EARLY SCIENCE IN OXFORD

V

CHAUCER
AND
MESSAHALLA
ON THE ASTROLABE

NOW PRINTED IN FULL FOR
THE FIRST TIME WITH THE
ORIGINAL ILLUSTRATIONS

R. T. GUNTHER

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MS. Ashmole 391

PREFACE

It is certainly remarkable that the oldest work written in English upon an elaborate scientific instrument should never have been printed in full. And when we remember that the instrument is one of the most important that the world has known, that the author was our greatest astronomer-poet, Geoffrey Chaucer, and that his works are very widely studied, the neglect appears to be more than accidental: it is symptomatic of the attitude of the English mind to matters scientific.

A possible reason for this neglect is that the full understanding of the Treatise on the construction and use of an Astrolabe requires a greater mental effort than many more familiar scholastic exercises. As an introduction to the history of early science this Treatise is unique.

In many of its forms the Astrolabe can still claim to be one of the most valuable of educational instruments.

(1) It is a beautiful piece of workmanship, having a basis of beauty and order in mathematical curves.
(2) It is concrete and meant to be handled.
(3) It can be taken to pieces and put together again by a boy of 10, and so is superior to a watch or clock.
(4) It will provide an introduction to great and worthy fields of investigation—the heavens and the earth, geography, longitude and time, latitude, &c.
(5) It will serve to illustrate much of the great scientific work done by the ancients.

In short, the Astrolabe contains material for an

education from the nursery to the University, and Chaucer was very fully alive to its great and manifold utility. Manuscript copies of this work of Chaucer approaching completeness are not only very few in number and inaccessible to the general reader, but no single one has ever been printed in full. A most essential part, the figures of the various parts and uses of the instrument, has always been omitted. It is therefore scarcely surprising that many readers should complain of the author's meaning being obscure, and that they should ask, What is an Astrolabe?

To answer this question in simple language was Chaucer's chief object. He wrote his Treatise on the Astrolabe in 1387 for little Lewis, his 10-years-old son, to learn at Oxford, choosing 'naked wordes in Englissh', and deeming it better to write 'unto a child twice a good sentence than that he forget it once'. Modestly he disclaims further originality and acknowledges the earlier labour of the ancients, the 'olde Astrologiens', Alkabitius and Ptolemy; but he undoubtedly obtained the greater part of his book from some Latin version of the *Compositio et Operatio Astrolabii* of Messahalla, an Arabian astronomer who is thought to have flourished about the end of the eighth century. Chaucer certainly was of opinion that he had achieved simplicity in his explanations, for he gave his Treatise the title of

Bread and Milk for Children.

No one understood better than the great poet that words alone would not suffice to make his meaning clear. He directed his son to read the book with a real Astrolabe in hand. To make the description easier to comprehend, he illustrated every chapter with a neatly drawn diagram, specially drawn to explain each successive proposition, as in Euclid. Fifty-seven paragraphs conclude with the instruction, 'For more

declaracioun, lo here thi figure', and as many as sixty-two explanatory figures may occur in the more complete manuscripts, as in the fine manuscript in the Cambridge University Library known as Dd. 3. 53. Though Chaucer regarded diagrams as essential to his text, none of his publishers appears hitherto to have regarded them in the same light, and even Dr. Skeat has replaced them by sketches of his own devising, so that the modern reader has no means of ascertaining for himself what Chaucer intended. Chaucer's figures are now printed for the first time.

It is generally agreed that the Treatise is unfinished, for whereas the preface promises us a work in five parts only two are extant. It may be possible in the future to reconstruct the other three parts with the aid of contemporary copies of such astronomical codices as Chaucer is likely to have had at his disposal. In the meantime we print the headings of the missing parts, and suggest their contents.

The source to which the bulk of the matter can be traced is the parent book of Messahalla, of which copies are not rare in the great libraries of Europe. It was in two parts: on the Making, and on the Use of the Astrolabe. In the best manuscripts, Part I, the *De Compositione Astrolabii*, which begins, 'Scito quod astrolabium sit nomen Graecum', is illustrated with figures beautifully drawn in red ink. They were not included by Chaucer, probably because they would have made his Treatise too difficult for little Lewis. He would hardly have required them, since he had a ready-made instrument. The *De Compositione* is now printed in collotype facsimile with an English rendering and an expanded Latin version. Unhappily the reference letters in the text do not always correspond with those on the figures, and further adjustments will have to be made before a definitive text can be produced. Part II, the *De Operatione Astro-*

labii, beginning, 'Nomina instrumentorum sunt hec', supplied the main basis of Chaucer's work, and of this an English version is also appended. The original figures, with their finely drawn black lines and red lettering, are most attractive.

I desire to offer special thanks to the University Librarian at Cambridge, through whose courtesy the Cambridge manuscript was made accessible to me there; to Professor Garrod of Merton College, to the President of Corpus Christi College, and to Mr. Madan for elucidating difficulties in the text; especially to Sister Lavinia, for a first translation of the text of the *Compositio*; to Miss Bonstead for assistance in copying figures; and to the Rev. H. Green for reading the introduction and helping to settle the form to be adopted. While the style of the original drawings has for the most part been preserved, I have tried to modernize spelling and forms of expression in Chaucer's text, but hope I have not gone too far. Whether the 'translation' be easier to understand than the original, I do not know, but for those who desire a closer copy there is a reprint of a considerable portion of Skeat's transcript, and as Chaucer might have said

'With this swerd shal I slen envie.'

R. T. GUNTHER.

The Old Ashmolean,
Oxford.
May 1929.

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CHAUCER'S TREATISE ON THE ASTROLABE

MESSAHALLA ON THE ASTROLABE

English Translation

Latin Text.

TREATISE ON THE ASTROLABE.

Bread and milk for children.

Little Lewis my son, I have perceived well by certain signs thy ability to learn sciences touching numbers and proportions; and I also consider thy earnest prayer specially to learn the Treatise of the Astrolabe. Then forasmuch as a philosopher saith, 'he wrappeth him in his friend, who condescendeth to the rightful prayers of his friend,' therefore I have given thee an astrolabe for our horizon, composed for the latitude of Oxford, upon which, by means of this little treatise, I purpose to teach thee a certain number of conclusions appertaining to the same instrument. I say certain conclusions, for three reasons.

The first is this: understand that all the conclusions that have been found, or possibly might be found in so noble an instrument as an astrolabe, are not known perfectly to any mortal man in this region, as I suppose.

Another reason is this: that truly, in any treatise of the astrolabe that I have seen, there are some conclusions that will not in all things perform their promises. And some of them are too hard for thy tender age of ten years to understand.

I will show thee this treatise, divided into five parts, under full easy rules and in plain English words; for Latin thou knowest as yet but little, my little son. But nevertheless, these true conclusions are sufficient for thee in English, as they are in Greek

for noble Greek scholars, and in Arabic for Arabians, and in Hebrew for Jews, and in Latin for the Latin folk, for they have written them first out of other different languages, in their own tongue, that is to say, in Latin. And God knows, that in all these languages, and in many more, these conclusions have been sufficiently learned and taught, though by diverse rules, just as diverse paths lead diverse folk the right way to Rome. Now will I meekly pray every discreet person that readeth or heareth this little treatise, to have my rude inditing and my superfluity of words excused, for two causes. The first, that curious inditing and hard sentences are at once too difficult for a child to learn. And the second, that indeed it seems better to me to write a good sentence twice unto a child, rather than that he forget it once. And Lewis, if I show thee in my easy English as true conclusions touching this matter, and not only as true but as many and as subtle conclusions as are shown in Latin in any common treatise of the astrolabe, grant me the more thanks; and pray God save the King, who is lord of this language, and all that are true to him and obey him, each in his degree, the more and the less. But consider well, that I do not claim to have found this work by my own labour or ingenuity, I am but an unlearned compiler of the labour of old astrologians. I have translated it into English only for thy instruction; and with this sword shall I slay envy.

The first part of this treatise will rehearse the figures and the parts of thy astrolabe, so that thou mayest have the greater knowledge of thy own instrument.

The second part will teach thee to work the exact practice of the aforesaid conclusions, as far and as exactly as may be showed in so small and portable an instrument. For every astrologian well knows

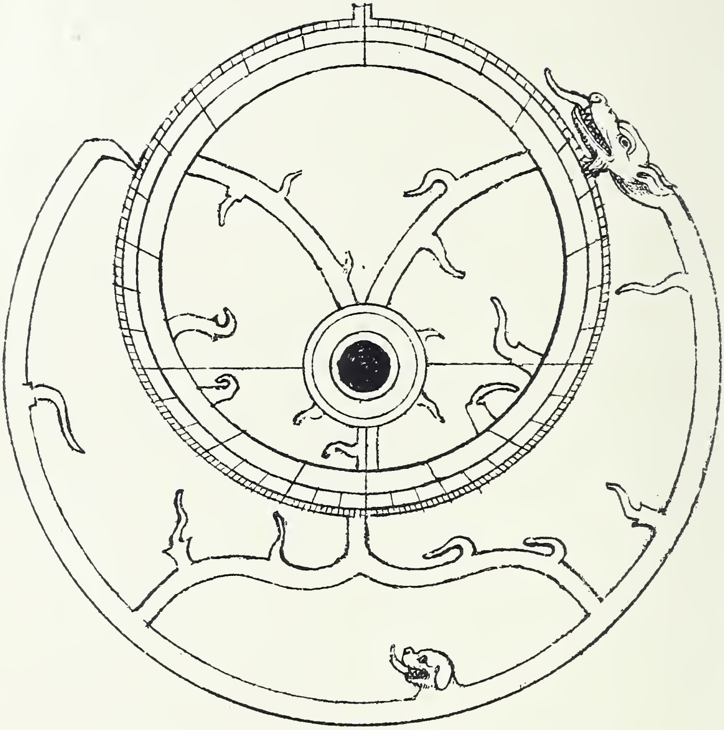
that the smallest fractions are not shown in so small an instrument, as they are in subtle tables calculated on purpose.

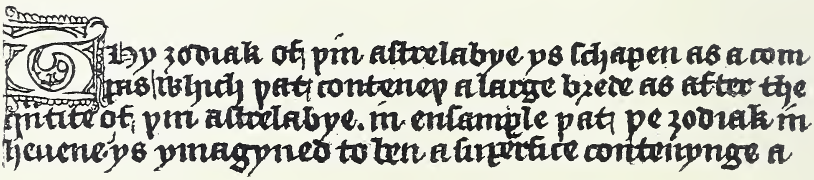
The third part will contain diverse tables of longitudes and latitudes of fixed stars for the astrolabe, and tables of declinations of the sun, and tables of longitudes of cities and of towns; both for the regulation of a clock and to find the meridian altitude, and many another notable conclusion, in accordance with the calendars of the reverend scholars, friar John Somer and friar Nicholas Lenne.[1]

The fourth part will be a theory to explain the moving of the celestial bodies with the causes. In particular it will show a table of the exact moving of the moon from hour to hour, every day and in every sign, after thy almanac; after which table there follows an explanation, sufficient to teach both the manner of the working of that same conclusion, and to know in our horizon the degree of the zodiac with which the moon rises in any latitude, and the arising of any planet in accordance with its latitude from the ecliptic line.

The fifth part will be an introduction according to the rules of our doctors, in which thou mayest learn a great part of the general rules of theory in astrology. In this fifth part thou wilt find tables of equations of 'houses' for the latitude of Oxford; and tables of dignities of planets, and other useful things, if God and his mother, the maid, will grant more than I promise.

[1] Somer's Calendar was calculated for 140 years from 1367. Lynn's for 76 years from 1387.





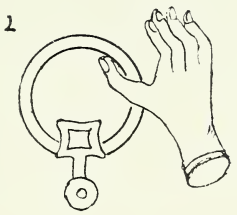
Thy zodiak of þin astrelabye ys schapen as a com
pas which þat conteneþ a large brede as after the
quantite of þin astrelabye. in ensample þat þe zodiak in
heuene ys ymagyned to ben a superfice conteynynge a

THE RETE OF CHAUCER'S ASTROLABE.
MS. Rawlinson D. 913.

PART I.

Here begynneth the Description of the Astrolabe.

1. Thy astrolabe hath a *ring* to put on the thumb of thy right hand when taking the height of things.



And note that from henceforward, I will call the height of any thing that is taken by thy 'rule', the *altitude*, without more words.

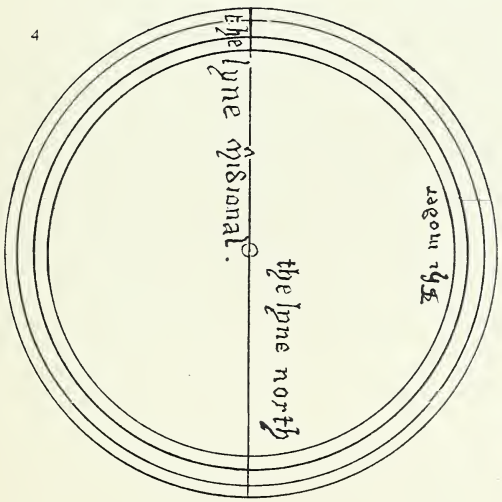
2. This ring runs in a kind of *eyelet*, fastened to the 'mother' of thy astrolabe, in so roomy a space that it does not prevent the instrument from hanging plumb.

3. The *mother* of thy astrolabe is a very thick plate, hollowed out with a large cavity, which receives within it the thin *plates*, marked for different climates, and thy *rete*, shaped like a net or the web of a spider. For more explanation, lo here the figure:

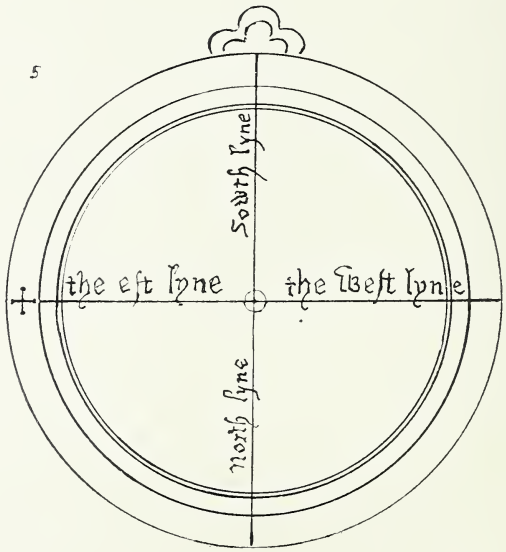
FIGURE SHOWING THE RETE LYING IN THE MOTHER.

Like the other text-figures it has been taken from MS. Cambridge Dd. 3. 53, and is obviously from the same source as the Rete on p. 4, with the head of the Dogstar, Alhabor, reversed.

4. This mother is divided on the backhalf with a line, which descends from the ring down to the lowest border. This line, from the aforesaid ring to the centre of the large cavity in the middle, is called the *south line*, or the *line meridional*. And the remainder of this line down to the border is called the *north line*, or the *line of midnight*. And for more explanation, lo here the figure:

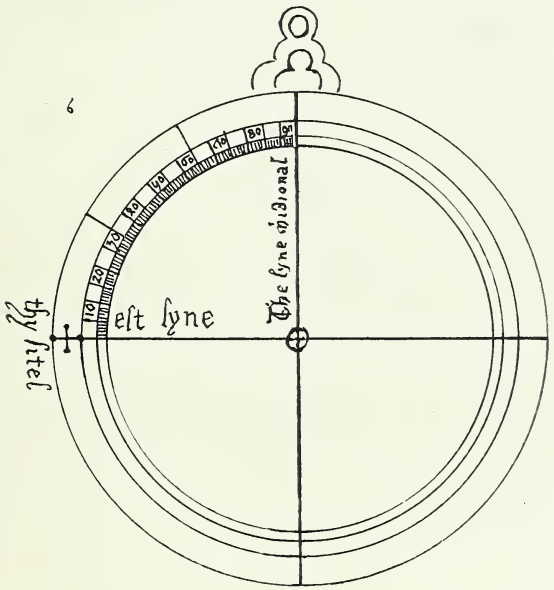


5. At right angles to the meridional line, there crosses it another line of the same length from east to west. This, from a little cross + in the border to the centre of the large cavity, is called the *east line*, or *line oriental*; and the remainder of the line from the aforesaid + to the border, is called the *west line*, or *line occidental*. Now hast thou here the 4 quarters of thy astrolabe, divided according to the 4 principal quarters of the compass, or quarters of the firmament. And for more explanation, lo here thy figure:



6. The east side of thy astrolabe is called the right side, and the west side is called the left side. Forget not this, little Lewis. Put the ring of thy astrolabe upon the thumb of thy right hand, and then its right side will be towards thy left side, and its left side will be towards thy right side; take this as a

general rule, as well on the back as on the hollow side. Upon the end of the east line, as I first said, is marked a little +, which is always regarded as the beginning of the first degree in which the sun rises. And for more explanation, lo here the figure:

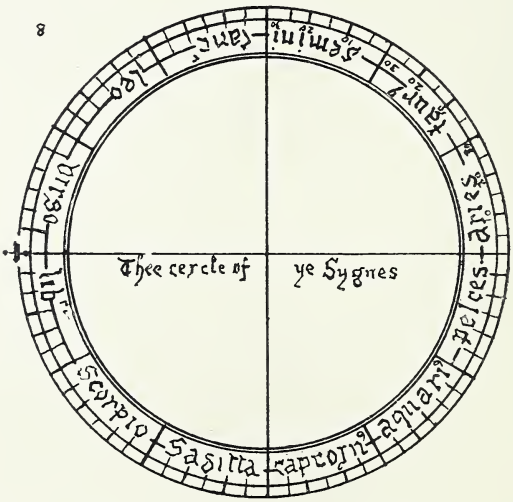


7. From this little + up to the end of the meridional line, under the ring, thou wilt find the *border divided into* 90 *degrees*; and every quarter of thy astrolabe is divided in the same proportion. Over these degrees are numbers, and the degrees are divided into fives as shown by long lines between. The space between the long lines containeth a mile-way.[1] And every degree of the border contains 4 minutes, that is to say, minutes of an hour. And for more explanation, lo here the figure:

[*The Figure is similar to the figure drawn above*].

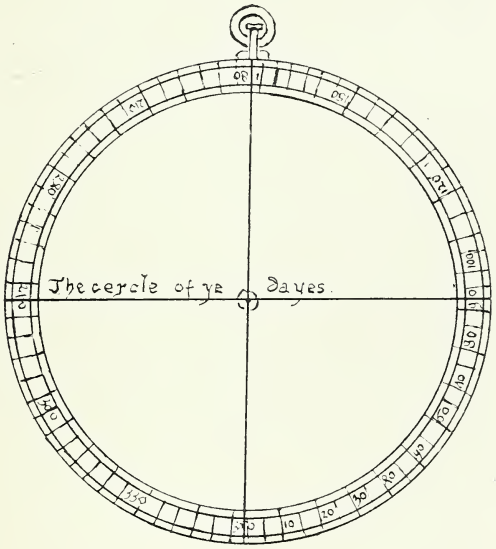
[1] The time it takes to walk a mile.

8. Under the circle of these degrees are written the *names of the 12 Signs*, as Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpio, Sagittarius, Capricornus, Aquarius, Pisces; and the numbers of the degrees of the Signs are written in Arabic numerals above, and with long divisions, from 5 to 5, divided from the time that the Sign entereth unto the last end. But understand well, that these degrees of Signs are each of them considered to be of 60 minutes, and every minute of 60 seconds, and so forth into small fractions infinite, as saith Alkabucius,[1] and therefore, know well, that a degree of the border containeth 4 minutes, and a degree of a Sign containeth 60 minutes; remember this. And for more explanation, lo here thy figure:



[1] Abdilazi Alchabitius, *Introductorium ad scientiam judicialem astronomiae*, printed 1473.

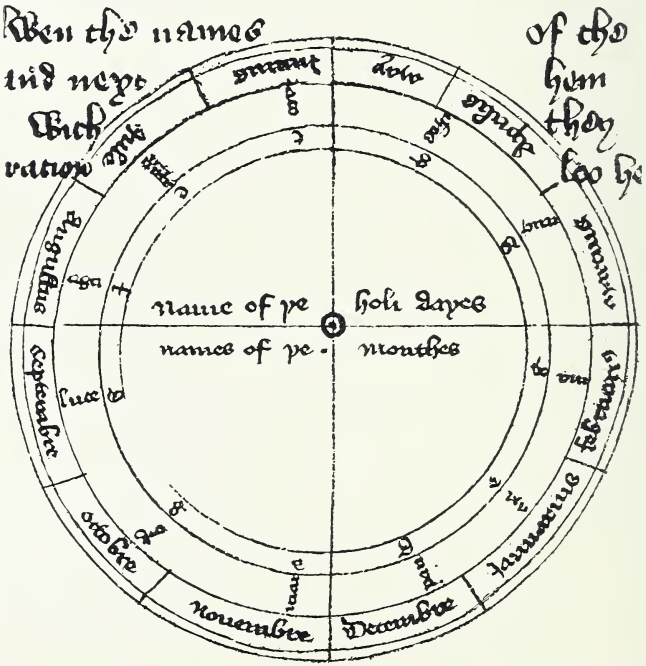
9. Next follows the *Circle of the Days*, in number 365 that are numbered as are the degrees, and divided also by long lines from 5 to 5; and the numbers under that circle are written in Arabic numerals. And for more explanation, lo here thy figure:



10. Next the circle of the days follows the *Circle of the Months*; that is to say, January, February, March, April, May, June, July, August, September, October, November, December. These months were named amongst the Arabians, some for their prophets, and some by statutes of lords, some by other lords of Rome. Also, as it pleased Julius Caesar and Caesar Augustus, some months were composed of different numbers of days, as July and August. Then hath January 31 days, February 28, March 31, April 30, May 31, June 30, July 31, August 31, September 30, October 31, November 30, December 31. Nevertheless, although Julius Caesar took 2 days out of

February and put them in his month of July,[1] and Augustus Caesar called the month of August after his own name and ordained it of 31 days; yet trust well, that the sun never dwelleth on that account more or less in one sign than in another.

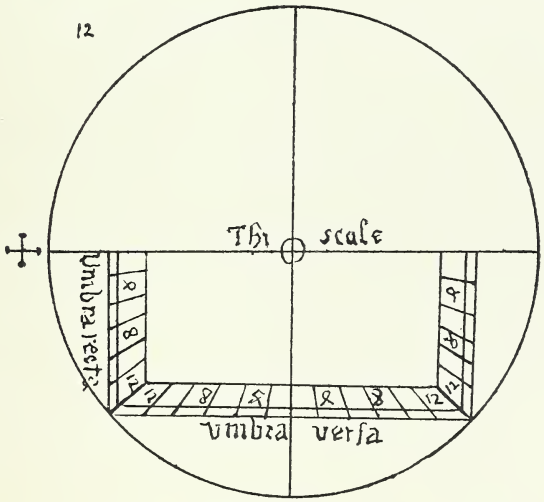
11. Then follow the names of the *Holydays* in the calendar, and next them the letters of the a. b. c. on which they fall. And for more explanation, lo here thy figure:[2]



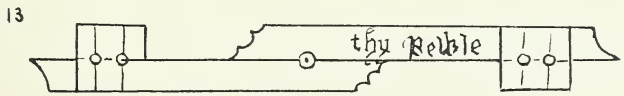
[1] This is not right. Julius Caesar added 2 days to January, August, and December, and 1 day to April, June, September, and November.

[2] The Festivals marked in the figure are those of St. Paul (Jan. 25), Purification (Feb. 2), Annunciation (March 25), Invention of the Cross (May 3), St. John Baptist (June 24), St. James (July 25), St. Lawrence (Aug. 10)?, Nativity B.V.M. (Sept. 8), St. Luke (Oct. 18), All Souls (Nov. 2), Conception B.V.M. (Dec. 8). But the scribe has put them in the wrong months.

12. Next to the aforesaid circle of the a. b. c., and under the crossline is marked a *scale*, like 2 measuring-rules or else like ladders, that serveth by its 12 points and its divisions for full many a subtle conclusion. Of this aforesaid scale, the part from the cross-line to the right angle, is called *umbra versa*, and the nether part is called *umbra recta*, or else *umbra extensa*.[1] And for more explanation, lo here the figure:



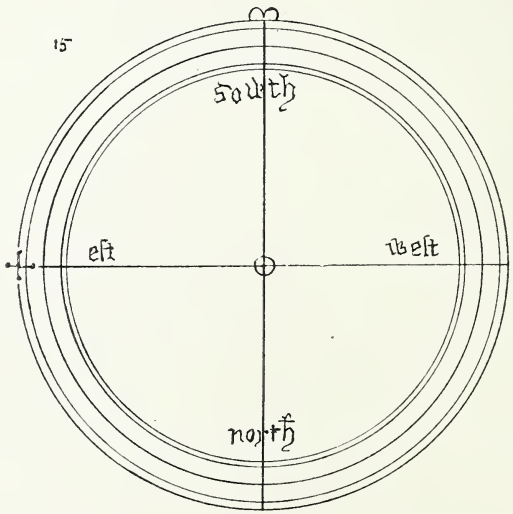
13. Then hast thou a broad *rule*, that hath on either end a square plate pierced with certain holes, to receive the streams of the sun by day, and also by means of thy eye, to know the altitude of stars by night. And for more explanation, lo here thy figure:



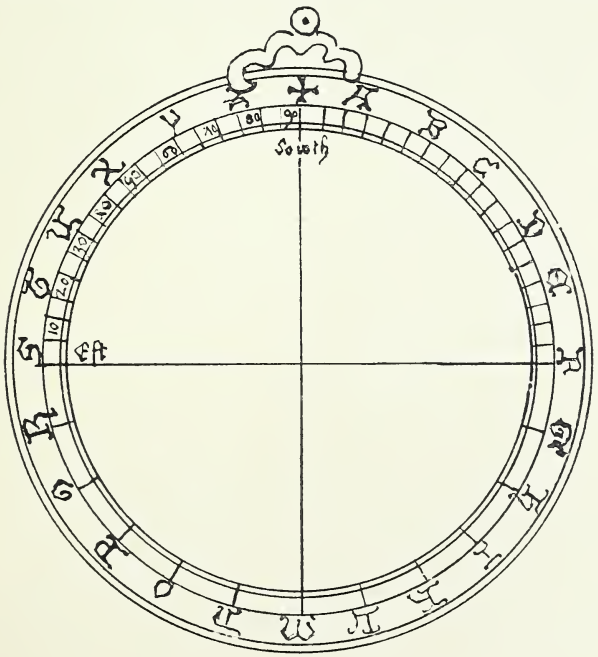
[1] The names are transposed in the original MS. and in the figure.

14. Then is there a large *pin* like an axle-tree, that goeth through the hole, and holdeth the tables of the climates and the rete in the cavity of the mother. Through this pin there goeth a little *wedge*, called the *horse*, which compresses all the parts in a heap; the pin which resembles an axle-tree, is imagined to be the pole arctic (north pole) in thy astrolabe. And for the more explanation, lo here the figure:

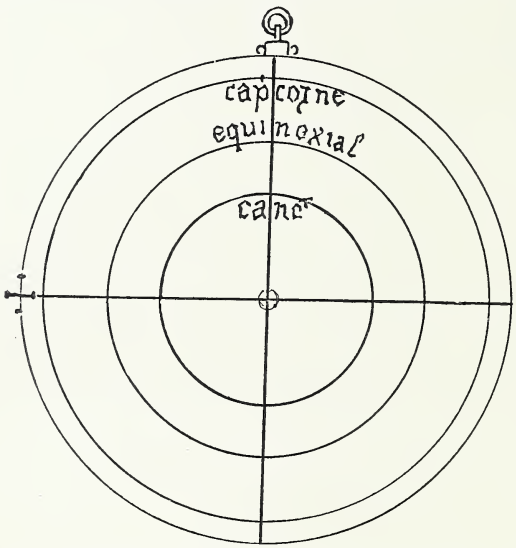
15. The hollow side of thy astrolabe is also divided with a long cross into 4 *quarters* from east to west, from south to north, from right side to left side, as is the back-side. And for the more explanation, lo here thy figure:



16. The border of the hollow-side is divided from the point of the east line to the point of the south line under the ring, into 90 *degrees*; and every quarter is divided by that same proportion. So too is the back-side divided, and that amounteth to 360 *degrees*. And understand well, that degrees of this border correspond with, and are concentric to, the degrees of the equinoctial, that is divided into the same number as is every other circle in the high heaven. This same border is also divided with 23 capital letters and a small cross + above the south line, so as to show the *24 equal hours* of the clock; and, as I have said, 5 of these degrees make a mile-way, and 3 mile-ways make an hour. And every degree of this border contains 4 minutes of time, and every minute contains 60 seconds. Now have I told thee twice, and for more explanation, lo here the figure:

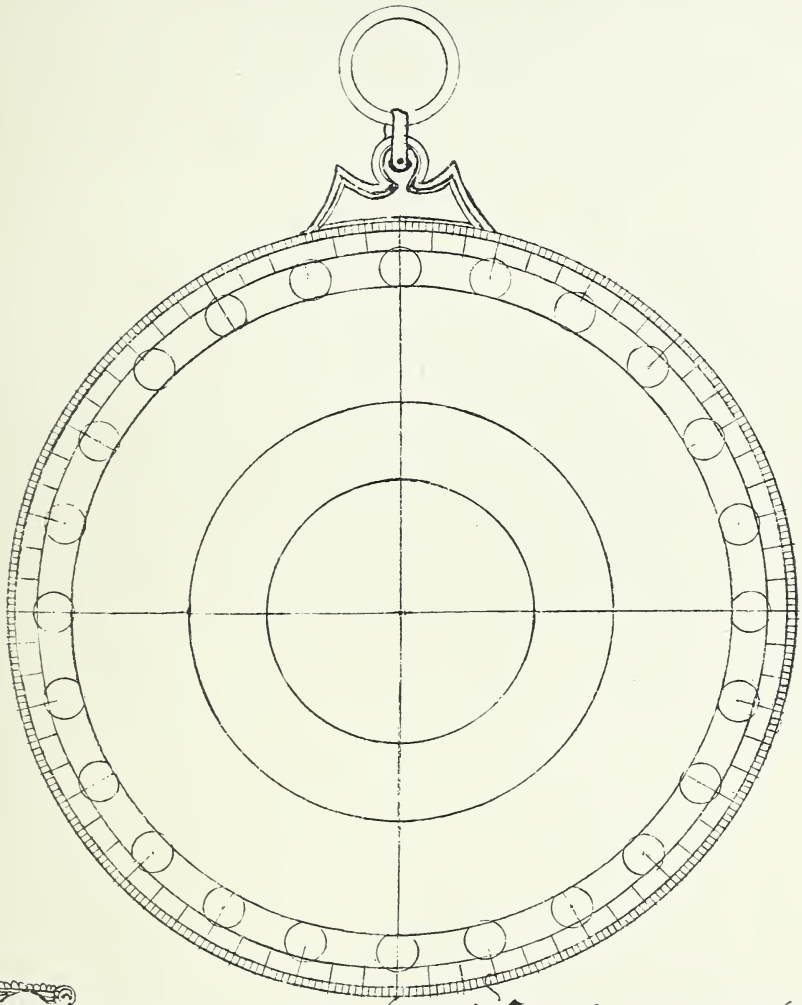


17. The *plate* under thy rete is marked with 3 principal circles; of which the least is called the *Circle of Cancer*, because that the head of Cancer, or the beginning of the Sign of Cancer in the rete, turneth evermore concentric upon this same circle.



In this head of Cancer is the greatest declination northward of the sun. And therefore is it called the solstice of summer; which declination, according to Ptolemy is 23 degrees and 50 minutes, as well in Cancer as in Capricorn. This sign of Cancer is called the *tropic* of summer, from *tropos*, that is to say a turning, for then beginneth the sun to pass away from us; and for the more explanation, lo here the figure:

The middle circle in wideness, of these 3, is called the *Equinoctial Circle*, upon which turns evermore the heads of Aries and Libra. And understand well, that evermore this equinoctial circle turns exactly from very east to very west; as I have shown thee in the solid sphere. This same circle is called also the weigher, *equator*, of the day, for when the sun is in the heads of Aries and Libra, then are the days and the nights equal in length in all the world. And therefore are these two signs called the *equinoxes*. And all that moveth within the heads of these Aries

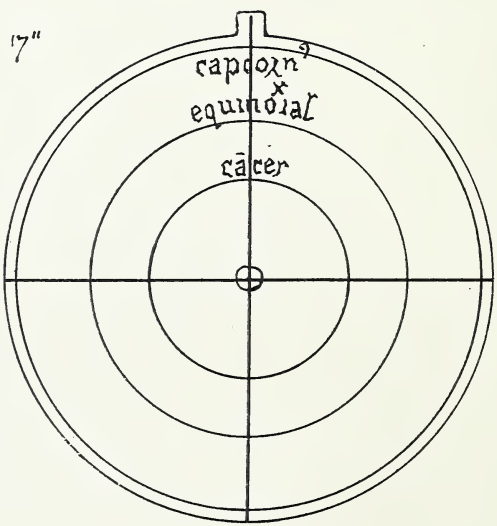


The plate under ye rete is discryued wip. 3. prin cipal cercles. Of which leeste ps clepd ye cercle of cancr. by cause pat ye hed of cancr turney cūmo con centrik upon ye same cercle. ¶ In pis hed of cancr is

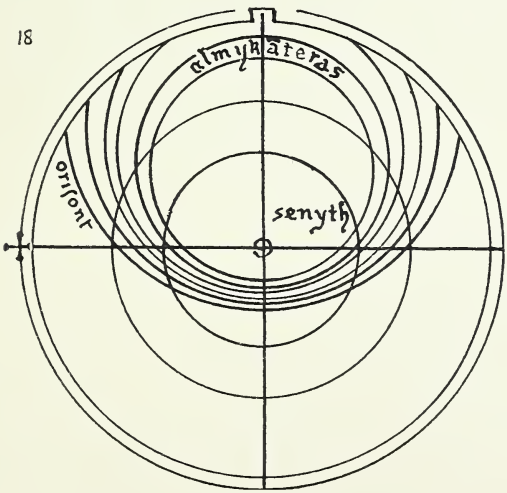
ALTERNATIVE FIGURE OF THE MOTHER OF CHAUCER'S ASTROLABE.
MS. Rawlinson D. 913.

and Libra, their moving is called northward, and all that moveth without these heads, their moving is called southward as from the equinoctial. Take heed of these latitudes north and south, and forget it not. By the equinoctial circle the 24 hours of the clock are considered; for [evermore] the arising of 15 degrees of the equinoctial maketh an equal hour of the clock. This equinoctial is called the girdle of the *first moving*, or else of the *angulus primi motus vel primi mobilis*. And note, that first moving is called 'moving' of the first movable of the 8th sphere, which motion is from east to west, and after again into east, also it is called 'girdle' of the first moving, for it divideth the first movable, that is to say, the sphere, in 2 equal parts, evenly distant from the poles of this world.

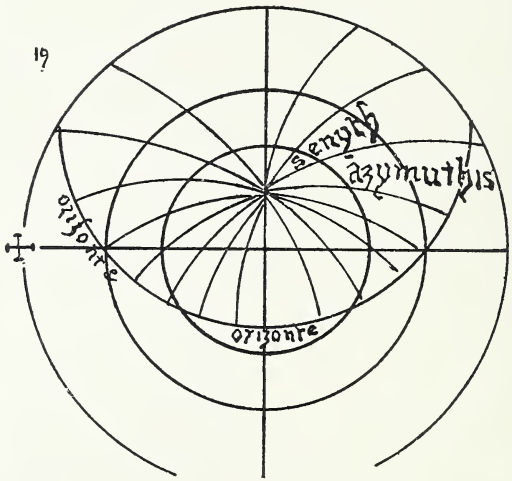
The widest of these 3 principal circles is called the *Circle of Capricorn*, because that the head of Capricorn turneth evermore concentric upon the same circle, in the head of Capricorn is the greatest declination southward of the sun, and therefore is it called the *solstice of winter*. This sign of Capricorn is also called the *tropic of winter* for then beginneth the sun to come again towards us. And for the more explanation, lo here thy figure:



18. Upon this aforesaid plate are drawn certain circles [of altitude] that are called *Almicanteras*, some of which seem perfect circles, and some seem imperfect. The centre that standeth amidst the narrowest circle is called the *zenith*; and the lowest circle, or the first circle, is called the *horizon*, that is to say, the circle that divides the two hemispheres, i. e. the part of the heaven above the earth, and the part beneath. These almicanteras are compounded by 2 and 2 [or are two degrees apart], but some other astrolabes have the almicanteras divided by one degree, others by two, and others by 3 degrees according to the size of the astrolabe. The aforesaid zenith is imagined to be the point exactly over the crown of thy head, and also the zenith is the exact pole of the horizon in every region. And for more explanation, lo here thy figure:

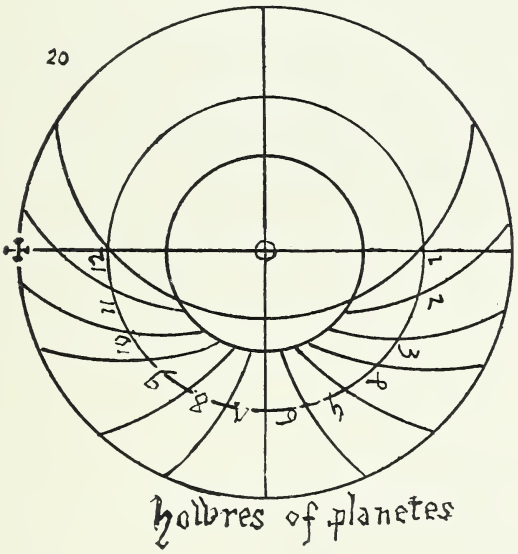


19. From this zenith, as it seemeth, there comes a kind of crooked lines like the claws of a spider, or else like the work of a woman's caul, crossing the almicanteras at right angles. These lines or divisions are called *azimuths*. They divide the horizon of thy astrolabe into 24 divisions. And serve to indicate the directions of the firmament, and to other conclusions, such as the position of the cenith [1] of the sun and of every star. And for more explanation, lo here thy figure:



[1] The cenith (*not* zenith) was the 'point of the horizon denoting the sun's place in azimuth' (Skeat). In the figure the 18 azimuth lines have been carelessly sketched: they should be symmetrical and 24 in number.

20. Next the azimuths, under the Circle of Cancer, there are 12 oblique divisions, much like to the shape of the azimuths; they show the spaces of the *hours of planets.* And for more explanation, lo here thy figure:



21. The *rete* of thy astrolabe with thy zodiac, shaped like a net or a spider's web, according to the old description, thou mayest turn up and down as thyself liketh. It contains a certain number of fixed stars, with their longitudes and latitudes properly ascertained, if the maker have not erred. The *names of the stars* are written in the margin of the rete where they are situate; and the small point of each star is called the centre. Understand also that all stars situated within the zodiac of thy astrolabe are called stars of the north, for they rise north of the east line. And all the rest of the fixed stars, out of the zodiac, are called stars of the south; but I say not that they all rise to the south of the east line; witness one, Aldebaran and Algomeisa. Understand generally this rule, that those stars that are called stars of the north rise sooner than the degree of their longitude; and all the stars of the south rise later than the degree of their longitude; that is to say, the fixed stars in thy astrolabe. The measure of this longitude of stars is taken in the *ecliptic line* of heaven, on[1] which line, when the sun and moon are in an exact line, or else closely bordering upon it, then an eclipse of the sun or of the moon is possible, as I shall declare, and also the cause why. But truly the ecliptic line of the zodiac is the outermost border of thy zodiac, where the degrees are marked.

The *zodiac* of thy astrolabe is shaped like a circle that contains a large breadth, in proportion to the size of thy astrolabe, to signify that the zodiac in heaven is imagined to be a surface containing a latitude of 12 degrees, whereas all the rest of the circles in the heaven are imagined true lines without any latitude. Amidst this celestial zodiac is imagined

[1] Chaucer wrote 'under', as on p. 62.

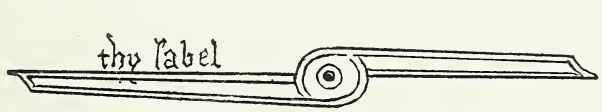
a line, called the ecliptic line, on which line is evermore the way of the sun. Thus there are 6 degrees of the zodiac on one side of the line, and 6 degrees on the other. In the rete of an astrolabe the zodiac band represents the 6 degrees of the zodiac on the northern side of the ecliptic line. The zodiac is divided into 12 principal divisions, dividing the 12 signs. And, for the accuracy of thy astrolabe, every small division in a sign is divided by two degrees and two; I mean degrees containing 60 minutes. And this aforesaid heavenly zodiac is called the circle of the signs, or the circle of the beasts, for 'zodia' in the Greek language means 'beasts' in the Latin tongue. And in the zodiac are the 12 *signs* that have names of beasts; either because when the sun enters into any of the signs, he taketh the property of such beasts; or else because the stars that are fixed there are disposed in signs of beasts, or shaped like beasts; or else, when the planets are under these signs, they act upon us by their influence, operations and effects like to the operations of beasts. And understand also, that when a hot planet comes into a hot sign, then its heat increaseth; and if a planet be cold, then its coldness diminisheth, because of the hot sign. And by this conclusion thou mayest take example in all the signs, be they moist or dry, movable or fixed; reckoning the quality of the planet as I first said.

And each of these 12 signs hath respect to a certain part of the body of a man and hath it in subjection; as Aries hath thy head, and Taurus thy neck and thy throat, Gemini thy armholes and thy arms, and so forth; as shall be shown more plainly in the 5th part of this treatise. This zodiac, which is part of the 8th sphere, cuts across the Equinoctial; and crosses it again in equal parts, of which one half declineth southward, and the other northward, as the

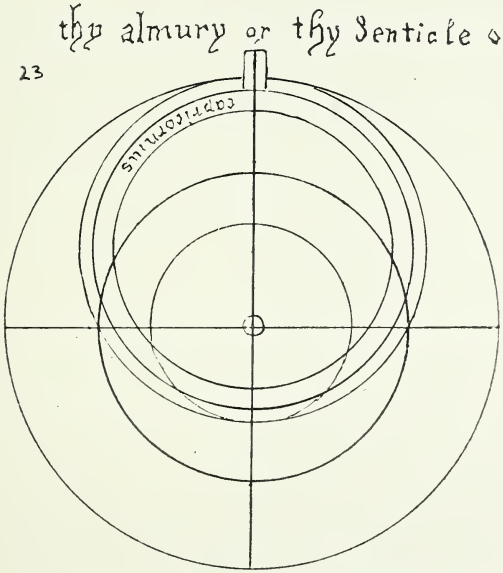
Treatise of the Sphere plainly declareth. And for more explanation, lo here thy figure:

as a label þt is shapen lik a rewle

22. Then thou hast a *label*, that is shaped like a rule, save that it is straight and hath no plates with holes at the ends; but by the point of the aforesaid label, thou wilt calculate thy equations in the border of thy astrolabe, as by thy almury. And for more declaration, lo here thy figure:



23. Thy *almury* is called the denticle of Capricorn or else the calculator. It is situate fixed in the head of Capricorn, and it serveth for many a necessary conclusion in equations of things, as shall be shown. And for the more declaration, lo here thy figure:



Her endith the Description of the Astrelabie.

*** The sections that have been derived from the Treatise on the Astrolabe of Messahalla are noted on pages 168 and 169.

PART II.

Her bygynnen the Conclusions of the Astrelabie.

1. To find the degree in which the sun is day by day, after her[1] course about.

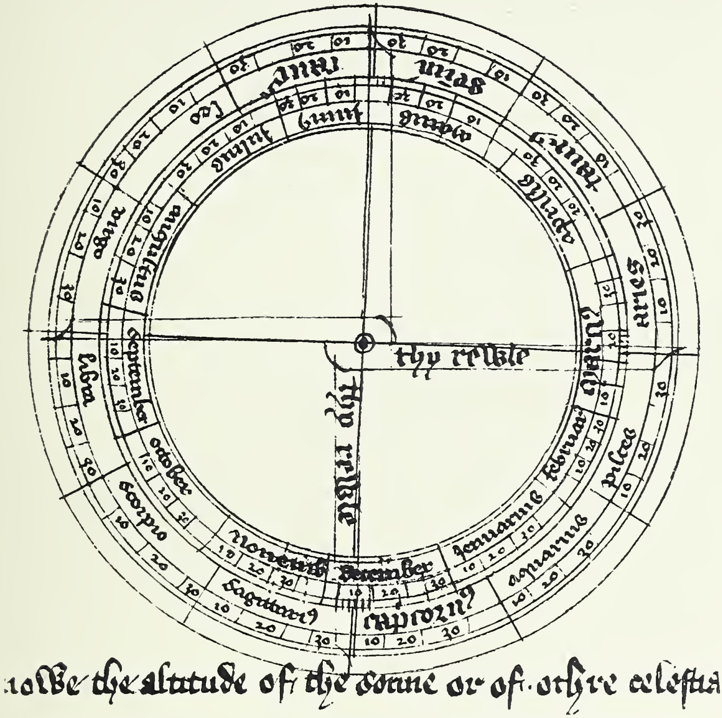
Ascertain the day of thy month, and lay thy rule upon that day, then the true point of thy rule will sit in the border, on the degree of thy sun.

Example as thus: In the year of our Lord 1391, on the 12th day of March[2] at midday, I wished to know the degree of the sun. I sought in the back-half of my astrolabe, and found the circle of the days, which I know by the names of the months written under the circle. Then I laid my rule over the said day, and found the point of my rule in the border upon the first degree of Aries, a little within the degree; thus I know this conclusion.

On another day, I wanted to know the degree of my sun at midday on the 13th day of December; I found the day of the month as I have said, then I laid my rule upon the said 13th day, and found the point of my rule in the border upon the first degree of Capricorn, a little within the degree. And then I had the full experience of this conclusion; and for the more explanation, lo here thy figure:

[1] The sun was of the feminine gender in Anglo-Saxon.

[2] Chaucer's dates are about 8 days behind ours, e. g. his March 12 is our March 21.



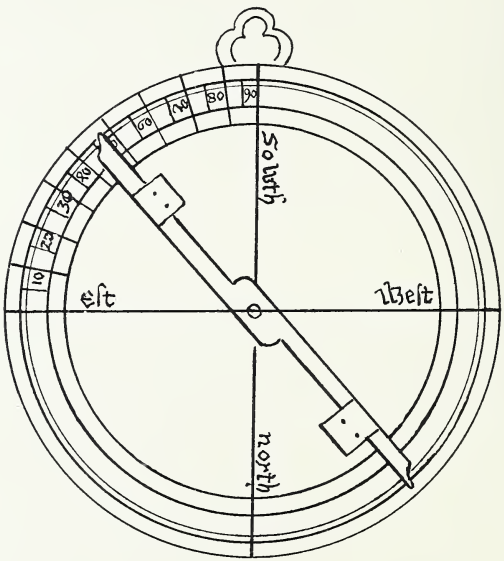
1. To fynde the degree in which the sonne is day by day, after hir cours abowte.

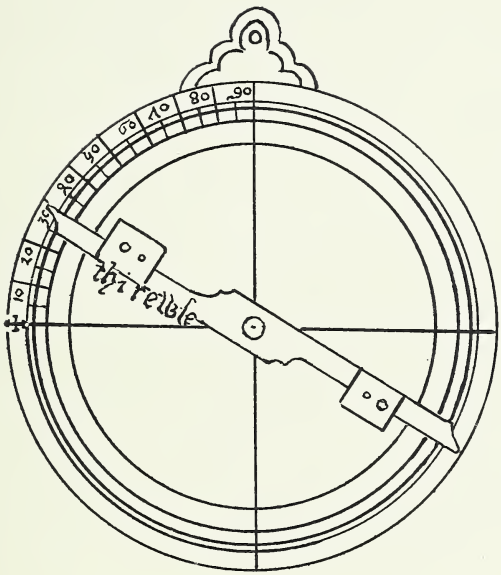
[*Hic incipiunt Conclusi nes Astrolabii; et prima est ad inveniendum gradus solis in quibus singulis diebus secundum cursum sol est existens.*]

Rekene and knowe which is the day of thi monthe and ley thi reule vp that same day, and thanne wol the verray point of thy rewle sitten in the bordure, vpon the degree of thy sonne. Ensample as thus; the yer of oure lord 1391, the 12 day of March at Midday, I wolde knowe the degree of the sonne. I sowhte in the bakhalf of myn astrelabie, and fond the sercle of the daies, the which I knowe by the names of the Monthes writen vndur the same Cercle. Tho leide I my rewle ouer this forseide day, and fond the point of my rewle in the bordure vpon the firste degree of Aries, a litel within the degree and thus knowe I this conclusioun. Another day, I wolde knowe the degree of my sonne, and this was at Midday in the 13 day of decembre; I fond the day of the monthe in maner as I seide tho leide I my rewle vpon this forseide 13 day, and found the point of my rewle in the bordure vpon the first degree of capricorne a lite within the degree, and than had I of this conclusioun the ful experience. And for the more declaracioun, lo her thi figure. [*Messahalla*, § 1.

2. To find the altitude of the sun, or of other celestial bodies.

Put the ring of thy astrolabe upon thy right thumb and turn thy left side against the light of the sun. And move thy rule up and down till the streams of the sun shine through both holes of thy rule. Then look to see how many degrees thy rule is raised from the little cross upon thy east line, and take there the altitude of thy sun. In this same wise thou mayest find by night the altitude of the moon, or of bright stars. This chapter is so general, that there needeth no more explanation; but forget it not. And for the more explanation, lo here thy figure:





2. To knowe the altitude of the sonne, or of othre celestial bodies.

[*De altitudine solis et aliorum corporum supracelestium.*]

Put the ring of thin Astrelabie vpon thi riht thowmbe and turne thi lift side agayn the light of the sonne. And remeue thi rewle vp and down til that the stremes of the sonne shyne thorgh bothe holes of thi rewle. Loke thanne how many degrees thi rewle is areised fro the litel crois vpon thin est line, and tak ther the altitude of thi sonne: and in this same wyse maistow knowe by nyhte the altitude of the Mone, or of brihte sterres. This chapitre is so general euer in on, that ther nedith no more declaracion; but forget it nat. And for the more declaracioun, lo here the figure.

[*Messahalla*, § 2.

3. **To know every time of the day by the light of the sun, and every time of the night by the fixed stars, and also to know by night or by day the degree of any sign that ascendeth on the east horizon, which is commonly named the ascendent or horoscope.**

Take the altitude of the sun when thou listeth, as I have said: and if it be before the middle of the day, set the degree of the sun among thy almicanteras on the east side of thy astrolabe; and if it be after the middle of the day, set the degree of thy sun upon the west side. Take this manner of setting for a general rule, once for ever. And when thou hast set the degree of thy sun upon as many almicanteras of height as was the altitude of the sun taken by thy rule, lay thy label over the degree of the sun; and then the point of thy label will be situate in the border, upon the true time of the day.

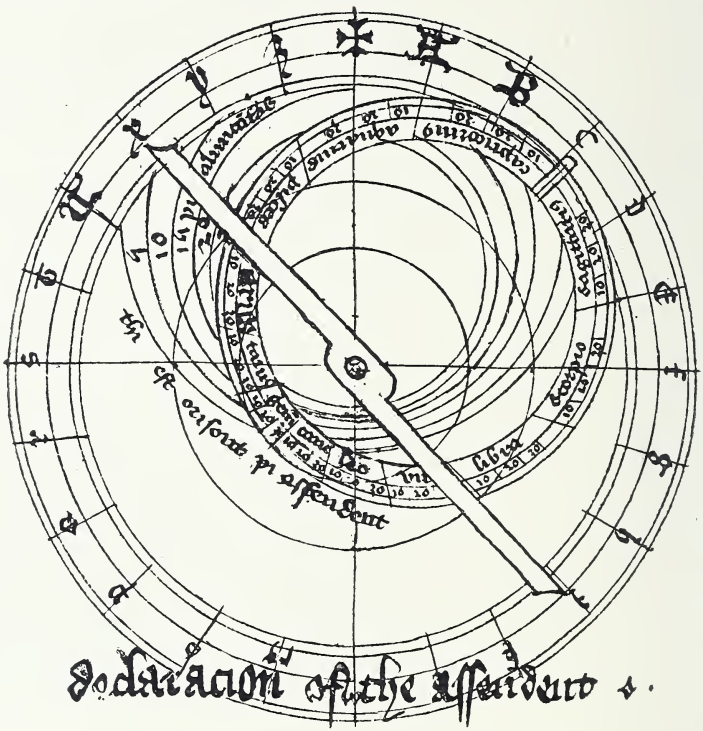
Example as thus: In the year of our Lord 1391, on the 12th day of March, I wished to know the time of the day. I took the altitude of my sun, and found that it was 25 degrees and 30 minutes of height in the border on the backside. I then turned my astrolabe, and because it was before midday, I turned my rete and set the degree of the sun; that is to say the 1st degree of Aries, on the right side of my astrolabe, upon that 25 degrees and 30 minutes of height among the almicanteras; then I laid my label upon the degree of my sun, and found the point of my label in the border, upon a capital letter that is named an X; then I counted all the capital letters from the line of midnight to the aforesaid letter X, and found that it was 9 o'clock of the day. Then I looked at east horizon, and found there the 20th degree of Gemini ascending, and I took that for my ascen-

dent. In this wise I had learnt for evermore how to find out the time of the day, and also the ascendent.[1]

On the following night I desired to know the hour of the night, and wrought in this wise, among an heap of fixed stars, I determined to take the altitude of the fair white star that is named Alhabor (Sirius), and found her situate on the west side of the midday line at 18 degrees of height taken by my rule on the backside. Then I set the centre of this Alhabor upon 18 degrees among my almicanteras upon the west side, because she was found on the west side. Then I laid my label over the degree of the sun that had descended under the west horizon, and reckoned all the capital letters from the midday line unto the point of my label in the border; and found that it was passed 8 o'clock by the space of 2 degrees (i. e. 8 minutes); then I looked at my east horizon, and found there 23 degrees of Libra ascending, which I took for my ascendent; and thus I learned to know once for all how to find the hour of the night, and my ascendent, as accurately as may be done by so small an instrument. But nevertheless in general I would warn thee for ever. Never make thee bold to have taken a just ascendent by thy astrolabe, or to have set a clock exactly right, when any celestial body which thou believest to govern those things is nigh the south line: it is certain that when the sun is nigh the meridional line, the degree of the sun runs concentric upon the almicanteras for so long that thou shalt err from the true ascendent. The same conclusion is declared by the observation of any fixed star at night. And moreover, by experience, I know well that in our horizon, from 11 o'clock unto one o'clock, it is too hard to determine a just ascendent with a small portable astrolabe. I mean, from 11 o'clock before the hour of noon, till 1 o'clock

[1] MS. Bodley 619 here adds a passage printed on p. 182, note.

next following. And for the more explanation, lo here thy figure:



3. To knowe euery tyme of the day by liht of the sonne, and euery tyme of the nyht by the sterres fixe, and eke to knowe by nyht or by day the degree of any signe that assendith on the est Orisonte, which that is cleped communly the assendent or elles oruscupum.

[*Ad cognoscendum quidlibet tempus diei per solis indicacionem, et quodlibet tempus noctis per quasdam stellas in celo fixas; ac eciam ad inveniendum et cognoscendum signum super orizontem qui communiter vocatur ascendens.*]

Tak the altitude of the sonne whan the list, as I haue said; and set the degree of the sonne, in kas that it be byforn the Middel of the day, among thin almykanteras on the est side of thin astralabie; and ghif it be after the Middel of the day, set the degree of thy sonne vpon the west side: tak this manere of settyng for a general rewle, ones for euere. And whan thow hast set the degree of thy

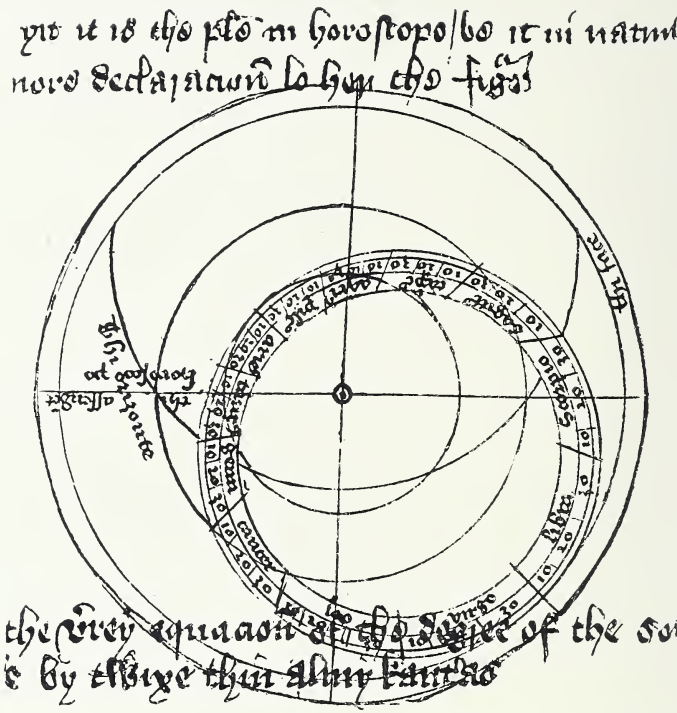
sonne vp as many Almykanteras of heyhte as was the altitude of the sonne takyn by thi rewle, ley ouer thi label, vpon the degree of the sonne; and thanne wol the point of thi label sitten in the bordure, vpon the verrey tid of the day. Ensample as thus the yer of owre lord 1391, the 12 day of March, I wold knowe the tyd of the day. I tok the altitude of my sonne, and fond that it was 25 degrees and 30 of Minutes of heyhte in the bordure on the bakside. Tho turnede I Myn astrelabie, and by cause that it was byforn Midday, I turnede Mi riet and sette the degree of the sonne, that is to seyn the .l. degree of Aries on the riht side of myn Astralabie, vpon that 25 degrees and 30 of Minutes of heyhte among myn almykanteras, tho leide I my label vpon the degree of my sonne, and fond the poynte of my label in the bordure, vpon a capital lettre that is cleped an X; tho rekened I alle the capitalles lettres fro the lyne of Midnyght vnto this forseide lettre X, and fond that it was 9 of the clokke of the day. Tho loked I down vpon the Est Orisonte, and fond there the 20 degree of gemynis assending; which that I tok for Myn assendent. And in this wyse hadde I the experience for euermo in wich maner I sholde knowe the tyde of the day and ek myn assendent. Tho wold I wyte the same nyght folwyng the howr of the nyght, and wrowhte in this wyse among an hep of sterris fixe, it liked me for to take the altitude of the feire white sterre that is cleped Alhabor, and fond hir sitting on the west side of the line of Midday, 18 degres of heyhte taken by my rewle on the bakside. Tho sette I the centre of this Alhabor vpon 18 degrees among myn Almykanteras, vpon the west side; by cause that she was fonden on the west side. Tho leide I my label ouer the degree of the sonne that was descended vnder the weste Orisonte, and rikened alle the lettres capitals fro the lyne of Midday vnto the point of my label in the bordure; and fond that it was passed 8 of the clokke the space of 2 degrees, tho loked I doun vpon myn est orisonte, and fond ther 23 degrees of libra assending, whom I tok for myn assendent; and thus lerned I to knowe ones for euer in which Manere I shuld come to the howre of the nyht and to myn assendent; as verreyli as may be taken by so smal an instrument, but natheles in general wold I warne the for euere, ne mak the neuere bold to haue tak a Iust Ascendent by thin Astrilabie, or elles to haue sette Iustly a clokke, whan any celestial body by which that thow wenest gouer e thilke thynges ben ney the sowth lyne for trust wel, whan that the sonne is ney the Meridional lyne, the degree of the sonne rennyth so longe consentrik vpon the almykanteras, that sothly thow shalt erre fro the Iust assendent. The same conclusioun sey I by the centre of any sterre fix by nyht; and moreouer, by experience, I wot wel that in owre Orisonte, from .xi. of the clokke vnto oon of the clokke, in takyng of a Iust assendent in a portatif Astrelabie, hit is to hard to knowe. I mene, from .xi. of the clokke byforn the howre of noon til oon of the clok next folwyng. And for the more declaracion, lo her thi figure.

