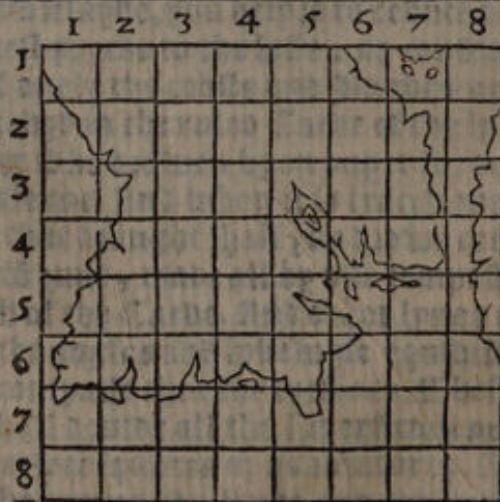
paper greater or lesse then the Carde, according to the
 poynt that you desyre to reduce it vnto. And in the length
 and breadth thereof, you shall deuyde so many spaces as
 are betwene the lynes of the other paper. And if it be
 greater, the squares shalbe greater: and if lesse, lesse.
 To kepe order in y^e correspondence of the squares (which
 shalbe a great lyght to translate the one from the other)
 you shall number the orders of the squares) as those of
 the longitude, by the fronte or bypermost part: and those
 of the latitude, by the syde, as well in the one paper as in
 the other, conformable. Also those of the fronte, from the
 lefte hande to the ryght. And those of the syde, frō aboue
 downwarde. Then beholde the coast howe it goeth by
 the squares of the fyrrst paper. And likewise the traceing
 or drawyng in the squares of the seconde, in the self same
 order and propoztion as it is there. And so shall it re-

mayne reduced to the poynte whiche you de-
 syre. And this shal serue for a paterne
 to set in the ruled Carde.



It is to be noted that the squares of the
 first Carde

Here foloweth the maner of translatyng the
Carde from one fourme into another
greater or lesse.



Here foloweth a similitude of the Pary-
ners Carde.

The Pilottes and Maryners neyther vse nor haue the knowledge to vse other Cardes then only these that are playne, as I haue sayde. The which, because they are not globous, sphericall, or rounde, are imperfecte, and fayle to shewe the true distaunces. For in howe muche they depart from the Equinoctiall toward which soeuer of the Poles, the Meridian lines are contrate narrower and narrower: In suche maner, that yf two Cities or poyntes in the Equinoctiall, shoulde be distaunt of longitude. 60. leaques, and in the selfe same Meridians at 60. degrees from the Equinoctiall toward epyther of the Poles, shoulde be other two Cities or poyntes, they shoulde be distaunt in longitude but onely. 30. leaques. And for the better declaration and vnderstandyng hereof, I say that yf two shypes should depart from the Equinoctiall, the one distaunt from the other a hundreth leaques by East and Weste, and that epyther of them should sayle directly by his Meridian toward the North: then when epyther of them hath the Pole ouer his Horizon. 60. degrees, the one shalbe distaunt from the other only. 50. leaques by the paralelle of East and West: as appeareth by the plaine Cardes, that they haue the selfe same hundreth leaques. And beside these considerations, one error byngeth in an other: and so an other another. Wherof to speake any more here, it shalbe to certen Pilottes (as the Proverbe saith) not onely to geue musicke to the deafe, or to paynt a house for blynd men, but shall also be an endlesse confusion. Furthermore it is necessarye to consider, that good Cardes ought to haue the Coastes, Portes, Cities, & other places, ituate accordyng to the wyndes or lines therof, proportionally as they are in the world: and not by the wyndes that the compasse sheweth. This I say for the Northeasting or Northwestyng of the compasse (called the variation) as hereafter I wyll touche in the. v. Chapter. And lyke wyse shall you diligently obserue that the graduation of the Carde shewe the same in theyr proper altitudes. The Cardes that lacke this, ought to be corrected

The playne
cardes are
imperfecte

Example of
error in the
plaine Cardes.

The ignorance
of
certen pilots.

Good Cardes.

The variation
of the
compass.

Altitudes.

fed and amended by wyse and experie men: Hauynge that in the Leuiant sea (called Maré Mediterraneum) and in the Chanell of Flaunders (called the narrowe seas) it is not inconuenient for the Nauigation, that the portes be marked in the Cardes by the wyndes, whiche the compasse sheweth: so;asmuche as they sayle not by the altitudes of the Pole: Lyke wyse it shall not be inconuenient, but rather very necessary (to auoyde so manye errors, of the whiche do flowe great daungours and such a confusion) that your Maiestie shoulde commaunde certen learned Cosmographers, and experie in the arte of saylyng, to verifie the altitudes of the Pole, that are of portes, Capes, Ilandes, and people by the coastes of the Sea. And in lyke maner truely to describethe coastes of the lande: Especiallye of the Nauigation of the West Indies or Mundo Nuevo, where it hath pleased God that so many nations and people haue receaued the water of holy baptisme, comynge to the knowledge of the true God: where by the Chrystyan Emppre is greatly amplified, besyde the greates riches had by the sayd Indies. And this hath God miraculously wrought by the conquestes of your Maiestie, in subduynge Infidels and Gentyles to the obedience of the true Catholyke fayth. Where by not only God hath ben well pleased, but also your Maiestie hath receaued perpetuall fame, with eternall renowne and immortall glorie to your posteritie in woordes to come.

The West Indies.

Charles the first.

The. iii. Chaviter of the vertue and propertie of the Lode stone, called in Latin Magnes, and in Spayne the Piedrayman.

In the narrow seas they sayle not by the elevation of the pole.

In the narrow seas they sayle not by the elevation of the pole.

Corrected of the sea card.

The first part of the book.

The first part of the book.

The first part of the book.

The first part of the book.



The Lode stone (as wyrteth Cardinall Cusanus) hath substaunce, vertue, and operation. His vertue is engendred of his substaunce, essence, or beyng.

The vertue, substaunce, & operation of the Lode stone.

And of his essence and vertue proceedeth his operation and effecte: In such sorte, that this stone communicatynge his vertue to iren, by reason thereof, causeth the iren to moue, although betwene the one and the other be a cuppe or plate of syluer, or a table, or any other lyke thyng.

The attractyue or drawyng force of the Lode stone, causeth the nature of Iron to be and reste in it: And that so firmly and quietly, that beyng naturallie heauye and ponderous, it descendeth not, because his nature resteth not in hym selfe, but is vnite with the nature of the stone, which seemeth to extende it selfe, and as it were to caste forth a lively spirite of enchauntynge vertue. Insomuche that (as we see by experience) by the sayde vnion, it not onely distributeth his vertue to one Iron, but that Iron likewise to another, and that other agayne to another: and so forth, vntyll of many rynges or lynkes of Iron be made a chayne.

Vertue attracts.

Cusan applieth this to the glorified bodye of Christ, according to these wordes. If I shalbe exalted, I wyl draw all vnto me.

Saint Augustine (as he wyrteth in his booke De Ciuitate Dei) dyd maruaile that he sawe an Iron moue it selfe vppon a vessell, by mouynge the Lode stone vnder the vessell.

It is called Magnes, because the inuentour or fynder therof was so named: Who (as Plinie wyrteth) keepynge cattayll in Gaste India, had his shoes soled with plates of Iron, and Iron nayles, such as they vse in Gasconie, and had in his hand a staffe with a pyke or hooke of Iron. And resting hym selfe vppon a quantitie of this stone, coulde not remoue his fete, neither lyfte by his staffe. Then staying a while astonysht, as ignorant of the cause, at the length began to perceauie the proper tie of the stone, & to vnderstande the attractiue vertue thereof. The coloure of it differeth not from Iron.

Why the Lode stone was called Magnes, & the fynding therof.

And

Sandye
hynden of
the lodestone

The lode sto
ne of Spain

The lode sto
ne of Elua.

The lode sto
ne of Den
marke.

The lode sto
ne of Ethio
pe.

Diuers opi
nions of the
lode stone.

The qual
ties and pro
perties of the
lode stone.

The partes
of the lode
stone.

What part of
the stone an
swereth to
the North &
South.

And was therefore called quicke Iron or luyng Iron. The beste kynde of these stoonnes, is of Azurine or blew colour, as the Sea sometymes appeareth.

Of these are founde fyue kyndes or differences. The first is of Ethiopie. The seconde of Macedonie. The thyrde of Lechio in Boecia. The fourth of Troade neare to Alexandria: And the fifth of Asia. But at this day, it is found in diuers other places. It is founde also in many places in Spayne: As in the hyll Morena neare vnto the village of Calera, beyng of the order of saint James in the prouince of Leon. Lykelwyse in a hyll of Moron in the territorie of the Erle of Vrenia is great quantitie therof, & in diuers other places. The stone that we moste commonly vse, is of the Iland of Elua of the Loyde of Pomblin: whiche I iudge to be better then that of Denmarke. This and the other, haue vertue to drawe iron vnto them. And trewe it is that Teanxedes wyrteth: That in Ethiopie is founde an other kynde of this stone, that putteth iron from it. Auerroes the commentator of Aristotle, denieth that Magnes draweth iron vnto it. But sayth that iron by his naturall inclination, doth moue to the stone as to his naturall place, by a certayne qualitie which the stone impresseth in iron. And besyde this vertue and propertie that it hath to drawe iron vnto it, it hath also an other. And that is, that it geueth vnto iron vertue and powre to shewe the two pointes of the Horizon where it cutteth y Meridian, that is in the two wyndes of North and Southe. These vertues are found more intent in only two partes of the stone. And these are euer opposite or contrarie the one to the other. And so are they contrarie in operation. For iron touched with the one parte, and placed where it maye moue frely, wyl shewe the North. And an other iron touched with the other parte, wil shewe the South. Fyndyng this experience, may be knowen what part of the stone aunswereth to the North: which the Mariners call the face of the stone: And lykelwyse of the Southe. This stoonne is so necessarye, that without it, Navigation shoulde bee imperfecte and vncertayne.

Because

because it geueth lyfe to the needle and compasse which leadeth and guydeth the Pilotte that he may go certainly in the day, and not erre or wander in the nyght. Also it sheweth and directeth to compasse the worlde, and to know the wyndes. And therfore, soasmuch as the compasse is so necessary, we entende to shewe the order and maner howe it ought to be made. For it may chaunce to fayle or be lost in the biage.

The use of
making of
the Marys
new compasse.

The.iiii. Chapter, of the making of the Maryners compasse for nauigation.

Take such past of paper wherof Cardes are made. And make in it a circle, of the quantitie of a spanne, or lyttle more or lesse. In the which you shall paynt the. 32. wyndes with theyr coloures, in suche order as we gaue in the fyrst and seconde Chapiture of the wyndes, and of the Cardes: Not forgettyng to mark the North with a floure deluce, and the East with a crosse. And more then this may euery man garnyshe and beautifie the same as seemeth best to his phantasie. Then on the lower or nether part of this paste, you must draw a line which shalbe directly vnder that of the North and South: whiche shalbe the marke for the settinge of the Irens and Stieles. Then shall you take wyze of iren or stiele of the byggenesse of a great pinne, or accordyng to the byggenesse of the roundenes of the paste, floure, rose or flye, as it may be called. This wyze muste be bowde double, so that euery of the partes maye be equallye as longe as the Diameter of the flye, and a quarter parte more. The endes or poyntes of these irens or stieles, muste be pinched together & made close, and open in the myddest the one from the other, vntyll the endes come to be equall with the extremities of the Diameter of the flye. And so shal the stieles remayne in maner in fourme of an egge. These wyzes or irens must be made fast in the

The floure
deluce and
the crosse.

The flye,
floure or
rose of the
compasse.

The line of
North and
South.

