

ARIST. DE MAGNIT.  
PROPOSITIO. VIII.

*Cum sol totus deficit, tunc idem conus comprehendit solem & lunam, ad visum nostrum verticem habens.*

Quoniam enim si deficiat sol, ob lunæ oppositionem deficit. incidit autem sol in conum lunam comprehendentem, qui ad visum nostrum verticem habet. vel igitur sol ipsi cono congruit, vel excedit, vel ab eo exceditur, & si quidem excedit, non deficiet totus, sed eminebit ipsius pars excedens, si vero ab eo exceditur, permanebit solis defectus, quoad partem illam, qua exceditur, pertransuerit. atqui deficit totus, & non permanet deficiens. illud enim ex obseruatione manifestum est. quare neq; excedit, neq; exceditur. ipsi igitur congruat necesse est. & comprehendetur à cono lunam comprehendente, qui ad visum nostrum verticem habet.

PROPOSITIO. IX.

*Solis diameter maior est, quàm duodevigintupla diametri lunæ: minor vero quàm vigintupla.*

Sit noster quidem visus ad A; solis autem centrum B, & lunæ centrum C, quando conus solem & lunam comprehendens ad visum nostrum verticem habeat, hoc est quando puncta ACB sint in eadem recta linea. & per ACB planum producat, quod faciet sectiones in spheris quidem maximos circulos

*PROPOSITION VIII*

*When the sun is totally eclipsed, then one and the same cone, which has its vertex at our eye, comprehend the sun and the moon.*

If the sunlight lacks, it lacks because the moon is in opposition; at that time the sun falls into the cone comprehending the moon and having its vertex at our eye. In fact or the sun coincides exactly with the same cone, or it surmounts it, or it falls short of it. If also the sun surmounts it, itself would not be totally eclipsed, but the exceeding portion of himself stands out; however if it falls short, the sunlight will be missing for the time which it takes to pass through the portion by which it falls short, and although it is totally eclipsed it not does remain missing, this is manifest from observation, therefore it can neither surmount nor fall short; consequently it must exactly coincide with the cone, and will be comprehended by the cone comprehending the moon and having its vertex at our eye

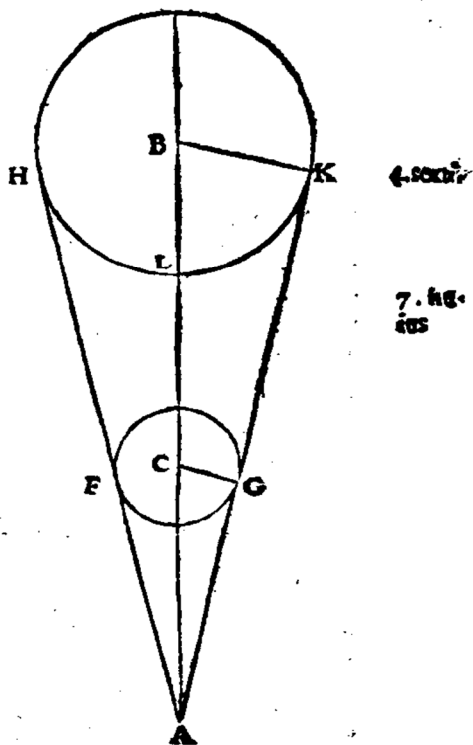
*PROPOSITION IX*

*The diameter of the sun is greater than 18 times, but less than 20 times, the diameter of the moon.*

Let our eye be at A, while let B the centre of the sun, and C the centre of the moon when the cone comprehending both the sun and the moon has its vertex at our eye, that is, when the points A,C,B are in a straight line. Let a plane be carried through ACB which will cut the spheres in great circles

ET DIST. SOL. ET LVNAE. 18

los, in cono autem  
 rectas lineas. faciat  
 igitur in sphaeris ma-  
 ximos circulos FG,  
 KLH: & in cono re-  
 ctas lineas AFH, A  
 GK, & CG, BK iun-  
 gantur. erit ut BA  
 ad AC, ita BK ad C  
 G. sed BA ipsius A  
 C ostensa est maior,  
 quidē, quā duodeci-  
 gitupla, minor vero,  
 quā uigintupla. er-  
 go & BK maior erit,  
 quā duodecigintu-  
 pla ipsius CG, & mi-  
 nor, quā uigintupla.



PROPOSITIO.

X.

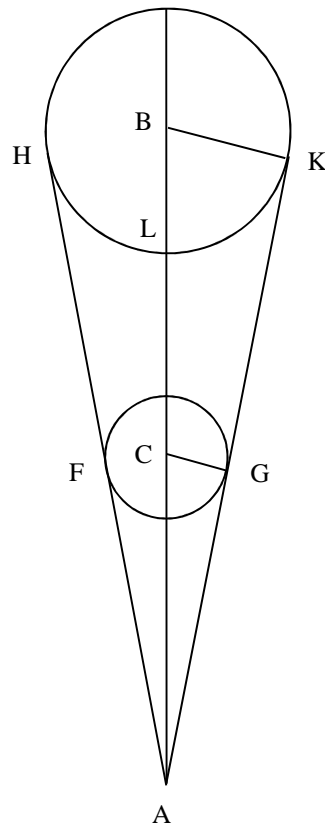
*Sol ad lunam  
 maiorem propor-  
 tionē habet, quā  
 1832 ad 1, mino-  
 re vero quā 8000 ad 1.*

Sit solis quidē diameter A; lunę vero diameter B. ergo A ad B maiore proportionē hēt, quā 18 ad 1, & minore quā 20 ad 1. Et quā cubus, qui fit ex A ad cubum qui ex B triplā proportionē hēt eius, quā A habet ad B: habet autem & sphaera circa diametrum

33 unde  
 cimi de  
 men.  
 28. duo  
 decies.

E 2 A ad

and the cone in straight lines. Then let it generate on the spheres the great circles FG& KLH and on the cone the straight lines AFH& AGK, let C&G and B&K be joined. As BA is to AC, so will BK be to CG, but it was proved that BA is greater than 18 times, but less than 20 times, AC. Therefore BK will also greater than 18 times, but less than 20 times, CG.



*PROPOSITION X*

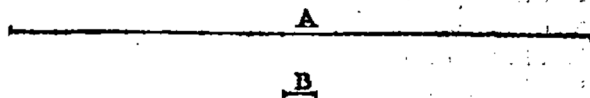
*The sun has to the moon a ratio greater than that which 5832 has to 1, but less than that which 8000 has to 1.*

Let A be the diameter of the sun, B that of the moon; then A has to B a ratio greater than that which 18 has to 1, but less than that which 20 has to 1. As the cube on A has to the cube on B the ratio triplicate of that which A has to B,



## ARIST. DE MAGN.

Et quia  
 A ad sphaeram circa diametrum B triplam proportionem eius, quam habet A ad B. est igitur ut cu-



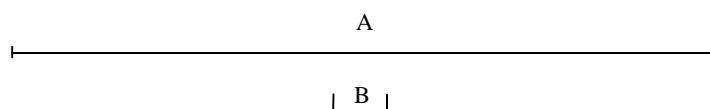
bus ex A ad cubum ex B, ita sphaera circa diametrum A ad sphaeram circa diametrum B. sed cubus ex A ad cubum ex B maiorem proportionem habet, quam 5832 ad 1, minorem vero quam 8000 ad 1, quonia A ad B maiorem proportionem habet, quam 18 ad 1; & minorem, quam 20 ad 1. ergo & sol ad lunam maiorem proportionem habebit, quam 5832 ad 1, minorem vero, quam 8000 ad 1.

## PROPOSITIO. XI.

*Luna diameter, minor est, quam dua quadragesima quinta partes, maior vero, quam pars trigesima distantie, qua centrum luna à visu nostro distat.*

Sit enim noster visus ad A, & luna centrum B, quando conus solem, & lunam comprehendens ad visum nostrum verticem habeat. Dico fieri ea, quae in propositione continentur. iungatur enim AB, & per ipsam planum producat, quod faciet in sphaera circulum, in cono autem rectas lineas. faciat igitur in sphaera circulum CED: & in cono rectas lineas AD, AC: iungaturque CB & ad E producat. itaque constat ex eo, quod demonstratum est, angulum BAC dimidij

then the sphere about the diameter A also will have to the sphere about the diameter B, the ratio triplicate of that which A has to B.



Therefore, as the cube on A is to the cube on B, so the sphere about the diameter A is to the sphere about the diameter B; but the cube on A has to the cube on B a ratio greater than that which 5832 has to 1, but less than that which 8000 has to 1, since A has to B a ratio greater than that which 18 has to 1, but less than that which 20 has to 1; consequently the sun will have to the moon a ratio greater than that which 5832 has to 1, but less than that which 8000 has to 1.

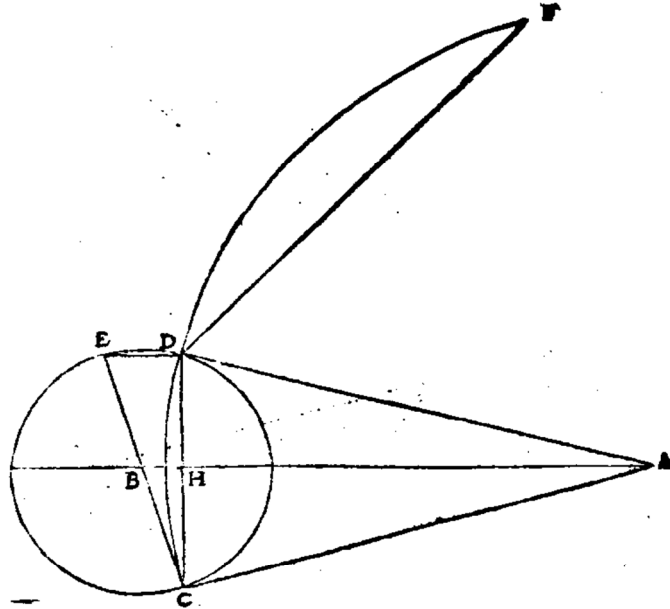
#### PROPOSITION XI

*The diameter of the moon is less than two forty-five parts, but greater than thirtieth part of the distance of the centre of the moon from our eye.*

Let our eye be at A, and let B the centre of the moon when the cone comprehending both the sun and the moon has its vertex at our eye. I say that all that is written in the above proposition takes place. Indeed let A&B be joined and let the plane through AB be drawn, which will cut the sphere in a circle and the cone in the straight lines, then this plane cut the sphere in the circle CED and the cone in the straight lines AD, AC; let C&B joined and produced to E. Then it is manifest from what has before been proved that the angle BAC is the forty-fifth part of half a right angle<sup>A</sup>, and

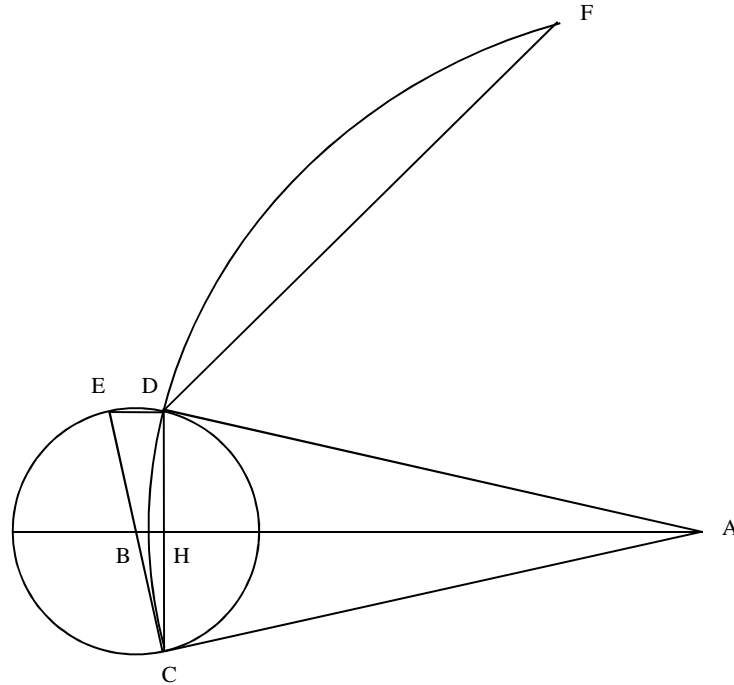
## ET DIST. SOL. ET LVNAE. 19

dimidij recti esse partem quadragessimam quintam:  
 & eadem ratione BC ipsius CA minorē, quā  
 quadragessimam quintam partem: multo igitur mi-  
 nor est BC, quā quadragesima quinta pars ipsius



BA. estque ipsius BC dupla CE. ergo CE minor est. B  
 quā duæ quadragessimæ quintæ partes ipsius A  
 B. sed CE est lunæ diameter, & AB distātia, qua cētrū  
 lunæ à visu nostro distat. lunæ igitur diameter, distā-  
 tia, qua centrum lunæ à visu nostro distat, minor est  
 quā duæ quadragessimæ quintæ partes. Dico etiam  
 CE ipsius BA maiorem esse, quā trigesimā partē.  
 lun-

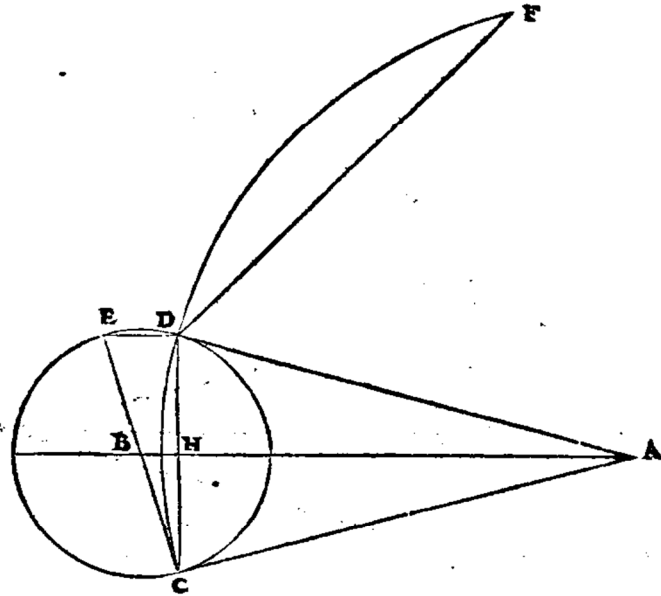
for the same reason as before,  $BC$  is less than the forty-fifth part of  $CA$ , therefore  $BC$  is much less than the forty-fifth part of  $BA^B$ . And  $CE$  is double of  $BC$ ; therefore  $CE$  is less than two forty-fifth parts of



$AB$ ; but  $CE$  is the diameter of the moon and  $AB$  is the distance which separates the centre of the moon from our eye. Therefore the diameter of the moon is less than two forty-fifth part of the distance of the centre of the moon from our eye. I say that  $CE$  is also greater than the thirtieth part of  $BA$ .

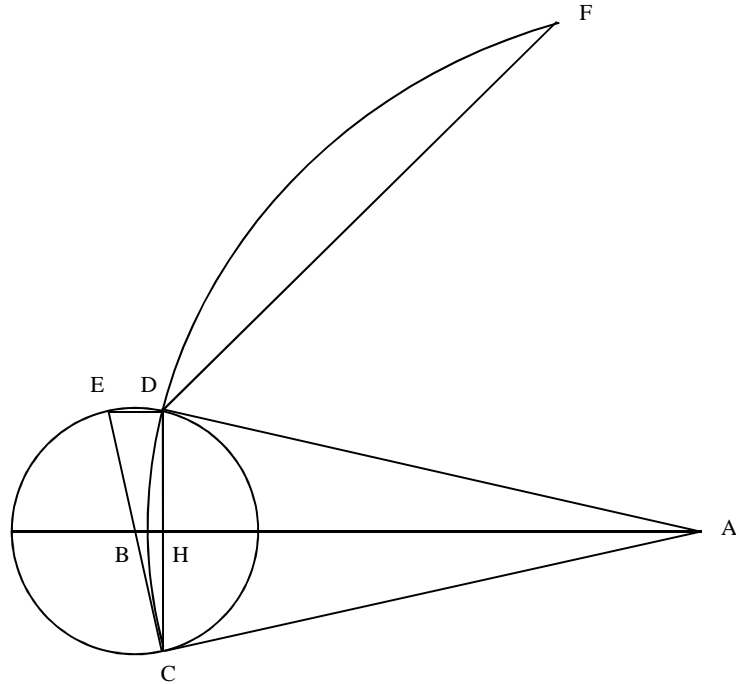
## ARIST. DE MAGN.

Trigatur enim DE DC. & cetro quide A, interuallo  
autem DC circulus describatur CDE, atque in eo  
aptetur recta linea DF, aequalis ipsi AC. Quoniam  
igitur rectus angulus EDC est equalis recto BCA:



**C** & angulus BAC equalis ipsi ECD; erit reliquus DE  
C reliquo HBC equalis: & triangulum CDE trian-  
gulo ABC aequiangulum, ergo ut BA ad AC, ita est  
**D** EC ad CD: & permurando ut AB ad CE, ita AC ad  
CD; hoc est ita DF ad CD. Rursus quoniam angulus  
**E** DAC est unius recti pars quadragesima quinta,  
erit circumferentia CD pars centesima, & octage-  
sima

Let D&E and B&C be joined; after with centre A and distance DC<sup>1</sup> let the arc CDF be described; let DF equal to AC be fitted into the same arc. Then, since the right angle EDC is equal to right angle BCA and the angle BAC is equal to ECD itself<sup>c</sup>, the remaining angle



DEC will be equal to remaining angle HBC. The triangle CED is also equiangular with the triangle ABC, then as BA is to AC, so EC is to CD; and, by permutando property, as AB is to CE, so is AC to CD, that is, DF to CD. Again, since the angle DAC is the forty-fifth part of a right angle<sup>D</sup>, then the arc CD will be one hundred and eightieth part of whole

ET DIST. SOL. ET LVNAE. 20

lima totius circuli. & circumferētia DF circuli pars sexta. quare circumferētia CD circumferētia DF trigesima pars est. atque habet circumferētia CD, quæ minor est circumferētia DF, ad circumferētia DF minorem proportionem, quàm recta linea CD ad rectam DF. recta igitur linea CD ipsius DF recte maior est, quàm trigesima pars. est autem DF æqualis AC. ergo DC maior est, quàm trigesima pars ipsius AC; & propterea EC ipsius BA maior, erit, quàm trigesima pars. ostensa est aut & minor, quàm duæ quadragesimæ quinte partes ipsius BA. quod ostendendum proponebatur.

F E D. C O M M A N D I N V S.