4. Special explanation of the ascendent.

The ascendent indeed, both in all nativities as in questions and elections of times, is a thing which Astrologers greatly observe. Wherefore it seemeth me convenient to make special explanation of the ascendent. The ascendent in truth, to take it at the largest, is the degree that ascends upon the east horizon at any of these aforesaid times; and therefore, if any planet ascend at the same time in that aforesaid degree of its longitude, men say that that planet is *in horoscopo*.[1] But truly, the house of the ascendent, that is to say, the first house or the east angle, is a broader or larger thing. For according to their laws Astrologers reckon every planet or celestial body that is 5 degrees or less than 5 degrees above the degree that ascendeth, to be in the ascendent. And whatever planet is within 25 degrees under the degree that ascendeth, they say that that planet is like to the one that is in the house of the ascendent; but truly, if it pass the bounds of these aforesaid spaces, above or beneath, they say that the planet is remote from the ascendent. These astrologers say that the ascendent and also the lord of the ascendent may be fortunate or unfortunate; as thus, a fortunate ascendent is when no wicked planet, as Saturn or Mars, or else the tail of the Dragon is in the house of the ascendent, nor any wicked planet has an aspect of enmity upon the ascendent; but they will cast that they have a fortunate planet in their ascendent, and in his felicity they say that it is well. Furthermore, they say that the unlucky condition of an ascendent is the contrary of these aforesaid things. The lord of the ascendent they say is

[1] The horoscope is the point of the ecliptic which is just rising.

fortunate, when he is in a good place from the ascendent, as in an angle, or in a succedent, where he is in his dignity and comforted with friendly aspects of planets, and is well received; also that he may see the ascendent, and be not retrograde nor quenched, nor joined with any evil planet in the same sign, nor be in his descension, nor joined with any planet in his descension, nor have upon him any unfortunate aspect; then they say that he is well. Nevertheless, these are observances of judicial matter and of rites of pagans, in which my spirit hath no faith, nor any knowing of their *horoscopum*; for they say that every sign is divided into 3 even parts by 10 degrees, and every such portion they call a *face*. And although a planet may have a latitude from the ecliptic, yet some folk say that so long as the planet arises in the same sign as any degree of the aforesaid face in which its longitude is reckoned, yet the planet is still *in horoscopo*, be it in nativity or in election, etc. And for more explanation, lo here the figure.



4. Special declaracion of the assendent.

[*Specialis declaracio de ascendente.*]

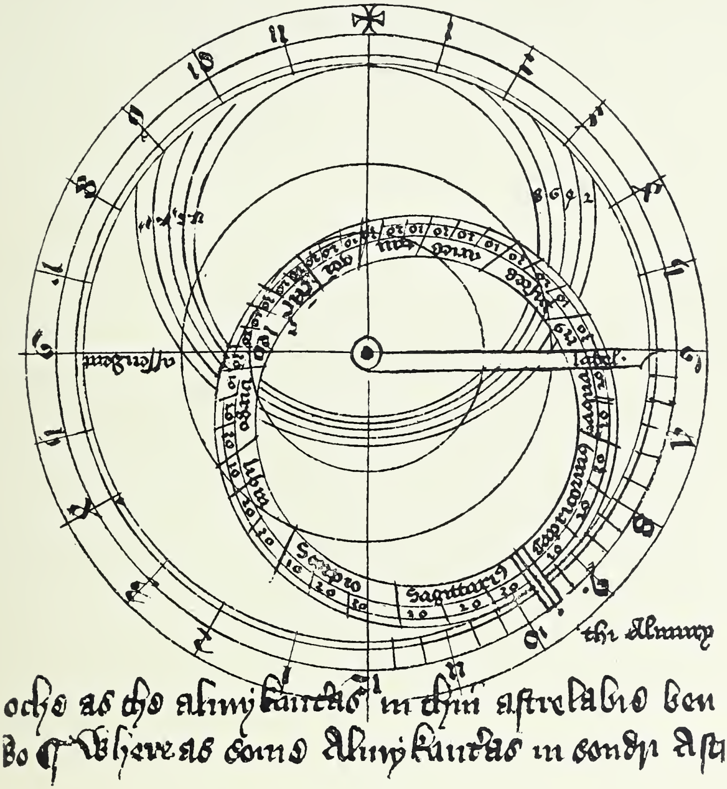
The assendent sothly, as wel in alle natiuitez as in questiouns and eleccioun of tymes, is a thing which that thise Astrologiens gretly obseruen, wherfore me semeth conuenient, sin that I speke of the assendent, to make of it special declaracioun. The assendent sothly, to take it at the largeste, is thilke degree that ascendith at any of thise forseide tymes vpon the est Orisonte; and therefor, yif that any planet assende at that same tyme in thilke forseide degre of his longitude, Men seyn that thilke planete is in *horoscopo.* But sothly, the hows of the assendent, that is to seyn, the firste hous or the est Angle, is a thing more brod and large. For after the statutz of Astrologiens, what celestial body that is 5 degres aboue thilk degre that assendith, or within that nowmbre, that is to seyn, nere the degree that assendith yit rikne thei thilke planet in the Assendent. And what planete that is vnder thilke degree that assendith the space of 25 degrees, yit sein thei that thilke planete is lyk to him that is in the hows of the assendent but

sothly, yif he passe the bondes of thise forseide spaces, aboue or bynethe, they sein that the planete is failling fro the assendent. Yit sein thise Astrologiens, that the assendent and eke the lord of the assendent, may be shapen for to be fortunat or infortunat, as thus, a fortunat assendent clepen they whan that no wykkid planete, as saturne or Mars, or elles the tail of the dragoun, is in the hows of the assendent, ne that no wikked planete haue non aspecte of enemyte vpon the assendent; but they wol caste that thei haue a fortunat planete in hir assendent and ghit in his felicite, and than sey they that it is wel. Fortherouer, they seyn that the infortunyng of an assendent is the contrarie of thise forseide thinges. The lord of the assendent sey they that he is fortunat, whan he is in god place fro the assendent as in angle; or in a succedent, whereas he is in his dignite and conforted with frendly aspectys of planetes and wel resceiued, and ek that he may sen the assendent, and that he be nat retrograd ne combust, ne ioigned with no shrewe in the same signe ne that he be nat in his descencioun, ne ioigned with no planete in his discencioun, ne haue vpon him non aspecte infortunat; and than sey they that he is wel. Natheles, theise ben obseruauncez of iudicial matiere and rytes of paiens, in which my spirit ne hath no feith, ne no knowyng of hir *horoscopum*; for they seyn that euery signe is departid in 3 euene parties by 10 degrees, and thilke porcioun they clepe a face. And althogh that a planete haue a latitude fro the Ecliptik, yit sey some folk so that the planete arise in that same signe wyth any degree of the forseide face in which his longitude is rekned, that yit is the planete *in horoscopo* be it in natiuite or in elecciouu, &c. And for the more declaracioun, lo here the figure.

5. **To find the true equation of the degree of the sun, if so be that it fall betwixt two Almicanteras. (i.e. to find the mean between two observations.)**

Forasmuch as the almicanteras in thy astrolabe are compounded by two and two, whereas some almicanteras in sundry astrolabes are compounded by one and one, or else by two and two, it is necessary to thy learning to teach thee first to know and work with thy own instrument. Wherefore, when that the degree of thy sun falleth betwixt two almicanteras, or else if thy almicanteras be engraved too far apart, for both these things may cause error, both for knowing the tide of the day, as well as the true ascendent, thou must work in this wise. Set the degree of thy sun upon the higher almicantera of the two, and carefully observe where the almury touches the border, and set there a dot of ink. Set down again the degree of thy sun upon the lower almicantera of the two, and set there another dot. Then move thy almury backwards and forwards in the border halfway between the two spots of ink, and this will lead the degree of thy sun to sit exactly in its right place betwixt both almicanteras. Then lay thy label over the degree of thy sun; and find in the border the true tide of the day or of the night. And in as true a manner shalt thou find thy ascendent upon thy east horizon. And for more explanation, lo here thy figure.

Note. In the figure the almicanteras are drawn for every alternate degree. The dots on the border may be seen between 9 and 10 in the hour circle.



5. To knowe the verrey equacioun of the degree of the sonne, yif so be that it falle bytwixe thin Almykanteras.

[*Ad cognoscendum veram equacionem de gradu solis, si contigerit fore in duas Almicanteras.*]

For as moche as the almykanteras in thin astrelabie ben compownet by two and two, whereas some Almykanteras in sondri Astrelabies ben compownet by on and on, or elles by 2 and 2, it is necessarie to thy lernyng to teche the first to knowe and worke with thin owne Instrument. Wherfor, whan that the degree of thy sonne falleth bytwixe two Almykanteras, or elles yif thin Almykanteras ben grauen with ouer gret a point of a compas, for bothe thise thinges may causen errour as wel in knowyng of the tid of the day as of the verrey Assendent, thow Most werken in this wise. Set the degree of thy sonne vpon the heyer Almykanteras of bothe and waite wel wher as thin Almury towcheth the bordure, and set ther a prikke of ynke. Set down agayn the degree of thy sonne

5. *continued.*

vpon the nethere Almykanteras of bothe and set ther another prikke. Remewe thanne thin Almury in the bordure euene amiddes bothe prikkes, and this wol lede iustly the degree of thi sonne to sitte bytwixe bothe Almykanteras in his riht place. Ley thanne thy label ouer the degree of thy sonne; and find in the bordure the verrey tide of the day or of the nyht. And as verreyly shaltow fynde vpon thin est orisonte thyn assendent; and for more declaracioun, lo here thi figure.

6. To find [the time of] the spring of the dawn and the end of the evening twilight, commonly called the two twilights.

Set the nadir of thy sun upon 18 degrees of height, among thy almicanteras on the west side, and lay thy label on the degree of thy sun; then shall the point of thy label show the spring of day. Also set the nadir of thy sun upon 18 degrees of height among thy almicanteras on the east side, and lay thy label upon the degree of the sun, and with the point of thy label find in the border the end of the evening, that is, real night.

The nadir of the sun is the degree that is opposite to the degree of the sun, in the 7th sign, as thus, every degree of Aries by order is nadir to every degree of Libra by order, and Taurus to Scorpion, Gemini to Sagittarius, Cancer to Capricorn, Leo to Aquarius, Virgo to Pisces, and if any degree in thy zodiac be dark, its nadir shall declare it. And for more explanation, lo here thy figure.

Note. In the figure the label indicates a quarter after 7 o'clock.

6. To knowe the spring of the dawyng and the ende of the euenyng, the which ben called the two crepusculus:

[*Ad cognoscendum ortum solis et eius occasum, que uocatur vulgariter crepusculum.*]

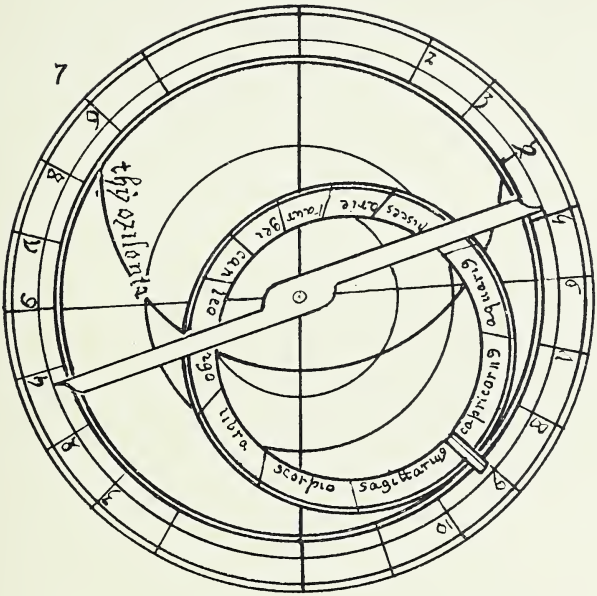
Set the nadir of thy sonne vpon 18 degrees of heyhte among thyn Almykanteras on the west side, and ley thy label on the degre of thy sonne, and thanne shal the poynt of thi label schewe the spryng of day. Also set the nadir of thy sonne vpon 18 degres of heyhte among thin Almykanteras on the est side, and ley ouer thy label vpon the degree of the sonne, and with the point of thy label fynd in the bordure the ende of the euenyng, that is, verrey nyht. The nadir of the sonne is thilke degree that is opposit to the degree of the sonne, in the 7 signe, as thus, euery degree of aries bi ordre is nadir to euery degree of libra by ordre and taurus to Scorpion, gemini to Sagittare, Cancer to Capricorne, leo to aquarie, uirgo to pisces, and ghif any degree in thi zodiak be dirk, his nadire shal declare him. And for the more declaracioun, lo heere thi figure.

[*Messahalla*, § 4.

7. To find the arc of the day, that some folk call the artificial day, from the sun's rising till it go to rest.

Set the degree of thy sun upon thy east horizon, and lay thy label on the degree of the sun, and at the point of thy label in the border set a dot of ink. Then turn thy rete about till the degree of the sun sit upon the west horizon, and lay thy label upon the same degree of the sun, and at the point of thy label set another dot. Reckon then the quantity of time in the border betwixt both dots, and take there thy arc of the day. The remnant of the border under the horizon is the arc of the night. Thus mayest thou reckon both arcs, or part of an arc, as thou likest. And by this manner of working, mayest thou see how long any fixed star dwells above the earth, from the time that he rises till he goes to rest. But the natural day, that is to say 24 hours, is the revolution of the equinoctial with that part of the zodiac that the sun of his proper moving passeth in the same time. And for the more explanation, lo here thy figure.

Note. The dots are not marked in the figure. If rightly set, the first dot would be made at the left-hand end of the label at about 4·45, and the other dot would come at about 7·15. The arc or length of the day would be $14\frac{1}{2}$ hours.



7. To knowe the arch of the day, that some folk kallen the day artificial, from the sonne arisyng til hit go to reste.

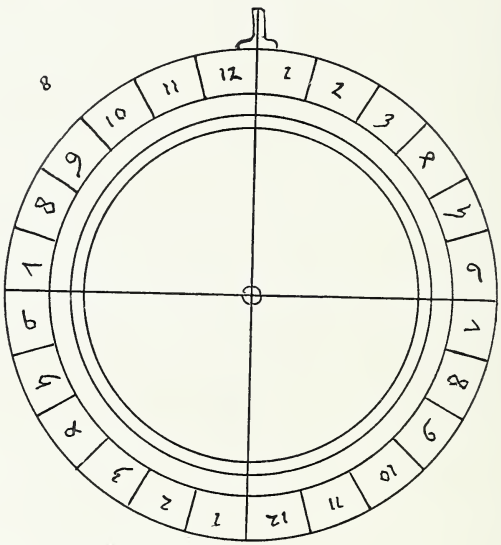
[*Ad cognoscendum archum diei, quem vulgus vocat diem artificialem in hoc ab ortu solis vsque ad occasum.*]

Set the degree of thy sonne vpon thin Est orisonte, and ley thy label on the degree of the sonne, and at the poynt of thy label in the bordure set a prikke. Turn̄ thanne thi riet aboute til the degree of the sonne sit vpon the west Orisonte, and ley thi label vpon the same degree of the sonne, and at the point of thi label set another prikke. Rekne thanne the quantite of tyme in the bordure bytwixe bothe prikkes, and tak ther thin ark of the day. The remenant of the bordure vnder the Orisonte is the ark of the nyht. Thus maistow rekne bothe arches or euery porcion of wheither that the liketh. And by this Manere of wyrkyng maistow se how longe that any sterre fix dwellith aboue the erthe, fro tyme that he risith til he go to reste. But the day natural, that is to seyn 24 houris, is the reuolucioun of the equinoxial with as moche partie of the zodiak as the sonne of his propre Moeuinge passeth in the mene while. And for the more declaracioun, lo her thi figure.

[*Messahalla*, § 5.

8. To turn unequal hours into equal hours.

Find the number of degrees in the unequal hours, and divide them by 15, and take there thine equal hours. And for the more explanation, lo here thy figure.



[If all the hours in an entire day between dawn and sunset correspond to 240°, then $240 \div 15 = 16$ is the number of equal hours.]

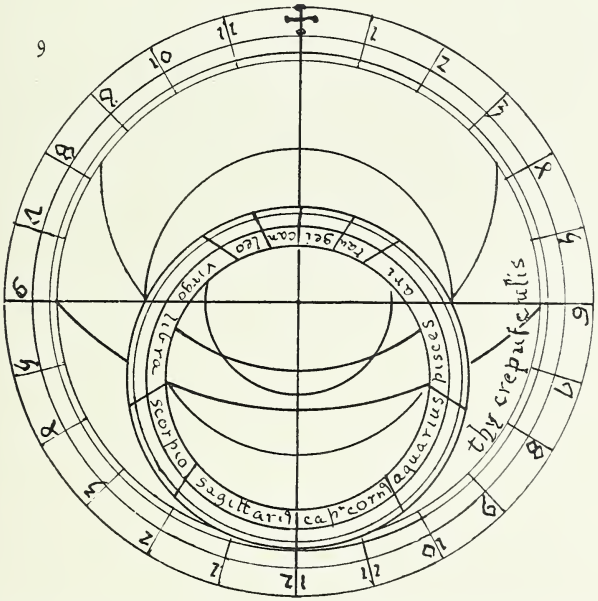
8. To turn the howres inequales in howres equales.

[*Ad conuertendum horas inequales in horas equales.*]

Knowe the nombre of the degrees in the howris inequales, and departe hem by 15, and tak ther thin howris equales. And for the more declaracioun, lo here thi figure. [*Messahalla*, § 6.

9. To find the length of a vulgar day, that is to say, from the spring of the day unto real night.

Know the length of thy twilights, as I have taught in a previous chapter (6), and add them to the arc of thy artificial day, and thus find the space of the whole vulgar day, unto real night.[1] By the same method thou mayest find the length of the vulgar night. And for the more explanation, lo here the figure.



9. To knowe the quantite of the day vulgare, that is to seyen, from spring of the day vnto verrey nyht.

[*Ad cognoscendum quantitatem diei vulgaris, viz. ab ortu diei vsque ad noctem.*]

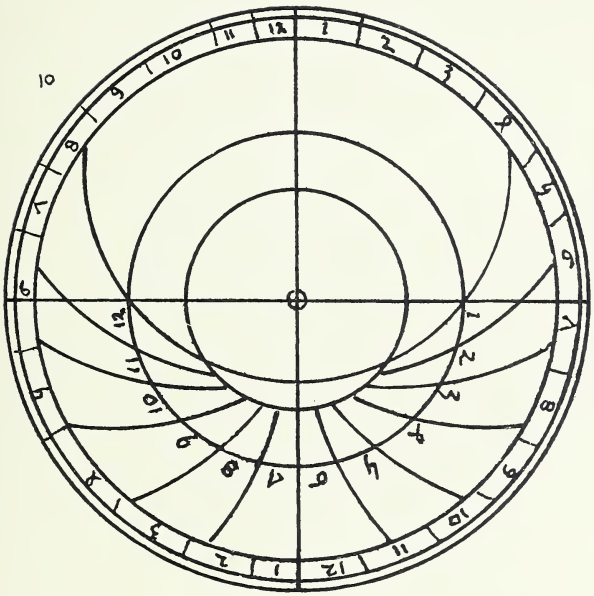
Know the quantite of thi crepusculis, as I haue tawht in the chapitre byforn, and adde hem to the arch of thi day artificial, and tak ther the space of alle the hole day vulgar, vnto verrey nyht. The same manere maistow worke to knowe the quantite of the vulgar nyht. And for the more declaracioun, lo here the figure.

[1] 'Vulgar day' = 'artificial day' + two twilights.

10. To find the length of the unequal hours by day.

Understand well, that these unequal hours are called hours of planets, and understand well that sometimes they are longer by day than by night, and sometimes the contrary. But understand that it is a general rule that the unequal hour of the day with the unequal hour of the night contains 30 degrees of the border, which border-degrees always correspond to the degrees of the equinoctial; wherefore divide the arc of the artificial day in 12, and so obtain the length of the unequal hour by day. If you subtract the length of the unequal hour by day from 30, then shall the remnant that remains be the length of the unequal hour by night. And for the more explanation, lo here the figure.

Note. The curved lines in the lower part of the figure delimit the 12 unequal or planetary hours. Cf. p. 21.



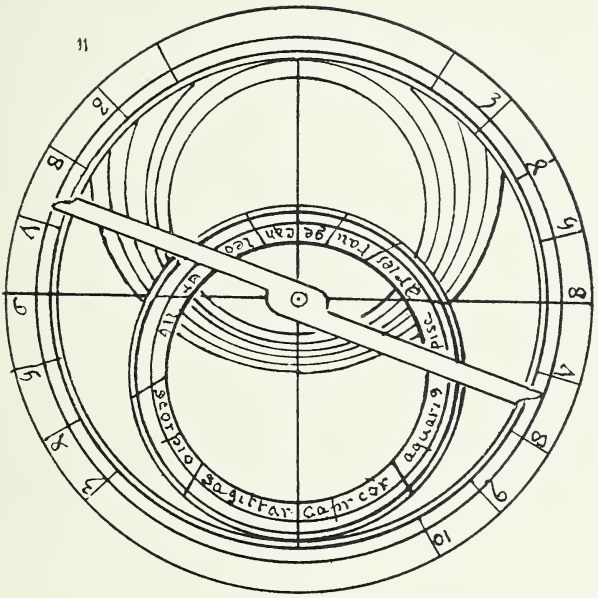
10. To knowe the quantite of howres inequales by day.

[*Ad cognoscendum horas inequales in die.*]

Vnderstond wel, that thise howris inequalis ben cleped howres of planetes, and vnderstond wel that some tyme ben thei lengere by day than by nyht, and som tyme the contrarie. But vnderstond wel that euermo generaly the howr inequal of the day with the howr inequal of the nyght contenen 30 degrees of the bordure, whiche bordure is euermo answering to the degrees of the equinoxial; wherfor departe the arch of the day artificial in 12, and tak ther the quantite of the howr inequal by day. And ghif thow abate the quantite of the howr inequal by daye owt of 30 than shal the remenant that leueth performe the howr inequal by nyght. And for the more declaracioun, lo here the figure. [*Messahalla*, § 6.

11. To find the length of the equal hours.

The equal hours, that is to say, hours of the clock, are already divided by 15 degrees in the border of thy astrolabe, both by night and by day, generally for ever. What needeth more explanation? Wherefore, when thee list to know how many hours of the clock are passed, or what part of any of these hours is passed, or else how many hours or part of hours are to come, from such a time to such a time by day or by night, find the degree of thy sun, and lay thy label on it, turn thy rete about jointly with thy label, and with the point reckon in the border from sunrise unto that place which thou desirest, by day or by night. This conclusion will I explain in the last chapter of the 4th part of this treatise so openly that there shall lack no word needful to the explanation. And for more explanation, lo here the figure.



11. To knowe the quantite of howres equales.

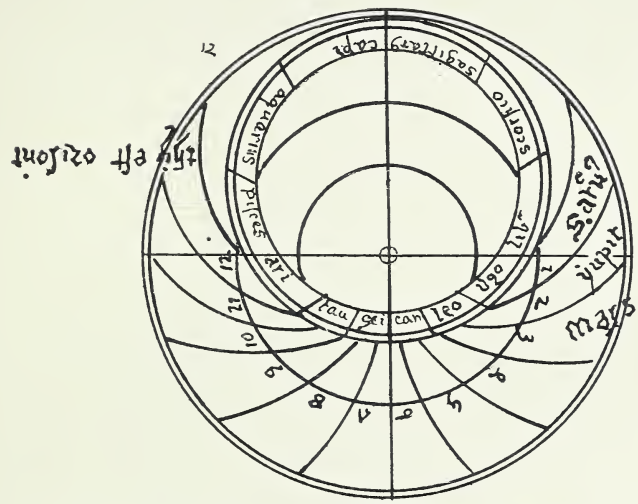
[*Ad cognoscendum quantitatem horarum equalium.*]

The quantite of howres equales, that is to seyn, the howres of the clokke ben departid by 15 degrees alredy in the bordure of thin astralabie, as wel by nyht as by day, generaly for euere. What nedith more declaracioun? Wherfor, whan the list to know how manye howres of the clokke ben passed, or any part of any of thise howris that ben passed, or elles how many howres or partie of howres ben to come, fro swich a tyme to swych a tyme, by day or by nyhte, knowe the degree of thy sonne, and ley thy label on it, turne thi Riet abowte ioyntly with thy label, and with the point of it rekne in the bordure fro the sonne arise vnto the same place ther thow desirest, by day as by nyhte. This conclusioun wol I declare in the laste chapitre of the 4 partie of this tretis so openly, that ther shal lakke no worde that nedith to the declaracioun. And for the more declaracioun, lo here the figure. [*Messahalla*, § 8.

12. Special explanation of the hours of planets.

Understand well, that evermore from the rising of the sun till it go to rest, the nadir of the sun shall show the hour of the planet, and from that time forward, all the night till sunrise, then shall the exact degree of the sun show the hour of the planet.

Example as thus: Peradventure the 13 day of March fell upon a Saturday, and at the arising of the sun, I found the second degree of Aries sitting upon my east horizon, albeit that it was but a little; then I found the 2nd degree of Libra, nadir of my sun, descending on my west horizon, upon which west horizon every day, at the sunrise, entreth the hour of any planet after which the day is named; and endeth in the next line of the plate under the aforesaid west horizon. And ever as the sun climbeth higher and higher, so goeth his nadir down and down, teaching by such lines the hours of planets in order as they are situate in the heaven. The first unequal hour of every Saturday is the hour of Saturn; and the second of Jupiter; the 3rd of Mars; the 4th of the Sun; the 5th of Venus; the 6th of Mercury; the 7th of the Moon; and then again the 8th is of Saturn; the 9th of Jupiter; the 10th of Mars; the 11th of the Sun; the 12th of Venus; and now is my sun gone to rest for that Saturday. Then the true degree of the sun shows the hour of Mercury entering under my west horizon at even; and next him succeedeth the Moon, and so forth by order, planet after planet, in hour after hour all night long till the sun rises. Now when the Sun riseth on the morrow, Sunday, the nadir of the sun upon the horizon showeth me the entering of the hour of the aforesaid sun. And in this manner succeedeth planet under planet, from Saturn unto the Moon, and from the Moon up again to Saturn, hour after hour generally. And thus know I this conclusion. And for more explanation, lo here the figure.

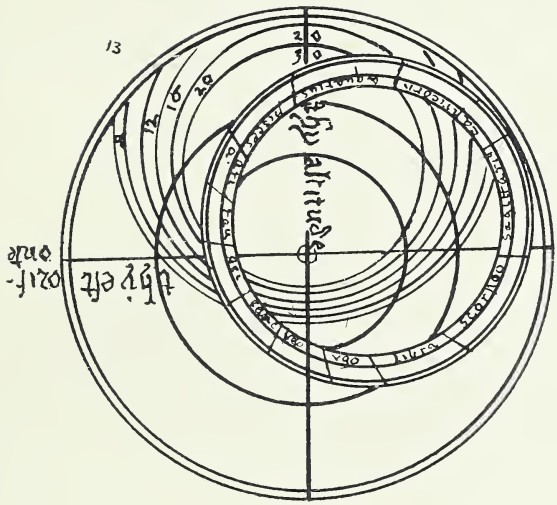


12. Special declaracioun of the howres of planetes.
[*Specialis declaracio de horis planetarum.*]

Vnderstond wel, that eueremo fro the arising of the sonne til it go to reste, the nader of the sonne shal shewe the howr of the planete, and fro that tyme forward al the nyht til the sonne arise, than shal the verrey degree of the sonne shewe the howr of the planete. Ensample as thus. The xiij. day of March fil vpon a saterday per auenture, and at the arising of the sonne, I fond the secounde degree of aries sitting vpon myn est Orisonte, al be it that it was but lite; than fond I the 2 degree of libra, nadir of my sonne, dessending on my west Orisonte, vpon which west Orisonte euery day generally, at the sonne ariste, entrith the howr of any planete, after which planete the day berith his name; and endith in the nexte strik of the plate vnder the forseide west Orisonte, and euere as the sonne clymbith vppere and vppere, so goth his nadir downere and downere, techyng by swych strikes the howres of planetes by ordre as thei sitten in the heuene. The first howr inequal of euery Satterday is to Saturne; and the secounde to Iupiter; the 3 to Mars; the 4 to the sonne; the 5 to venus; the 6 to Mercurius; the 7 to the mone; and thanne agayn the 8 is to saturne; the 9 to Iupiter; the 10 to Mars; the 11 to the sonne; the 12 to venus; And now is my sonne gon to reste as for that setterday. Thanne shewyth the verrey degree of the sonne the howr of Mercurie entryng vnder my west orisonte at eue; and next him succedith the Mone; and so forth by ordre, planete aftur planete, in howr after howr, al the nyht longe til the sonne arise. Now risith the sonne that Sonday be the morwe; and the nadir of the sonne vpon the west Orizonte shewith me the entring of the howre of the forseide sonne. And in this maner succedith planete vnder planete, fro saturne vnto the mone, and fro the mone vp agayn to satourne, howre after howre generaly. And thus knowe I this conclusioun. And for the more declaracioun, lo here the figure.

13. To find the altitude of the sun or meridian altitude in middle of the day.

Set the degree of the sun upon the meridional line, and count how many degrees of almicanteras are betwixt the east horizon and the degree of the sun. And take thy meridian altitude, i. e. the highest of the sun for that day. So by the same line thou mayest know the highest point to which any fixed star climbs by night; that is to say, that when any fixed star has passed the meridional line, then it begins to descend, and so doth the sun. And for more explanation, lo here thy figure.



13. To knowe the altitude of the sonne in Middes of the day, that is cleped the altitude Meridian.

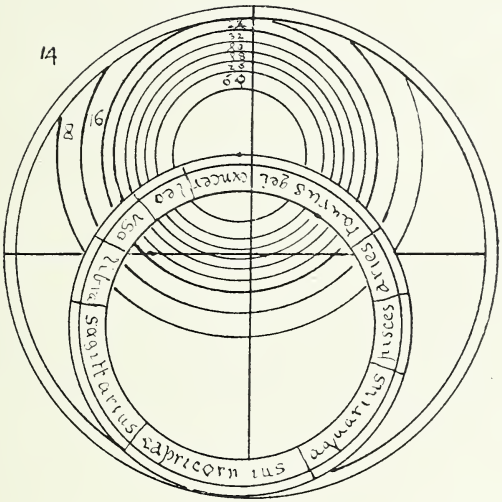
[*Ad cognoscendum altitudinem solis in medio diei, que vocatur altitudo meridiana.*]

Set the degree of the sonne vpon the lyne Meridional, and rikene how many degrees of Almykanteras ben bytwyxe thyn est Orisonte and the degree of the sonne. And tak ther thyn altitude Meridian, this is to seyne, the heiest of the sonne as for that day. So maistow knowe in the same lyne, the heiest cours that any sterre fix clymbith by nyht; this is to seyn, that whan any sterre fix is passed the lyne Meridional, than bygynnyth it to descende, and so doth the sonne. And for the more declaracioun, lo here thi figure. [*Messahalla*, § 10.

14. To find the degree of the sun by thy rete, as a matter of curiosity.

Seek busily with thy rule the highest point reached by the sun at midday; turn thy astrolabe, and with a dot of ink mark the number of that same altitude on the meridional line. Then turn thy rete about till thou find a degree of thy zodiac according with the dot, that is to say, situate on the dot; and in truth, thou wilt find but 2 degrees in all the zodiac of that condition. These 2 degrees will be in different signs; but by the season of the year thou mayest easily know the sign in which the sun is. And for the more explanation, lo here thy figure.

The reverse of Proposition 13 and a useful method for testing the accuracy of the almicanteras.



14. To knowe the degree of the sonne by thy riet, for a maner curiosite, &c.

[*Ad cognoscendum gradum solis curiose.*]

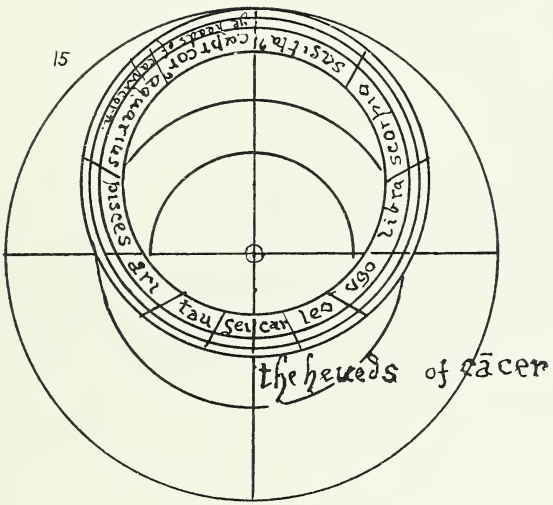
Sek bysily with thi rewle the heiest of the sonne in Midde of the day; turne thanne thyn Astrelabie, and with a prikke of ynk marke the nombre of that same Altitude in the lyne Meridional. Turne thanne thy Ryet abowte til thow fynde a degree of thi zodiak acording with the prikke, this is to seyn, sittynge on the prikke; and in soth, thow shalt fynde but 2 degrees in al the zodiak of that condicioun; and yit thilke 2 degrees ben in diuerse signes; than maistow lyhtly by the sesoun of the yere knowe the signe in whiche that is the sonne. And for the more declaracioun, lo here thi figure. [*Messahalla*, §§ 14, 25.

15. To know which days are of equal length.[1]

Look for degrees which are equally far from the heads[2] of Cancer and Capricorn; then, when the sun is in any of these degrees, the days are of equal length. That is to say, that the day in one month is as long as the like day in the other month, with but little variation. Also if thou take 2 days naturally in the year equally far from either point of the equinoctial but on opposite sides, then the length of the artificial day in one case is equal to the length of the night of the other, and the contrary. And for the more explanation, lo here thy figure.

[1] Skeat points out that this may best be done by the circular calendar on the back of an astrolabe.

[2] 'Heads' are the beginnings of the Signs.



15. To know which day is lik to wych day as of lengthe, &c.

[*Ad cognoscendum quales dies in longitudine sunt similes.*]

Loke whiche degrees ben illik fer fro the heuedes of Cancer and Capricorn; and lok, whan the sonne is in any of thilke degrees, than ben the dayes ilike of lengthe. This is to seyn, that as long is that day in that Monthe, as was swych a day in swich a month: ther varieth but lite. Also yif thow take 2 daies naturaly in the yer ilike fer fro eyther pointe of the equinoxial in the opposit parties, than as long is the day artificial of that on day as is the nyht of that othere, and the contrarie. And for the more declaracioun, lo here thi figure. [*Messahalla*, § 15.

16. This chapter is an explanation of conclusions that follow.

Understand well that thy zodiac is divided into 2 half-circles, from the head of Capricorn to the head of Cancer, and backward from the head of Cancer to the head of Capricorn. The head of Capricorn is the lowest point, to which the sun goes in winter; and the head of Cancer is the highest point, which the sun reaches in summer. Therefore understand well, that any two degrees that are equally far from either of these two heads, are of equal declination, be it south or north; their days are equal in length, and their nights also; the shadows and the altitudes are likewise equal at midday for ever. And for more explanation, lo here thy figure.

16. This chapitre is a Maner declaracioun to conclusiouns that folwen.

[*Illud capitulum est quedam declaracio ad certas conclusiones sequentes.*]

Vnderstond wel that thy zodiak is departid in 2 halfe cercles, as fro the heued of capricorne vnto the heued of Cancer and agaynward fro the heued of cancer vnto the heued of Capricorne. The heued of Capricorne is the lowest point, wher as the sonne goth in wynter; and the heued of Cancer is the heiest point, in whiche the sonne goth in somer. And therfor vnderstond wel, that any two degrees that ben ilike fer fro any of thise two heuedes truste wel that thilke two degrees ben of ilike declinacioun, be it sowthward or northward; and the daies of hem ben ilike of lengthe, and the nyhtes also; and the shadwes ilike, and the Altitudes ilike at Midday for euere. And for more declaracioun, lo here thi figure.

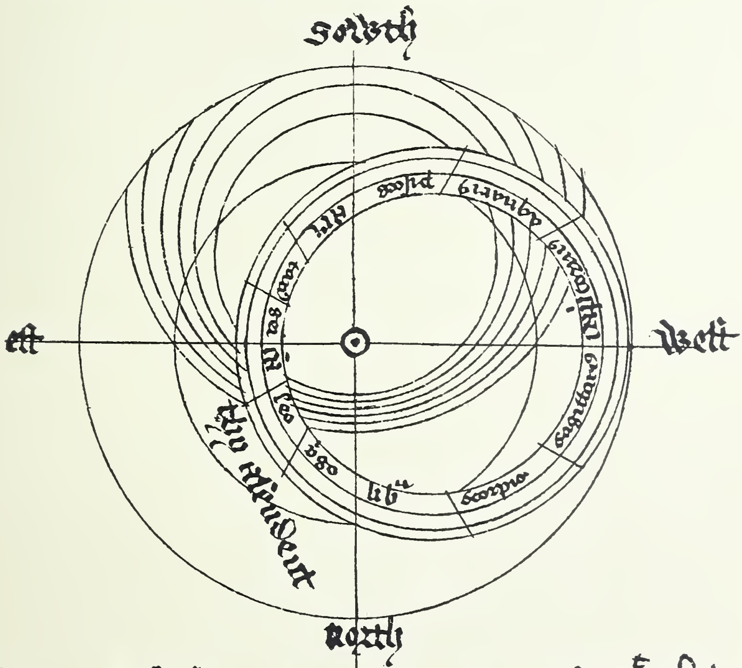
[*Messahalla*, § 13.

17. To find the true degree of any sort of star, unknown or known, according to its longitude, though it be not marked in thy astrolabe; in truth, thus will it be found.

Take the altitude of the star when it is on the east side of the meridional line, as nigh as thou mayest guess; and take an ascendent anon right by some fixed star which thou knowest, and do not forget the altitude of the first star, nor thy ascendent. When this is done, espy diligently when this same first star passeth some way to the south-westward, and hath exactly the same altitude on the west side of the meridional line, that it had when observed on the east side; then take a new ascendent by some fixed star that thou knowest; and forget not this second ascendent. When this is done, reckon how many degrees there are betwixt the first ascendent and the second ascendent, and reckon well the middle degree between both ascendents, and set that middle degree upon thy east horizon; then note what degree is situate upon the meridional line, and take there the exact degree of the ecliptic in which the star is standing at the time.[1] For it is in the ecliptic that the longitude of a celestial body is reckoned, even from the head of Aries unto the end of Pisces. And its latitude is reckoned from its declination, north or

[1] The method here given for finding the longitude of a star, or degree of the zodiac which is on the meridian with it, is not quite accurate. By Conclusion 3, Chaucer finds the ascending degree of the zodiac from the altitude of the star taken at equal times before and after southing. The mean is the degree that ascends when the star is on the meridian. If this degree be set on the eastward part of the horizon obliquus, then the degree upon the meridian souths together with the star. If degrees of the equinoctial (i. e. right ascension) instead of longitude reckoned from the ecliptic had been prescribed, the method would have been correct.

south toward the poles of this world, as thus. In the case of the sun or of any fixed star, reckon its latitude or its declination from the equinoctial circle; and in the case of a planet, reckon then its latitude from the ecliptic line. Albeit so that the declination or the latitude of any celestial body may be reckoned from the equinoctial, having regard to its site north or south, and to the magnitude of its declination. And so too the latitude or the declination of any celestial body, save only of the sun, having regard to its site north or south and to the magnitude of its declination, may be reckoned from the ecliptic line; from which line all planets at sometime decline north or south, save only the aforesaid sun. And for more explanation, lo here thy figure.



degrees of the longitudes of fixe sterres after that they
trafable wise as be that they ben trewely set.

17. To knowe the verrey degree of any maner sterre straunge or vnstraunge after his longitude, thow he be indeterminat in thin astralabie ; sothly to the trowthe, thus he shal be knowe.

[*Ad cognoscendum verum gradum alicuius stelle aliene secundum eius latitudinem, quamvis sit indeterminata in astrolabio; veraciter isto modo.*]

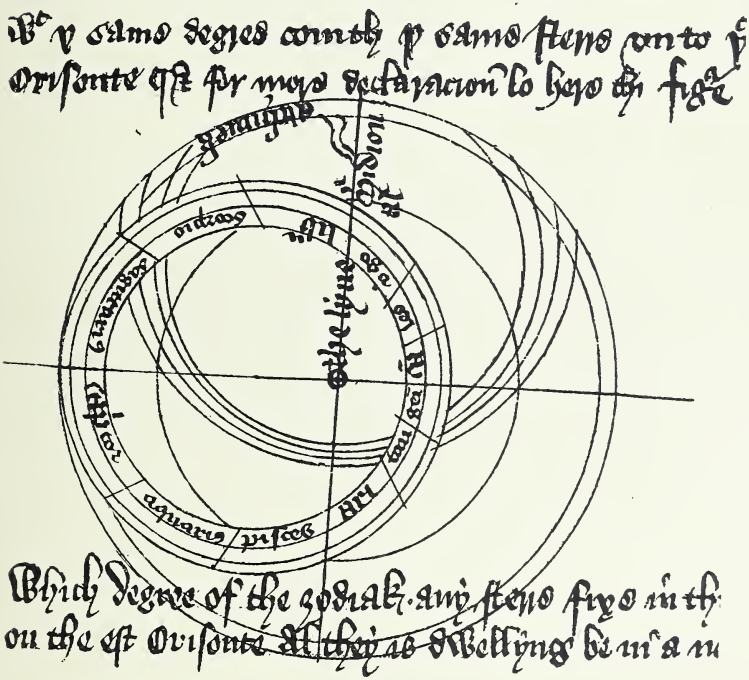
Tak the altitude of this sterre whan he is on the Est side of the lyne Meridional, as ney as thow maist gesse ; and tak an assendent anon riht by som maner sterre fix which that thow knowest and forget nat the altitude of the firste sterre, ne thyn assendent ; and whan that this is don espie diligently whan this same firste sterre passeth anything the sowth westward, and hath him anon riht in the same nowmbre of altitude on the west side of this lyne Meridional as he was kawht on the est side ; and tak a newe assendent anon riht by som Maner sterre fixe which that thow knowest ; and forget nat this secounde assendent. And whan that this is don, rikne thanne how manye degrees ben bytwixe the firste assendent and the seconde assendent, and rikne wel the Middel degree bytwyne bothe Assendentes, and set thilke Middel degree vpon thin est Orisonte ; and waite thanne what degre that sit vpon the line Meridional, and tak ther the verrey degre of the Ecliptik in which the sterre stondeth for the tyme. For in the Ecliptik is the longitude of a celestial body rekened, euene fro the heued of aries vnto the ende of pisces. And his latitude is Rikned after the quantite of his declinacion, north or sowth towarde the poles of this world as thus. Yif it be of the sonne or of any fix sterre, rekene his latitude or his declinacioun fro the Equinoxial cercle ; and yif it be of a p'anete, rekne than the quantite of his latitude fro the Ecliptik lyne. Al be it so that fro the Equinoxial may the declinacion or the latitude of any body celestial be rikned, after the site north or south, and after the quantite of his declinacion. And riht so may the latitude or the declinacion of any body celestial, saue only of the sonne, after his site north or south, and after the quantite of his declinacioun, be rekned fro the Ecliptik lyne ; Fro which lyne alle planetes som tyme declinen north or south, saue only the forseide sonne. And for the more declaracioun, lo here thi figure. [*Messahalla*, § 34.

18. To find the degrees [of the zodiac] of fixed stars marked in thy astrolabe, if so be that they are truly placed therein.

Having set the centre of the star[1] upon the meridional line, take heed of thy zodiac, and at the same time note the degree of any sign that is situate on

[1] The tip of the star-pointer on the rete. In the figure the fixed star is shown southing along with the first degree of Libra.

the meridional line, and take [it as] the degree in which the star standeth; then the star will come on to the meridian from the horizon with that same degree. And for more explanation, lo here thy figure.



18. To knowe the degrees of the longitudes of fixe sterres after that they ben determinat in thin astralabie, yif so be that they ben trewly set.

[*Ad cognoscendum gradus longitudinis de stellis fixis que determinantur in astrolabio, sicut in suis locis recte locentur.*]

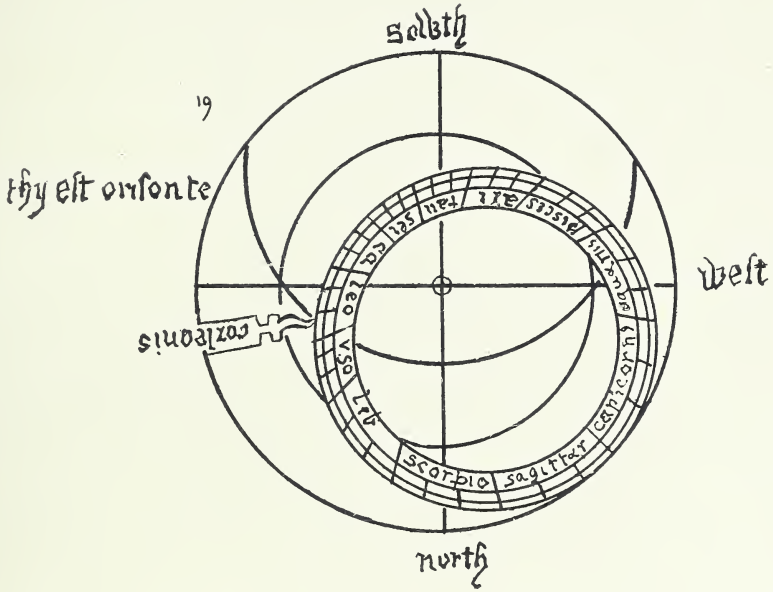
Set the centre of the sterre vpon the lyne Meridional, and tak kep of thi zodiak, and loke what degree of any signe that sit on the same lyne Meridional at that same tyme, and tak the degree in which the sterre standith; and with that same degree cometh that same sterre vnto that same lyne fro the Orisonte. And for more declaracioun, lo here thi figure. [*Messahalla*, § 16.

19. To find the degree of the zodiac with which any fixed star in thy astrolabe ariseth upon the east horizon, although its dwelling be in another sign.

Set the centre of the fixed star upon the east horizon, and note the degree of any sign that sits upon the same horizon at the same time. And understand well, that the star rises with the same degree; and this marvellous rising with a degree not its own in another sign is because the latitude of the fixed star is either north or south of the ecliptic.[1] But truly, the latitudes of planets are commonly reckoned from the ecliptic, because none of them declineth more than a few degrees from the breadth of the zodiac. And take good heed of this chapter concerning the rising of the celestial bodies; for understand that neither moon nor star in our oblique horizon riseth with the same degree of its longitude, save in one case; and that is, when they have no latitude from the ecliptic line.[2] But nevertheless every one of these planets is sometimes on the same line. And for more explanation, lo here thy figure.

[1] The MS. reads 'equinoxial' here, which was doubtless a mistake because the latitude is north or south of the *ecliptic*. In modern usage it is usual to speak of *declination* from the equator and of *latitude* from the ecliptic.

[2] This case is illustrated in the figure where the star Cor leonis, or Regulus, being on the ecliptic, rises with the degree in which it is situated.



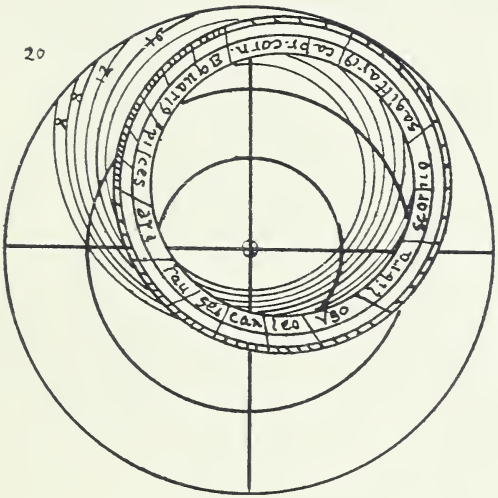
19. To knowe with which degree of the zodiak any sterre fixe in thin Astrelabie arisith vpon the est Orisonte, Althey his dwellyng be in another signe.

[*Ad cognoscendum cum quibus gradibus zodiaci que stella fyxa in astrolabio ascendit super orizontem orientalem, quamuis eius orizon sit in alio signo.*]

Set the Sentre of the sterre vpon the est Orisonte, and loke what degre of any signe that sit vpon the same Orisonte at that same tyme. And vnderstond wel, that with that same degre arisith that same sterre; and thys merueyllous arising with a strange degree in another signe is bycause that the latitude of the sterre fix is either north or sowth fro the equinoxial. But sothly, the latitudes of planetes ben comunly rekned fro the Ecliptik, bicause that non of hem decline th but fewe degrees owt fro the brede of the zodiak. And tak god kep of this chapitre of arising of the celestial bodies; for truste wel, that neyther mone ne sterre as in owre Embelif orisonte arisith with that same degree of his longitude, saue in O cas; and that is, whan they haue no latitude fro the Ecliptik lyne. But natheles some tyme is eueriche of thes planetes vnder the same lyne. And for more declaracioun, lo here thi figure.

20. To find the declination from the equinoctial circle of any degree in the zodiac.

Set the degree of any sign upon the meridional line, and reckon its altitude in almicanteras from the east horizon up to the same degree situate in the aforesaid line, and make a dot there. Then turn up thy rete, and set the head of Aries or Libra in the same meridional line, and set another dot there. When this is done, consider the altitudes of them both; for the difference of these altitudes is the declination from the equinoctial of that degree. And if so be that that degree be north of the equinoctial, then is its declination north; if it be southward, then is it south. And for more explanation, lo here thy figure.



20. To knowe the declinacioun of any degree in the zodiak fro the equinoxial cercle, &c.

[*Ad cognoscendum declinacionem alicuius gradus in zodiaco a circulo equinoctiali.*]

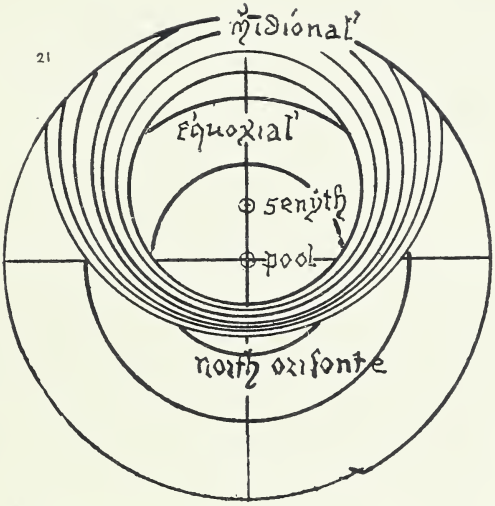
Set the degree of any signe vpon the lyne Meridional, and rikne his altitude in Almykanteras fro the Est Orizonte vp to the same degree set in the forseide lyne, and set ther a prikke. Turne vp thanne thy Riet, and set the heued of aries or libra in the same Meridional lyne, and set ther another prikke. And whan that this is don, considere the Altitudes of hem bothe; for sothly the difference of thilke altitudes is the declinacion of thilke degre fro the equinoxial. And yif so be that thilke degree be northward fro the equinoxial, than is his declinacion north; yif it be sowthward, than is it sowth. And for the more declaracioun, lo here thi figure.

[*Messahalla*, § 20.

21. To know for what latitude in any region the almicanteras of any tablet are compounded.

Count how many degrees of almicanteras in the meridional line be from the equinoctial circle unto the zenith; or else from the arctic pole unto the north horizon. For so great a latitude, or for so small a latitude, is the tablet compounded. And for more explanation, lo here thy figure.[1]

[1] The figure is inadequate because the smaller circles surrounding the zenith are not drawn in. To solve the problem it is necessary to count these either (*a*) between the southern intersection of equinoctial circle and the meridian, or (*b*) between the horizontal obliquus or 'north orisonte' and the pole.



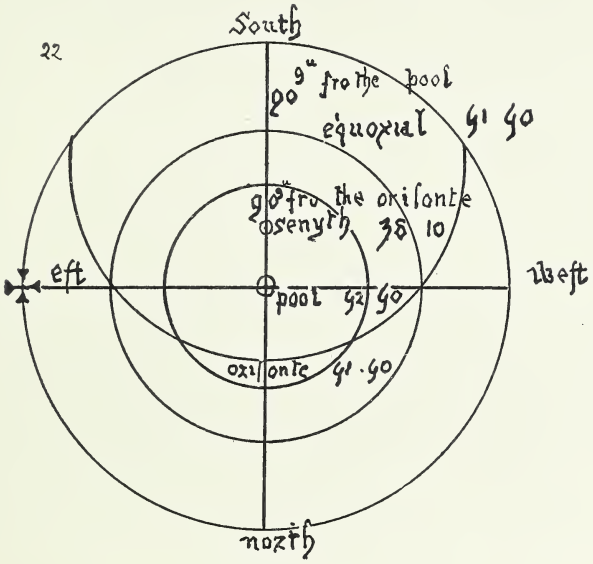
21. To knowe for what latitude in any regioun the Almikanteras of any table ben compowned.

[*Ad cognoscendum pro qua latitudine in aliqua regione almicantre tabule mee sunt composite.*]

Rikne how manie degrees of Almikanteras in the Meridional lyne be fro the cercle equinoxial vnto the senyth; Or elles fro the pool artik vnto the north Orisonte; and for so gret a latitude or for so smal a latitude is the table compowned. And for more declaracion, lo here thi figure. [*Messahalla*, § 23.

22. To find the latitude of our country, I mean the latitude of Oxford, and the height of our pole.

Understand well, that the head of Aries or Libra in the equinoctial is as far from [the south point of] our horizon as is the zenith from the pole arctic; and the pole arctic is as high above the [north point of the] horizon as the equinoctial is far from the zenith. I prove it thus by the latitude of Oxford. Understand well, that the height of our arctic pole from our north horizon is 51 degrees and 50 minutes; then the zenith is 38 degrees and 10 minutes from our pole arctic; and the equinoctial is 51 degrees and 50 minutes from our zenith; and our south horizon is from our equinoctial 38 degrees and 10 minutes. Understand well this reckoning. Also forget not that the zenith is 90 degrees of height from the horizon, and our equinoctial is 90 degrees from our pole arctic. Also this short rule is true; that the latitude of any place in a region is the distance from the zenith unto the equinoctial. And for more explanation, lo here thy figure.



22. To knowe in special the latitude of owre countray, I mene after the latitude of Oxenford, and the heyhte of owre pol.

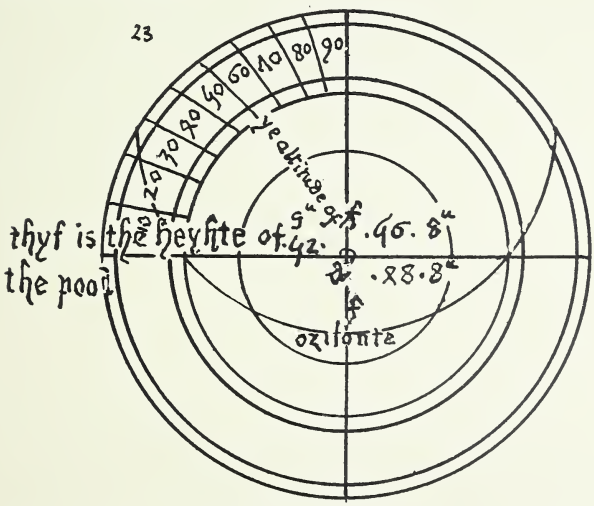
[*Ad cognoscendum specialiter latitudinem nostri centri, scilicet latitudinem Oxonie, et altitudinem poli nostri.*]

Vnderstond wel, that as fer is the heued of aries or libra in the equinoxial from owre orisonte as in the cenyth fro the pole artik; and as hey is the pol Artik fro the Orisonte as the Equinoxial is fer from the senyth. I proue it thus by the latitude of Oxenford. Vnderstond wel, that the heyhte of owre pool Artik fro owre north Orisonte is 51 degrees and 50 Minutes; than is the cenyth from owre pool Artik 38 degrees and 10 Minutes; than is the equinoxial from owre senyth 51 degrees and 50 Minutes; than is owre south Orisonte from owre equinoxial 38 degrees and 10 Minutes. Vnderstond wel this Reknyng. Also forget nat that the cenyth is 90 degrees of heyhte fro the Orisonte, and owre equinoxial is 90 degrees from owre pool Artik. Also this shorte rewle is soth, that the latitude of any place in a regioun is the distance fro the senyth vnto the Equinoxial. And for more declaracioun, lo here thi figure.

23. To prove by observation the latitude of any place in a region, by the proof of the height of the arctic pole in that same place.

On a winter's night, when the firmament is clear and thick-starred, choose a time when some fixed star is situate line-right perpendicular *over* the pole arctic, and call that star ɑ (or the Pole Star). And observe another star that is situate line-right under ɑ, and under the pole, and call that star ſ. And understand well, that ſ is not considered except to show when ɑ is situate evenly over the pole. Take then right anon the altitude of ɑ above the horizon, and forget it not. Let ɑ and ſ alone till near the dawn after a great while, then come again and abide till ɑ is directly *under* the pole and under ſ; for soothly ſ will then be situate over the pole, and ɑ will be situate under the pole. Then take the altitude of ɑ from the horizon, and note its second altitude as thou didst its first altitude, and when this is done, count how many degrees the first altitude of ɑ exceedeth its second altitude, and take half that number in excess, and add it to its second altitude; and thou wilt have the elevation of thy pole, and the latitude of thy region; for these two are of a number; this is to say, the number of degrees that thy pole is elevated, is the latitude of the region.

Example as thus: peradventure the altitude of α in the evening is 56 degrees of height,[1] then will its second altitude before the dawning be 48, that is 8 less than 56, that was his first altitude at evening. Take then the half of 8, and add it to 48, that was its second altitude, and then hast thou 52. Now hast thou the height of thy pole and the latitude of the region. But understand well that to prove this conclusion and many another fair conclusion, thou must have a plummet hanging on a line on a perch higher than thy head, and this line must hang even perpendicular betwixt the pole and thy eye, and then shalt thou see if α is situate even over the pole and over ƒ at evening, and also if ƒ sit even over the pole and over α before day. And for more explanation, lo here thy figure.



[1] In the time of Chaucer the pole-star was 4° distant from the pole, i. e. further than it is at present. There is no other star that would have conformed to the altitudes stated for his star α. The mean between 56° and 48° is obviously 52°, the height of the pole.

23. To proue euidently the latitude of any place in a Regioun, by the preue of the heyhte of the pol Artik in that same place.

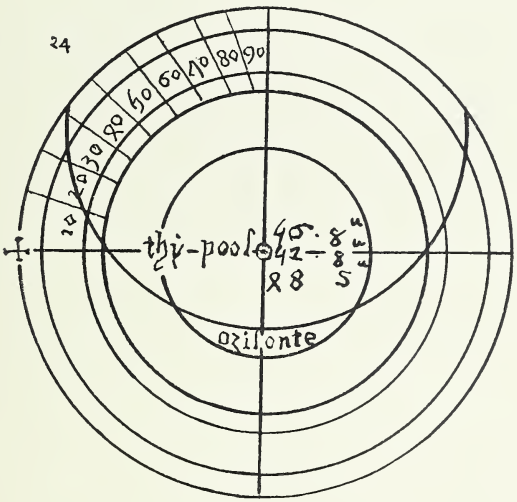
[*Ad probandum euidenter latitudinem alicuius loci in aliqua regione, per probacionem altitudinis de polo artico in eodem loco.*]

In some wynters nyht, whan the firmament is clere and thikkesterred, waite a tyme til that any sterre fix sit lyneriht perpendiculer ouer the pol Artik, and clepe that sterre A. And wayte another sterre that sit lyneriht vnder A, and vnder the pol and clepe that sterre F. And vnderstond wel, that F is nat consideret but only to declare that A sit euene ouere the pool. Tak thanne anon riht the altitude of A from the Orisonte and forget it nat. Lat A and F go farwel til agayns the dawenyng a gret while, and come thanne agayn and Abid til that A is euene vnder the pol and vnder F; for sothly, than wole F sit ouer the pool and A wol sit vnder the pool. Tak than eftsones the altitude of A from the Orisonte and note as wel his secounde altitude as his furste Altitude and whan that this is don, rikne how manye degrees that the firste altitude of A excedith his seconde altitude, and tak half thilke porcioun that is excedit, and adde it to his seconde altitude; and tak ther the eleuacioun of thi pool, and eke the latitude of thy regioun; for thise two ben of a nombre; this is to seyn, as many degrees as thy pool is eleuat, so michel is the latitude of the Regioun. Ensample as thus: par auenture the altitude of A in the euenyng is 56 degrees of heyhte, than wol his seconde altitude or the dawyng be 48, that is 8 lasse than 56, that was his furste altitude at euen. Take thanne the half of 8 and adde it to 48, that was his seconde altitude, and than hastow 52. Now hastow the heyhte of thy pol and the latitude of the regioun. But vnderstond wel that to proue this conclusioun and many another fair conclusioun, thow most haue a plomet hanging on a lyne heyer than thin heued on a perche and thilke lyne mot hange euene perpendiculer bytwixe the pool and thin eye, and thanne shaltow sen yif A sitte euene ouer the pool and ouer F at euene, and also yif F sitte euene ouer the pool and ouer A or day. And for more declaracion, lo here thi figure.