The touchyng of the
needle with
the lode stone

The breasyng of the
stone to
drawe out
his vertue.

the nether parte of the flye : so that their extremitiees, endes, or poyntes, come precisely by the line of North and South. And to fixe or fasten them so, they muste be couered with a thynne paper glued, leauynge the poyntes and endes vncouered. And these endes muste be touched with the lode stone in this maner. The parte that is vnder the floure deluce, muste be rubbed on that parte of the stone that aunswereth to the North, as is sayde in the Chapter before. And this shall suffice for the perfection of the compasse. Yet some there be that for superabundaunce do touche the other part of the iron with that part of the stone that aunswereth to the south, although it maye suffice to touche it onelye with the other parte. This touchyng of the iron with the stone, that the demonstratiue or woozkyng vertue maye shewe it selfe forth, must be done with geuyng certain strokes with a hammer on that part of the stone wherewith the iron muste be touched: That is to saye, in the North parte or the South. And from these wyll come forth of the stone certen beardes lyke small pycles, wheron you shall rubbe the poynte of the iron as you wolde whette a knyfe: And so shall certen of those beardes of the stone cleaue and sticke faste to the iron. And the irons thus touched with the beardes cleauyng to them, you must take a pycke or poynt of laton, of pyramidall sharpe, or steeple fourme, whiche is brode belowe and sharpe aboue towarde the poynt. This is made rounde or eight square, as seemeth beste. And in the nether parte or breadth, it must be bozed (but not thorough) with a bozer which must also be of pyramidall fourme, and enter into the myddeste of the sayde pyramidall pycke or poynte of laton, vnto the myddest, or somewhat more. This Pyramidall poynt (which the Maryners call the Capytell) must be of heyght halfe a finger breadth, or accordyng as the compasse shalbe, and muste be put through the center of the flye, so that the poynte come forth on the hygher parte thereof, and muste there be made faste and well

well sirte. When shall you take a rounde bore of wood, within the whiche the needle maye be, not touchynge the sydes of the same: And this must be of the heyght of the halfe Diameter of the compasse. And the grounde or bottome therof muste be sette to it, as the couerynge of a bore, that it maye be easely taken of and put on, to haue often recourse to touche the Irons with the stone (whiche they call seedyng) when neede shalbe, that the vertue of the compasse fayle not. Also in the myddest of the grounde or floore of the bore, you must set a sharpe poynt or prycke made of a wyze of laton: This muste stande ryght vp. And vpon the prycke or poynte thereof, you shall sette the bozed hole of the Capitell. And that the wynd enter not aboue, you shall couer the bore with a glasse. And thus beyng touched with the stone and set vpon the poynte, it shall shewe the true parte of the North, and consequentelye all the other wyndes.

The bore of
the compasse

Feasyng the
needle with
the stone.

And here is to be noted, that after the Irons or needle of the compasse hath ben touched in anye of these maners, yf you bryng the North parte of the stone to the North of the needle or compasse: then wyll the North of the needle come to it. And yf you bryng the North parte of the stone to the South parte of the needle, it wyll flee from it.

A notable ex-
perience of
the Lode
stone.

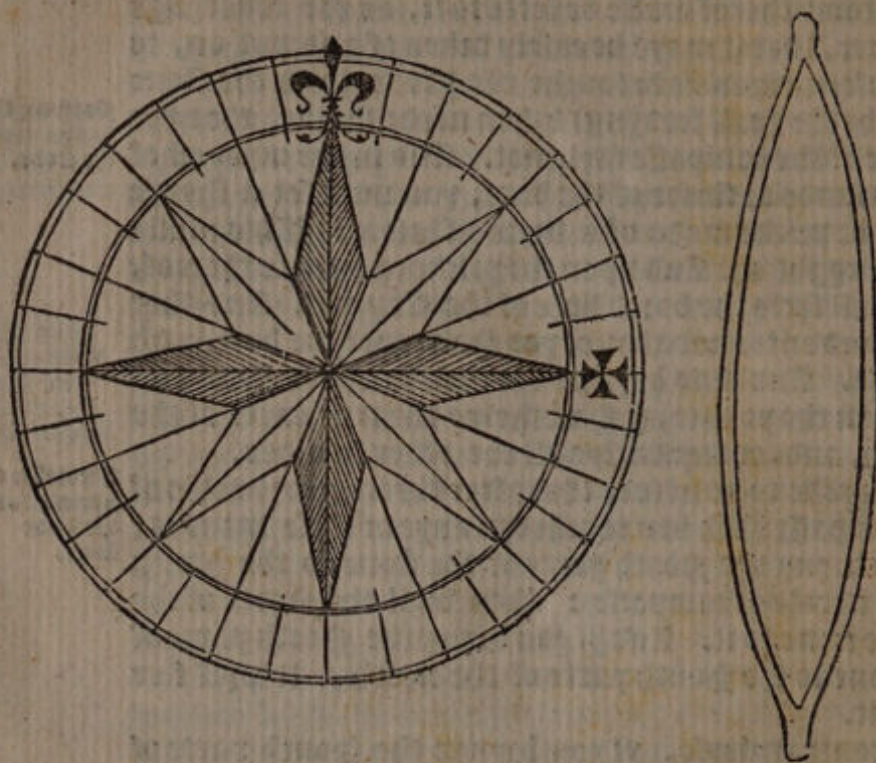
And contrarywyse, yf you bryng the South parte of the stone to the South of the needle, it wyll come to it: and yf to the North, it wyll flee from it. This is vnderstode, the needle or compasse standynge as it shoulde be. And this also is a good signe to knowe whiche is the North parte and South parte of the stone.

Moreover, this bore muste be putte within another bore, in the whiche it muste hange vpon two circles of laton, annered the one within the other: whiche serue that the compasse wape not or hange not towarde the one syde or the other, althoughe the shyppe swaye. And this bore also muste haue his couer of woodde, to kepe the other. You shall lykewyse obserue that the poynte of the Capitell and the hole thereof, and also the point or prycke vpon the which it resteth, be vpryght,

and

The. 3. part.

and lykewyse the Rose, that it decline not to one parte
or other. And yf it be quicker then it ought to be, then
make the poynt that it goeth vpon somewhat blunter.



The. v. Chapter, of the effecte

or proprietie that the compasse hath to
Northeastynge, or Northwesting
wherby is knowen the
variation of the
compasse.

The variati
on of the
compasse



Any and diuers are the opinions that
I haue harde, and also read in certein
wyrters of later dayes, as touchynge
the Northeastynge, and Northwesting
of the compasse. And yet mee see-
meth that none doeth touche the
pycke, and seue the whyte. They
call it Northeastynge, when the
needle

needle sheweth or poynteth from the North (whiche is his true marke) toward the Northeast. And Northwesting, when from the North it declineth toward North west. For the better vnderstandyng of these differences whereby the needles differ or varie from the Pole, you must (being in the Meridian where the compasses shew the pole) imagen a poynt vnder the pole of the worlde.

And this poynt to be without all the heauens conteyned vnder the fyrst mouable. The whiche poynt or parte of heauen, hath a vertue attractiue that draweth vnto it iren touched with the parte of the lode stone correspondent to that, certayne parte of heauen imagined without or vnder all the heauens moued by the fyrst mouable. For if it were imagined to be moued within any of the moued heauens, then the attractiue poynte by the mouyng of the fyrst mouable, and consequently the compass, should make the selfe same mouing in. 24. houres, whiche is neuer seene. And therefore, this poynt is not in the moueable heauens, neyther in the pole. For if it were in it, the compass should not varie Northeasting or North westing. Therefore the cause of Northeasting and North westing, or departing from the pole of the worlde, is, that being in the sayde Meridian, the attractiue poynt & the pole, are in the selfe same or in one Meridian: And the compass shewyng the attractiue poynt, sheweth directly the pole. And departing from the same Meridian toward the East (the worlde being rounde) the pole of the worlde remaineth to vs on the left hande: And the point of the attractiue vertue, shalbe on the ryght hand, which is towarde the Northeast wynde. And in holwe muche more we shall sayle toward the East, the distaunce shall appeare greater vnto vs vntill we come vnto the. 90. degrees: And there shalbe the most and greatest Northeasting. And passing from thence further forwarde, it shall appeare vnto vs that the attractiue poynt cometh nearer and nearer vnto the Meridian lyne: And so muche shal the compass go betteryng or amendyng the North easting, vntyll it returne to the selfe same Meridian in the opposite or contrarie parte from whence they came

The poynte attractiue is imagined vnder the pole of the worlde

The cause of the variatio of the compass

Departinge of the pole fro the point attractiue.

The greatest northeasting

The greatest
Northwest
Ring.

The attrac-
tive point is
under the
pole.

The North-
east and
Northwest
Ring is not
uniforme.

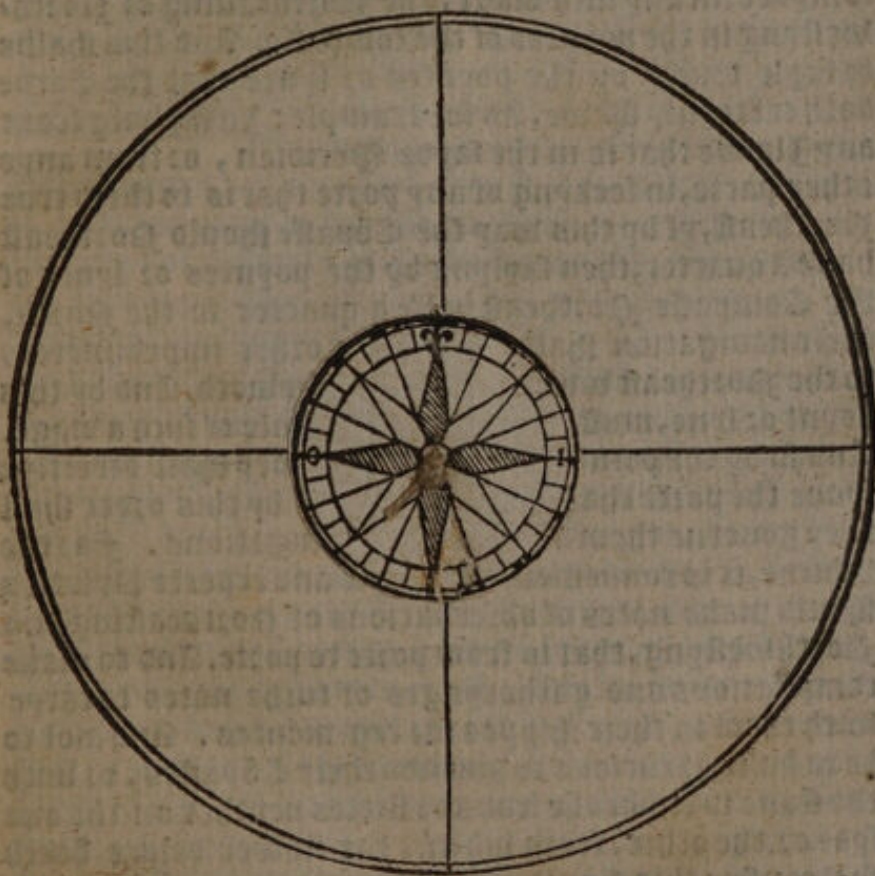
The declina-
tion of the
Sunne.

or where they began. And then shall the attractive point be to them directly upon or against the pole of the world: And the compass shall shewe or poynthe directly toward it. And agayne passynge further forwarde, the pole of the world shall remayne to the ryght hande: and the poynthe attractive to the lefte hande. And so shal the compass begynne Northwestyng, increasynge it vntyll it come from thence to the. 90. degrees: and there shalbe the moste of his Northwestyng. For tournyng toward the Meridian from the attractive poynthe, it shall goe ameyng or betteryng vntyll it retourne to the selfe same Meridian from whence it departed. And there shall the compass shewe the pole of the world directly by or ouer against the attractive poynthe, whiche is perpendicularly under the pole. And if from thence they should tourne to passe toward the West, the pole should rest to the right hande, and the attractive poynthe to the lefte: And so shall the variatio be to the Northeast. And this is the cause of the Northeastyng and Northwestyng, or variatio of the compass. Also it is not to be understood that this north-eastyng and Northwestyng is uniforme as is the departing (or according to the departure) from the Meridian where the compass sheweth perfectly: but rather before at the begynnyng of the departing from the sayde Meridian, it maketh difference or variation in a certayn quantitie. And the increase that is afterwarde, is little: And so muche the lesse, in howe muche the more the departing is from the sayd Meridian. For it is a passion of circles deuidyng or cutting them selues in the sphere. So that these differences are, as are they of the declinations of the Sunne: Whiche neare vnto the Equinoctials, are great, & neare to the Solstitials, are little. All the which shall evidently appeare in the figure folowynge: which is a circle deuided by two Diameters into foure equal partes, cutting them selues in the center in ryght angles. And from the center poynthe (called the pole) cometh forth a moueable Meridian. And in it goeth a compass lyke wyse moueable about the circle. The attractive poynthe is somewhat distant from the pole of the world. And fro it, cometh

it, cometh forth a threde whiche must euer passe by the North and South of the compasse. And the compasse being in the Meridian of the point attractive that passeth by the pole, shall shewe the pole. And without that, shall go Northeastynge or Northwestynge, so varyng and departing from the true Meridian that cometh forth of the pole of the worlde. It is the opinion of some mariners, that the Meridian where the compasse sheweth directly the pole, passeth by the Iland of Sancta Maria. And other saye, by the Ilande of Cueruo in the Afores.

The meridian that sheweth the pole.

Demonstration of Northeastynge.