Itaque constat ex eo, quod demonstratum est angulum BAC dimidij recti esse partem quadragesimam quintam ] *Demonstratum est hoc in quarta huius.* A

Multo igitur minor est BC, quàm quadragesima quinta pars ipsius BA ] *Est enim BA maior, quàm AC, cum maiori angulo subtendatur.* B

Et angulus BAC æqualis ipsi ECD ] *Ex 8. sexti elementorum. Quoniam enim ab angulo recto ACB perpendicularis ducta est CH, sunt triangula ACH HCB similia toti, & inter se se. quare angulus BCH, videlicet ECD est æqualis angulo BAC.* C

Rursus quoniã angulus DAC est vnus recti pars quadragesima quinta ] *Hoc demonstratum est in quarta huius.* D

Erit circumferētia CD pars centesima, & octogesima totius circuli ] *Angulus enim rectus consistit in quarta parte circumferētia totius circuli, hoc est in gradibus nonaginta, cuius circumferētia pars quadragesima quinta* E

circle<sup>E</sup>; the arc DF will also be the sixth part of the circle; thus the arc CD is the thirtieth part of the arc DF. And the arc CD, being less than the arc DF, has to the arc DF itself a ratio less than that which the straight line CD has to the straight line DF<sup>F</sup>. Therefore the straight line CD is greater than the thirtieth part of DF; but DF is equal to AC, therefore DC is greater than thirtieth part of AC, consequently EC will be greater than the thirtieth part of BA itself<sup>G</sup>. Then it is proved to be also less than two forty-five parts of BA itself, as we had proposed to demonstrate.

*Federico Commandino*

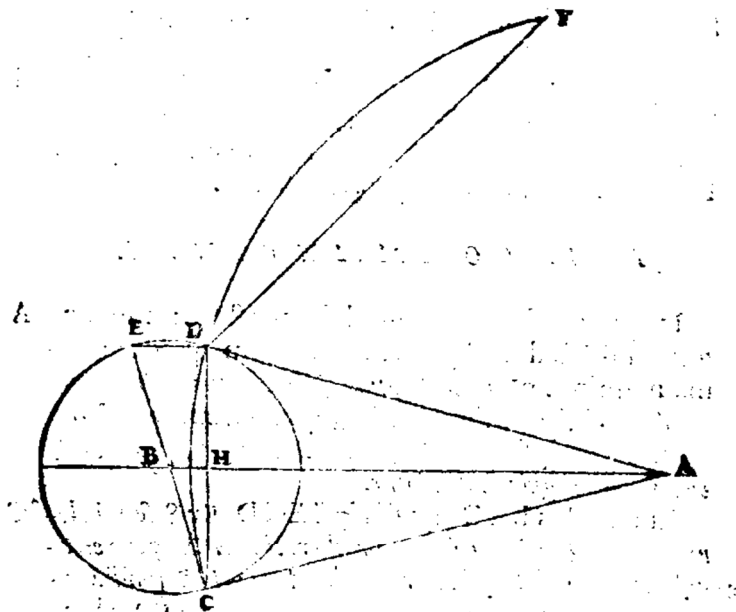
- A. Then it is manifest, from what has before been proved, that the angle BAC is the forty-fifth part of half a right angle. *This was demonstrated in the fourth proposition of this book.*
- B. Therefore BC is much less than the forty-fifth part of BA. *In fact BA is greater than AC because it subtend a greater angle..*
- C. And the angle BAC is equal to ECD itself. *From 8<sup>o</sup> proposition of sixth book of Elements. Indeed, since the perpendicular CH was conduct from the right angle ACB, the triangles ACH and ACB become completely similar between them, therefore the angle BCH, and cleary ECD is equal to the angle BAC.*
- D. Again, since the angle DAC is the forty-fifth part of a right angle. *This was demonstrated in the fourth proposition of this book.*
- E. Then the arc CD will be one hundred and eightieth part of whole circle. *Indeed a right angle subtend the fourth part of thw whole circle, i.e. ninety degrees, the forty-fifthy part of which arc*



**P R I S T . D E M A G N .**

*quinta sunt duo gradus, videlicet centesima, & octogesima pars totius circuli.*

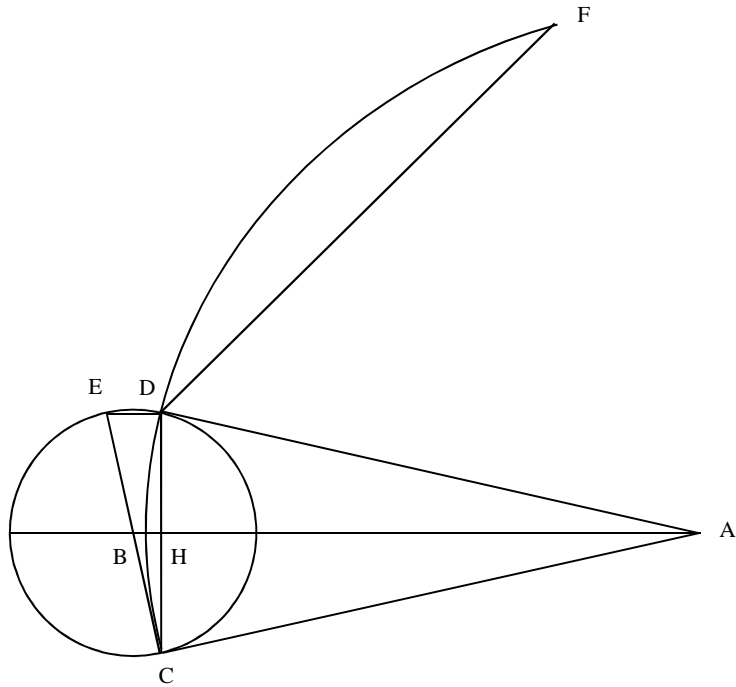
¶ Atque habet circumferentia CD, quę minor est circumferentia DF ad ipsam circumferentiam DF



minorem proportionem; quàm recta linea CD ad rectam DF ] Nam circumferentia DF, quae maior est circumferentia CD ad ipsam CD. circumferentiam maiorem proportionem habet, quàm recta linea DF ad rectam CD, quod demonstravit Ptolemęus in principio magnae constructionis. quare conuertendo ex 26 quinti circumferentia CD ad circumferentiam DF minorem habet

are two degrees, or the one hundred and eightyth part of whole circle.

F. And the arc CD, being less than the arc DF, has to the arc DF itself



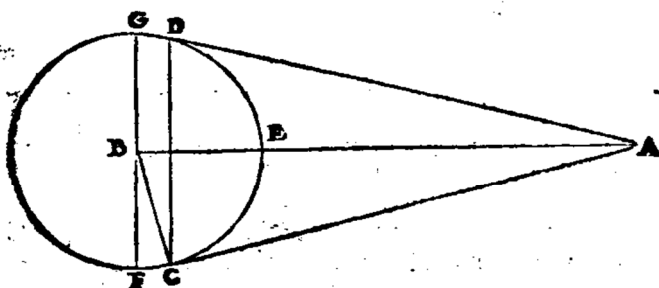
a ratio less than that which the straight line CD has to the straight line DF. *Indeed the arc DF, which is greater than the arc CD, has to CD itself a ratio greater than that which the straight line DF has to the straight line CD, which Ptolemy has demonstrated at the beginning of Liber Magnae Constructionis; wherefore, by convertendo property, from the proposition 26 of fifth book, the arc CD has to te arc DF*

ET DI. SOL. ET LVNAE. 21

Det proportionem, quàm recta linea CD ad DF rectam.  
 Ac propterea EC ipsius BA maior, quàm trigesima pars] Superius namque demonstratum est, ut AB ad CE, ita esse AC ad CD. quare convertendo ut CE ad AB, ita DC ad CA. Quòd cum DC maior sit, quàm trigesima pars ipsius CA, & CE ipsius AB, quàm trigesima pars maior erit.

PROPOSITIO XII.

Diameter circuli determinantis in luna opacum, & splendidum diametro lune minor quidem est, maiorem autem proportionem habet ad ipsam, quàm 89 ad 90.



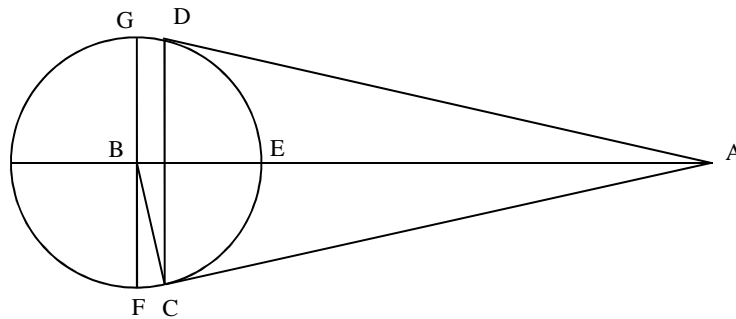
Sit noster visus ad A; lunę vero centrum B, quando conus solem, & lunam comprehendens ad visum nostrum verticem habeat: & iuncta AB per ipsam producat planum, quod faciet sectiones, in sphaera quidem circulum; in cono autem rectas lineas. faciat in sphaera circulum DEC, & in cono rectas lineas

*A ratio less, than that which the straight line CD to the straight line DF.*

- G. Consequently EC will be greater than the thirtieth part of BA itself. *Indeed we have above shown that as AB is to CE, so DC is to CA. Then, by convertendo property, as CE is to AB, so DC is to CA. Therefore, being DC greater than the thirtieth part of CA itself, CE will also be greater than the thirtieth part of AB.*

*PROPOSITION XII*

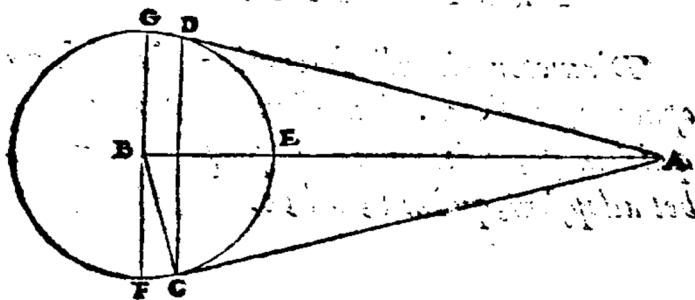
*The diameter of the circle which divides the dark and the bright portions in the moon is less than the diameter of the moon, but has to itself a ratio greater than that which 89 has to 90.*



Let our eye be at A, while let B be the centre of the moon when the cone comprehending both the sun and the moon has its vertex at our eye; let A&B joined, and let a plane be carrier through AB; this plane will cut in fact the sphere in a circle while the cone in straight lines. Let it cut the sphere in the circle DEC e the cone the straight lines

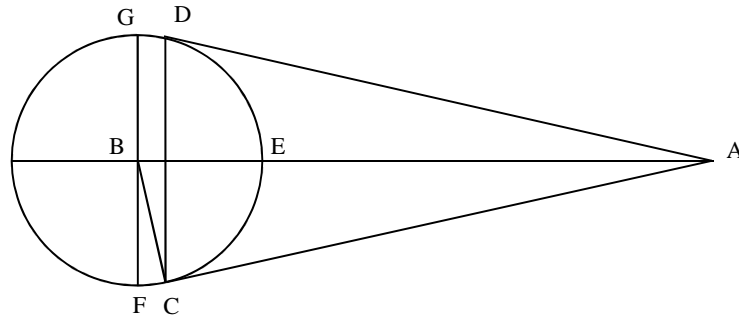
## ARIST. DE MAGN.

neas AD AC CD. ergo CD est diameter circuli determinantis in luna opacum & splendidum. Dico CD diametro lunę minorem esse, maiorem vero ad ipsam proportionem habere, quam 89 ad 90. Itaque CD minorem esse diametro lunę, manifestum est. Dico & maiorem habere proportionem, quam



- 89 ad 90. Ducatur enim per B ipsi CD parallela **F** **G**, & BC iungatur. Rursus eadem ratione erit angulus DAC quadragesima quinta pars unius recti: & angulus BAC recti pars nonagesima. atque est BAC angulus æqualis angulo CBF. ergo & angulus C
- A** BF est pars nonagesima recti, videlicet anguli FBE; & ob id circumferentia CF circumferentię FCE est nonagesima. quare circumferentia CE ad circumferentię ECF eam proportionem hęc, quā 89 ad 90. estq;
- B** ipsius CE dupla circumferentię DEC; ipsius vero ECF dupla GEF, ergo DEC circumferentię ad circumferentię GEF eam proportionem habebit, quam 89 ad 90. habet autem recta linea DC ad rectam CF maiorem proportionem, quam DEC circumferentię

AD, AC, CD. Therefore CD is the diameter of the circle which divides the dark and the bright portions in the moon. I say that CD is less than the diameter of the moon, but has to it a ratio greater than that which 89 has to 90. Indeed is manifest that CD is less than the diameter of the moon. Yet I say that it has to it a ratio greater than



that which 89 has to 90. Let FG be drawn through B parallel to CD itself, and let B&C joined. Then again, for the same reason as before, the angle DAC will be the forty-fifth part of a right angle: and the angle BAC will be the ninetieth part of a right angle; but the angle BAC is equal to the angle CBF; therefore the angle CBF is also the ninetieth part of a right angle, that is of the angle FBE; therefore the arc CF is the ninetieth part of the arc FCE<sup>A</sup>; so that the arc CE has to the arc ECF that ratio which 89 has to 90. The arc DEC is double of arc CE and GEF is double of ECF itself, then the arc DEC will have to the arc GEF that same ratio which 89 has to 90<sup>B</sup>. Moreover the straight line DC will have to the straight line GF a ratio greater than that which the arc DEC has to the arc GEF<sup>C</sup>. Therefore the straight line DC will have to the straight line GF a ratio greater than that which 89 has to 90.

**ET DIST. SOLI ET LUNAE. 29**

ad circumferentiam GEF. recta igitur linea DC ad rectam GF maiorem proportionem habet, quam 89 ad 90.

**F E D. C O M M A N D I N F S.**

Et ob id circumferentia CF circumferentiæ FCE <sup>A</sup> est nonagesima ] Anguli enim eundem habet proportionē quam circumferentiae, in quibus insistant, ex ultima sexti elementorum.

Ergo DEC circumferentia ad circumferentiam <sup>B</sup> GEF eam proportionem habebit, quam 89 ad 90. ] Ex 15 quinti elementorum.

Habet autem recta linea DC ad rectam GF <sup>C</sup> maiorem proportionem, quam DEC circumferentia ad circumferentiā GEF ] Ex demonstratis à Ptolemaeo. nam circumferentia GEF ad circumferentiā DEC maiorem habet proportionē, quā GF recta ad rectā DC. ergo conuertēdo circumferentiā DEC ad circumferentiā GEF minorē proportionē habet, quam recta DC ad rectam GF. ideoq; recta DC ad rectā GF maiorem proportionem habebit, quam circumferentia DEC ad GEF circumferentiam.

**P R O P O S I T I O. X I I I.**

Recta linea subtendens circumferentiam circuli, in quo feruntur extrema diametri de terminantis in luna opacum, & splendidum, quæ in terræ umbra continetur, maior quidem est, quam dupla diametri lune, maior

*Federico Commandino*

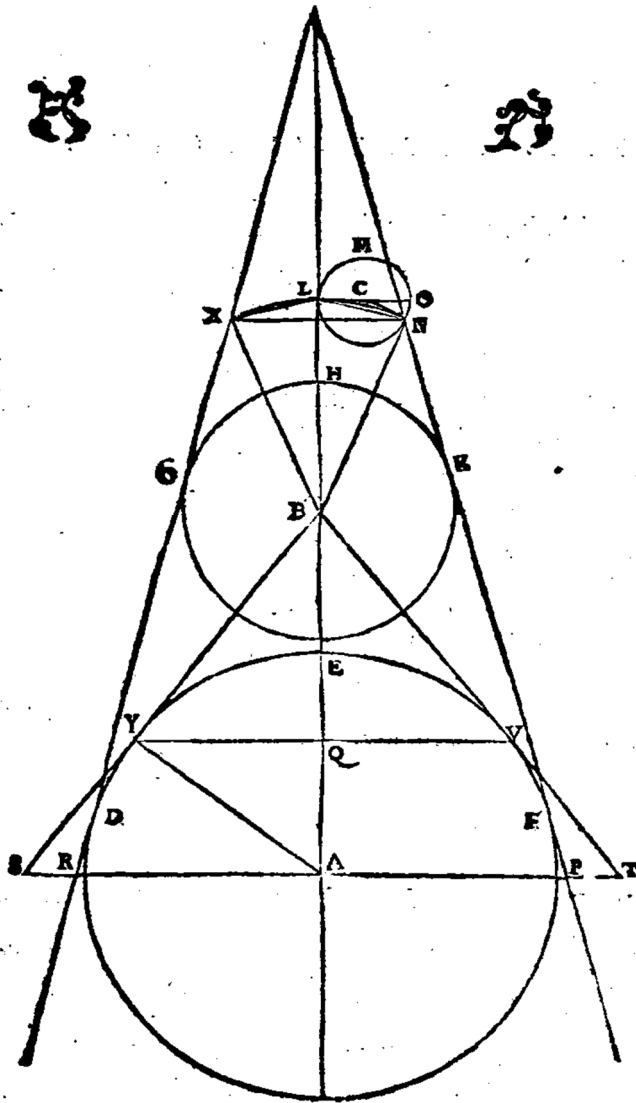
- A. Therefore the arc CF is the ninetieth part of the arc. *Indeed the angles have the same ratio than the arcs which subtend, from the last proposition of the sixth book of Elements.*
- B. Then the arc DEC will have to the arc GEF the same ratio which 89 has to 90. *From the 15° proposition of the fifth book of Elements.*
- C. Moreover the straight line DC will have to the straight line GF a ratio greater than that which the arc DEC has to the arc GE. *By the Ptolemy's demonstrations, indeed the arc GEF has to the arc DEC a ratio greater than that which the straight line GF has to the straight line DC; and therefore the straight line DC is proportionally greater to the straight line GF than the arc DEC is to the arc GEF.*

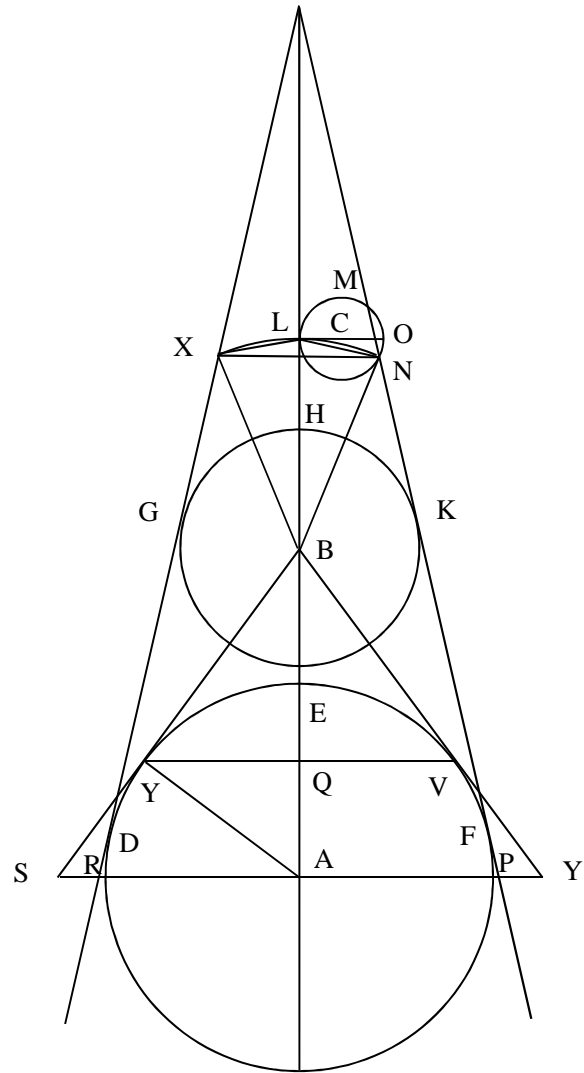
*PROPOSITION XIII*

*The straight line which subtend the arc of circle, intercepted within the earth's shadow, along which the extremities of the diameter of the circle dividing the dark and the bright portions in the moon move, is less<sup>2</sup> than the double of the diameter of the moon, but has*



ARIST. DEMAGN.