[*Note to* § 24.] If a circumpolar star be observed to have 18° of altitude when due north and 86° of altitude when due south, then $18+86=104$, and the half of 104 is 52, which is the height of the pole or the latitude. In the case illustrated in the diagram $48+56=104$, and $\frac{104}{2}=52$.

24. Another conclusion to prove the height of the arctic pole from the horizon.

Take any fixed star that never descendeth under the horizon in the region, and consider his highest altitude and his lowest altitude from the horizon; and add both these altitudes together. Then subtract half the sum, and take the result as the elevation of the arctic pole in that same region. And for more explanation, lo here thy figure.



24. Another conclusion to proue the heyhte of the pool Artik fro the orisonte.

[*Alia conclusio ad probandum altitudinem de polo artico ab orizonte.*]

Tak any sterre fixe that neuere dissendith vnder the Orisonte in thilke regioun, and considere his heiest altitude and his lowest Altitude fro the Orisonte; and make a nombre of bothe thise altitudes. Tak thanne and abate half that nombre, and tak ther the eleuacioun of the pol Artik in that same Regioun, and for more declaracioun, lo here thi figure. [*Messahalla*, § 22.

25. Another conclusion to prove the latitude of the region, etc.

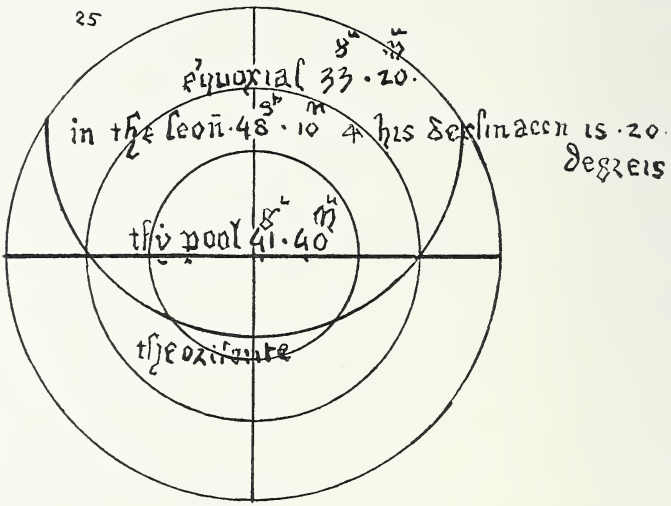
Understand well that the latitude of any place in a region is verily the space betwixt the zenith of them that dwell there and the equinoctial circle, north or south, taking the measure in the meridional line, as shown by the almicanteras of thy astrolabe. And this space is as much as the arctic pole is elevated above the horizon. And also the antarctic pole is beneath the horizon by the same quantity of space, neither more nor less. Then, if thou desire to know the latitude of the region, take the altitude of the sun at midday, when the sun is in the head of Aries or of Libra, for then the sun is moving in the equinoctial line, and subtract the sun's altitude from 90°, and then the remainder is the latitude of the region, as thus:

I suppose that the sun is this day at noon 38 degrees and 10 minutes of height. Subtract then these degrees and minutes from 90°; there remaineth 51 degrees and 50 minutes, the latitude. I say not this but for example; for well I know the latitude of Oxford is certain minutes less, as I might prove.

Now if so be that it seemeth to thee too long a-delaying, to abide till the sun is in the head of Aries or of Libra, then observe the sun when he is

in any other degree of the zodiac, and consider the degree of his declination from the equinoctial line; and if it so be that this declination be northward from the equinoctial, subtract his declination then from the sun's altitude at noon, and then hast thou the height of the heads of Aries and Libra; as thus:

My sun is, peradventure, in the first degree of Leo, 58 degrees and 10 minutes of height at noon, and his declination is almost 20 degrees northward from the equinoctial; subtract then these 20 degrees of declination from the altitude at noon, then remaineth the 38 degrees and odd minutes; lo there the head of Aries or Libra, and thy equinoctial in that region. Also if the sun's declination be southward from the equinoctial, add then this declination to the altitude of the sun at noon, and take there the heads of Aries and Libra and thy equinoctial. Subtract then the height of the equinoctial from 90 degrees, and the remainder is the distance, 51 degrees and 50 minutes of the pole, of that region from the equinoctial. Or else, if it pleases thee, take the highest altitude from the equinoctial of any fixed star that thou knowest, and take his nether elongation extending from the same equinoctial line, and work in the manner aforesaid. And for more explanation, lo here thy figure.



25. Another conclusioun to proue the latitude of the Regioun.

[*Alia conclusio ad probandum latitudinem regionis.*]

Vnderstond wel that the latitude of any place in a Regioun is verreyly the space bytwixe the senythe of hem that dwellen there and the equinoxial cerkle, north or sowthe, takyng the mesure in the Meridional lyne, as shewith in the Almykanteras of thin Astrelabie. And thilke space is as moche as the pool artik is hey in the same place fro the Orisonte. And than is the depressioun of the pol antartik, that is to seyn, than is the pol antartik bynethe the Orisonte the same quantite of space, neither mor ne lasse. Thanne, yif thow desire to knowe this latitude of the Regioun, tak the altitude of the sonne in the Middel of the day, whan the sonne is in the heuedes of aries or of libra, for thanne Moeuyth the sonne in the lyne equinoxial; and abate the nombre of that same sonnes Altitude owt of 90, and thanne is the remenaunt of the noumbre that leuyth the latitude of the Regioun, as thus: I suppose that the sonne is thilke day at noon 38 degrees and 10 minutes of heyhte. Abate thanne thees degrees and minutes owt of 90; so leueth there 51 degrees and 50 minutes, the latitude. I sey nat this but for ensample; for wel I wot the latitude of Oxenforde is certein minutes lasse, as y myght proue. Now yif so be that the semith to long a tarienge, to abide til that the sonne be in the heuedes of aries or of libra, thanne whaite whan the sonne is in any other degree of the zodiak, and considere the degree of his declinacion fro the equinoxial lyne; and yif it so be that the sonnes declinacion be northward fro the equinoxial, abate thanne fro the sonnes altitude at noon the nombre of his declinacion, and thanne

hastow the heyhte of the heuedes of aries and libra. As thus, My sonne is, par Auenture, in the firste degre of leoun, 58 degrees and 10 Minutes of heyhte at noon, and his declinacion is almost 20 degrees northward fro the equinoxial; abate thanne thilke 20 degrees of declinacion owt of the altitude at noon, than leueth the 38 degrees and odde Minutes; lo ther the heued of aries or libra, and thin equinoxial in that Regioun. Also yif so be that the sonnes declinacioun be sowthward fro the Equinoxial, Adde thanne thilke declinacion to the altitude of the sonne at noon and tak ther the heuedes of aries and libra and thin Equinoxial. Abate thanne the heyhte of the Equinoxial owt of 90 degrees, and thanne leuyth there the distans of the pole, 51 degrees and 50 Minutes, of that regioun fro the Equinoxial. Or elles, yif the lest, take the heiest altitude fro the equinoxial of any sterre fix that thow knowest, and tak his nethere elongacioun lengthing fro the same equinoxial lyne, and wirke in the maner forseid. And for more declaracion, lo here thi figure. [*Messahalla*, § 21.

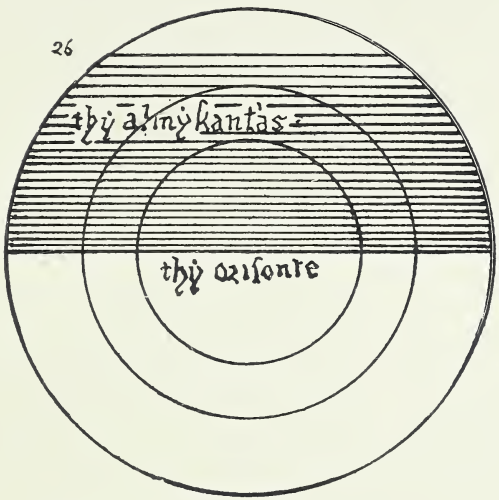
26. Explanation of the ascension of signs, etc.

The excellence of the solid sphere, amongst other noble conclusions, showeth manifest the diverse ascensions of signs in different places, as well in the right circle as in the oblique circle. These authors [of the Treatise of the Sphere?] write that a sign is called of right ascension, when a greater part of the equinoctial circle and a less part of the zodiac ascendeth with it; and a sign ascendeth obliquely, when a less part of the equinoctial and a greater part of the zodiac ascendeth with it.

[Further more they say, that in a country where the zenith of them that dwell there, is in the equinoctial line and their horizon passes the poles of this world, the folk have this right circle and the right horizon];[1] and there the arc of the day and the arc of the night is equally long, and twice every year the sun passes through the zenith over their head; and this aforesaid people have 2 summers and 2 winters in a year. The almicanteras in their astrolabes are straight as a line, as is shown in this figure.

The utility of knowing the ascensions in the right circle is this, that by means of these ascensions astrologians by their tables and their instruments can accurately find the ascension of every degree and minute in all the zodiac, as shall be shown. And note, that this aforesaid right horizon, called *horison rectum*, divides the equinoctial at right angles; and the oblique horizon, where the pole is elevated upon the horizon, cuts across the equinoctial at oblique angles, as is shown in the figure. And for more explanation, lo here the figure.

[1] This important passage in brackets, wanting in the Cambridge MS., is supplied by Skeat from MS. Bodley 619. It states that at the equator the poles are on the horizon.



26. Declaracioun of the assensioun of signes, &c.

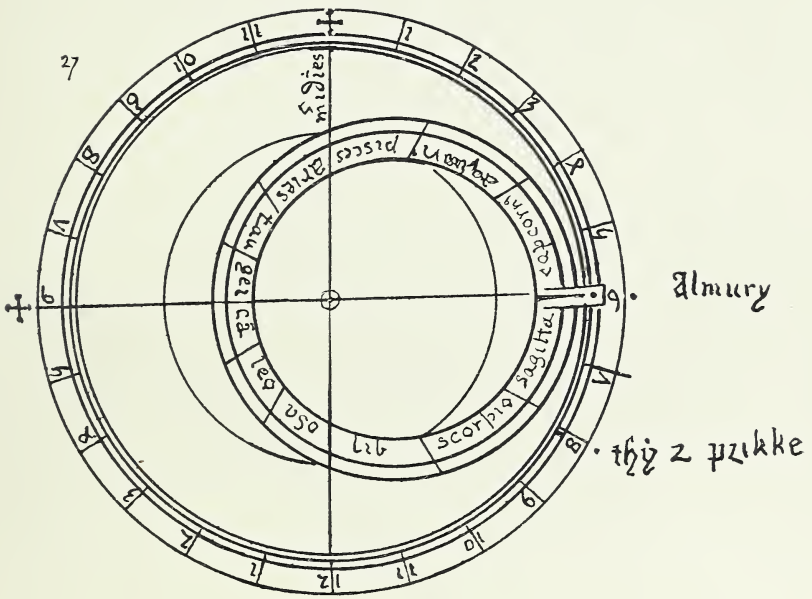
[*Declaracio de ascensione signorum.*]

The excellence of the spere solide, amonges other noble conclusiouns, shewyth Manifeste the diuerse assenciouns of signes in diuerse places, as wel in the rihte cercle as in the Embelif cercle. Thise Auctours writen that thilke signe is cleped of riht Ascensioun, with which more part of the cercle Equinoxial and lasse part of the zodiak ascendith, and thilke signe assendith Embelif, with whiche lasse part of the Equinoxial and more part of the zodiak assendith. Ferther ouer they seyn, that in thilke cuntrey where as the senith of hem that dwellen there is in the equinoxial lyne and her orisonte passyng by the poles of this worlde, thilke folke han this right cercle and the right orisonte; and euere mo the Arch of the day and the arch of the nyht is ther ylike long, and the sonne twyes euery yer passinge thorow the cenyth of her heued; and 2 someres and 2 wynteres in a yer han this forseide poeple. And the Almykanteras in her Astrolabies ben streyhte as a lyne so as shewyth in this figure. The vtilite to knowe the Assenciouns in the rihte cercle is this truste wel that by mediacioun of thilke assenciouns thise Astrologiens by hir tables and hir instrumentz knowen verreyly the Assencioun of euery degree and Mynut in al the zodiak, as shal be shewyd. And nota, that this forseid rihte orisonte, that is clepid *orison rectum* diuideth the equinoxial into riht Angles; and the embelif orisonte, wher as the pol is enhawsed vpon the orisonte, ouerkeruyth the equinoxial in Embelif Angles, as shewith in the figure. And for the more declaracioun, lo here the figure.

27. This is the conclusion to find the ascension of signs in the right circle, that is, the *circulus directus*.

Set the head of whatever sign ye list to find his ascending in the right circle, upon the meridional line, and watch where thy almury toucheth the border. Set there a dot, and turn thy rete westward till the end of the aforesaid sign is situate upon the meridional line. And soon after watch where thy almury toucheth the border, and set there another dot. Count then the number of degrees in the border betwixt both dots, and take the ascension of the sign in the right circle. And thus mayest thou work with every portion of thy zodiac, &c. And for more declaration, lo here thy figure.

Note. In the figure the sign Aries has been chosen. The first dot is distant 30° from 'thy second prikke' marked upon the border.



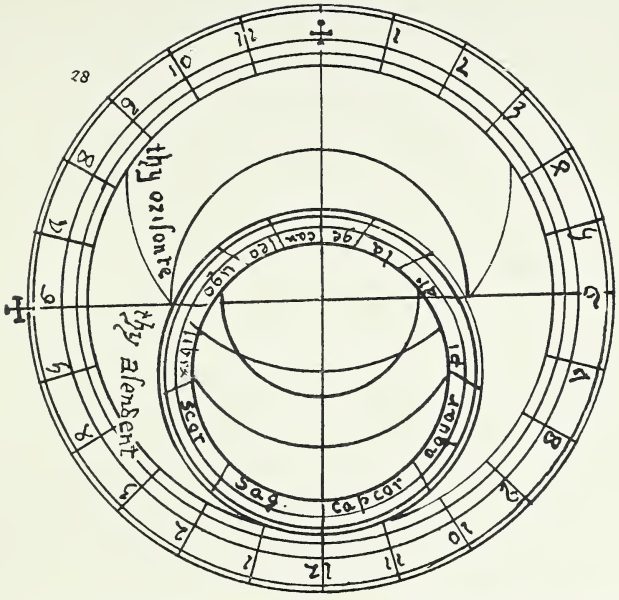
27. This is the conclusioun to knowe the Assenciouns of signes in the riht cercle, that is, circulus directus, &c.

[*Ad cognoscendum ascenciones signorum in recto circulo, qui vocatur circulus directus.*]

Set the heued of what signe the liste to knowe his Assending in the riht cercle vpon the lyne Meridional, and waite wher thin Almury towchieth the bordure, and set ther a prikke. Turne thanne thy riet westward til that the ende of the forseide signe sitte vpon the Meridional lyne and eftsones waite wher thin almury towchith the bordure, and set ther Another prikke. Rikne thanne the nombre of degrees in the bordure bytwyxe bothe prikkes, and tak the Assencioun of the signe in the riht cercle. And thus maistow wyrke with euery porcioun of thy zodiak, &c. And for the more declaracioun, lo her thi figure. [*Messahalla*, § 28.

28. To find the ascensions of signs in the oblique circle in every region, I mean, *in circulo obliquo.*

Set the head of the sign which ye list to find his ascension upon the east horizon, and watch where thy almury touches the border, and set there a dot. Then turn thy rete upward till the end of the same sign is situate upon the east horizon, and note where thy almury toucheth the border, and set there another dot. Count then the number of degrees in the border betwixt the two dots, and take there the ascension of the sign in the oblique circle. Understand well, that all signs in thy zodiac from the head of Aries unto the end of Virgo are called Signs of the North from the equinoctial, and these signs arise betwixt the true east and the true north in our horizon generally for ever. And all signs from the head of Libra unto the end of Pisces are called Signs of the South from the equinoctial; and these signs arise evermore betwixt the true east and the true south in our horizon. Also every sign betwixt the head of Capricorn and the end of Gemini rises on our horizon in less than 2 hours of equal length; and these same signs, from the head of Capricorn unto the end of Gemini, are called 'tortuous signs' or 'crooked signs', for they arise obliquely on our horizon; and these crooked signs are obedient to the signs that are of right ascension. The signs of right ascension are from the head of Cancer to the end of Sagittarius; and these signs arise more upright, and they are called also 'sovereign signs'; and each of them riseth in more than two hours. Of which signs Gemini obeyeth to Cancer, and Taurus to Leo, Aries to Virgo, Pisces to Libra, Aquarius to Scorpion, and Capricorn to Sagittarius. And thus for evermore 2 signs that are equally far from the head of Capricorn, obey each of them to the other. And for more explanation, lo here the figure.



28. To knowe the assencions of signes in the Embelif cercle in euery regioun, I mene, in circulo obliquo.

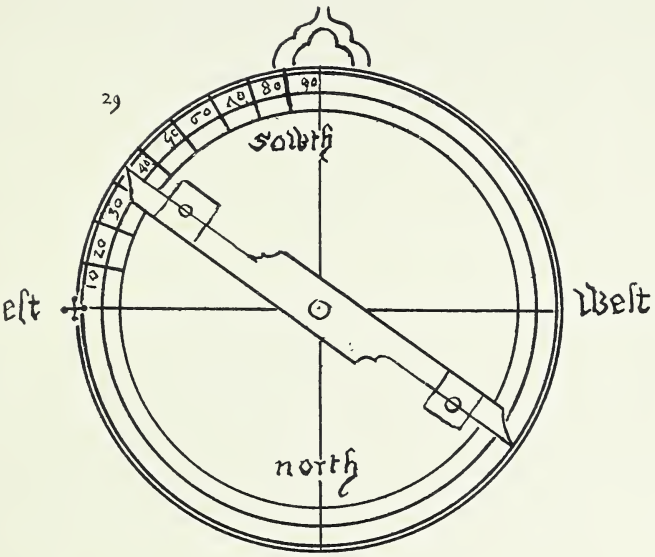
[*Ad cognoscendum ascenciones signorum in recto circulo in omni regione, hoc est, in circulo obliquo.*]

Set the heued of the signe which as the list to knowe his Ascensioun vpon the est Orisonte, and waite wher thyn Almury towchith the bordure, and set ther a prikke. Turne thanne thy riet vpward til that the ende of the same signe sitte vpon the Est Orisonte and waite eftsones wher as thin almury towcheth the bordure, and set ther another prikke. Rikne thanne the nowmbre of degrees in the bordure bytwyxe bothe prikkes, and tak ther the Assencioun of the signe in the Embelif cercle. And vnderstond wel, that alle signes in thy zodiak fro the heued of aries vnto the ende of virgo ben cleped signes of the north fro the Equinoxial, and these signes arisen bytwyxe the verrey est and the verrey north in owre Orisonte generaly for euere; and alle signes fro the heued of libra vnto the ende of pisces ben cleped signes of the sowth fro the Equinoxial; and thise signes arisen euermo bytwyxe the verrey est and the verrey sowth in owre orisonte. Also euery signe bytwixe the heued of capricorne vnto the ende of geminis ariseth on owre Orisonte in lasse than 2 howres equales; and thise same signes, fro the heued of capricorne vnto the ende of geminis, ben cleped tortuos signes or kroked signes for they arisen embelif on oure Orisonte; and this crokede signes ben obedient to the signes that ben of riht Assencioun. The signes of riht assencioun ben fro the heued of cancer to the ende of sagittare; and thise signes arisen more vpriht, and they ben called eke souereyn signes; and euerich of hem ariseth in mor space than in to howres. Of which signes gemini obeieth to Cancer, and taurus to leo, Aries to virgo, pisces to libra, Aquarius to Scorpioun, and Capricorne to Sagittare. And thus euermo 2 signes that ben illike fer fro the heued of capricorne obeien euerich of hem til other. And for more declaracioun, lo here the figure.

29. To find exactly the 4 quarters of the world, east, west, north, and south.

Take the altitude of thy sun when it pleases thee,[1] and note well the quarter of the world in which the sun is at the time by the azimuths. Then turn thy astrolabe, and set the degree of the sun in the almicanteras of his altitude on the side where the sun is, as in the taking of hours; lay thy label on the degree of the sun, and count how many degrees of the border are betwixt the meridional line and the point of thy label; and note well that number. Again turn thy astrolabe, and set the point of thy great rule with which thou takest thy altitudes, upon as many degrees from the meridional in the border, as the point of thy label was from the meridional line on the womb-side. Then take thy astrolabe with both hands carefully and skilfully, and let the sun shine through both holes of thy rule; and skilfully in this shining let thy astrolabe lie down even upon a smooth ground, and then will the meridional line of thy astrolabe lie due south, and the east line will lie east, and the west line west, and the north line north. If thou work gently and carefully in the laying down, thou hast thus the 4 quarters of the firmament. And for more explanation, lo here the figure.

[1] If a true result be required the observation should be made near midday.



29. To knowe Iustly the 4 quarters of the world, as est, west, north, and sowth.

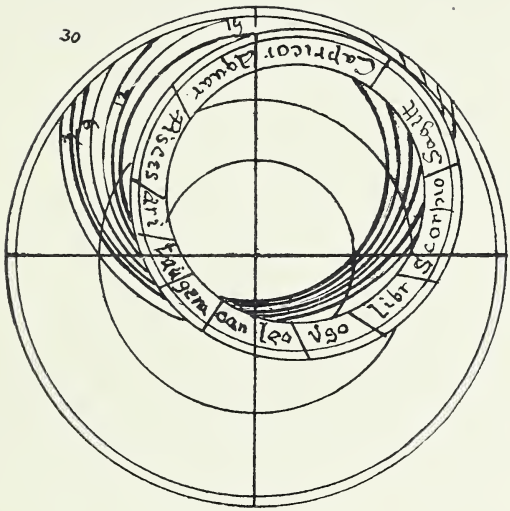
[*Ad cognoscendum euidenter quatuor partes mundi, scilicet, orientem, austrum, aquilonem, et occidentem.*]

Take the altitude of thy sonne whan the list, and note wel the quarter of the world in which the sonne is for the tyme by the Azymutz. Turne thanne thin Astrolabie and set the degree of the sonne in the Almykanteras of his altitude on thilke side that the sonne stant as is the manere in takyng of howres; and ley thy label on the degree of the sonne, And rikene how many degres of the bordure ben bytwixe the lyne Meridional and the point of thy label; and note wel that nowmbre. Turne thanne agayn thyn Astralabie, and set the point of thy gret Rewle ther thow takest thyne Altitudes vpon as many degrees in his bordure fro his Meridional as was the point of thy label fro the lyne Meridional on on the wombeside. Tak thanne thyn Astrolabie with bothe handes sadly and slely, and lat the sonne shyne thorow bothe holes of thy rewle; and sleyly in thilke shynynge lat thyn Astrelabie kowch adown euene vpon a smothe grond, and thanne wol the verrey lyne Merydional of thyn Astrolabie lye euene sowth, and the est lyne wole lie est, and the west lyne west, and north lyne north, so that thow werke softly and avisely in the cowchyng; and thus hastow the 4 quarters of the firmament. And for the more declaracioun, lo here the figure. [*Messahalla*, § 19.

30. To find the altitude of planets from the way of the sun, whether they be north or south of the aforesaid way.

When a planet is in the meridional line, observe if its altitude be of the same height as the degree of the sun for that day, then the planet is exactly in the way of the sun,[1] and hath no latitude. But if the altitude of the planet be higher than the degree of the sun, then the planet is north of the way of the sun by such a quantity of latitude as is shown by thy almicanteras. And if the altitude of the planet be less than the degree of the sun, then the planet is south of the way of the sun by such a quantity of latitude as is shown by thy almicanteras. This is to say, from the way where the sun went on the day of the observation, but not from the way of the sun in every place of the zodiac. And for more explanation, lo here the figure.

[1] The 'way of the sun' is not the zodiacal circle, but its apparent path across the sky at a given date, which will of course vary from day to day. If the sun's altitude be $61\frac{1}{2}°$ the way is the tropic of Cancer, and if then the planet be on the zodiac in Capricorn it may be 47° S. of the way of the sun (Skeat).



30. To knowe the Altitude of planetes fro the wey of the sonne, whether so they be north or sowth fro the forseide wey.

[*Ad cognoscendum altitudinem planetarum a cursu solis, utrum sint in parte australi vel boreali a cursu supra dicto.*]

Lok whan that a planete is in the lyne Meridional, yif that hir altitude be of the same heyhte that is the degree of the sonne for that day, and than is the planete in the verrey wey of the sonne, and hath no latitude. And yif the altitude of the planete be heyere than the degree of the sonne, than is the planete north fro the wey of the sonne swych a quantite of latitude as shewith by thyn Almykanteras. And ghif the altitude of the planete be lasse than the degree of the sonne thanne is the planete sowth fro the wey of the sonne swich a quantite of latitude as shewith by thin almykanteras; This is to seyn, fro the wey wher as the sonne wente thilke day but nat from the wey of the sonne in euery place of the zodiak. And for the more declaracioun, lo here the figure.

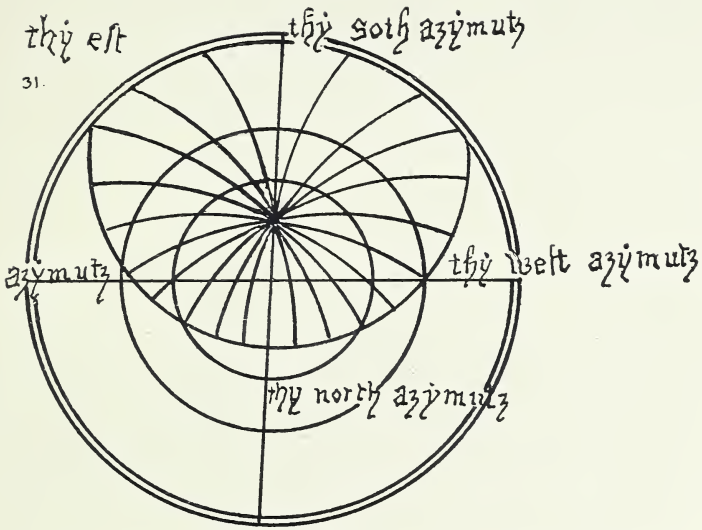
[*Messahalla*, § 35.

31. To find the senith[1] from the rising of the sun, that is to say, that part of the horizon where the sun rises.

Thou must first consider that the sun does not always rise due east, but sometime north of east, and sometime south of east. In fact the sun never rises due east in our horizon, unless he be in the head of Aries or Libra. Now thy horizon is divided into 24 parts by thy azimuths, in signification of the 24 parts of the world (albeit shipmen reckon with 32 parts), then there is no more to do than to watch in which azimuth thy sun entreth at its rising, and take from that the senith of the rising of the sun.

The manner of the division of thy astrolabe is this, I mean in this respect. First it is divided into 4 cardinal quarters of the compass by the line that goeth from east to west, and then by another line that goeth from south to north. Then is it divided into small parts of azimuths, as east, and east by south, where the first azimuth is above the east line; and so forth from part to part, till that thou come again to the east line. Thus mayest thou understand also the senith of any star, in which part he riseth, &c. And for more explanation, lo here the figure.

[1] By 'senyth' is meant the *signum* or point on the horizon where the sun is seen to rise. In Chaucer's astrolabe the horizon was divided by 24 azimuths, though only 22 are drawn in the figure in the manuscript.



31. To knowe the senyth of the arysing of the sonne, this is to seyn, the partie of the Orisonte in which that the sonne arisith.

[*Ad cognoscendum signum de ortu solis, scilicet, illam partem orientis in qua oritur sol.*]

Thow most first considere that the sonne ariseth nat alwey verrey est, but some tyme by north the est, and som tyme by sowthe the est. Sothly the sonne ariseth neuermo verrey est in owere Orisonte, but he be in the heued of aries or libra. Now is thin Orisonte departed in 24 parties by thi azymutz, in significacion of 24 partiez of the world; al be it so that shipmen rikne thilke partiez in 32 thanne is ther no more but waite in which azymut that thi sonne entreth at his arisyng and take ther the senyth of the arising of the sonne. The manere of the deuisioun of thin Astralabie is this, I Mene as in this cas. First is it deuided in 4 plages principalx with the lyne that goth from est to west, and than with another lyne that goth fro sowth to north. Than is it deuided in smale partiez of Azymutz, as est, and est by sowthe, whereas is the firste Azimut aboue the est lyne; and so forth fro partie to partie, til that thow come agayn vnto the est lyne, thus maistow vnderstond also the senyth of any sterre, in which partie he riseth, &c. And for the more declaracion, lo here the figure.

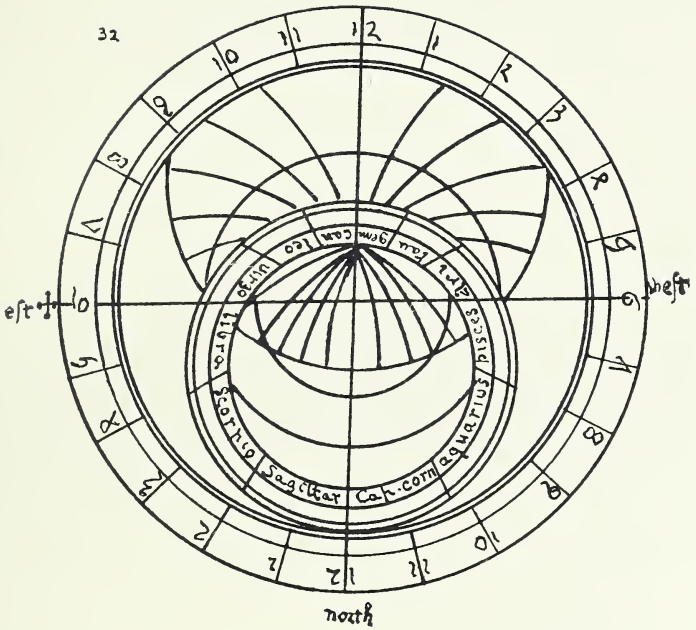
[*Messahalla*, § 18.

32. To find in what part of the firmament a conjunction [of the sun and moon occurs].

Consider the time of the conjunction by thy calendar, as thus; see how many hours this conjunction is from the midday of the day preceding, as is shown by the canon of thy calendar. Reckon then this number of hours in the border of thy astrolabe, as thou art wont to do in finding the hour of the day or of the night; and lay thy label over the degree of the sun, and then the point of thy label will be situate upon the hour of the conjunction. Note then the azimuth in which the degree of thy sun is situate, and in that part of the firmament is the conjunction. And for more explanation, lo here thy figure.

[1] The figure is not helpful. Skeat illustrates as follows:

The problem is to find the azimuth of the sun at a given hour. The method may be illustrated by the following example. Suppose that the calendar gives 9 A.M. as the time of the conjunction on March 12th when the sun is in the first point of Aries. Now 9 A.M. is 21 o'clock, reckoned from the preceding midday, which answers to the letter X in the border (see p. 32). Turn the label to X and bring the sun's position, i.e. the 1st point of Aries beneath it, and note its azimuth. In this case it will be found to be near the azimuth 50° to the E. of the S. point.



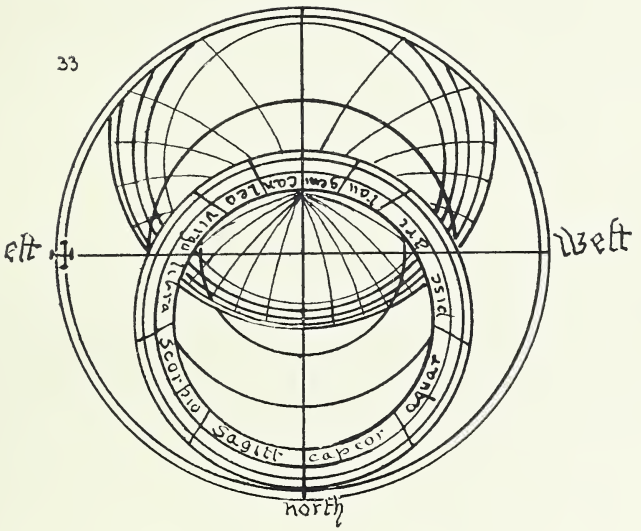
32. To knowe in which partie of the firmament is the coniunccioun.

[*Ad cognoscendum in qua parte firmamenti sunt coniuncciones solis et lune.*]

Considere the tyme of the coniunccion by thy kalender as thus; lok how many howres thilke coniunccion is fro the Midday of the day precedent, as shewith by the canoun of thi kalender; rikne thanne thilke nombre of howres in the bordure of thyn Astralabie as thow art wont to do in knowyng of the howres of the day or of the nyht; and ley thy label ouer the degree of the sonne; and thanne wol the point of thy label sitte vpon the hour of the coniunccion. Loke thanne in which Azymut the degree of thy sonne sittith, and in that partie of the firmament is the coniunccioun. And for the more declaracioun, lo here thy figure.

33. To find the azimuth from the altitude of the sun, &c.

This is no more than to say that at any time of the day the altitude of the sun may be taken, and by the azimuth in which he standeth, mayest thou see in which part of the firmament he is. In the same wise mayest thou see, at night, in the case of any star, whether the star sit east or west or north, or any part between, according to the azimuth in which the star is. And for more explanation, lo here the figure.



33. To knowe the senyth[1] of the Altitude of the sonne, &c.

[*Ad cognoscendum signa de altitudine solis.*]

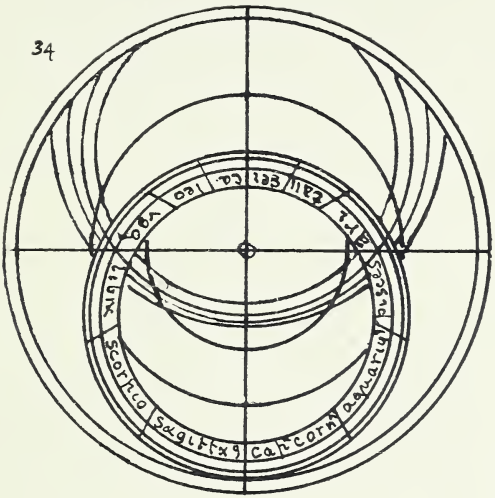
This is no mor to seyn but any tyme of the day tak the altitude of the sonne, and by the Azymut in which he stondith, Maistou sen in which partie of the firmament he is, and in the same wyse maistou sen, by the nyht, of any sterre, wheither the sterre sitte est or west or north, or any partie bytwene, aftur the name of the Azimut in which is the sterre. And for the more declaracioun, lo here the figure. [*Messahalla*, § 17.

[1] Chaucer here again uses the word 'senyth' in the sense of azimuth.

34. To find truly the degree of the longitude of the moon or of any planet that hath no latitude for the time from the ecliptic line.

Take the altitude of the moon, and reckon thy altitude up among thy almicanteras on the side on which the moon stands, and set there a dot. Take then right anon, upon the moon's side, the altitude of any fixed star that thou knowest, and set its centre upon its altitude among thy almicanteras. Watch then which degree of the zodiac toucheth the dot marking the altitude of the moon, and take there the degree in which the moon standeth. This conclusion is very true, if the stars in thy astrolabe have been marked in their true position. Commonly, treatises of the astrolabe make no exception, whether the moon have latitude, or none, nor on which side of the moon the altitude of the fixed star be taken. And note, that if the moon show himself by light of day, then mayest thou work this conclusion by the sun, as well as by a fixed star. And for more explanation, lo here thy figure.

Note. Again the figure is not helpful.



34. To knowe sothly the degree of the longitude of the mone, or of any planete that hath no latitude for the tyme fro the Ecliptik lyne.

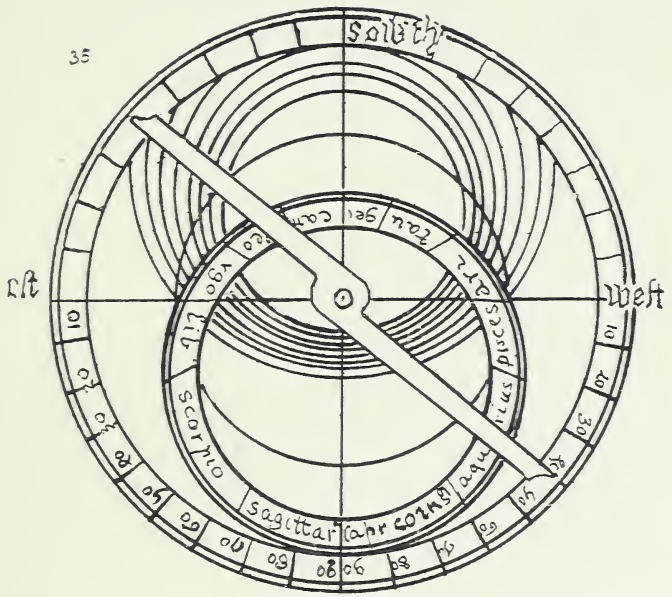
[*Ad cognoscendum veraciter gradum de longitudine lune, vel alicuius planete qui non habet longitudinem pro tempore causante linea ecliptica.*]

Tak the altitude of the mone, and rikne thin altitude vp among thyne Almykanteras on which side that the Mone stande, and set there a prikke. Tak thenne anon riht, vpon the mones side, the Altitude of any sterre fix which that thow knowest, and set his Centre vpon his altitude among thin Almykanteras ther the sterre is fownde. Waite thanne which degree of the zodiak towchith the prikke of the altitude of the mone, and tak ther the degree in which the mone standith. This conclusioun is verrey soth, yif the sterres in thin Astrolabie stonden aftur the trowthe: of comune, tretis of Astralabie ne make non excepcioun wheyther the mone haue latitude, or non, ne on wheither side of the mone the Altitude of the sterre fix be taken. And nota, that yif the Mone shewe himself by liht of day, than maistow wyrke this same conclusioun by the sonne, as wel as by the fix sterre. And for the more declaracioun, lo here thy figure. [*Messahalla*, § 32.

35. This is the working of the conclusion, to know whether a planet be direct or retrograde.

Take the altitude of any star that is called a planet, and note it well. And take also anon the altitude of any fixed star that thou knowest, and note it well also. Come again on the third or the fourth night following; for by then shalt thou perceive well the moving of the planet, whether he has moved forward or backward. Watch closely when thy fixed star is in the same altitude that it was when thou took its first altitude; and take then soon after the altitude of the aforesaid planet, and note it well. For be assured that if the planet be on the right side of the meridional line, so that its second altitude be less than its first altitude was, then is the planet direct. And if it be on the west side in that condition, then is it retrograde. And if so be that this planet be upon the east side when its altitude is taken, so that its second altitude be more than its first altitude, then is it retrograde, and if it be on the west side, then is it direct.

But the course of the moon is an exception to these rules; for the moon moveth the contrary from other planets in her epicycle, but in no other manner. And for more explanation, lo here thy figure.



35. This is the workinge of the conclusioun, to knowe yif that any planete be directe or retrograde.

[*Hec conclusio operatur ad cognoscendum si aliqua planeta sit directa uel retrograda.*]

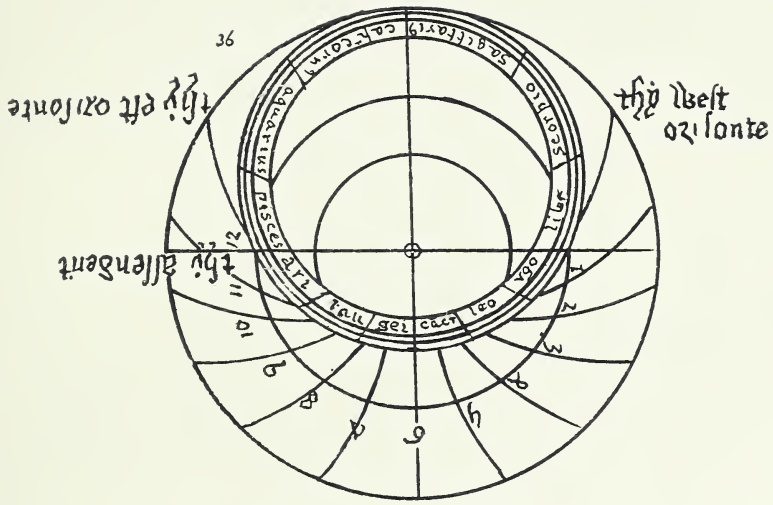
Tak the altitude of any sterre that is cleped a planete, and note it wel. And tak ek anon the altitude of any sterre fix that thow knowest, and note it wel also. Come thanne agayn the thridde or the ferthe nyht next folwyng; fos thanne shaltow aperceyue wel the Moeuyng of a planete, wheither so he Moeue forthward or bakward. Awaite wel thanne whan that thi sterre fix is in the same altitude that she was whan thow toke hir firste altitude; and tak than eftsones the Altitude of the forseide planete, and note it wel. For trust wel, yif so be that the planete be on the riht side of the Meridional lyne, so that his seconde altitude be lasse than his firste altitude was, thanne is the planete directe. And yif he be on the west side in that condicion, thanne is he retrograd. And yif so be that this planete be vpon the Est side whan his altitude is taken, so that his secounde altitude be more than his firste altitude, thanne is he retrograde, and yif he be on the west side, than is he directe. But the contrarie of this parties is of the cours of the Moone: for sothly the Moone Moeuyth the contrarie from othere planetes as in hire Episicle, but in non othere manere. And for the more declaracioun, lo here thi figure. [*Messahalla*, § 36.

36. The conclusions of equations of houses,[1] by the astrolabe.

Set the beginning of the degree that ascendeth upon the end of the 8th unequal hour; then the beginning of the 2 houses will be situate upon the line of midnight. Then move the degree that ascendeth backwards and forwards, and set it on the end of the 10th unequal hour; and then the beginning of the 3rd house will be situate upon the midnight line. Bring up again the same degree that ascended first, and set it upon the horizon, and then the beginning of the 4th house will be situate upon the line of midnight. Take then the nadir of the degree that first ascended, and set it on the end of the 2nd unequal hour, and then the beginning of the 5th house will be situate upon the line of midnight; set then the nadir of the ascendent on the end of the 4th hour, then the beginning of the 6th house will be situate on the midnight line. The beginning of the 7th house is nadir of the ascendent, and the beginning of the 8th house is nadir of the 2nd; and the beginning of the 9th house is nadir of the 3rd; and the beginning of the 10th house is nadir of the 4th; and the beginning of the 11th house is nadir of the 5th; and the beginning of the 12th house is nadir of the 6th. And for the more explanation, lo here the figure.

[1] Equations of houses are the equal parts into which the sphere is divided. The first, or 'ascendent' or rising house was of chief importance; then came the tenth just reaching the meridian; then the seventh or 'descendent', just about to set; then the fourth coming on to the midnight line.

The lines in the figure are those of the planetary hours, not of the houses



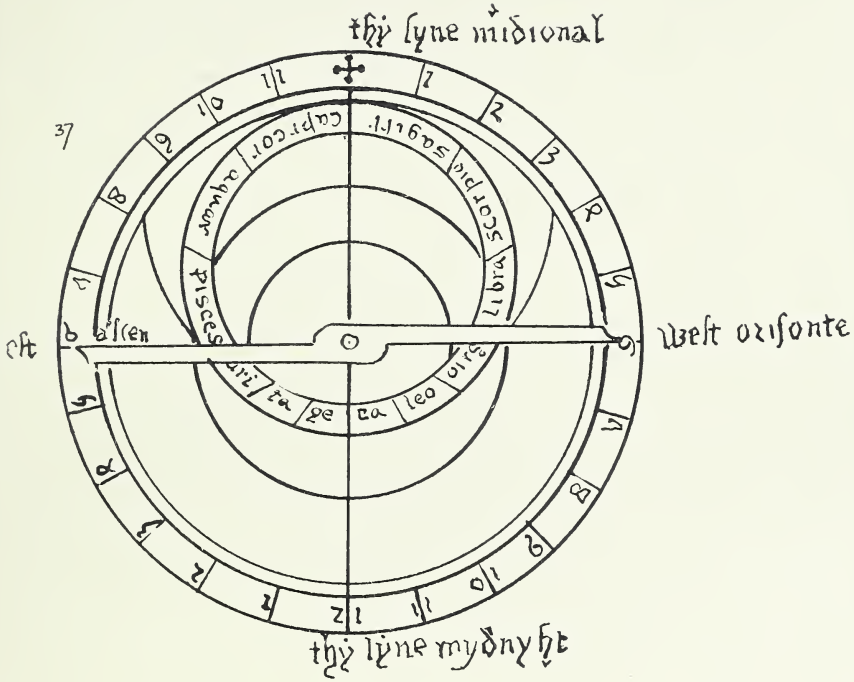
36. The conclusiouns of equaciouns of howses, after the astralabie, &c.

[*Conclusio de equacione domorum.*]

Set the bygynnyng of the degree that assendith vpon the ende of the 8 howre inequal; thanne wol the bygynnyng of the 2 hows sitte vpon the lyne of Midnyht. Remeue thanne the degree that assendith, and set him on the ende of the 10 howr inequal; and thanne wol the bygynnyng of the 3 howis sitte vpon the Midnyht lyne. Bryng vp agayn the same degree that assendith first and set him vpon the Orisonte, and thanne wol the begynnyng of the 4 howys sitte vpon the lyne of Midnyht. Tak thanne the nadir of the degree that first Assendith and set him on the ende of the 2 howre inequal, and thanne wol the bygynnyng of the 5 howys sitte vpon the lyne of Midnyth; set thanne the nadir of the assendent on the ende of the 4 howre, than wol the bygynnyng of the 6 house sitte on the Midnyht lyne. The bygynnyng of the 7 hows is nadir of the Assendent, and the bygynnyng of the 8 hows is nadir of the 2; and the bygynnyng of the 9 hous is nadir of the 3; and the bygynnyng of the 10 hows is the nadir of the 4; and the bygynnyng of the 11 hows is nader of the 5; and the bygynnyng of the 12 hows is nadir of the 6. And for the more declaracion. lo here the figure. [*Messahalla*, § 37.

37. Another manner of equations of houses by the Astrolabe.

Take thy ascendent, and then hast thou thy 4 angles; for thou knowest well that the opposite of thy ascendent, that is to say, thy beginning of the 7th house, is situate upon the west horizon; and the beginning of the 10th house is situate upon the meridional line; and its opposite upon the line of midnight. Then lay thy label over the degree that ascendeth, and reckon from the point of thy label all the degrees in the border, till thou come to the meridional line, and divide all these degrees into 3 even parts, and take the even equation of 3; if thy label be layed over each of the 3 parts, then mayest thou see by thy label in which degree of the zodiac is the beginning of each of these same houses from the ascendent, that is to say, the beginning of the 12th house next above thy ascendent, and then the beginning of the 11th house, and then the 10th, upon the meridional line as I first said. By working in the same manner from the ascendent down to the line of midnight, thou hast other 3 houses, that is to say, the beginning of the 2nd and the 3rd and the 4th houses; then is the nadir of these 3 houses the beginning of the 3 houses that follow. And for more explanation, lo here thy figure.



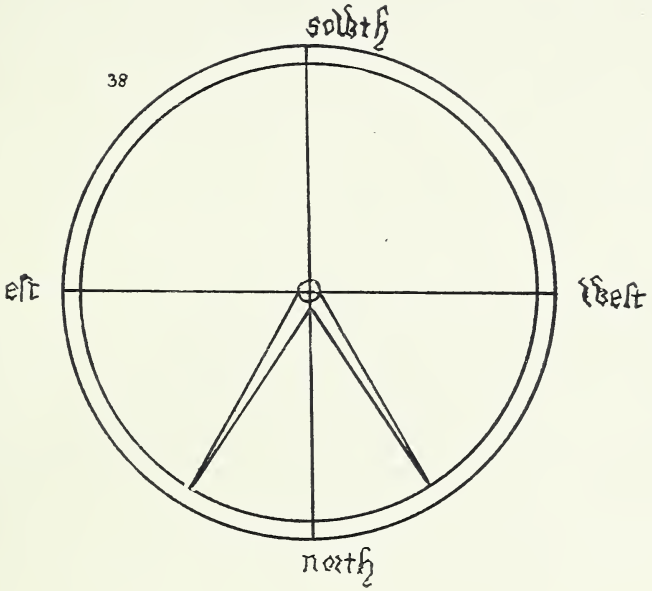
37. Another manere of equaciouns of howses by the Astrelabie.

[*De aliqua forma equacionis domorum secundum astrolabium.*]

Tak thin assendent, and thanne hastow thi 4 Angles; for wel thow wost that the opposit of thin assendent, that is to seyn, thy bygynnyng of the 7 howis, sit vpon the west orizonte; and the bygynnyng of the 10 howis sit vpon the lyne Meridional; and his opposit vpon the lyne of Mydnyht. Thanne ley thi label ouer the degree that assendeth and rekne fro the point of thy label alle the degrees in the bordure, til thow come to the Meridional lyne, and departe alle thilke degrees in 3 euene parties, and take the euene equacion of 3; for ley thy label ouer euerich of 3 parties, and than maistow se by thy label in which degree of the zodiak is the bygynnyng of euerich of thise same howses fro the assendent, that is to seyn, the begynyng of the 12 howse next aboue thin assendent. And thanne the begynnyng of the 11 howse, and thanne the 10 vpon the Meridional lyne, as I first seide. The same wyse wyrke thow fro the assendent down to the lyne of Mydnyht, and thanne thus hastow other 3 howses, that is to seyn, the bygynnyng of the 2 and the 3 And the 4 howses; thanne is the nader of thise 3 howsez the bygynnyng of the 3 howses that folwen. And for the more declaracioun, lo here thi figure. [*Messahalla*, § 38.

38. To find the meridional line permanent in any place.

Take a round plate of metal, to prevent warping the broader the better; and make thereupon an exact circle, a little within the border, and lay this round plate upon an even ground or on an even stone or on an even stump of wood fixed in the ground, and lay it even by a level, and in centre of the circle stick a straight pin, or a wire, upright, the smaller the better. Set thy pin by a plumb-rule even upright, and let this pin be no longer than a quarter of the diameter of thy circle. And observe diligently about 10 or 11 o'clock, when the sun is shining, when the shadow of the pin entreth an hair's breadth within the circle of thy plate, and mark there a dot with ink. Wait, still observing the sun after 1 o'clock, till the shadow of the wire or of the pin pass out of the circle, be it ever so little, and set there another dot of ink. Then take a compass, and exactly measure the middle betwixt both dots, and set there a dot. Then take a rule, and draw a line, straight from the pin unto the middle dot; and take this as thy meridional line for evermore, for that same place. And if thou drawest a cross-line exactly at right angles to the meridional line, then hast thou east and west and south, and in consequence the north, for the nadir of the south line is the north line. And for more explanation, lo here thy figure.



38. To fynde the lyne Merydional to dwelle fix in any certein place.

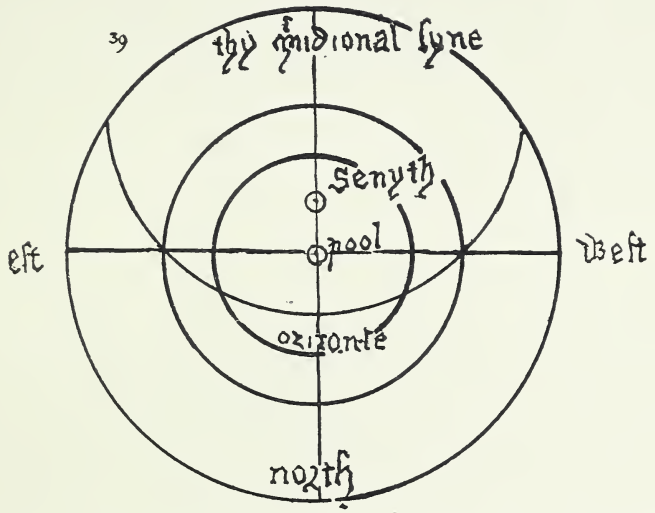
[*Ad inueniendum lineam meridionalem per subtiles operaciones.*]

Tak a rond plate of metal, for warpyng the brodere the bettre; and make thervpon a Iust compas, a lite within the bordure; and ley this ronde plate vpon an euene grond or on an euene ston or on an euene stok fix in the gronde and ley it euen bi a leuel, and in centre of the compas stike an euene pyn or a whir vpriht, the smallere the betere, set thy pyn by a plomrewle euene vpryht and let this pyn be no lengere than a quarter of the diametre of thi compas, fro the centre. And waite bisily aboute 10 or 11 of the clokke, and whan the sonne shynyth, whan the shadwe of the pyn entreth anythyng within the cercle of thi plate an hermele, and mark ther a prikke with inke. Abide thanne stille waityng on the sonne aftur 1 of the clokke, til that the schadwe of the wyr or of the pyn passe onythyng owt of the cercle of the compas, be it neuer so lite, and set ther another prikke of ynke. Take than a compas, and mesure euene the Middel bytwixe bothe prikkes, and set ther a prikke. Take thanne a rewle and draw a strike, euene alyne fro the pyn vnto the Middel prikke; and tak ther thy lyne Meridional for eueremo, as in that same place. And yif thow drawe a croslyne ouerthwart the compas Iustly ouer the lyne Meridional, than hastow est and west and sowth and, par consequence, than the nader of the sowth lyne is the north lyne. And for more declaracioun, lo here thi figure.

39. Description of the meridional line, of longitudes and latitudes of cities and towns relatively to one another, and of climates.

This meridional line is only a kind of imaginary line, that passeth through the poles of this world, and the zenith over our head, and it is called the meridional line, for in whatever place any manner of man may be at any time of the year, when the sun by moving of the firmament cometh to his true meridian place, then is it just mid-day, as we call our noon (as far as the man is concerned); and therefore is it called the line of mid-day. And note, for evermore, of 2 cities or of 2 towns, that when one town approacheth more toward the east than doth the other town, trust well that these towns have different meridians. Note also, that the arc of the equinoctial that is contained or bounded betwixt the 2 meridians is called the longitude of the town. And if so be that two towns have the like meridian, or one meridian, then both of them are equally far from the east, and the contrary. And in this manner they change not their meridian. But soothly they change their almicanteras, with the elevation of the pole and the distance of the sun.

The longitude of a climate is a line imagined from east to west, equally distant between them all. The latitude of a climate is a line imagined from north to south the space of the earth, from the beginning of the first climate unto the very end of the same climate, even direct towards the pole arctic. Thus say some authors, and some of them say that if men speak of latitude, they mean the meridian arc that is contained or intercepted betwixt the zenith and the equinoctial. Then say they that the distance from the equinoctial unto the end of a climate, straight in the direction of the pole arctic, is the true latitude of a climate. And for more explanation, lo here thy figure.



39. Descripcion of the Meridional lyne, of longitudes, and latitudes of Citees and townes from on to another of clymatz.

This lyne Meridional ys but a Maner descripcion of lyne ymagined, that passeth vpon the pooles of this world and by the cenyth of owre heued. And hit is ycleped the lyne Meridional for in what place that any maner man ys at any tyme of the yer whan that the sonne by moeuyng of the firmament cometh to his verrey meridian place than is hit verrey Midday, that we clepen owre noon, As to thilke man; And therfore ys it clepid the lyne of Midday. And nota, for euermo, of 2 citees or of 2 Townes, of whiche that o town aprochith more towarde the Est than doth that other town, Truste wel that thylke townes han diuerse Meridians. Nota also, that the Arch of the Equinoxial that is conteyned or bownded bytwyxe the 2 Meridians ys cleped the longitude of the town. And yf so be that two townes haue illike Meridian, or on Meridian, Than is the distance of hem bothe ylike fer fro the Est and the contrarie. And in this Manere they chaunge nat her Meridian. But sothly they chaungen here Almikanteras, For the enhausyng of the pool and the distance of the sonne. The longitude of a clymat ys a lyne ymagined fro Est to west, illike distant bytwene them alle. The latitude of a climat is a lyne ymagined from north to south the space of the erthe, fro the bygınnyng or the firste clymat vnto to the verrey ende of the same climat, euene directe agayns the poole Artik. Thus seyn some Auctours. And somme of hem seyn that yif men clepen the latitude, thay mene the arch meridian that is contiened or intercept bytwixe the cenyth and the equinoxial. Thanne sey they that the distaunce fro the equinoxial vnto the ende of a clymat, euene agayns the pool artyk, ys the latitude of a climat for sothe. And for more declaracioun, lo here thi figure. [*Messahalla*, § 26.

40. To find the degree of the zodiac with which any planet ascendeth on the horizon, and whether his latitude be north or south.

Find by thy almanac the degree of the ecliptic of any sign in which the planet is reckoned to be, and that is called the degree of its longitude; and find also the degree of its latitude from the ecliptic, north or south. And by these examples following in special, thou mayest work accurately in every sign of the zodiac. The degree of longitude peradventure of Venus, or of another planet, was 6° of Capricorn, and the latitude of it was northward 2 degrees from the ecliptic line. I took a subtle compass, and called one point of my compass A, and the other point F. Then I took the point A, and set it in the ecliptic line even in my zodiac, in the degree of the longitude of Venus, that is to say, in the 6th degree of Capricorn; and then I set the point F upward in the same sign, because the latitude was north, upon the latitude of Venus; that is to say, in the 6th degree from the head of Capricorn; and thus have I 2 degrees betwixt my two pricks; then I laid down my compass gently, and set the degree of the longitude upon the horizon; then I took and waxed my label, as a set of tables is waxed, to receive distinctly the pricks of my compass. Then I took this prepared label, and laid it steady over the degree of my longitude; I then took up my compass, and set the point A in the wax on the label, as even as I could guess over the ecliptic line, in the end of the longitude, and set the point F endlong in my label upon the space of the latitude, inward and over the zodiac, that is to say, northward from the ecliptic. Then I laid down my compass and looked well in the way upon the pricks of A and of F; then I

turned my rete till the prick of F sat upon the horizon, then I saw well that the body of Venus, in her latitude of 2 degrees north, ascended, in the end of the 6th degree, in the head of Capricorn.

And note, that in the same manner thou mayest work with any north latitude in all signs; but soothly the meridional latitude of a planet in Capricorn may not be taken, because of the small space betwixt the ecliptic, and the border of the astrolabe; but soothly, in all other signs it may.

Also the degree, peradventure of Jupiter or of another planet, was in the first degree of Pisces in longitude, and its meridional latitude was 3 degrees; then I took the point A, and set it in the first degree of Pisces on the ecliptic, and then set I the point F downward in the same sign, because the latitude was south 3 degrees, that is to say, from the head of Pisces, and thus have I 3 degrees betwixt both pricks. Then I set the degree of the longitude upon the horizon; then took I my label, and laid it firmly upon the degree of the longitude; then I set the point A on my label, even over the ecliptic line in the end even of the degree of the longitude, and set the point of F endlong in my label the space of 3 degrees of the latitude from the zodiac, this to say, southward from the ecliptic, toward the border; and turned my rete till the prick of F sat upon the horizon; then I saw well that the body of Jupiter, in its latitude of 3 degrees meridional, ascended with 14 degrees of Pisces *in horoscopo*. And in this manner mayest thou work with any meridional latitude, as I first said, save in Capricorn.

And if thou wilt apply this craft to the rising of the moon, see that thou reckon well her course hour by hour; for she only dwelleth in a degree of her longitude a little while, as thou well knowest, but nevertheless, if thou ascertain her true moving by

thy tables hour after hour, thou shalt do well enough.

Here endith the Treatise of the Conclusions of the Astrolabe compiled by Geoffrey Chaucer for his son Lewis, when a scholar at Oxford under the tutorship of that most eminent philosopher Master N. Strode.

40. To knowe with which degree of the zodiak that any planete Assendith on the Orisonte, wheyther so that his latitude be north or sowth.