And where as the inconuenience is manifest & notorious, the same must be remedied with prudence & tyme: And not to be neglygent in the viage. But euer to vse and obserue experience, more profytable then the subtile

Experience the grounds of reason.

Advertises
mente to
Pilottes.

Exemple of
saylyng.

The varia-
tion of the
compasse.

and curious questions of the secrete searchers of natural thynges without experience, whereof reason taketh his principall grounde. And therfore the wyse Pilotte ought to knowe by experience (as many of them doe not) howe muche a good cōpasse doth varie Northeastynge or Northwestynge from one port to an other. So that to knowe howe muche the compasse doth varie, Northeastynge or Northwestynge from one place to an other (as to saye, halfe a quarter or more or lesse in quantitie as they are distaunt from the sayde Meridian where the compasses shewe the pole) shall in the nauigatiō take heede and wel consyder, in any such viage, the Northeastynge or Northwestynge in the poyntes of the compasse. And this shalbe to saye truely by the poyntes or lynes that the Carde doth certaynly shewe. As for example: In saylyng from any Ilande that is in the sayde Meridian, or from anye other parte, in seekyng of any porte that is to them true Northeast, yf by this way the Cōpasse should Northeast halfe a quarter, then saylyng by the poyntes or lynes of the Compasse Northeast halfe a quarter to the North, their nauigation shalbe (excepting other impedimētes) to the Northeast whiche the Carde sheweth. And by this poynt or lyne, must be made the accounte of such a viage. And so by the pointes of the Carde, they shall directlye fynde the porte that they sought. And by this order shall they gouerne them selues in all nauigations. For the whiche, it is conuenient that wyse and experte Pylottes should make notes of obseruations of Northeastynge and Northwestynge, that is from porte to porte. And to make compilations and gatherynge of suche notes to carye with them in their shippes for regimētes. And not to be to busie or curious to amende their Cōpasses, or with the stone to rubbe the irons or stieles neyther on the one syde or the other, from whence the flower deluce doeth shewe: For this should cause many inconueniēces. Neither ought they to admitte in their Cardes two graduations: Especially for that to knowe howe muche in euery place the Compasse doth go asyde or varie from the true Meridian, may easely be made an instrument to shewe the same

the same by the Sunne in the daye, and by the starres in the nyght.

The. vi. Chapter of the introduction and principles of the Arte of Nauigation.



As muche as nowe we haue the guide, whiche is the compasse, it is conuenient to enter into the waye: which is Nauigation. The which (as we haue sayde) is to go or passe by water from one place to an other. And this presupposed, I saye that he that desyareth to attempte Nauigations, muste knowe two thynges whiche the Carde shal shew hym. The one is, by what point or lyne he ought to sayle. And this, shal the lynes of the saylyng Carde shewe him. The other is, the leagues of the distaunce: And this shal the scale or trunke of the leagues shewe. Takynge with a compasse the distaunce of two places, and applying it to the scale. The knowledge of these two thynges, ought the Pylote to beare in memozy. And to put them in effecte, ought to directe his foreshyppe to the selfe same wynde which the compasse doeth shewe. For the distaunce, he ought to knowe howe muche the shyppe goeth dayly: well considering and obseruing the wynde, tydes, currentes, and all suche thynges as may be with hym or against hym. And accordyng herunto, he shal knowe howe muche he hath gone, and what remayneth for hym to go: and whether he be farre of or neare vnto the place whyther he intende to sayle: The whiche in nauigation, is the ende desyzed. And because this estimation or computation can not be iust and exacte, especially in a long viage or in long tyme, it shalbe conuenient that we rectifie or amende it, knowyng the place where the shyp is on the superficiall parte of the water, by the place that aunswereth to it in heauen. This place of heauen, is knowne by the altitude of the pole. And by the altitude of the pole, is knowne

In nauigation what is chiefly to be considered.

The distaunce

The altitude of the pole and Equinoctiall.

The meridi-
an altitude.

To knowe
the place of
heauen.

To knowe the
waye of the
viage.

Rules to
knowe the al-
titudes.

Longitude &
latitude.

Differences of
degrees.

altitude of the Equinoctiall. And by the altitude of the Equinoctiall and declination of the Sunne, is knowen the Meridian altitude. And contrarie wyse, knowynge the Meridian altitude and declination of the Sunne, is knowen the altitude of the Equinoctiall: and by the Equinoctial the pole: and by the altitude of the pole, is knowen the latitude. And this is the place that is desyred to be knowen. But for as muche as the heauen is moueable from the East to the West, this place is not knowen as a certen poynte. But is knowen as a lyne or paralele at a certen distance from the Equinoctiall. And it is not knowen in what poynt of this paralele the Shyppe is, by the altitudes that are taken from heauen: But it is knowen by the line that the Shyp hath gone, as we wyll further declare in the .viii. Chapter of making a poynte or pycke in the Carde. And in this maner you shall haue rectified the waye that the Shyppe hath gone: and consequently the waye that it hath yet to goe.

And for as much as these altitudes are so profitable and necessary, it shalbe nedefull to gyue rules howe we may vse them to our mosse commoditie. And for this, is presupposed to know, that all places situate on the superficiall parte of the earth and water, either they are vnder one Meridian, so that they haue, or where they haue one selfe same longitude, and differ in latitude, or are in one paralele where they haue one self same latitude, and differ in longitude: or are in diuers Meridians and paraleles where they differ in longitude and latitude. And I saye, that if they haue one self same longitude, they sayle from the one to the other by the lyne of North & South. And howe many degrees doth varpe the altitude of the pole, and of the Equinoctial in heauen, so many degrees haue they gonne by Sea or by lande. If two places haue one selfe same latitude, they passe from the one to the other by the lyne of East and West. And in suche maner of viage, the altitudes do not profite vs, because there is no variation. If they dyffer or varie in longitude and latitude, they sayle from the one to the other by some of the other lynes. But there are moze degrees that correspond

responde to the waye that the hypppe maketh, then the degrees that varie the altitudes of the Equinoctial & the pole. And this difference shalbe greater, in howe muche the lyne shall drawe neare to East and West. And howe muche it shall drawe neare to North and South, it shall be lesse. Of the degrees, or leagues that aunswere to every degree of the variation of the altitude, we wyl entreate hereafter in the. vii. Chapter.

These altitudes are knowen many wayes: but especially by two: As, by the Meridian altitude and declination of the Sunne (as we haue sayde) is knowen the altitude of the Equinoctial: and by it, the altitude of the pole. The seconde waye, they are knowen by the altitude of some fyfte starre of those that are not hydde. And among many other, the North Starre is taken because it is nearest to the pole. To knowe the altitudes by the Sunne, three thynges are necessary. That is to saye, an instrument, the declination of the Sunne, and rules.

How the altitudes are knowen.

The fyfte starre.

The North starre.
To knowe the altitudes by the sunne

The instrument to knowe the Meridian altitude, shalbe the Astrolabe because it is moſte commodious for this purpose: whereof we wyl intreate in the Chapter following. The declination of the Sunne, (whiche is to take it away, or to ioyn it with the Meridian altitude,) we haue already described in the thyrde Chapter of the seconde parte. The rules to knowe when the declinations must be ioined with the Meridian altitude, or taken from it, we wyl geue in the. viii. Chapter. To knowe the altitudes of the pole by the altitudes of the North starre two thynges are necessary. That is: an instrument and rules. The instrument wherewith the Mariners are accustomed to take the altitudes of the North, they call Ballestilia: whiche is a crosse staffe, wherof we wyl wyte

The meridian an altitude.

The declination of the sunne.
The altitudes of the pole.

Jacobys staffe

hereafter in the nyth Chapter. And the rules of the tourne or compasse whiche the North starre maketh about the pole, we wyl declare in the tenth Chapter.

A. lfff.

The

The.vii.Chapiter of the makynge and vse of the Astrolabe, with the whiche the Mariners take the altitudes of the Sunne.



Take a plate of copper or laton (whiche
for this purpose is better then any o-
ther metall) of the bygnesse that you
desyre to make the Astrolabe. And is
commonly of the bygnesse of a spanne
the Diameter. And let it be of the thic-
nesse of half a finger at the least: For
the weightier that it shalbe, so muche
shall it be moze steddie to take the altitude. This plate
must be made rounde by a cyrcle, leauing comyng forth
of the circle, a cozner in the whiche you shall put a ryng
or handle with a hole wherby you may hange the Astro-
laby by a threedde or lyne to take the altitude. After it is
thus made with the ryng or hadle annered therto, make
it bryght and smothe polished on both sydes, and all of
one equall thychkenesse that one syde be not heuier then
an other: whiche you shall trie in this maner. Hange the
plate by the ryng or hole that you haue made: And from
the same hole, hange a plomet of leade fastened to a beare
or lyne threedde of sylke. The Astrolabe thus hangynge
free and at libertie with the plomet, if then the threedde
fall vpon the center of the Astrolabe, it is well. But yf
the threedde do leane or swarue to the one syde or the o-
ther from the center, then is that syde thicker and heuier
then the other: and must therfore be made thynner buttill
the threedde fall iustly vpon the center. This done, make
a circle vpon the sayde center, a little within the circum-
ference of the Astrolabe. Then drawe a Diameter fro
the center of the hole in the which the ryng or handle is,
vnto the center of the Astrolabe, trauersing or ouerth-
warting the hole circle. And this shalbe called the lyne
of the Zenith or verticall poynt: whiche also shalbe cutte
with an other Diameter vpon the center, makynge right
lynnes with it. And this Diameter shalbe called the Ho-
rizon:

The rectify-
ing of the
Astrolabe.

The threedde
of plomet.

The lynnes
verticall and
horizontall.

rizontall lyne. These two Diameters shall deuide the
 cyrcle into foure equall partes. After this, you shall make
 an other circle so muche moze within the second, that be-
 twene the circumferences of both the circles, may be co-
 teyned the numbers of the degrees. When (the Astrola-
 bie hangyng befoze you) you shall deuide the one parte
 (being the superioz and left parte) fyfte into thzee equall
 partes. And euery part shall conteyne. 30. degrees. When
 shall you deuide euery parte of these into other thzee e-
 quall partes. And they shall conteyne ten degrees. And
 euery of these deuide into two partes, and they shall con-
 teyne fyue degrees. This done, put a ruler vpon the cen-
 ter of the Astrolabie, applyng it to euery of the poyntes
 that deuide the sayde partes. And drawe certayne lynes
 that passe from the circumference of the first circle vnto
 the lesse circumference. And in the spaces of the lesse
 cyrcle, wyte the numbers of the degrees: Begynnyngs
 in the Horizontall lyne. And in that space put fyue, and
 in the seconde tenne, and so forth of the other, vntyll
 the. 90. degrees ende in the lyne of the Zenith. When
 shall you deuide the spaces that are betwene the fyfte
 Circle and the seconde, euery space into fyue, whiche
 shall make the. 90. degrees. The Astrolabie thus made,
 you shall make the Alhidada or Labell. For the whiche,
 you shall take a plate of laton of the breadth of scarcelye
 two fyngers, and as thicke as the Astrolabie: also as
 long as the Diameter of the Astrolabie. And make a line
 in the myddest thereof by the longitude. In the myddest
 of this lyne, make a circle so great, that it may touche in
 the sydes of the plate. When cut of this plate on the one
 syde, that that it hath from the lyne to the ryght hande:
 And on the other syde, that that it hath from the lyne to
 the lefte hande, leauyng the cyrcle whole. This line that
 shall passe by the center of the cyrcle, is called Linea fidu-
 cia (that is) the lyne of confidence: whiche is that that
 sheweth in the degrees, the altitude that is taken. When
 shall you take away the endes or corners of the Alhidada
 that are without the line, so that you touche not the line.
 This done, you shall make two lyttle ryfing or rayfed
 tablettes