**ET DIST. SOL. ET LVNAE A;**

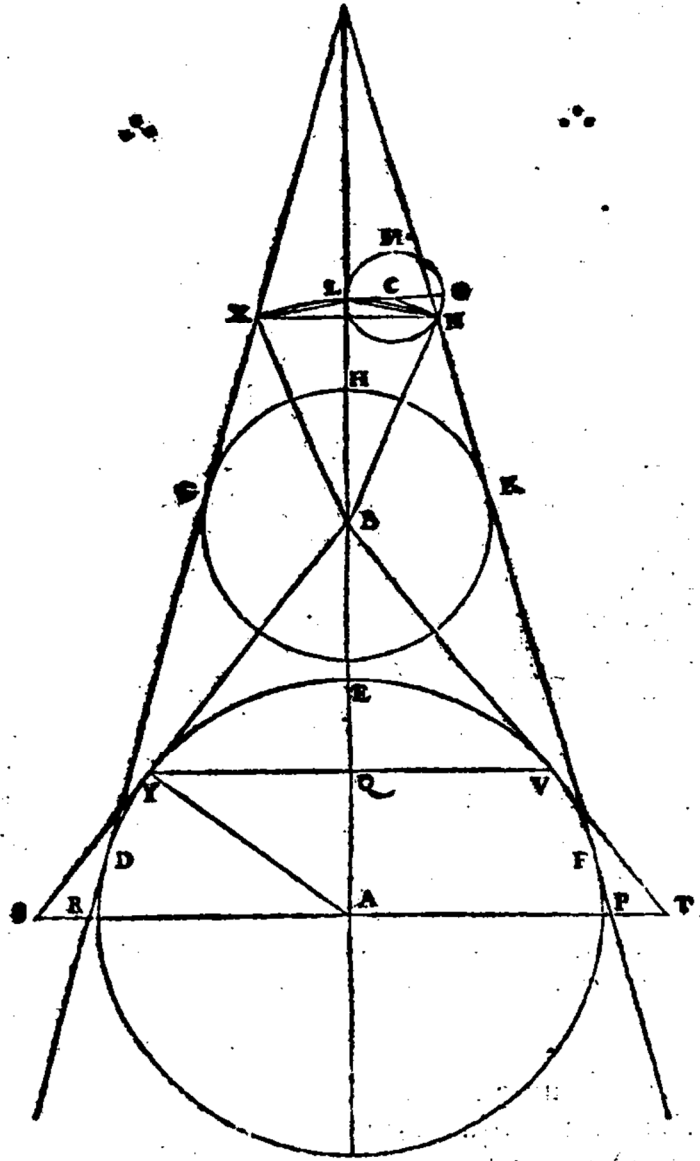
*rem autem ad ipsam proportionem habet, quàm 89 ad 45. et minor est, quàm nona pars diametri solis, maiorem vero proportionem habet ad ipsam, quàm 22 ad 225. sed ad eam, quae à centro solis ducitur ad rectos angulos axi, & conii lateribus applicatur, maiorem habet proportionem, quàm 979 ad 10125.*

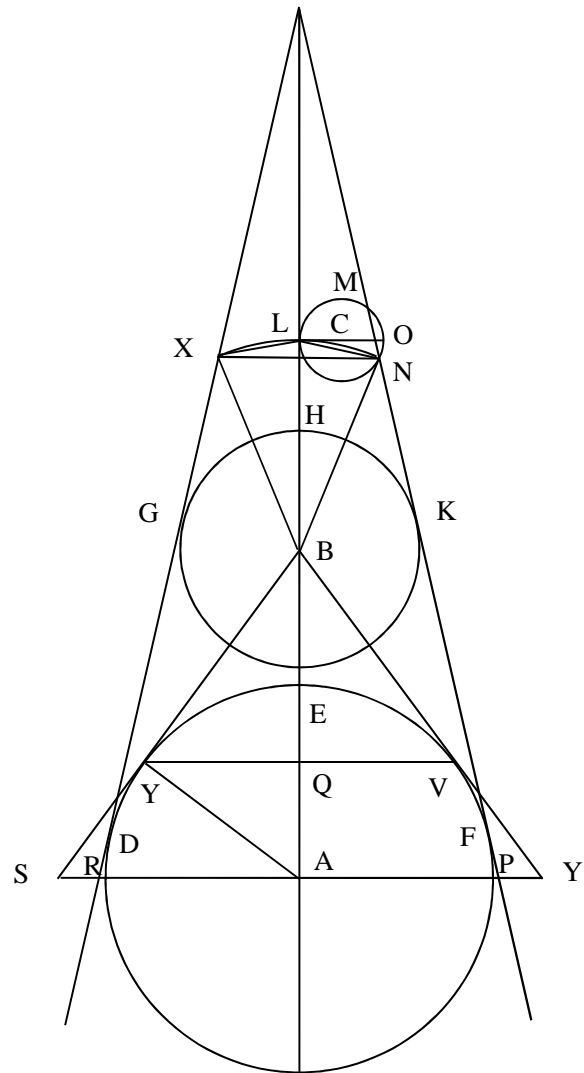
Sit enim solis quidem centrum ad A, terræ vero centrum B, & lunæ centrum C, perfecta existente ecclipsi, & primum tota in terræ vmbra incidente. producatursque per ABC planum, quod faciet sectiones in spheris quidem circulos; in cono autem comprehendente solem & lunam, rectas lineas. faciat in spheris maximos circulos DEF GHK LMN. in vmbra vero terræ circulum, in quo feruntur extrema diametri determinantis in luna opacum, & splendidum, XLN: & in cono rectas lineas DCX FKN. axis autem sit ABL. manifestum est ABL axem contingere circulum LMN: propterea quòd vmbra terræ sit duarum lunarum, & circumferentia NLX ab axe ABL bifariam secetur: & adhuc luna primum in terræ vmbra incidat. Itaque iungantur XN NL BN LX. ergo LN est diameter circuli, in luna opacum, & splendidum determinantis: & BN contingit circulum LMN; quòd B sit ad nostrum visum, & LN diameter circuli determinantis in luna opacum, & splendidum. Quoniam igitur XL LN æquales sunt, duplè erunt ipsius LN. quare XN ipsius NL minor est, quàm dupla. iungantur LC CN, & LC ad O producaturs. multo igitur XN minor est, C  
quàm

*to it a ratio greater than that which 89 has to 45; moreover it is less than the ninth part of the diameter of the sun, but has to itself a ratio greater than that which 22 has to 225. But it has to the straight line drawn from the centre of the sun perpendicularly to the axis and meeting the sides of the cone a ratio greater than that which 979 has to 10125.*

In fact let A be the centre of the sun, let B be the centre of the earth and C the centre of the moon during a total eclipse, before falling completely into the shadow of the earth, and let a plane be carried through ABC, which will cut of course the spheres in circles and the cone comprehending both the sun and the earth in straight lines. Let it cut the spheres in the great circles DEF GHK LMN, while the earth's shadow in the circle XLN, in which the extremities of the diameter of the circle dividing the dark and the bright portions in the moon move, and the cone in the straight lines DGX e FKN. Let after ABL be the axis; then is manifest that the axis ABL touches the circles LMN, because the shadow is twice the moon- breadth, and the arc NLX is bisected by the axis ABL, and moreover that the moon has fallen at first within the earth's shadow. So let X&N, N&L, B&N, L&X be joined; then LN is the diameter of the circle dividing the dark and the bright portions in the moon; BN touches the circle LMN because B is at our eye and LN is the diameter of the circle dividing the dark and the bright portions in the moon. Then, since XL and LN are equal, they will be twice than LN itself; consequently XN is less than double of NL<sup>A</sup>. Let L&C and C&N be joined, and let LC be produced to O; then XN is much less than

## ARIST. DE MAGN.





**ET DIST. SOL. ET LUNAR. 24**

quàm dupla ipsius LO. Et cum CL perpendiculari: **D**  
 sit ad LB, erit ipsi XN parallela. angulus igitur LX **E**  
 N est equalis angulo CLN. atq; est NL equalis LX,  
 & LC ipsi CN. quare triagulum XNL simile est tria-  
 gulo LNC. est igitur vt XN ad NL, ita NL ad LC. **4. scilicet**  
 sed NL ad LC maiorē proportionē hēt, quam 89 ad **F**  
 45; hoc est quadratum ex NL ad quadratum ex LC **G**  
 maiorem habet proportionem, quā 7921 ad 2025.  
 ergo & quadratum ex NX ad quadratū ex NL ma-  
 iorem proportionem habebit, quā 7921 ad 2025  
 & ipsa XN ad LO maiorem, quā 7921 ad 4050. ha- **H**  
 bet autem 7921 ad 4050 maiorem proportionem, **K**  
 quam 88 ad 45. quare XN ad LO maiorem propor- **L**  
 tionem habebit, quā 88 ad 45. & ob id recta linea  
 subtendens circumferentiam circuli, in quo ferun-  
 tur extrema diametri determinantis in luna opa-  
 cum & splendidum, quæ in terræ umbra comprehē-  
 ditur, minor est, quā dupla diametri lunæ, maio-  
 rem autem ad ipsam proportionem habet, quā  
 88 ad 45.

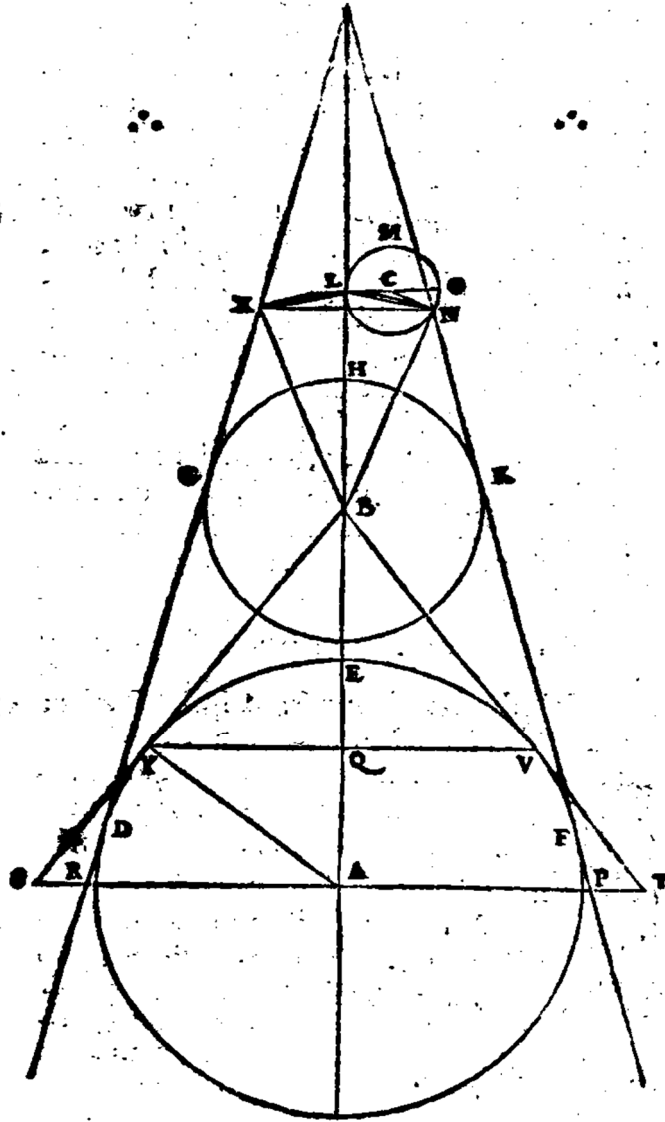
Iisdem positis ducatur à puncto A ipsi AB ad re **M**  
 ctos angulos PAR. Dico XN minorem quidē esse,  
 quā nonam partem diametris solis; maiorem ve-  
 ro ad ipsam proportionē habere, quā 22 ad 225;  
 & ad PR maiorē habere proportionem, quā ~~39~~  
 ad 1125. Quoniam enim ostensa est XN diametri  
 lunæ minor, quā dupla; lunæ autem diameter dia- **N**  
 metri solis minor est, quā duodeuigesima pars,  
 erit XN minor, quā nona pars diametri solis. Rur-  
 sus quoniam XN ad diametrū lunæ maiorem pro-  
 portionem habet, quā 88 ad 45, & diameter lunæ  
 ad solis diametrum maiorem hēt, quā 45 ad 900. **15. quæ**  
 quippe quòd lunæ diameter ad diametrū solis ma-  
 iorem

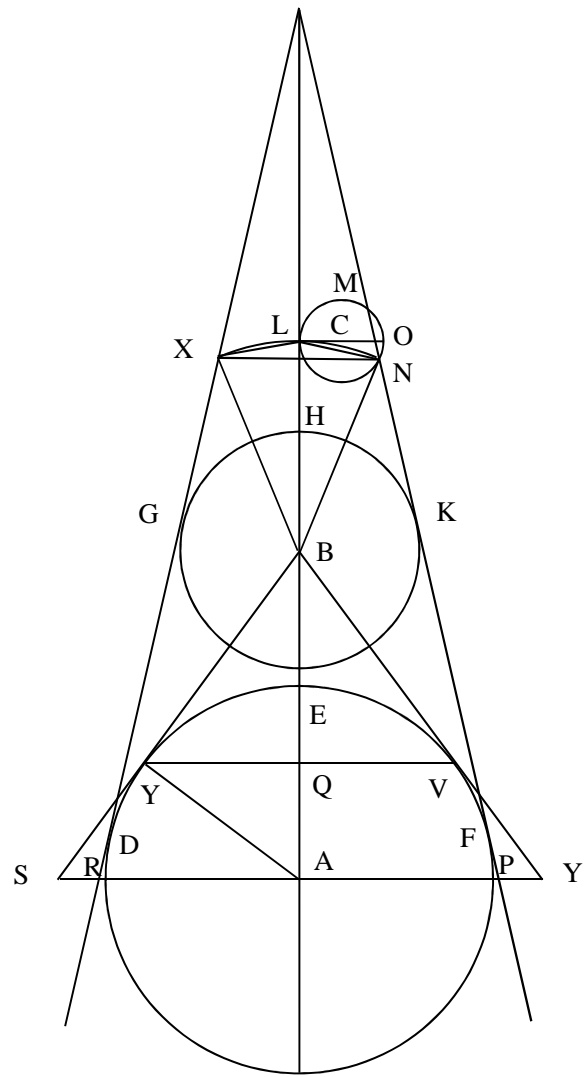
double of  $LO^B$ ; and since  $CL$  is perpendicular to  $LB^C$ , it will be parallel to  $XN$  itself<sup>D</sup>, therefore the angle  $LXN$  is equal to the angle  $CLN^E$ , and  $NL$  is equal to  $LX$  and  $LC$  to  $CN$  itself; therefore the triangle  $XNL$  is similar to the triangle  $LNC$ , therefore as  $XN$  is to  $NL$  so  $NL$  is to  $LC$  <sup>4<sup>prop. of sixth b.</sup></sup>, but  $NL$  has to  $LC$  a ratio greater than  $89$  a  $45^F$ , that is, the square on  $NL$  has to the square on  $LC$  a ratio greater than that which  $7921$  has to  $2025^G$ . Therefore the square on  $NX$  also has to the square on  $NL$  a ratio greater than that which  $7921$  has to  $2025$ , therefore  $XN$  itself also has to  $LO$  a ratio greater than that which  $7921$  has to  $4050^H$ ; but  $7921$  also has to  $4050$  a ratio greater than that which  $88$  has to  $45^K$ , therefore  $XN$  will have to  $LO$  a ratio greater than that which  $88$  has to  $45^L$ . Therefore the straight line that subtends the arc of circle, intercepted within the earth's shadow, along which the extremities of the diameter of the circle dividing the dark and the bright portions in the moon move, is less than double of the diameter of the moon, but has to it a ratio greater than that which  $88$  has to  $45$ .

The same hypothesis being made, let  $PAR$  be drawn from the point  $A$  perpendicularly to  $AB$  itself<sup>M</sup>. I say that  $XN$  is certainly less than the ninth part of the sun's diameter, but has to it a ratio greater than that which  $22$  has to  $225$ , and has to  $PR$  a ratio greater than that which  $979$  has to  $10125^3$ . Since it was demonstrated that  $XN$  is less than double of the moon's diameter, while the diameter of the moon is less than the eighteenth part of the sun's diameter<sup>N</sup>, then  $XN$  will be less than the ninth part of the diameter of the sun. Again, since  $XN$  has to the moon's diameter a ratio greater than that which  $88$  has to  $45$  and the moon's diameter has to the sun's diameter a ratio greater than that which  $45$  has to  $900^{15} <sup>prop. of fifth b.</sup>, since the diameter$



## ARTS DE MAGN





**ET DISSONANTIAE ET LUNA** 25

lorem habeat proportionem, quàm 1 ad 20, & omnia quadragies quinquies sumantur: habebit XN P ad diametrum solis maiorem proportionem, quàm 88 ad 900; hoc est quàm 22 ad 225. ducantur à puncto B circuli DEF contingentes BYS BVT. & YV, YA iungantur. erit igitur ut diameter circuli in luna opacum, & splendidum determinantis ad diametrum lunę, ita YV ad solis diametrum, quòd idē conus solem, & lunam comprehendat, ad visum nostrum verticem habens. diameter autem circuli determinantis in luna opacum, & splendidum ad diametrum lunę maiorem proportionem habet, quàm 89 ad 90. ergo & YV ad diametrum solis maiorem habet, quàm 89 ad 90: & QY ad YA habebit maiorem, quàm 89 ad 90. At autem QY ad YA, ita YA ad AS, cum parallelæ sint SA: YQ. quare & YA ad AS maiorem habet proportionem, quàm 89 ad 90. multo igitur YA ad AR maiorem proportionem habebit, quàm 89 ad 90. ostensa est autem & XN ad diametrum solis maiorem habere proportionem, quàm 22 ad 225; & ex æquali. ergo XN ad PR multo maiorem proportionem habet, quàm numerus productus ex 22, & 89 ad eum, qui ex 90 & 225 producitur. hoc est 1958 ad 20250: & horum dimidia videlicet 979 ad 10125.