Knowe be thin almenak the degree of the Ecliptik of any signe in which that the planete is rekned for to be, and that is cleped the degree of his longitude; and knowe Also the degree of his latitude fro the Ecliptik, north or sowth. And by this samples folwynge in special maistow wyrke for sothe in euery signe of the zodiak. The degree of longitude par auenture, of venus or of another planete was 6 of Capricorne, and the latitude of him was northward 2 degrees fro the Ecliptik lyne. I tok a subtil compas, and cleped that on poynt of my compas A, and that other poynt F. Than tok I the point of A, and set it in the Ecliptik line euene in my zodiak, in the degree of the longitude of venus that is to seyn, in the 6 degree of Capricorne, and thanne set I the point of F vpward in the same signe, bycause that the latitude was north, vpon the latitude of venus, that is to seyn, in the 6 degree fro the heued of capricorne; and thus hauy 2 degrees bytwixe my to prikkes; than leide I down softely my compas, and sette the degree of the longitude vpon the Orisonte, tho tok I and wexede my label in Maner of a peyre tables to resceyue distynctly the prikkes of my compas. Tho tok I this forseide label, and leide it fix ouer the degree of my longitude; tho tok I vp my compas, and sette the point of A in the wex on my label, as euene as y kowde gesse ouer the Ecliptik lyne, in the ende of the longitude, and sette the point of F endlang in my label vpon the space of the latitude, inwarde and ouer the zodiak, that is to seyn, northward fro the Ecliptik. Than leide I down my compas and lokede wel in the wey vpon the prikke of A and of F; tho turned I my Riet til that the prikke of F sat vpon the Orisonte than saw I wel that the body of venus, in hir latitude of 2 degrees septentrionalis, assendid, in the ende of the 6 degree, in the heued of capricorne. And nota, that in the same maner maistow wyrke with any latitude septentrional in alle signes; but sothly the latitude Meridional of a planete in Capricorne may not be take, by cause of the litel space bytwixe the Ecliptik and the bordure of the Astrelabie; but sothly, in alle other signes it May.

Also the degree, par auenture, of Iuppiter or of another planete, was in the furst degree of pisces in longitude, and his latitude was 3 degrees Meridional; tho tok I the point of A and set it in the firste degree of pisces on the Ecliptik, and thanne set I the point of F downward in the same signe, by cause that the latitude was sowth 3 degrees, that is to seyn, fro the heued of pisces, and thus hauy 3 degrees bytwixe bothe prikkes; thanne sette I the degree of the longitude vpon the Orisonte; tho tok I my label and leide it fix vpon the degree of the longitude; tho sette I the point of A on my label, euene ouer the Ecliptik lyne in the ende euene of the degree of the longitude, and set the point of F endlang in my label the space of 3 degrees of the latitude fro the zodiak, this is to seyn, sowthward fro the Ecliptik, toward the bordure; and turned my Riet til the prikke of F sat vpon the Orisonte; thanne saw I wel that the body of Iuppiter, in his latitude of 3 degrees Meridional, ascendit with 14 degrees of pisces *in horoscopo*, and in this Maner maistow wyrke with any latitude Meridional, as I first seide, saue in Capricorne. And yif thow wolt pleie this craft with the arisyng of the Mone, loke thow rekne wel her cours howre by howre; for she ne dwellith nat in a degree of hire longitude but a litel while, as thow wel knowest, but natheles, yif thow rekne hir verreye Moeuyng by thy tables howre after howre—[thou shalt do wel ynow].

Explicit tractatus de Conclusionibus Astrolabii compilatus per Galfridum Chauciers ad Filium suum Lodewicum scolarem tunc temporis Oxonie ac sub tutela illius nobilissimi Philosophi Magistri N. Strode, &c.

Magister Strode.

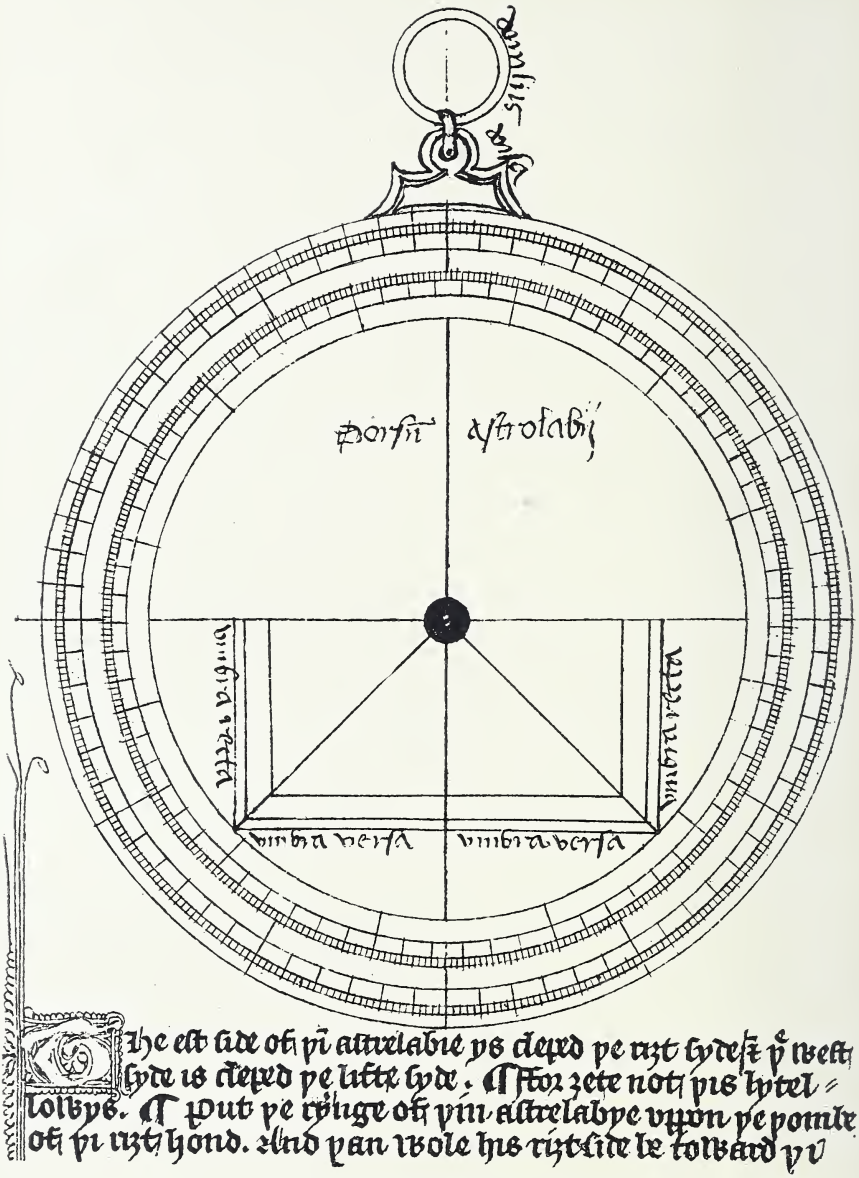
Authorities differ as to whether the name N. Strode was not written by mistake for R. Strode. In certain scripts a capital R might easily have been mistaken for a capital N.

A Ralph Strode figures in Bale's list of the more erudite members of Merton College in the reign of Edward III as a distinguished poet, the author of a book of elegiac poetry called 'Fantasma Radulphi'. In 1377 Ralph Strode of Aldersgate in the city of London was engaged in a business transaction with the then Warden of the house of scholars of Mertonhalle in Oxford, and also, in 1382 was associated with Chaucer as mainpernor for one Hende, a London draper. Cf. Life Records of Chaucer, *Times Literary Supplement*, Oct. 4, 1928.

THE USE OF THE SCALES OF THE SHADOWS

The three following sections deal with the measurement, the heights of towers or other objects by means of the Shadow Scales or Scales of *Umbra Recta* and *Umbra Versa* upon the back of such an astrolabe as the one in the hands of Lewis Chaucer, or the one figured on the next page. They explain the methods of measuring the height of an accessible object by a single observation (§ 41); or of an inaccessible object by two observations (§§ 42 and 43). Similar instructions are included in the treatise composed by Messahalla, pp. 190, 191.

Alternative readings for the three methods, occur in some of the manuscripts. These are believed to have been based on notes added by students after the time of Chaucer. The pictorial illustrations have been taken from Johan Stöffler's well-known treatise on the Astrolabe printed at Oppenheim in 1524, in which these survey methods have been further elaborated.



The est side of þi astrelabie ys clepid þe riȝt syde of þ weste syde is clepid þe lifte syde. ¶ For zete noti þis lytel tolbys. ¶ Out þe rynge of þin astrelabye vppon þe pomle of þi riȝt hond. And þan wole his riȝtside be tolband vp

Back of Chaucer's Astrolabe.
MS. Rawlinson D. 913.

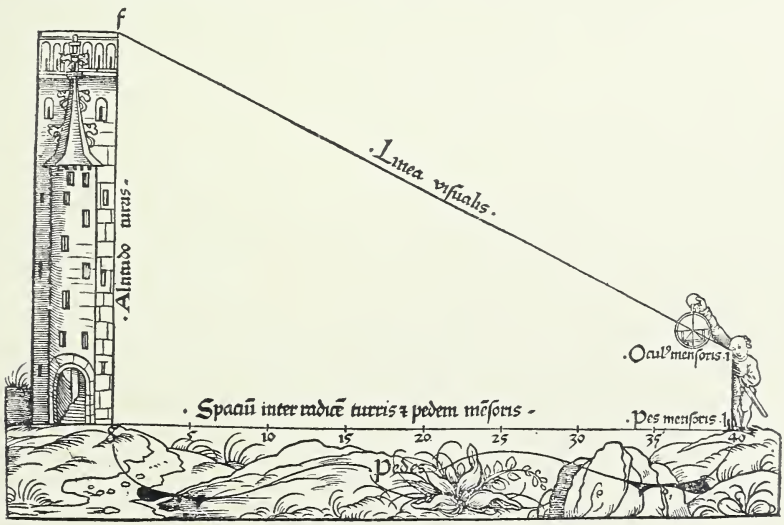
The names of the shadow scales, *umbra recta* and *umbra versa*, have been transposed in this figure.

41. Umbra Recta.

[*St. John's Coll. Cambridge MS.*]

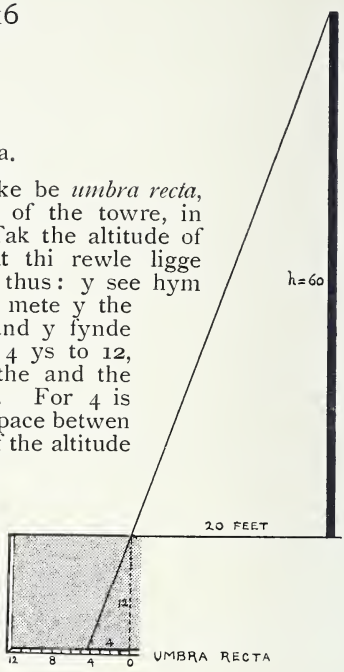
If it so be that thou willt work by *umbra recta*, and canst get to the base of the tower, thou shalt work in this manner:—

Take the altitude of the tower by both holes so that the rule lies even on a point. For example: [Suppose] I see him [the top of the tower] at the point of 4; I then measure the space between myself and the tower and find it 20 feet; then I say that as 4 is to 12, right so is the space between thee and the tower to the height of the tower. 4 is a third part of 12, so is the space between thee and the tower a third part of the height of the tower. Then thrice 20 feet is the height of the tower, with the addition of [the height of] thy person to thine eye. And this rule is general for *umbra recta* from the point of 1 to 12. And if thy rule fall upon 5, then the space between thee and the tower is five-twelfths of the height of the tower, with the addition of thine own height.



41. Vmbra Recta.

Yif it so be that thou wylt werke be *umbra recta*, and thou may come to the bas of the towre, in this maner thou schalt werke. Tak the altitude of the tour be bothe holes, so that thi rewle ligge euyn in a poynt. Ensample as thus: y see hym thorw at the poynt of 4; than mete y the space betwen me and the tour, and y fynde yt 20 feet; than beholde y how 4 ys to 12, right so is the space betwen the and the tour to the altitude of the tour. For 4 is the thridde part of 12, so is the space betwen the and the tour the thridde part of the altitude of the tour; than thries 20 feet ys the heyghte of the tour, with addyng of thyn owne persone to thyn eye; and this rewle is so general in *vmbra recta*, fro the poynt of oon to 12. And yif thi rewle falle vppon 5, than is 5 12-partyes of the heyght the space betwen the and the towre; wyth addyng of thyn owne heyghth.



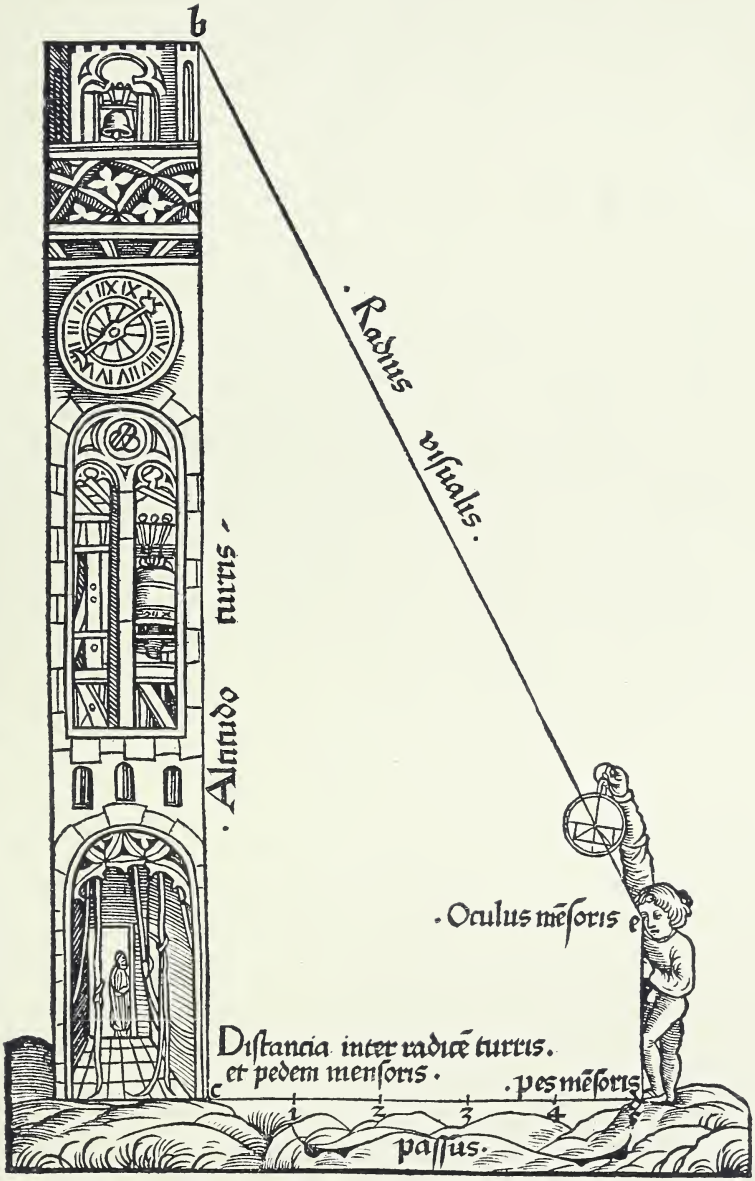
On f. 34b of the same MS. are the following two variants of the same method.

41*a*. Vmbra Recta.

Yif thi rewle falle vppon the 8 poynt on right schadwe, than make thi figure of 8; than loke how moche space of feet ys betwen the and the tour, and multiplie that be 12, and whan thou hast multiplied it, than diuide yt be the same nombre of 8, and kepe the residue, and adde therto vp to thyn eye to the residue, and that schal be the verry heyght of the tour. And thus mayst thou werke on the same wyse, fro 1 to 12.

41*b*. Vmbra Recta.

Another maner of werkyng vppon the same syde. Loke vppon whych poynt thi Rewle fallith whan thou seest the top of the tour thorow too litil holes, and mete than the space fro thi foot to the baas of the tour; and ryght as the nombre of thy poynt hath hymself to 12, ryght so the mesure betwen the and the tour hath hymself to the heighte of the same tour. Ensample: y sette caas thi rewle falle vpon 8, than ys 8 to-thridd partyes of 12; so the space ys the too-thridd partyes of the tour.



Measuring an accessible tower by Umbra Recta.
After Stöffler 1524.

42. Umbra Versa.

Another method of working is by *umbra versa*, if so be that thou canst not get to the base of the tower. I see him [the top of the tower] through the number of 1 [on the scale], and I set a mark at my foot. Then I go nearer to the tower and look at him through the point of 2, and there I set another mark. I then consider the ratio of 1 to 12, and find that [1 goes into 12] 12 times; and I consider the ratio of 2 to 12, and thou willt find it to be 6 times. Then thou willt find that as 12 is more than 6 by the number of 6, so is the space between the two marks the space of 6 times the height [you wish to measure]. And note that at the first altitude of 1, thou settest a mark, and again when thou sawest it at 2, thou settest another mark, and thou findest [the space] between the two marks to be 60 feet; then thou willt find that 10 is the sixth part of 60. Hence 10 feet is the height of the tower.

For other points, if it [the rule] fall in *umbra versa*, as thus: suppose it fell upon 2, and at the second [sighting] upon 3, then thou willt find that 2 is one-sixth of 12, and 3 is one-fourth of 12; then as 6 is greater than 4 by 2, so is the space between the two marks twice the height of the tower, and if the difference were thrice, then will it be 3 times; and thus thou mayest proceed from 2 to 12; and if it be 4, 4 times, or 5, 5 times and *sic de ceteris*.

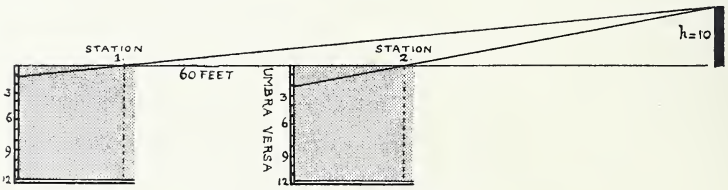
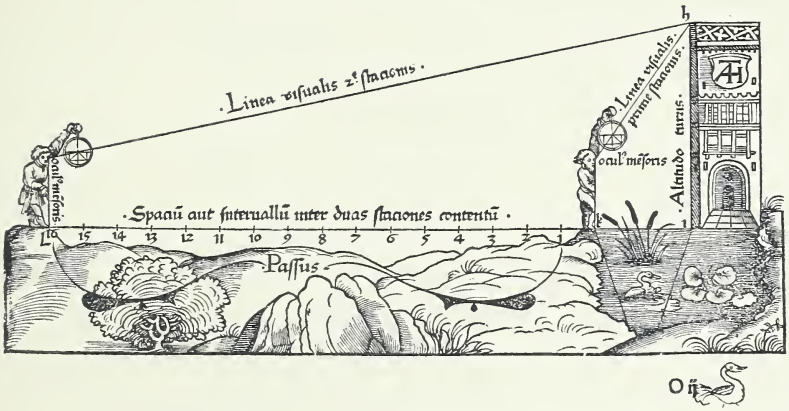


Diagram to illustrate Chaucer's method.



Measuring height of inaccessible tower.
After Stöffler 1524.

42. Vmbra Versa.

Another maner of werkynge, be *vmbra versa*. Yif so be that thou may nat come to the bas of the tour, y see hym thorw the nombre of 1; y sette ther a prikke at my foote; than goo y ner to the tour, and y see hym thorw at the poynt of 2, and there y sette another prikke; and y beholde how 1 hath hym to 12, and ther fynde y that yt hath hym twelfe sithes; than beholde y how 2 hath hym to 12, and thou schalt fynde it sexe sythes; than thou schalt fynde that as 12 above 6 is the numbre of 6, Ryght so is the space betwen thi too prikkis the space of 6 tymes thyn altitude. And note, that at the ferste altitude of 1, thou settest a prikke, and aftyrward, whan thou seest hym at 2, ther thou settest another prikke, than thou fyndest betwen too prikkys 60 fett; than thou schalt fynde that 10 is the 6-party of 60. And then is 10 fete the altitude of the tour. For other poyntis, yif yt fylle in *vmbra versa*, as thus: y sette caas it fill vppon 2, and at the secunde vppon 3; than schalt thou fynde that 2 is 6 partyes of 12; and 3 is 4 partyes of 12; than passeth 6 4, be nombre of 2; so ys the space betwen too prikkes twyes the heyghte of the tour. And yif the differens were thries, than schulde it be thre tymes; and thus mayst thou werke fro 2 to 12; and yif yt be 4, 4 tymes; or 5, 5 tymes, and *sic de ceteris.*

The St. John's College MS. also includes two variants of this method, both of which have been transcribed by Skeat.

42*a*. Vmbra Versa.

To knowe the heyth by thy poyntes of *vmbra versa*. Yif thy rewle falle vppon 3, whan thou seest the top of the tour, sett a prikke thereas thi foot stont; and goo ner tyl thou mayest see the same top at the poynt of 4, and sette ther another lyk prikke; than mete how many foot ben betwen the too prikkis, and adde the lengthe vp to thyn eye therto; and that schal be the heyghte of the tour. And note, that 3 ys fourthe party of 12, and 4 is the thridde party of 12. Now passeth 4 the nombre of 3 be the distaunce of 1; therfore the same space, wyth thyn heyght to thyn eye, ys the heyght of the tour. And yif it so be that ther be 2 or 3 distaunce in the nombres, so schulde the mesures betwen the prikkes be twyes or thries the heyghte of the tour.

42*b*. Per vmbram versam.

Furthermore, yif thou wilt knowe in *vmbra versa* be the craft of *vmbra recta*, y suppose thou take the altitude at the poynt of 4, and makest a marke. and thou goost neer tyl thou hast yt at the poynt of 3, and than makest thou ther annother mark. Than muste thou diuide 144 be eche of the poyntes befornseyd, as thus: yif thou deuide 144 be 4, and the nombre that cometh therof schal be 36, and yif thou deuide 144 be 3, and the nombre that cometh therof schal be 48, thanne loke what ys the difference betwen 36 and 48, and ther schalt thou fynde 12; and ryght as 12 hath hym to 12, ryght so the space betwen too prikkes hath hym to the altitude of the thyng.

The second of these variants may be re-stated as follows:—

42b. By Umbra Versa.

Furthermore, if thou willt solve the problem by umbra versa, as thou hast done by the craft of umbra recta, suppose that thou takest an altitude at the point of 4 and make a mark, and then that thou approach until thou hast it at the point of 3; and then make another mark. Then must thou divide by each of the aforesaid points, as thus: If thou dividest 144 by 4, and the number that cometh thereof is 36, and if thou divide 144 by 3, and the number that cometh thereof is 48, then note the difference between 36 and 48, which you will find to be 12; then as 12 is to 12, just so is the space between the two marks to the height of the object.

43. Another manner of working by umbra [recta].[1]

If so be that thou canst not get to the base of the tower, thou shalt work in this manner:—Set thy rule upon [point 1] till thou seest the altitude, and make a mark at thy foot. Then set thy rule upon 2, and behold what is the difference between 1 and 2, and thou willt find that it is 1. Then measure the space between the two marks, and that is the twelfth part of the height of the tower. If it were 2, it would be the sixth part; and if it were 3, the fourth part; and *sic deinceps*. And note, if it were 5, it would be a $\frac{1}{5}$th part of 12; and if 7 a $\frac{1}{7}$th part of 12; and note to the height of thy estimate, add the height of thy stature.

43. Vmbra Recta.

An other maner of wyrkyng be *vmbra recta*. Yif it so be that thou mayst nat come to the baas of the tour, yn this maner thou schalt werke. Sette thi Rewle vppon 1 till thou see the altitude, and sette at thi foot a prikke. Than sette thi Rewle vppon 2, and beholde what ys the differense betwen 1 and 2, and thou shalt fynde that it is 1. Than mete the space betwen too prikkes, and that ys the 12 partie of the altitude of the tour; and yif ther were 2, yt were the 6 partye; and yif ther were 3, the 4 partye, and *sic deinceps*. And note, yif it were 5, yt were the 5 party of 12; and 7, 7 party of 12; and note, at the altitude of thi conclusioun, adde the stature of thyn heythe.

This proposition is repeated on f. 36v of the same MS. in the following terms:—

43a. To find the Height of any Object by Umbra [Recta].

To find the height of a thing, if thou mayest not come to its base. Aim thy rule at the desired object, so that thou mayest see the top through the two holes, and make a mark where thy foot standeth. Then go nearer or farther, until thou canst see [the top] through [the holes of the rule] otherwise aimed, and make another mark. Then note the difference between

[1] *Versa* in MS.

the two points [or inclinations of the rule] on the scale, and just as that difference is to 12, so is the space between thee and the two marks to the height of the object.

For example: Suppose thou first seest it through a point of 4, and afterwards at the point of 3. Then the number 4 exceeds the number 3 by a difference of 1, so just as this difference 1 hath to 12, just so is the measure between the two marks to the height of the object, with the addition of the height of the eye. And so thou mayest work from 1 to 12.

43*a*. Ad cognoscendum altitudinem alicuius rei per vmbram rectam.

To knowe the heyghte of thynges, yif thou mayst nat come to the bas of a thyng. sette thy rewle vppon what thou wylt, so that thou may see the topp of the thyng thorw the too holes, and make a marke ther thy foot standeth; and goo neer or forther till thou mayst see thorw another poynt, and marke ther another marke; and loke than what ys the differense betwen the too poyntes in the scale; and right as that difference hath hym to 12, right so the space betwen the and the too markys hath hym to the heyghte of the thyng. Ensample: y set caas thou seest it thorw a poynt of 4; aftyr, at the poynt of 3. Now passith the nombre of 4 the nombre of 3 be the difference of 1, and right as this difference 1 hath hymself to 12, right so the mesure betwen the too markis hath hym to the heyghte of the thyng, puttyng to the heyghte of thiself to thyn eye; and thus mayst thou werke fro 1 to 12.

PART III.

Book of Astronomical and Geographical Tables.

1. Latitudes and Longitudes of Stars represented on Astrolabes.
2. The Daily Declinations of the Sun.
3. Longitudes of Cities and Towns.
4. Tables for Setting Clocks and for Finding the Meridian Altitude of the Sun.

Volumes containing such Tables are to be found in all the older libraries. We have already figured an example of a Table of Astrolabe Stars in vol. ii, p. 205 of this work[1] wherein several other references to manuscripts are given. A table such as Chaucer would have had in his mind is printed below after p. 162. The Tables of Longitudes and Latitudes of Towns were often engraved in circular form in the mother of oriental astrolabes.

[1] Gunther, *Early Science in Oxford* ii.

PART IV.

Description of the Planets and their Motions.

Tables of the Moon's Motion according to an Almanac.

Such tables were prepared by the early members of the Merton School of astronomers. In manuscripts in which planetary tables occur the table is frequently followed by a canon to explain the use of the tables. From such a source Chaucer is believed to have derived the explanation which is printed overleaf. Skeat cites *MS. St. Johns*, F. 25, and *MS. Camb.* Ii. 3 . 3, fol. 143, as including illustrative examples.

44. Another kind of Proposition, to find the Mean Motion and the Arguments of any Planet.

To find the mean motion and the arguments of every planet from year to year, from day to day, from hour to hour, and from small fractions infinite.

[*MS. Digby 72.*]

In this manner shalt thou proceed:—Consider thy root first, which is made the beginning of the Tables from the year of our Lord 1397,[1] and write it on thy slate for the last midday of December. Then consider the year of our Lord and the date, and behold whether the date be more or less than the year 1397. And if it be more, note how many years it is in excess, and look in thy tables where on the first line is written '*Anni collecti et expansi*'. Look where the [name of the] planet is written at the top of the table, and note what you find in the column of the year of our Lord which is in excess, be it 8, or 9, or 10, or whatever number it be, till you come to 20, or 40, or 60. And what thou findest on the same line, write on thy slate under thy root, add both together, and that is thy mean motion for the last midday of December in the same year which thou hast in mind.

And if it so be that it exceeds 20, bear in mind that from 1 to 20 are *anni expansi*, and from 20 to 3000 are *anni collecti*; and if thy number exceed 20, then take what thou findest in the line of 20, and if it be more, as 6 or 18, then take what thou findest in the line thereof, that is to say signs, degrees, minutes, and seconds, and add them to thy root; and thus make roots.

[1] The root used by Nicholas Lenne was 1387, and Skeat suggests that that year was intended here. 1391 is the year mentioned on p. 26.

And note that if it so be that the year of our Lord be less than the root which is for the year of our Lord 1397, then shalt thou write on thy slate in the same way first thy root, and then look up in thy table the same year that is less, as I taught before; and then consider how many signs, degrees, minutes, and seconds thy entry containeth. And if so be that there are two entries, then add them together and afterwards subtract them from the root for the year of our Lord 1397. The residue that remaineth is thy mean motion from the last midday of December, which thou hast in mind.

And if it so be that thou willt know thy mean motion for any day, or for any fraction of a day, thou shalt operate in this manner:—Determine thy root from the last day of December, in the way I have taught, and then see how many months, days, and hours have passed from the last midday of December, and with that look up [in thy table] the last month that is passed and take what thou findest on the same line and write it down on thy slate; and look up in thy table the entry for the days in excess, and write what thou findest in the line of the same planet, that thou [looked up] before; and likewise do the same in the table of hours for the hours that have passed, and add all these to thy root.

The sum is the mean motion for the same day and the same hour.

44. Another maner conclusion, to knowe the mene mote and the argumentis of any planete. To know the mene mote and the argumentis of euery planete fro yere to yere, from day to day, from owre to owre, And from smale fraccionis infinite.

[Ad cognoscendum medios motus et argumenta de hora in horam cuiuslibet planete, de anno in annum, de die in diem.]

In this maner shalt thou worche: consider thy rote furst, the wyche is made the begynning of the tabelis fro the yere of owre lord 1397, and entere hit into thy slate for the laste merydye of December; and than consider the yere of ovre lord, what is the date, and behold whether thy date be more or lasse than ye yere

1397. And yf hit so be that hit be more, loke how many yeris hit passith, and with so many entere into thy tabelis in the furst lyne ther as is wreten *anni collecti et expansi.* And loke where the same planet is wreten in the hede of thy tabele, and than loke what thou findest in directe of the same yere of owre lord wyche is passid, be hit 8, or 9, or 10, or what nombre that euere it be, tyl the tyme that thou come to 20, or 40, or 60. And that thou fyndest in directe wryte in thy slate vnder thy rote, and adde hit togeder, and that is thy mene mote, for the laste meridian of the december, for the same yere wyche that thou hast purposid. And yf hit so be that hit passe 20, consider welle that fro 1 to 20 ben *anni expansi*, And fro 20 to 3000 ben *anni collecti;* and yf thy nombere passe 20, than take that thou findest in directe of 20, and yf hit be more, as 6 or 18, than take that thou findist in directe thereof, that is to sayen, signes, degreis, Minutes, and secundis, and adde togedere vnto thy rote; and thus to make rotes; and note, that yf hit so be that the yere of ovre lord be lasse than the rote, wyche is the yere of ovre lord 1397, than shalt thou write in the same wyse furst thy rote in thy slate, and after entere into thy table in the same yere that be lasse, as I taughth before; and than consider how many signes, degrees, Minutes, and secundis thyne entrynge conteynith. And so be that ther be 2 entres, than adde hem togeder, and after withdrawe hem from the rote, the yere of ovre lord 1397; and the residue that lewyth is thy mene mote fro the laste merydie of December, the wyche thou haste purposid; and yf hit so be that thou wolt weten thy mene mote for eny day, or for ony fraccion of day, in this maner thou shalt worche. make thy rote fro the laste day of Decembere in the maner as I thaghthe, and afterward behold how many monythis, dayes, and howris ben passid from the merydye of Decembere and with that entere with the laste moneth that is ful passid, and take that thou findest in directe of hym, and wryte hit in thy slate; and entere with as mony dayes as be more, and wryte that thou findest in directe of the same planete that thou worchyst fore; and in the same wyse into the table of howris, for hovris that ben passid, and adde alle these to thy rote; and the residue is the mene mote for the same day and the same hovre.

45. Another way to find the Mean Motion.

[*MS. Digby 72.*]

When thou willt determine the mean motion of any planet by the Tables of Arzachel, take the root for the year of our Lord 1397, and if so be that thy year has passed that date, write down that date and then write the number of the years. Then subtract the years from the years that have passed that root.

Example as thus:—For the year of our Lord 1400, I would know precisely my root. First I wrote 1400, and under that number I wrote 1397; then I subtracted the last number from the former, and I found the remainder to be 3 years. So I knew that 3 years had passed from the root which was written in my tables. Then I searched in my tables for the *Annis collectis et expansis*, and among the Expanse years I found 3 years. Then I took all the signs, degrees, and minutes that I found on the line under the same planet that I worked with before, and wrote the same number of signs, degrees, and minutes on my slate, to which I added the signs, degrees, minutes, and seconds which I found in my root for the year of our Lord 1397; and kept the sum, and thus I had the mean motion for the last day of December.

And if thou wouldst know the mean motion of any planet in March, April, or May, or at any other time or month of the year, find how many months and days are passed from the last day of December in the year of our Lord 1400, and so look up in thy table among the months and days where thou findest written thy mean motion for months and days, and take all the signs, degrees, minutes, and seconds that thou findest written in the line of thy months, and add to the signs, degrees, minutes, and seconds that thou findest with thy root for the year of our Lord 1400, and the sum that remaineth is the mean motion for that same day.

And note if it so be that thou wouldst know the mean motion in any year that is less than thy root, subtract the number of years that it is less than the year of our Lord 1397; and note the remainder. And look up in thy tables of mean motion for the years, months, and days, and take all the signs, degrees, minutes, and seconds that thou findest in the line of all the years, months, and days and write them on thy slate; and above this number write the signs,

degrees, minutes, and seconds which thou findest with thy root for the year of our Lord 1397. Then subtract all the lower signs and degrees from the signs and degrees, minutes, and seconds of the signs with thy root, and the residue that remaineth is thy mean motion for that day.

45. Another manere to knowe the mene mote.

Whan thou wolte make the mene mote of eny planete to be by arsechieles tables, take thy rote, the wyche is for the yere of ovre lord 1397; and yf so be that thy yere be passid the date, wryte that date and than write that nombere of the yeris. Than wythdrawe the yeris oute of the yeris that ben passid that rote. Ensampulle as thus: the yere of ovre lord 1400, I-wryton precise, my rote; than wrote I furst 1400. And vnder that nombere I wrote a 1397; than withdrowe I the laste nombere owte of that, and than fond I the residue was 3 yere; I wyst that 3 yere was passid fro the rote, the wyche was wreten in my tabelis. Than afterward soghth I in my tabelis the *annis collectis et expansis*, and amonge myne expanse yeris fond I 3 yere. Than toke I alle the signes, degreis, and minutes, that I fond directe vnder the same planete that I wroghth fore, and wrote so many signes, degreis, and Minutes in my slate, and afterward added I too signes, degreis, Minutes, and Secundis, the wiche I fond in my rote the yere of owre lord 1397; And kepte the residue; and than had I the mene mote for the laste day of Decembere. And yf thou woldest wete the mene mote of any planete in March, Aprile, or may, other in any other tyme or monyth of the yere, loke how many monethes and dayes ben passid from the laste day of Decembere, the yere of owre lord 1400; and soe with monithis and dayes entere into thy table ther thou findist thy mene mote I-wreten in monethis and dayes, and take alle the signes, degrees, Minutes, and secundis that thou findest I-wrete in directe of thy monethis, and adde to signes, degreis, Minutes, and secundis that thou findest with thy rote the yere of ovre lord 1400, and the residue that leuyth is the mene mote for that same day. And note yf hit so be that thou woldest wete the mene mote in ony yere that is lasse than thy rote, withdrawe the nombere of so many yeris as hit is lasse than the yere of ovre lord a 1397, and kepe the residue; and so many yeris, monythis, and dayes entere into thy tabelis of thy mene mote. And take all the signes, degreis, and Minutes, and Secundis, that thou findest in directe of alle the yeris, monythis, and dayes, and wryte hem in thy slate; and abowe thilke nombere write the signes, degreis, Minutes, and secundis, the wyche thou findest with thy rote the yere of ovre lord a 1397; and withdrawe alle the nethere signis and degreis fro the signes and degrees, Minutes, and Secundis of other signes with thy rote, and thy residue that lewyth is thy mene mote for that day.

46. To find the hour of the day or night at which flood or ebb-tide will be.

[*MS. Bodley 619.*]

First get to know for certain how the haven which thou desirest to investigate is situated; that is to say, the place in the firmament that the moon must be in to make a full sea there; also note the degree of the zodiac in which the moon is at that time. Apply the label, and set its point in that same quarter [of the compass] in which the moon maketh flood tide and set there the degree of the moon [on the rete by turning it to] the edge of the label. Next note the degree of the sun at that time. Remove the label from the moon and set it accurately upon the degree of the sun, then the point of the label will show thee the hour of the day or night of flood tide.

Further, thou mayest also learn by the same point of the label whether it be at that same time flood or ebb, or half flood or quarter flood, or ebb or half or quarter ebb; or else thou mayest easily find out at what hour it occurred last, or shall occur next time by night or day.

Furthermore, if it so be that thou happenest to work out this matter about the time of conjunction, bring forward the degree of the moon [by turning the rete] to the label [set] to that quarter as before said; but then thou must understand that thou needest not to bring the label forward from the degree of the moon as thou didst before; because the sun is then in the same degree with the moon. And so at that time thou mayest find the hour of the flood and ebb by the point of the label as beforesaid. And evermore as thou findest the moon passing away from the sun, remove the label from the degree of the moon and bring it to the degree of the sun, and then proceed

as thou didst before, or else ascertain what hour it is that thou art in by your instrument. Then bring the label forward and lay it on the degree of the moon, and thereby thou mayest also know when it was flood, or when the next flood will be flood, be it night or day.

46. For to knowe at what houre of the day, or of the night, shal be Flode or ebbe.

First wite thou certeinly, how that haven stondith, that thou list to werke fore; that is to say in whiche place of the firmament the mone beyng, makith fulle see. Than awayte thou redily in what degree of the zodiak that the mone at that tyme is ynne. Bringe furth than the labelle, and sett the point therof in that same cost that the mone makith flode, and sett thou there the degre of the mone according with the egge of the label. Than afterward awayte where is than the degre of the sonne, at that tyme. Remeue thou than the label fro the mone, and bringe and sette it iustly vpon the degre of the sonne. And the point of the label shal than declare to the, at what houre of the day or of the night shal be flode. And there also maist thou wite by the same point of the label, whethir it be, at that same, flode or ebbe, or half flode, or quarter flode, or ebbe, or half or quarter ebbe; or ellis at what houre it was last, or shalbe next by night or by day, thou than maist esely knowe, etc. Furthermore if it so be that thou happe to worke for this matere about the tyme of coniunccioun, bringe furthe the degre of the mone with the labelle to that coste as it is before seyde. But than thou shalt vnderstonde that thou may not bringe furthe the label fro the degre of the mone as thou dide before; For-why the sonne is than in the same degre with the mone. And so thou may at that tyme by the point of the labelle vnremevid knowe the houre of the flode or of the ebbe as it is before seyd, &c. And euermore as thou findest the mone passe fro the sonne, so remeve thou the labelle than fro the degre of the mone, and bringe it to the degre of the sonne. And worke thou than as thou dide before, etc. Or ellis knowe thou what houre it is that thou art inne, by thin instrument. Than bringe thou furthe fro thennes the labelle and ley it vpon the degre of the mone, and therby may thou wite also whan it was flode, or whan it wol be next, be it nyght or day; &c.

This chapter on Tides, taken from MS. Bodley 619, does not occur in other manuscripts, and its attribution to Chaucer has been doubted. There is, however, no reason why he should not have been conversant with the method of finding the time of high water at a port that is here described.

PART V.

The General Rules of Astrology.

1. Tables of Equations of Houses.
2. Tables of Dignities of Planets.

It is possible that this part, if extant, would have included or have been an expansion of Sections 36 and 37, but there is no evidence to show that Chaucer ever wrote it. He certainly had no sympathy with the 'observauncey' of astrologers for he defined them as 'rytes of paiens, in which my spirit ne hath no feith'.

THE END.

MESSAHALLA.

Messahalla was one of the earliest astronomers of Islam. He is one about whom we would fain know more, for during his lifetime Arabian Science and Art, which are said to have been practically non-existent when he was born, were being generously fostered and raised to a high level by the celebrated Al-Mansor (754–75) and the still more renowned Haroun Al-Raschid (786–808).

There is even a doubt as to his real name. It is said that he was a Jew from Egypt, who found employment with Al-Naubakht the Persian in making a survey of the site of Bagdad preliminary to the foundation of that city in 762–763. We must therefore regard him as an early town-planner of distinction, as a man versed in the practical use of the instrument, the Astrolabe, which as much as any other had helped to keep the feeble flame of civilization flickering through the dark ages. In any case a book regarded by Chaucer as of such educational value as the work of Messahalla on the Astrolabe is deserving of at least one appearance in print in Chaucer's own country. In one of the two copies of this work with which Elias Ashmole endowed his new-founded Museum of Natural History at Oxford in 1683, the name is written 'Marcellania', and several other variations are known, but the settlement of the question whether we ought to read out of this

'Manasseh', or the Arabic 'Misha', is better left to the ingenuity of philologists.

The only Arabic text that is at present attributed to him is unfortunately not a scientific treatise, but it has the interest of being the oldest known book in Arabic on the subject of the prices of merchandise. About 1150 Johannes Hispalensis, or Gerard of Cremona, translated into Latin, and thereby preserved, his *De Scientia Motus Orbis*. Further publicity was given to this Latin translation by its being printed at Nuremburg in 1504. A second edition in 1549 appeared under the title of *De Elementis et orbibus coelestibus* and contains 27 chapters. Whether Gerard translated the *De compositione et utilitate Astrolabii* at the same time, we do not know. A manuscript copy of Messahalla's Latin text may have been one of Chaucer's bed-books

'On shelves couched at his beddes head,'

perhaps alongside 'books great and small,' including the Latin *Almagest* of Ptolemy, itself the work of the same indefatigable translator from an Arabic version c. 812, but which Messahalla may not have had the benefit of studying in his own language, although he quoted from it.

It is in the hope of gaining further information concerning Messahalla, that we now print in full, and for the first time, one of the manuscripts attributed to him. We have examined two copies, both written about the time of Edward II. Both are admirably illustrated with figures, and either might have been read by Chaucer. The Cambridge text is perhaps the clearer of the two, because it is written in long lines right across the page. We have therefore chosen it for reproduction in preference to the Ashmolean text which is in double columns. The Cambridge MS. moreover is the one of which the second part dealing with the Use of the Astrolabe was printed by Skeat in 1872. The first

part on the Composition of the Astrolabe has not hitherto been printed in England. In Germany, however, in 1512 Greg. Reisch printed a short *De compositione et utilitate Astrolabii* as a chapter in his most attractive and encyclopaedic *Margarita Philosophica*, and this was translated into Italian in 1593 by Gallucci. No later editions of Messahalla have appeared under his own name. Nor is this surprising, for the greater part of his work was abstracted by a multitude of sixteenth- and seventeenth-century writers, who served it out to the public as their own work, much as numberless editions of elementary text-books are now provided without a word of acknowledgement of the real sources of their contents. A casual inspection, however, shows that the text of Messahalla, as printed by Reisch, is not the text of the Cambridge and Ashmole MSS. It is true that the earlier chapters are common to both, but the Reisch text then proceeds to different topics and is far shorter than the English Universities' texts. And as the latter probably represent more nearly the version which Chaucer studied, no further apology is needed for its extraction from the dust of ages. For it is only by the examination of many variants that the descent of the text can be traced.

The production of this English translation has been a matter of great difficulty, both on account of the imperfections of the manuscript, and of the frequent discrepancies that occur between the reference letters in the text and those of the figures. The scribe appears to have copied both unintelligently. Perhaps even Chaucer's own copy of Messahalla was so defective in this respect, that he refrained from attempting a translation which would either not have done justice to the Latin text, or might have confused the youthful mind of Lewis. In the present instance, in the many cases where the meaning of a passage has

seemed doubtful, the translation has been kept as close to the original text as possible, for even errors or omissions in the text may be of assistance, when the examination of more copies than have hitherto been examined, makes a definitive text possible.

In all instances where the meaning is not clear, the student should refer to the expanded text printed at the end of the book, as well as to the collotype plates of the manuscript.

The present editor will be very grateful for corrections to his text.

A matter for special investigation is the occurrence of the *explicit* in MS. Ashmole 1796 at the end of Chapter 16 of the *De compositione*. Chapters 17–22 in the other manuscripts are written in a somewhat different style to the preceding chapters, and may have been incorporated from another work, on the Sphere.

THE ASTROLABE

BY MESSAHALLA.

Rendered into English from the Latin Manuscript MS. *Camb. Univ. Libr.*, Ii. 3. 3, dated A.D. 1276.

PART I. ON THE CONSTRUCTION OF AN ASTROLABE.

The Beginning of the Treatise of the Astrolabe.

[f. 61.] The Introduction of the Edition of Messehallach.

You must know that 'astrolabium' is a Greek noun meaning 'the taking of stars', because by it the truth is known of those facts as are sought for from the positions of stars. Ptolemy also said that [the astrolabe] is like a sphere spread out on a plane. Therein will be seen the point of its axis and the *almucantars* which are [marked] on every one of its plates. They are opposite the circles which are in a straight line. Their centre is the centre of the zenith of the heads [of the zodiacal signs] in any one climate, and they begin at the circle of the hemisphere of the same climate for which they, i.e. the almucantars, are lined. We find that the ancients were content with a habitable world of 7 climates, because they had found in them the population and the larger part of [human] habitation. The name of 'climate' is the [Greek] name of 'declension'.

Wherefore, since the earth is of a round figure, those who dwell under the equinoctial line live in an equality

of seasons. Likewise because the zenith of the heads [of zodiacal signs] lies off the aforesaid line, the times of the hours are made different for the inhabitants. And so the ancients divided the declension into 7 parts, which they called Climates.[1] The length of the first division from the equinoctial line was according to the length of one equal hour; and the length of the difference of the other parts comes to half an hour, because the difference in the seventh climate is 4 equal hours, and the longer day of that place was made 16 hours, and the shorter 8 [hours].

Chapter I. On the Composition of the Astrolabe and the Preparation of the Mother.

When you wish to make an astrolabe for the latitude of any region, there is need of one thing and this is the same in every latitude.

Make a disc[2] for the Mother which is broader than the disc for the Rete by the breadth of the border. This border indeed, ought to be somewhat broader than the circle of Capricorn. Make it of such a size that the *muri* can be marked out on it. This *muri* is a little tooth projecting from the head of Capricorn over the degrees [marked on] the aforesaid border. The thickness of the border ought to be [decided] according to the thickness of the Rete if the astrolabe is to be for one latitude only; or according to the bulk of the plates and Rete together, so that they may be equal [in thickness] when the axis is placed [in position], and they may not overlap one another. And fasten the border with rivets in 4 places, or completely as some

[1] '*Climates*' are zones parallel to the equator, which decrease in breadth as they approach the pole according to the increasing length of the longest day, each climate marking the difference of half an hour of day. They were named by the old geographers διὰ Μερόης, διὰ Συήνης, δι' Ἀλεξανδρίας, διὰ Ῥόδου, διὰ Ῥώμης.

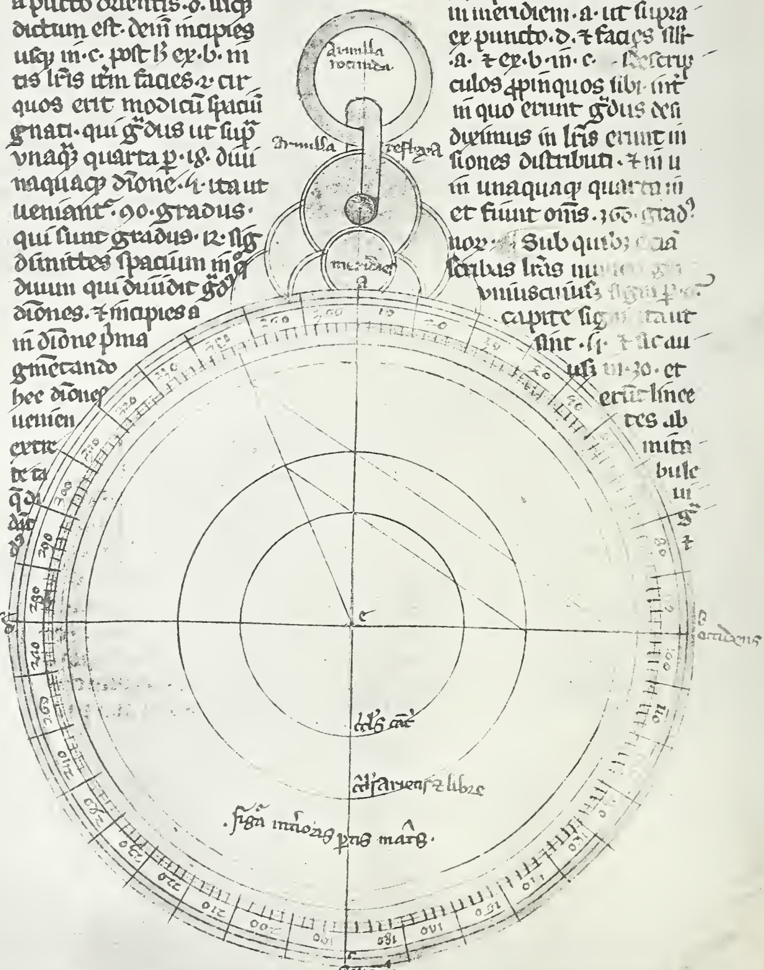
[2] The Latin 'tabula' is used indifferently for the base plate of the Astrolabe for which we use the word 'disc', and for the 'tablets' which we call 'plates', and for the pinnules or sight vanes of the alidade.

Scito q astrolabium e nomen grecu. Incip tractatus
cuius interptacio e acceptio stellarum Astrolabiu ecia
eo q accipiat ex eo veritas earum. qui ad omis mesichi
scientia qu erit ex locis stellaru. Et dixit Mach pro
ptholomeus q fit sicut spa extensa in plano. hemi
ceritq punctus ipius axis appens & almucantharat u
que sunt in omni tabula eius. sunt opposite circulis qui sunt nim.
directo. quor punctus est punctus cenith capitu in eod climate.
& inicium eor e ex circulo emispii eidem climatis cu linea ter. s. ille. al
mucantharath. Inuenimus q antiqs contentos fuisse in mansione
.7. climatu. eo q hbitationem & plus hbitationis inuenissent i eis.
Et nomen climatis est nomen declinationis. q cum eet tra
rotunde figure. e contra illi qui hbitant sub equinoctiali linea in eq
litate tempor. Similit q quor cenith capitu declinauit a predca
linea. fuit eis diuisa horar tempora. Ideoq diuiserunt antiqui de
clinationem p .7. diones. quas uocauerunt climata. fuitq longi
tudo prime dionis a linea equinoctiali. s quantitatem hore unius e
qualis. & longitudo diuisitatis reliquar pturi dimidium hore unius p
uenit q diuisitas in .7. climate ad .8. horas equales. & ftis e dies lon
gior illius loci. 16. horar. & breuior. 8. p pmu capitulu in compositionem
Cum uolueris face astrolabium. ad cuiuscq astrolabii. & primo
latitudine regionis primum est opus atq de preparatione
equale in omni latitudine. Fac tabulam p matre. que matris q
sit latior tabula rethis p quantitatem latitudinis limbi. qui poste
quidem limbi d3 ee latior circulo capricorni paulisp. s eam. s. na
quantitate q possit in ea describi almuri. qui e denticulus egrediens
ens a capite capricorni sup gdus limbi predicti. Cuius limbi
densitas sit s quantitate rethis. si fuerit astrolabium unius latitu
dinis. aut sm quantitatem tabular & rethis ut equent dum ponit
axis. & n transgredient inuicem. & figes limbum clauis i. e. ptibus.
vl absolute ut quibsdam placet. in quibsdam locis ad placitu & co
niges ipm limbu mat cu stagno ul argento. & facies s extremi
tatem eius circlm. pt h dimittes spaciu lris. & facies itm .2. circlos
ad inuicem ppinquos. int quos erunt gdus succedentes rethi. di
uides q ipm spacium qd fuit int ipos circulos p .360. diones eqles.
& incipies scribe ab linea qrte occntalis & midiane ex puncto .a. eundo
ad punctu .c. continuatu ysq in .360. gdus. & eluciadabis & eqbis eam.
put melius poteris. Deinde extrahes diametra illius que qua
drauit eam. abscindens unum eor p alterum sup .e. punctum
cuspidis. ita ut quadrantes sint equales. & facies in alia pte sili-

Sintque dyametra que abscindunt se in alia parte opposita dyametris que se abscindunt in alta. i. sint in directo eorum. post hec statues in interiori parte circulum arietis. et circulum cancri. Circulus autem capricorni est qui incedit per extremitatem tabule. et ipse est maior circulus qui cadit in matre inferius. Facies iam circulum super extremitatem tabule. dimittes quoque spacium in quo possint scribi littere numeri. et incipies scribere litteras a puncto .d. qui est in oriente. usque in punctum .a. qui est sub armilla. qui signat in astrolabio meridiem. perficies quoque eandem quartam hec in. Diuides predictam quartam per .18. diuisiones equales. et scribes in prima diuisione .4. et in secunda .10. et in 3a .14. atque sic augmentando usque ad .90. Per hanc quartam accipies altitudinem solis atque stellarum. Similiter facies in ceteris quartis.

a puncto orientis .d. usque
dictum est. deinde incipies
usque in .c. post hec ex .b. in
tis litteris item facies .2. cir
quos erit modicum spacium
gnati. qui gradus ut sup
unaquaque quarta per .18. diui
naquaque diuisione .4. ita ut
ueniant .90. gradus.
qui sunt gradus .12. sig
dimittes spacium in q
duum qui diuidit gradus
diuisiones. et incipies a
in diuisione prima
gmentando
hec diuisiones
uenien
extre
de ta
q
dic
d

Incipies autem scribere
in meridiem .a. ut supra
ex puncto .d. et facies illi
.a. et ex .b. in .c. Describes
culos propinquos sibi. int
in quo erunt gradus desi
diximus in litteris erunt in
siones distributi. et in u
in unaquaque quarta in
et fiunt omnes .360. grad
nos. Sub quibus
scribas litteras nu
uniuscuiusque signi
capite signi ita ut
sint .5. et sic au
usque in .30. et
erunt linee
tes ab
mita
bule
in
gradus
et



people like it in certain places, as you please; and join the border itself to the Mother with tin or silver, and make a circle on its edge. After this leave a space for lettering and make again 2 circles close together between which there will be degrees going towards the Rete. Then divide the space, which will be between the circles, into 360 equal divisions, and begin to inscribe the lettering from the beginning of the SE. quadrant at the point A, going towards C even to 360 degrees. And make the plate as clear and even as you can. Then draw its diameters, divide the circle into quadrants, one of them cutting the other at the centre C, so that the quadrants are equal. Do the same on the other side.

[61 v.] And the diameters that cut one another on one side [of the disc of the Mother] are opposite to the diameters that cut one another on the other [side], i.e. they are in a straight line with them. After this put in the inner part the circle of the Ram and the circle of the Crab; the circle of Capricorn, however, is the one that begins at the edge of the disc and is a larger circle, which falls lower in the Mother.

2. On the Back of the Astrolabe.

Then make a circle at the edge of the disc and leave a space in which the list of numbers can be inscribed, and begin to inscribe the list at point D, which is in the East, [and continue] even to the point A which is under the ring which marks the South on the astrolabe; and finish the quadrant in this way.[1]

Divide the aforesaid quadrant into 18 equal parts and mark against the first division 5, against the second 10, against the third 15, and thus increasing [go on] even to 90. By this quadrant you may take the altitude of the sun and stars. Do the same in the other quadrants.

[1] 'He tells how the first circle on the back must be divided. This is outside and is called the circle of altitude.' Addition in MS. Ashmole 1769.

Begin, moreover to letter from the East point D [and go on] even to the South point A, as has been said above. Then begin from the point D and do the same even as far as C; after this from B to A, and from B to C. When the list has been inscribed, again make 2 circles near together between which there will be a fair-sized space in which the degrees will be marked. These degrees, as we have said above, will be distributed [so that there are] 18 divisions in each quadrant, and in each division there will be 5 [smaller divisions] so that in each quadrant 90 degrees will be found; and they make 360 degrees in all, which are the degrees of the 12 [zodiacal] Signs. Under these also leave a space in which you may inscribe the list of the number of degrees, [the number that is] which divides the degrees of each Sign into 6 divisions, beginning at the head of the Sign, so that in the first division there may be 5, and in the second 10, and so increasing up to 30. And these divisions will be lines coming from the edge of the plate [i.e. radial lines], which divide the degrees and the numbers made first. [f. 62.]

After this make 2 circles leaving a space between. Divide this into 12 equal parts, in which you write the names of the 12 Signs; and all those circles will be drawn from the one point E, i.e. they will have the same centre E, which is in the centre of the plate. And begin from Aries and the beginning of the SW. quadrant (this is the point B), going towards the South, that is the point A; and divide each sign by 30 divisions as above. After this lay the ruler on the 27th degree of Gemini and join it to the centre by a light line.[1] Then divide [the line] from the centre to the circumference of the circle just above it into 32 divisions and lay the highest number of the first division at the centre of the circle of the Signs. And take from this

[1] Faint lines, being drawn for constructional purposes only, will afterwards be erased.

division 30 divisions, and there will be between these centres one division of these divisions, and between the ends of the line another division, keeping them from touching one another. Again make a circle and divide it into 365 parts according to the number of days in a solar year, if it is a large astrolabe; if it is a small one, put the days by twos. Then under this [circle] make another in which there will be the number of days in the Latin months. After this place the ruler on the 15th degree of Sagittarius and join it to the centre of the circle of the Signs and put a mark on the circle of months. This will be the beginning of December, and from that point even to the point C which is in the North, there will be 15 days. After these 15 days of December have been divided off, there will remain a space = 350 days, for which divide the remaining portion of the circle, i.e. take seven times 50 by dividing first in 7 [parts], secondly [by dividing each of these] in 5 parts, thirdly [by dividing each space] in 2 parts. And this device was invented for the reason that multiplication was not suitable for 365. And know that the sun enters the head of Aries, on the 14th day of March, and the beginning of Cancer on the 16th day of June, and the beginning of Libra on September 19th and the beginning of Capricorn on December 15th. Again when you divide the year, always place the ruler on the centre of the Signs and on the division of the day. And note that the circle of the months can be made concentric with the circle of the Signs and it is the same thing.

[A Solar Table for placing the Months follows here in MS. Ashmole 1796. See p. 198.]

[62 v.] 3. On the Laying on of the Quadrate of the Shadow.

When you wish to add the quadrate of the shadow, join the centre of the circle of Signs by a light and inconspicuous line passing through the middle of the NW. quadrate, ending at the circle of the months. Afterwards draw from the end of it, 2 lines [at right angles] to the highest part of the table, and there will be a right-angled quadrate. Then draw two other lines near them, and between the two sets there will be points. Again draw 2 other lines further apart within which there will be the numerals, and divide the spaces which are between these [two] lines on each side [of the quadrate] by 6 divisions for the list [of numerals]. But divide the narrower space more into 12 parts, according to the number of points, two points to each numeral, and begin to write at the diameters. And if you wish [to have] 2 quadrates on the astrolabe do the same in the other, i.e. the NE. quadrant which is next it.

Between those same 2 diameters, below the circle of the months, you may also put the hour lines, as is done on a quadrant, and by means of these you will have on the back [of the astrolabe] the natural hours of the day as is clear in the figures above.[1]

4.—Of making an Allidada which is called a Rule or Mediclinium.