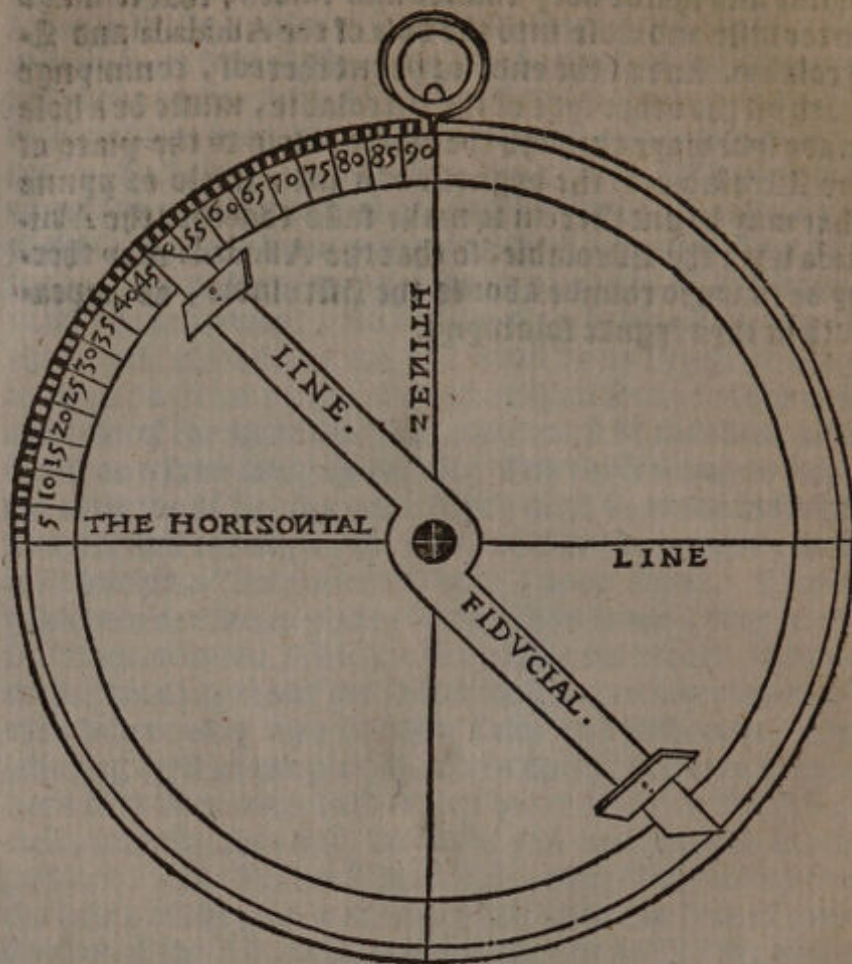
The Alhidada
 or Labell of the As-
 trolabie.

The holes of
the Alhidada

tablettes or plates of the same metall wherof the Astro-
labie is made, & of the selfe same thychnesse that is the
Alhidada, or little lesse: and of the breadth of the Diame-
ter of the circle of the Alhidada. And let the be a thumbe
in heyght or breadth. In the myddest of these two pla-
tes by the height, you shall make a lyne. When these
are made equall and al they angles ryght, in euery line
of these that you haue made, you shall also make two ho-
les equally distant from the sydes or edges of the sayde
plates or tablettes. And of the two holes of euerye of
the se lytle plates, the one hole must be as bygge as may
conteyne a great pynne. And these shall serue to take the
altitude of the Starres. The other must be so subtile and
small as a fyne solwynge needle: And these serue to take
the altitude of the Sunne. They must be made in suche
maner, that the outwarde parte of them be bygger, and
lesse within, of the quantitie that I haue sayde. These
tablettes or erected plates beyng thus made, they must
be sothered in the Alhidada betweene the center and ex-
tremities or endes of the same: makynge in it certen not-
ches where they may be made faste and sothered. Or
leauynge fyrst in the plates, certen sharpe poyntes or cor-
ners that may enter into certen holes made in the Alhi-
dada, wherby they may be made fast vnderneath wyth
pynnes. And they must be so sette, that the lyne where
the holes of the plates are, may fall vpon the lyne of con-
fidence of the Alhidada. So that the one half of the plate
be set vpon the Alhidada, and the other halfe without
it or at large. In lyke maner shall you take good aduer-
tisment that the great hole of y one plate, stand directly
agaynst the great hole of the other plate, and be nothing
at all awrye. This done, you shall boze the Astrolabie
through by the center: makynge a very rounde hole that
may haue in the myddest of it the center of the Astro-
labie. This hole shall be of the bygnesse of a goose quyle.
And the lyke shall you make in the center of the cyrle
of the Alhidada. Then shall you make a pynne or nayle
of the same laton: The whiche on the vpper parte of the
Alhidada maye haue a playne and rounde head. This
pynne

pynne also shalbe very rounde and smoth, that it maye enter iuste and close into the hole of the Alhidada and Astrolabie. And at the ende or poynt thereof, commynge forth on the other syde of the Astrolabie, muste be a hole made sydelwaye throughe the pynne, close to the plate of the Astrolabie, of the bygnesse of a little nayle or pynne that may be put therein to make faste together the Alhidada with the Astrolabie, so that the Alhidada may thereby be tourned rounde aboute the Astrolabie, as appeareth in thys figure folowynge.





To take the
altitude of
the Sunne.

To take the altitude of the Sunne, hange by the Astrolabie by the ryng: and set the Alhidada against the Sunne. And rayse it or put it downe in the quarter that is graduate, vntyll the beames of the Sunne enter in by the lyttle hole of the tablet or rayfed plate, and pꛛecysely by the other lyttle hole of the other tablet. Then looke vppon the lyne of confydence. And howe manye degrees it sheweth in the quarter that is graduate (begynnyng frō the Horizontall lyne) so many degrees of height hath the Sunne. In lyke maner shall you doe to take the altitude of any other Starre lookynge thozough the greates holes,

holes, because this may hardelye be seene by the lyttle holes.

The. viii. Chapter of the definition
of the Altitudes. And howe the Altitudes of the
pole may well be knowen by the Peri-
dian altitude and declination of
the Sunne.



It is convenient to define the Altitude be-
fore we geue rules of the vse therof. The
Altitude of the Sunne or the Moone, or of
any other Starre, is the distaunce that is
betwene it & the Horizon. And this ought
to be accompted by the degrees of the grea-
ter cyrcle whiche passeth by the Zenith and by the cen-
ter of the Sunne or of the Moone, or of the Starre vnto
the Horizon. And the degrees that are from the Horizon
to the Starre or to the Sunne, that is the Altitude: And
the degrees that are from the center of the Starre or of
the Sunne vnto the Zenith, is called the complement or
supplement of the Altitude. The altitude of the equinoc-
tiall, is euer counted by the Peridian. And the degrees
of the Peridian that are betwene the Equinoctiall and
the Horizon, is the altitude of the Equinoctiall. And o-
ther so many, are they that are from the Zenith to the
pole. For the Altitude of the Equinoctiall, is equal to
the complement of the Altitude of the pole. The degrees
of the Peridian that are betwene the Equinoctiall and
the Zenith, is called the complement of the Altitude of
the Equinoctiall: and is equal to the altitude of the pole.
And although we haue defined the altitude in generall,
yet shall we only profite our selues by the Peridionall
altitude of the Sunne. The Peridian altitude, is the
greatest altitude that the Sunne hath every daye. And
this shall be when the center of the Sunne is in the Peri-
dian. And the arke of the Peridian that is betwene the
Horizon and the Sunne, is the Peridian altitude. So
that when we saye the altitude of the Sunne is taken, it
is vnder-

What is the
altitude of
planetes or
starres.

The comple-
ment of alti-
tude.

From the ze-
nith to the
pole.

The Peridi-
an altitude
of the sunne.

The shadowes that the sunne maketh at myddaye.

Rules for all variations.

The perpendicular shadowe.

The declining shadowe.

is vnderstode at midday. The shadowes that the Sunne the maketh, are in thre sortes. For either to vs it casteth the shadowe toward the North part, or toward the south, or perpendicular by a right vp lyne, so that at myddaye or noone, nothing that standeth vpryghte, geueth any shadowe at all. But for as much as there is suche variation in declinations, altitudes, shadowes, and paraleles, it shalbe necessary to geue rules for all variations. And these shalbe reduced into foure brieue and compendious rules: the whiche I haue here described that the wyttie may take profite by them, and the rude learne the: Not carryng for the rules of the Mariners, because they are so long and tedious. For (as the Philosopher sayeth) it is vayne done by many, that may well be done by fewe.

When the shadowe shalbe perpendicular, it is because the Sunne is in the Zenith, and, 90. degrees aboue the Horizon. And then how many degrees of declination the Sunne hath, so much shall we be distant from the Equinoctiall toward the parte where the Sunne declineth. And if it haue no declination, it and we shalbe vnder the Equinoctiall.

When the Sunne and the shadowes shalbe to vs from the Equinoctiall toward one of the poles, we shal take away the declination from the Meridian altitude. And the complement for, 90. shall we be distant from the Equinoctiall toward the same pole.

When the Sunne declyneth from the Equinoctiall toward the one pole, and the shadowes shalbe toward the other, we shal ioine the declynation with the Meridian altitude. And if all come not to, 90. then the complement for the, 90. shall we be distant from the Equinoctiall toward that pole to the whiche the shadowe falleth. And if they be mo in number then, 90. then the ouerplus of, 90. shall we be distant from the Equinoctiall toward the pole where the Sunne declyneth. And yf they be iust, 90. we shalbe vnder the Equinoctiall.

When the Sunne hath no declynation, we shalbe distant from the Equinoctiall the complement of the Meridian

dan altitude towarde the pole where the shadowes are.

By these rules, besyde the vse whereof we haue spoken) maye be knowen howe muche is the greatest declination of the Sunne, the altitude of the Equinoctiall, the daye, houre, & minute, when the Equinoctiall was: the whiche is knowen as foloweth.

why the sun
hath no decli
nation.

Hauiing taken the greater Meridian altitude of the spring (whiche is in the beginning of Cancer) & the lesse of wynter (whiche is in the beginning of Capricorne) takinge alwaye the lesse from the more, the rest is that that is from Tropike to Tropike. And consequently parted by the myddest, is the greatest declination. As for example: Take the greater Meridian altitude from the beginning of Cancer in. 77. degrees: And the lesse from the beginning of Capricorne in. 30. degrees, takinge them out of the. 77. remayne. 47. degrees: and so muche is from Tropike to Tropike. And the halfe (whiche is. 23. and a halfe, is the greatest declination.

To knowe
the greatest
declination
of the sunne

Example.

Consequentlye the greater declination added to the lesse Meridian altitude, or takinge it away from the greater Meridian altitude: that ysleth therof is the altitude of the Equinoctiall. Example. 23. and a halfe of the greatest declination, ioyned with. 30. of the least Meridian altitude, or taken away from the. 77. of the greatest Meridian altitude: remayne. 53. degrees and a halfe, whiche is the altitude of the Equinoctiall in the cytie of Cadiz. Hereof it foloweth, that when we shall take the Meridian altitude in. 53. degrees and a halfe, that daye is the true Equinoctiall. But if one daye it had lesse, and the other daye folowynge it had more, we must take the lesse from the more, and fourme the rule of thre vppon the rest: saying. If the rest come to me of foure and twenty houres, then of those houres that shall come to me, that that lacketh of thre and systie and a halfe: that is the altitude of the Equinoctiall: And that that cometh thereof, shall bee the houres of the Equinoctiall after mydday.

Example.

The true equinoctiall.

Exam.

Example.

Example of the experience that I made in the cytie of Cadiz the tenth day of Marche at mydday or hygh noone. I toke the altitude of the Sunne. in 53. degrees 4. 26. minutes: They lack to be the Equinoctiall. 4. minutes. An other day the. xi. of Marche, at noone, I toke the Sunne in. 53. degrees and. 50. minutes: whiche are more then the Equinoctiall by. 20. minutes. Then to knowe at what houre the Sunne was in the. 53. degrees and. 30. minutes of the Equinoctiall, I toke away the Meridian altitude that I tooke at the tenth of Marche, from that that I toke at the. xi. whiche is the difference. 24. minutes. And I formed the rule, saying: If. 24. minutes the Sunne dyd ryse to me in. 24. houres, then in howe muche tyme shall ryse vnto me the. 4. minutes that sayled me at the tenth of Marche: I multiplied, deuided, and founde that in foure houres: And so shal you say that the Equinoctiall was in the cite of Cadiz the tenth daye of Marche at foure of the clocke at after noone. Whiche is vnderstode (accoording to the Astronomers) at foure houres runne at the. xi. daye of Marche of this present yeare 1545.

The. ix. Chapter of the ma-

kyng of the Crosse staffe wherwith
the Mariners take the Altitude
of the North Starre.