**F E D. C O M M A N D I N V S.**

Quare XN ipse NL minor est, quàm dupla A  
Sunt enim trianguli LXN duo latera XL LN reliquo XN  
maiora, ex 20 primi elementorum.

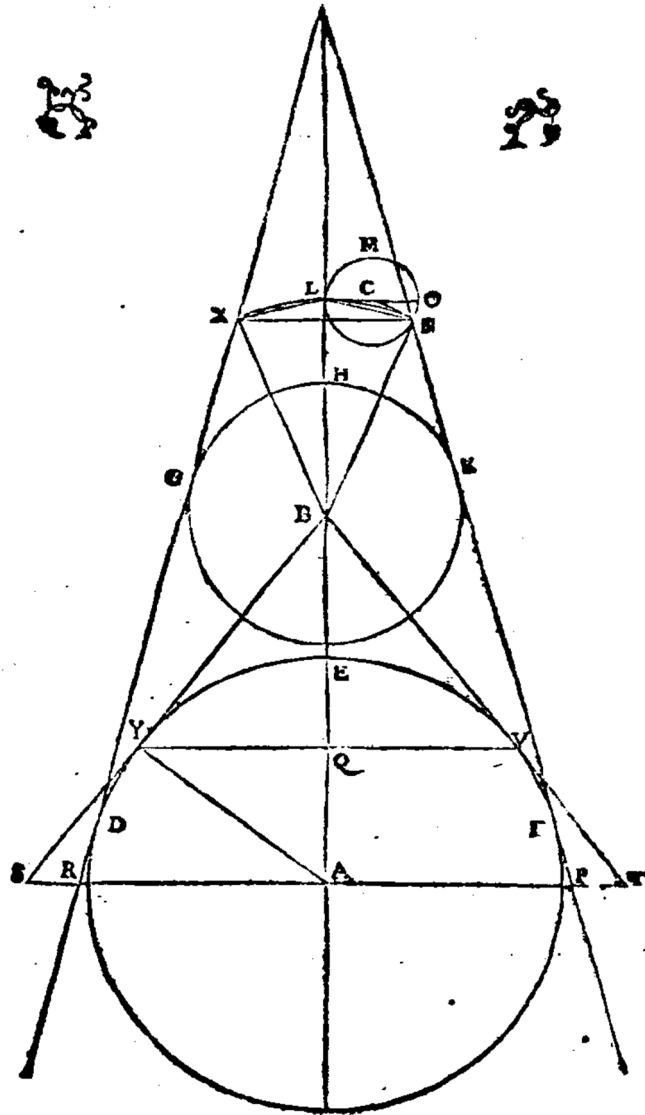
Multo igitur XN minor est, quàm dupla ipse L B  
O] Namque LO cū sit lunæ diameter, maior est, quàm LN  
G diame-

of the moon has to the diameter of the sun a ratio greater than that which 1 has to 20, if we multiply throughout by forty five<sup>O</sup>, then XM will have to the diameter of the sun a ratio greater than that which 88 has to 900<sup>P</sup> i.e. than that which 22 has to 225. Let the BYS e BVT be drawn from point B tangent the circle DEF<sup>Q</sup> *15<sup>th</sup> prop. of fifth b.* and let Y&V and Y&A be joined; then, as the diameter of the circle dividing the dark and the bright portions in the moon is to the diameter of the moon, so YV will be to the diameter of the sun, because the sun and the moon are comprehended by one and the same cone which have its vertex at our eye<sup>R</sup> *as said before*. But the diameter of the circle dividing the dark and the bright portions in the moon has a ratio greater than that which 89 has to 90, therefore YV also has to the diameter of the sun a ratio greater than that which 89 has to 90; QY also will have to YA a ratio greater than that which 89 has to 90<sup>S</sup>. After, as QY is to YA, so is YA to AS, because SA and YQ are parallel<sup>T</sup>; therefore YA also has to AS a ratio greater than that which 89 has to 90. Therefore YA will have to AR a ratio much greater than that which 89 has to 90<sup>V</sup>. It is also demonstrated that XN has to diameter of the sun a ratio greater than that which 22 has to 225; also XN, by direct proportionality, has to PR a ratio much greater than that which the product of 22 and 89 has to the product of 90 and 225<sup>X</sup>, that is 1958 to 20250, and clearly also to their half i.e. 979 to 10125.

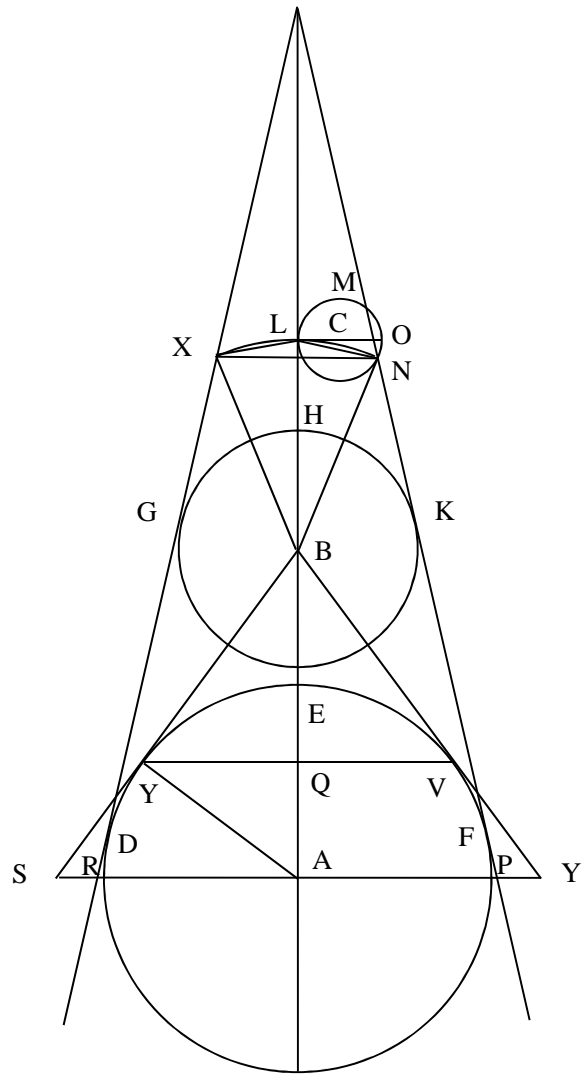
### *Federico Commandino*

- A. Consequently XN is less than double of NL: *in fact XL ed LN are two sides of the triangle LXN greater than the remaining XN, for the 20<sup>th</sup> proposition of first book of Elements.*
- B. Then XN is much less than double of LO: *since LO is the moon's diameter it is greater than LN which is the diameter*

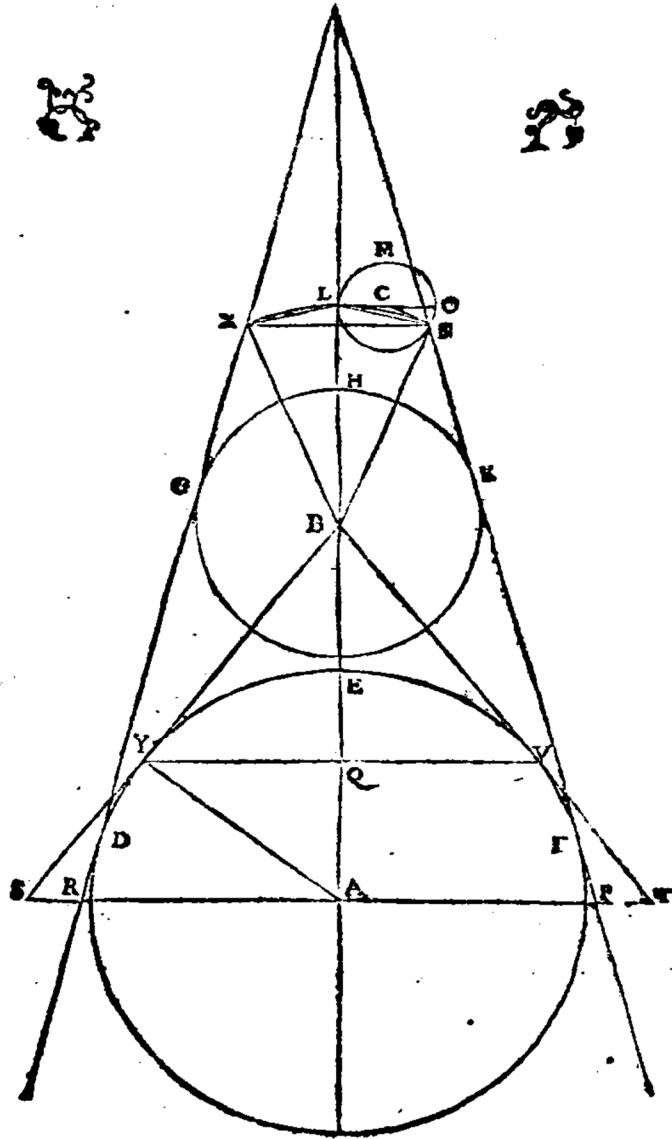
ARIST. DEMAGN

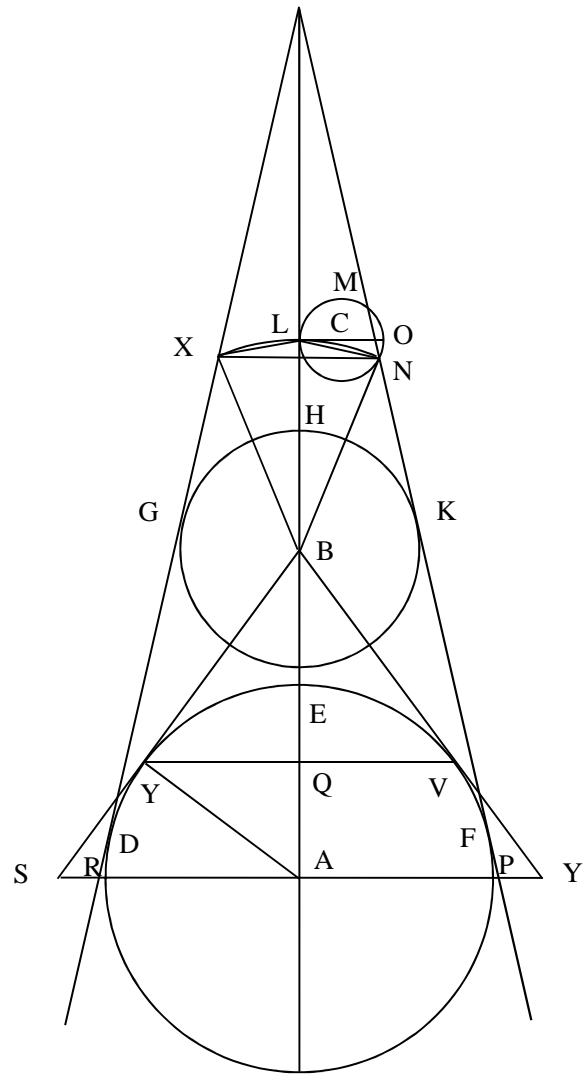


A.



## ARIST. DEMAGN







## ET DIST. SOL ET LVNAE

*Diameter circuli, qui in luna opacum, & splendidum determinat.*

Et cum CL perpendicularis ad LB] Ex 18 tertij ele  
mentorum, quod recta linea BL circum LMN contingat. C

Erit ipsi XN parallela] Ex 28 primi elementorum, est. n. D  
BL et ad XN perpendicularis, cum ipsam bisariam secet. 1. coroll.

Angulus igitur LXN est æqualis angulo CLN] E  
Quonia. n. LO XN parallelæ sunt, erit angulus LNX æqua  
lis angulo CLN. Sed angulus LXN est æqualis angulo ENX,  
& angulus CNL ipsi CLN, quod XL LN æquales sint, ite q.  
æquales LC CN. ergo & reliquus angulus XLN est æqua  
lis reliquo LCN, & triangulum triangulo simile. 29. p. 1.  
mi. 1. p. 1.  
mi.

Sed NL ad LC maiorem proportionem habet, F  
quàm 89 ad 45] Habet enim NL ad lunæ diametrum LO  
maiorem proportionem, quàm 89 ad 90, quod in antecede  
te demonstratum est.

Hoc est quadratum ex NL ad quadratum ex LC G  
maiorem habet proportionē, quàm 7921 ad 2025]  
Est enim 7921 numerus quadratus, qui fit ex 89, & 2025  
quadratus, qui ex 45.

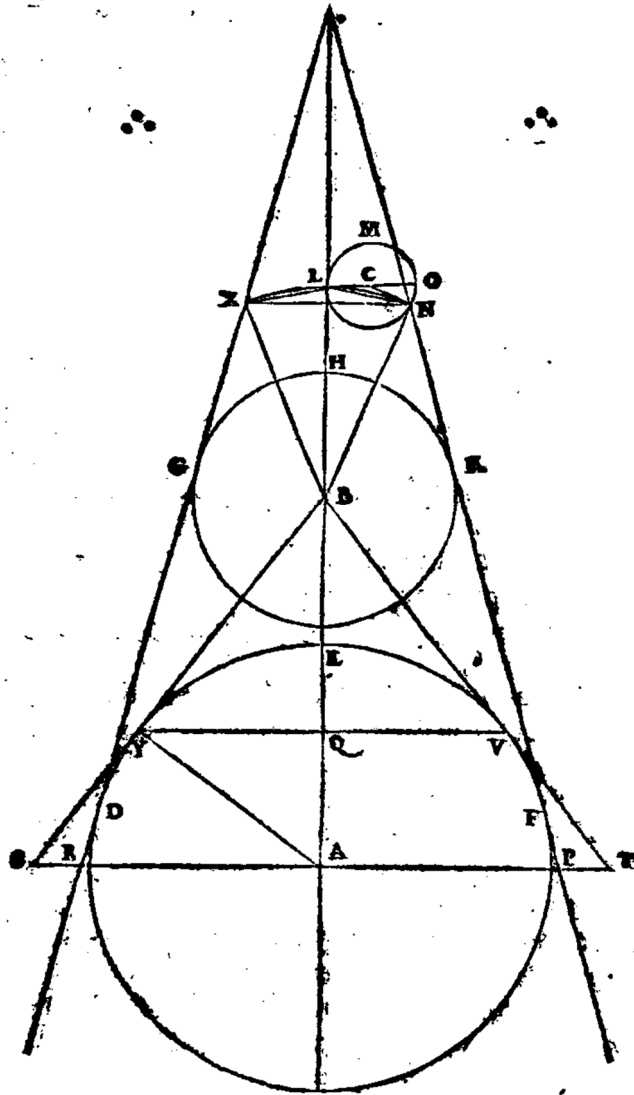
Et ipsa XN ad LO maiorē, quàm 7921 ad 4050] H  
Nam cum XN ad NL maiorem habeat proportionem, quàm  
89 ad 45, hoc est quàm 7921 ad 4005; & NL ad LO ma  
iorem, quàm 89 ad 90, hoc est quàm 4005 ad 4050: habe  
bit ex æquali XN ad LO multo maiorem proportionem, quàm  
7921 ad 4050, ex ijs quæ nos demonstrauimus ad 13 quin  
ti elementorum.

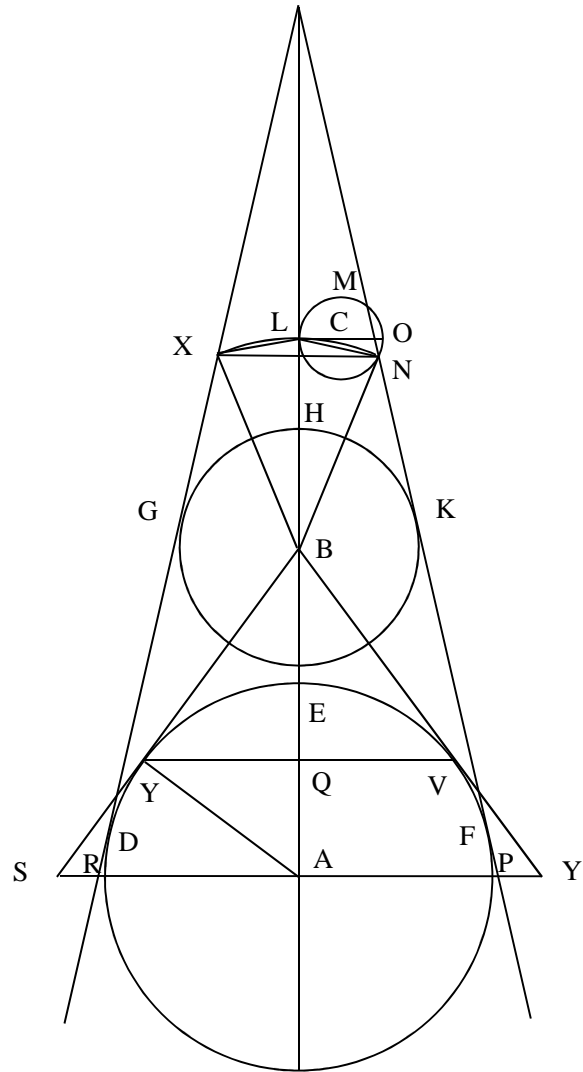
Habet autem 7921 ad 4050 maiorem propor  
tionem, quàm 88 ad 45] Est enim 88 ad 45, ut 7921  
ad 4050  $\frac{4}{3}$ . sed 7921 ad 4050 maiorem habet propor  
tionem, quàm ad 4050  $\frac{4}{3}$ . ergo 7921 ad 4050 maiorem  
proportionem habebit, quàm 89 ad 45. 8. quia  
ii.