When you wish to make the *allidada*, i.e. the rule which is placed on the back of the astrolabe, prepare a narrow sheet [of metal] like a ruler, of which the length is as the width of the disc [of the mother], and as much more as is required to allow of the cutting off

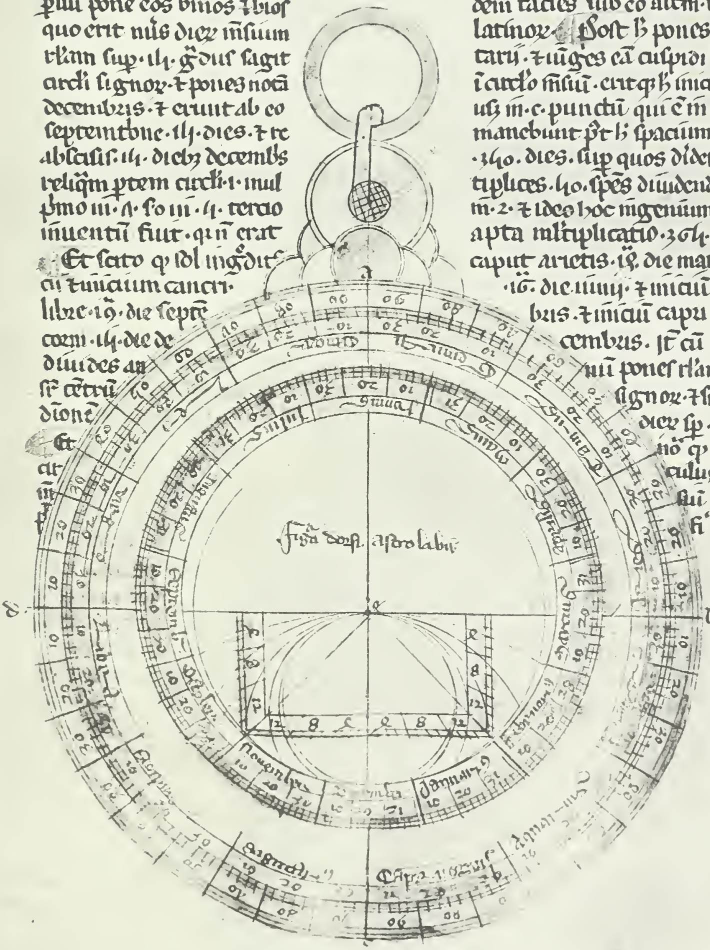
[1] In the figure on f. 62, the hour lines have been superimposed on the quadrates of the shadows. They should of course have been drawn in the vacant quadrants above them as in MS. Ashmole 1522 f. 81.

lras supiores · post h facies · 2 · circulos int quos dimittes spaciu qd diuides p · 12 · ptes equales · in quib describes noia · 12 · signor · et erunt oms isti circli ex uno puncto · c · i · hebunt unu centru · e · f · qui e in medio table · et incipies ab ariete · et inicio · occidentalis midiane · q e punct · b · iens usus midiem · qui e punctus · a · et diuides vnuqdq signu p · 30 · diones · ut sup · Post h pones rlam s · 24 · gdum gelor · et iuges ea cuspidi p linea subtilem · dein diuides eam a cuspide us in circlm s pcem · p · 12 · diones · et pone summitate pme dionis ex pte cuspidis circuli signor · et accipies ex hac dione · 30 · diones · eritq int has cuspides utrs vna dio · ex ipis dionib · et int capita linee alta dio pnus eos ne se otingant · itm facies circlm · et diuides eu p · 364 · diuisiones s numerum diez

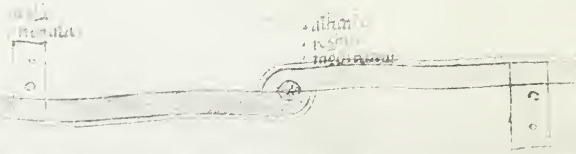
anni solis · Si fuit astrolabium puu pone eos binos et binos quo erit nus diez insuum rlam sup · 14 · gdus sagit circli signor · et pones nota decembris · et erunt ab eo septeintone · 14 · dies · et re abscisis · 14 · dieb decembs reliqm ptem circli · i · mul pmo in · a · so in · 4 · tercio inuentu fuit · qn erat

Et scito q sol ingdit ... ci tunicium cancri · libre · 19 · die septe ... coem · 14 · die de ... diuides ar ... sr cetru ... dione ... Et ... cir ... in ... f ...

bium magnu · et si fuerit deni facies sub eo altm · i latinor · Post h pones tary · et iuges ea cuspidi i circlo misu · eritq h inicu us in · c · punctu qui e in manebunt p h spacium · 340 · dies · sup quos dides tiplices · 40 · spes diuidendo in · 2 · et ideo hoc ingenium apta miltiplicatio · 364 · caput arietis · 18 · die mar ... · 16 · die iuny · et inicu ... bris · et inicu capu ... cembris · It cu ... nu pones rlam ... signor · et si ... diez sp · ... no q ... culus ... sui ... fi



concentricus circulo signorum et idem in c. ¶ Cum volueris ponere quadran
tem umbre. iunge cuspidem circuli signorum per lineam subtilem et
occultam. que vadit per medium quarte occidentalis septemtrionalis
equaliter. cuius finis erit circulus mensium. postea produces ex
fine eius .2. lineas ad summitatem tabule. et erit quadrans erectis an
gulis. deinde facias prope ipsas duas lineas alteras prope eas. inter
quas erunt puncti. iterum facias alias .2. lineas latiores inter quas
erunt littere. et divides spacia que sunt inter has lineas ex utraque parte per
.6. distinctiones ad litteras. spacium vero quod est strictius divides per .12. per
numerum punctorum. ad unamquamque litteram .2. punctos. et incipies scri
bere ex diametris. ¶ Et si vis in astrolabio .2. quadrantes. facies in
alia quarta septemtrionali scilicet orientali. que est iuxta eam similiter.
¶ Potes et inter quadrantes .2. eosdem infra circulum mensium con
stituere lineas horarias. ut fit in quadrante. per quas etiam ho
ras dies naturales in dorso. ut patet in figuris super hiis.
Cum vis facere allidadam .i. regulam que [illegible] allidada dicitur
ponitur super dorsum astrolabii. ¶ Facta enim que regula
tabulam angustam in similitudine regule. cuius longitudo vel medieta
tudo sit sicut longitudo tabule. et plus per eam quantitatem [illegible]
que possunt abscindi due tabule perforate ad accipiendum alti
tudinem. et lineabis illam regulam per medium in longitudinem. et
postquam lineaveris ipsam abscindes ipsam sicut tantum sufficiat ad a
gendum duas tabulas predictas. et maneat postea secundum longitu
dinem tabule. vel prope. et paulominus ne accipiat vel habeat in [illegible]
¶ Postea divides eam per medium certissime in duas partes. et pones in
medio eius notam super quam erit aptio axis. deinde abscindes di
midium regule ex una parte. scilicet que notum tibi. et ex alia parte e contra
rio. et servabis lineam que est in medio eius que vadit per axem. dum
abscideris. que in ea erit fiducia. et acues summitates regule.
usque lineam a sursum usque deorsum. ut fiat subtilis summitas
regule. et possunt videri gradus. ¶ Post hec compones super
unam longitudinem ab axe tabulas. et servabis ut linee que
sunt in predictis tabulis cadant super lineam regule. et perforabis eas ante
communem earum. et sunt foramina unius longitudinis a regula.
sint [illegible] ipsa foramina super lineam tabularum. equaliter perforata. et
in unaquaque tabula sint duo foramina. maius scilicet et minus.
maius ad accipiendum radios solis in die. et minus ad accipien
dum stellas in nocte. ¶ Nota quod centra duarum tabularum
que sunt super capiti allidade. et debent habere idem centrum. et
linea que est in regula debet respondere centro dictarum tabularum.



of two perforated vanes for taking the altitude [of the sun and stars]. Draw a line along that rule lengthwise along its middle, and after you have ruled [the rule], cut off as much as suffices for making the two aforesaid vanes, and let it remain according to the dimension of the disc [of the mother] as near and a little less, that it may not catch and cling to in your clothes. Afterwards divide it very accurately down the middle into 2 parts and place in the middle of it a mark, where the opening for the axis is to be. Then cut off half the rule on one side, according as I have instructed you. And, [cut away] from the other side in the opposite way. But preserve the line which is in the middle of it, which passes through the axis, until you have done the cutting, because in it will be the *Fiducial* edge. And sharpen the top of the rule towards the line [of trust] from the above downwards, so that the top edge of the rule may be thin, and the degrees can be seen.

After this lay together the vanes in one length from the axis, and take care that the lines which are on the aforesaid vanes coincide with the line of the rule. Pierce them before laying them together, so that the holes may both be of the same distance from the rule and may be evenly pierced on the line of the vanes; and in each vane let there be 2 holes, a larger and a smaller, the smaller for taking the rays of the sun by day, and the larger for taking the stars by night. And note that the centres of the 2 vanes which are over the ends of the allidada also ought to have the same centre, and the line which is on the rule ought to correspond to the centre of the aforesaid vanes, equally when they are placed together on the rule or allidada.

[f. 63.] And know that the rings by which an astrolabe is suspended are bevelled on their *spinae* for as far as one runs upon the other, as if upon the

edge of a sword,[1] lest their movement be impeded, and there might perhaps be some leaning towards one side or other. That this may not be, the hole in which the allidada is, and that [second hole] in which the bevelled ring is, register most accurately on the middle line on the Mother, yet from this cause there may be some torsion [or error] in the taking of an altitude. And this you ought to test in this way. Pass a thread through the hole and hang something heavy from it; then hang up the astrolabe by another thread from the same hole. Then if thread falls on thread and if there is no divergence, the astrolabe will be true. But if there is divergence, study to adjust it by moving the hole towards that side to which the thread diverges, [if God be willing].

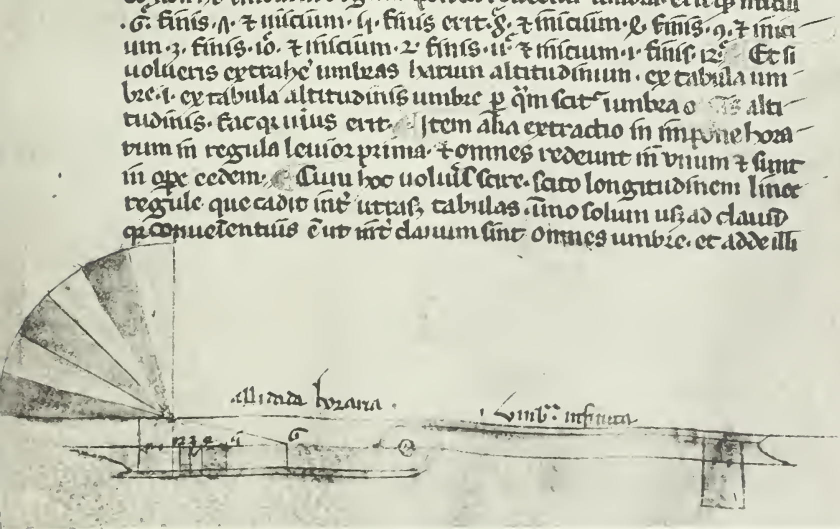
Chapter 5. On Placing the Hours on the Rule which is also an Allidada for Hours.

When you wish to place the hours on the rule, divide the length of one of the vanes [pinnules], which are on the rule and in which there are holes, into 12 divisions and the vane itself will be a position. Then divide a diagram of these positions on a flat surface, or on parchment, or on anything you please, divide them, i.e. the diagrams by points. After this lay the rule on 15 degrees of altitude and you will know how much [the allidada] will have from the versed shadow. Place the compasses over that number of points, [that is] of degrees which you have found for the said altitude, and put that amount on the rule [measuring] from the lower part of the vane which you have divided, as far as it will go. This will be the end of the first hour. Then further place the rule on 30 degrees—you may find out how much is fitting from the versed shadow—open the compasses according to the extent

[1] In our more peaceful parlance we usually refer to this as a 'knife-edge'.

equalit' cum collocant' in regula. sive allidada. Et scito
q' armille p quas suspenditur astrolabium. reflectunt' sup
spinas suas. quousq' unaq' ear curvat' in alia quasi sup acumē
gladii ne tardet' s. motus. Et forte erit in sede aliqua decli
natio ad aliquā ptium. ut si non fuerit foramen in quo est al
lidada. et in quo ē armilla reflexa. que figit' in matre sup lineā
mediantem ēctissime. acppt' hoc sit aliq' tortuositas in acceptio
ne altitudis. quod debes ita pbare. mitte p foramen filum
et suspende ex eo aliquid ponderosum. post hec suspendes astrola
bium. p alterum filum ex eodem foramine. tunc si obiciat' fi
lum sup filum. si non declinaverit ab eo erit verum. si vero de
clinaverit ab eo stude tunc adaptare eum. removendo fora
men ad ipsam ptem ad quā declinat filum. De horis constituendis

Cum volueris constituere horas in tabula i regula que alli
divide longitudinem unius tabularum. dicta horaria
que sunt in regula in qua sunt foramina p. 12. divisi diaciu
ones. eritq' ipsa tabula status. deinde divides silitudine eas.
ipsor statuum in tabula vel in pergameno. vel in quo vis. divi
des eas. s. silitudines p punctos. post pones regulam super
.44. gradus ex altitudine. et scies quantum habebit ex umbra
versa. et eriges circinū sup quātitatem ipsor punctor graduū
quos invenisti ad eandem altitudinem. et pones ipsam quātitatē
in regula. a radice tabule. quam divisisti. quousq' pvenerit. erit
q' finis hore prime. deinde pones etiam regulam supra. 30. gra
dus. et scias quātum convenit ei ex umbra versa. et apies circi
num scd'm quātitatem eor punctor. et pones ipsam quantitatē
in regula. a radice predicte tabule quam divisisti. quousq' pve
nerit eritq' idem terminus finis secunde hore. Et pones regulā
sr' umbram. 44. deinde sume umbram. 60. post umbram. 44. qui
ē finis hore. 4. et quod residuum fuerit ex regula erit hora. 6.
et non ht' finem in regula. postea revertetur umbra. eritq' initiū
.6. finis. 7. et initium. 4. finis erit. 8. et initium. 3. finis. 9. et initi
um. 3. finis. 10. et initium. 2. finis. 11. et initium. 1. finis. 12. Et si
volueris extrahe' umbras horarum altitudinum. ex tabula um
bre. i. ex tabula altitudinis umbre p quā scit' umbra o altitudinis
tudinis. facq' unius erit. Item alia extractio in impone hora
rum in regula levior prima. et omnes redeunt in unum et sunt
in ope eedem. Cum hoc volueris scire. scito longitudinem linee
regule que cadit int' utrasq' tabulas. initio solum usq' ad clavum
ex convenientius ē ut int' clavum sint omnes umbre. et adde illi



longitudini · & altitudines · siue similitudines totius tabule · a su-
perficie regule usque ad summum ipsius tabule · et si plus fuerit · q · simi-
litudinibus totius tabule cum summitatibus suis · et si sic non fuerit · non
sit unus eas · q · similitudinibus · quia finis · q · similitudinis est finis hore
· 4 · postea pone ipsam lineam in tabula · vel in pergameno vel in alio ·
deinde extrahe ex summitate linee lineam super erectum angulum · et
accipe ex eo secundum quantitatem tabule · et cito ipsum punctum extrahe
ex eo puncto lineam super angulum erectum quousque uolueris ·
deinde pone punctum qui est finis tabule cuspidem · et mensura
quamlibet longitudinem quam uolueris · et quartam partem fac circuli ·
post diuides ipsam quartam per · 6 · partes equales · deinde iunge dio-
nes punctos · scilicet eorum cuspidi · et extrahe lineas quousque peruenerint
linee regule · et quecumque se abscindant ipsa erunt puncta horarum ·
prime videlicet et · 2 · 3 · et · q · ac · 4 · et initium · 6 · est finis · 4 · quia · 6 · nullum
habet finem · Cumque reuersa fuerit umbra ostendet et reliquas
horas · Si autem fuerit linea sicut · q · similitudines tabule · to-
tius erit finis · 4 · hore · apud radicem pre tabule · et sic apud
clauum quod dentius est · Cumque reuersa fuerit umbra · ac alti-
ori summitatem erunt hec finis · 6 · hore · et initium · 7 · initium · 8 ·
et cum peruenit ad finem · q · erit finis · 8 · et initium · 9 · et cum peruenit
ad finem · 3 · erit finis · 9 · et initium · 10 · et cum peruenerit ad fi-
nem · 2 · erit finis · 10 · et initium · 11 · et cum peruenerit ad finem
prime erit finis · 11 · et initium · 12 · Post hec mutabis horas
cum circino in regulam · et pone initium regule iuxta radicem
tabule ut patet in hac figura · [illegible]

Perforata tabula facies clauum totildum et decentem com architob vel
positum et perforatum · et habens caput bene factum · qui clauilla
clauus sit utilis ad colligendas inter se tabulas dum perforate fu-
erint · et uocatur arabice architoph · quem nos latini uocamus
axem · Facie quoque in modum equi uel cimei · siue cuiuis alte-
rius tabulam animalis puram bene factam · quam mittes in fora-
men axis decenter · ita ut retineat tabulas · et dicitur alpheras si-
ue equus · quia ex consuetudine fit in modum equi · Facies
etiam regulam · que nouella dicitur ut hic patet · que sit diui-
sa per notas · secundum diuisionem linee meridionalis tabule latitudinis
tue regionis per almucanthath · et hec currere sic faciem rethis ·
Huc usque meminimus [illegible] de diuisis [illegible] nunc redeamus ·
Accipe tabulam quam volueris et cuiuslibet [illegible]
quantitatis · et facies in ea circulum · cuius [illegible]
dimidium sit dyameter sinus · dimidio dyameter eius [illegible]

of those points, and put that quantity on the rule from the base of the aforesaid vane, which you have divided, as far as it will reach. And there will be the terminus, the end of the second hour. Likewise place the rule upon the shadow of 45 degrees, then upon the shadow of 60 degrees, and afterwards of 75 degrees, which is the end of the 5th hour. And what remains of the rule will be the 6th hour, and it will have no end upon the rule. Afterwards the shadow will return, and the beginning of the 6th hour will be the end of the 7th; the beginning of the 5th, the end of the 8th; the beginning of the 4th, the end of the 9th; the beginning of the 3rd, the end of the 10th; the beginning of the 2nd, the end of the 11th; the beginning of the 1st, the end of the 12th. And if you wish to extend the shadows of these altitudes from the table of the shadow, i.e. from the table of the altitude of the shadow by means of which the shadow of every altitude is known, do so because it will be truer [if God be willing].

There is likewise another direction[1] for the placing of hours on the Rule, easier than the first. They all go back to the same thing and are the same in operation. When you wish to know [how to do it] by this [method], take heed of a length of line of the rule which falls between both vanes, from one [vane] only as far as the nail, because it is more convenient that all shadows should be inside the nail. Add along that length 4 measures of the height of the whole vane, from the surface of the rule to the top of the vane itself, or the equivalents of these measures, and if there are more than 4 equivalents of the measure of the whole vane with its top[s], it is well: if it were not so, and one of the 4 equivalents be not there, [it is] because the end of the 4th equivalent is the end of the 5th hour. After that place a line on a flat plate, or on parchment, or on any other material. Then from the end of the

[1] 'Extractio'.

line extend a line at right angles, and take from this according to the size of the vane and on the nearer side of the point. Extend from this point a line at right angles as far as you wish.

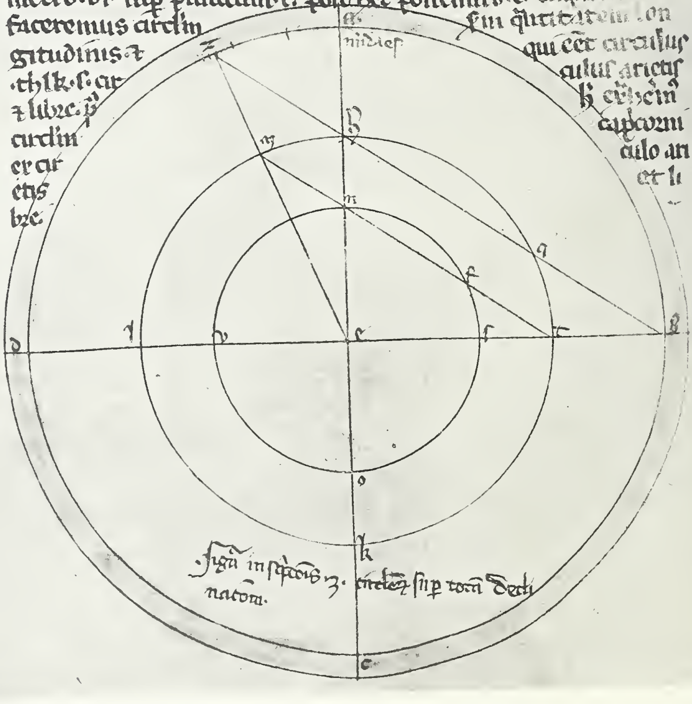
[Table on p. 201]

Then put the point which is the end of the vane [as] centre, measure as long a distance as you wish, and describe a quarter of a circle. After this, divide this quadrant into 6 equal parts, then join the divisions, that is their points, to the centre, and extend the lines until they meet the aforesaid line of the ruler, and wherever they intersect will be the points of the hours, that is, of the 1st, 2nd, 3rd, 4th and 5th; and the beginning of the 6th hour is the end of the 5th, because the 6th has no end. And when the shadow returns it will show you the remaining hours. If however the line is as 4 equivalents of the whole vane, it will be the end of the 5th hour near the base of the second vane, and so near the nail which is more convenient. And when the shadow is on the return towards the higher top (vane), it will be the end of the 6th hour and the beginning of the 7th hour; and when it has returned to the end of the 5th it will be the end of the 7th hour and the beginning of the 8th; and when [the shadow] gets to the end of the 4th, it will be the end of the 8th and the beginning of the 9th; and when it gets to the end of the 3rd, it will be the end of the 9th and the beginning of the 10th; and when it gets to the end of the 2nd it will be the end of the 10th and the beginning of the 11th; and when it gets to the end of the 1st hour it will be the end of the 11th and the beginning of the 12th.

After this you will transfer the hours with your compass to the rule. Place the beginning of the [scale of hours] near the bottom of the vane as is shown in this figure.

quod cadit ex matre infra limbum . et cum feceris circulum abscin
des quod superfluum fuerit extra ipsum circulum de tabula preter quendam
locum. quem ibi dimittes in modum denticuli. ut intret in limbo in
foramen ad hoc constitutum. et intrauerit tabula in matrem. et ipse den
ticulus fuerit in suo foramine. ut non possit predicta tabula huc uel
illuc moueri. et hoc cum feceris extrahe dyametra eiusdem circuli in di
recto. quousque se abscindant super cuspidem. erectis lineis. et ista erunt
dyametra. a. b. c. d. Cum uolueris facere arietis et libre circulum
.i. per quem uadit caput arietis. et libre. et circulum cancri. i. per quem
uadit caput cancri. deinde circulum. a b c d. per. 360. gradus. sitque
omnis quarta circuli ex. 90. partibus. deinde pone arcum. ab. simile
nisi graduum. et. 41. minuta. secundum albategni. 23. graduum. et. 36. minu
ta. sed etiam in diebus almeonis inuenerunt obseruatores. 23. gradus.
et. 33. minuta. et sicut uidisti ex modis prouenit hec declinatio. ad. 28.
gradus. Accipe ergo hanc declinationem. secundum quod uolueris. quia non
erit ibi sensibilis discordia. Cum igitur uis extrahere circulum
arietis. deinde circulum capricorni in circulum. a b c d. per. 360. diui
siones. et accipe ex eis secundum predictam declinationem. ex puncto
. a. uersus. d. et pone ibi notam. Et si uis diuide ipsam quartam
per. 14. accipe ex eis. 8. ex parte. a. uersus. d. et pone ibi notam. et uide ut
quarte sint equales. Et si uis diuide quartam per. 3. et iterum di
uide ipsam terciam que fuerit iuxta. a. per. 4. et ex ipsis. 4. accipe. 8. que
fiunt a parte. a. et ibi pones notam. Si autem circulus uis diuidere
fac ut dicam. postquam diuiseris tabulam per dyametra. et equales feceris
quartas. scripseris que litteras super capita dyametrorum. ut ponere in infe
riori parte tabule que est sub armilla. et significat meridiem. a. in
occidente. b. in septentrione. c. et in oriente. d. diuidens unam quarta
rum. scilicet ex. a. in. d. in. 90. gradus. et accipies. 23. gradus et. 41. mi
nuta. secundum ptholomeum. quia magis est autenticum. licet in ordine
sapientes acceperit. 23. gradus pro certo. et. 33. minuta. Vel sic. diui
des omnem circulum posita tabula in matre. et ea dyametra. accipe
in limbo ex. a. in. d. 28. gradus sinus. et in tuo ipsorum et super. c. pone
regulam. et fac subtilem lineam que uocetur. e. x. et hoc includit
cum linea. e. a. spacium. 28. graduum. omnis circuli intra inscripti.
Et nota quod hoc modo in quolibet circulo intra limbum scripto
quotquotlibet gradus accipimus. et hic modus est melior. secundum eum.
Accipe igitur in predicto nisi sit preduximus. et scribes super eam
notam. z. eritque. az. archus declinatio tota. deinde iunges. z b. per
lineam. abscindetque lineam. a c. super punctum. h. tunc pones. c. punctum
cuspidem. et fac circulum secundum ... titatem longitudinis. eh. i.

pones circlm ex una pte sr e. et ex alia sr b. et fac circlm qui erit
h t k l. et ipse erit circls p quem vadit caput arietis et libre. itm
diuides illum circlm p 360. aut 4. ut eius ut supra. et pone sr
num grduum pdicte declinatois ut s dcm e. notam et scribes
sr eam m. et iunges m cum t. p lineam mt. et abscindet linea mt
lineam ac. sup punctu n. et poner punctu e cuspidem. et fac
circulum fm qntitatem longitudinis e. ex n. qui erit circulus
n s u o. p quem vadit caput cancri. Et hec e figura.
Et si constituerimus circulum klht. qui est circulus arietis
et libre. et vellemus ex eo extrahe circulum capricorni et canc.
diuideremus circulum hlkt. p 360. ptes. vel diuidemus 4
ut sup. postea poneremus arcum tq. sicut totam declinationem
et iungemus h. cum q. et extraheremus lineam donec abscinde
ret dyametru lt. sup b. et poneremus e. cuspidem. et faceremus
cuspidem fm qntitatem longitudinis e b. qui eet circulus capri
corni. post h etiam abscinderemus arcu hm. sup totam declinati
onem. et iungemus m cum t. et abscindet linea mt lineam hk
sr punctu n. et poneremus e. cuspidem. et faceremus circulum scdm
qntitatem longitudinis e n. qui eet circulus n s o y. circulus canc.
Et si ex hoc vellemus extrahe circulum capricorni diuidere
mus circulum n s o y. p 360. diones et poneremus arcum
sr totam declinationem et iungemus n cum f. p lineam nf. et
extraheremus lineam in directo donec se abscinderet cum dya
metro ys. sup punctum t. post hec poneremus e. cuspidem et
faceremus circlm fm qntitatem lon
gitudinis et qui eet circulus
t h l k. s. cir culus arietis
et libre. p h ex hc in
circlm capricorni
ex cir culo ari
etis et li
bre.



6. On making the Nail which is the 'Horse': it is called Architob or Camilla.[1]

The rule being finished, make a round nail, well-fashioned and pierced, with a well-formed head. This nail is useful for binding the tables together while they are being bored. It is called in Arabic *Architoph*[2] which we Latins call '*Axis*'. Make in fashion of a horse or wedge or of any other animal, a small well-fashioned flat piece [of metal] which you put neatly into the hole of the axis, so that it may hold fast the plates. This is called 'alpheras' or 'horse', from a custom by which it is made in the fashion of a horse: make also a ruler, which is called the '*Novella*' as is shown here, which is divided by marks [spaced] according to the division of the meridional line by the almucantars of the plate of the latitude of your region. And let this [novella] run upon the face of the Rete.

Up to this point we have indeed interrupted [our discourse] on account of various treatises: but now let us return.

7. Preparation for the Construction of the Rete and of Latitude Plates.

[Figure 64 v]

Take a plate of the kind and size that you fancy, and draw a circle upon it, the semi-diameter of which is like the semi-diameter [64] of the mother below the limb. When you have made that circle, cut away what is superfluous outside it excepting the part which you leave in the form of a little tooth so as to enter a hole in the limb formed for it. And it is to be well made, so that when the plate enters into the mother, and the denticle into its hole, it cannot be shifted one way or another. Having done this, draw the diameters of the

[1] We have not met with this word elsewhere.

[2] Alcocoli MS. Evidently *al Ḳuṭb* or bolt is intended.

circle intersecting one another at right angles at E. They will be AC, BD.

When you wish to make the Circle of Aries and Libra, i.e. that along which the heads of Aries and Libra go, and the Circle of Cancer, along which the head of the Crab goes, divide the circle ABCD in 360 degrees, and let each quarter of the circle consist of 90 parts. Then make the arc AZ equal to the number of degrees of the whole declination,[1] which is 23° 51′ according to Ptolemy, 23° 35′ according to Albategni, and observers even in the days of Almeon found it to be 23° 33′, and, as we learn from the Indians, it approaches 24°. Wherefore take this declination at what figure you please, for it won't produce an appreciable error if you wish to draw the Circle of the Ram. Now the Circle of Capricorn, i.e. ABCD, is divided into 360. Measure the said declination among them from the point A to D, and make a mark there. If you like you may divide the quadrant into 15 parts and take 4 of them from A towards D and place the mark there, but see that the quadrants are equal. Or if you would rather, divide the quadrant into 3, and divide the third next to A into 5, and take four of these parts, and there place your mark. If you want to divide accurately, do as I tell you. After you have divided the plate by diameters, and have made equal quadrants, and have written letters on the heads of the diameters, as at the top of the plate under the ring A indicating the south, and B on the west, C on the north, D on the east, you should divide one quadrant, e.g. A to D into 90°, and take 23° 51′ according to Ptolemy, because it is more correct. Generally modern savants take 23° and 33′ as established.

You may divide every circle as follows: the plate with its diameters having been placed in the mother measure from A towards D, on the limb 24 degrees if

[1] Meaning the obliquity of the ecliptic.

you wish. Place the rule upon the 3rd of them and on E, and draw a faint line EZ. This with the line AE includes a space of 24 degrees of the entire circle inscribed within. And note that in this manner we take the degrees in any circle within the limb, however many may be inscribed. And this is the better way: follow it. [You may do this most readily by drawing a line from mark Z to E, cutting the Circle of the Ram in M, and thus you will have in the Circle of the Ram a like declination, viz. the arc MH. Then do as the letters teach.]

Then be satisfied with the aforesaid number as we have said before, and write above it the mark Z, then the arc AZ will be the whole declination. Join BZ cutting AE in H, with centre E and radius EH draw a circle HTKL along which the head of Aries and Libra travels. Again divide it in 360, and its quadrants as above, and place a mark on the number of degrees of the aforesaid declination as described, marking it M, join MT cutting AE at N. With centre E and radius EN describe the circle NSOV, along which travels the head of Cancer. This is the figure [at the first representation which is not a very great work if the mother be first measured and figured].

But if we should first settle on the Circle of Aries and Libra KLHT, the desire to derive the Circles of Capricorn and Cancer from it, we divide circle KLHT in 360 parts, or we divide a quadrant as before. Then we place arc TG equal to the whole declination, and join HG, extending it to cut the diameter LE in B. With centre E and radius EB draw the circle ABCD which is the Circle of Capricorn. Also cutting off arc HM equal to the whole declination, and joining MT cutting HK in N; and with centre E and radius EN, we can draw circle NSOV, the Circle of Cancer.

But if from the latter we wish to construct the Circles of Aries and Capricorn we divide circle NSOV into

360 divisions, make arc SF equal to the whole declination, join NF, extending the line until it cuts diameter VS in F. Then with centre E and radius ET we may draw circle THLK which is the Circle of Aries and Libra. After this we may construct the Circle of Capricorn from the Circle of Aries and Libra.

8. On the Construction of the Zodiac and its Divisions.

[Figure 65]

After the construction of these three Circles of Capricorn, Aries and Libra, and Cancer, make the Circle of the Signs. This is done by bisecting AO and drawing a circle upon it, which will pass through the points T and L, if you have done the work well. If it does not pass through these two points, you have blundered, so repeat the work until it comes out right. This is the Circle of Signs.

9. On the Division of the Circle of Signs or the Zodiac. A Chapter.

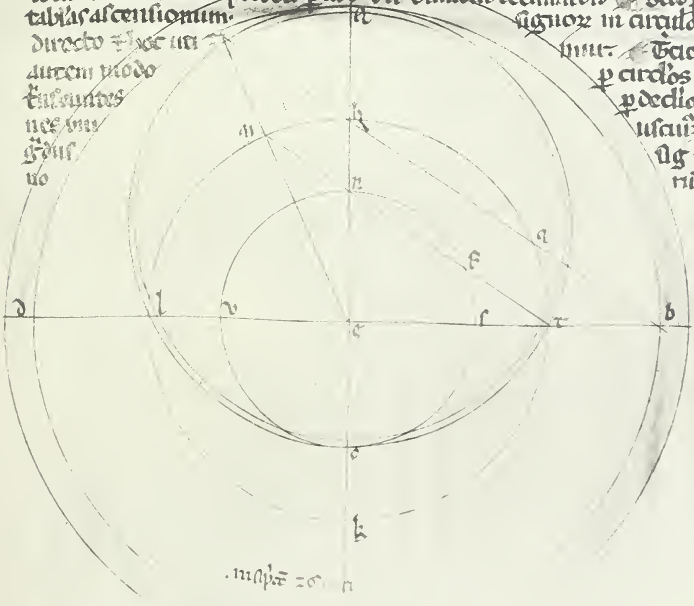
[Figure 65 v]

When you have made the Circle of Signs, you ought to divide it into Signs and degrees of Signs, and as an example of this you will make the Circle of the head of Aries and Libra ABCD,[1] whose diameters intersect at E, and the Circle of Signs AZCH. Then divide circle ABCD into 360 degrees, and make arc CT equal to the half of the whole declination. Join AT cutting

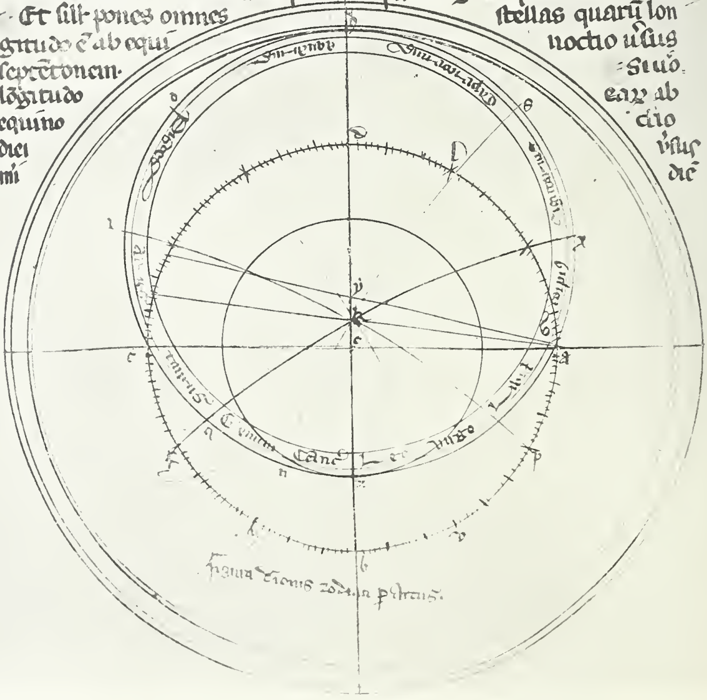
[1] These letters refer to the figure on f. 65 v. MS. Ashmole 1796 has a different set of letters.

c [E]t post ostensionem horum trium circulorum .s. capricorni arietis et libre et cancri fac circulum signorum. hoc est ut dividas lineam .a.c. per medium et facies super lineam .a.c. circulum transeuntem per duo puncta .e.l. si sic iam invenisti opus. si vero transierit per hos 2 punctos certasti. reitera ergo opus donec verificetur. et hic circulus est circulus signorum.

c Cum igitur feceris circulum signorum oportet te postea dividere eum per signa et gradus signorum. cuius rei exemplar est ut facias circulum capitis arietis et libre qui est .a.b.c.d. et diametri abscidant se super .e. et sit circulus signorum .a.z.e.h. deinde divides .a.b.c.d. per 360 gradus. post hoc pone circinum .e. super quantitatem dimidie totius declinationis deinde usque .n. circini et abscindet linea .a.t. diametrum .b.d. in puncto .k. deinde extende diametrum .b.d. in directo donec abscindat circulum signorum super .h. tunc punctus .a. erit punctus capitis libre et punctus .h. capricorni et punctus .e. arietis et punctus .z. capitis cancri. post hoc pone arcum .d. .b. in unumquodque videlicet istorum ex 30 gradibus. deinde quere arcum qui cadit super punctum .m.k.l. et abscindet circulum signorum super .n.s. eritque .h.s. arcus signum sagittarii et arcus .z.n. signum geminorum. post hoc pones unumquemque ex arcubus .l.g. et .m.f. 30 gradus. deinde quere arcum qui vadit per punctum .f.k.g. et abscidet circulum signorum super .q.x. eritque arcus .t.x. signum scorpionis et arcus .n.q. tauri et remanebit arcus .e.a. signum libre et arcus .q.e. signum arietis. post hoc pone arcum .h.o. sicut arcum .h.s. et arcum .o.r. sicut arcum .s.x. eritque .r.e. signum piscium et arcus .r.o. signum aquarii et arcus .h.o. signum capricorni. postea et pones arcum .z.v. sicut arcum .z.n. et arcum .v.p. sicut arcum .n.q. eritque arcus .a.p. signum virginis et arcus .p.v. signum leonis et arcus .v.z. signum cancri. Et similiter si [illegible] arcum [illegible] gradus et arcus [illegible] erit arcus .h.o. 3 gradus ex capricorno et arcus .z.n. [illegible] ex cancro [illegible] divisum circulum signorum per singulos gradus ut patet in figura. post et aliis [illegible] zodiaci per lineas [illegible] et sit tota declinatio in 1 precedenti parte et sit dimidium declinationis. secundo per tabulas ascensionum signorum in circulo directo et hoc uno [modo]. Tertio autem modo per circulos transeuntes per declinationes unius gradus cuiuslibet signi.



Cum diuiserimus circulum signorum ē tūssime·oi Sequitur de inscip. nos postea describere stellas fixas in circulo signorum cōne stellarum cuius rei exemplar ut ponamus stellam cum longitudine fixam in re sua ab equinoctio diei cum gradu qui venit ad medium celi cum ea·i eius ea· et hoc fit sic. Ponemus circulum equinoctii diei· scilicet circulum arietis zodiaci et libre·a b c d· et diametra abscindant se super·e· et sint scilicet circulum signorum zodiaci a z c h· Et ponemus exemplum ut una stella ex stellis quarum longitudo ē ab equinoctio diei versus septemtrionem· sitque illa stella vultur volans· et abscindemus ex puncto·d· versus·c· quantum ē longitudo eius ab equinoctio diei· et ē·19·gradus· Estque arcus·dt· jungemusque·t·cum·a·et abscindet diametrum super punctum·k· et ponemus punctum·e· eidem cuspidem· et faciemus circulum· secundum quantitatem longitudinis·e· ex·k· et est circulus·km· vaditque per stellam· post hoc aspiciemus punctum qui cum eo est in medio celi ex circulo signorum· et ē·16·gradus· ex capricorno qui ē punctus·l· post hoc iungemus·l·cum·e· abscindetque linea·le· circulum·km· scilicet·m· punctus gradus·m· ē cuspidis·l·cum·e· vulturis volantis· Similiter pones universas stellas· quarum longitudo est ab equinoctio diei ad septemtrionem. Postea ponemus aliud exemplum in stella cuius longitudo ē ab equinoctio versus septemtrionem· et sit ipsa stella cor tauri· abscindemus quoque ex puncto·d· versus·c· longitudine eius ab equinoctio diei· et que longitudo eius versus septemtrionem est ·19·gradus· et·30·minuta· et ē arcus·du· Jungemusque·a·cum·n· et extrahemus eum donec abscindet lineam·hb· super punctum·s· deinde ponemus punctum·e· cuspidis et faciemus circulum secundum quantitatem longitudinis·es· et est circulus·ff· deinde aspiciemus punctum cum quo ē in medio celi·ex circulo signorum hoc ē·19·gradus ex tauro qui ē punctus·g· et iungemus·e·cum·g· et extrahes eum donec abscindat circulum·ff· scilicet punctum·f· punctus gradus·f·e· ē punctus cordis tauri· Et similiter pones omnes stellas quarum longitudo ē ab equinoctio versus septemtrionem. Similiter longitudo earum ab equinoctio diei versus meridiem



diameter BD in K. Then produce diameter BD straight until it cuts the Circle of Signs at H. Then A will be at the head of Libra, H at the head of Capricorn, C at the head of the Aries, and Z at the head of Cancer. After this make arcs DL and BM each equal to 30°. Then find an arc which will pass through M, K and L and cut the Circle of Signs at N and S. The arc HS will then be the Sign of Sagittarius, and arc ZN the Sign of Gemini. Next make the arcs LG and MF each equal to 30°. Then find an arc which will pass through F, K and G, and let it cut the Circle of Signs at Q and X. SX will then be the arc of the Sign of Scorpio and NQ that of Taurus. There will then remain arc XA of Libra and the arc QC of Aries. After this place the arc HO like arc HS, and arc OR like arc SX, then RC will be the arc of the Sign of Pisces, RO of Aquarius and HO of Capricorn. Next place arc ZV like arc ZN, and arc VP like NQ, then arc AP will be the arc of Virgo, PV of Leo and YZ of Cancer. Similarly you may place 30[1] degrees on arcs DL and BM, the arcs HS of Sagittarius and ZN of Gemini may be similarly divided in 30 degrees. By this method you may divide the entire Circle of Signs into single degrees, as the figure shows.

The Zodiac may be divided by 3 other methods. Firstly by straight lines and according to the whole declination as in the preceding account, and by arcs according to the half of the declination. Secondly by tables of the ascensions of Signs in the 'direct' circle, and we make use of this. But the third method is by circles cutting the declinations of every degree of the Signs.

[1] 3 in MS.

10. On the Insertion of Fixed Stars in the Rete [in the Zodiac].

[Figure f. 66]

And when we have accurately divided the Circle of Signs we must mark the fixed stars in the Circle of Signs. And in illustration of this, we place a star with its longitude from the equinoctial day with the degree which comes to the mid-sky with it. And this is done thus: We place the Equinoctial Circle, i.e. Circle of Aries and Libra ABCD, and its diameters cutting at E and upon the Circle of Signs AZCH. And for one example, we choose a star whose latitude is towards the north of the Equinoctial Day, viz. the star *Vultur volans*, and from the point D[1] in the direction of C we cut off the measure of its distance from the equinoctial day which is 7° 25′; this is the arc DT. We join TA cutting the diameter at K. With centre E and radius EK we describe the circle KM, which traverses the star. After this we note the point in the Circle of Signs which is in mid-sky with the star; this is the 16th degree of Capricorn at L. Join LE, cutting circle KM in M. M is therefore the centre of *Vultur volans*. Similarly you may place all stars whose declination[2] is to the north of the equinoctial.

[1] D is omitted in figure. For its position see fig. 65 v.

[2] 'longitudo' in MS., but the corresponding figure in MS. Ashmole 1522 is inscribed 'secundum latitudines suas ab equinoctiali'.

accipies longitudinem eius ab equinoctio ex .d. usque .a. et iungens .a. cum illa longitudine accepta et extrahes lineam donec abscindat lineam .dh. cadetque ex circulum equinoctii versus meridiem et erit longitudo eius meridiana. Mensurabisque longitudinem et facies circulum qui erit super ipsam longitudinem sicut fecisti in stellis septemtrionalibus. Possunt et alie stelle fixe inscribi per .s. tabulam verificatam ad plenius per armillas continentes stellas cum distancia earum ab orbe signorum et cum longitudo earum per veritatem que habetur ex circulo magno eunte per polos zodiaci et per stellas ad eclipticam. Qui modus inscribendi habetur in quodam capitulo in fine compoti apposito. Capitulum

Cumque posueris stellas fixas et divisis circulum rethis sive re signorum oportet ut extrahas tabulam et abscindas eam secundum araneam et non dimittas nisi circulum signorum et signa stellarum fixarum seu sal postquam univeris eas circulo signorum. Postea lineabis eam et planabis ago optime donec sit planatio eius et distinctio cum circulo ita quod non re augeat vel minuat. Similiter facies cum stellis fixis et planabis eam optime et scribes super omne signum nomen ut est in hac figura. Sit caput capricorni almuri gradum .i. omnium gradum quod reliqui latinorum ut in quodam libro diximus calculatorem dicunt. Et iam scripsimus super eum in figura almuri gradum. Sitque axis huius tabule cuspis circuli equinoctii diei et iam scripsimus super eum in figura almuri gradum. Sitque axis huius tabule cuspis circuli equinoctii diei et iam scripsimus super eum in figura hac axem. Cum autem perfecta fuerit eius explanatio ac descriptio tunc perficietur et hec tabula vocatur alhanthabuth .i. aranea et dicitur rethe ut hic patet.

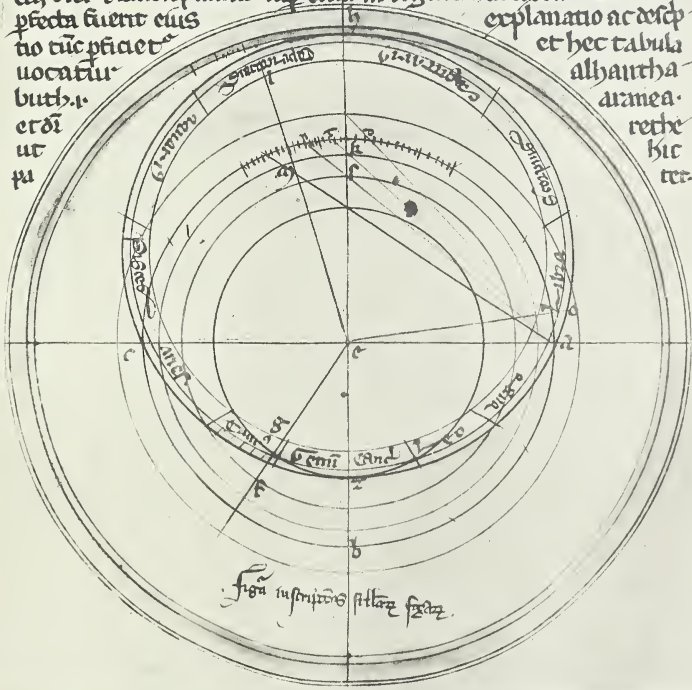


Figura inscriptionis stellarum fixarum

After this we may place another example of a northern star,[1] e.g. *Cor Tauri* or *Aldebaran*, cutting off the arc DN equal to 14° 30′ the latitude of the star. We join AN and extend it until it cuts HB in S. With centre E and radius ES describe a circle SF. Then as the star is in mid-sky with the 18th degree of Taurus, G, we join EG and produce it to cut the circle SF in F, then F is the place of *Cor Tauri*. Similarly you may place all stars whose declination is to the north of the equinoctial. If, however, you wish to find the position of those whose declination from the equinox is towards the south, take the declination from the equinoctial from D towards A and join A with the declination [♁], drawing the line [A ♁] until it cuts DH; it will fall beyond the circle of the equinox towards the south, and will be the distance [or declination] on the meridian, then you will measure the longitude and draw a circle upon it, as you have done for the northern stars [if God will].

MS. 1796 here continues:—The fixed stars may also be inscribed by another method, by a table for Armillae verified for Paris, comprising the stars with their distance from the zodiac, and with the longitudes that they have from the great circle passing through the poles of the zodiac and through stars to the ecliptic, which method of inscribing [is described] in a certain chapter appended at the end of the *Computus*.

[1] The translation is shortened here.

11. The Fitting of the Rete, or Spider-web, or Walzagora.[1] Rubrica.

[Figure 66 v]

When you have placed the fixed stars and have divided the Circle of Signs you must withdraw the plate and cut it, and not pause before the circle of the Signs and the [marks] of the fixed stars [are complete]. After you have joined them to the circle of the Signs, draw lines on it and flatten it thoroughly until its surface is even and its separation from the third [circle] is such as neither to increase nor lessen. Do the same with the fixed stars, and true the surface of the plate thoroughly, and inscribe the names of all the Signs [and the name of every star], as it is in this figure.[2] And at the head of Capricorn let there be *al-muri* [or the muri], the pointer of degrees which some of the Latins, as we have said in a certain book, call the 'calculator'. We have written above it in the figure 'almuri graduum', the muri of degrees. And let the axis of this plate be the centre of the equinoctial circle: and in the figure we have written over it 'axis'. When the flattening and lettering of the disc have been done, it is finished, and it is named '*alhanthabuth*' (*alancabut*), i.e. spider, and it is called the rete, as is well-known.

[1] Several Arabic words for parts of instrument are not only preserved, but are still widely used. In the East the Astrolabe itself is sometimes called the *Wazah al-Kurah* or position of the sphere, corrupted to *Walzagora*.

[2] In the figure in MS. Ashmole 1522 f. 87 v additional star pointers for *Corvus* and *Algorab* are inserted.

Post h' accipies tablam aliam, et ipa e in qua de inscriptione circu-
lis circl's emisphy et circli qui succedit eum in hemispio in
directo eius qui dnr alimuthanthath, quos latini uocat per lat-
pgressiões solis et hore atq azimuth. sitq3 hec tabula maior quam
tabla alhantabuth p qntitatem limbi. et primu quod oz te
facie in hac figa e ut facias circlin maiorem. et sit circl's h-
a.b.c.d. et exhe dyamet eius quousq se abscindat rectis anglis
s. e. eritq3 linea e.a. linea medii celi. et linea e.b. linea occidentis.
et linea e.d. orientis. linea u'o. e.c. erit linea recessionis. postea
pones e cuspidem. et facies circlin eius dimidium dyametrum
sit dimidiu circli dyamet capricorni. quem fecimus in retha
et e circl's z h t k. deui facies sup circlin hunc altm qui sit equal'
circulo rethis qre eum. post h' diuides eum p 360 diones et
scribes in eo numeru sicut uides in hac figura. fac etiam in
ea circlin p quem uadit caput arietis et libre sicut fecisti in re-
thi qui e circulus lmns. et circulum cancri qui e circl's f g q o.
et erit punctus a locus allidadath. que e armilla reflexa. ex

Post h' debes facie circlin emisphy et circl'os in superficie al-
qui succedunt ei in directo i. eque distant
qui sunt almuthanthanth. ponesq3 circlin capricorni
circlin a b c d. et abscindant se dyametra sup punctu e. circl's
u'o arietis et libre erit circl's z h t k. et punctus allidadath
erit punctus a. diuides deui circlin z h t k p 360 diones.
pones arcu k l sicut latitudine regionis. et arcu h m
arcu q z g. sili. postea iuges g cu h et abscindes dyametru
sup p eritq3 punctus   p cenith capitum.
deui iuges h cu l   et abscindes dia-
metru a c sup   deui iuges
h cum m

emisperii· deinde diuides per medium· et facies partem circuli abscindentem circulum capricorni super puncta· v s· et est per illa· s· v t· quod si hec absciderit super punctos· h s k· iam inuenisti et opus certissimum est· Si uero aliter fuerit errasti· Reitera ergo opus· Postea abscindes ex puncto· m· usque· z· arcum ex· 10· gradibus· uel· 10· uel quot uolueris· et sit arcus· m r· et l q s· Postea iunges· h· cum· q· et abscindet dyametrum super· i· deinde iunges ·h· cum· r· et extrahes lineam· donec abscindet dyametrum super· o· postea diuides ·o i· per medium· et facies partem circuli abscindentem circulum capricorni ·y x· Similiter non cessabis facere donec peruenias ad punctum cenith capitum ·s p· secundum quod processisti in hac figura· et scribes super almucantharath numerum· sicut uides in figura· De diuisione circulorum et azimuth

Capitulum 3· ostendens facere azimuth· quorum opus est ut parum... figures tabulam in aliqua tabula lignea cum piccem uel ali- et protrahes in ea circulus emisperii· deinde diuides circulum emisperii sicut diuisisti circulum signorum per istos· 3· modos· Et ueris in loco tocius declinationis tota altitudine arietis et librae· in eadem regione est· ut minuas regionis latitudinem ex· 90· et quod remansit est altitudo arietis· et iteremus rem in eo quod magis propalabitur si deus uult· ponamus ergo circulum emisperii· a b c d· et circulum arietis et librae ·e· b· x d· et eius dyametri abscindant se super centrum· h· et extrahemus dyametrum· z c· in directo· usque· a· ponemus arcum· t d· altitudinem arietis in eadem regione· deinde diuidemus eum per· 2· equalia· super· k· cum· b· et abscindemus dyametrum· a z· super· l· postea ponemus arcum· e n· 10· gradus aut quantum uis et arcum· z m· similem eius· postea protrahe arcum qui est super punctum· m· et· l· et· n· et abscindet ipse arcus circulum emisperii super punctos· f· et· o· Item fac similiter quousque diuides reliqua ·ab cd· postea diuides quartam· a d· sic quartam ·ab· et quartam ·e·b· similiter diuidenem ·cd· sic fe a m

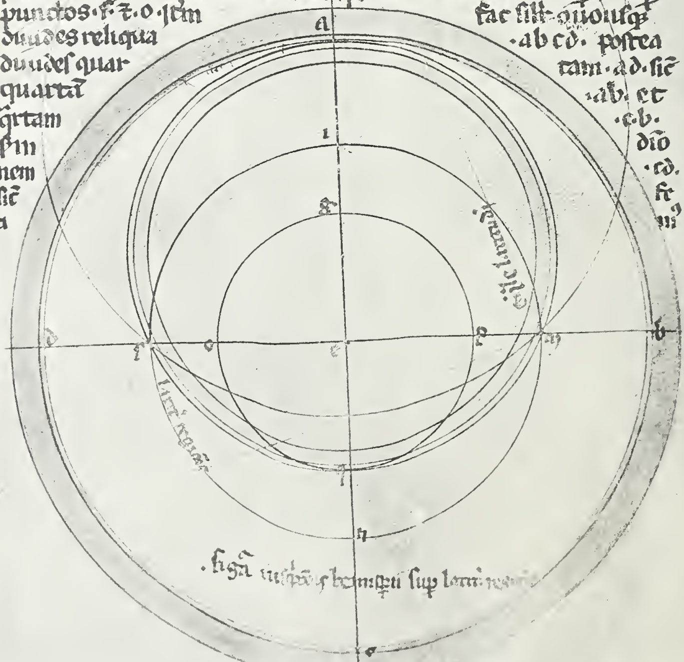


figura ... hemisperii super latitudinem ...

12. On Constructing Almucantars. Of the Inscription of a Circle of the Hemisphere for the Latitude of a Region.

[Cf. figure 67 v]

After this take another plate, the one on which is to be the circle of the Hemisphere and the circles which are in a series with it in a straight line, which are called 'almucantars', which Latins call progressions of the sun and also the hours and the azimuths. Let this plate be made larger than the alhanthabuth plate by the breadth of the rim. And the first thing you must do in this figure is to draw the large circle [which will be the edge of the plate]. Let it be circle ABCD, and draw its diameters cutting one another at right angles at E. EA will be the line of mid-sky, EB the West line, ED the East line, and EC the line of recession. Then with centre E and diameter equal to half the diameter of the circle of Capricorn, which we made on the rete, make the circle ZHTK. Then draw upon it a second circle equal to the circle of the rete near it. After this divide it in 360 parts, and write the number upon it as you see in this figure. Also describe on it the circle through which the head of Aries and Libra passes, as you did on the rete. This is circle LMNS; and [also draw the] circle of Cancer which is FGQO. And point A will be the place for the *allidadath* [or alilacat], which is the *Armilla reflexa*.

13. Chapter on the Inscription of the Almucantars.

[Figure 67 v]

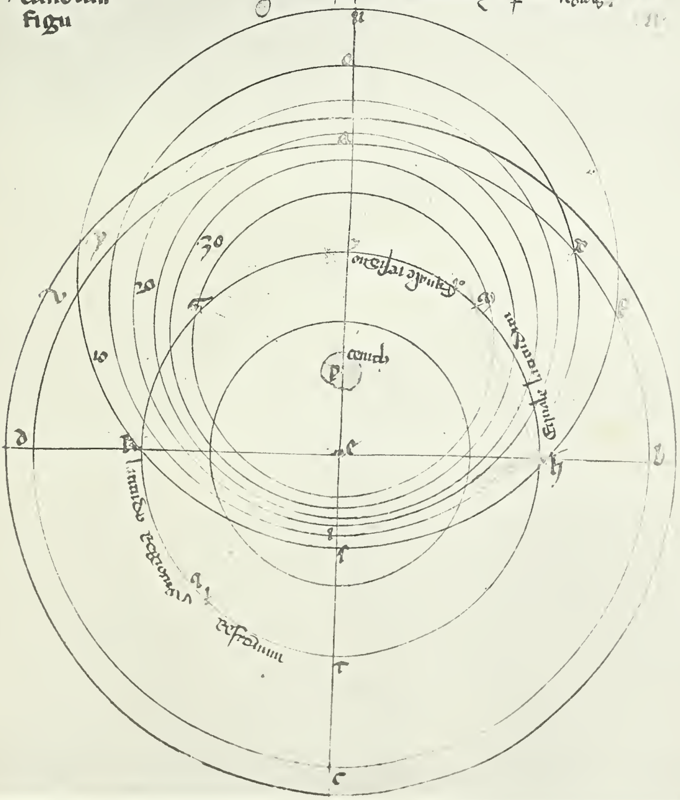
Afterwards you ought to make the circle of the hemisphere and the circles which follow it at equal distances apart in series, which are the almucantars. Set down the circle of Capricorn ABCD, whose diameters intersect at E; ZHTK is the circle of Aries and Libra, and A is the point of the *allidadath*. Then divide the circle ZHTK into 360 parts. And place arc KL as the latitude of the region, and arc HM like it, and [arc] ZG likewise. Join GH cutting diameter AC at P, and P will be the zenith of the Heads. Then join HL, cutting the diameter at S. Join H with M, and produce HM until it joins [the diameter at] N; NS will be the diameter of the circle of the hemisphere which you bisect; and draw part of a circle VSF cutting the circle of Capricorn at V and F; and if it cuts the points H, S, K which you have already found, the work is true. If it be otherwise, you have blundered: so repeat the work. After this cut off an arc of 30°, or of 10°, or of as many as you wish from M towards Z, and let it be arc MR; and make LQ in the same manner.

Then join H with Q, cutting the diameter at I, then join H with R and produce the line until it cuts the diameter at O. Afterwards bisect OI and draw part of a circle cutting the circle of Capricorn at YX likewise. Do not cease from your labour until you arrive at the zenith of the Heads P, according to the procedure in this figure; and write on each almucantar its number as you see in the figure.

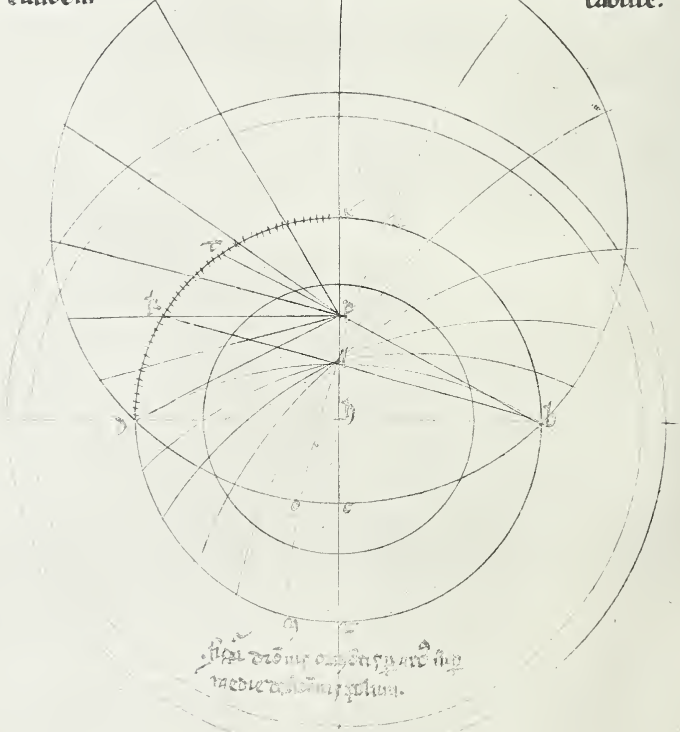
in divisione circuli signorum. et sic divides circulum emisperii per 10. et per 10 vel per 20. et 20. aut per gradum et gradus. aut per minuta et minuta. ut si quidem volu eris ut in hac figura. Dividitur et melius orizon per lineas rectas transeuntes per totam altitudinem arietis. i. per punctum cenith et gradus equinoctialis. et hoc utimur. De inscriptione circulorum azimuth.