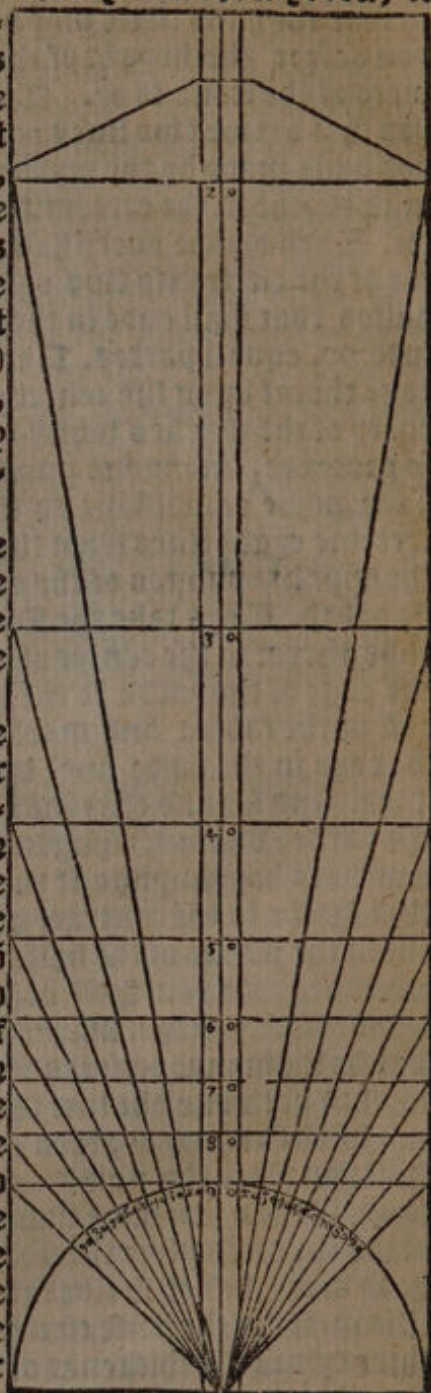
Make a square staffe or yarde of the thynnesse of a synger, more or lesse accoordinge to the goodnesse of the wood: And of length fyre spannes or more. For the longer that it is, the more pzeise shal it be, and the degrees shalbe y greater, whereby foloweth the certayntie of the altitude. Then take a very playne table of the lengthe of the staffe, and two spannes of breath, or at the least a spanne and a halfe: And in the myddest of this table, make a ryght lyne by longitude, and in the one ende of this lyne, make an other line that may cut it in ryght angles. And vpon the cutting of these
two

two lines, put the foote of the compasse, and make halfe a circle which may remayne on the part of the long line, so that the halfe circle may haue so muche Diameter as you desyre the heygth of the Hammer, head, or crosse piece of the staffe to be. This halfe circle beyng made, you shal drawe two lines equidistaunt to the line which you haue made by the myddest of the table. These lines must touche in the extremities or endes of the halfe circle. When deuide euery halfe of the halfe circle or quarter of the circle into two equall partes: and the twoo halfes that shal ende in the fyrst line, deuide eche of the into. 90. equall partes. When take a ruler, and put the edge therof vpon the center of the halfe circle, and vpon euery of the markes which deuide the. 90. partes: And so proceade, makynge punctes in the lines whiche you haue made equidistant to the fyrste line. When drawe certeine ryght lines from the punctes of the one line, to the opposite punctes of the other: & so shal the draught be ended. When take the staffe or yarde, and put the one ende therof in the center of the halfe circle, and applye the edge of the yarde to the line that goeth by the myddest of the table: and marke in the yarde the markes that are in the sayde line, by meanes of the trauersyng lines. And see also that the markes whiche you make in the yarde, be trauersyng lines. And make them theyr numbers begynnynge at the ende or poynte of the yarde that shalbe to the contrary part from that which you did put in the puncte of the halfe circle. And to knowe with what degrees you shal begyn the yarde or staffe, and what nūber you shal marke in the fyrst line of the punct: loke howe manye degrees are from the circle which you deuided betwene the line that goeth to the laste marke: and with so many degrees enter. And so consequentlye shal you place the numbers from . 5. to . 5. or from . 10. to . 10. When you haue thus numbered the yarde, then to make the crossepiece thereof, take a table or planke of good wooo, which shalbe so much in length as shalbe the Diameter of the halfe circle, and so much in breadth as thye tymes the thickenes of the yarde, and of thickenes

two fingers or lytle lesse. On the one syde also 't must be very playne, and on the other syde in the myddest, it must haue a square or qua-
 drature of all the thickenes of the planke. And from the square to the endes, it must be made thinner & thinner, so that it haue in maner the fourme of suche pickeares wherewith myll stones are picked. And in the myddest (by longitude and latitude) it muste haue a square hole, by the which the yarde may enter iust, & make ryght angles with the crossepiece. And the poynte of the yarde must enter by the plain side of the crossepiece, and come forth the of the square syde therof.

To take the
 altitude of
 the starre.

To take the altitude of the North starre, or anye other starre on the Sea (for it serueth not on the land nor for the Sunne, excepte yf the Sunne shalbe vnder anye thinne cloude, & the Horizō cleare) you shal put the head of the staffe to the corner of your eye, raysyng it vp, or putting it downe vntyl the nether part of the crossepiece come with the Horizō. And being so, if the higher parte of the crossepiece shal come with the starre, you muste looke the playne syde of the crossepiece in what number



of degrees of the staffe it falleth : and those degrees shal be the altitude of the starre. As yf the crossepiece reache not to the starre, you must bryng the crossepiece nearer to your eye, vntyl the one part therof come with the Horizon, and the other with the starre : and the degrees which it sheweth shalbe the altitude.

C The. x. Chapter, of the Altitude of
the Pole, knowen by the Altitude
of the North starre.

I know the paralel in the which the styp is, ouer and besyde the rules heare before of the altitudes of the Sunne : it is lyke- wise knowe by the altitudes of the North starre. These two maners are vsed, for that more credit is geue to two witnesses then to one. So that yf by one aryse any doubt, the same may be certified by the other. And also because time may sometyne serue for the one and not for the other : As to haue a cloudy mydday or noone, and a cleare nyght.

The altitude is taken of the North starre : which is a starre in the extremitie or ende of the tayle of the lesse Beare, being a constellation comonly called the Horne. For this North starre (of the most notable starres about the Pole) is nearest vnto it, and shall therefore shewe a lesse circle then any of the other : and so shal his altitude dyffer lytle from the altitude of the Pole. This starre hath declination. 87. degrees, and. 51. minutes. And the complement to. 90. (whiche are. 4. degrees and. 9. minutes) is his distaunce from the Pole. And although the Maryners holde opinion that it is not distaunt more then three degrees & a halfe: yet to my iudgement, more credit ought to be geuen to the Astronomers then to the Maryners : Forasmuch as the Astronomers do knowe the places of the starres, with their longitudes, latitudes, declinations and ryght ascensions, more perfectly & precisely then do the Maryners. For they account not onely by degrees, but also by minutes and secundes. But let none deceaue them selues through my opinion.

The North
starre.
The lesse
beare.
The horne.

The distace
of the
North starre
from the
Pole.

Therefore, whosoever wyll precysely knowe it, let hym take the hyghest altitude of the North starre, whiche is his beyng ouer the Pole: and the lesse altitude, whiche is his beyng vnder it. Then take awaye the lesse from the more: and the halfe of that that remaineth, shal be the distaunce of that starre from the Pole of the worlde. And lyke wise by this experience may be knowen the altitude of the Pole, and what all the other starres that go not downe vnder the Horizon, be distaunt from it, ioyninge the greater altitude with the lesse: And that shal amount therof, deuided by the halfe, shal be the altitude of the Pole. And takynge awaye this altitude of the Pole, from the greater altitude of the starre, or the lesse from the altitude of the Pole: the rest that remaineth, shal be the distaunce of the starre from the Pole.

The Pole
is inuisible

And as the Pole is inuisible, it can not be sene or knowen when the North starre is hygher or lower, excepte it be by the meane of some other marke. And for this is considered the position of the former Guardes or watch, beyng one of the two starres called the Guardes, which are in the mouth of the Horne. The Maryners haue noted eyght positions from the former Guardes starre to the North starre, whiche aunswere to the eyght principall wyndes. And as the Guardes is to the North accordinge to the placeyng of these positions, so shal it be hygher or lower from the Pole. Lette vs here put the common rules which the Maryners vse, to comply with those that are of opinion of the thye degrees and a halfe. And for the opinion of the Astronomers (whiche is the distaunce of. 4. degrees and. 9. minutes) I wyll hereafter giue a circular figure with a moueable horne. Then the eyght wyndes of the eyght positions being marked, and puttyng the Guardes and the North in euerye of the wyndes: it shal be the distaunce that the North starre is hygher or lower from the Pole.

The two
starres called the guardes
of the
North starre

Common
rules of the
Maryners.

Common Rules.

The former Guard beyng in the East, the North starre is in one degree and a halfe vnder the Pole.

The

The Guard beyng in the North, the Starre is thzee degrees vnder the Pole.

The Guard in the Northwest, the Starre is halfe a degree vnder the Pole.

The Guard in the west, the Starre is one degree & a halfe aboue the Pole.

The Guard in the Southwest, the Starre is thzee degrees and a halfe aboue the pole.

The Guard in the South, the Starre is thzee degrees aboue the pole.

The Guard in the Southeast, the said North starre is halfe a degree aboue the pole.

Note that these eyght wyndes are made accoꝝdyng to foure lynes. Wherof two are ryght: which are North and South, and East and West. And the other two are crooked: whiche are Northeast Southwest, and Southeast Northwest. When the garde and the North shalbe in the ryght lyne, it shall appeare cleare how they are. And when they shalbe in the crooked lynes, it maye bee scene, because the gardes are the one by the other in a ryght lyne.

The eyght
principall
wyndes ac-
coꝝding to
foure lynes.

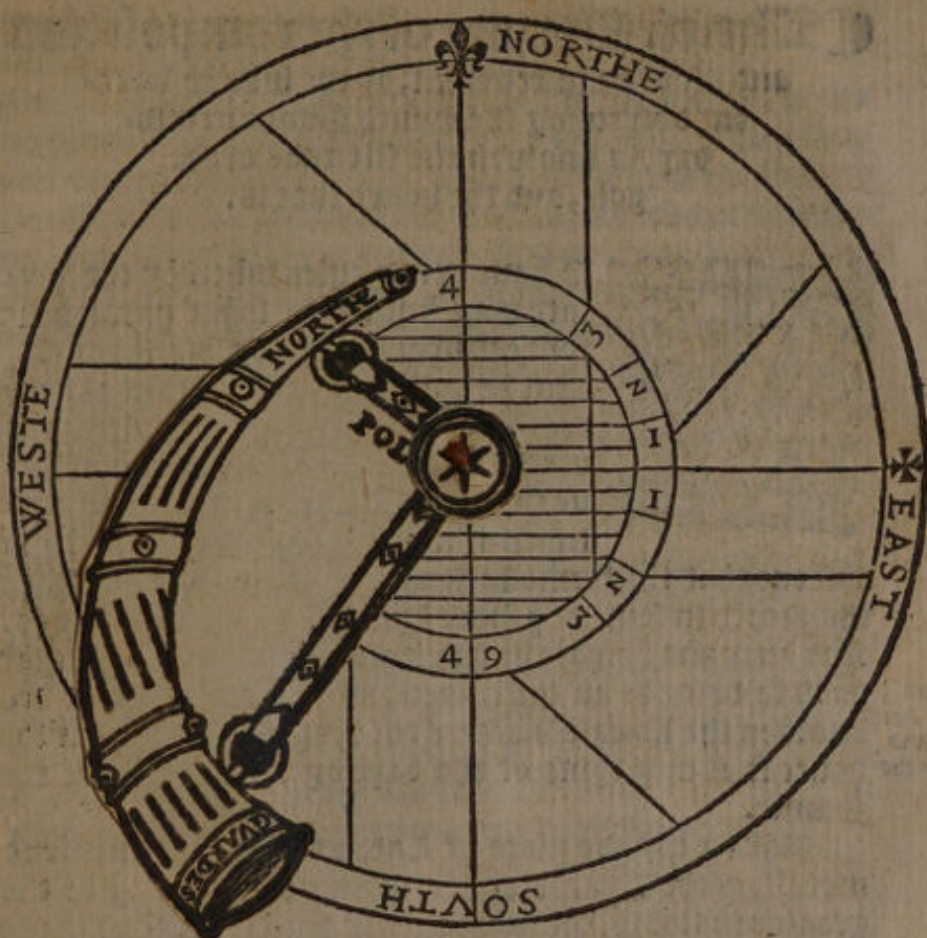
To see by theozike or speculation howe the North starre ryseth vp and goeth downe from the pole of the worlde, I wyll here descrybe the sayd circular figure or instrument: which is a circle in whose circumference are wytten the eyght wyndes. The North in the hyghest place of the instrument whiche they call the head: And the South in the nether parte therof, whiche they cal the foote. The East in the ryght arme: The West in the lefte arme. The foure rest, betwene these in their places. And here is to be noted that the lynes whiche passe not through the center, are of the wyndes of their equidistances that passe through the center. Within this circle, is an other little circle which describeth the starre of the North by the mouyng of the fyrst moueable: And hath for his center the pole of the worlde, as hath the first. This lyttle cyrcle hath for his Diameter eyght degrees and eyghtenne minutes: as foure degrees and nyne minutes aboue the pole, and the other foure de-

An instru-
ment to knowe
the ryling or
falling of the
North starre
from the
pole of the
worlde.