Quare XN ad LO maiorem proportionē habe  
bit, L  
G 2 bit,

- of the circle dividing the dark and the bright portions in the moon.*
- C. And since CL is perpendicular to LB: *by the 18° proposition of tirth book of Elements, because the straight line BL touch the circle LMN.*
- D. It will be parallel to XN itself: *from 28° proposition of first book of Elements, indeed BL is also at right angle to XN, because it cuts into two equal parts.*
- E. Therefore the angle LXN is equal to the angle CLN: *since LO and XN are parallel, the angle LNX will be equal to the angle CLN* <sup>29° prop. of first book</sup>. *But the angle LXN is equal to the angle LNX, and the angle CNL is equal to a CLN itself* <sup>5° prop. of first book</sup>, *since XL and LN are equal, similary are equal LC and CN, therefore the remaining angle XLN is equal to remaining LCN and the triangles are similary, from 3° proposition of tirth book.*
- F. But NL has to LC a un ratio greater than 89 a 45: *indeed NL will have to the moon's diameter LO a ratio greater than that wich 89 to 90, as we have demonstrated previously.*
- G. The square on NL has to the square on LC a ratio greater than that which 7921 has to 2025: *ideed 7921 is the square of 89, and 2025 is the square of 45.*
- H. therefore XN itself also has to LO a ratio greater than that which 7921 has to 4050: *since XN has to LO a ratio greater than that wich 89 to 45, i.e. 7921 to 4005, and NL have to LO a ratio greater than that 89 to 90, i.e. 4005 to 4050, XN will have to LO, by direct porporzionality, a ratio much greater than that which 7921 to 4050, for this which we have demonstrated at 13 of fifth book of Elements.*
- K. But 7921 also has to 4050 a ratio greater than that which 88 has to 45: *in fact 88 is to 45 as 7921 is to  $4050 + \frac{45}{88}$ , but 7921 has to 4050 a ratio greater than that which  $4050 + \frac{45}{88}$ , therefore 7921 has to 4050 a ratio greater than that wich 89 has to 45.*
- L. Therefore XN will have to LO a ratio greater than that which

## ARIST. DE MAGN.





**ET DIST. SOLIS ET LVNAE. 27**

bit, quàm 88 ad 45 ] *Immo vero longe maiorem ex ante dictis.*

Isdem positus ducatur à puncto A ipsi AB ad re M  
ctos angulos PAR ] *Ita ut secet rectam lineam NKF in  
puncto P, & rectam lineam XGD in R.*

Lunæ autem diameter diametri solis, minor est, N  
quàm duodeuigesima pars ] *Ex 9 huius; solis enim dia-  
meter maior est, quàm duodeuigintapla diametri lunæ.*

Et diameter lunæ ad solis diametrum maiorem O  
hêt, quàm 45 ad 900. quippe quòd lunæ diameter ad  
diametrum solis maiorem habeat proportionem, quàm  
1 ad 20, & omnia quadragies quinquies firmantur ]  
*Ex nona huius. nã cù solis diameter minor sit, quàm vigintu-  
pla diametri lunæ, habebit diameter lunæ ad solis diame-  
trum maiorem proportionem, quàm 1 ad 20, hoc est 45 ad  
900, ex 15 quinti.*

Habebit XN ad diametrum solis maiorem pro- P  
portionem, quàm 88 ad 900. ] *Immo vero longe maiorẽ.*

Ducatur à puncto B circulum DE contingentes Q  
BYS BVT ] *Secent aut rectam lineam PAR in punctis S T.*

Erit igitur ut diameter circuli in luna opacum & R  
splendidum determinantis ad diametrum lunæ, ita  
YV ad solis diametrum, quòd idem conus solem &  
lunam comprehendat, ad visum nostrum verticem  
habens. ] *Illud nos hoc lemmate demonstrabimus.*

Sit noster visus ad A, solis centrum B, lunæ vero  
centrum C, quando conus solem & lunam compre-  
hendens ad visum nostrum verticem habeat. erunt  
ACB puncta in eadem recta linea. Ducatur per AC  
B planum, quod faciat sectiones, in spheris quidem  
circulos maximos DEF, GHI, in cono autem re-  
ctas lineas DGA FKA: iunganturque BD, CG, &  
à punctis D G ad B A ducantur ad rectos angulos  
DLF

88 has to 45: *indeed much greater because of the things said before.*

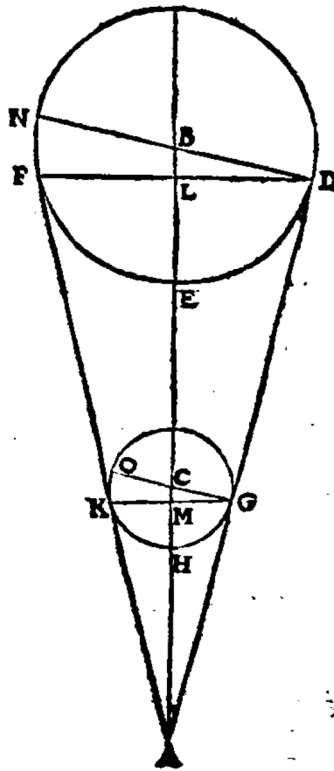
- M. The same hypothesis being made, let PAR be drawn from the point A perpendicularly to AB itself: *so it will cut the straight line NKF at point P and the straight line XGD at R.*
- N. While the diameter of the moon is less than the eighteenth part of the sun's diameter: *from 9° proposition of this book: indeed the diameter of the sun is less than the eighteenth part of the diameter of the moon.*
- O. And the moon's diameter has to the sun's diameter a ratio greater than that which 45 has to 900, since the diameter of the moon has to the diameter of the sun a ratio greater than that which 1 has to 20, if we multiply throughout by forty five: *from ninth proposition of this book, in fact since the diameter of the sun is less than twenty times the moon's diameter, the diameter of the moon will have to the diameter of the sun a ratio greater than that which 1 has to 20, i.e. 45 to 900, from 15° proposition of fifth book.*
- P. Then XM will have to the diameter of the sun a ratio greater than that which 88 has to 900: *to tell the truth, far greater.*
- Q. Let the BYS e BVT be drawn from point B tangent the circle DEF: *these will cut the straight line PAR at the points S and T.*
- R. Then, as the diameter of the circle dividing the dark and the bright portions in the moon is to the diameter of the moon, so YV will be to the diameter of the sun, because the sun and the moon are comprehended by one and the same cone which have its vertex at our eye: *we will demonstrate this with this lemma.*  
 Let be our eye at A, the centre of the sun at B, the centre of the moon at C when the cone comprehending both the sun and the moon has its vertex at our eye. The points A,C,B will be on the same straight line. Let a plane be carried through ACB. This plane will cut the spheres in the great circles DEF e GHK and the cone in the straight lines DGA and FKA; let be joined B&D and C&G and let DLF and GMK be drawn from the points D and G at right angles at AB and let DB and GC be produced

ARIST. DE MAGNIT.

DLF GMK:& DB G  
 C ad pūcta N O pro  
 ducantur . Dico vt K  
 G ad GO, ita esse FD  
 ad DN.

18. ter-  
 uij.  
 Quoniam enim recta  
 linea AGD circulos DE  
 F GHK contingit: & a  
 centris B C ad conta-  
 ctus ducuntur BD, CG,  
 erunt anguli ADB AG  
 C recti. quare trianguli  
 ABD angulus ADB est  
 aequalis angulo AGC  
 trianguli ACG: atque est  
 angulus DAB utriusque  
 communis . reliquus igitur  
 DBA est aequalis re-  
 liquo GCA. Rursus trian-  
 guli BDL angulus DLB  
 rectus est aequalis recto  
 GMC, & angulus DBL  
 aequalis ipsi GCM. ergo  
 & reliquus reliquo ae-  
 qualis, & triangulum  
 4. v. c. m.  
 triangulo simile. Vt igitur  
 MG ad LD, ita GC

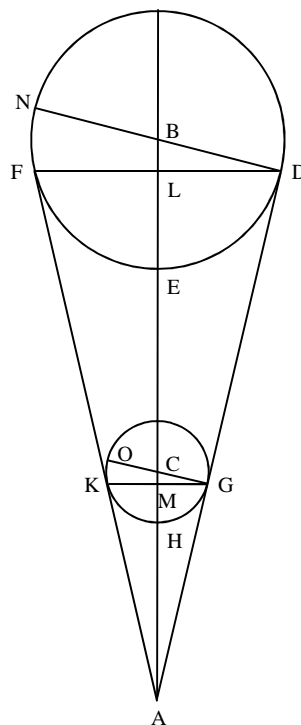
15. quif-  
 m.  
 ad DB: permutandoq; vt MG ad GC, ita LD ad DB. & eorū  
 dupla, vt KG ad GO, ita FD ad DN. est autem GK dia-  
 meter circuli, qui in luna opacum & splēdidum determinat,  
 & GO lunae diameter. ergo vt diameter circuli in luna opa-  
 cum, & splēdidum determinantis ad diametrum lunae, ita  
 FD ad DN, hoc est ad solis diametrum.



EA

to the points N and O. I say that as KG is to GO, so FD is to DN.

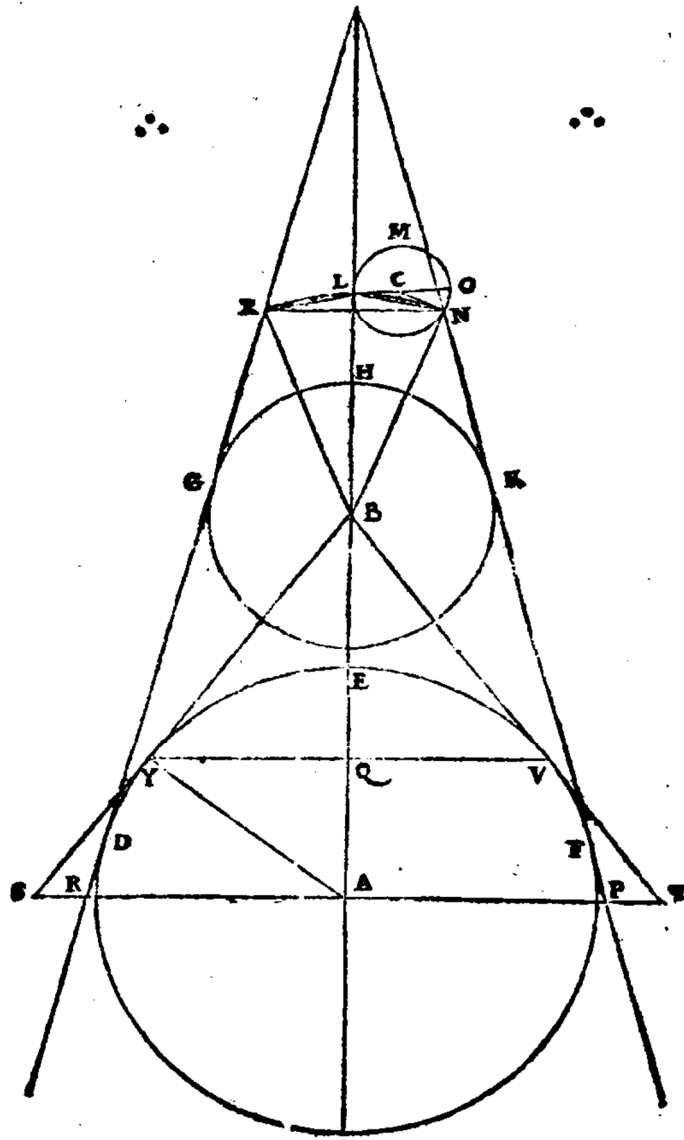
Since the straight line AGD touches the circles DEF and GHK and both BD and CG are drawn from the centres B and C at contact points, the angles ADB and AGC will be right; therefore the angle ADB of the triangle ABD is equal to the angle AGC of the triangle ACG, and the angle DAB is in common, then the remaining DBA is equal to the remaining GCA. Yet the straight angle DLB of the triangle BDL is equal to the straight angle GMC, and the angle DBL is equal to GCM itself; therefore the remaining angle is also equal to the remaining angle and the triangles are

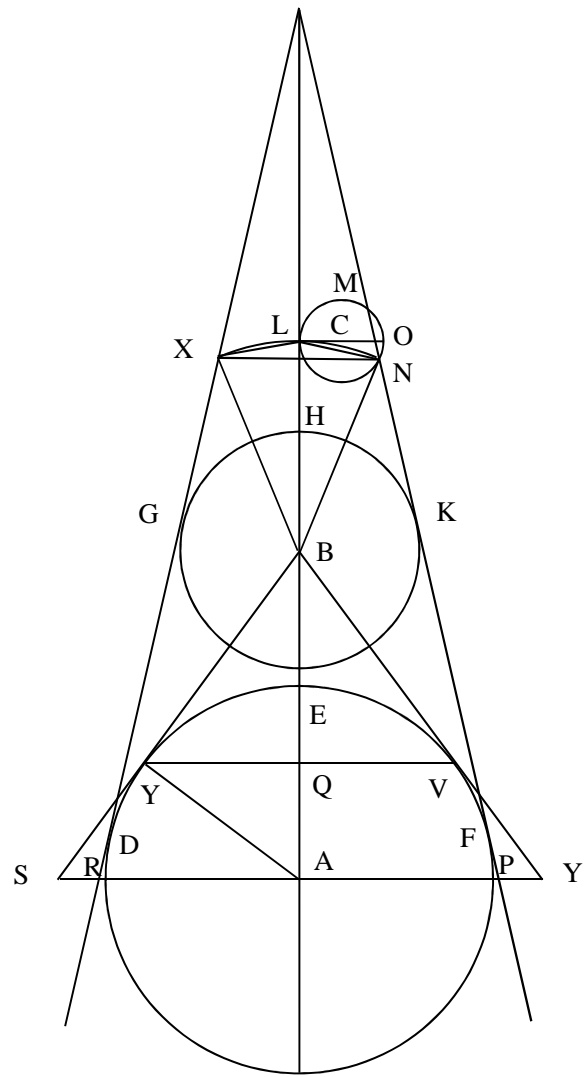


similar. Then as MG is to LD so CG is to DB, and so that, permutando, as MG is to GC so LD is to DB and also their double as KG is to GO so FD is to DN. But GK is the diameter of the circle dividing the dark and the bright portions in the moon, and GO is the diameter of the moon; consequently as the diameter of the circle dividing the dark and the bright portions in the moon is to the diameter of the moon so FD is to DN, that is the diameter of the sun.



DE DIT. SOL. ET LVNAE. 22





A R I S T. D E M A G N I T.

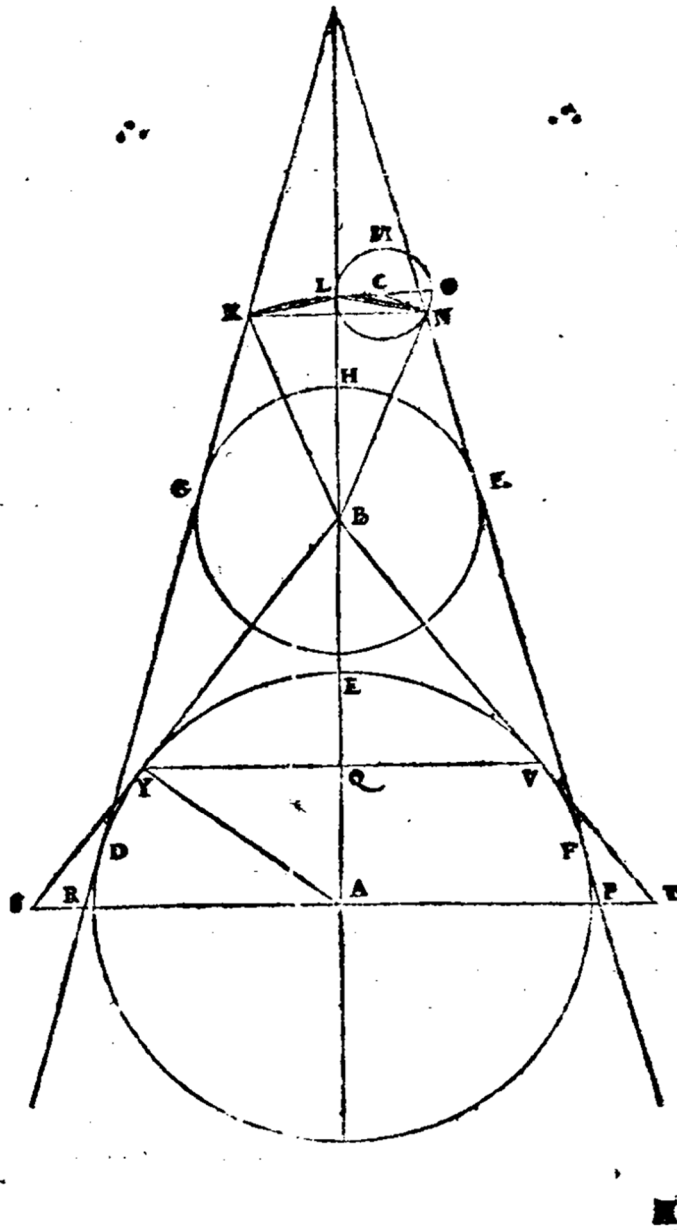
- S** Et QY ad YA habebit maiorem, quam 89 ad 90] Vt enim YV ad solis diametrum, ita QY ad YA, cum sint earum dimidia, ex 15 quinti.
- T** Vt autem QY ad YA, ita YA ad AS, cum parallelae sint SA YQ] Quoniam enim parallelae sunt SA YQ, erit angulus YAS aequalis angulo AYQ: atq; est angulus AYS rectus aequalis recto AQY. ergo & reliquis rel. quo equalis, et triangulum simile triangulo. Vt igitur QY ad YA, ita est YA ad AS.
- V** Multo igitur YA ad AR maiorem proportionem habebit, quam 89 ad 90] Ex 8 quinti: est enim AR minor, quam AS. quare & dupla ipsius YA ad duplam ipsius AR, hoc est solis diameter ad PR maiorem habebit proportionem, quam 89 ad 90.
- X** Ergo XN ad PR multo maiorem proportionem habet, quam numerus productus ex 22 & 89 ad eum, qui ex 90 & 225 producitur] Quoniam enim XN ad diametrum solis maiorem habet proportionem, quam 22 ad 225. & diameter solis ad PR maiorem habet, quam 89 ad 90, fiat vt 225 ad 22, ita 89 ad alium. erit ad  $8 \frac{158}{22}$ . Cum igitur XN ad diametrum solis maiorem habeat proportionem, quam 22 ad 225, hoc est, quam  $8 \frac{158}{22}$  ad 89: & solis diameter ad PR habeat maiorem, quam 89 ad 90; habebit ex aequali XN ad PR multo maiorem proportionem, quam  $8 \frac{158}{22}$  ad 90. sed  $8 \frac{158}{22}$  hoc est  $\frac{1158}{22}$  ad 90, est vt 1958 ad 20250. quod ita manifestum erit. dispositis enim numeris in hunc modum, & decussatim multiplicatis videlicet 225 in 90. fient 20250, & 1 in  $\frac{1158}{22}$   $\frac{20250}{22}$  1958, fient 1958. habebit  $\frac{1158}{22}$  ad 90 eandem proportionem, quam 1958 ad 20250. quod nos demonstrauimus in commentarijs in tertiam propositionem. libri Archimedis de circuli dimensione, propositione septima. quare XN ad PR multo maiorem proportionem habebit, quam numerus