Cum autem divisis circulum emisperii constitues in eo azimuth in sequenti. fac circulum capricorni. a. b. c. d. circulum arietis et libre. z. y. m. et circulum cancri. b. e. g. f. et circulum emisperii predictum. l. v. m. deinde dividendo eum per aliquas mensuras proportionales et sint eius divisiones. e. n. n. s. s. m. m. h. h. t. t. v. v. r. r. p. p. l. l. q. q. o. et o. e. et extrahemus punctum cenith capitum. sitque punctus. k. postea queremus arcum circuli. qui vadit per punctum. n. et vadit per punctum. t. et punctum cenith capitum. et sit arcus. n. k. t. et abscindet motum arietis super punctum. z. et motum capricorni super punctum. i. et motum tauri super punctum. h. et faciemus arcum similem predictum. et erit arcus vadens per punctum. o. et abscindet hic arcus circulum capricorni super punctum. d. et circulum arietis super punctum. e. et circulum cancri super punctum. a. similiter facies in arcu. s. k. p. et. q. k. h. et. m. k. l. perficies quod ponemus loco azimuth per hanc divisionem sub. 30. et. 30. gradibus. similiter divides gradum gradu aut cui volueris. scribes que in eis numerum secundum figuram

Figura inscriptionis almucantarath super lancem regionis ut est in



Et post positionem azimuth oportet pone horas
ut sequitur. pone circulum capricorni . a b c . et
circulum arietis et libre . d e z . et cancri . h t q . et quod cecidit in eo ex
circulo emisperii [?] sub se a d h . q z c . et linea . l t e b . ipsa vadit per
alhadadath . et per punctum tabule . i . centrum . et ipsa est linea recessi
onis . et erit linea . l b . finis . 6 . hore . et initium . 7 . et postea divides arcum
. h t . per . 6 . divisiones equales . h . m . n . f . o . k . t . et divides arcum . d e . per . 6 . diviones
equales . suntque partes . d l . k r . r x . x y . y p . p e . divides etiam arcum
. a b . per . 6 . diviones equales et sint . a . h e . h e . et t e . et . t e . t o . et t o . h o . et
. h o . e p . postea queres arcum eundem per punctum . m k l h e . perficiesque horam
primam . et scribes sic eam primam . deinde secundam . terciam . quartam . quintam .
sextam ut est in hac figura . postea divides reliquas horas secundum primam divionem .
et scribas sic eas . 8 . 9 . 10 . 11 . 12 . ut est ibidem . et scribas apud horam i prima
occasus . et apud . 12 . oriens . deinde scribas in ea latitudinem regionis .
in loco descripto . postea cum feceris horas perficietur ipsa facies illius
tabule et hoc modo facies ceteras
longitudines regionis
eiusdem tabule.



14. Of the Division of the Horizon and Azimuths by Arc. [First Method.]

[Figure 68]

After this azimuths must be made, and for this you should fix the plate to a board by means of pitch or other [adhesive], and draw the circle of the hemisphere upon it. Then divide the circle as you have divided the circle of the Signs by the same 3 methods, only instead of making use of the whole declination you must employ the whole altitude of Aries and Libra in that region. This means that you subtract the latitude of the region from 90, and the remainder is the altitude of Aries. We repeat the account of it because it will be found very serviceable, if God is willing.

Let us set down the circle of the hemisphere ABCD and the circle of Aries and Libra EBZD, with their diameters cutting one another at H, and let us produce diameter ZE towards A. Let us place arc TD equal to the altitude of Aries in the region. Then let us bisect it in K, and join KB, cutting diameter AZ at L. After this let us make an arc EN of 10 degrees, or as much as you please, and arc ZM like it. Then extend the arc which passes through M and L and N, to cut the circle of the hemisphere at S and O. Do this again and similarly so that you divide the remainder of ABCD. Then divide the quadrant AD like the quadrant AB, and the quadrant CB according to the dividing of CD. Thus have we worked in the division of the circle by tens of degrees, or by single degrees, or as you wish.

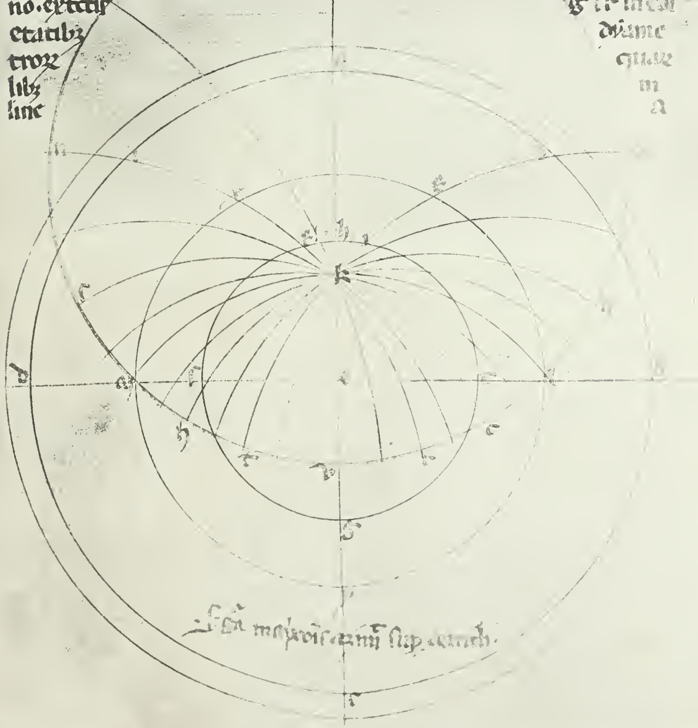
15. Of the Inscription of the Azimuth Circles. [First Method.]

[Figure 68 v]

When you have divided the circle of the hemisphere, you may construct azimuths on it as follows:—Draw the circles of Capricorn ABCD, of Aries and Libra ZLYM, of Cancer HTGS and of the hemisphere LVM. Then let us divide it by any of the aforesaid methods. And let the divisions be EN, NS, SM, MH, HT, TV, VR, RP, PL, LQ, QO, OE; and let us construct the point of the zenith of the Heads, K. Then let us seek the arc of a circle which passes through N and its nadir, the point R and the zenith of the Heads. Let this arc be NKR, cutting the course of Aries at X, the course of Capricorn at I, and the course of Cancer at F,[1] and let us draw a similar arc [to said arc NKR], namely the arc passing through O [and through T, the opposite point to O] cutting the circle of Capricorn at D, circle of Aries at F and the circle of Cancer at [I]. Do likewise in the case of arcs SKP, QKH and MKL, and complete the placing of these azimuths by dividing them into degrees in thirties. Similarly divide [ ] to a degree or to what measure you wish. And write on them their number as in the figure [where they are placed by thirties, if God be willing].

[1] H in MS.

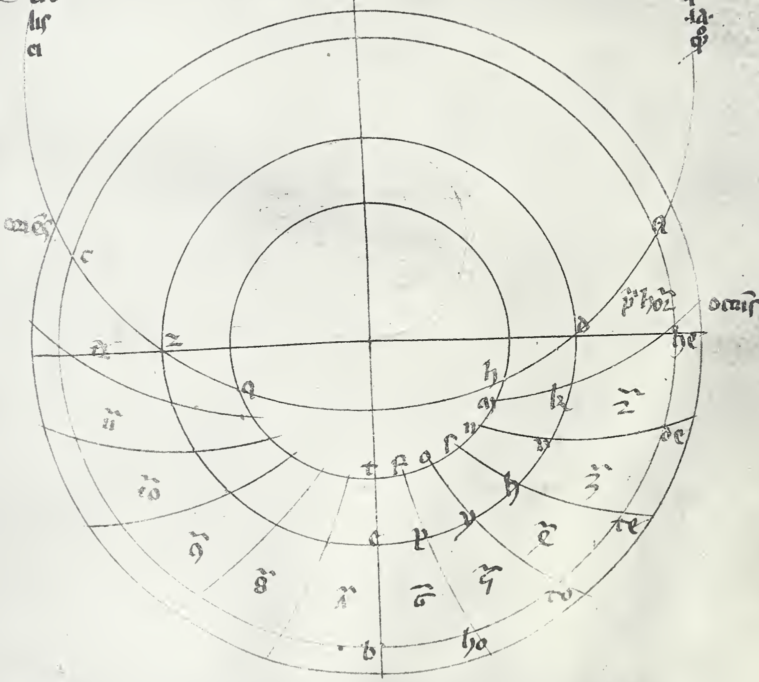
Concussio sit extensio · immo nūs ꝑiectio
spe in planū ꝑ visum fit hoc modo · sit
planum linea · mbn · axis spe linea · ab · stans ortogonaliter
sup planum · mbn · ita qz polus septemtrionalis contin
gat planū · mbn · in puncto · alter uero sit meridionalis · et
maxime distet a plano in puncto · a · qui ꝛ oculus videntis sit
colurus solsticius ꝑ maximas solis declinationes fit abcd · linea
qz · c · d · eque distans planum ē eqtor diei · ef · tpicus cancri · gf ·
tropicus capricorni · ꝛ hij duo etiam distant eque a plano · li
nea uero · ef · ē ecliptica Exeant igitur a puncto · a · poli australi ·
ab australi polo · s · ab oculo videntis due linee · ꝑ duas extremi
tates equatoris · f · c · ꝛ · d · ad duo puncta in plano · p · ꝛ x · et erit
linea · px · dyameter equatoris · et ab eodem puncto alie due li
nee · s · p · eh · extremitates tropici cancri ueniāt in planum ī
punctis · z · ꝛ · y · ꝛ hec linea · zy · erit dyamet eiusdem tropici in
plano · Similit ꝛ alie due linee ꝑ · gf · extremitates tropici ca
pricorni plano inci dentes in punctis
m · ꝛ · n · faciunt ex ipsa linea · m · n ·
dyametrū cap corni in pla
no · extitis qz sit in eo
etatibz dyame
troz
libz
line



.mbn. sagittariorum circulus. sicut circuli in plano primi ex spera per visum proportionaliter proiecti.

Si autem cuiuslibet puncti in spera eque distantis ecliptice in plano picture velimus proiectio-sic fiet. Circulus .ab. transiens per polos mundi qui sunt .a. et .b. .b. autem contingens planum. et linea .bmn. est communis sectio circuli .ab. et plani .cd. est dyametrum equatoris .ef. dyametrum zodiaci .gh. dyameter unius ex equantibus zodiaco qui sunt ad partem septentrionis. .kl. dyameter alterius eque distantis zodiaco qui est ad partem meridiei. Unde uterque duorum arcuum .ce. et .df. est declinatio zodiaci ab equatore. duo autem arcus .eg. et .dh. sunt .2. maxime declinationes circuli cuius dyameter .gh. ab equatore. Eodem quoque modo duo arcus .ck. et .dl. sunt due maxime declinationes circuli cuius dyameter .kl. ab equatore transeant. g° linea a. .kom. acp. aczq. agir. ahzr. adt. .af. tu. alsu. eritque punctus dyameter equatoris qui tu sibi per .q. na cum sit ei e q lis ia ei q

.figura .n. ...



16. Of the Method of Placing the Hours.

[Figure 69]

After placing the azimuths you must mark the hours as follows: Set on the Circles of Capricorn ABCD, of Aries and Libra DEZ, of Cancer HTQ, and the part that falls outside the circle of the hemisphere has under it ADHLQZE, and the line LTEB passes through the allidadath and through the centre of the plate, and is itself the Line of Recession. The line LB will be the end of the 6th hour and the beginning of the 7th. Afterwards divide arc HT into 6 equal parts, H, M, N, S, O, F, T, and also divide the arc DE into 6 equal parts DK, KR, RX, XY, YP, PE. Also divide arc AB into 6 equal parts A-HE, H-DE, DE-TE, TE-RO, RO-HO, HO-B. After this find the arc which passes through points M, K and HE; [and so for DE, R, N; and TE, X, S; and TO, Y, O; and HO, P, F]. And finish the first hour [MK-HE] and write over it 1st, then 2nd, 3rd, 4th, 5th, 6th, as in the figure. Afterwards divide the remaining hours according to the first division, and write over them, 7, 8, 9, 10, 11, 12, as it is in the same place. And write by the first hour 'West', and by the 12th hour 'East'. Then inscribe on the plate the latitude of the region in the place indicated. After you have made the hours, the face of this plate will be completed, and by this method you can make the remaining longitudes of the region of the same plate [if God be willing].

[Here endeth the Work on the Astrolabe according to Marcellania. Blessed be God. Amen.]

MS. *Ashmole* 1796 ends here.

MS. *Ashmole* 1522 and MS. *Cambridge* Ii. 3. 3 continue as follows:

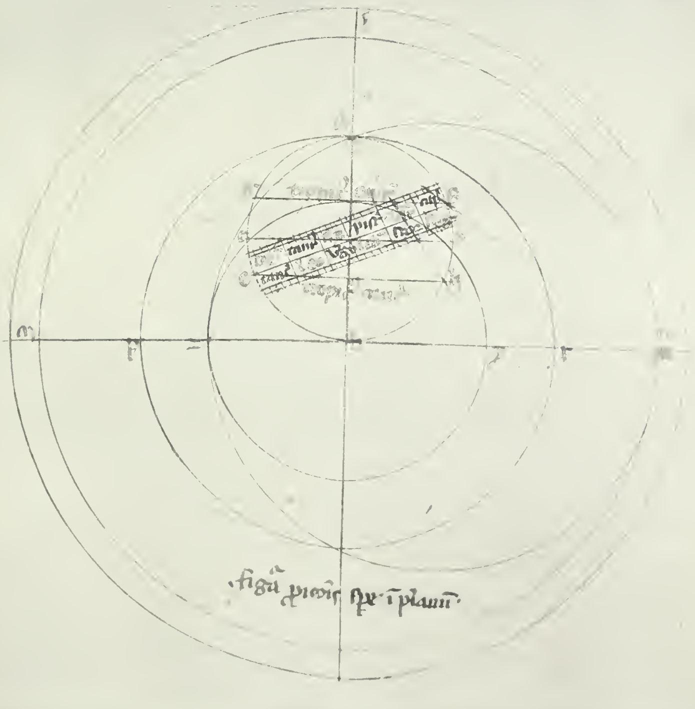
17. Of the Projection of the Sphere on a Plane Surface.

[Figure f. 69v] [1]

The casting or extension, or rather the complete projection of a sphere upon a flat surface by means of sight is effected in this manner. Let MBN be a line on the plane, and AB the axis of a sphere standing at right angles to plane MBN, so that the north pole touches the plane MBN at the point B. Let the other, the south pole, and farthest away from the plane, be at A and let there be the eye of the spectator. Let the colure passing through the greatest declinations of the sun be ABCD. The line CD, also equidistant from the plane, is the Equator of the day, E[H] is the tropic of Cancer, GF the tropic of Capricorn, and these two are also equidistant from the plane. EF is the Ecliptic. Then there go out from A, the south pole, i.e. from the eye of the spectator, two lines drawn through the two ends of the equator viz. C and D to two points in the plane through Z, X, and the line PX is the diameter of the equator. And from the same point A two other lines drawn through the ends of the tropic of Cancer meet the plane at points Z and Y, and this line ZY will be the diameter of this tropic [projected] on the plane. And so too the other two lines drawn through G, F the ends of the tropic of Capricorn meeting the plane in M and N, make the line MN the diameter of Capricorn [projected] on the plane. If the mid-points of any diameters that are marked on the line MBN, be produced, there will be a circle like to the first circles of a sphere projected proportionally on a plane surface by sight.

[1] A variant of this figure, ' figura resolutionis solide sphere in planum ', was printed by Reisch in 1512 as a frontispiece to the *Tractatus Astrolabii*, but without lettering or description to explain its significance.

·pa· equalis ·ua· Item ·zn· erit dyameter zodiaci· qui eciam transibit
per ·a· qui ipse diuidit per equatorem per aliqua equalia· z ·zz· erit dyameter
in plano circuli· cuius ·kl· est dyameter in spera. eritque eciam arcus
·pq· similis similis arcui ce· vterque enim sub dicitur arcui ·paq·
in circumferentia utriusque circuli existenti· z pr· est similis· gt· propter
eandem causam· et ·po· similis ·ck· Eodem quoque modo et propter eandem
causam arcus ·xs· erit similis ·dl· z ·xy· similis ·dh· Cum igitur
aliquem equedistantem zodiaco uis depingere in plano si fuerit
meridionalis a zodiaco sume in equatore a puncto ·x· uersus ·a· ar-
cum unum equalem arcui composito ex declinatione zodiaci ab e-
quatore. et illius circuli pingendi a zodiaco ut est hic arcus ·xs· qui
componitur ex arcu ·xt· qui est declinatio zodiaci ab equatore· de
declinatione huius si potes a zodiaco ut hic ·pq· de arcu ·oq· z residu
um quod est ·po· sume a puncto
uersus ·a· q si non potes
subtrahe declinati
onem zodiaci
ab e qua
to re
de de



·figura proiectionis spere in planum·

clinatione huius a zodiaco. de declinatione zodiaci ab equatore. et residuum sume a puncto .p. non versus .a. sed versus partem oppositam protrahe itaque .a.s. et .a.o. usque secent dyametrum .m.b.n. in puncto .m. et .n. eritque .o.m. dyametrum circuli quod queritur. Si autem ipse fuerit septentrionalis ab orbe signorum. sume declinationem compositam sub .p. et differentiam .x. declinationum sub .x. si declinatio zodiaci ab equatore est minor aut supra si est maior et subtrahe lineas ab .a. que est dyametrum .m.b.n. rescindent dyametrum circuli .z.z. qui queritur ut satis patet in figura.

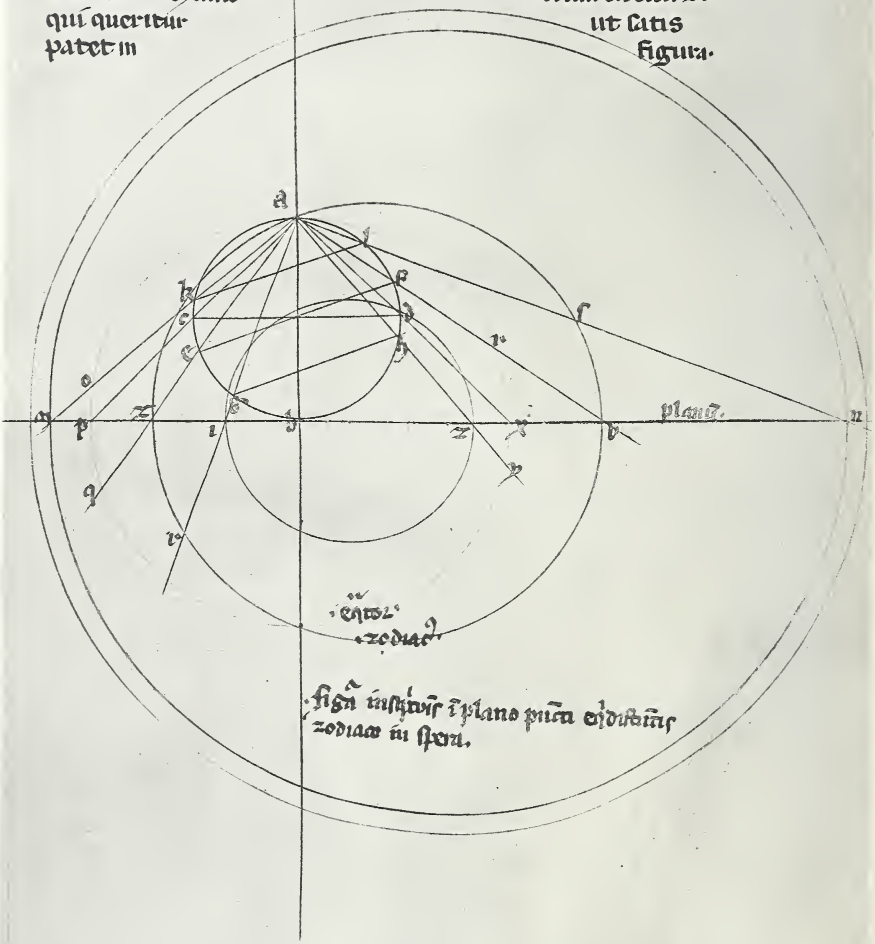


figura instrumenti in plano picta ex diversitatis zodiaci in spera.

18. Projection on a Plane Surface of a Point in a Sphere Equidistant from the Zodiac. Rubric.

[Figure f. 70]

But if we wish to make a projection on a plane surface of any point on a sphere equidistant from the ecliptic, it is to be done thus: AB is a circle passing through the poles of the globe A and B (and B is touching the plane). The line BMN is the common intersection of the circle AB and the plane; CD is the diameter of the equator, EF is the diameter of the zodiac, GH the diameter of one of the equants to the zodiac on the northern side, KL the diameter of the other equant parallel to the zodiac which is on the south side. It follows that either of the two arcs CE or DF is the declination from the equator of the zodiac, also that the two arcs CG and DH are the two greatest declinations from the equator of the circle whose diameter is GH. Similarly arcs CK and DL are the two greatest declinations from the equator of the circle whose diameter is KL. They will therefore cross the lines AKOM, ACP, AEXG, AGIR, AKZY, ADX, AFRU, ALSN, and PX will be the diameter of the equator which will pass through A, for since EI is equal to IA, therefore PA is equal to VA.[1]

Also ZN will be the diameter of the zodiac which will also pass through A since it itself divides the equator by equal parts,[1] and IZ will be the diameter in the plane of the circle of which KL is the diameter in the sphere; and arc PQ will be similar to the arc CE, for each is subtended to the angle PAQ in the circumference of both the two circles, and arc PR is similar to GC for the same reason, and arc PO is similar to CK. In the same way and for the same reason arc XS is similar to DL, and

[1] Both the reference letters and the meaning of this passage are very doubtful.

XY is similar to DH. When therefore you wish to plot on a flat surface any [point?] equidistant from the zodiac, if it be south of the zodiac, measure on the equator from point X towards A an arc equal to the arc composed of the declination of the zodiac from the equator, and of that circle to be drawn from the zodiac: in this case the arc XS, which is composed of arc XT, which is the declination of the zodiac from the equator [and] of the declination of this [circle] if you can[1] from the zodiac, and this PQ from arc OQ, the remainder being PO take from the point towards A. If you cannot subtract the declination of the zodiac from the equator from the declination of this circle from the declination of the zodiac from the equator, take the remainder from point P, not in the direction of A but away from it, and so produce AS and AO until they cut diameter MBN in M and N and OM will be the diameter of the circle which you seek. But if it be to the north of the ring of signs, take the combined declination at P, and the difference of the two declinations at X, if the declination of the zodiac from the equator is less as above[2]; if it is larger draw lines from A which will cut the diameter of circle IZ which is sought, as is clear in the figure.

Table of the Fixed Stars which are placed on an Astrolabe, with the degrees with which they south and with their distance from the Equinoctial Line.

[See f. 70 v]

Table of Fixed Stars verified by the Armillae of Paris.

[See f. 71]

[1] 'Si potes' may be a scribe's carelessness, but it *might* be necessary to add 'if you can'.

[2] Read 'ut supra' instead of 'aut supra'.

Tabula stellarum fixarum verificata per armillas parisius et longitudo earum gradus celi signi per circulum transeuntem per polos zodiaci et stellas. latitudo vero earum est arcus eiusdem circuli cadens inter stellas et gradus longitudinis earum.

Signa	Nomina stellarum fixarum	ymagines stellarum	longitudo g°	m'	latitudo g°	m'	pars latitudinis
Aries	Batnalkaitoz	vent' ceti	10	0	20	0	merid'
	Aldebaran.	oc's vel cor tauri	20	0	5	0	merid'
Taurus	Algenib.	latus dextri persei	20	0	30	0	aquilon'
	Menkar.	naris ceti.	2	0	12	0	merid'
	Rigil allgeuze	pes orionis	5	0	30	0	merid'
Gemini	Alhaioth.	hircus	10	0	22	40	aquilon'
	Betelgeuze	hu'us dext' orionis.	15	0	15	30	merid'
	Alhabor	In ore canis	3	0	39	10	merid'
Cancer	Algomeiza.	In collo canis minoris	12	0	15	30	merid'
	Razelgeuze	capud geminorum	8	0	10	0	aquilon'
	Dubhe.	vrsa	4	0	40	0	aquilon'
Leo	Calbalesed	cor leonis.	19	0	0	10	merid'
	Alfart.	co' vel singularis agl'	15	0	22	30	merid'
	Denebalesed.	cauda leonis	9	0	12	0	aquilon'
Virgo	Algorab.	corvus.	29	0	15	0	merid'
	Acimenas	[illegible]	16	0	13	30	aquilon'
Libra	Alramech	lanceator	13	30	31	30	aquilon'
	Alchimech.	[illegible]	11	30	20	30	aquilon'
Scorpio	Alfeta.	In corona	1	20	44	30	aquilon'
	Calbalacrab.	cor scorpii	28	0	4	30	merid'
Sagittarius	Rastaben.	capud draconis	12	0	47	0	merid'
	Razelgeuze	capud serpentis	10	0	36	0	aquilon'
	Alwega	vultur cadens	13	0	62	30	aquilon'
Capricornus	Altair.	vultur volans	20	0	29	30	merid'
	Addigege	cauda galline	21	0	60	30	aquilon'
	Denebalgedi	cauda capri	13	0	2	30	merid'
Aquarius	Delfin	Nebulosior ei' locie	6	0	32	0	aquilon'
	Enifelfaz.	[illegible] eq' pegasi	21	0	22	40	aquilon'
	Scheat.	[illegible]	24	0	7	0	merid'
	Alferaz mentel.	humer' equi	20	0	31	0	aquilon'
Pisces	Denebkaitoz.	cauda ceti.	21	0	20	0	merid'.

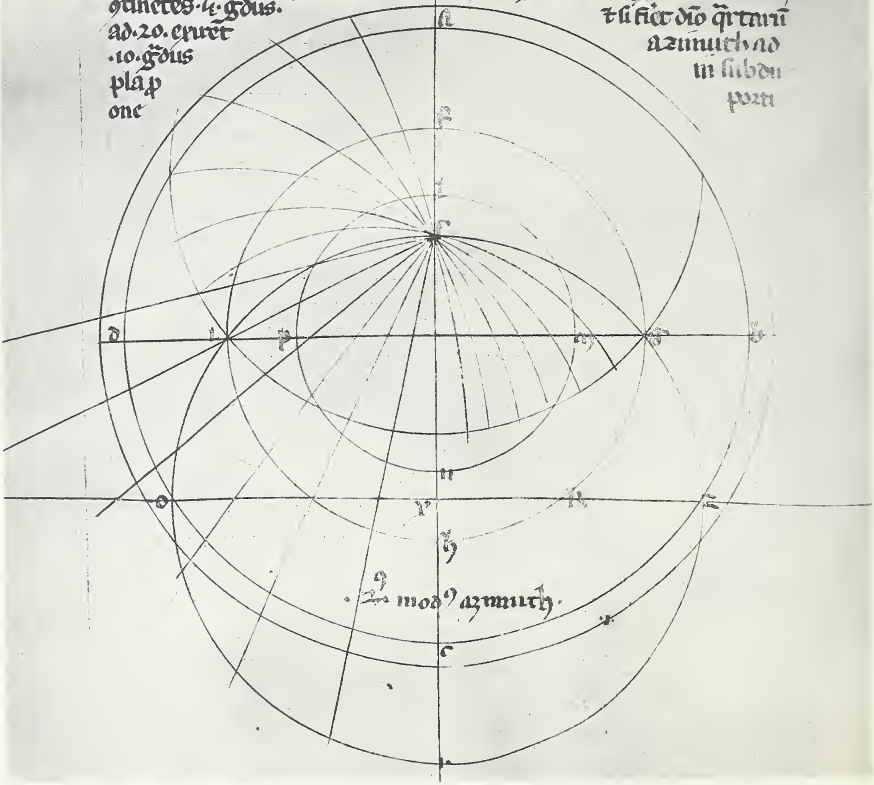
Tabula stellarum fixarum que ponuntur in astrolabio cum gradibus celi [alb] mediant et distancia earum ab equinoctiali

Nomina signorum	Nomina stellarum	ymagines stellarum	longitudo gr	longitudo min	latitudo gr	latitudo min	Septentrionalis vel meridionalis est
	mirach		0	0	32	30	aquilon'
	Bathenkaitoz		18	30	13	30	merid'
Aries	menkar	venter ceti	20	0	16	0	merid'
	enif		22	0	23	30	aquil'
	finis fluvii		25	0	8	30	merid'
	mencalbar	naris ceti	6	0	1	0	aquil'
	algenib	latus algonis	10	0	29	0	aquil'
Taurus	algecmar		22	0	16	0	merid'
	aldebaran	oculus vel cor tauri	29	0	12	30	aquil'
	alhaioth	hyrcus vel hyrcus sag'	6	0	24	0	aquil'
Gemini	rigel	pes orionis	11	0	10	0	merid'
	algeuze	humerus dexter orionis	24	0	8	0	aquil'
	alhabor	stella canis maioris	3	0	14	0	merid'
Cancer	algomeisa	caput gemini	9	0	33	0	aquil'
	[illegible]	in collo canis	13	0	4	0	aquil'
	markeb		21	0	22	30	merid'
	egregor		29	0	25	0	aquil'
	alduun	in fronte leonis	6	0	6	0	merid'
Leo	alfart	canis vel aquila	13	0	18	30	merid'
	alhabhezed	cor leonis	20	0	14	0	aquil'
	almeath	vesta	20	0	34	0	aquil'
	corvus		1	0	11	0	merid'
	dubhe	id est ursa	2	0	6	0	aquil'
Virgo	denebulezed	cauda leonis	16	0	19	30	aquil'
	algorab	in corvo	22	0	13	30	merid'
	alchimec	iulius	10	0	8	0	aquil'
Libra	venenaz	sive [illegible]	9	0	12	0	[illegible]
	alnimech	lanceator	24	0	22	0	aquil'
	alfeca	in corona ad[illegible]	15	0	26	0	aquil'
	aluedo		11	0	16	0	aquil'
Scorpio	yed		20	0	3	0	merid'
	calbalacrab	cor scorpii	24	0	3	0	merid'
	alhauc	caput draconis	12	0	14	0	aquil'
Sagittarius	alhathen	caput serpentis	24	0	1	0	aquil'
	vega	vultur cadens	3	0	41	0	aquil'
	altair	vultur volans	16	0	38	0	aquil'
Capricornus	delfin		29	0	4	0	aquil'
	alrif	in cigno	29	0	12	30	aquil'
	addigege	cauda gallinae	30	0	62	0	aquil'
	alkedich	cauda capri	6	0	63	0	merid'
	delfin	[illegible]	10	0	22	0	aquil'
Aquarius	alduun		10	0	6	0	aquil'
	enifelfaz	[illegible]	13	0	49	0	aquil'
	denebalgedi	cauda capri	12	0	4	0	merid'
	scheat	crus	30	0	19	34	merid'
	alferaz	in pectore	6	0	19	0	aquil'
	menkar	[illegible]	18	0	28	0	aquil'
Pisces	denebkaitoz	cauda ceti	22	0	24	0	merid'
	scheder		18	0	10	0	aquil'
					43	0	aquil'

Possunt et azimuth hoc modo fieri. sint 3 circuli utpote ... modo
abcd. capricorni. efgh. arietis. lump. cancri. ac ...
pe g a puncto. h. de. 18. hg. 18. gradus latitudinis ut sit. k. et tandem ...
a. bf. de opposito quarta fi. ubi sit. q. 2. ut linea. ag. in. k. protracta dyameter ...
ac. deciderit sit. r. ut uero linea. ag. in. q. protracta dyameter. ac. occurrerit ...
sit. s. quod cenith. deinde sic. rg. diuisi per medium in puncto. x. describe primum
azimuth. et sit eius ea pars. que in adit in circulum orizontis. in azimut ...
reliqua uero. q. occulta. q. postmodo delebitur. quod necesse transibit per puncta. gr. sicut
orizon. Com diuisis per medium semicirculi. fgr. ris. in punctis. zo. circe
lineam in ultimam partem transeuntem necesse per centrum. x. in linea. n. iuncienter
centra reliquorum azimuth hoc ordine diuides. s. portionem primi azimuth
que est 12. in. 91. partes equales. quelibet sit maior ... imposita tamen est. x. et t. ... a. br. sit
rt. ta. tr. x. yz. itaque uero linea a puncto. s. quod est cenith. ad partes tamen nouas
deducte. s. ad sam. est. g. et deinceps. premissis in partibus dyametrum primi
azimuth tetigerit centrum reliquorum azimuth statuentur. et omnes per g. ar
cuientur. ita ut partes eorum orizonte uel circulum capricorni excedentes
minime figurentur. et sic inuenies ad dextram centrum. 18. centrum sibi numero cor
dein ac per eam distanciam. sibi faciens ad sinistram. 10. Et non oportet facias
diuisionem quartarum per. 90. ut qualibet non contineat. 10. gradus. et tamen erunt azimuth
continentes. 4. gradus.

ad. 20. exiret
.10. gradus
pla p
one

et si fiet diuisio quartarum
azimuth ad
in subdi
porti



19. The Second Method of Constructing Azimuths.

[Figure f. 71 v]

Azimuths may also be constructed in this way. Let ABCD, FGHI and LMNP be the three circles of Capricorn, Aries, and Cancer as before, measure from point H towards HG 18 degrees of latitude, let it be K; and [measure] the same quantity from F in the opposite quarter and mark it Q, and let R be where the line from G to K cuts the diameter AE produced, and let S which is the zenith be where line AG produced from G to Q cuts diameter AC. Then upon RS bisected at X, describe the first azimuth, namely that part which falls within the circle of the horizon; the remaining portion, the part which refers to the 365 days of the year which is hidden, and which is afterwards to be erased, will necessarily pass through the points G and I, on the horizon. In the same way, having bisected semicircles SGR and RIS in the points Z and O, draw a line on both sides, necessarily passing through the centre X: you will find the centre in line N. You may find the centres of the other azimuths in succession, you divide the part of the first azimuth which is IZ into 41 parts equal and let the first on the side opposite to BR be RT, the second TX, [the third] XY, the fourth YZ, and so when lines are drawn from the point S, the zenith, to the new parts, viz. from S to the second, fourth, eighth [ ] in parts omitted (?), the diameter of the first azimuth will touch the centre of the remaining azimuths, and all will go through the 8 in circular progression, so that their parts passing beyond the horizon or the circle of Capricorn are the least marked. And thus you will find to the right of the mid-line (?) 18 centres according to their number, for a like distance. Similarly you may make 10 to the left. And note that when you divide the quarters by 90, each mark contains 10 degrees, and there will come out azimuths containing 5 degrees. And if the division of the quadrants be 20, there will come out azimuths to 10 degrees in a halved proportion.

Note. Comparison with MS. Ashmole 1522 f. 92 shows that lines GSQ and GKR have been omitted. The chords radiating from S should intersect semicircle ROIS in order at R, T, X, Y, and Z.

20. The Third Method of forming Azimuths.

[Figure f. 72]

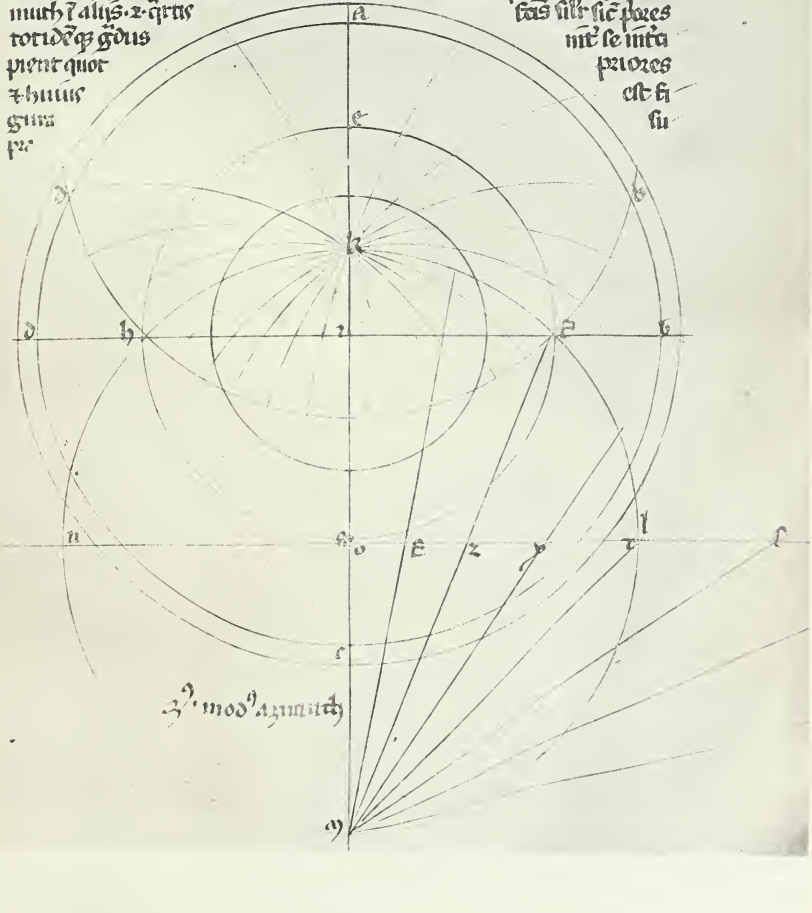
Another way of forming Azimuths, easier and simpler than the aforesaid. With centre I draw the circle of Capricorn ABCD, and the equator[ial circle] GFEH, and let us make a part of the circle BFHD [i.e. the diameters AC and BD] intersect at right angles at I, and let K be the zenith of the heads. Having again placed the centre on point O of the diameter AG produced in a straight line, [let us draw] a circle KFLNMH through points H, K, and F, and produce its diameter NL parallel to HF on both sides as [far as] may be necessary. And let us divide the semicircle MLK, into divisions of 3, or 5, or 10 degrees, according as we wish to make the azimuths. And let us join the point M which is a point opposite to the point overhead, with each of these divisions on the line LN, and let the lines drawn be MP, MR, MS, MT,[1] MY, MZ, MSF. Then with centres placed on points P, R, S, etc., describe circles passing through K, which is the zenith of the heads. If these circles were to be completed, they would pass through M which is opposite the zenith of the heads. In what manner soever they may pass the opposite point, in the sphere they will all be among the greater circles, but of these circles you will only form the parts that show above the circle of the hemisphere as far as the circle of Capricorn, and between any three of these circles there will be as many degrees as have been intercepted between the divisions of semicircle KFLM. When you have done this, measure off from line LN on the N side parts equal to OSF, OZ, OY, etc. and using these points as centres describe circles passing through K; and these will be the azimuths. When the other two quarters have been similarly treated like the former ones, they will intercept among themselves just as many degrees as the former. And the figure of this is above [fig. f. 72].

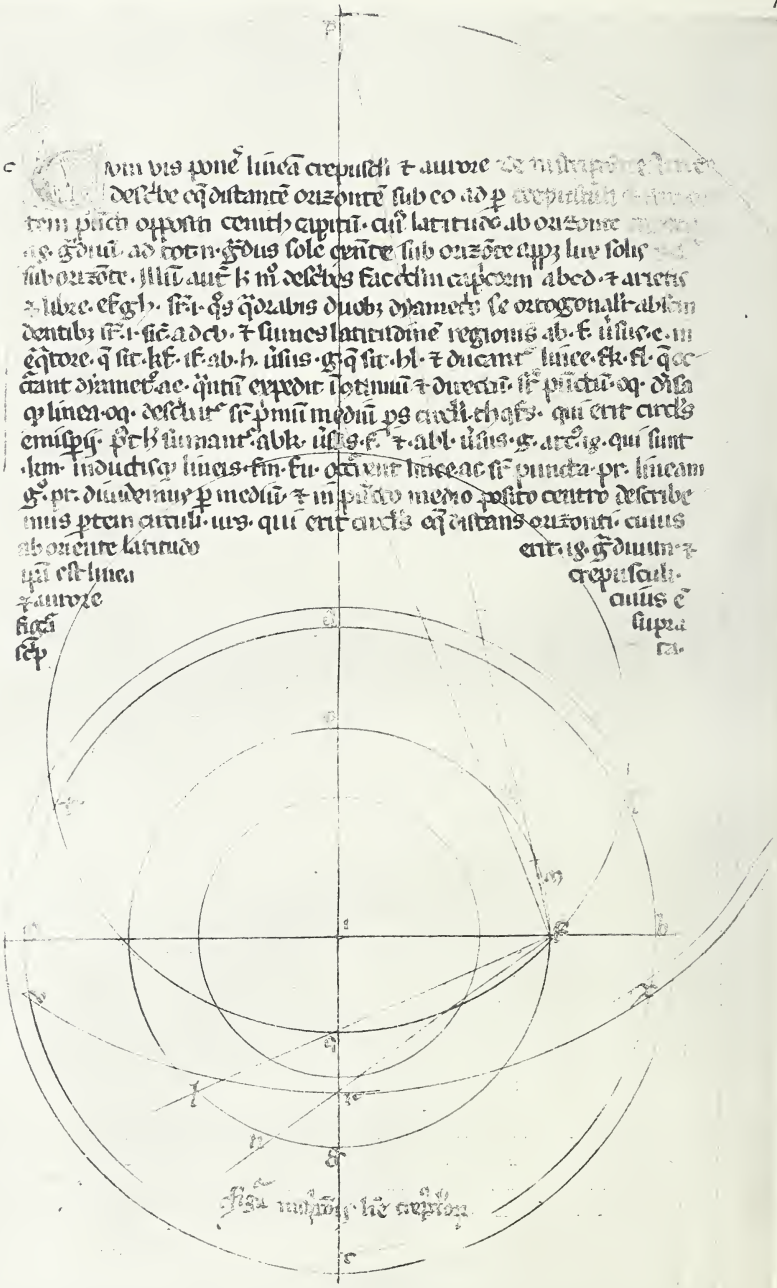
[1] 'ML and MU' are also mentioned in the text.

Alius modus faciendi azimuth levior et planior predictis. fac circulum capricorni .abcd. et equatorem gfeh. sitque centrum .i. et facientes partem circuli .bfhd. ortogonaliter secantes se super .i. sitque punctus .k. cenith capitis. rursum posito centro in dyametro .ag. in continuum directum protracta super punctum .o. circulum transeuntem per .hkf. puncta qui sit .k.flmnh. protrahemusque dyametrum nl. equidistantem .hf. in utramque partem quam oportuit. et dividemus semicirculum .mlk. per .3. vel quinos gradus. vel denos. prout volumus facere azimuth. et punctum .m. qui est punctus oppositus summitati capitis coniugemus cum unaquaque illarum divisionum usque ad lineam .ln. sintque linee producte .mp. .mr. .ms. .mt. .ml. .mu. .mx. .my. .mz. .mf. post hoc posito centro super puncta .pqr. et cetera describe circulos transeuntes per punctum .k. qui est cenith capitis. et illi si perficerentur transirent per punctum .m. qui est oppositus cenith capitis quia omnes per opposita transeunt in spera erunt omnes ex circulis maioribus. horum autem circulorum solum facies partes apparentes supra circulum emisperii usque ad circulum capricorni. eruntque inter quoslibet .3. ex circulis illis tot gradus quot intercipiebantur inter divisiones semicirculi .kflm. Cum autem hoc feceris sume de linea .ln. apte .n. partes equales .os. .oz. .oy. et cetera. et super illa puncta positis centris. describe circulos transeuntes per .k. eruntque illi azimuth in aliis .2. quartis totidemque gradus intercipient quot

facias similiter sic priores inter se intercipientes priores est fi-su-

et huius figura pre-





21. Of the Inscription of the Line of Twilight and Dawn.

[Figure f. 72 v]

When you wish to add the Line of Twilight and Dawn, describe an equidistant horizon under the real horizon on the side remote from the zenith of the Heads, whose latitude is 18° from the horizon, since when the sun is setting below the horizon for this number of degrees one can see the light of the sun below the horizon.

You may construct this in this manner: With centre I draw the circles of Capricorn ABCD, and of Aries and Libra EFGH, and quarter them by two diameters intersecting at right angles at I, viz. AC, BD. Set off the latitude of the region KF from F towards E; also HL from H towards G. Draw lines FK and FL, meeting the diameter AE produced in a straight line, at points O and Q: OQ is bisected and part of a circle THQFS is first described on the mid-point; this is the circle of the hemisphere. Then [two] arcs of 18° are set off KM from K towards F, and LN from L towards G. When FM and FN are joined, they will cross AC at P and R. We then bisect PR and with the mid-point as centre describe part of a circle VRX, which will be the circle equidistant from the horizon, whose latitude measured from the east point will be 18 degrees. This is the Line of Twilight and Dawn, and its figure is drawn above.

22. Of the Inscription of the Fixed Stars.

[Figure f. 73]

When you have divided the Circle of Signs accurately you must fix the position of the fixed stars in the circle of signs in this way: We place on the circle of the Equinoctial day and of Aries and Libra from D towards T the sun's declination: i. e. 24°. Similarly on the opposite side from B towards A and place there X, then place the rule on TX, i. e. on as large a number as 24°, and draw a faint line from T to X. Then look in the Table of Fixed Stars for the star which you want to place on the circle of signs in which sign it may be, and its longitude and latitude, whether N or S. If it be N, you will count in the circle of Aries and Libra for the point T towards D as many degrees as the latitude of the star, and place there V, and on the opposite side viz. from X towards A and place there Y. Then place one end of the rule on point C, which is the head of Aries, and the other end on the end of the latitude of the star, i. e. on V, and mark where the rule and diameter HB touch; set there R. Then likewise place one end of the rule on C and on Y, and where the rule cuts diameter HB, mark P. Draw a circle through R and P, and in this circle the true place of the star ought to be. Then look in the Table of Fixed Stars for the longitude of the said star, namely in what degree of what sign it may be, and for the whole number of its degrees and for the whole number of its nadir, viz. from the outer circle of the zodiac and through the pole of the signs

Cum diuiseris circulum signorum certissime oportet te postea … describere stellas fixas in circulo signorum hoc modo. stellarum fixarum. Proicimus circulum equinoctii diei et arietis et libre ex puncto … ca .d. … .e. declinationem solis .i. 23 gradibus et pones ibi … in parte … opposito .s. … ex .b. versus .a. et pones ibi .x. deinde pone regulam super .t. x. .i. super … 23 gradus utrumque et duces lineam occultam ex .t. in .x. postea considerabis in tabula stellarum fixarum stellam quam uis pone in circulo signorum in quo fuit et eius longitudine et latitudine septentrionali vel meridionalis sit. quod si fuit septentrionalis numerabis in circulo arietis et libre a puncto .s. versus .d. tot gradus quota est latitudo illius stelle et pones ibi .v. in parte opposita .s. ab .x. versus .a. et pones ibi .y. deinde pone unum caput regule super punctum .e. qui est caput arietis et aliud caput super finem latitudinis stelle .i. super .v. et nota contactum regule et diametri .h.b. et pones ibi .r. postea pones similiter unum caput regule super punctum .e. et super .y. et ubi regula abscindet diametrum .h.b. pones notam .s. postea fac circulum transeuntem per notas .r.s. et in hoc circulo summitas stelle illius erit dicte. considera in tabula fixarum longitudinem dicte stelle in quo gradu cuius signi fuit et per totum numerum graduum illius et per totum numerum … eius videlicet ab exteriori circulo zodiaci et per polum signorum … .i. per punctum .k. fac fixere unum pedem circini equaliter et in circinus abscidet circulum .r.s. ibi erit summitas illius stelle. et si cum gradu illius longitudinis et latitudinis fuerint minuta accipe de gradu sequenti sextam partem si sint .10. minuta … partem si .20. … terciam et sic de aliis et fac etc.

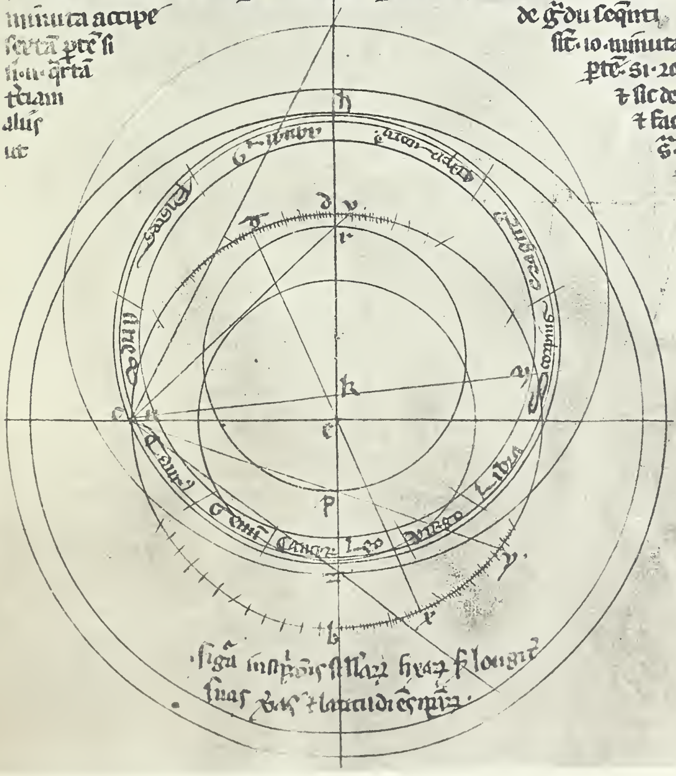


figura instrumenti stellarum fixarum secundum longitudines suas et latitudines [illegible]

of the zodiac, i.e. through point K, stretch one leg of the compasses equally, and where the compass cuts circle RP, there will be the tip of the star. And if there be some minutes in addition to the degree of its longitude and latitude, when there are 10 minutes take a sixth part of the following degree if 15, a quarter, if 20, a third and so on, and do as above [described], in the case of northern stars. If it be a southern star, you will count degrees of the latitude of the star in the circle of Aries and Libra from the mark of the declination, viz. from T towards C, so too on the opposite side from X towards B, and there make a mark. Then place the rule on one of the marks and on the head of Aries, viz. upon C, and where it cuts the diameter HB make a mark on the straight line. Likewise place the rule upon the other mark and on C, and where it cuts the diameter HB make a mark [Z]. Then make a circle according to the distance between those two marks on the diameter. The tip of the star will be in this circle.

Then look up in the Table of Fixed Stars the degree of the Sign in which it is. Stretch your compasses so that one leg is at the end of the number of that degree and the other on its nadir, viz. from the outer circle of the zodiac and through the pole of the zodiac, K ; and where the compass cuts the circle on the two marks on the diameter there will be the tip of the star. Similarly you can place all southern stars. You may find the pole of the zodiac thus: In the circle of Aries count 24 degrees from A towards D, make a mark there and place the rule on it and on C Where it cuts diameter DB make a mark K. That mark will be the pole of the zodiac, as is shown in this figure:

Here endeth the Science of the Composition of an Astrolabe.

PART II. THE USE OF THE ASTROLABE

Operacio Astrolabii.

The names of the instruments are these: The First is the suspending-ring for use when taking an altitude; in Arabic it is called *alhahucia* (1).[1] The Second is *alhabor*, that is, the *ansa* (loop or shackle) which is joined to it (2). Then the mother, or *rotula*, containing within itself all the tablets and the *aranea*, to which is joined a marginal rim divided into 360 degrees (3, 16). The tablets contained within this are inscribed with three circles, of which the smaller is the Circle of Cancer, the middle circle is the Equinoctial Circle, and the largest is the Circle of Capricorn (17). Then comes the circle *almucantherath*, which are circles described on the upper middle portion, and of these some are complete, others appear incomplete. The first of them is the horizon which divides the two hemispheres. The centre of the inner almucantherath is called the *cenit* (zenith) of the heads (18). Then there is the *azimuth*, which are parts of circles cutting the almucantherath (19). And next these are the hours, drawn in the lower middle portion. Within the 2nd hour-lines are the lines of the twilights (20). Then there is the line of mid-sky, which is a line descending from the ring through the centre to the opposite side of the astrolabe; a part

[1] The numbers (1–19) refer to the sections of Part i of Chaucer's Treatise on the Astrolabe.

of this line from the centre to the ring is called the line of the meridian, and the other part is called the angle of the earth (*angulus terrae*) and of midnight (4, 15). After these comes the *alhanthabuth*, i. e. aranea or spider, wherein are set the Signs, comprising the zodiac in which the path of the sun is said to be, and also the fixed stars. And whatever is beneath the [line of] moving of the head of Aries and Libra is north of this zodiac, but what is outside it is south (21). Then comes the *muri*, which is called 'ostensor' in Latin, viz. a little tooth outside the Circle of Capricorn. In the alhanthabuth is the *almenath*, i. e. a hole which is in the middle of the rete (23), in which is the *axis* for holding the tablets of the climates, and into which the *alphaeraz*, i. e. the 'horse', enters, tightly fastening the tablets to the rotula, like a wedge (14). On the other side of the mother are two circles of the equation of the sun, the outermost of which contains the number of 365 days of the year (9), and the names of the months are written below it (10). The other [contains] the degrees of the Signs (7), and the names of the Signs are written beneath it (8). Then there is a quarter for taking altitudes. Then a quadrant of which the sides are divided into 12 points (12). Then follows the rule (*alidade*) which turns about the back of the astrolabe, and on which are perforated plates for taking the altitude of the sun in the day-time and of stars by night (13).

[§ 1.] To find the true Motion of the Sun, and the Day and the Month.

When you wish to know the degree of the sun, set the alidade upon the day of the present month: then the degree touched by its tip will be the degree of the sun. Look to see of what Sign it is, and note

it on the zodiac of the rete on the other side. Also note its nadir,[1] which is likewise the degree of the 7th Sign. And you may also find the day of the month from the degree of the sun; for the alidade, when once set upon the degree of the sun, will point out the desired day. [*Chaucer*, ii. 1.

[§ 2.] Capitulum. Of finding the Altitude of the Sun and Stars.

When you want to know the altitude of the sun, hang the astrolabe by its ring from your right hand, and with your left side turned towards the sun, raise or lower the rule, until a ray of the sun traverses the holes of both sight-vanes. When this has been done, see how many degrees the rule is raised above the East line: this is the altitude of the sun. You may do likewise at night by the fixed stars.

But if you want to know the exact time and also the ascendant, set the degree of the sun upon the almucantherath of its altitude, on the side of the east, if the altitude was [taken] before noon; or on the side of the west, if the altitude was taken after mid-day; then the hour upon which the nadir of the degree of the sun will have fallen will be the present hour, and the Sign which was on the east side of the horizon is rising, that is, ascending; and that which is on the western side is setting. And that which will have coincided with the line of the middle of the sky is in the middle of the sky and its nadayz is the 'angle of the earth'.[2]

And if it will have fallen between two almucantherath, note the difference of number between the preceding almucantherath and the altitude of the sun, and subtract the difference from the number of the distance [between the] almucantherath, which is

[1] Spelt *nadayz* here and elsewhere in the MS.

[2] The term *angulus terrae* is explained on p. 169.

6 if the almucantherath be compounded for 6 and 6 degrees;[1] and if the almucantherath be compounded 3 and 3 degrees, subtract the part of them from 3; and so for the others. Then examine the movement of the muri from the beginning of the first almucantherath to the beginning of the second among the degrees on the border; and place over them the part subtracted from them, in proportion of the said differences, from 6 or from 3 degrees; and then you will have an assured degree between two almucantherath.

Then consider the hours, &c., as has been declared above. If you wish to know the hour at night, take the altitude of any star, marked on the alhanthabuth (rete), which crosses from the east or the west; place the *cacumen* (tip of the pointer) of the star on the almucantherath of its altitude, and the degree of the sun will show you the hour of the night, as its nadayz [showed the hour] of the day; for all other [operations] do as instructed above. [*Chaucer*, ii. 2.

[§ 3.] Of Evening and Morning Twilight.

When you wish to find the end of evening twilight and the beginning of dawn, note when the degree of the sun shall have come to the line of western twilight, then is its end; and when to the eastern, then is the beginning of dawn.

[§ 4.] The same.

Or thus: Note when the nadir of the sun shall have come to the 18 degree almucantherath in the east; this will be the end of evening twilight. And when it shall have come to the 18 degree almucantherath in the west, it is the beginning of dawn: and this is easy. [*Chaucer*, ii. 6.

[1] Almucantars for every 6th degree.

[§ 5.] Of finding the Arcs of the Day and of the Night. Rubric.

If you want to know the arc of the day and of the night, set the place of the sun, that is the degree in which it is, upon the first almucantherath, and mark the place of the muri among the degrees of the rim; then move the degree of the sun until it comes to the west; and also note its place among the degrees. Its motion from one mark to the other is the arc of the day; the other part of the circle is the arc of the night, because these two [together] will comprise 360 degrees, which is the measure of the day and night. You may do likewise with the fixed stars, should you wish to find out about their sojourn above the earth.

[§ 6.] Of the Length of the Unequal Hours of the Day.

Should you wish to know the length of the unequal hours of the day, divide the arc of the day by 12, and you will have the number of the degrees of a day-hour; and if you subtract this [number] from 30 there will remain the number of degrees of a night-hour, because in every day an unequal night-hour with an unequal day-hour makes 30 degrees, which are two equal hours.

If you wish to find out about the equal hours of the day, divide the arc of the day by 15, and you will have the number of the equal hours; and so likewise for the night. [*Chaucer*, ii. 10.

[§ 7.] Capitulum. To find the Fraction of a divided Hour by the Muri.

When a part of an hour has passed, and you want to know what fraction of an hour it may be, examine the number of degrees on the rim between the begin-

ning of the hour to the muri; and in whatever proportion that number stands to the number of degrees of the whole hour, the fraction will stand in the same proportion to the whole hour.

[§ 8.] Capitulum. To find the Number of Equal Hours of a Day that have passed.

If you want to know how many equal hours have passed in a day, take the degree of the sun, set it upon the almucantherath of the altitude and mark the place of the muri among the degrees. Then turn the degree of the sun backwards as far as the first degree almucantherath on the east; and mark its place accordingly; then divide the degrees which are between the two marks by 15, and you will have the equal hours.

You may do the same at night; for after you have found the unequal hour by the degree and altitude of some star, and the place of the muri has been marked, turn back the degree of the sun to the western horizon and again mark the place of the muri. Divide the space between these two places by 15 as before, and you will obtain [the answer to the problem]. In the same manner you may know how many equal hours there are between midday and any other point, and at whatever moment you please. [*Chaucer*, ii. 11.

[§ 9.] Rubric: To convert Unequal Hours into Equal Hours.

If you wish to convert unequal hours into equal hours, find out how many degrees of the unequal hours there are, divide them by 15, and you will have the equal hours. You may do the like with equal hours. [*Chaucer*, ii. 8.

[§ 10.] Capitulum. Of the Altitude of the Sun at Midday.

If you wish to know the altitude of the sun in the middle of the day, which is the beginning of its receding, set the degree of the sun upon the line of mid-sky, then the number of almucantherath degrees from the place of the sun on the horizon is its altitude at midday. Do likewise with the fixed stars.

[*Chaucer*, ii. 13.

[§ 11.] Capitulum. To find the Hour of the Day by the Alidade.[1]

If you wish to know the natural hour of the day by the horary alidade, set the alidade on the [sun's] altitude at midday on the back of the astrolabe suspended, turn the back to the sun until the shadow of each corner of the upper pinnule falls on the alidade anywhere in line with its side. Then the division on which it falls will be the desired hour.

[§ 12.] To find the same by the Lines.

Also by the alidade on the back and by the hour-lines between the sides of the gnomon if they are placed as on a quadrant, thus: Set the alidade to the meridian altitude of the sun on the day; and note where the meridian circle, i. e. the 6th hour line, cuts the line of trust of the alidade; place thereon a mark of ink[2]; and that mark will take the place of the bead on the quadrant. Then take the sun's altitude at any hour you please, and the mark between the hours will give the natural hour, as on a quadrant.

[1] Elsewhere the translator has used the term 'regula', or rule.

[2] 'Un segno non apparente' in the Italian translation.

[§ 13.] Capitulum, Preliminary to certain Consequences.

Further you must know that the circle of the Signs is divided into two semicircles, one of which is from the head of Capricorn to the head of Cancer, and the other is from the head of Cancer to the head of Capricorn. The head of Capricorn is the winter solstice, and the head of Cancer [is] the summer [solstice]. And you must know that every two degrees equidistant from any one of the hours of the solstice are of one declination either towards the north or the south, their days and nights are equal, and the shadows and altitudes at midday are equal.

[*Chaucer*, ii. 16.

[§ 14.] Of finding the unknown Degree of the Sun by the Rete.

If you wish to learn the unknown degree of the sun, place a mark on its meridian altitude, which you have previously taken by the rule on the back of the astrolabe; then turn the rete, and two degrees will fall upon the said mark, one of which you may recognize as the degree of the sun by the Sign of the month to which the day belonged.

[*Chaucer*, ii. 14.

[§ 15.] What Day is equal to any given Day?

If you wish to find a day that is equal to a given day, you may find it by a degree that is equidistant from the solstices, because the days of those degrees are equal, as has been stated above. [*Chaucer*, ii. 15.

[§ 16.] Of the finding of the Degree of a Star with which it comes to the middle of the Sky.