The horn of
the seven stars
exp.

Advertised
to Mariners

degrees and .9. minutes under it. And they are divided by
certain lynes equidistant to the East and West. In the
center of this circle, is annexed a horne with his seven
starres moueable rounde aboute by all the wyndes.
And seying them in heauen, howe, and in what wynde
they are, euen so in this fygure shall we see the North
starre in what parte it is of the degrees hyghe or lowe
from the pole. And that the Pilot or Mariners shall
not erre, I say that he ought not to put the soseguarde in
the wyndes that passe through the center of the fygure.
For it shalbe North and South with the pole, and not
with the starre of the North as it ought to be. And so of
the other wyndes. And in this maner the Starre of the
North, shall shewe in the lynes equidistant from the
lesse circle, the degrees and partes of degree that it is
hygher or lower then the pole of the worlde. For the
same course, differences, and variations, it maketh in
heauen.



Thus beyng knowen howe muche the North starre
is vnder or aboue the pole, let vs take the altitude ther-
of. And that of it that is vnder the pole, let vs ioyne to
his heyght. And as muche of it as is aboue, let vs take
away: And that shall ryse thereof, shalbe the altitude of
the pole aboue our Horizon.

B. lxxx.

The

The altitude
of the pole
aboue the ho-
rizon.

The. xi. Chapter of the composition

and vse of an instrument, by the whiche without obseruyng the South Sunne or midday, is knowen the Altitude of the pole, and the houre that is.



I haue geuen rules whereby the Pilot may knowe in what paralele he fyndeth hym selfe with his thyppe. But he may not knowe this at all houres: for as muche as for the altitudes of the Sunne, it is necessary to obserue the mydday iustly. And for the altitudes of the North, it is necessary to

obserue that the forme of the Guard be placed iustly with the North in some of y^e foure lynes of the eyght wyndes. And ouer and besyde the rules aforesayd, I haue thought good to describe an instrument by the whiche maye be knowen the Paralele where the thyppe is, and what the houre is at any tyme of the daye by the beames of the Sunne.

An instrument
to knowe the
paralele and
houre by the
Sunne.

Make a rounde plate of Laton or other conuenient metall, of the Diameter of a spanne or more. For the greater that it is, the more p^recise shall it be. And make in it two Diameters that may cut them selues in ryght angles vpon the center. In the foure extremes or endes of these diameters, leaue foure round punctes or pointes that may serue for Aris. The one of these Diameters, shall be called the Aris of the worlde: and the other, the lyne of East and West. This done, make of the same laton a semicircular piece of the thickenesse of the plate or little lesse: And of the breadth of halfe a synger. This must stande vpon an edge, so that the conuere part maye come iustly with the halfe of the circūference of the plate to the whiche it must be nayled or sothered in the nether part of the plate, the semicircle being rayled, & that the endes therof may come with the endes of the Aris of the worlde. And this semicircle shall you deuide into two equal partes, and euery half into. 90. degrees, beginning from

from the halfe pointe towarde the endes of the Axis of the worlde, whiche are the Poles.

In like maner shall you make two circular pieces, of the byggenesse of a piece of foure ryals of plate, which they call rundels for the houres. These must be made faste in the plate by the Poles of the worlde, which maye holde or beare them by theyr centers. And euery of these rundels must be deuided into. 24. equal partes: & although not all, yet the vppermost part of the plate. And aboue in the hyghest poynt of these deuisions, you must wyte. 12. because that there it shall shew the mydday or noone. And from thence, the afternoone houres must begynne their numbers towarde the West part: and shall end. 6. houres in the halfe or myddell of the ioynt of the circle with the plate. In the other ioynt of the other part, shall begyn. 6. of the houres before noone: and shall ende. 12. in the hyghest poynt. You must also make an other Semicircular piece, of the breadth of a fenger. This must be playne or flatte: and the concauitie or holownesse therof, equal to the Semicircle of the edge or syde of the plate, and in the endes muste haue two holes, wherein may iustly enter the poyntes that come forth of the circles for the houres, which are the Poles of the worlde. Also this Semicircle muste haue two lines: one on the vppermost part, and the other on the nethermost, which maye deuide the breadth into two equall partes. This halfe circle lyke wyse muste be deuided into two equall partes by longitude, with a trauesed line which shall be called the Equinoctiall. And fro this line to the inward part therof, must be counted. 23. degrees and a halfe towarde the one parte, and as muche towarde the other part of the. 90. that euery halfe of the circle conteyneth. And at euery part where ende the. 23. degrees & a halfe, make a trauesed line, so that from the one to the other may be. 47. degrees. And in this space shall you drawe certeyne lines equidistant with them of the myddell, that they and the myddle line, may deuide into. 4. equal partes the breadth of the halfe circle. Then loke in the table of the declinations of the Sunne, what declinati-

on

The. 3. part.

The carac-
ters of the
xii. signes.

The hole
that repres-
senteth the
Sunne.

The place-
ing or set-
tyng of the
Instrument

on haue the. 5. degrees of Aries : and that shall you ac-
count from the Equinoctiall toward the one part, and
as muche moze toward the other, makynge a line that
may traueise that of the myddest, where that declinati-
on doth ende and touch in the other two lines. And the
same shall you do at . 10. 15. 20. 25. and. 30. whiche is the
ende of Aries and begynnynge of Taurus : and then the
line shall traueise all the breadth. The lyke also shall
you do to Taurus & Gemini. Then in the spaces, wyte
the caracters of the. xii. signes : begynnynge Aries from
the Equinoctiall toward the North Pole. And then do
Taurus and Gemini ende in the greatest declination,
begynnynge Cancer in the other parte of it. Then Leo
and Virgo do ende in the Equinoctiall where shall be-
gynne Libra, Scorpio, Sagittarius : And in the other
part, Capricornus, Aquarius, and Pisces, shall ende in
the Equinoctiall where Aries beganne. This halfe cir-
cle must haue an openyng or open place, euen and iust in
the myddest from the Equinoctiall vnto somewhat moze
then the greatest declinations : and must be a little bro-
der on the inner parte then without, and not so brode as
may come to the two lines, because it woulde then take
awaye the graduation of the signes. And in this open
place must be put a square grayne or stubbe, whiche on
the inner part maye come playne with the halfe circle,
and on the vtter part may come forth a lyttle, where
shalbe nayled a square piece of laton of the breadth of
the halfe circle. This grayne or stubbe beyng so nayled
with the piece, must haue in the myddest a hole, so small
as may receaue a lyttle pynne : and by the center of this
hole, must passe a line which shall traueise all the graine.
And this line shall serue to putte the Sunne (whiche the
hole representeth) in the degree of the signe where it
is. This halfe circle where it goeth in the circumferen-
ces of the rundelles for the houres, must be fylled on the
one syde vnto the line that is in the myddeste, to marke
it and shewe the number of it. For the placeynge or
settyng of this Instrument, you must cutte a gyddell or
rynge.

rynge of laton, as thicke as the plate, and of the breadth of a fynger, or lyttle lesse: and so large, that of it maye be made a circle somewhat bygger then the plate, so that the plate and the Meridian maye easely be conteyned within it. This circle shalbe called the Horizon, which must be deuyded into foure quarters.

In lyke maner muste be made two semicirculer pieces: and the endes of them muste be nayled or sothered in the poyntes that deuide the quarters of the circle: And deuyde the one fro the other in two equal partes, making ryght spherall angles. And in this ioynt of these two pieces, muste be nayled or sothered a mastell, the which at the one ende is deuyded into two bzaunches or forkes. Then shall you make a base or soote for the same: whiche in the vppermoste parte thereof shall haue a concauitie or holownesse, where maye be sette a saylyng compasse or a needle, touched with the Lode stone, and couered ouer with a glasse. And on the hygheste edges of this base, the two bzaunches of the Mastell shalbe made faste. And this Base with the Mastell, the halfe cyrle, and the cyrle, shall be all one piece, whiche shalbe called the seate or frame of the Instrument. The Horizontall circle in the endes of one halfe circle, muste haue two holes, in the whiche maye enter the Aris that are made in the endes of the lyne of East and Weste.

Also you must take good heede when you sother or make faste the Mastell in the Base, that the North and South of the plate or Horizon come with the North and South of the needle that is beneathe: Hauynge euer respecte howe muche the needle doeth varpe from the Meridian, by Northeastynge or Northwestynge. In the ioynte of the two halfe cyrcles vppon the Mastell, muste be a poynte (called the Index or shewer) whiche shall shewe in the halfe cyrle sothered in the plate on the neather parte, the degrees that the pole is rayed aboue the Horizon.

The Base
or Base of
the Instru-
ment.

The Index
or shewer.

The placing
of the
Horizon.

For the land

For the sea.

The vse of
the instru-
ment.

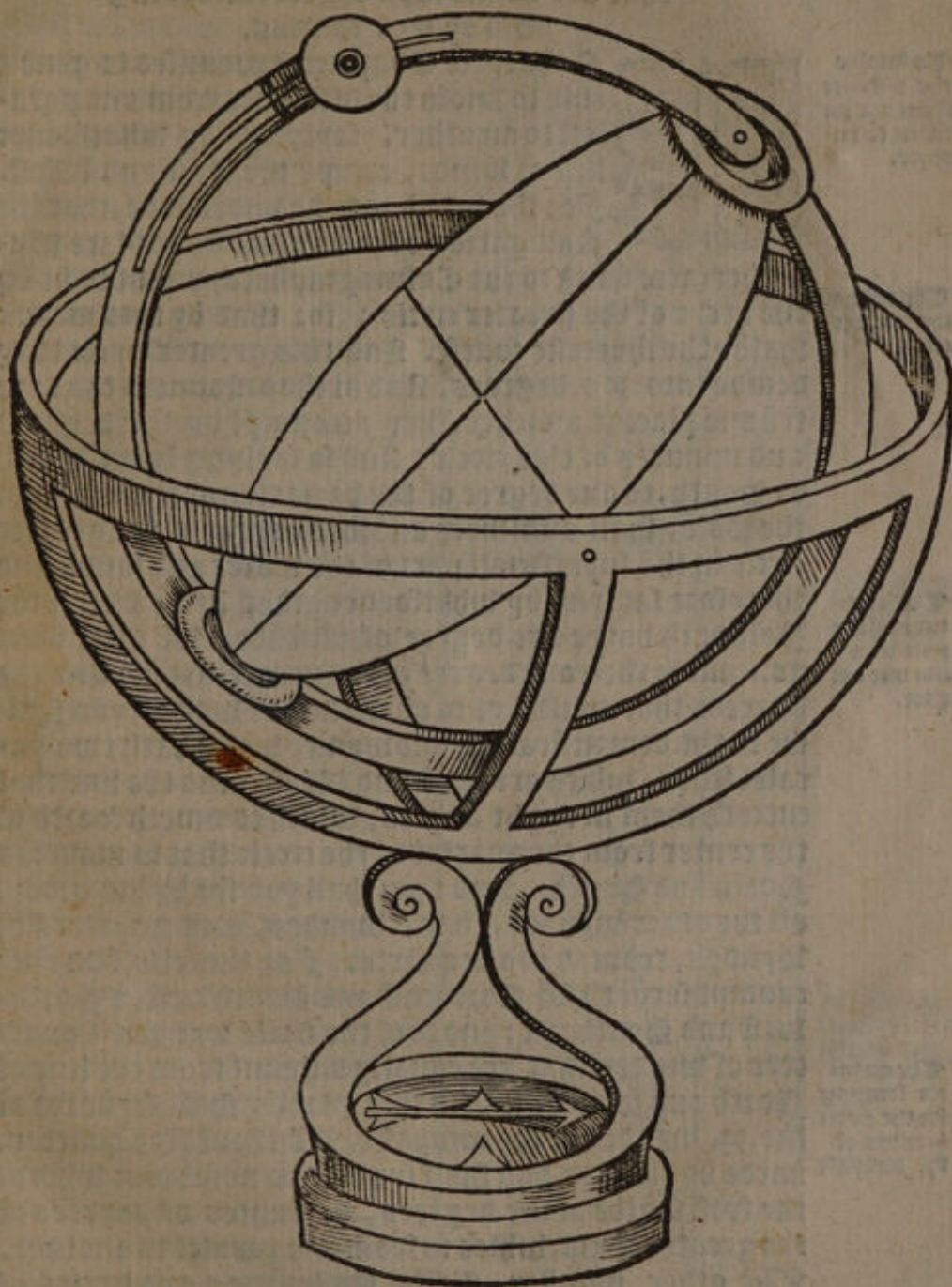
The alti-
tude of the
Pole.