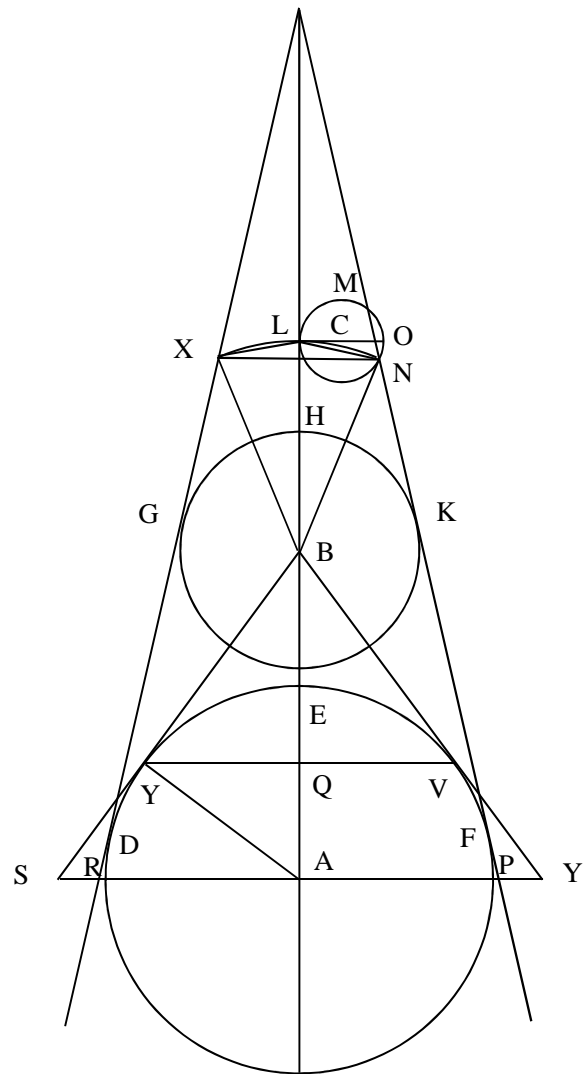
- S. QY also will have to YA a ratio greater than that which 89 has to 90: indeed as YV is to diameter of the sun, so QY is to YA since it is half of those, by the 15° proposition of fifth book.
- T. After, as QY is to YA, so is YA to AS, because SA and YQ are parallel: indeed, since SA and YQ are parallel, the angle YAS will be equal to the angle AYQ, then the right angle AYQ is equal to the right angle AQY, therefore the remaining angles will also be equal and both the triangles are similar. As QY is also to YA so YA is to AS.
- V. Therefore YA will have to AR a ratio much greater than that which 89 has to 90: from the 8° definition of fifth book, in fact AR is less than AS; therefore the double of YA will be also to double of AR itself, that is the diameter of the sun will have to PR a ratio greater than that which 89 has to 90.
- X. Also XN, by direct proportionality has to PR a ratio much greater than that which the product of 22 and 89 has to the product of 90 and 225: in fact since XN has to diameter of the sun a ratio greater than that which 22 has to 225, and the diameter of the sun has to PR a ratio greater than that 89 has to 90, it will occur that as 225 is to 22 so 89 is to something; it will be  $8 + \frac{158}{225}$ . Since XN has also to the diameter of the sun a ratio greater than that which 22 has to 225, i.e.  $8 + \frac{158}{225}$  to 89, and since the diameter of the sun has also to PR a ratio greater than that 89 has to 90, by direct proportionality, XN will have to PR a ratio much greater than that which  $8 + \frac{158}{225}$  has to 90; but  $8 + \frac{158}{225}$  a 90 is as 1958 to 20250; this thing will be so demonstrated: if we have the numbers in this way and multiply at cross that is to say  $225 \times 90$  we will have 20250, and 1 for 1958 we will have 1958,

$$\frac{\frac{1958}{225}}{\frac{90}{1}} = 20250$$

$\frac{1958}{225}$  will have to 90 the same ratio which 1958 has to 20250, which we have demonstrated in the commentaries to third proposition of book by Archimedes on measurement of a circle at seventh proposition; therefore XN will be much greater to PR than the number

ET DIST. SOL. ET LVNAB. ☾





## ARIST. DE MAGN.

merus productus ex 22 & 89, hoc est 1958 ad eū, qui pro-  
ducitur ex 90 & 225, videlicet ad 20250.

## PROPOSITIO XIII.

*A centro terra ad luna centrum iuncta  
recta linea ad rectam lineam, quæ ex axe  
abscinditur, inter eam, quæ subtendit cir-  
cumferentiã circuli in terre umbra conten-  
tam, & centrum luna, maiorem proportionē  
habet, quam 675 ad 1.*

Sit eadem figura, quæ prius: & luna ita se habeat,  
ut centrum ipsius C fit in axe conis solem, & terram  
comprehendentis: maximus autem in sphaera cir-  
culus sit POM in eodem existens plano; & MO iun-  
gatur. ergo MO est diameter circuli determinantis  
in luna opacum, & splendidum. Itaque iungantur M  
B, BO LX XB MC. rectæ igitur lineæ MB BO  
contingunt circulum MOP; propterea quod MO  
fit diameter circuli determinantis in luna opacum,  
& splendidum. Et quoniam XL est æqualis MO;  
vtraque enim ipsarum est diameter circuli in luna  
opacum, & splendidum determinantis: erit XML  
circumferentia æqualis circumferentiæ MLO. ideoque  
circumferentia XM ipsi LO æqualis. sed OL est æ-  
qualis LM. ergo & XM ipsi ML æqualis erit. est au-  
tem & XB æqualis BL, quod punctum B fit terræ cē-  
trum; habeatque terra puncti, ac cētri rationem ad  
sphaeram luna; & circulus MOP in eodem sit plano.  
quare BM perpendicularis est ad XL. atque est CM  
ad

A  
B  
C  
Ex 2.  
posi-  
tione.  
DE

ad

*obtained by multiplication of 22 x 89, i.e. 1958, to that which result by multiplication 90 x 225, or 20250.*

*PROPOSITION XIV*

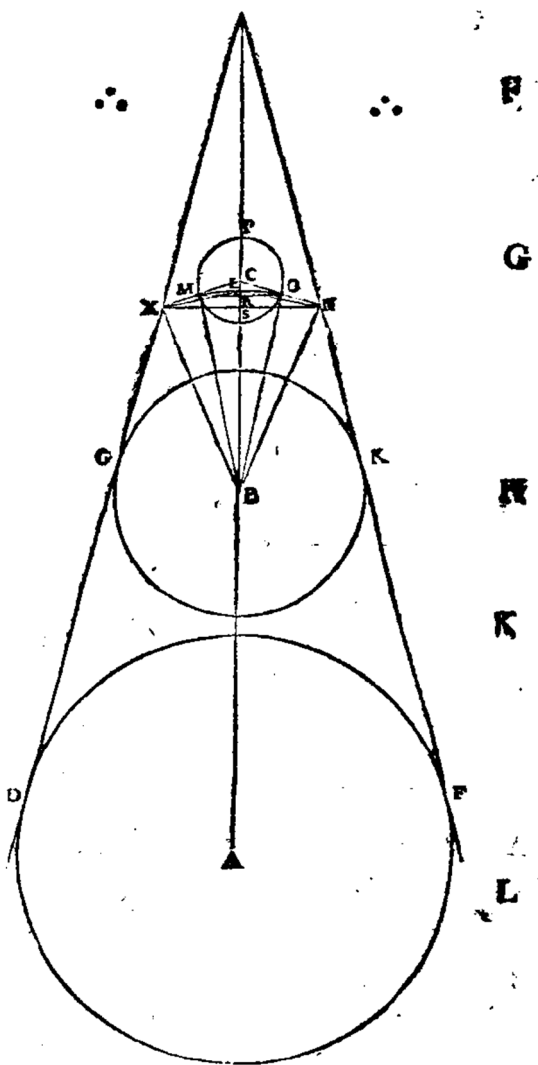
*The straight line joining the centre of the earth to the centre of the moon has, to the straight line cut off from the axis towards the moon's centre by the straight line subtending the arc of circle within the earth's shadow, a ratio greater than that which 675 has to 1.*

For let the same figure as before be considered, and let the moon be so placed that its centre C is on the axis of the cone comprehending both the sun and the earth; let the great circle POM in the sphere (moon's sphere) be in the same extant plane and let be joined M&O; therefore MO is the diameter of the circle which divides the dark and the bright portions in the moon. Let M&B, B&O, L&X, X&B, M&O be joined, therefore the straight lines MB and BO touch the circle MOP because MO is the diameter of the circle which divides the dark and the bright portions in the moon. And, since XL is equal to MO, both of these are a diameter of the circle which divides the dark and the bright portions in the moon, therefore the arc XML will be equal to the arc MLO<sup>A</sup>, therefore the arc XM is equal to the arc LO, but OL is equal to LM<sup>B</sup>, therefore XM will be also equal to ML; and consequently XB will be also equal to BL<sup>C</sup> because the point B is the centre of the earth and the earth has the relation of a point and centre to the sphere in which the moon moves and the circle MOP is also in the same plane, therefore BM is perpendicular to XL,<sup>D</sup> but



E T DIST. SOL. ET LYNÆ. 30

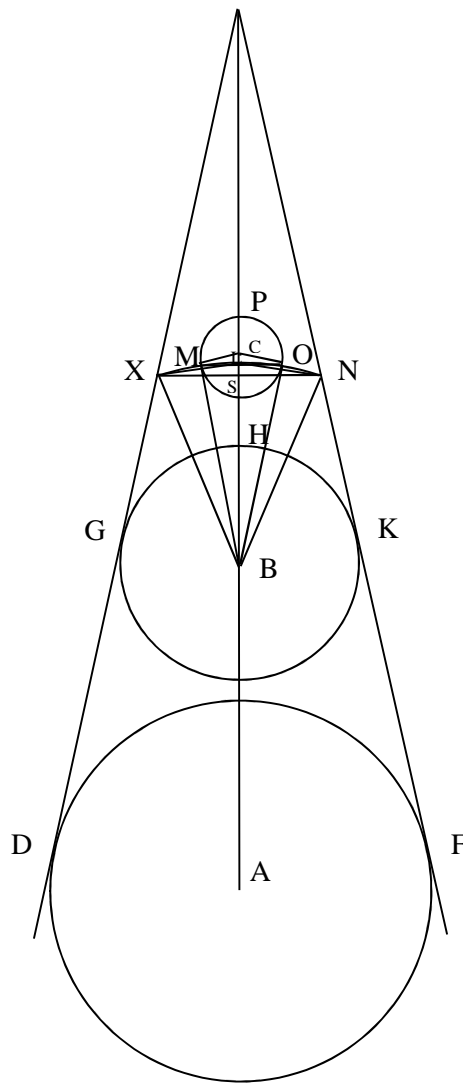
ad MB perpendicularis .  
 parallela igitur est CM ip  
 si LX. est autem & SX pa  
 rallela ipsi M R; ac propte  
 rea triangu  
 lum LXS si  
 mile est trian  
 gulo M R C.  
 ergo ut SX  
 ad MR, ita S  
 L ad RC. sed  
 SX ipfius M  
 R minor est,  
 quam dupla;  
 quoniã & X  
 N est minor,  
 quam dupla  
 ipfius MO. er  
 go & SL ip  
 fius CR mi  
 nor erit, quã  
 dupla : &  
 R multo mi  
 nor, quã du  
 pla ipfius R  
 C. ex quibus  
 sequitur SC  
 ipfius CR mi  
 norẽ esse, quã triplã. habebit igitur RC ad CS maio M



A.

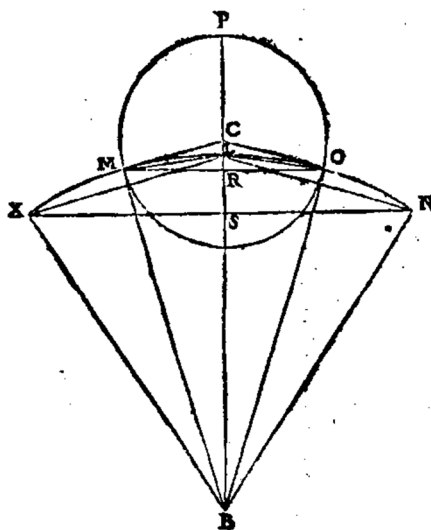
H 2 rem

CM is also perpendicular to  $MB^E$ ; therefore CM is parallel to  $LX^F$ , but SX is also parallel to MR, therefore the triangle  $LSX$  is similar to the triangle  $MRC^G$ ; therefore, as  $SX$  is to  $MR$  so is  $SL$  to  $RC$ , but  $SX$  is less than double of  $MR^H$  and since  $XN$  is also less than double of  $MO^K$  then  $SL$  is also less than double of  $CR$  and  $SR^4$  will be much less than double of  $RC^L$ . Consequently  $SC$  is less than triple of  $CR$ , therefore  $RC$  will have to  $CS$  a ratio greater than that



## ARIST. DE MAGN.

rē proportio-  
 nē, quā 1 ad  
 N 3. Et qm̄ est vt  
 BC ad CM, ita  
 MC ad CR, ha-  
 O betq; BC ad  
 CM maiorem  
 proportione, quā  
 45 ad 1, & RC ad CS  
 maiorem, quā  
 1 ad 3: ex æ-  
 quali MC ad  
 CS maiorem  
 habebit pro-  
 portione, quā  
 45 ad 3, hoc  
 est, quā 15 ad  
 1. ostēsa est au-



tem & BC ad CM habere maiorem proportionem,  
 P quā 45 ad 1. rursus igitur ex æquali BC ad CS ma-  
 iorem proportionem habebit, quā 675 ad 1.

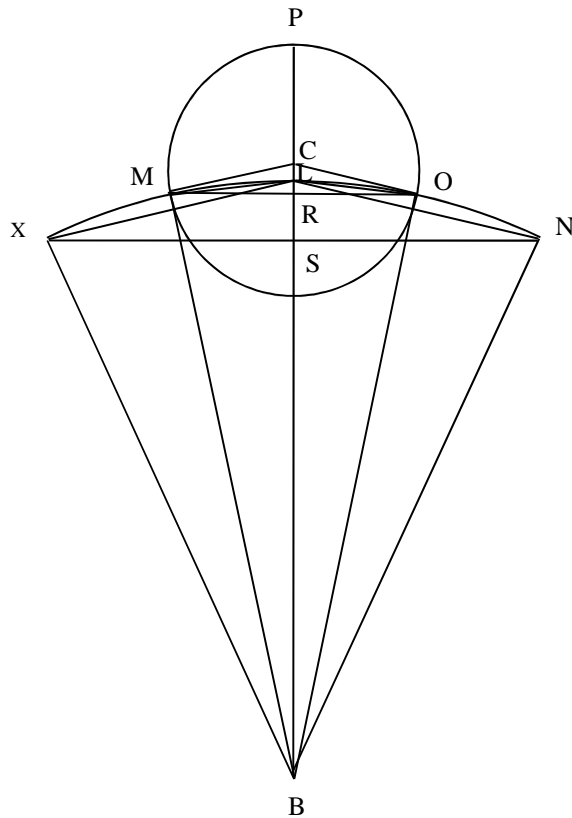
## F E D. C O M M A N D I N V S.

A Erit XML circumferentia æqualis circumferen-  
 tiæ MLO ] Ex 28 tertij elementorum. In æqualibus enim  
 circulis æquales rectæ lineæ æquales circumferentias  
 auferunt.

B Ideoque circumferentia XM ipsi LO æqualis ] Quo-  
 niam enim circumferentia XML est æqualis circumferen-  
 tiæ MLO, dempta circumferentia ML vtrique communi, erit  
 reliqua XM reliquæ LO æqualis.

Est

which 1 has to  $3^M$ , and since as BC is to CM so is MC to  $CR^N$ , then BC has to CM a ratio greater than that which 45 has to  $1^O$  and RC has to CS a ratio greater than that which 1 has to 3; For direct proportionality MC will have also to CS a ratio greater than that which 45 has to 3 i.e. than that 15 has to 1. Then it was proved that BC has also to CM a ratio greater than that which 45 has to 1; again, for direct proportionality, BC has to CS a ratio greater than that which 675 has to  $1^P$ .



*Federico Commandino*

- A. The arc XML will be equal to the arc MLO: *by 28<sup>o</sup> proposition of tirth book of Elements. In fact equal straight lines identify equal arcs on equal circles.*
- B. therefore the arc XM is equal to the arc LO, but OL is equal to LM: *poiché infatti l'arco XML è uguale all'arco MLO, tolto l'arco ML comune ad entrambi, il restante XM sarà uguale al restante LO.*

## ET DIST. SOL. ET LVNÆ. 31

Est autem & XB æqualis BL] A centro enim B ad cir C  
sumferentiam ducuntur.

Quare BM perpendicularis est ad XL] Ex 3 tertij D  
elementorum, nam recta linea BM ex centro ducta circum-  
ferentiam XML, & ob id rectam lineam XL bifariam secat.

Atque est CM ad MB perpendicularis] Ex 18 ter- E  
tij. ducta est enim recta linea ex centro C ad punctum, in quo  
BM circulum POM contingit.

Parallela igitur est CM ipsi LX] Ex 28 primi el- F  
mentorum.

Ac propterea triangulum LXS simile triangulo G  
MRC] Namque angulus LXS æqualis est angulo CMR, & 29 pri-  
angulus LSX rectus æqualis recto CRM. ergo & reliquis mi.  
reliquo æqualis, & triangulum triangulo simile.

Sed SX ipse MR minor est, quàm dupla] Ex 15 H  
quinti elementorum.

Quoniam & XN est minor, quàm dupla ipsius M K  
O] Ex demonstratis in antecedente.

Et SR multo minor, quàm dupla ipsius RC] Est L  
enim RS minor, quàm SL.

Habebit igitur RC ad CS maiorem proportionē, M  
quàm 1 ad 3] Ex 8 quinti elementorum.