If you wish to know with which degree any star comes to the meridian, or rises, set the star upon the meridional line, because the degree which falls on the same line is the degree sought. Do likewise for the east and west line. By a thread placed above the pole of the zodiac, you will have the degree of longitude found for the whole declination. [*Chaucer*, ii. 18.

[§ 17.] Of finding the Azimuth of the Sun from its Altitude.

If you wish to know the cenith of the sun, take its altitude at the hour when you wish to know it, and set the degree of the sun upon the almucanthanth of altitude on the side where it should be, as you do for finding the time. Then take what coincides with the degree of the sun in azimuth, and over this degree is the cenith for the quarter which is opposite. It necessarily follows that this quarter is south-east or north-east; or south-west or north-west. And you may do likewise in the case of the fixed stars by means of their altitudes. [*Chaucer*, ii. 33.

[§ 18.] Of finding the Cenith[1] of the Rising of the Sun and of the other Planets.

And if you wish to know the cenith of the rising of the sun or of any fixed star, set the degree of the sun or star upon the eastern horizon, and look at what degree of azimuth falls near, and likewise in what degree the rising is; and this is the cenith of the rising,

[1] Skeat interprets this not as our zenith but as the point of *sunrise*. Cf. *Chaucer* ii. 31.

and above the corresponding degree will be the setting in the corresponding quarter, either east[1] or south. [*Chaucer*, ii. 31.

[§ 19.] **Of the four Regions[2] of the World. Rubric.**

To find the four quarters of the world with exactitude, take the altitude of the sun as above, and note in what quarter it is; then see in what altitude the degree of the sun is in among the azimuth lines in the beginning of the eastern quarter, which starts from the northern colure or from the line of midnight, from which you begin to count; and whatever the number was, take it on the back of the astrolabe from the same colure towards the ring, proceeding to the east[3] if it be before noon, or to the west if it be afternoon; and where the said number finishes, there place the rule. Then, holding the astrolabe in both hands, with its back surface raised, attentively face towards the sun, until the sun beams pass through both pin-holes. Then place it carefully on the ground, so that it is not moved to either side, and you will have the 4 lines which meet at the centre of the astrolabe pointing in the direction of the 4 opposite regions of the world, namely east, west, &c. You can work in the same manner at night by a fixed star. Or, having previously placed the rule on the back of the astrolabe with its face turned upwards, equidistant from the horizon, as was said at first, make the shadow of the two angles of the vane fall upon the two sides of the rule, namely, the right shadow on the right side, and the left shadow on the left side; and forthwith you will have the four lines and the four regions of the world [indicated as] aforesaid. [*Chaucer*, ii. 29.

[1] The Italian translation reads 'settentrionale'.

[2] *Plagae* rendered 'Playes' or 'quarters of the compass' by *Chaucer* ii. 31

[3] MS. reads 'orizonten'; we translate 'orienten'.

[§ 20.] Of finding the Declination of any given Degree.

If you wish to know the declination of any degree of the Signs, set it upon the line of mid-sky or midday, and find out its altitude from the East [Horizon].[1] Then ascertain the altitude of the head of Aries and of Libra on the same line; then consider either altitude, and the difference of their altitudes is the declination of that same degree from the equinoctial line. If the degree of the Sign was northward, the declination is north; if southward, south. Also know that the degrees of the northern Signs are higher at the equinox, which is in the head of Aries and of its opposite [Libra]; and that the degrees of the southern Signs are lower, according to their declination from it.

The greater declination is in the head of Cancer and Capricorn. By the same method you can find the declination of the fixed stars. [*Chaucer*, ii. 20.

[§ 21.] Of the Altitude of the Pole or the Latitude of a Region.

You must know that the latitude of a region is the altitude of the zenith of the heads from the equinoctial circle towards the north or south, which is like unto the altitude of the north pole, and its opposite depression below the horizon, which two are equal in part. Therefore when you wish to know the latitude of any region, pay attention to the altitude of the sun at midday, subtract it from 90, and if the sun was in the beginning of Aries and Libra, the remainder will be the latitude of the region, for at that time the motion of the sun will be in the equinoctial line. If the sun be in any other degree, look up the declination of that degree in the Table of the Declination of the sun, or by the

[1] 'Horizonte' in the Italian translation.

rules afore-stated; you must subtract this declination from the altitude of the sun at noon, if it be northern, but if it be southern, add it. You will obtain the altitude of the beginning of Aries in the region, which you subtract from 90 as afore-directed, and what remains is the distance of the region[1] from the equinoctial line. [*Chaucer*, ii. 25.

[§ 22.] **Capitulum. Of the same, but otherwise. Rubric.**

Or, if you wish to take the higher altitude of any star, examine its elongation from the equinoctial line; and treat this in the afore-said manner. Or, observe the higher and the lower altitudes of any star that does not set in the same region, and take the mean of both collected in like manner, and this is the altitude of the Pole in the region. [*Chaucer*, ii. 24.

[§ 23.] **Of the Marking of a Tablet of Almucanterat.**

If you want to know the latitude for which an almucantheral tablet has been constructed, examine the meridional line to see how many almucantheras there are in the equinoctial circle up to the zenith, or from the axis northwards to the horizon; then the tablet is made for that latitude. The altitude of Aries is just as many degrees as there are from the same circle to the horizon, or from the zenith to the axis.

[*Chaucer*, ii. 21.

[§ 24.] **Of finding the Hours [i. e. the Time] by means of the Tablets of the Latitude. Rubric.**

When you wish to find the hours by an astrolabe in any region whose latitude is not inscribed on the tablets of the astrolabe, you must take note of the

[1] 'Zenit' in the Italian translation.

difference between the latitude of the region and the nearest greater latitude [for which there is a tablet], and note the lesser latitude [for which there is also a tablet], then commit to memory the proportion of that difference to the difference between the lesser and the greater latitudes, between which the latitude of the region comes. After that having accurately taken the sun's altitude in that region, ascertain the time [by the tablet] for the lesser latitude and also [by the tablet] for the greater latitude, and of the difference between these different hours find a proportional part, in accordance with the proportion of the difference taken above. Add this part to the hours of the lesser latitude, if they are fewer than the hours of the greater latitude, or subtract from them, if they are more numerous. Those hours which then remain will be the time in that region. Do likewise in respect of the hours of the night and of other calculations.

[§ 25.] **Of finding the unknown Degree of the Sun.**

When you wish to find the degree of the sun by the alhanthabuth for any day, determine its altitude at noon, and mark it on the almucanthanth on the meridional line, then turn the quarter of the circle of Signs in which the sun was; and the degree which touches the mark of the altitude in the middle line is the degree of the sun. [*Chaucer*, ii. 14.

[§ 26.] **Of finding the Distance between two Regions by an Eclipse.**

The longitude of one region from any other is the distance of the meridian circle of one from the meridian circle of the other.[1] So when you wish to know the distance between two regions, consider how many equal hours it is from noon of the day before to the beginning of an eclipse of the moon in both regions.

[1] *Chaucer*, ii. 39, l. 11. But no mention of eclipses is made there.

Then subtract the hours of one region from the hours of the other, and the remainder will be the hours of longitude between the two. Multiply this number by 15, and you will get the number of degrees of longitude between the two regions. Longitudes of certain regions, or, distances of their meridional circles from the meridional circle of the farthest habitable region in the west, and their longitudes and distances from the equinoctial circle, we have sufficiently noted in a certain table.

[§ 27.] Capitulum. Of the same in Roman miles (*miliaria*).

If you seek to know how many miles there may be between two regions which are far from one another, consider the longitude and latitude between both. Then assemble and consider the longitude reckoned in itself with the latitude multiplied in itself; and extract the [square] root of the sum, and for each one degree and a half of that root give 100 miliaria; by this number of miliaria is one region distant from the other. But if their latitude be the same, treat the degree of longitude as a degree of the root ought to be treated. If their longitude be one and the same, treat as in the case of the latitude, and you will find what you seek.

[§ 28.] The Science of the Ascension of the Signs in the Direct Circle (*circulus directus*).

But if you desire to know the ascensions of the Signs in the direct circle, (19) place the beginning of any Sign on the meridional line, and mark the place of the muri on the margin. Then move the rete until the end of the Sign falls on the meridional line, and the degrees in which the muri will be moved will be the ascension of the Sign. You may treat any portion of the circle in the same way.

[§ 29.] Of the Ascensions of the Signs in the Oblique Circle.

You will be able to find the Ascensions of the Signs in any region you please, thus: Move the rete from the beginning to the end of the Sign, and the degrees in which the muri will move in the margin will be the ascensions of the Signs in that region, for you will move the Sign in the eastern part of the horizon that you may know its ascension. But that you may know its retardation in setting, you will move it in the western part of the horizon; this may also be done in any part of the circle. Moreover, if the degrees of the ascensions are divided by 15, and the remainder reckoned for fractions of an hour, you will have the equal hours, or if they be divided by the number of degrees of the unequal hour, there will appear the number of natural or unequal hours with fractions, any Sign or planet or any part [of the sky] takes to ascend or to set in any region. [*Chaucer*, ii. 28.

[§ 30.] Of the Recognition of the unknown Stars placed on the Astrolabe.

That you may recognize unknown stars which are placed in an Astrolabe, first take the altitude of a known star, and place it on the almucantherath over the like altitude; then examine the star which you desire to recognize, as to the altitude upon which it is lying among the almucantherath, and as to the side, namely whether east or west. When this has been apprehended, set the rule on the back of the astrolabe to the same altitude and turn it to that region of the sky in which you have observed the star; then the larger star which you see through the sight-holes is the star you seek.[1]

[1] Skeat found an additional paragraph added to the text of Chap. 3 of Chaucer's Astrolabe in MS. Bodley 619, which obviously

[§ 31.] Of the Recognition of unknown Stars not placed on the Astrolabe.

When wishing to find the degree of an unknown star, not placed on the astrolabe, or of a planet, wait until the planet or star is on the meridian, then having observed some star, of whose place you are certain, and which is marked on the astrolabe, set the rete to suit its altitude, placing the star among the almucantherath on a like altitude; then in line with the degree of the Signs which are in the midline of the sky will be the star of which you are in doubt, and its longitude is made known. Its latitude is obvious, when the almucantherath have been counted from the known [almucantherath] of its altitude to the equinoctial. If no star be known to you, you may set your rete by the setting sun, and thus you may get to know all the stars.

[§ 32.] To ascertain the Degree of the Sign where the Moon [or a Planet] is. Rubric.

Should you wish to know the degree of a Sign in which the Moon[1] may be, determine the altitude of the moon, and mark it on the almucantherath, on the

paraphrases this passage. 'Nota. That by this conclusion you may know also where be at that same time all other sterres fixed that be sette in thin Astrelabie, and in what place of the firmament; and also their arising in thy orizonte, and how long that they wol be above ye erthe with ye Arke of ye nyght. And loke evermore how many degrees you fynde any sterre at that tyme sitting upon thine almycanteras, and upon as many degrees set you ye reule upon ye altitude in ye border; And by the mediacioun of thy eye through ye 2 smale holes shalt thou se ye same sterre by the same altitude aforeseid, and so by this conclusion may you redely knowe which is oo sterre from another in the firmament for as many as ben in the Astrelabie. For by that same altitude shal thou se that same sterre, & non othir for there ne wolle non othir altitude accorde therto.'

[1] MS. *Camb.* Ii. 3. 3 has *Stella.*

side on which it was. Then set some star that is in the rete upon its altitude taken at the same hour as the altitude of the moon, on the side on which it was; then the degree of the zodiac circle which falls between the almucantherath over the altitude of the moon, will be the degree of the moon. But if she appears in the daytime, you must do the same with her altitude and the altitude of the sun. Consider therefore, of what Sign the degree may be. In the same manner too you may discover the places of the planets, if you can determine their altitude at night. [*Chaucer*, ii. 34.

[§ 33.] Capitulum. Of finding the Place of the Moon.

When you desire to know the degree in which the Moon may be, think of how many days the lunar month has on that day, and having doubled them [i.e. days of moon's age], distribute what has been collected by fives, giving five to each Sign, beginning from the Sign in which the sun was; and in that same Sign where the number finishes is the moon; and if there is a remainder [of one], i.e. below 5, the moon has already proceeded 6 degrees [if 2, 12, if 3, 18, and so on up to 5].

[§ 34.] Of finding the Places of the Planets.

You may find out the places of planets in another manner, and with greater exactitude. Take the altitude of the planet when it is near the line of mid-sky, and keep note of it. Also at the same hour take the ascendant by any of the fixed stars, and keep account of this also with the hour; later on, observe when the planet begins to descend from the line of mid-sky, and take its altitude when it is at an altitude equal to that taken before it reached the line of mid-sky; and again at the same hour take the ascendant and

hour by some fixed star. Take the mean between the first and second ascendants by the muri on the rim; then the degree which will then fall upon the line of mid-sky is where the planet is.

[*Chaucer*, ii. 17.

[§ 35.] Of finding the Latitude of the Planets from the Path of the Sun.

When you desire to know whether a planet is south or north of the sun's path, think whether the altitude which you have taken when [the sun] was near the line of mid-sky is equal to the degree of altitude in which the planet is, or whether it is greater or smaller. For if it be equal, then [the planet] is directly in the sun's path, and has no latitude; but if the altitude of the planet is greater than the degree in which the sun is, then the planet is north of the sun's path; if smaller then it is south. It declines from the sun's path by as much as it is greater or smaller. [*Chaucer*, ii. 30.

[§ 36.] Of the Direction and Retrogradation of the Planets.

Whether a planet is retrograde or direct you may ascertain as follows: Commit to memory the altitude of any one of them and also the altitude of a fixed star; then after a third or fourth night, when its movement is perceptible, consider whether the stars are at the same altitude as the first altitude and the altitude of the planet. Then, if its altitude be less than its first altitude, the planet is direct if it be on the eastern side, and retrograde if it be on the western side. And if the second altitude of the planet be greater than the first, it is retrograde if the hour when the altitude was taken was on the eastern side, and it is direct, if it were on the west. But the opposite you may know to be the case with the moon. [*Chaucer*, ii. 35.

[§ 37.] Of the Equation of the Twelve Houses by the Astrolabe.

When you wish to equate the 12 Houses, place the ascending degree upon the 8th hour line, then the degree which falls upon the line of midnight is the beginning of the 2nd House. Further, the degree of the ascendant having been brought back to the end of the 10th hour, the degree found on the aforesaid line of midnight is the beginning of the 3rd House. Turn back each degree to the eastern horizon, and its nadir will be on the western horizon; the degree on the aforesaid line will be the beginning of the 4th House. You may also place the nadir of the ascendant degree over the end of the second hour, then the aforesaid line will show you the beginning of the 5th House. But if you have placed the nadir over the end of the 4th hour, the beginning of the 6th House will fall over the same line of midnight. But the beginning of the 7th House is the nadir of the ascendant. And the beginning of the 8th, is the nadir of the second; the beginning of the 9th is the nadir of the 3rd; of the 10th, the nadir of the 4th; the beginning of the 11th, is the nadir of the 5th and of the 12th the nadir of the 6th. [*Chaucer*, ii. 36.

[§ 38.] Capitulum. Of the same, but otherwise treated.

Again, having obtained the ascendant and the other three angles, place the rule arranged anew upon the rete on the ascendant degree, and the degrees of the rim between it and the ring or south point, divided into 3 [equal] parts, are the ascensions of three houses from the ascendant at noon; whence if you place it upon the first 3rd from the ascendant, you will have in the zodiac the beginning of the 12th House, and

upon the second 3rd, the beginning of the 11th House. In the same manner, you may work from the degrees of the rim between the ascendant and the point in the angle of the earth (line of midnight), and you will have another 3 [1] houses, viz. the beginning of the second [and] third house. The nadir of these are the beginnings of the six opposite houses.

[*Chaucer*, ii. 37.

[§ 39.] Of the Aspects of the Planets.

But if you wish to know the aspects of two planets, or of any 2 degrees, place the rule over them, and take note of the [number of] degrees between them on the rim. If they be 60, the aspect is sextile; if 90, quartile; if 120, trine; if 180, opposition; if no degree, conjunct. But if the number be 5 less than these limits, it will be an addition to the aspect; if more, a separation from it. According to some persons, the same aspects are derived from equal degrees. According to Ptolemy it is not so, you number according to the degrees of the ascensions just as in the case of the equation of the houses.

[§ 40.] Of the Radiations.

As to the radiations some are right, some left; for a left-hand radiation, set the degree of the planet upon the meridian line, and note the muri; then the muri itself, by moving to the right, for hexagonal radiation, advances 60 degrees; for tetragonal, 90; for triangular, 120; and the degree of mid-sky is noted, for that is the place of the first radiation; then set the degree of the planet on the eastern almucantherath, and note the muri, the muri advances by right-hand motion for hexagonal [radiation] 60, for triangular 120, for tetragonal 90; and the ascending degree is noted, for

[1] 2 in the Italian translation.

that is the place of the second radiation; so take the difference of those two radiations, and keep a note of it. Then at the hour of taking the observation place the degree of mid-sky upon the meridian, and let another mark be made; and the planet will advance by right motion, until its degree rests on the meridian, then let a note as to the muri be made, and the space between the two numbers be taken, and be reckoned into the difference of the radiations; and what is then produced is divided by the arc of the light or of the day of that planet, if the radiation of the planet be above the earth; but by the arc of its night if below the earth; and what results from this division, will be the equation of the radiation. And this equation will be less than the greater radiation, if the planet be between the 10th and the 7th, or between the 4th and the first. The equation is then added to the lesser radiation; and by this means after the addition or subtraction you will have the desired radiation. But for finding the right radiation, the muri is to be advanced by moving to the left and the rest of the procedure will be as above.

[§ 41.] The Knowledge of the Year of the Earth or Natural Year.

When you wish to know the revolution of the natural year or of the meridian, place the degree of the ascendant of the past year upon the horizon on the East, and note the place of the muri on the rim. Then move the muri thence to degree 93, and the degree which falls upon the horizon is the degree of the ascendant for that year. But if the years were of a planet reduce the muri 93 degrees for every year, and the degree on the eastern horizon will be the ascendant for that year.

[§ 42.] How many Equal Hours there are between the past Year and the revolved Year.

But if you wish to know how many equal hours there may be between the past year and the revolved year, divide the degree of the course of the muri by 15, and the number which will proceed from the division is the number of equal hours between the two expiring years.

[§ 43.] Of the purpose of a Gnomon; and first, of the Shadow of Altitude.

Two sides of the quadrant on an astrolabe are divided into 12 equal parts, which are called points of shadow. It is, however, to be remarked that the lower side is called the *umbra extensa* or extended shade; and the other side is called the *umbra versa* or turned shade, because one shows the points of an extended shadow, the other of a versed shadow. Accordingly, when for any purpose you may wish to know how many points of the gnomon the *umbra versa* or *extensa* makes, consider the altitude of the sun. If [the altitude be 45 degrees], one of the two [shadows] is of 12 equal points, viz. by its gnomon. But if the altitude of the sun be greater, the rule will touch the side of the *umbra extensa*, and if you divide 144 by it you will find the puncta of the [*umbra*] *versa*. If, however, the altitude of the sun be less than 45°, the touch of the rule in the *umbra versa* will show its point; divide by this and you will have the points of *umbra extensa*, for if you have multiplied the points of *umbra versa* into the points of *umbra extensa*, there will proceed from the multiplication 144, which also proceed from the multiplication of 12 into itself, which are the parts of one gnomon. It is also knowable if in taking a shadow for altitude, the

rule shall have fallen on the part of any point and you wish to denominate it from the whole, move the rule from the beginning of that point into its part, and observe how many degrees the rule moves, which will be the degree of that part. Then move the rule from the beginning of that part to the end of the same and again observe how many degrees the rule is moved, they will be degrees of the whole. This is the proportion that a part of a point bears to the whole point.

[§ 44.] Capitulum. The finding of the Height of Things by Points of the Shadow.

In order that you may find a height by the shadow, place the rule over the points of the *umbra extensa*; if they be fewer than 12, its touch in the quarter of altitude will show the height. But if they be more than 12, divide 144 by them and you will find the points of *umbra versa*; place the rule upon these, and its touch in the quarter of altitude will show you the height. If the umbra be 12 points, the altitude is 45[°]. If you have to deal with fractions, ascertain what they amount to in degrees, as has been shown above.

[§ 45.] The finding of a Shadow at Noon by the Altitude.

When you wish to know the [length of a] shadow at midday, ascertain the altitude of the sun in the middle of the same day, and by it you will find the shadow, as stated above.

[§ 46.] The finding of the Height of an Accessible Object.

When you wish to know the height of a high object, set the rule on 45th degree in the quarter of altitude, and move forwards or backwards until you

can see the top of the high object through the holes in both sights, then the distance from the spot where you are to the base of the object together with the addition of your height from your eye to the ground is undoubtedly the height of the object.

Should, however, you wish to find its height without moving from one spot, raise or lower the rule until you see the summit through both holes, then if the rule falls upon points of *umbra extensa*, consider in what proportion 12 has to those points, for the height of the object will be in the same proportion to the distance between you and it, plus your height. If on the other hand [the rule] fall upon points of *umbra versa*, whatever part will be points from 12 the same part will be the height of the object of that distance between it and its base, your height being added to the distance. It should be remarked that if the rule be upon the diameter of the quadrant, the height of the object is equal to the distance, with your height added. And if it be upon the *umbra extensa*, the height is greater than the distance; but if it be upon the *umbra versa*, it is less than the distance. [*Chaucer*, ii. 41.

[§ 47.] Capitulum. Of Measuring the Height of an Inaccessible Object.

If the height of an inaccessible object has to be measured, sight the top of the object that is to be measured through both holes of the alidade; because having read how many points there may be, they will have to be measured. Let there, for example, be said to be 3 points, which are contained four times in the side of the *umbra* [*versa*]. When you have done this, move back from the spot [where you were standing] that you may look at the object through both holes for measuring its summit again; and

having sighted it, read the number of the points of the umbra anew, which [let us suppose] to be 2 points, which are contained in 12 six times; and the distance between the stations be noted as 12 feet. And then, on bringing these values into agreement the minus *continens ternarii*, viz. 4, is taken away from the larger containing binarii, viz. 6, and the binarius which is carried over is committed to memory. The distance separating the two stations, because it remained binarius from the proportions, is certainly double the inaccessible height. This rule is universal in all cases: after the continents have been subtracted, if one remains over, the interval between the stations will be equal to the height of the object to be measured; if 2, double; if 3, thrice; and so on for the rest. [*Chaucer*, ii. 46.

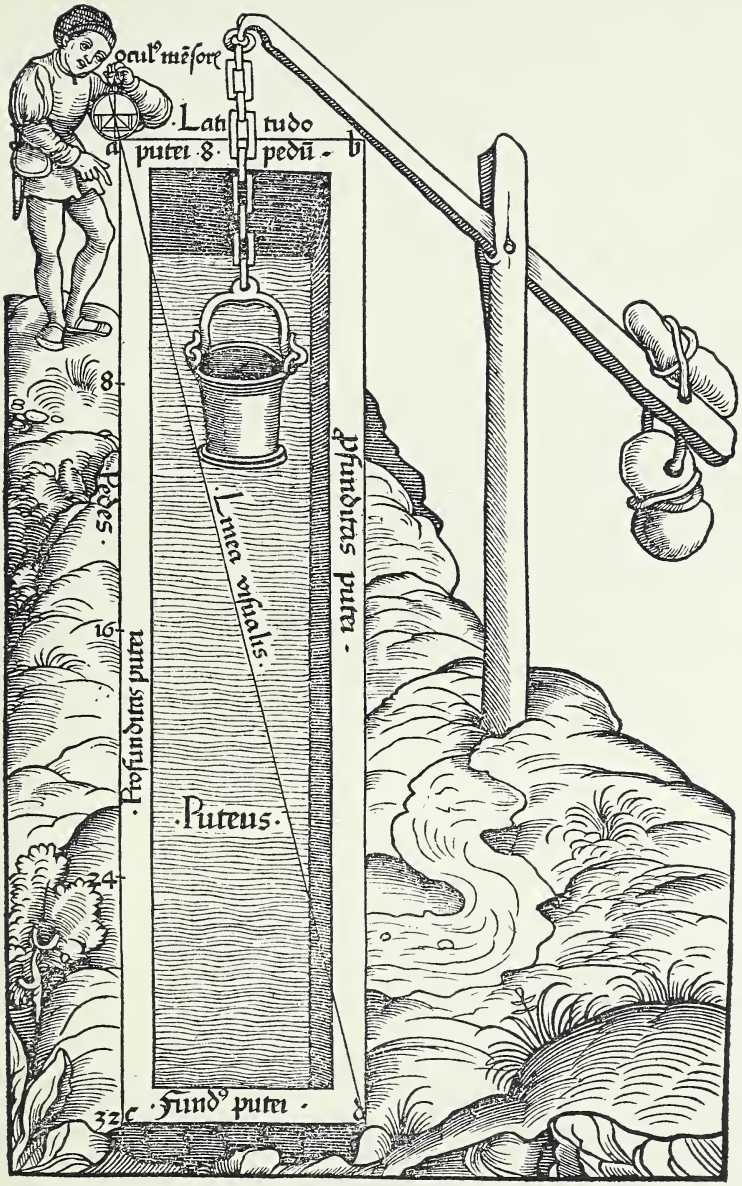
[§ 48.] **Of Measuring a Level Surface. Rubric.**

If you seek to measure a level surface with an astrolabe, sight its boundary from the opposite side through both holes [in the sights of the alidade]; then compare the points of the umbra on [which] the alidade rests with 12; and whatever be the proportion that these points bear to 12, that is the proportion of your height to the [measure of] the level surface.

Here ends the Astrolabium of Messahalla.

Simon Bredon, an Oxford astronomer of the Merton School, is believed to have made the abstract of Messahalla's treatise which is contained in MS. Sloane 321. This abstract includes an additional chapter on finding the depth of a well—**Putei profunditatem cognoscere.**

The chapter was probably illustrated by a simple diagram which may have been the predecessor of Stöffler's attractive figure reproduced below.



Measuring Depth of a Well with an Astrolabe.
After Stöffler, but not included by Chaucer.

f. 61] I. DE COMPOSITIONE ASTROLABII

The text is that of MS. Cambridge Ii 3. 3, collated with the later and shorter MS. Ashmole 1796, whence the additions in angular brackets ⟨ ⟩ and the readings in the critical notes are derived; a few readings from MS. Ashmole 1522 are in ⟨⟨ ⟩⟩. The additions in square brackets represent editorial suggestions.

Incipit Tractatus Astrolabii edicionis Messehallach prohemium.

Scito quod 'Astrolabium' est nomen Grecum cuius interpretatio est 'acceptio stellarum', eo quod accipiatur ex eo veritas earum rerum quarum scientia queritur ex locis stellarum. Et dixit Ptholemeus quod fit sicut spera ⟨que fuerit⟩ extensa in plano. Eritque punctus ipsius axis apparens et *almucanthant* que sunt in omni tabula eius, sunt oppositi circulis qui sunt in directo, quorum punctus[1] est punctus cenith capitum in eodem climate, et inicium eorum est ex circulo emisperii eiusdem climatis cui lineate ⟨sunt⟩, scilicet ille almucanthanth. Invenimus quoque antiquos contentos fuisse mansione 7 climatum eo quod populationem et plus habitationis invenissent in eis. Et nomen climatis est nomen ⟨grecum significans⟩ declinationem, quia cum esset terra rotunde figure, essentque illi qui habitant sub equinoctiali linea in equalitate temporum. Similiter[2] quoque quorum cenith capitum declinaverit a predicta linea fiunt eis diversa⟨rum⟩ horarum tempora. Ideoque diviserunt antiqui declinationem per 7 divisiones, quas vocaverunt climata. Fuitque longitudo prime divisionis a linea equinoctiali secundum quantitatem hore unius equalis, et longitudo diversitatis reliquarum partium dimidium hore unius, perven⟨er⟩itque diversitas in septimo climate ad 4 horas equales, et factus est dies longior illius loci 16 horarum, et brevior 8 ⟨horarum⟩.

Primum capitulum in Compositionem Astrolabii et primo De Preparatione Matris, que postera dicitur.

Cum volueris facere astrolabium ad cuiuscumque latitudinem regionis, unum ⟨enim⟩ est opus atque equale in omni latitudine. Fac tabulam pro matre que sit latior tabula rethis per quantitatem latitudinis limbi, qui quidem limbus debet esse latior circulo Capricorni paulisper secundum eam scilicet, quantitatem que

[1] cuspis. [2] semper.

possit in ea describi almuri,[1] qui est denticulus, egrediens a capite Capricorni super gradus limbi predicti. Cuius limbi densitas sit secundum quantitatem rethis, si fuerit astrolabium unius latitudinis, aut secundum quantitatem tabularum et rethis ut equentur dum ponitur axis et non transgredientur invicem. Et figes limbum clavis in 4 partibus vel absolute ut quibusdam placet in quibusdam locis ad placitum; et coniunges ipsum limbum matri cum stagno vel argento ⟨si volueris⟩, et facies super extremitatem eius circulum. Post hoc dimittes spacium ⟨pro⟩ litteris, et facies iterum 2 circulos ad invicem propinquos, inter quos erunt gradus succedentes rethi. Dividesque ipsum spacium quod fuerit inter ipsos circulos per 360 divisiones[2] equales, et incipies scribere ab initio quarte occidentalis et meridiane ex puncto *a*, eundo ad punctum *c* continuatim usque in 360 gradus. Et elucidabis ⟨tabulam⟩ et equabis eam prout melius poteris. Deinde extrahes dyametra illius que quadrant eam abscindens unum eorum per alterum super *c* punctum cuspidis, ita ut quadrantes sint equales: et facies in alia parte similiter.

f. 61 v]. Suntque dyametra que abscindunt ⟨-ant⟩ se in alia parte ⟨tabule matris⟩ opposita dyametris que se abscindunt in altera, id est, sint in directo eorum. Post hec statues in interiori parte circulum Arietis et circulum Cancri. Circulus Capricorni[3] per extremitatem tabule, et ipse est maior circulus qui cadit in matre inferius.

[De Dorso astrolabii. Cap. 2.][4]

Facies inde circulum super extremitatem tabule, dimittesque spacium in quo possint ⟨-sunt⟩ scribi littere numeri, et incipies scribere litteras a puncto *d* qui est in oriente usque in punctum

[1] in qua poterit esse muri graduum. [2] partes.
[3] autem est qui incedit.
[4] In the figure of the back of an astrolabe illustrating this chapter in MS. Ashmole 1796, f. 41, the following Saints' days are indicated with their golden letters:

Jan.	1	a	Circm	July	7	f	Thome
	6	f	Epiph		25	c	Jacob
Feb.	2	e	Purifi	Aug.	1	c	Pet
	22	d	Pet		15	c	Maire
Mar.	12	a	Gre	Sept.	8	f	Mar
	25	g	Mari		14	e	Cruc
Apr.	4	c	Ambr	Oct.	18	d	Luce
	25	c	Marc		28	g	Si. Iud
May	1	b	Phi	Nov.	1	d	S[an]ctorum
	25	f	August		30	e	Andr.
June	12*	e	Alban	Dec.	8	f	Mar
	29	e	Petri		25	b	N. dō̄.

* Error for 21.

a qui est sub armilla, qui sign⟨ific⟩at in astrolabio meridiem, perficiesque eandem quartam[1] hoc modo.
⟨Dicit modum dividendi primum circulum in dorso, qui est exterior omnibus, et dicitur circulus altitudinis.⟩

Divides predictam quartam per 18 divisiones equales, et scribes in prima divisione 5, et in secunda 10, et in tertia 15, atque sic augmentando usque ad 90; per hanc quartam accipies altitudinem solis atque stellarum. Similiter facies in ceteris quartis. Incipies autem scribere a puncto orientis *d* usque in meridiem *a*, ut supra dictum est. Deinde incipies ex puncto *d* et facies similiter usque in *c*; post hoc ex *b* in *a* ⟨ad ultimum vero⟩ ex *b* in *c*. Descriptis litteris iterum facies 2 circulos propinquos sibi inter quos erit modicum spacium in quo erunt gradus designati, qui gradus, ut supra diximus, in litteris erunt in unaquaque quarta per 18 divisiones distributi, et in unaquaque divisione 5, ⟨et in alia divisione 10⟩, ita ut in unaquaque quarta inveniantur 90 gradus; et fiunt omnes 360 gradus qui sunt gradus 12 signorum. Sub quibus eciam dimittes spacium in quo scribas[2] litteras numeri graduum qui dividit gradus uniuscuiusque signi per 6 divisiones, et incipies[3] a capite signi ita ut in prima divisione sint 5, [et in secunda 10] et sic augmentando usque in 30. Et hec divisiones erunt linee venientes ab extremitate tabule que dividant gradus et litteras superiores.

f. 62]. Post hec facies 2 circulos inter quos dimittes spacium quod divides per 12 partes equales in quibus describes nomina 12 signorum, et erunt omnes isti circuli ex uno puncto *e*, i.e. habebunt unum centrum *e*, scilicet, qui est in medio tabule. Et incipies ab Ariete et initio quarte occidentalis [et] meridiane qui est punctus *b*, iens versus meridiem qui est punctus *a*; et divides unumquodque signum per 30 divisiones ut supra. Post hec pones regulam super 27[4] gradum Geminorum et iunges eam cuspidi per lineam subtilem. Deinde divides eam[5] a cuspide usque in circulum sibi prop[r]iorem ⟨scilicet signorum⟩ per 32 divisiones, et pone[s] summitatem prime divisionis ex parte cuspidis circuli signorum ⟨i.e. centrum⟩, et accipies ex hac divisione[6] 30 divisiones, eritque inter has cuspides utrasque una divisio ex ipsis divisionibus, et inter capita ⟨-ut⟩ linee altera divisio prohibens eos ne se contingant. Iterum facies circulum et divides eum per 365 divisiones secundum numerum dierum anni solis,[7] si fuerit astrolabium magnum; et si fuerit parvum pones eos binos et binos. Deinde facies sub eo alterum ⟨circulum⟩ in

[1] in eadem quarta 90. [2] describes. [3] incipiendo.
[4] 24. [5] ipsam lineam. [6] linea. [7] solaris.

quo erit numerus dierum mensium latinorum. Post hec pones regulam super 15 gradus Sagitarii, et iunges eam cuspidi circuli signorum et pones notam in circulo mensium.[1] Eritque hoc inicium Decembris[2] et erunt ab eo usque in *c* punctum, qui est in septentrione, 15 dies et remanebunt post hoc spacium, abscisis 15 diebus Decembris, 350 dies, super quos dividis reliquam partem circuli, i. e. multiplices 50 septies †dividendo primo in 7, secundo in 5, tertio in 2†,[3] et ideo hoc ingenium inventum fuit quia non erat apta multiplicatio 365 ⟨dies⟩. Et scito quod sol ingreditur caput Arietis ⟨in⟩ 14 die Martii, et initium Cancri 16 die Junii, et initium Libre 19 die Septembris, et initium Capricorni 15 die Decembris. † Iterum cum divides annum pones regulam super centrum signorum et super divisionem dierum semper. Et nota quod circulus mensium potest fieri [f. 62v] concentricus circulo signorum et idem est.†[3]

[Tabula solis ad locandum menses.

Menses	gr.	m.	Sign.	Menses	gr.	m.	Sign.
Martius	16	53	Piscis	Septe	14	35	Virgo
Aprilis	14	15	Aries	Octob	14	13	Lib
Maius	16	15	Thaurus	Novĕb	15	20	Scorp
Junius	16	13	Gem	Decem	15	52	Sagitta
Julius	14	47	Cancer	Januar	17	28	Cap:
August	14	0	Leo	Februarius	18	53	Aqua]

[**De impositione Quadrantis Umbre.** Cap. 3].

Cum volueris ponere quadrantem umbre, junge cuspidem circuli signorum per lineam subtilem et occultam, que vadit per medium quarte occidentalis et septentrionalis equaliter, cuius finis erit circulus mensium. Postea produces ex fine eius 2 lineas ad summitatem tabule, et erit quadrans erectis angulis. Deinde facias post ipsas duas lineas alteras prope eas, inter quas erunt puncti. Item facias alias 2 lineas latiores inter quas erunt littere, et divides spacia que sunt inter has ⟨duas⟩ lineas ex utraque parte ⟨*sc.* quadrantis⟩ per 6 divisiones ad litteras. Spacium vero quod est strictius[1] divides per 12 ⟨partes⟩ secundum numerum punctorum ad unamquamque litteram 2 punctos, et incipies scribere ex diametris. Et si vis ⟨volueris⟩ in astrolabio 2 quadrantes ⟨habere⟩, facias in alia quarta septemtrionali scilicet et orientali, que est juxta eam, similiter. Potes etiam

[1] signorum.
[2] Septembris. Reisch's printed text has a note here referring to the year 1494.
[3] The passages between † and † are omitted in MS. 1796. [4] superius.

inter quadrantes 2 eosdem infra circulum mensium constituere lneas horarias ut fit in quadrante, per quas eciam horas diei naturales in dorso, ut patet in figuris suprahabitis.

De Allidada facienda que Regula vel Mediclinium dicitur.
Cap. 4.

Cum vis facere allidadam, que est regula que ponitur supra dorsum astrolabii, fac tabulam angustam in similitudine regule, cuius longitudo sit sicut longitudo tabule ⟨*sc.* matris⟩, et plus per eam quantitatem qua possint abscindi due tabule perforate ad accipiendum altitudinem ⟨soli et stellarum⟩. Et lineabis illam regulam per medium ⟨i. e. facies in eam lineam apparentem et divides eam per medium⟩ in longitudinem et postquam lineaveris ipsam, abscindes ⟨de ea⟩ in quantum sufficit ad agendum duas tabulas predictas, et maneat[1] postea ⟨*sc.* de regula⟩ secundum longitudinem tabule ⟨*sc.* matris⟩ vel prope et paulominus ne accipiat[2] vel adhereat in pannis. Postea divides eam per medium certissime in duas partes, et pones in medio eius notam super quam erit apertio[3] axis. Deinde abscindes dimidium regule ex una parte, secundum quod notavi tibi, et ⟨abscindes eam⟩ ex alia parte e contrario, et servabis lineam que est in medio eius que vadit per axem ⟨*i. e.* clavum⟩ dum abscideris, quia in ea erit fiducia, et acues summitates regule versus lineam ⟨fiducie⟩ a sursum usque deorsum ut fiat subtilis summitas regule et possint videri gradus. Post hoc compones tabulas super unam longitudinem ab axe et servabis ut linee que sunt in predictis tabulis cadant super lineam regule. Et perforabis eas ante compositionem earum, et sint foramina unius longitudinis a regula sintque ipsa foramina super lineam tabularum equaliter perforata et in unaquaque tabula sint duo foramina, maius scilicet et minus, minus ad accipiendum radios solis in die et maius[4] ad accipiendum ⟨-as⟩ stellas in nocte. Nota quod centra duarum tabularum que sunt super capita allidade et debent habere idem centrum, et linea que est in regula debet respondere centro dictarum tabularum [f. 63] equaliter cum collocantur in regula sive allidada.

Et scito quod armille per quas suspenditur astrolabium reflectuntur super spinas suas quousque unaquaeque earum curret in alia, quasi super acumen gladii, ne tardetur, *sc.*, motus, et forte erit in sede aliqua declinatio ad aliquam partium. Ut si non fuerit[5] foramen in quo est allidada, et in quo est armilla reflexa que figitur in matre supra lineam mediatricem certissime, ac

[1] remanet. [2] accipiatur. [3] apparicio.
[4] *MS.* minus. [5] sit.

propter hoc sit aliquis tortuositas in acceptione altitudinis, quod debes ita probare. Mitte per foramen filum et suspende ⟨de⟩ eo aliquid ponderosum, post hec suspendes astrolabium per alterum filum ex eodem foramine. Tunc si obiciatur[1] filum super filum, ⟨id est⟩ si non declinaverit ab eo, erit verax; si vero declinaverit ab eo, stude tunc adaptare eum removendo foramen ad ipsam partem ad quam declinat filum, ⟨si deus voluerit⟩.

De Horis constituendis in Regula que Allidada Horaria dicitur. Cap. [5.]

Cum volueris constituere horas in regula, divide longitudinem unius tabularum ⟨pinnularum⟩ que sunt in regula, in qua sunt foramina, per 12 divisiones, eritque ipsa(m) tabula status. Deinde divides similitudinem ipsorum statuum in tabula vel in pergameno, vel in quocumque vis, et divides eas [*sc.* similitudines], per punctos. Post ⟨hec⟩ pones regulam ⟨*i. e.* allidadam⟩ super 15 gradus ex altitudine ⟨*sc.* in dorso⟩ et scies quantum habebit ex umbra versa, et eriges circinum super quantitatem ipsorum punctorum graduum quos invenisti ad eandem altitudinem, et pones ipsam quantitatem in regula a radice tabule quam divisisti quousque pervenerit; eritque finis hore prime. Deinde pones eciam regulam super 30 gradus, et scias quantum convenit ⟨etiam⟩ ei ex umbra versa, et aperies[2] circinum secundum quantitatem eorum punctorum, et pones ipsam quantitatem in regula a radice predicte tabule, quam divisisti quousque pervenerit, eritque ⟨hec⟩ idem terminus finis secunde hore. Item pones regulam supra umbra 45, deinde ⟨super⟩ umbra 60 ^{gr}, postea super umbram 75, qui est finis hore 5. Et quod residuum fuerit ex regula erit hora 6^{ta}, et non habet finem in regula. Postea revertetur umbra, eritque initium 6^{e} ⟨hore⟩ finis 7, et initium 5^{te} finis erit $8^{e}_{\frac{1}{2}}$, et initium 4^{te} finis 9, et initium 3 finis 10^{e}, et initium 2 finis 11^{e}, et initium 1 finis 12^{e}. Et si volueris extrahere umbras harum altitudinum ex tabula umbre, i. e. ex tabula altitudinis umbre per quam scitur umbra omnis altitudinis, fac, quia verius erit ⟨si deus voluerit⟩.

Item alia extractio in impositione horarum in regula levior prima, et omnes redeunt in unum et sunt in opere eedem. Cum hoc volueris scire, scito longitudinem linee regule que cadit inter utrasque tabulas [ex] uno solum usque ad clavum quia convenientius est ut inter clavum sint omnes umbre, et adde illi [f. 63v] longitudini 4 altitudines sive similitudines tocius tabule †a superficie regule usque ad summum ipsius tabule et si plus fuerit 4 similitudinibus tocius tabule † cum summitatibus[3] suis,

[1] abierit. [2] capies. [3] foraminibus.

⟨⟨bene est⟩⟩, et si sic non fuerit, non sit unus eis [1] 4 similitudinibus quia finis 4 similitudinis ⟨-um⟩ est finis hore 5. Postea pone ipsam lineam in tabula vel in pergameno vel in alio ⟨quo volueris⟩. Deinde extrahe ex summitate linee lineam super erectum angulum, ⟨et⟩ accipe ex eo secundum quantitatem tabule, et scito ipsum punctum et extrahe ex eo puncto lineam ⟨hanc⟩ super angulum erectum quousque volueris.

Tabula umbre verse per quam constitues horas in regula.

Gra.	Punct.	Min.
15	3	13
20	6	46
45	12	0
60	20	47
75	44	46
90	infinita	

Deinde pone ⟨ipsum⟩ punctum qui est finis tabule cuspidem ⟨*i.e.* centrum⟩ et mensura quamlibet longitudinem quam volueris, et fac quartam partem circuli. Post hec divides ipsam quartam ⟨partem⟩ per 6 partes equales ; deinde iunge divisiones punctos *sc.* eorum cuspidi, et extrahe lineas quousque pervenerint linee ⟨ad dictam lineam, *i.e.* ad regulam regule, et quecumque se abscindant ipsa erunt puncta horarum ; prime videlicet, et 2^{e}, 3^{e} et 4^{e} ac 5^{e}, et initium 6^{e} est finis 5, quia sexta nullum habet finem. Cumque reversa fuerit umbra ostendet tibi reliquas horas.[2] Si autem fuerit linea sicut 4 similitudines tabule tocius erit finis 5^{e} hore apud radicem secunde tabule (et sic apud clavum quod convenientius est). Cumque reversa fuerit umbra ex altiori summitate erit hic finis 6^{e} hore et initium 7^{e}, et cum reversa fieret ad finem 5^{e} erit finis 7^{e} et initium 8^{e}, et cum pervenerit ad finem 4^{e} erit finis 8 et initium 9, et cum pervenerit ad finem 3 erit finis 9 et initium 10, et cum pervenerit ad finem 2 erit finis 10 et initium 11^{e}, et cum pervenerit ad finem prime erit finis 11 et initium 12. Post hec mutabis [3] horas cum circino in regulam, et pone inicium regule juxta radicem tabule ut patet [4] in hac figura ⟨*sc.* in prima perfigurata⟩.

6. De Clavo faciendo quod est Equus, Architob vel Camilla dicitur.

Peracta regula facies clavum rotundum et decenter compositum et perforatum et habens caput bene factum qui clavus sit utilis ad colligendas inter se tabulas dum perforate fuerint, et vocatur

[1] maius.
[2] regula.
[3] circinabis.
[4] quemadmodum vides.

arabice '*Architoph*'[1] quem nos Latini vocamus 'axem'. Facies quoque[2] in modum equi vel cunei sive cuiusvis alterius, tabulam animalis[3] parvam et bene factam quem mittes in foramen ⟨-ine⟩ axis decenter ita ut retineat tabulas, et dicitur 'alpheram' sive 'equus', quia ex consuetudine ⟨venit ut sit⟩ in modum equi ⟨formata⟩. †Facies etiam regulam que 'novella' dicitur ut hic patet, que fit divisa per notas secundum divisionem linee meridionalis tabule latitudinis tue regionis per almucanthanth, et hec curret super faciem rethis.†

Huc usque intermisimus vero de diversis tractatibus, sed nunc redeamus ⟨ad librum⟩.

7. Preambulum ad Compositionem Rethis et Tabularum [Alt]itudinis.

[Figura f. 64v]

Accipe[4] tabulam quam volueris et cuiuscumque[5] quantitatis ⟨fuerit⟩, et facies in ea circulum, cuius dimidium dyametri sit simile dimidio [f. 64] dyametri eius quod cadit[6] ex matre infra limbum, et cum feceris circulum abscindes quod superfluum fuerit extra ipsum circulum de tabula praeter quendam locum quem ibi dimittes in modum denticuli ut intret in limbo in foramen ad hoc constitutum, et ⟨bene factum ut cum⟩ intraverit tabula in matrem, et ipse denticulus fuerit in suo foramine, ut non possit predicta tabula huc vel illuc moveri. Et hoc cum feceris extrahe dyametra eiusdem circuli in directo quousque se abscindant super ⟨*e*⟩ cuspidem rectis lineis, et ista erunt dyametra *abcd*.[7] Cum volueris facere Arietis et Libre circulum, *i. e.* per quem vadit caput Arietis et Libre, et circulum Cancri, *i. e.* per quem vadit caput Cancri, divide circulum *abcd* per 360 gradus[8], sitque omnis quarta circuli ex 90 partibus. Deinde pone arcum *az*[9] simile numero graduum ⟨totius declinationis que est secundum Ptholomeum 23^{gr}⟩ et 51 minuta, ⟨et⟩ secundum Albategni 23 graduum et 35 minuta, atque eciam in diebus Almeonis[10] invenerunt observatores 23 gradus et 33 minuta, sicut habuisti ex Indis[11] pervenit hac declinatio ad 24 gradus. Accipe ergo hanc declinationem pro quod[12] volueris, quia non erit ibi sensibilis discordia, cum igitur vis[13] extrahere circulum Arietis.

[1] Alcocoli. [2] ergo.
[3] MS. reads 'annualis', which does not make sense. MS. 1522 omits the word.
[4] Accipies. [5] in quas cumque. [6] cecidit.
[7] Three lines are repeated here in MS. [8] partes.
[9] 73 in MS. [10] The son of Albumazar.
[11] habemus per Indos. [12] secundum quem.
[13] ergo volueris.

Deinde circulum Capricorni ⟨i. e.⟩ circulum *abcd* per 360 divisiones. Et accipe ex eis secundum predictam declinationem ex puncto *a* versus *d*, et pone ibi ⟨aliquam⟩ notam. Et si vis[1] dividere ipsam quartam per 15, ⟨et⟩ accipe ex eis 4 ex parte *a* versus *d* et pone ibi notam, et vide ut quarte sint equales. Et si vis[1] dividere quartam per 3 et iterum divide ipsam terciam que fuerit[2] iuxta *a* per 5, et ex ipsis 5 accipe 4 qui fiunt a parte *a*, et ibi pones notam. Si autem certius vis dividere fac ut dicam.[3] Postquam diviseris tabulam per dyametra et equales feceris quartas scripserisque litteras super capita dyametrorum, utpote in ⟨sup-⟩eriori parte tabule que est sub armilla ⟨*a*⟩, et significat meridiem; et in occidente *b*, in septemtrione *c*, et in oriente *d*, divideris unam quartarum, sc. ex *a* in *d* in 90 gradus, et accipies [23] gradus et 51 minuta secundum Ptholomeum, quia magis est autenticum licet in ordinem sapientes acceperit[4] 23 gradus per certo et 33 minuta. ⟨Hec levissime facies sic. Protrahe lineam a nota *z* usque ad centrum *e* secando circulum Arietis, et ubi secat pone notam *m*, et sic habes in circulo Arietis similem declinationem arcus sc. *mh*, et post hec fac ut docet littera⟩; vel sic divides omnem circulum posita tabula in matre et ea dyametra accipe in limbo ex *a* in *d* 24 gradus si vis, et in tertio ipsorum et super *e* pone regulam et fac subtilem lineam que vocetur *ez* et hoc includit cum linea *ea* spacium 24 graduum omnis circuli intra inscripti. Et nota quod hoc modo in quolibet circulo intra limbum scripto quotquotlibet gradus accipimus; et hic modus est melior, serva eum.

Accipe igitur in predicto numero ut prediximus et scribes super eam notam *z*, eritque arcus *az* tota declinatio. Deinde junges *b* cum *z* per lineam *zb*, abscindens lineam *ac* super punctum *h*, tunc pones punctum *e* cuspidem, et fac circulum secundum quantitatem longitudinis *eh*, i. e. [f. 64v] pones circulum ex una parte super *e* et ex alia parte super *h*, et fac circulum qui erit *htkl*, et ipse erit circulus per quem vadit caput Arietis et Libre. Iterum divides circulum illum per 360, ⟨sit⟩ autem 4ta eius ut supra, et pone super numerum graduum predicte declinationis ut supra dictum est, notam et scribes super eam *m* et junges *m* cum *t* per lineam *mt*; et abscindet linea *mt* lineam *ae* super punctum *n*, et pones punctum *e* ⟨ei⟩ cuspidem et fac circulum secundum quantitatem longitudinis *e* ex *n*, qui erit circulus *nsov* per quem vadit caput Cancri. Et hec est figura.[5]

[1] volueris, as in many similar places.
[2] sint. [3] hoc sicut tibi narrabimus.
[4] quia in *a* autencius est licet sapientes moderni * pro certo habeant.
* Also MS. 1522.
[5] Primo scilicet figurando ipsum quod cum non est faciendum maxime cum mater sit priua mensurata et figurata.

Et si constituerimus circulum *klht*, qui est circulus Arietis et Libre, et vellemus ex eo extrahere circulum Capricorni et Cancri, divideremus circulum *klht* per 360 partes, vel divideremus quartam ut supra. Postea poneremus arcum *tq* sicut totam declinationem, et iungeremus *h* cum *q* et extraheremus lineam donec abscinderet dyametrum *le* super *b*, et poneremus *e* cuspidem et faceremus circulum secundum quantitatem longitudinis *e* ex *b*, qui esset *abcd*, circulus Capricorni. Post hec eciam abscinderemus arcum *hm* ⟨sicut⟩ totam declinationem, et iungeremus *m* cum *t* et abscindet linea *mt* lineam *hk* super punctum *n*, et ⟨post hec⟩ poneremus *e* cuspidem et faceremus circulum secundum quantitatem longitudinis *e* ex *n*, quia esset circulus *nsov* circulus Cancri.

Et si ex hoc vellemus extrahere circulum ⟨Arietis et Libre et circulum⟩ Capricorni divideremus circulum *nsov* per 360 divisiones et poneremus arcum ⟨*sf*⟩, sicut totam declinationem, et iungeremus *n* cum *f* per lineam *nf*, et extraheremus lineam in directo donec se abscinderet cum dyametro *vs* super punctum *t*. Post hec poneremus *e* cuspidem et faceremus circulum secundum quantitatem longitudinis *e* ex *t*, qui esset circulus *thlk*, qui est circulus Arietis et Libre.

Post hoc extraheremus circulum Capricorni ex circulo Arietis et Libre.

f. 65.] 8. ⟨**De constitutione Zodiaci et eius divisiones**⟩.

[Figura 65]

Et post constructionem horum trium circulorum sc. Capricorni. Arietis et Libre, et Cancri, fac[1] circulum signorum. Hoc est ut dividas lineam *ao* per medium et facies super lineam *ao* circulum transeuntem per duo puncta *t l* si sic jam invenisti opus. Si non transierit per hos duos punctus errasti, reitera ergo opus donec verificetur. Et hic circulus est circulus signorum.

9. De divisione circuli signorum sive Zodiaci Capitulum.

[Fig. 65v]

Cumque feceris circulum signorum oportet te postea dividere eum per signa et gradus signorum, cuius rei exemplar est ut facias[2] circulum capitis Arietis et Libre qui est *abcd*[3] et diametra abscindant se super circulum signorum *azch*. Deinde divides *abcd* per 360 gradus. Post hoc pone arcum *ct* similem dimidio tocius declinationis. Deinde iunge *a* cum *t*, et abscindet linea *at* dyametrum *bd* in puncto *k*, deinde extrahe dyametrum *bd*

[1] faciemus. [2] faciamus. [3] *htkl* in MS.

in directo, donec abscindat circulum signorum super *h*. Tunc punctus *a* erit punctus capitis Libre, et punctus *h* Capricorni, et punctus *c* Arietis, et punctus *z* capitis Cancri. Post hoc pone arcum *dl* et ⟨arcum⟩ *bm* unumquemque scilicet istorum ex 30 gradibus. Deinde queres arcum qui eat super punctum *m* et *k* et *l* et abscindet circulum signorum super *ns*, eritque *hs* arcum [-us] signum Sagittarii, et arcus *zn* signum Geminorum. Post hoc pones unumquemque ex arcubus *lg* et *mf* 30 gradus. Deinde queres arcum qui vadit per puncta *f*, *k*, *g* et abscindet circulum signorum super *qx*, eritque arcus *sx* signum Scorpionis, et arcus *nq* Tauri, et remanebit arcus *xa* signum Libre, et arcus *qc* signum Arietis. Post hoc pone arcum *ho* sicut arcum *hs* et arcum *or* sicut arcum *sx*, eritque *rc* signum Piscium et arcus *ro* signum Aquarii, et arcus *ho* signum Capricorni. Postea etiam pones arcum *zv* sicut arcum *zn* et arcum *vp* sicut arcum *nq*, eritque arcus *ap* signum Virginis et arcus *pt* signum Leonis, et arcus *vz* signum Cancri. Et similiter si poneres arcum *dl* 3 gradus, et arcus *bm* similiter esset arcus *hs* 3 gradus ex Sagittario et arcus *zn* 3 gradus ex Geminis.[1] Hunc divides universum circulum signorum per singulos gradus, ut patet in figura.

⟨De constitutione Zodiaci et eius divisione⟩.

⟨Statue circulum super lineam *ao* ita quod transeat per *lt*, et sit circulus zodiaci. Deinde divide circulum *abcd* per 360 gradus, post hec pones arcum *e* ut similem dimidio declinacionis Ptholomei. Deinde iunges *a* cum *c* et abscindet diametrum super *k*, qui est punctus medius inter polum ex una parte et super *aq* ex altera, et concordat cum centro capreis in linea medii celi.⟩

⟨**De positione stellarum in rethe in circulo signorum**, cum longitudine sua ab equinoxiali cum gradu cum quo venit ad medium celi, id est declinatione sua ⟩

Post et aliis 3 modis dividi zodiacus. Primo per lineas rectas et super totam declinationem videlicet in precedenti per arcus et super dimidium declinationis. Secundo per tabulas ascensionum signorum in circulo directo, et hoc utimur. Tercio autem modo per circulos transeuntes per declinationes uniuscuiusque gradus signorum.

[1] The MS. reads 'Capricorno' and 'Cancro', probably through the scribe having been misled by the figure, the zodiacal signs of which are wrongly named.

f. 65v.] **10. Sequitur de inscripcione Stellarum fixarum in Rethe in eius Zodiaco.**

[Figura f. 66]

Cum diviserimus circulum signorum certissime oportet nos postea describere stellas fixas in circulo signorum ; cuius rei exemplar ⟨est⟩ ut ponamus stellam cum ⟨⟨latitudine⟩⟩ (longitudine)[1] sua ab equinoctio diei cum gradu qui venit ad medium celi cum ea. Et hoc fit sic : Ponemus circulum equinoctii diei, scilicet circulum Arietis et Libre *abcd*, et dyametra abscindant se super *e*, et (sint) super circulum signorum *azch*. Et ponemus exemplum ⟨nostrum⟩ ut una stella ex stellis quarum ⟨⟨latitudo⟩⟩ (longitudo) est ab equinoctio diei versus septemtrionem. ⟨Non curetur de illa stella nec de grad[u] eius quia hoc quod dicit gracia exempli est ut sciamus collocare stellas in rethi. Ponentur autem in suis gradibus per tabulam que in fine compositionis posita est⟩, sitque illa stella *Vultur volans*, et abscindemus ex puncto *d* versus *c* quantum est ⟨⟨latitudo⟩⟩ (longitudo) eius ab equinoctio diei, et est 7[2] gradus ⟨et 25 minuta⟩ ; estque arcus *dt*. Iungemusque *t* cum *a* et abscindet dyametrum super punctum *k*, et ponemus punctum *e* eiusdem cuspidem. Et faciemus circulum secundum quantitatem longitudinis *e* ex *k*[3] et est circulus *km*, vaditque per stellam. Post hoc aspiciemus punctum qui cum eo est in medio celi ex circulo signorum, et est 16 ⟨13⟩ gradus ex Capricorno, qui est punctus *l*. Post hoc iungemus *l* cum *e*, abscindetque linea *le* circulum *km* super punctus *m*, ergo *m* est cuspis[4] *Vulturis volantis*. Similiter pones universas stellas quarum ⟨⟨latitudo⟩⟩ (longitudo) est ab equinoctio diei ad septemtrionem. Postea ponemus aliud exemplum in stella cuius longitudo est ab equinoctio versus septemtrionem, et sit ipsa stella *Cor Tauri* ⟨*i. e.* Aldebaran⟩. Abscindemusque ex puncto *d* longitudinem eius ab equinoctio diei versus *c*, quia longitudo eius versus septentrionem est 14 gradus et 30 minuta, et est arcus *dn*, iungemusque *a* cum *n* et extrahemus eum donec abscindat lineam *hb* super punctum *s*. Deinde ponemus punctum *e* cuspidem, et faciemus circulum secundum quantitatem longitudinis *es*, et est circulus *sf*. Deinde aspiciemus punctum cum quo est in medio celi ex circulo signorum, hoc est 18 ⟨26⟩ gradus ex Tauro, qui est punctus *g*, et iungemus *e* cum *g*, et extrahes eum donec abscindat circulum *fs* super punctum *f*, punctus ergo *f* est punctus *Cordis Tauri*. ⟨Hec leviter facies si memoriter recerneris que dicta sunt in fine illius cuius circulus est in inicium operis

[1] All through this section there is confusion between 'latitudo' and 'longitudo' in the MSS.

[2] 28. [3] Last line omitted in MS. [4] *l* cum *e* omitted.

tabularum. Ibi enim docetur qualiter ex circulo Arietis, circulus Capricorni sicut igitur arte constitues circulum declinacionis stelle ab equinoxiali circulo versus meridiem. Ista autem falso et nulla hec in annis docet et nulla arce et propter hoc diligencius notentur que hic dicta sunt.〉 Et similiter pones omnes stellas quarum (longitudo) 〈latitudo〉 est ab equinoctio versus septemtrionem. Si vero 〈scire〉 longitudo earum ab equinoccio diei [f. 66] versus meridiem, accipies longitudinem eius ab equinoctio ex *d* versus *a*, et iungemus *a* cum illa longitudine (accepta), et extrahes lineam donec abscindat lineam *dh*, cadetque extra circulum equinoctii 〈diei〉 versus meridiem et erit longitudo eius meridiana 〈*i. e.* declinacionem〉 mensurabisque longitudinem et facies circulum qui erit super ipsam longitudinem sicut fecisti in stellis septemtrionalibus 〈si deus voluerit〉.