For the perfection of this instrument, it shalbe con-
uenient to sette the Horizon verpe playne and equall at
the tyme of the operation or practisynge with the instru-
ment. And this may be done in two maners. Wherof
the one is: hangyng by a fine threde at the center of the
plate, a plomet made some what poynted at the nether
ende: So that the Horizon standyng playne and leuell,
the poynt of the plomet may fall vpon the poynt of the
inder. And this maner is good for the lande. But for the
Sea, you shall sother in the Horizon two Arcs, lyttle
stubbcs, or endes commyng forth. These shalbe put
in the two opposite holes of a circle of metal made some
what stronge: and this circle muste haue other two
stubbcs lyke wyse commyng forth, and equally distant
from the two holes. These muste be sothered or nayled
in two holes of an other circle in lyke maner. And the
other circle with other two stubbcs, inclosed in a bore.
If then the bore stande even and leuell, the poyle or
wayght shall cause the Horizon to stand leuell, although
the shyppe sway or roule from syde to syde. The vse of
this instrument is in this maner.

When you desyre to knowe the paralell in the which
you are, and the houre that is: put the line that traues-
seth the grayne, in the degree of the signe in the which
the Sunne is (which you shall knowe by the table of the
place of the Sunne, in the second Chapter of the second
part) and set the North and South of the plate with the
North and South of the needle. Then turne the moue-
able Meridian agaynst the Sunne, the foote of the in-
strument standyng faste: and rayse it or put it downe in
the plate, vntyll the beame of the Sunne enter in at the
hole of the grayne, and fall in the center of the plate.
And standyng so, beholde the inder, and how many de-
grees it sheweth from the Meridian: so muche is the al-
titude of the Pole. Then loke where the moueable Me-
ridian sheweth in the rundell of the houres: and there
shall you see the houre that is.

¶ Here

¶ Here foloweth the Demonstration.



The

The .vii. Chapter, of the leagues
that are runne for a degree, according
vnto dyuers courses.

To knowe
the distance
from one pa-
rall to an
other.



The arke of
the greater
circle.

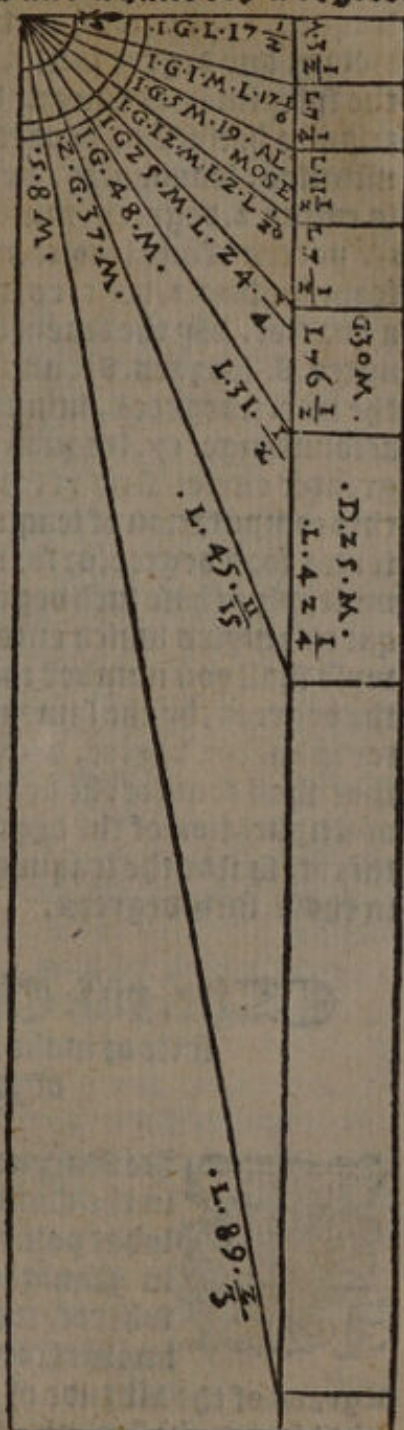
The alti-
tude of the
pole vary-
ing one de-
gree.

The quar-
ter seruyng
for the .xxii
wyndes of
the compasse

R the fyrte Chapter I promised to geue a rule to know the distaunce from one parallel to an other, saylynge by whatsoeuer line of wynde, except the East and West. For the which is to be vnderstode, that the Nauigation of course from one place to another (according to the Cosmographers) ought to be by the arke of the greater circle: for that by this maner shalbe the shorreste course. And this greater circle they deuide into .360. degrees. And al the distaunces that are fro one place to another, they account by the degrees and minutes of this circle: And so saylynge from North to South, to one degree of the variation of the height of the Pole, shall aunswere another degree of the greater circle in the superficial part of the water and land. And therefore saylynge by whatsoeuer other line, vntyll the Pole doth varye one degree of altitude, we shall haue gone more then one degree of the greater circle. And the degrees that aunswere to euery line of wynde, you shall see in the demonstration folowynge, which hath two parallel lines, which are East and West. And the line that cutteth them in ryght angles, which commeth forth of the center from the quarter of the circle that is made: is North and South. And then shall you see by his order, all the other wyndes, halfe wyndes, and quarters of wyndes, reduced to one quarter. For the selfe same account serueth for Northeast and Southwest, & North-west and Southeast: and so of the halfe wyndes & quarters of wyndes that are equally distaunt from the line of North and South. And so this quarter shall serue for al the .32. wyndes of the compasse. Without this quarter, harde by the line, you shall fynde two numbers: wherof the fyrst shalbe of the degrees, & minutes of degrees of the greater circle, which is from one parallel to another. The other number, shalbe the leagues and partes of leagues that suche degrees and minutes do amount vnto,

so, after the rate of .17. leagues and a halfe for a degree.

In lyke maner in the parallel where the lines of wyndes do concurre, shall be set jointly to every line the degrees & minutes of the distaunce from the line of North and South: and leagues & partes of leagues that such degrees and minutes amount vnto. And so it is, that saylyng by the lyne, wynde, or poynte of North & South, vntyll the altitude of the Pole varye one degree, is run another degree: whiche conteyneth leagues. 17. & a halfe. And by the next line, for one degree of the variation of the altitude of the pole, is run one degree, one minute. 17 leagues, & .5. syrte partes. And they that runne vpon that line or poynt, departe from the lyne of North and South, or Meridia line. 12 minutes, leagues. 3. and a halfe. By the second line, is run one degree. 5. minutes, and leagues. 19. scant. And in this course they departe from the Meridian. 25. minutes, leagues. 7. and a quarter. By the thyrde line is run one degree. 12. minutes, leagues. 21. and a. 20. part of a league. And depart from the Meridia line. 40. mi. leag. 12. & two partes



Example.

One degree
of variation
of the pole.

Departing
from the Me-
ridian line.

By

Degrees of
the greater
circle.

By the fourth line, is runne one degree, minutes. 25. leagues. 24. & thzee quarters. And depart from the Meridian, one degree iustly, leagues. 17. and a halfe. By the fyfte line, is run one degree, minutes. 48. leagues 31. and a halfe. And departe from the line one degree. 30. minutes, leagues. 26. & one quarter. By the sirte line, is runne. 2. degrees, minutes 37. leagues. 45. and of the 15. partes of one league, the eleuenth part. And depart from the line. 2. degrees, minutes. 25. leagues. 42. and a quarter. By the seuenth line, is runne. 5. degrees, minutes. 8. leagues. 89. and two terces. And depart from the line. 5. degrees, minutes. 2. whiche are leagues. 88. accountynge. 17. leagues and a halfe for a degree of the greater circle. And yf for euery line you desyre to know this computation of leagues, after. 16. leagues and two terces for a degree, or for more or lesse leagues or myles: multiplye those such degrees by the number of the leagues or myles which enter into euery degree. And lyke wyse shall you number the minutes that are more then the degrees, by the same number of the leagues that enter in euery degree, deuydunge them by. 60. And that that shall come of the deuision, you shall ioyne with the multiplication of the degrees: and that shall amounte therof, shalbe the leagues & partes of leagues that was in those such degrees.

The. xiii. Chapiter: Howe to sette or make a prycke in the Carde of Nauigation.

To know in
what part
or poynt the
Gyppe is.

The Altitude of the
Pole.



He Maryners call the pricking of a point in the Carde, to see and appoynt in it, in what point or part of the sea the Gyppe is in Nauigation. For the perfourmyng wherof, it shalbe requisite that the Pilot knowe from what degree or howe manye degrees of the altitude of the Pole he departed, & with what wynde he sayleth. And when he desireth to know where

where he is, let hym knowe the altitude of the Pole by some of the aforesayde rules. And if taking the altitude, he fynde hym selfe in the same degrees where he was when he departed, his nauigation hath bene from the East to the West. And what he hath gonne can not bee knowen but by the iudgement of a wyse and expert mā, according to the swiftnesse or goodnesse of his shippe, with consideration of the more or lesse tyme he hath had, as we haue sayde befoze in the fyrte Chapter. But if he fynde hym selfe in more or lesse degrees, let hym take two payze of compasses, and put the foote of one in the poynt or place where his shippe was when he departed: And the other in the lyne or wynde, by the whiche he sayleth. And lykelwyse let hym set the one poynt of the other compasse in the graduation of the Carde in that number of degrees y he fyndeth the altitude of y pole. And the other poynt of the same compasse in the next lyne of East and West. And so with both the compasses, one in the one hande, and the other in the other hande, lette hym go ioyning them together, takyng good heade that the poynt of the compasse do not swarue from the wynd, wherby he hath sayled: Neyther the poynt of the other compasse fro the line of East and West where he set it. And folowynge these two compasses by these two lynes, vntyll the poyntes of the two compasses ioyne (that is to meane, the point that was set in the place fro whence he departed, and the other that was set in the degrees that were founde) then wher these two pointes do ioyne, is the point where the shipp is. But (as we haue sayde in the fyrte Chapter) they muste haue great respecte to the wyndes and Seas, and other thynges which experience sheweth them, to knowe if they haue gone directlpe by that lyne, or if they hane fallen fro it, and to what parte. The whiche I remitte to the iudgement of men of good experience. From thence forwarde, they shall retorne to kepe the same accounte as when they departed from the hauen: especially when they chaunge theyr course.

To fynde
the distance
by the card.

Aduertises
mentes to
the Pilot.

L. i.

The

The. viii. Chapter of the making
 and vse of an Instrument generall to knowe the
 houres and quantities of the daye: And
 at what wynde the Sunne ryseth
 and falleth.