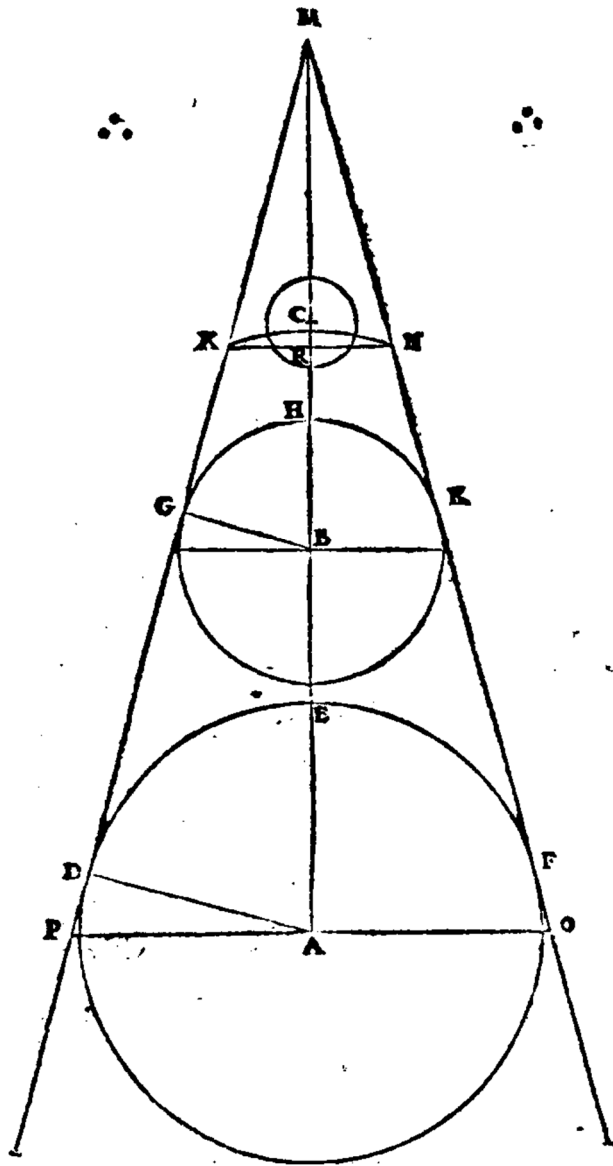
Et quoniam est ut BC ad CM, ita MC ad CR] Ex N  
4 sexti nam triangula BMC, MCR similia sunt ex 8 eiusdē,  
quod ab angulo recto trianguli BMC ad basim perpendicu-  
laris ducta est MR.

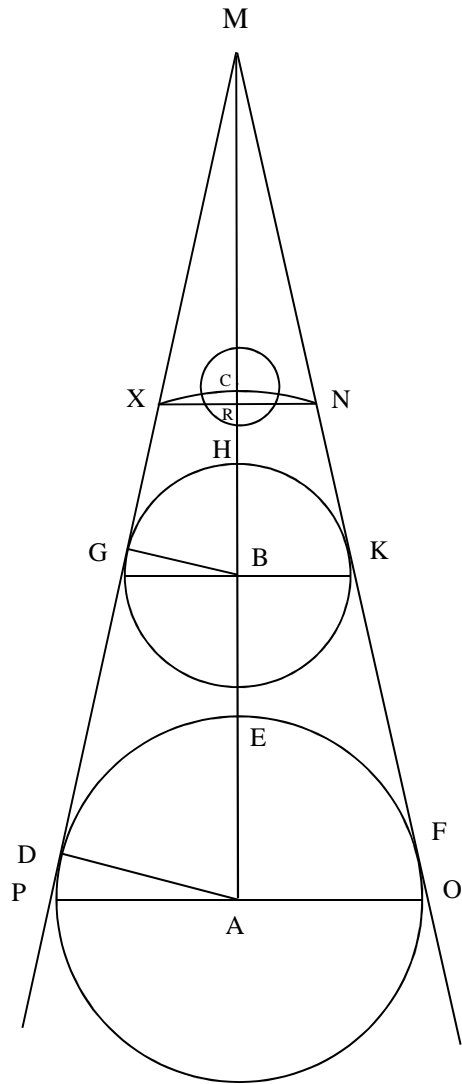
Habetque BC ad CM maiorem proportionem, O  
quàm 45 ad 1.] Ex undecima huius.

Rursum igitur ex æquali BC ad CS maiorem pro- P  
portionem habebit, quàm 675 ad 1.] Si enim fit, ut  
1 ad 45, ita 15 ad alium, erit ad 675. Itaque quoniam BC  
ad CM maiorem proportionē habet, quàm 45 ad 1, hoc est,  
quàm 675 ad 15; & MC ad CS maiorem, quàm 15 ad 1, ha  
bebit

- C. And consequently XB will be also equal to BL: *indeed both of them are drawn from center B to the circle.*
- D. Therefore BM is perpendicular to XL: *from 3° proposition of tirth book of Elements, indeed the straight line BM is drawn from the center to the circle XML and for this reason per questo bisect the straight line XL.*
- E. But CM is also perpendicular to MB: *from 18° proposition of tirth book, indeed a straight line is drawn from the center C to point in which BM touch the circle POM.*
- F. Therefore CM is parallel to LXQuindi CM è parallela ad LX: *from 28° proposition of first book of Elements.*
- G. Therefore the triangle LSX is similar to the triangle MRC: *indeed the angle LXS is equal to the angle CMR, and the right angle LSX is equal to the straight angle CRM. Therefore the remaining angles will be also equal, and the triangles will be similar.*
- H. But SX is less than double of: *from 15° proposition of fifth book of Elements.*
- K. And since XN is also less than double of MO: *as shown previously.*
- L. SR will be much less than double of RCS: *in fact RS is less than SL.*
- M. therefore RC will have to CS a ratio greater than that which 1 has to 3: *from 8° proposition of fifth book of Elements.*
- N. Since as BC is to CM so is MC to CR: *from 4° proposition of sixth book, indeed the triangle BCM and MCR are similar by 8° proposition of the same, because the perpendicular line is drawn from the straight angle of the triangle BMC to the base MR.*
- O. Then BC has to CM a ratio greater than that which 45 has to 1: *from the eleventh proposition of this book.*
- P. Again, for direct proportionality, BC has to CS a ratio greater than that which 675 has to 1: *if be it as 1 is to 45, so 15 will be to another, which will be 675. And so, since BC has to CM a ratio greater than that 45 has to 1, i.e. 675 to 15, MC will have to CS, for direct proportionality, a ratio greater than that 15 has to 1.*

## ARIST. DE MAGN.







**ET DIST. SOL. ET LVNÆ. 43.**

bebit ex æquali BC ad CS maiorem proportionem, quàm  
675 ad 1.

**PROPOSITIO XV.**

*Solis diameter ad diametrum terre maio-  
rem habet proportionem, quàm 19 ad 3; mi-  
norem vero, quàm 43 ad 6.*

Sit enim solis quidem centrum A, terræ vero cen-  
trum B, & lunæ centrum C, perfecta existente eccli-  
si, hoc est ita ut puncta ABC in eadem recta linea cõ-  
stituantur: & per axem producatum planum, quod  
faciat sectiones, in sole quidem circulû DEF; in ter-  
ra vero circulum GHK, & in umbra circumferentiã  
NX; denique in cono rectas lineas DM FM. iunga-  
turque NX, & per punctum A ducatur ipsi AM ad  
rectos angulos OAP. Quoniã igitur NX minor est, **A**  
quàm nona pars diametri solis; habebit OP ad NX  
multo maiorem proportionem, quàm 9 ad 1: & per **B**  
conuersionem rationis MA ad AR minorem pro-  
portionem habebit, quàm 9 ad 8. Rursus quoniam **C**  
AB ipsius BC maior est, quàm duodeuigintupla,  
erit multo maior, quàm duodeuigintupla ipsius BR. **D**  
ergo AB ad BR maiorem proportionem habet, quàm  
18 ad 1: & conuertendo RB ad BA minorem, quàm <sup>26. quæ</sup>  
1 ad 18: componendoque RA ad AB minorem ha-  
bet, quàm 19 ad 18. ostensa est autem & MA ad AR <sup>28. quæ</sup>  
minorem habere proportionem, quàm 9 ad 8. ergo **E**  
ex æquali MA ad AB minorem habebit proportio-  
nem, quàm 171 ad 144: & quàm 19 ad 16, partes enim <sup>15. quæ</sup>  
eodem modo multiplicium eandem habent pro-  
portionem

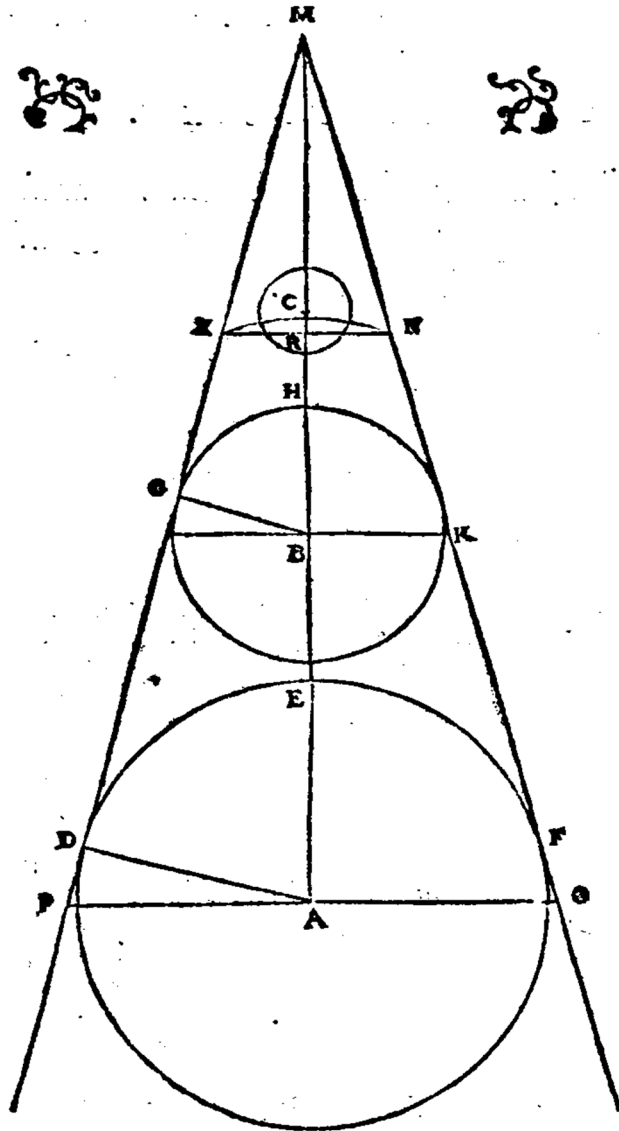
*per proporzionalità diretta BC rispetto a CS avrà un rapporto maggiore di 675 ad 1.*

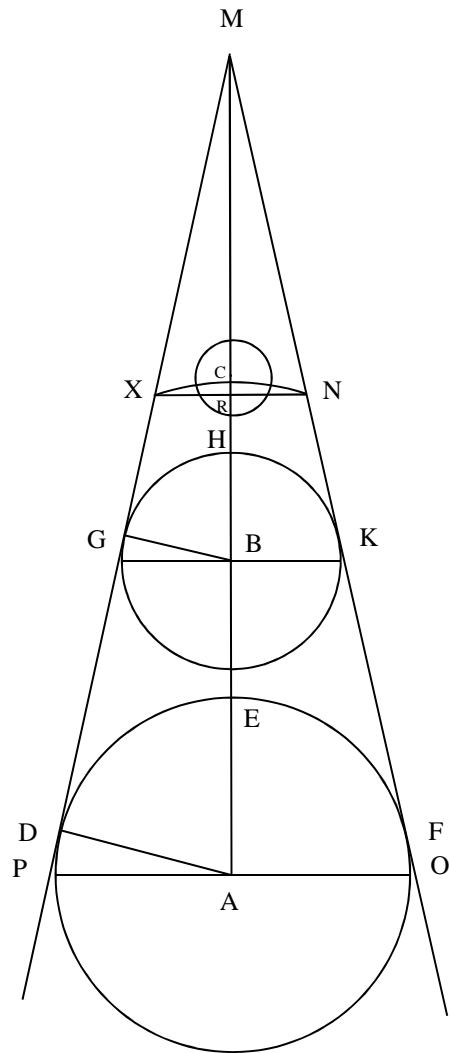
*PROPOSITION XV*

*The diameter of the sun has to the diameter of the earth a ratio greater than that which 19 has to 3, but less than that which 43 has to 6.*

Let A be now the centre of the sun, while B the centre of the earth and C the centre of the moon when the eclipse is total, so that the points ABC may set in a straight line, and a plane be carried through the axis which will cut the sun in the circle DEF, the earth in GHK and the shadow in the arc NX, and at last the cone in the straight line DM and DF; let N&X be joined and from point A let OAP be drawn perpendicularly to AM itself. Then, since NX is less than ninth part of the diameter of the sun, therefore OP will have to NX a ratio much greater than that which 9 has to 1<sup>A</sup> and, convertendo, MA will have to AR a ratio less than that which 9 has to 8<sup>B</sup>. Again, since AB is greater than 18 times BC<sup>C</sup>, then it is much greater than eighteen times BR<sup>D</sup>, therefore AB has to BR a ratio greater than that which 18 has to 1<sup>26° prop. of fifth b.</sup>, and, for inverse proportionality, RB has to BA a ratio less than that which 1 has 18 and, componendo, RA has to AB a ratio less than that which 19 has to 18. Then it was proved that MA also has to AR a ratio less than that which 9 has to 8.<sup>28° prop. of fifth b.</sup> Therefore, ex aequali, MA will have to AB a ratio less than that which 171 has to 144<sup>E</sup> and than that which 19 has to 16, because parts have the same ratio as the same multiplies of them.

## ARIST. DE MAGNIT.



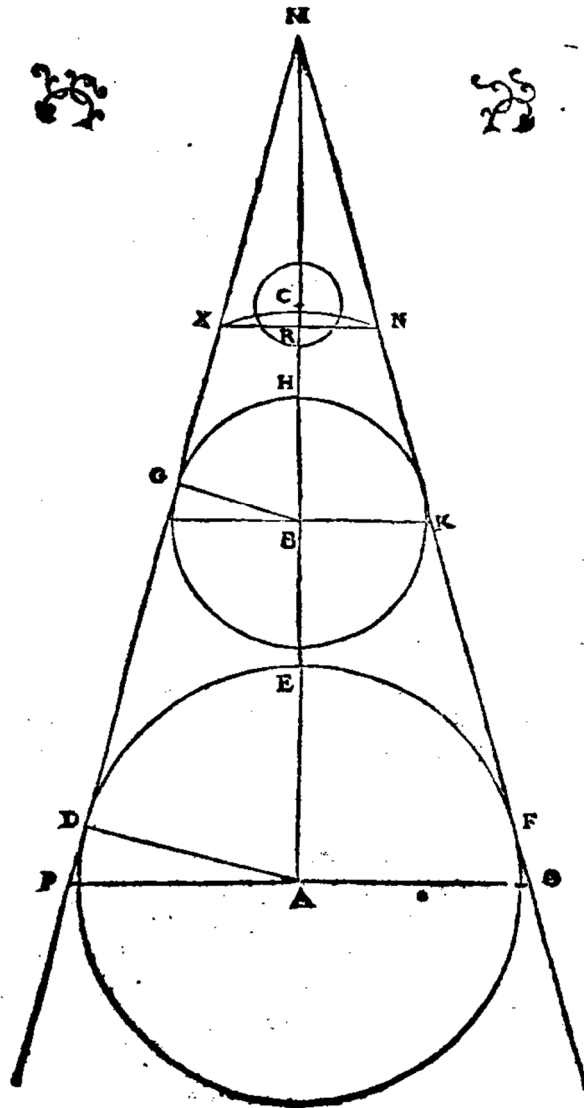


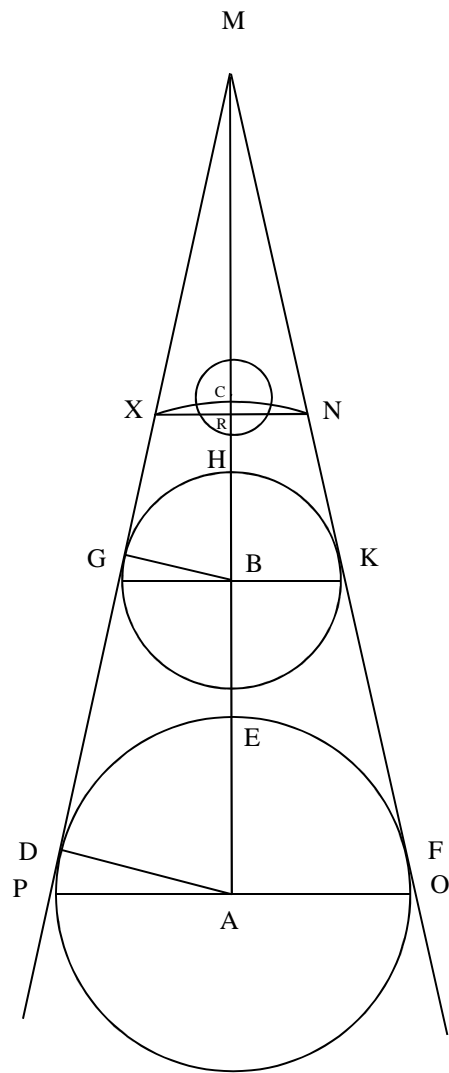
ET DIST. SOL ET LVNÆA 33

portionem . quare per conuersionem rationis AB <sup>30. quæ</sup>  
ad BM maiorem proportionem habet, quàm 19 ad <sup>ii.</sup>  
3. vt autè AM ad MB, ita DEF circuli diàmetèr ad <sup>F</sup>  
diàmetrum circuli GHK. solis igitur diàmetèr ad  
diàmetrum terræ maiorem habet proportionem,  
quàm 19 ad 3. Dico præterea minorè proportionè  
habere, quàm 43 ad 6. Quoniam enim BC ad CR <sup>G</sup>  
maiorem habet proportionem, quàm 675 ad 1, ha-  
bebit per conuersionem rationis CB ad BR propor- <sup>30. quæ</sup>  
tionem minorem, quàm 675 ad 674. sed AB ad BC <sup>ii.</sup>  
minorem proportionem habet, quàm 20 ad 1. ergo <sup>H</sup>  
ex æquali AB ad BR minorem habebit proportio- <sup>K</sup>  
nem, quàm 13500 ad 674, hoc est quàm 6750 ad 337.  
& conuertendo, cõponendoque RA ad AB maio- <sup>26. quæ</sup>  
rem proportionem habebit, quàm 7087 ad 6750. <sup>ti.</sup>  
Quòd cum NX ad OP maiorem habeat proportio- <sup>28. quæ</sup>  
nem, quàm 979 ad 10125, habebit conuertèdo OP <sup>ii.</sup>  
ad NX minorem proportionem, quàm 10125 ad <sup>L</sup>  
979. Vt autem OP ad NX, ita AM ad MR. ergo & A <sup>26. quæ</sup>  
M ad MR minorem proportionem habebit, quàm <sup>ti.</sup>  
10125 ad 979. & per conuersionem rationis MA ad <sup>M</sup>  
AR habebit maiorem proportionem quàm 10125  
ad 9146. sed RA ad AB maiorem proportionem ha-  
bet, quàm 7087 ad 6750. ex æquali igitur MA ad A <sup>N</sup>  
B maiorè habebit proportionè, quàm numerus produ-  
ctus ex 10125 & 7087 ad eum qui ex 9146, & 6750  
producitur; hoc est quàm 71755875 ad 61735500.  
habet autem & 71755875 ad 61735500 maiorem. <sup>O</sup>  
proportionem, quàm 43 ad 37. ergo & MA ad AB  
maiorem proportionem habebit, quàm 43 ad 37.  
& per conuersionem rationis AM ad MB habebit  
minorem proportionem, quàm 43 ad 6. sed vt AM  
ad MB, ita est solis diàmetèr ad diàmetrum terræ.  
I ergo