〈Possunt etiam aliter stelle fixe inscribi per *s* tabulam verificatam ad Parisius per armillas continentes stellas cum distancia earum ab orbe signorum, et cum longitudo [*sic*] earum secundum veritatem que habentur ex circulo magno eunte per polos zodiaci et per stellas ad eclypticam, qui modus inscribendi habetur in quodam capitulo in fine compoti apposito.[1]〉

II. Aptatio Rethis sive Tele Aranee seu Valzagore Rubrica.

[Figura 66v]

Cumque posueris stellas fixas et diviseris circulum signorum oportet ut extrahas tabulam et abscindas eam et non dimittas nisi circulum signorum et (signa) stellarum fixarum. Postquam iunxeris eas circulo signorum, postea lineabis eam et planabis 〈eam〉 optime donec sit planatio eius, et distinctio 〈eius〉 cum tercio [2] ita quod non augeat vel minuat. Similiter facies cum stellis fixis et planabis eam optime, et scribes super omne signum nomen 〈suum et super omnem stellam nomen suum secundum quod est in supra dicta〉, ut est in hac figura. 〈Et〉 sit 〈super〉 caput Capricorni almuri 〈vel *muri*〉 graduum i. e. *ostensor graduum*, quam quidam Latinorum ut in quodam alio libro diximus 'calculatorem' dicunt. Etiam scripsimus super eum in figura 〈hac〉 almuri graduum. Sitque axis huius tabule cuspis circuli equinoctii diei, et iam scripsimus super eum in figura hac axem. Cum autem perfecta fuerit eius explanatio ac descriptio tunc perficietur et hec tabula 〈que〉 vocatur *alhanthabuth* 〈alancabut〉, id est *aranea*, et dicitur *rethe* ut hic patet.

[1] This indented paragraph in MS. Ashmole 1796 is not in MS. 1522 and is undoubtedly a later addition.

[2] circulo.

⟨**De Constitucione Almicantaraz**⟩.

12. De inscriptione circuli hemisperii super latitudinem regionis.

f. 66v.] Post hoc accipies tabulam aliam et ipsa est in qua erit [1] circulus emisperii et circuli qui succedunt eum in directo eius qui dicuntur almuthanthath, quos Latini vocant 'progressiones solis' et ⟨⟨lune⟩⟩ hore atque azimuth.[2] Sitque hec tabula maior tabula alhanthabuth per quantitatem limbi, et primum quod oportet ⟨te⟩ facere in hac figura est ut facies circulum maiorem, ⟨qui extremitas tabule erit⟩, et sit circulus *abcd* et extrahe dyametra eius quousque se abscindant rectis angulis super *e*, eritque linea *ea*, linea medii celi, et linea *eb* linea occidentis, et linea *ed* orientis linea vero *ec* erit linea recessionis. Postea pones *e* cuspidem et facies circulum eius ⟨cuius diametri sit sicut⟩ dimidium dyametrum sit dimidium circuli dyametrum Capricorni, quem fecimus in rethi, et est circulus *zhtk*. Deinde facies super circulum hunc alterum qui sit equalis circulo rethis prope eum. Post hoc divides eum per 360 divisiones et scribes in eo numerum sicut vides in hac figura. Fac eciam in ea circulum per quem vadit caput Arietis et Libre, sicut fecisti in rethi qui est circulus *lmns*, et circulum Cancri qui est circulus *fgqo*. Et erit punctus *a* locus *allidadath* [3] que est armilla reflexa.

13. De inscriptione almucantharach capitulum.

Post hoc debes facere circulum emisperii et circulos qui succedunt eum in directo, id est eque distant, qui sunt almuthanthanth. Ponesque circulum Capricorni, circulum *abcd*, et abscindant se dyametra super punctum *e*, circulus vero Arietis et Libre erit circulus (et) *zhtk*, et punctus allidadath erit punctus *a*. ⟨Divides immo solam quartam ut possint ex illa sumi omnes latitudines regionum.⟩ Divides deinde circulum *zhtk* per 360 divisiones. Postea pones arcum *kl* sicut latitudinem regionis, et arcum *hm* similem eius, arcum quoque *zg* similiter. Postea iunges *g* cum *h* et abscindes dyametrum *ac* super *p*, eritque punctus *p* cenith capitum. Deinde iunges *h* cum *l* et abscindet dyametrum *ac* super *h*. Deinde iunges *h* cum *m* et extrahes *hm* quousque iungatur super *m*, eritque *ns* dyametrum circuli [f. 67] emisperii, quem divides per medium et facies partem circuli abscindentem circulum Capricorni super puncta *v*, *f*, et est pars illa sci. *vsf* ⟨⟨arcus *sfv*⟩⟩ quod si hec absciderit [4] super punctos *hsk* iam invenisti et opus certis-

[1] eris in MS.
[2] MS. reads 'gradus et minute hore' and omits 'azimuth'.
[3] alilacat.
[4] abierit.

simum est. Si vero aliter fuerit errasti: Reitera ergo opus. Postea abscindes ex puncto *m* versus *z* arcum ex 30 gradibus vel 10 vel quot volueris, et sit arcus *mr* et *lq* similiter.

Postea iunges *h* cum *q* et abscindet dyametrum super *i*, deinde iunges *h* cum *r* et extrahes lineam donec abscindetur dyametrum super *o*. Post ⟨hec⟩ divides *oi* per medium et facies partem circuli abscindentem circulum Capricorni ⟨super punctus *yx* similiter⟩. ⟨Vero⟩ non cessabis facere donec pervenias ad punctum cenith capitum, scilicet *p*, secundum quod processit in hac figura; et scribes super almuthanthanth numerum sicut vides in figura.

14. De Divisione orizontis et ayzimucht per arcum.

[Figura 68]

Et post hoc oportet facere azimuth, quorum opus est ut figures tabulam in aliqua tabula lignea cum pice vel aliter ⟨retenabulo⟩ et perficies in ea circulum emisperii. Deinde divides circulum emisperii sicut divisisti circulum signorum per ipsos 3 modos, sed uteris in loco totius declinationis tota altitudine Arietis et Libre in eadem regione ⟨ex positione quid sit altitudo Arietis altitudine autem eius in eadem regione⟩, et ut minuas regionis latitudinem ex 90, et quod remanserit ⟨ipsam⟩ est altitudo Arietis. Et iteremus rationem [1] in eo quod [2] magis propalabitur, si deus vult.

Ponamus igitur circulum emisperii *abcd* et circulum Arietis et Libre *ebxd* et eius diametra abscindat se super centrum *h*, et extrahemus dyametrum *ze* in directo versus *a*, ponemus arcum *td* altitudinem [3] Arietis in eadem regione. Deinde dividemus eum per 2 equalia super *k* ⟨et iungemus *k*⟩ cum *b*, et abscindemus dyametrum *az* super *l*. Postea ponemus arcum *en* 10 gradus, aut quantum vis, et arcum *zm* similem eius. Postea proice arcum qui est super punctum *m* et *l* et *n*, et abscindet ipse arcus circulum emisperii super punctos *s* et *o*. Iterum fac similiter quousque divides reliqua ⟨⟨scilicet⟩⟩ *abcd*. Postea divides quartam *ad* sicut quartam *ab*; et quartam *cb* secundum divisionem *cd* sicut fecimus[4] [f. 67v.] in divisione circuli signorum, et similiter diuides circulum emisperii per 10 et 10 vel per 20 et 20, aut per gradum et gradus, aut per minuta et minuta aut quem volueris ut in hac figura.

⟨¶ *Expositio.* Cum arcus *hm* sit similis arcumque designat latitudinem regionis. Arcus vero *zmh* cum sit quarta circumferencia est similis arcu circuli maioris qui est a cenith capitis per equi-

[1] narracionem. [2] quia. [3] latitudinem.

[4] For the last eleven words, MS. Ashmole 1796 reads: secundum divisionem *cb* quem admodum fecimus.

noxialem usque ad orizonta que similiter est quarta circuli. Erit arcus *zm* similis elevat capitis Arietis in regione tua erit. Patet quod dicta linea *hm* quousque concurrat cum linea *ea* protracta terminabitur semidiameter circuli equidistantis recto contingentis circulum emisperii residua patent ex planisperio.〉[1]

f. 67v.] **15. De inscriptione circulorum azimuth.**

[Figura 68v]

Cum autem diviseris circulum emisperii, constitues in eo azimuth ut sequitur: Fac circulum Capricorni 〈super quem erunt〉 *abcd*, circulum Arietis et Libre 〈super quem erunt〉 *zlym*, et circulum Cancri 〈super quem erunt〉 *htgs*, et circulum emisperii perfectum *lvm*. Deinde dividemus eum per aliquem modum predictum.

〈Unus modus est dividere equinoxialem: alius modus est sumere medietatem declinacionis solis: tercius per illam medietatem in diametro signorum et predictus divisionis equinoxialis arcus dividentes Zodiacum querere, et eodem modo facies hic quos diximus ut〉 et sint eius divisiones *en*, *ns*, *sm*, *mh*, *ht*, *tv*, *vr*, *rp*, *pl*, *lq*, *qo*, & *oe*. Et extrahemus punctum cenith capitum, sitque punctus *k*. Postea queremus arcum circuli qui vadit per punctum *n* et 〈eius〉 nadayr 〈*i. e.* oppositum〉 punctum *t* et punctum cenith capitum. Et sit arcus *nkr*, et abscindet motum Arietis super punctum *z*, et motum Capricorni super punctum *i*, et motum Cancri super punctum [*h*], et faciemus arcum similem predictum 〈predicto arcu *nkr*〉 et erit arcus vadens per punctum *o*, 〈et per punctum *t* qui est oppositus puncto *o*〉 et abscindet hic arcus circulum Capricorni super punctum *d*, et circulum Arietis super punctum *f*, et circulum Cancri super punctum [*a*]. Similiter facies in arcu *skp* et arcu *gkh* et *mkl*, perficiesque positionem horum azimuth per hanc divisionem sub 30 et 30 gradibus. Similiter divides gradum gradui 〈id est per quot gradus volueris divide equinoxialem orizontem et describes azimut transeuntes per cenith capitis〉 aut cui volueris. Scribesque in eis numerum secundum est in figura 〈que ponuntur per 30 et 30, si deus voluerit〉.

f. 68.] **16. Sequitur de modo ponendi horas Rubrica.**

[Figura 69]

Et post positionem azimuth oportet ponere horas ut sequitur: [2] Pone circulum Capricorni *abcd*, et circulum Arietis et Libre *dez*, et

[1] This explanatory paragraph containing the words ‘ circumferencia ’ and ‘ semidiameter ’, which do not occur in the rest of the text, is perhaps a thirteenth-century addition.

[2] et eius positio est secundum quod narrabo.

Cancri *htq*, et quod ceciderit in eo ex circulo emisperii habeat sub se *adhqzc*, et linea *lreb* ipsa vadit per allidadath et per punctum tabule, id est centrum, et ipsa est linea recessionis. Et erit linea *lb* finis 6^{e} hore, et inicium 7^{e}. Et postea divides arcum *ht* per 9 divisiones equales ⟨sint que⟩ *h, m, n, s, o, f, t* et divides ⟨etiam⟩ arcum *de* per 6 divisiones equales, sunt que partes *dk, kr, rx, xy, yp, pe*. Divides eciam arcum *ab* per 6 divisiones equales, et sint ⟨divisiones⟩ *a he, he* et *te* et *te to* et *to ho* et *ho ep*.

⟨Et post hec queres arcum qui vadit per puncta *he, k, m*; et queres eciam arcum qui vadit per puncta *d e, r, n* et est arcus *dern*; et queres quoque arcum qui vadit per puncta *t e, x, s* et est arcus *texs*; et queres arcum qui vadit per puncta *t o, y, o* et est arcus *toyo*; et queres arcum qui vadit per puncta *h o, p, f*. e isque perficiens.⟩ Postea queres arcum eundem per punctum *mkhe*, perficiesque horam primam et scribes super eam 'primam', deinde secundam, terciam, quartam, quintam, sextam, ut est in hac figura. Postea divides reliquas horas secundum primam divisionem, et scribes super eas 8, 9, 10, 11, 12, ut est ibidem. Et scribas apud horam primam 'occidens', et apud ⟨horam⟩ 12 'oriens'. Deinde scribas in ea latitudinem regionis in loco descripto. Postea cum feceris horas perficietur ipsa facies illius tabule, et hoc modo facies ceteras longitudines regionis eiusdem tabule ⟨⟨si deus voluerit⟩⟩.

⟨Finit opus Astrolabii secundum Marcellania benedictus Deus. Amen.⟩[1]

f. 68v.] **17. De proieccione spere in planum. Capitulum co.**

Concussio siue extensio immo magis proiectio spere in planum per visum fit hoc modo. Sit planum linea *mbn*, axis spere linea *ab* stans ortogonaliter super planum *mbn*, ita quod polus septemtrionalis contingat planum *mbn* in puncto ⟨*b*⟩. Alter uero sit meridionalis et maxime distet a plano in puncto *a* qui et oculus videntis sit; colurus transiens per maximas solis declinationes fit *abcd*; linea quoque *cd* equedistans planum est equator diei, *ef* tropicus Cancri, *gf* tropicus Capricorni, et hii duo eciam distant eque a plano. Linea uero *ef* est eclyptica. Exeant igitur a puncto *a* poli australi[s] ab australi polo, scilicet ab oculo videntis, due linee per duas extremitates equatoris sci. *c* et *d* ad duo puncta in plano per *z, x*, eritque linea [id est] *px* dyameter equatoris: et ab eodem puncto ⟨*a*⟩ alie due linee scilicet per *e, h* extremitates tropici Cancri veniat in planum in punctis *z* et *y*,

[1] After this pious ending MS. Ashmole 1796 continues with 'Nomina instrumentorum sunt haec', p. 217.

et hec linea *y* erit dyameter eiusdem tropici in plano. Similiter et alie due linee per *gf* extremitates tropici Capricorni plano incidentes in punctis *m* et *n* faciunt ex ipsa linea *mn* dyametrum Capricorni in plano. Extractis igitur super medietatibus dyametrorum quorumlibet in linea *mbn* signatiuarum circulus, sicut circuli in plano primi ex spera per visum proportionaliter proiecti.

f. 69] **18. Puncti in spera equidistantis zodiaco in planum proieccio Rubrica.**

[Figura 70]

Si autem cuiuslibet puncti in spera equedistantis eclyptice in plano proicere velimus, sic fiet. Circulus *ab* transiens per polos mundi, qui sunt *a* et *b*, *b* autem contingens planum; et linea *bmn* est communis sectio circuli *ab* et plani, *cd* est dyametrum equatoris, ⟨*e*⟩*f* dyametrum zodiaci, *gh* dyameter unius ex equantibus zodiaco qui sunt ad partem septemtrionis, *kl* dyameter alterius equedistantis zodiaco qui est ad partem meridiei. Unde uterque duorum arcuum *ce* et *df* est declinatio zodiaci ab equatore, duo autem arcus *eg* et *dh* sunt 2 maxime declinationes circuli cuius dyameter *gh* ab equatore. Eodemque modo duo arcus *ck* et *dl* sunt due maxime declinationes circuli cuius dyametrum *kl* ab equatore transeant ergo linee *akon*, *acp*, *aexq*,[1] *agir*, *ahzy*, *adx*, *afru*, *alsn*, eritque punctus dyameter equatoris qui transibit per *a*, nam cum sit *ei* equalis *iu* ei quoque [69v.] *pb* equalis *ux*. Item *zn* erit dyameter zodiaci qui eciam transibit per *a* quoniam ipse dividit equatorem per aliqua equalia. Et *iz* erit dyameter in plano circuli cuius *kl* est dyameter in spera; ⟨⟨At *xv*, *mn* erit dyamet in plano circuli cuius *kl* est diam.⟩⟩ eritque eciam arcus *pq* similis [2] arcui *ce*, uterque enim ⟨⟨subtenditur angulo⟩⟩ subitur [3] arcui *paq* in circumferentia utriusque circuli existenti; et *pr* est similis arcus *gt*, propter eandem causam, et *po* similis *ck*. Eodemque modo et propter eandem causam arcus *xs* erit similis *dl*, et *xy* similis *dh*. Cum igitur aliquem equedistantem zodiaco vis depingere in plano, si fuerit meridionalis a zodiaco, sume in equatore a puncto *x* versus *a* arcum unum equalem arcui composito ex declinatione zodiaci ab equatore, et illius circuli pingendi a zodiaco, ut est hic arcus *xs* qui componitur ex arcu *xt*, qui est declinatio zodiaci ab equatore, de declinatione huius si potes a zodiaco ut hic *pq* de arcu *oq* et residuum quod est *po* sume a puncto versus *a* quod si non potes subtrahere declinationem zodiaci ab equatore de

[1] Letters altered to agree with Fig. 70. [2] Twice repeated in MS.
[3] MS. has 'sub dicitur'.

declinatione [f. 70] huius a zodiaco de declinatione zodiaci ab equatore, et residuum sume a puncto *p* non versus *a* sed versus partem oppositam, protrahe itaque *as* et *ao* usque secent dyametrum *mbn* in puncto *m* et *n*, eritque *om* dyametrum circuli quod queritur.

Si autem ipse fuerit semptemtrionalis ab orbe signorum, sume declinationem compositam sub *p*, et differentiam 2 declinationum sub *x*, si declinatio zodiaci ab equatore est minor ut supra; si est major et subtrahe lineas ab *a* que rescindent dyametrum qui est dyametrum *mbn* circuli *zz* qui queritur ut satis patet in figura.

f. 70v.] **Tabula stellarum fixarum que ponuntur in astrolabio cum gradibus quibus celum mediant et cum distancia earum ab equinoctiali linea.**

[*See* f. 70v.]

f. 71.] **Tabula stellarum fixarum verificatarum per armillas Parisius.**

[*See* f. 71.]

f. 71v.] **19. Alius modus faciendi Azimut est talis.**

[Figura 71v]

Possunt etiam azimuth hoc modo fieri: Sint 3 circuli ut prius *abcd* Capricorni, *fghi* Arietis, *lmnp* Cancri, accipe igitur a puncto *h* de quarta[1] *hg* 18 gradus latitudinis ut sit *k*; et tantumdem a *bf* de opposita quarta *fi* ubi sit *q*, 2 ubi linea a *g* in *k* protracta dyametro *ac* decurrit sit *r*, ubi uero linea a *g* in *q* protracta

[1] 14 in MS.

dyametro *ac* occurrerit sit *s*, quod cenith. Deinde super *rg* diuisi per medium in puncto *x* describe primum azimuth, et sit eius ea pars que incidit in circulum orizontis; in annua reliqua uero *q* occulta *q* postmodo delebitur que necessario transibit per puncta *gi* sicut orizon. Communiter[1] diuisis per medium semicirculi *sgr*, *ris* in punctis *z o*, eice lineam in utramque partem transeuntem necessario per centrum *x* in linea *n*. Inuenies centrum reliquorum azimuth hoc ordine diuides, scilicet portionem primi azimuth que est 12 in 41 partes equales quelibet sit maior quarta imposita tamen est 4 et prima contra a *br* sit *rt* secunda *tx* quarta *yz* itaque ubi linea a puncto *s* quod est cenith ad partes tantum nouas deducte, scilicet ad secundam quartam octauam et deinceps pretermissis in partibus dyametrum primi azimuth tetigerit centrum reliquorum azimuth statuentire et omnes per 8 circuientur ita ut partes eorum orizontem uel circulum Capricorni excedentes minime figurentur. Et sic inuenies ad dextram centri 18 centra secundum numerum eorumdem ac parem distanciam. Similiter facies ad sinistram 10. Et nota quod cum facis divisionem quartarum per 90 ubi quelibet nota continet 10 gradus et inde exibunt azimuth continentes 5 gradus, et si fieret divisio quartarum ad 20 exirent azimuth ad 10 gradus in subdupla proportione.

f. 72.] **20. Alius modus faciendi Azimuth levior et planior predicto.**

Fac circulum Capricorni *abcd* et equatorem *gfeh* super centrum *i*, et faciemus partem circuli *bfhd* ortogonaliter secantes se super *i*, sitque punctus *k* cenith capitum, rursum posito centro in dyametro *ag* in continuum directum protracta super punctum *o* circulum transeuntem per *hkf* puncta qui sit *kflnmh* protrahemusque dyametrum *nl* equedistanter *hf* in utramque partem quam oportuerit; et diuidemus semicirculum *mlk* per 3 uel quinos gradus, uel denos, prout volumus facere azimuth. Et punctum *m* qui est punctus oppositus summitati capitum coniungemus cum unaquaque illarum divisionum usque ad lineam *ln*, sintque linee producte *mp*, *mr*, *ms*, *mt*, *ml*, *mu*, *mx*, *my*, *mz*, *msf*. Post hoc posito centro super puncta *pqr* et cetera describe circulos transeuntes per punctum *k*, qui est cenith capitum; et illi si perficerentur transirent per punctum *m* qui est oppositus cenith capitum, qualiter cum per opposita transeant in spera erunt omnes ex circulis maioribus, horum autem circulorum solum facies partes apparentes supra circulum emisperii usque ad circulum Capricorni, eruntque inter quoslibet 3 ex circulis illis tot gradus quot intercipiebantur inter divisiones semicirculi *kflm*. Cum autem

[1] The reading is doubtful.

hoc feceris sume de linea *ln* aperte 11 partes equales *osf, oz, oy* et cetera. Et super illa puncta positis centris describe circulos transeuntes per *k*, eruntque illi azimuth. In aliis 2 quartis factis similiter sicut priores totidemque gradus inter se intercipient quot priores, et huius est figura supra.

f. 72v.] **21. De inscriptione linee crepusculi et aurore capitulum. R[ubrica].**

Cum vis ponere lineam crepusculi et aurore, describe equedistantem orizontem sub eo ad partem puncti oppositi cenith capitum cuius latitudo ab orizonte 18 graduum ad tot enim gradus sole exeunte sub orizonte app[aret] lux solis sub orizonte. Illum autem hoc modo describes: fac circulum Capricorni *abcd*, et Arietis et Libre *efgh* super *i*, quos quadrabis duobus dyametris se ortogonaliter abscindentibus super *i*, sicut *adcb*; et sumes latitudinem regionis ab *f* versus *e* in equatore que sit *kf*, item ab *h* versus *g*, que sit *hl*, et ducantur linee *fk*, *fl*, que occurrant diametro *ae* quantum expedit in continuum et directum super punctum *oq*, diversaque linea *oq* describatur super primum medium pars circuli *thqfs*, qui erit circulus emisperii. Post hoc sumantur *abk* uersus *f*, et *abl* uersus *g* arcus 18 qui sunt *km* inductisque lineis *fm*, *fu* occurrent linee *ac* super puncta *p*, *r*, lineam ergo *pr* diuidemus per medium et in puncto medio posito centro describemus partem circuli *urs*, qui erit circulus equedistans orizonti cuius ab oriente latitudo erit 18 graduum et ipsa est linea crepusculi et aurore, cuius est figura supra scripta.

f. 73.] **22. De inscriptione stellarum fixarum capitulum.**

Cum diuiseris circulum signorum certissime oportet te postea describere stellas fixas in circulo signorum hoc modo: Ponemus circulum equinoctii diei et Arietis et Libre ex puncto *d* versus *e* declinationem solis, id est 24 gradibus, et pones ibi te *x* in parte opposita; similiter ex *b* versus *a*, et pones ibi *x*, deinde pone regulam super *tx*, id est super tantum numeri 24 gradus utrumque et duces lineam occultam ex *t* in *x*. Postea considerabis in tabula stellarum fixarum stellam quam vis ponere in circulo signorum in quo fuerit, et eius longitudinem et latitudinem, septemtrionalis vel meridionalis sit. Quod si fuerit septemtrionalis numerabis in circulo Arietis et Libre a puncto *s* versus *d* tot gradus quota est latitudo illius stelle, et pones ibi *v* in parte opposita scilicet ab *x* versus *a* et pones ibi *y*. Deinde pone unum caput regule super punctum *c* qui est caput Arietis et aliud caput super finem latitudinis stelle id est super *v*, et

notabis contactum regule et dyametri *hb*, et pones ibi *r*. Postea pones similiter unum caput regule super punctum *e* et super *r*, et ubi regula abscindet dyametrum *hb* pones notam *s*. Postea fac circulum transeuntem per notas *rs*, et in hoc circulo summitas stelle illius esse debet. Tunc considera in tabula fixarum longitudinem dicte stelle in quo gradu cuius signi fuerit, et per totum numerum gradus illius et per totum numerum nadayz eius, videlicet ab exteriori circulo zodiaci et per polum signorum ⟨⟨zodiaci⟩⟩[1], id est per punctum *k* fac transire unum pedem circini equaliter et ubi circinus absciderit circulum *rs* ibi erit summitas illius stelle. Et si cum gradu illius longitudinis et latitudinis fuerint minuta, accipe de gradu sequenti sextam partem si sint 10 minuta, si 15[2] quartam partem, si 20 terciam, et sic de aliis, et fac ut supra[3] [et hoc in stellis septemtrionalibus. Si uero sit meridionalis, iterum numerabis in circulo Arietis et Libre a nota declinacionis scilicet *at* versus *c* tot gradus quota est latitudo eius. Et in parte opposita similiter ab *x* versus *b*, et ibi nota; et pone regulam super unam illarum notarum et super capud Arietis, scilicet super *c*, et ubi abscinderet dyametrum *hb*, fac notam in directo. Et super aliam notam similiter pone regulam [et] super *c*, et ubi abscinderet dyametrum *hb*, fac notam. Postea circulum secundum longitudinem illarum duarum notarum in diametro; et in hoc circulo erit summitas illius stelle. Tunc considera in tabula stellarum fixarum in quo gradu cuius signi fuerit. Et fac transire equaliter unum pedem circini per terminum numeri illius gradus et per terminum nadair eius, scilicet ab exteriori circulo zodiaci et per polum zodiaci scilicet per *k*. Et ubi circinus abscinderet circulum ad duas notas dyametri, ibi erit summitas illius stelle. Et similiter pone omnes stellas meridionales. Sic autem inuenies polum zodiaci: Numera a puncto *a* versus *d* in circulo Arietis 24 gradus, et pone ibi notam, et super notam illam et super *c* pone regulam, et ubi abscinderet dyametrum *db*, fac notam *k*; et nota illa erit polus zodiaci ut patet in ha[c] figura.]

Explicit sciencia composicionis astrolabij.

[1] MS. reads ydyaci ve. [2] 'ıı' in MS.

[3] The concluding paragraphs are derived from MS. Ashmole 1522, ff. 94v, 95.

II. DE OPERATIONE VEL UTILITATE ASTROLABII

The headings of the sections in brackets ⟨ ⟩ have been taken from Reisch's printed text, which preserves many interesting variants.

Nomina instrumentorum sunt hec. Primum est armilla suspensoria ad capiendam altitudinem, et dicitur arabice alhahucia. Secundum est alhabor, id est, ansa que iungitur ei. Postea mater, rotula scilicet, in se continens omnes tabulas cum aranea, cui coniungitur margolabrum scilicet in .360. gradus diuisum. Tabule autem ab hac contente figurantur tribus circulis quorum minor est circulus cancri, et medius est circulus equinoctialis, et maximus circulus capricorni. Postea circuli almucantherath, qui sunt circuli in medietate superiori descripti quorum quidam sunt integri, quidam apparent imperfecti; quibus prior est orizon, et diuidit duo emisperia. Centrum autem interioris almucantherath cenit capitum nominatur. Deinde est azimuth, qui sunt partes circulorum almucantherath intersecantes. Post quas sunt hore, in medietate inferiori descripte. Inter horas .2. sunt crepusculorum linee. Postea linea medii celi, que est linea descendens ab armilla per centrum in oppositam partem astrolabii, cuius medietas a centro in armillam dicitur linea meridiei; et alia dicitur angulus terre et medie noctis. Post hec et sequitur alhanthabuth, id est aranea, in quo sunt signa cum zodiaco constituta, stelle quoque fixe, in quo via dicitur esse solis; et quicquid fuerit infra motum capitis arietis et libre, ex hoc zodiaco, septemtrionale; quod autem extra, meridianum. Sequitur almuri, quod ostensor dicitur latine, denticulus scilicet, extra circulum capricorni; in alhanthabuth relictus deinde almenath, id est, foramen quod est in medio rethis; in quo est axis retinens tabulas climatum, in quam intrat alphaeraz, id est, equus restringens araneam cum rotula, quasi cuneus. Et in illa parte matris sunt .2. circuli equationis solis exterius, quorum unus continet numerum dierum anni .365., et scribentur sub eo nomina mensium. Et alius signorum

gradus, et infra eum scribuntur nomina signorum. Postea quarta capiende altitudinis. Postea quadrans, cuius latera in .12. puncta diuisa sunt. Sequitur regula, que circumuoluitur in dorso astrolabii, in qua sunt tabule perforate, ad capiendum altitudinem solis in die, stellarum in nocte.

1. [De gradu solis inveniendo capitulum.]

Cum uolueris scire gradum solis, pone regulam super diem mensis presentis, et gradus a summitate eius tactus erit gradus solis, qui cuius signi sit uidebis, et eum ex alia parte nota in zodiaco in rethi. Notabis et nadayz eius, quod est simul gradus ·7. signi. Diem quoque mensis per gradum solis inuenies; posita enim regula super gradum solis diem quesitum ostendet.

2. De altitudine solis et stellarum inuenienda capitulum.

(4 lines omitted)

Cum vis altitudinem solis scire, suspende astrolabium de manu tua dextra per eius armillam, et sinistro tuo latere soli opposito, subleua vel deprime regulam, donec radius solis per utriusque tabule foramen transeat; quo facto, vide quot gradus a linea orientali eleuatur regula, et est solis altitudo; similiter facies in nocte, per stellas fixas ⟨visas per foramina⟩.

⟨3. De inventione hore inequalis et signi ascendentis.⟩?

Si autem vis scire certitudinem hore et etiam ascendentis, pone gradum solis super almucantherath altitudinis, ex parte orientis, si altitudo sit ante meridiem; aut ex parte occidentis, si altitudo sit accepta post medium diem; et super quam horam ceciderit nadayz gradus solis erit hora presens, et signum quod fuit ex parte orizontis orientalis, est oriens, id est, ascendens; quod uero in occidentali, occidens. Quod uero ceciderit in linea medii celi est in medio celo, et eius nadays angulus terre.

Et si ceciderit inter duo almuchantherath, vide differentiam numeri inter almuchantherath precedentem et altitudinem solis, et denomina differentiam de numero longitudinis almuchantherath, quod est .6., si almuchantherat continet .6. gradus et .6.; quod si almuchanterath contineat .3. gradus et .3., denomina partem illorum de .3.; et sic de aliis. Postea scito motum almuri ab initio primi almuchanthanth usque ad inicium secundi de gradibus marginis; et pone super illorum partem denominatam ab eis, secundum proportionem differentie dicte, ex .6. vel de .3. gradibus; et tunc habebis certum gradum inter duo almuchantherath; et tunc considera eas horas, &c., sicut dictum est superius. Si illud idem in nocte scire desideras, accipe

altitudinem alicuius stelle, in alhanthabuth descripte, que transit ex parte orientis uel occidentis; et pone cacumen illius stelle in almucantherath sue altitudinis, et gradus solis indicabit tibi horas noctis, sicut nadayz eius diei; de aliis fac omnibus sicut dictum est in superioribus.

4. De crepusculo vespertino et matutino.

Cum uolueris scire finem crepusculi uespertini et inicium matutini, vide cum uenerit gradus solis ad lineam crepusculi occidentalis; tunc est finis eius; et cum ad orientalem, est inicium crepusculi.

Aliter idem.

Uel sic; vide quum nadayz solis uenerit ad .18. gradum almuchantherath in oriente, erit finis crepusculi uespertini; et cum venerit ad .18. gradum almuchanthanth in occidente, est initium crepusculi matutini; et hec est leuis. ⟨ ⟩[1]

5. De inuencione arcus diurni et nocturni : Rubrica.

Si vis scire arcum diei et noctis, pone locum solis, id est, gradum in quo est super primum almucantherath; et nota locum almuri inter gradus limbi; post hec moue gradum solis usque ad occidentem; et nota etiam locum eiusdem in ipsis gradibus; et motus eius ab una nota in aliam est arcus diei; reliqua uero pars circuli est arcus noctis, quia illa duo continebunt .360. gradus, que est quantitas diei et noctis; similiter facies de stellis fixis, si uolueris scire earum moram super terram.

6. De quantitate horarum diei inequalium.

Si volueris quantitatem horarum inequalium diei scire, diuide arcum diei per .12., et habebis numerum graduum hore diurne; quem si subtrahis a .30. remanebit numerus graduum hore nocturne, quia hora inequalis nocturna cum hora inequali diurna facit .30. gradus in omni die, qui sunt due hore equales.

⟨De horis inequalibus⟩

(6 lines)

⟨De horis inequalibus diei⟩

(17 lines)

⟨De inventione horarum equalium⟩

Si horas diei uolueris querere equales, diuide arcum diei per .15, et habebis numerum horarum equalium; similiter in nocte.

[1] Reisch, afterwards referred to as R., adds 4 lines here.

7. De parte hore partita inueniенda per almuri capitulum. ⟨De partibus horarum⟩.

Cum transierit pars hore, et uolueris scire quota pars sit hore, scito numerum graduum in labro ab inicio hore illius in almuri; et quomodo ille numerus se habebit ad numerum totius hore, sic pars transacta se habebit ad totam horam.

8. De numero horarum diei equalium preteritarum inueniendo capitulum.

Si uolueris scire quot hore equales transierunt de die, accipe gradum solis, et pone super almuchanthanth altitudinis et signa locum almuri in gradibus. Postea uolue retro gradum solis usque ad primum gradum almuchantherath in oriente; et secundo nota eiusdem locum; post hec diuide gradus qui sunt inter .2. notas per .15., et habebis horas equales. Similiter facies de nocte; postquam enim inueneris horam inequalem per gradum et altitudinem alicuius stelle, signato loco almuri, reduces gradum solis ad orizontem occidentalem, et notabis iterum locum almuri. Spacium inter hec duo loca diuides, sicut prius, per .15. scilicet, et inuenies. Eodem modo scies quot sint hore equales inter meridiem et quemlibet punctum alium, et quodlibet instans.

9. De conuersione horarum inequalium in horas equales: [1] Rubrica.

Si volueris reducere horas inequales in horas equales, scito gradus horarum inequalium, quot sint; et diuide eos per .15., et habebis horas equales; similiter facies de horis equalibus.

10. De altitudine solis in meridie habendo capitulum.

Si uolueris scire altitudinem solis in media die, quod est inicium recessionis, pone gradum solis super lineam medii celi; et numerus graduum almucantherath a loco solis in orizontem est altitudo eiusdem medie diei. Similiter fac cum stellis fixis.

11. Inuencio hore diei per allidadam: capitulum.[1]

Si per allidadam horariam uis scire horam diei naturalem, pone allidadam super altitudinem medie diei illius in dorso astrolabii suspensi; et uerte dorsum ad solem tam diu donec umbra vniuscuiusque anguli superioris pinnule cadat in allidada, quelibet in directo sui lateris; et vbi occiderit in diuisionibus erit hora quesita.

[1] Omitted by R.

12. De eodem inueniendo per lineas.

⟨De inventione horarum inequalium uso astrolabii⟩

Item per allidadam in dorso et lineas horarum inter latera gnomonis, si sint posite ut in quadrante, sic. Super altitudinem solis meridianam in illa die pone allidadam; et nota vbi meridianus circulus, id est, linea finis .6. hore, secuerit lineam fiducie ipsius allidade; et pone ibi signum de incausto; et illud signum valet situationem margarite in quadrante; deinde accipe altitudinem solis in quacunque hora vis, et illud signum inter horas dabit horam naturalem, ut in quadrante.

13. Capitulum preambulum adquedam sequencia.[1]

Amplius scito quod circulus signorum diuiditur in .2. semicirculos, quorum vnus est a capite capricorni in caput cancri, et alius a capite cancri in caput capricorni; et caput capricorni est solsticium hyemale, caput cancri estiuale. Scito et quod omnis duo equidistantes gradus ab aliquo horum solsticiorum sunt vnius declinacionis versus septentrionalem vel meridiem; et dies eorum vel noctes sunt equales, et umbre et altitudines in media die sunt equales.

14. De gradu solis ignoto per rethe habendo.

Si volueris cognoscere gradum solis ignotum, pone notam super altitudinem medie diei, quam sumpsisti prius per regulam in dorso astrolabii; deinde uolue rethe, cadentque duo gradus super ipsam notam; quorum vnum scies esse gradum solis per signum mensis cuius fuerit dies.

15. Quis dies cui diei sit equalis.

⟨De equalitate dierum⟩

Si volueris scire que dies cui diei sit equalis, scies hoc per gradum equedistantem a solsticiis, quia eorum dies sunt equales, sicut dictum est superius.

16. De inuencione gradus stelle cum quo celum mediat.

⟨De gradu longitudino stelle⟩

Si uolueris scire cum quo gradu uenit stella aliqua ad medium diem, uel oritur; pone stellam super lineam medie diei, quia gradus qui cecidit super eandem lineam est gradus quesitus; similiter fac ad lineam orientalem et occidentalem. Gradum uero longitudinis habebis per filum positum super polum zodiaci, per totam declinacionem inuentum.

[1] Omitted by R.

17. De altitudine cenith solis habendo.[1]

Si uolueris cenith solis scire, accipe altitudinem eius hora qua uolueris hoc scire, et pone gradum solis super almucanthanth altitudinis in parte qua fuerit, sicut facis ad inuentionem horarum. Post hec, accipe quid congruit gradui solis de azimuth, et super quem gradum sit cenith de quarta que opponitur; et necesse est ut hec quarta sit meridiana orientalis, uel septentrionalis orientalis; aut occidentalis meridiana, uel septentrionalis occidentalis; et similiter facies de stellis fixis per earum altitudines.

18. De cenith ortus solis habendo, et aliorum planetarum.

Et si uolueris scire cenith ortus solis, vel alicuius stelle fixe, pone gradum solis uel stellam super orizontem orientalem, et aspice quid sibi accidat de azimuth, similiter quam sit ortus; et hoc est cenith ortus, et super simile eius erit occasus in simili eius quarta, siue orientalis, siue meridionalis fuerit.

19. De quatuor plagis mundi: Rubrica.

Ad habendas quatuor plagas mundi veraciter, accipe altitudinem solis ut supra, et vide in qua quarta sit; deinde vide in qua altitudine ipse gradus solis sit inter lineas azimuth in principio quarte orientalis, que incipit a coluro septentrionali siue a medie noctis linea, a qua incipies computare; et quotus fuerit numerus, tantum sume in dorso astrolabii, ab ipso coluro uersus armillam, procedendum per orizontem, si est ante meridiem, vel per occidentem, si est post meridiem; et vbi numerus idem finitur, ibi pone regulam; deinde astrolabium utraque manu tenens, sursum uersa eius posteriori superficie, diligenter te oppone soli, donec radius solis transeat per ambo foramina; tunc caute illud pone super terram, ut non moueatur ad aliquam partem; habebis quatuor lineas in centro astrolabii concurrentes, quatuor mundi plagas directe oppositas indicantes, scilicet orientalem, occidentalem, &c.; similiter operabis in nocte per stellam fixam. Vel locata iam regula in dorso astrolabii, sursum uersa eius facie, eque distanter orizonti ut proximo dictum est, fac umbram amborum angulorum pinnule cadere super .2. latera regule, scilicet, dextram umbram super latus dextrum, et sinistram umbram super sinistrum latus; et statim habebis quatuor lineas et quatuor plagas mundi predictas.

[1] Omitted by R.

20. De declinacione cuiuslibet gradus ⟨signorum⟩ habenda.

Si scire uolueris declinacionem cuiuslibet gradus signorum, pone super lineam medii celi uel diei, et scito eius altitudinem ab oriente; postea scito altitudinem capitis arietis et libre in eadem linea; deinde scito altitudinem utramque, et differentia ipsarum altitudinum est declinatio eiusdem gradus ab equinoctiali linea. Si autem gradus signi fuerit septentrionalis, est declinacio septentrionalis; si meridiana, meridiana. Scito etiam quod gradus signorum septentrionalium sunt altiores equinoctio, quod est in capite arietis et eius opposito; et meridionalium inferiores, secundum declinationes eorum ab eo. Maior autem declinacio est in capite cancri et capricorni: eodem modo inuenies declinacionem stellarum fixarum.

21. De altitudine poli vel latitudine regionis.

Scito quod altitudo regionis sit latitudo cenith capitum ab equinoctiali circulo uersus septentrionalem vel meridiem, que similis est altitudini poli septentrionalis, et depressioni eius oppositi ab orizonte, que duo sunt in parte equales. Cum ergo latitudinem cuiusque regionis scire uolueris, altitudinem solis in media die considera, quam minues de .90., si fuerit sol in inicio arietis et libre, et quod est residuum erit latitudo regionis; tunc enim motus solis erit in equinoctiali linea. Si uero in alio gradu fuerit sol, eiusdem gradus declinacionem considera per tabulam declinacionis solis, uel per regulas ante datas; quam minues de altitudine solis in medio die, si fuerit septentrionalis; si uero meridionalis, adde illam; et habebis altitudinem inicii arietis in regione illa, quam subtrahes sicut predictum est a .90., et quod remanserit est distancia regionis ab equinoctiali linea.

22. De eodem, scilicet aliter, capitulum: Rubrica.

Uel si volueris accipere altitudinem cuiusuis stelle altiorem, et eius elongacionem ab equinoctiali linea considera; cum qua fac ut supra dictum est. Vel quere cuiusuis stelle non occidentis in eadem regione altitudinem altiorem et inferiorem, et utriusque ⟨simul⟩ collecte tolle medietatem, que est altitudo poli in eadem regione.

23. De noticia tabule almucanterath.

⟨De rotulis matris temporum almicantarath⟩

Si uis scire ad quam latitudinem facta sit tabula almucantheralis, vide in linea meridiana quot almucantherath sint in circulo

equinoctiali usque ad cenith, vel ab axe ad orizontem in septentrione; et super tantam latitudinem facta est tabula: altitudo uero arietis est tot graduum quot fuerint ab eodem circulo ad orizontem, vel a cenith ad axem.

24. De horis inueniendis per tabulas latitudinis: Rubrica.

⟨De inventione horarum per astrolabium ubi non habetur tabula⟩

Cvm in aliquo regione, cuius latitudo in tabulis astrolabii non fuerit descripta, uolueris inuenire per illud astrolabium horas illas, regionis latitudinis et latitudinis maioris propinquioris sibi et minoris ibi descripte nota differentiam; deinde proportionem illius differentie ad differentiam que est inter minorem latitudinem ibi descriptam et maiorem, inter quas videlicet est latitudo regionis illius, memorie commenda. Postea uero accepta solis altitudine in eadem regione, quere horas per latitudinem minorem, et similiter per latitudinem maiorem, et harum horarum diuersarum differentie tolle partem proportionalem, secundum proportionem differentie superius sumptam; quam partem addes horis minoris latitudinis, si fuerint pauciores horis maioris latitudinis, vel subtrahes ab eisdem, si fuerint plures; et que tunc remanserint erunt hore illius regionis; similiter facies in horis noctis et in aliis operibus.

25. De gradu solis ignoto habendo.

⟨De inventione gradus solis per alhentabuth rethi⟩

Cvm qualibet die gradum solis per alhanthabuth uolueris inuenire, altitudinem eius in media die considera, quam notabis in almucanthanth in meridiana linea; tunc quartam circuli signorum in qua fuerit sol gira; et gradus qui continget notam altitudinis in media linea est gradus solis.

26. De longitudine inter duas regiones habenda per eclypsim.

Longitudo regionis ab alia est distancia meridiani circuli vnius a meridiano circulo alterius. Cumque uolueris scire longitudinem inter .2. regiones, considera inicium eclypsis lunaris, per quot horas equales distet a medio precedentis diei in utrisque regionibus. Deinde minue horas vnius regionis de horis alterius, et que remanserint erunt hore longitudinis inter utrasque; multiplica ita ea in .15., et habebis quot gradus sit earum longitudo ab inuicem. Longitudines quarundam regionum, hoc est, elongationes circulorum earum meridianorum a meridiano circulo

ultime regionis habitabilis in occidente, et earum longitudines et distancias ab equinoctiali circulo notabimus in quadam tabula sufficienter.

27. De eodem in miliaribus capitulum.

⟨De distantiis civitatum⟩

Si quot miliaria sint inter .2. regiones a se inuicem distantes noscere queris, longitudinem et latitudinem inter utrasque considera; deinde longitudinem in se ductam latitudini in se multiplicate aggrega, et collige; inde summe tolle radicem, et unicuique gradui ipsius radicis et dimidio da .100. miliaria; et per tot miliaria distat vna regio ab alia. Si autem earum latitudo fuerit eadem, fac cum gradu longitudinis tantum, sicut deberet fieri cum gradu radicis. Si uero longitudo fuerit vna, fac cum latitudine tantum, et inuenies quod queris.

28. Scientia ascensionis signorum in circulo directo.

Si autem ascensiones signorum in circulo directo scire desideras, inicium cuiusuis signi super lineam meridianam pone, et locum almuri in margine nota; postea moue rethe donec finis signi cadat super lineam meridiei, et gradus quibus mouebitur almuri erunt ascensiones eiusdem signi; et similiter facies ad quamlibet portionem circuli.

29. De ascensionibus signorum in circulo obliquo.

Ascensiones autem signorum in qualibet regione sic poteris inuenire; moue rethe ab inicio signi usque ad finem eiusdem, et gradus quibus mouetur in margine almuri erunt ascensiones signorum in eadem regione; mouebis enim signum in orizontis parte orientali, ut scias eius ascensionem: ut autem scias eius moram in occasu, mouebis illud in orizontis parte occidentali; ita etiam fiet in qualibet circuli portione. Gradibus eciam ascensionum diuisis per .15., et residuo pro horis fractibus (*sic*) computato, habebis horas equales, uel eis diuisis per numerum graduum hore inequalis, patebit per quot horas naturales uel inequales, cum fractionibus, quodlibet signum uel planeta uel quelibet portio ascendat uel occidat in qualibet regione.

30. De noticia stellarum incognitarum positarum in astrolabio.

Ut habeatis noticiam stellarum incognitarum que posite sunt in astrolabio, sume primo altitudinem alicuius stelle note, et pone eam in almucantherath, super similem altitudinem; postea vide stellam quam uolueris scire, super quantam altitudinem iaceat

inter almucantherath, et in qua parte sit, scilicet, in oriente vel occidente; quo uiso, pone eam in dorso astrolabii super eandem altitudinem, et verte illud ad eandem plagam celi in qua accepisti stellam; et maior stella quam vides per foramina regule ipsa est quam queris.

31. De noticia stellarum incognitarum non positarum in astrolabio.

⟨De vero motu stellarum⟩

Scire uolens gradum stelle ignote, in astrolabio non posite, uel planete, expecta donec ille planeta vel stella sit in meridie; deinde visa aliqua stella cuius locum pro certo scias et astrolabio insignite, secundum altitudinem eius rethe dispone, ponendo stellam inter almuchantherath super similem altitudinem; et directo gradus signorum qui erit in linea medii celi erit stella de qua dubitas, et est longitudo eius nota; latitudo patet, computatis almucantherath a nota illius altitudinis usque ad equinoctialem. Potes eciam per occasum solis rethe tuum disponere, si nullam stellam cognoueris, et sic cognosces omnes stellas.

32. Ad sciendum in quo gradu signi luna sit: Rubrica.

⟨De loco lunae vel cuiusque planete⟩

Cvm in quo gradu signi luna sit scire uolueris, altitudinem lune considera; et eam in almucantherath, in parte in qua fuerit, nota; deinde stellam aliquam in rethi constitutam super altitudinem suam in eadem hora cum altitudine lune acceptam, in parte qua fuerit, pone; et gradus circuli zodiaci qui ceciderit inter almucantherath super altitudinem lune, eritque gradus lune. Si autem apparuerit in die, idem facies cum altitudine illius et altitudine solis. Considera igitur cuius signi sit gradus. Idem poteris quoque eodem modo planetarum loca inuestigare, si eorum altitudinem in nocte poteris notare.

33. De loco lune inueniendo capitulum.

Cvm in quo gradu sit luna scire desideras, quot dies habeat mensis lunaris in eadem die considera, quibus duplicatis, quod collectum fuerit distribue per .5., dando cuilibet signo .5., et incipias a signo in quo fuerit sol; et vbi numerus finierit, in eodem signo est luna; et si remanserit, id est, infra .5., iam perambulauit luna .6. gradus.

34. De locis planetarum inueniendis.

Loca planetarum poteris in alio modo inuestigare, et verius. Sume altitudinem planete quum est iuxta lineam medii celi, et serua eam. Item, sume ad eandem horam ascendens per aliquam stellarum fixarum, et hoc serua eciam cum hora; posthec vide quum ille planeta incipiat descendere a linea medii celi, et sume eius altitudinem quum sit equalis altitudini prius sumpte ante lineam medii celi; et iterum in eadem hora sume ascendens et horam per aliquam stellam fixam; deinde sume medium inter ascendens primum et secundum per almuri in limbo; et gradus qui ceciderit tunc super lineam medii celi, in illo est planeta.

35. De latitudine planetarum a via solis inuenienda.

Scire uolens utrum planeta sit australis uel septentrionalis in via solis, considera utrum altitudo quam sumpsisti quando erat prope lineam medii celi sit equalis altitudini gradus in quo est planeta, vel maior, vel minor; si enim est equalis, tunc directe est in via solis, et nullam habet latitudinem; si autem altitudo planete sit maior quam gradus in quo est sol, tunc planeta est septentrionalis a uia solis; si minor, tunc est australis; et tantum declinat a via solis quantum est maior vel minor.

36. De directione et retrogradacione planetarum.

Utrum planeta sit retrogradus uel directus sic poteris inquirere; cuiusuis eorum altitudinem et altitudinem stelle quoque fixe memorie commenda; deinde post terciam noctem uel quartam, in qua est sensibilis motus, cum stelle fuerint in eadem altitudine prime altitudini et altitudinem planete considera; quum, si fuerit minor sua altitudine prima, planeta est directus, si fuerit in parte orientali; et si fuerit parte occidentali, retrogradus; et si secunda altitudo planete fuerit maior prima, est retrogradus, si hora accepte altitudinis fuerit ex parte orientis; et si fuerit ex parte occidentis, est directus. Oppositum autem de partibus noueris esse in luna.

37. De equacione .12. domorum per astrolabium.

Cvm .12. domos uolueris adequare, gradum ascendentem super lineam .8. hore pone; tunc gradus qui ceciderit super lineam medie noctis est inicium secunde domus. Deinde reducto gradu ascendentis ad finem .10. hore, gradus inuentus super predictam lineam medie noctis est inicium .3. domus. Reduces quoque

eundem gradum ad orizontem orientalem, et erit eius nadayz in orizonte occidentis; gradus uero in eadem prenominata linea existens erit inicium .4. domus. Pones etiam nadayz gradus ascendentis super finem .2. hore, et tunc predicta linea indicabit tibi inicium .5. domus. Si autem posueris idem nadayz super finem .4. hore, cadet inicium .6. domus super eandem lineam medie noctis. Inicium autem .7. domus est nadayz ascendentis. Et inicium .8. nadayz secunde; principium .9.e nadayz .3.e; et .10.e nadayz quarte. Principium vndecime nadayz .5.e et .12. nadayz sexte.

38. De eodem, scilicet aliter, capitulum.

Item, habito ascendente et aliis tribus angulis, pone regulam nouiter super rethe constitutam super gradum ascendentem, et gradus limbi inter eam et armillam uel punctum meridianum diuisi in .3. partes sunt ascensiones trium domorum ab ascendente in meridiem; vnde si posueris eam super primam .3. ab ascendente, habebis in zodiaco inicium .12. domus, et super secundam .3., inicium .11. domus. Eodem modo de gradibus limbi inter eam in ascendente et punctum in angulo terre facies, et habebis alias .3. domos, scilicet, inicium secunde et .3. domus. Nadayz autem istarum sunt inicia sex oppositarum domorum.

39. De aspectibus planetarum.

Si autem aspectus duorum planetarum, uel .2. graduum quorumlibet scire uolueris, pone eandem regulam super ipsos, et vide gradus limbi intermedios, qui si fuerint .60., est aspectus sextilis; si .90., quartilis; si .120., trina; si .180., oppositionis; si nichil fuerit, coniuncti. Si autem citra hos terminos .5. minus fuerit, erit applicatio ad aspectum; si plus, separatio ab eodem. Secundum quosdam, iidem aspectus habentur ex gradibus equalibus. Secundum ptholomeum fit aliter, secundum gradus ascencionum, quemadmodum equatio domorum sic atque numeris. Radiationum alia dextra, alia sinistra; pro sinistra quidem radiatione, gradum planete super lineam meridianam pone, atque almuri signa; deinde ipsum almuri motu dextro, pro radiatione exagonali, .60. gradus procedat; pro tetragonali, .90.; pro triagonali, .120.; et notetur medii celi gradus, ipse enim radiationis prime locus est; deinde gradum planete super almucantherath orientale pone, atque almuri signa, procedatque almuri motu dextro pro exagonali quidem .60., pro triagonali .120., pro tetragonali .90.; et notetur gradus ascendens, ipse enim radiationis secunde locus est; accipe itaque differentiam istarum duarum

radiationum, et serua eam. Deinde gradum medii celi hora acceptionis operis super meridianum pone, et signetur alius; procedatque motu dextro, donec planete gradus meridiano insideat, fiatque nota in almuri et capiatur numerorum .2. intersticium, ducaturque in differentiam radiationum; quodque inde producetur per arcum lucis siue diei ipsius planete diuidatur, si super terram fuerit radiatio planete; si uero sub terra, per arcum noctis eius; et quod de diuisione exierit, erit radiationis equatio; que equatio minuetur a radiatione maiori, si fuerit planeta inter .10. et .7. aut inter .4. et primum; addetur equatio super radiationem minorem; sicque post additionem vel subtractionem habebis radiationem quesitam; pro dextra autem radiatione inuenienda, erit processus almuri motu sinistro promouendus; cetera ut supra.

40. Scientia anni mundani vel naturalis.

Cvm uolueris anni naturalis vel meridiani[1] reuolutionem scire, gradum ascendentis transacti anni pone super orizontem in oriente, et locum almuri in margine signa; posthec almuri ab eodem loco in .93.[2] gradu moue, et gradus qui ceciderit supra orizontem est gradus ascendentis eiusdem anni. Si autem planetes fuerint anni, pro vnoquoque anno reduces almuri .93. gradus, et gradus existens in orizonte in parte orientali erit ascendens ipsius anni.

41. Quot hore equalis sunt inter annum preteritum et reuolutum.[3]

Si autem uolueris scire quot hore equales sint inter annum preteritum et annum reuolutum, gradum perambulationis almuri diuide per .15., et numerus qui exierit de diuisione est numerus equalium horarum inter utrumque annum exientium.

42. De Gnomonis officio; et primo, de vmbra altitudinis.

⟨De dorso Astrolabii⟩

Qvadrantis in astrolabio constituti .2. sunt latera, in .12. partes equales diuisa, que uocantur puncta umbre. Sed notandum, quod latus inferius uocatur umbra extensa; et aliud latus vmbra uersa; quia vnum representat puncta vmbre extense, et aliud uerse. Cum ergo per hoc opus uolueris scire quot punctorum gnomonis fit vmbra uersa vel extensa, considera altitudinem solis; si fuerint .45. graduum est vnaqueque earum .12. punctorum equalium, scilicet, suo gnomoni. Si autem fuit maior altitudo solis,

[1] natalis vel mundani. [2] 87 in R. [3] Omit.

tanget regula latus vmbre extense; et si diuiseris per ea .144., inuenies puncta uerse. Si uero solis altitudo fuerit minor .45. graduum, tactus regule in vmbra uersa ostendet eius puncta; per que diuide, et habebis puncta umbre extense; nam si puncta umbre uerse multiplicaueris in puncta umbre extense, prouenient ex multiplicatione .144., que proueniunt eciam ex multiplicatione .12. in semet ipsis, que sunt partes gnomonis vnius. Sciendum est eciam quod si in acceptione umbre per altitudinem ceciderit regula in parte alicuius puncti, et uolueris eam denominare a toto, moue regulam ab inicio illius puncti in partem ipsam, et vide quot gradus moueatur regula, qui erunt gradus illius partis. Deinde moue regulam ab inicio illius partis in finem illius, et vide iterum quot gradus moueatur regula, qui erunt gradus totius; tanta proportione se habet pars puncti ad totum punctum.

43. Inuencio altitudinis rerum per puncta vmbre; capitulum.

Ut autem per umbram inuenias altitudinem, pone regulam supra puncta vmbre extense, si fuerint pauciora .12., et tactus eius in quarta altitudinis ostendet altitudinem. Si autem fuerint plura .12., diuide per ea .144., et inuenies puncta umbre verse; super que pone regulam, et tactus eius in quarta altitudinis ostendet tibi altitudinem. Si fuerit vmbra .12. punctorum, est altitudo .45. Si uero cum predictis habueris fractiones, vide quid debeatur sibi de gradibus, ut supra demonstratum est.

44. Inuencio vmbre meridiei per altitudinem.[1]

Cum uolueris medie diei umbram scire, altitudinem solis in medio eiusdem diei quere, et per ea inuenies umbram, ut supra dictum est.

45. Inuencio altitudinis rei accessibilis sequitur apponenda. ⟨De mensurationibus⟩

Cvm eleuate rei altitudinem uolueris scire, regulam super .45. gradum in quarta altitudinis pone, et tam ante uel retro moue, donec per vtriusque tabule foramen rei eleuate videas summitatem; tunc quanta est longitudo a loco in quo fueris in radicem rei, cum additione stature tue a visu usque ad terram, tanta est procul dubio altitudo rei. Si autem eius altitudinem, ita ut non remouearis a loco vno, uolueris inuenire, tam diu regulam subleua uel deprime quod per utriusque foramen videas cacumen; tunc

[1] Omitted in R.

si regula ceciderit super puncta umbre extense, considera quanta proportione se habeant .12. ad ista puncta ; et tanta proportione se habebit altitudo rei ad longitudinem inter te et ipsam, cum statura tua addita longitudini. Si uero ceciderit super puncta umbre uerse, quota pars erunt puncta de .12., tanta pars erit altitudo rei illius longitudinis inter se et eius radicem, coniuncta longitudini statura tua. Vnde notandum, quod si fuerit regula super dyametrum quadrantis, est rei altitudo equalis longitudini, sibi addita statura. Et si fuerit super umbram extensam, est altitudo maior longitudine ; si uero est super uersam, minor longitudine.

46. De altitudine rei inaccessibilis mecienda capitulum.

Si uero rei inaccessibilis altitudo fuerit metienda, per utrumque regule foramen metiende rei summitatem respice, quia inspecta puncta quot sint mecientur, que, exempli causa, dicantur .3., que in latere umbre quater continentur ; quo pacto,[1] retro ab eodem loco perge, ut mensurande rei cacumen iterum per utrumque foramen videas ; quo viso, numerum punctorum umbre denuo vide, que scilicet erunt .2. puncta, que in .12. punctis continentur sexies ; et interuallum stationum .12. pedum notabis esse. Hijs itaque pactis, minus[2] continens ternarij, scilicet .4., a maiori continente binarij, scilicet .6., auferatur, et binarius qui pertransierit memorie commendetur ; et interuallum .2. stationum, quia ex proportionibus remansit binarius, duplum altitudini inaccessibili pro certo habeatur. Est enim omnibus hec vniuersalis regula : subtractione continencium facta, si unum remanserit, interuallum stationum metientis erit altitudini rei equalis ; si duo, duplum ; si tria, triplum ; et sic de ceteris intellige.

47. De mensuracione plani : Rubrica.

Si queris cum astrolabio metiri planiciem, per utrumque foramen limitem eius ex aduerso posito considera ; post hec puncta umbre supra quam steterit regula ad .12. compara ; et qualis fuerit comparatio punctorum ad .12., talis est comparatio stature tue ad planiciem.

Explicit astrolabium messehalle.

⟨Finis practice messehalath⟩

[1] peracto (R). [2] His peractis numerus (R).

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