Take a rounde plate with a ryng or a handle aboue as in the Astrolabie: draw-
 ing a lyne from the rynge downe-
 ward passing throughe the center, and
 an other line that may cut it in righte
 angles throughe the center: And this
 last line shalbe called the Horizon.
 Then shall you geue a circle vpon the
 center: leauing so much space betwene it and the edge
 of the plate, that therein may be wyrtten the numbers of
 the degrees: Then also make an other circle somewhat
 more within: Leauing likewise a space where the gra-
 duations may be deuised. This done, deuide one of the
 highest quadrates toward the left hand, into. 90. partes
 whiche shalbe called the degrees of Altitude: beginning
 the number of them from the ringe, and ending the same
 in the Horizon. Then make an other rundell some what
 lesse then this, in suche maner that the degrees and nu-
 bers of the greater, remaine vncouered. And deuide this
 lesse, by two Diameters into foure equal partes. And at
 the one ende of the one Diameter, leaue a point comyng
 forth of the lesse rundell, cut directly with the same Dia-
 meter by the one parte. And this shalbe called the index
 or shewer. In this rundell you shall make a circle, halfe a
 fynger lesse then the rundell. Then with a compasse take
 23. degrees and a halfe from the Diameter whiche signi-
 fieth the Equinoctial. And where as end the. 23. degrees
 and a halfe for euery parte, make a ryght line from one
 poynt to an other: so that this be a line of. 47. degrees:
 and as much more at the other ende of the sayde Equi-
 noctiall. vpon euery one of these ryght lynes, you shall
 make a halfe cyrcle: And deuide euery of them into fyre
 equall partes whiche may aunswere to sixe signes. And
 euery

every signe into thre partes whiche may aunswer to the tenthes or tenth partes of degrees. And if the Instrumēt be great, you shall deuide every signe into fyue or more partes, so that you may make it perfecte & precise. This done, from the pointes or prickes of the one halfe circle, to the poyntes of the other, drawe certen lines whiche shalbe equidistant to the Equinoctiall. In the endes of these lines, betwene the lesse circle and the edge of the rundle, drawe also certen lines whiche may reache vnto the beginninges & endes of the signes. And in the top of the endes or ouer the endes of these lynes, make an arch so farre distant from the lesse circle, as is the thynknesse of the edge of a piece of foure rials of plate. And in the space that is lefte, graduate the sygnes from tenne to tenne, or as the diuision shalbe. The space that remaineth from thence to the edge of the rundle, you shall deuide by the halfe, and in it shalbe made twelue spaces where you shall set the sygnes with theyr names or characters orderly: So that Aries be nerte to the Equinoctiall. Then Taurus towarde the parte of the Inder. Then Gemini. And turning towarde the Equinoctiall, Cancer, Leo, Virgo. Like wyse on the other parte of the Equinoctiall, Libra, Scorpio, Sagittarius. And turning to the Equinoctiall, Capricornus, Aquarius, Pisces. And thus hauing signed the Zodiac, you shall also sygne or marke the houres in maner as foloweth. Deuide the lesse circle of this rundle into foure equal partes, so that every quarter may haue fyre partes. Reduce this deuision to the Diameter, puttyng the ruler vpon the poyntes equally distant from the Horizon. And where it toucheth the Equinoctiall, make pryckes or poyntes: So that the Equinoctiall remaine deuided into twelue partes. Then vpon one of the Tropikes, geue a circle whiche maye haue the same Tropike for his Diameter. Deuide this cyrcle into foure and twenty equall partes: And reduce these diuisions to the Tropike as is done in the Equinoctiall, & fro one Tropike to an other. Then the Equinoctiall and the Tropikes beyng thus deuided with these pryckes or poyntes, you shall passe

The placing
of the xii.
signes in
the instru-
ment.

The zodiac.

Deuision of
the Equino-
ctiall & Tro-
pikes.

The 3. part.

The houres
with their
numbers.

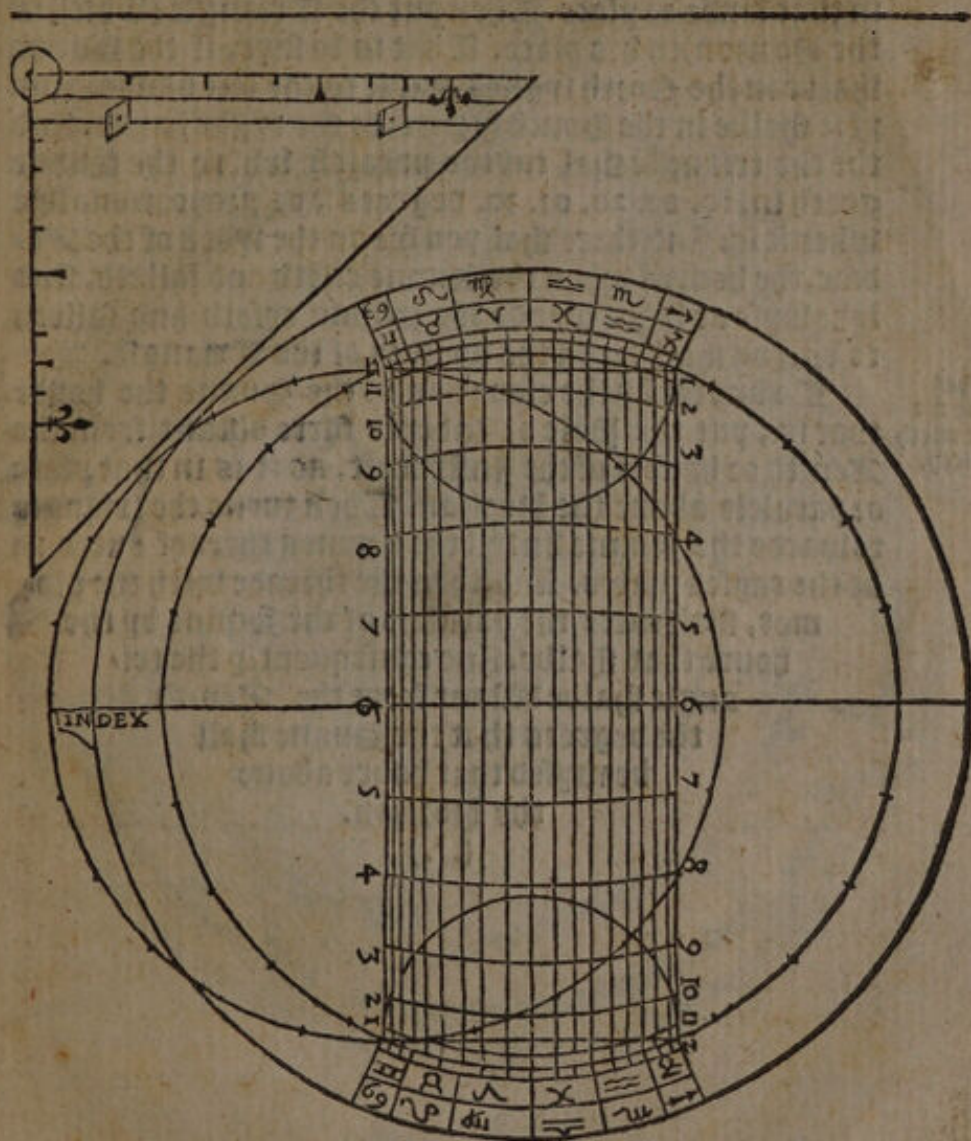
The triagle

Division of
the wyndes

With a payze of compasses by euery popnt equally orde-
red, from the Hoizon, to the one and the other parte.
And these shalbe called houres, wytyng in the endes of
them, their numbers: beginning the one parte in one,
and endyng it in twelue. On the other parte, begynne
one in thopposite part, and ende in twelue. This done,
these roundels shalbe brought to their perfectiō. More-
ouer, you shall make a Triangle, with a ryght Angle,
hauing two equal sydes that may make the right angle.
Euery of these sydes, must be as longe as is the Semi-
diameter of the greatest roundell: Also vpon and aboute
the right angle, you shall make a lytle circle, which shall
haue the same angle for his center: And on the one syde
of this triangle, set two rayfed plates as in the Astrola-
bie. On the contrary syde of these rayfed plates, must be
a hole, so farre distant from the center or angle, as is the
Semidiameter of the circle of the lesse roundell. In this
hole you must put a threade, hangyng thereat a lytle
weyght or plomet onely sufficient to holde the threade
streight, so that it cause nothing of the roundels to turn,
or the instrument to decline. Furthermoze, in a circle as
bygge as the lesse of the lesse roundell, you shall deuyde
into 32. partes the eight wyndes, and halfe wyndes, and
quarters of wyndes. And beyng thus reduced to theyr
Diameter (as is done in the Equinoctial) you shal tran-
sate them in the sydes of the triangle: In the whiche, by
the center of his little circle, and by the center of the rou-
dels, all the three pieces must be made fast with an Aris
or a nayle, so that they may be turned about close and be-
ry iust. Then put a ryng in the handle of the instrumēt,
wherby it may hange, as in the Astrolabie: And so shall
the instrument be synished and brought to perfection.

This

This is the trace or draughte of
the Instrument.



To knowe at
what houre
the Sunne
risseth or fal-
leth.

To knowe at what houre the Sunne risseth and falleth (by the Instrument folowynge) you shall put the pole of the lesse roundell (whiche is the Index) to the leftt hande in the greatestt rundle, in so many degrees aboue the Horizon, in howe many degrees the Pole is rayfed in that lande or place. Then put the Triangle (which is the Horizon) in his place. That is to saye, if the Sunne shalbe in the North sygnes, put it to the leftt hande. And yf it shalbe in the South sygnes, to the ryght hande. And the triangle shal cut the paralele where the Sunne goeth in. 10. or. 20. or. 30. degrees, or proportionallye wher it is. And there shal you see on the sydes of the Zodiac, the houres when the Sunne riseth and falleth. And lyke wyse at what wynde the Sunne risseth and falleth to vs, you shall see in the wyndes of the Triangle.

At what
wynde the
Sunne riseth
or falleth.

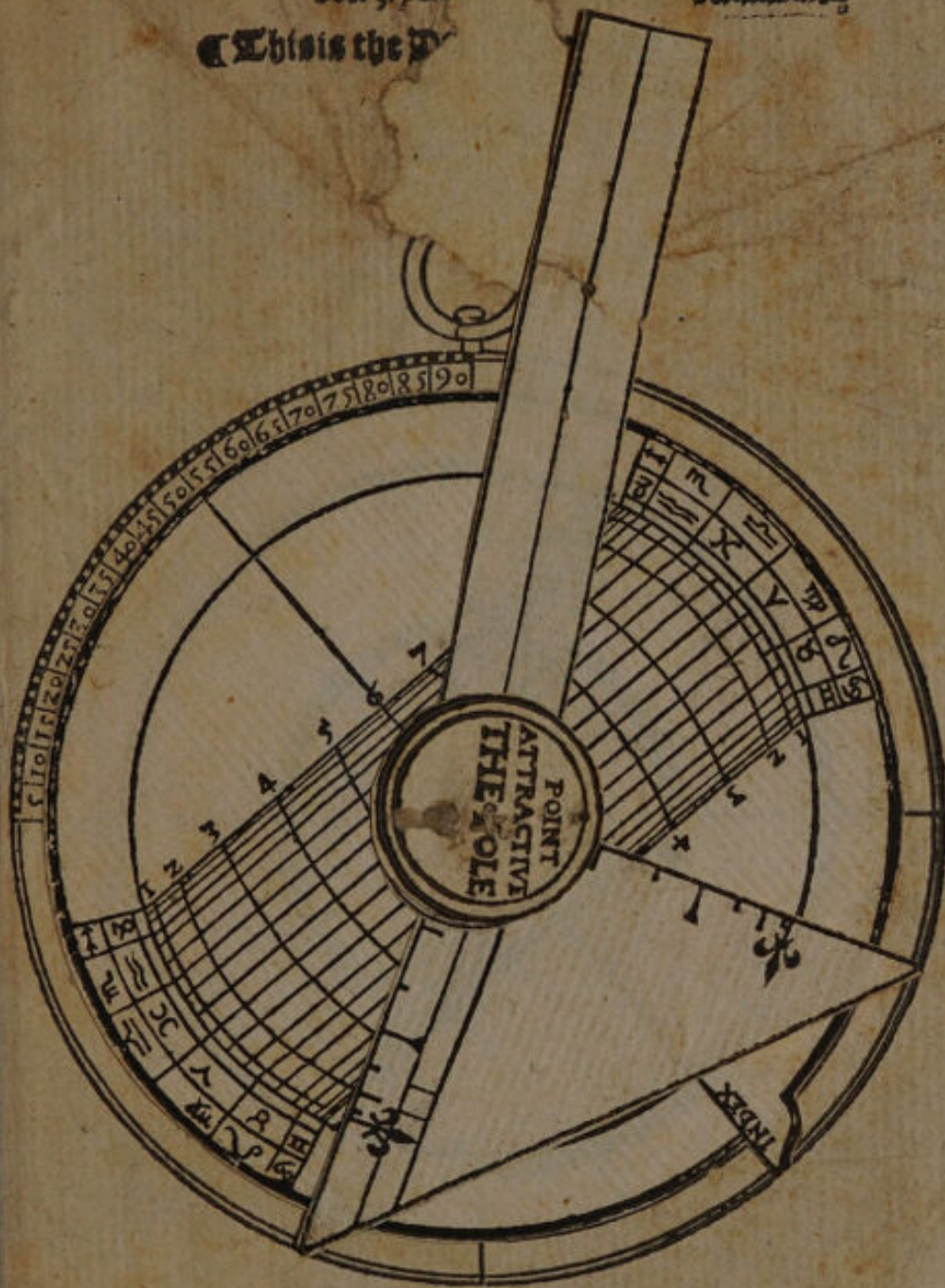
To knowe by the eleuation of the Sunne the houre that is, put the Pole or Index so farre distant from the Zenith or handle of the Instrumēt, as it is in that place or paralele aboue the Horizon. Then turne the triangle towarde the Sunne vntyll the beames thereof enter in at the rayfed plates. And then the threade with the plummet, shall cutte the paralele of the Sunne by the houre that shalbe. And consequently the triangle shalbe distant from the Zenith the degrees that the Sunne shall be rayfed that houre aboue the Horizon.

(. . .)

The 3. part

Fol. 100. 11.

Obtain the P



FINIS