Therefore, convertendo,<sup>30 prop. of fifth b.</sup> AB has to BM a ratio greater than that 19 has to 3, but as AM is to MB, so is the diameter of the circle DEF is to the diameter of the circle GHK<sup>F</sup>; therefore the diameter of the sun has to the diameter of the earth a ratio greater than that which 19 has to 3. Moreover I say that it has to it a ratio less than that which 43 has to. Indeed since BC has to CR a ratio greater than that which 675 has to 1<sup>G</sup> therefore, convertendo, CB will have to BR<sup>30<sup>o</sup> prop. of fifth b.</sup> a ratio less than that which 675 has to 674, but AB has to BC a ratio less than that which 20 has to 1<sup>H</sup>. Therefore, ex aequali, AB will have to BR a ratio less than that which 13500 has to 674, that is, than that which 6750 has to 337<sup>K</sup>, and for inverse poporzionalita and, componendo,<sup>26<sup>o</sup> prop. of fifth b.</sup> RA will have to AB a ratio greater than that which 7087 has to 6750. Therefore since NX has to OP a ratio greater than that which 979 has to 10125,<sup>L 18<sup>o</sup> prop. of fifth b.</sup> then, for inverse proporzionalita, OP will have to NX a ratio less than that which 10125 has to 979. Then, as OP is to NX, so is AM to MR<sup>M</sup>, therefore AM also will have to MR a ratio greater than taht which 10125 has to 979 and therefore, inversely, MA will have to AR a ratio greater than that which 10125 has to 9146; but RA has to AB a ratio greater than that which 7087 has to 6750, therefore, ex aequali, MA will have to AB a ratio greater than that which the product of 10125 and 7087 has to the product of 9146 and 6750, that is, 71.755.875 to 61.735.500<sup>N</sup>; but 71.755.875 has also to 61.735.500 a ratio greater than that which 43 has to 37<sup>O</sup>, therefore MA will have to AB a ratio greater than thath which 43 has to 37 and, convertendo, AM will have to AB a ratio greater than that which 43 has to 6. But, as AM is to AB, so is the diameter of the sun to the diameter of the earth;

## ARIST. DE MAGNIT.







ET DIS. SOLIS ET EVNAE. A 34

ergo diameter solis ad tetrae diametrum minorem proportionem habebit, quam 43 ad 6. ostensa est autem & maiorem habere proportionem, quam 19 ad 3.

F E D. C O M M A N D I N V S.

Quoniam igitur NX miuor est, quam nona pars A diametri solis, habebit OP ad NX multo maiorem proportionem, quam 9 ad 1. ] Ex 12 huius. ex quo sequitur ex 8 quinti NX ad diametrum solis minorem habere proportionem quam 1 ad 9. quare conuertendo ex 26 quinti diameter solis ad NX maiorem habet proportionem, quam 9 ad 1. & OP quae maior est, quam solis diameter, ad NX multo maiorem proportionem habet, quam 9 ad 1. sed ut A O ad RN, hoc est ut earum duplè OP ad NX, ita erit AM ad MR ob similitudinem triangulorum AMO RMN. ergo & AM ad MR multo maiorem proportionem habebit, quam 9 ad 1.

Et per conuersionem rationis MA ad AR minorem proportionem habebit, quam 9 ad 8 ] Ex 30 quinti.

Rursum quoniam AB ipsius BC maior est, quam duodeuigintupla ] Ex 7. huius.

Erit multo maior, quam duodeuigintupla ipsius BR ] Est enim BR minor, quam BC.

Ergo ex equali MA ad AB minorem habebit proportionem quam 171 ad 144. ] Quoniam enim MA ad AR minorem proportionem habet, quam 9 ad 8, hoc est, quam eorum vnde uigintupla, videlicet 171 ad 152: habet autem RA ad AB proportionem minorem, quam 19 ad 18. fiat ut 19 ad 18, ita 152 ad alium; erit ad 144. Cui igitur MA ad AR minorem habeat proportionem, quam 171 ad 152; habeatque RA ad AB proportionem minorem, quam 152 ad 144: ex equali MA ad AB minorem proportionem habe-

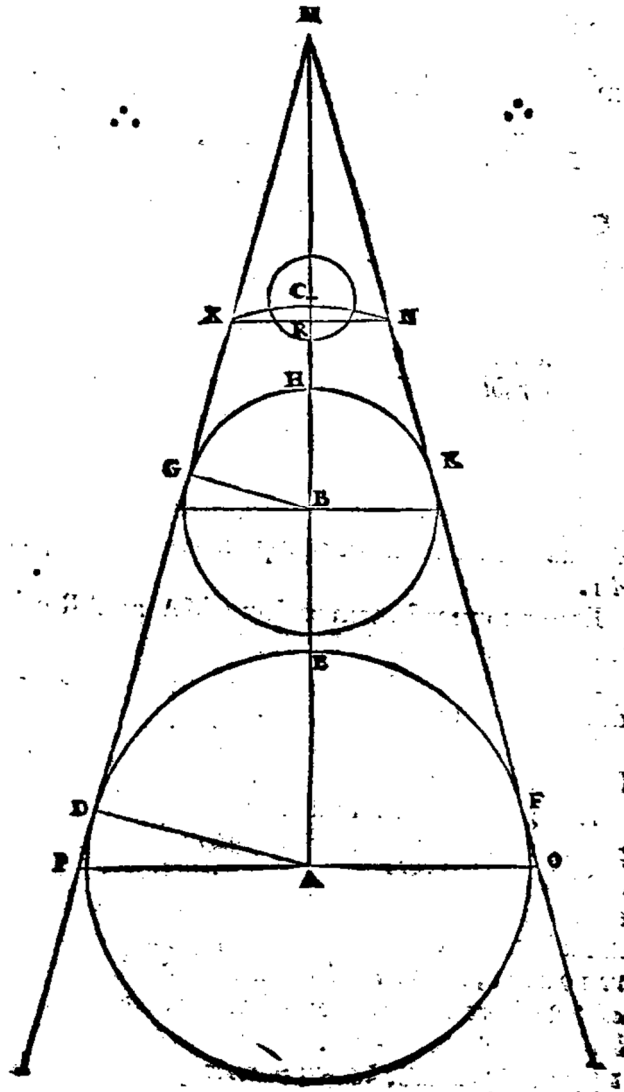
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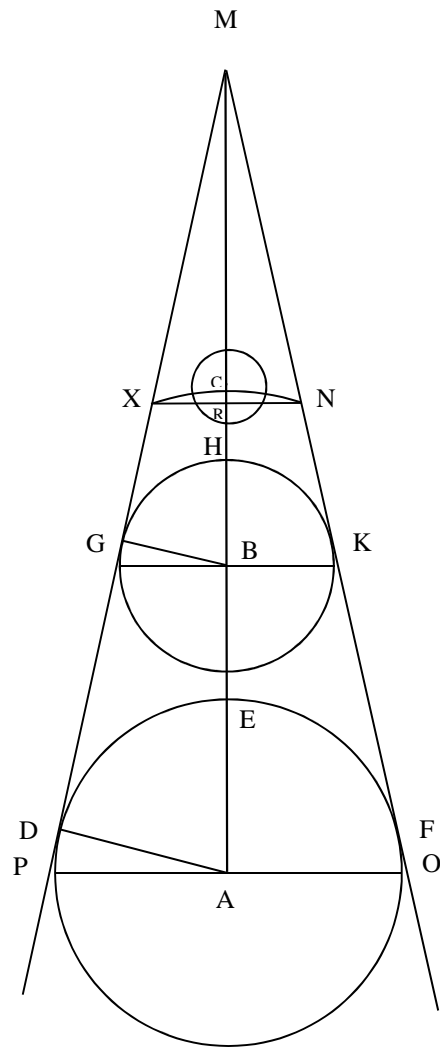
Therefore the diameter of the sun has to diameter of the earth a ratio less than that which 43 has to 6; it was also proved that it has to it a ratio greater than that which 19 has to 3.

*FEDERICO COMMANDINO*

- A. Then, since NX is less than ninth part of the diameter of the sun, therefore OP will have to NX a ratio much greater than that which 9 has to 1. *For the 12° proposition of this book, from this it follows, by 8° proposition of fifth book, that NX has a ratio to the diameter of the sun less than that which 1 has to 9; therefore, convertendo, from 26° proposition of fifth book, the diameter of the sun has to NX a ratio greater than that which 9 has to 1, and OP, which is greater than the diameter of the sun, <sup>8° prop. of fifth b.</sup> to NX has a ratio much greater than that 9 has to 1; but, as AO is to RN, or as OP is to NX, which are their double, <sup>15° prop. of fifth b.</sup> so will be AM to MR for similarity of the triangles AMO and RMN; therefore AM to MR will have also a ratio much greater than that 9 has to 1.*
- B. And, convertendo, MA will have to AR a ratio less than that which 9 has to 8. *By the 30° proposition of fifth book.*
- C. Again, since AB is greater than 18 times BC. *By 7° proposition of this book.*
- D. Then it is much greater than eighteen times BR. *In fact BR is much less than BC.*
- E. Therefore, ex aequali, MA will have to AB a ratio less than that which 171 has to 144. *Indeed since MA has to AR a ratio less than that which 9 has to 8, that is than their nineteenth part, that is to say than that which 171 has to 152: therefore RA has to AB a ratio less than that which 19 has to 18; 19 is to 18 so as 152 will be to another number which will be 144. Therefore since MA has to AR a ratio greater than that which 171 has to 152, and since RA has to AB a ratio less than that which 152 has to 144, ex aequali MA will have to AB a ratio less*

## ARIST. DE MAGN.





## ET DIST. SOL: ET LVNAEA 35

bit, quàm 171 ad 144; hoc est, quàm 19 ad 16.

Vt autem AM ad MB, ita DEF circuli diameter  
ad diametrum circuli GHK. ]Iungantur AD BG. erit  
trianguli MDA angulus ADM rectus aequalis recto BGM  
trianguli MGB. Sed angulus DMA est communis utriusque.  
ergo & reliquus reliquo aequalis, & triangulum triangulo  
duplae, videlicet diameter circuli DEF ad circuli GHK  
diametrum.

F

4. sexti  
15. qui-  
ti.

Quoniam enim BC ad CR maiorem habet pro-  
portionem, quàm 675 ad 1. ]Ex 13 huius.

G

Sed AB ad BC minorem proportionem habet,  
quàm 20 ad 1 ]Ex 7 huius.

H

Ergo ex aequali AB ad BR minorem habebit pro-  
portionem, quàm 13500 ad 674, hoc est quàm 6750  
ad 337 ] Nam cum AB ad BC minorem habeat proportio-  
nem, quàm 20 ad 1, hoc est quàm 13500 ad 675, & CB  
ad BR habeat minorem proportionem, quàm 675 ad 674;  
habebit ex aequali AB ad BR minorem proportionem, quàm  
13500 ad 674, hoc est, quàm eorum dimidia 6750 ad 337.

K

Quòd cum NX ad OP maiorem habeat propor-  
tionem, quàm 979 ad 10125 ]Ex 12 huius.

L

Vt autem OP ad NX, ita AM ad MR ] Sunt enim  
triangula AMO RMN inter se similia, ut superius dictum est.

M

Ex aequali igitur MA ad AB maiorem habebit pro-  
portionem, quàm numerus productus ex 10125 &  
7087 ad eum, qui ex 9146 & 6750 producitur, hoc est,  
quàm 71755875 ad 61735500 ] Quoniam enim MA ad  
AR maiorem habet proportionem, quàm 10125 ad 9146,  
& RA ad AB habet maiorem, quàm 7087 ad 6750, fiat  
vt 9146 ad 10125, ita 7087 ad alium. erit ad 7845  $\frac{5505}{9116}$ ;  
si enim multiplicemus 10125 per 7087, & quod produci-  
tur, videlicet 71755875 dividamus per 9146, exhibunt

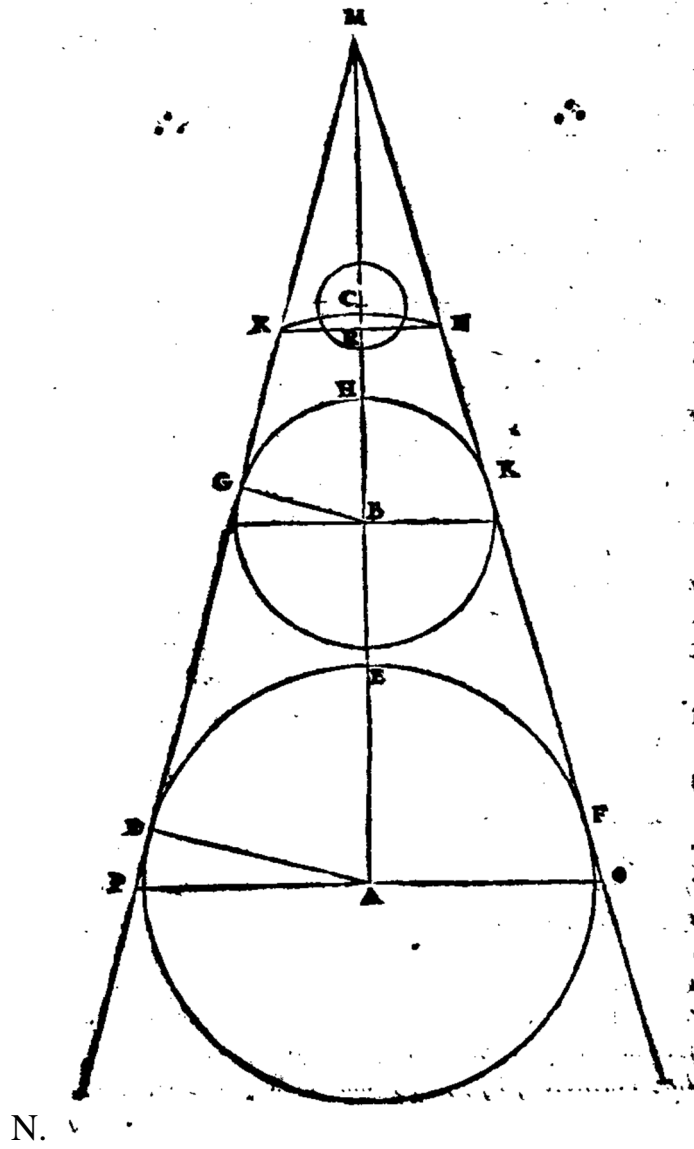
N

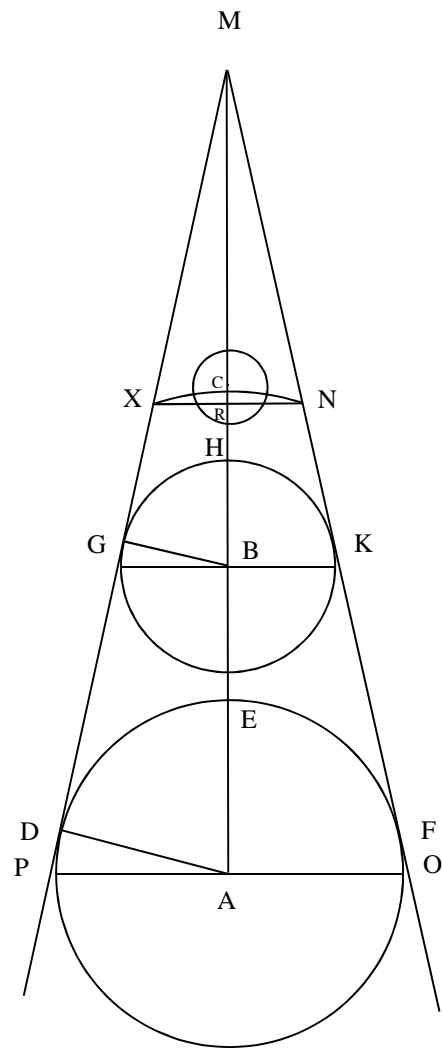
7845

*Than that which 171 has to 144; i.e. than that 19 has to 16.*

- F. But as AM is to MB, so is the diameter of the circle DEF is to the diameter of the circle. *Let be joined AD&BG, the right angle ADM of the triangle MDA will be equal to the right angle BGM of the triangle MGB, but the angle DMA is common to both triangles, therefore the remaining angle is equal and the two triangles are similar. Then as AM is to MB so AD is to BG, and so their double also, or the diameter of the circle DEF to diameter of the circle GHK.*
- G. Indeed since BC has to CR a ratio greater than that which 675 has to 1. *From the 13° proposition of this book.*
- H. But AB has to BC a ratio less than that which 20 has to 1. *Dalla 7° proposizione di questo libro.*
- K. Therefore, ex aequali, AB will have to BR a ratio less than that which 13500 has to 674, that is, than that which 6750 has to 337. *Indeed since AB has to BC a ratio less than that whici 20 has to 1, that is which 13500 has to 675 and CB rispetto a BR un rapporto minore di 675 a 674, per proporzionalità diretta AB avrà rispetto a BR un rapporto minore di 13500 a 674, cioè della loro metà 6750 a 337.*
- L. Therefore since NX has to OP a ratio greater than that which 979 has to 10125. *From 12° proposition of this book.*
- M. Then, as OP is to NX, so is AM to MR. *Come allora OP sta ad NX, così AM sta ad MR. Indeed the triangles AMO and RMN are similar to each other as previously mentioned.*
- N. therefore, ex aequali, MA will have to AB a ratio greater than that which the product of 10125 and 7087 has to the product of 9146 and 6750, that is, 71.755.875 to 61.735.500. *Indeed since MA has to AR a ratio greater than that which 10125 has to 9146, and RA to AB has a ratio greater than that which 7087 has to 6750, 9146 will be to 10125, so as 7087 will be to another number which will be  $7845 + \frac{5505}{9146}$ ; indeed if we multiply 10125 and 7087 and we divide their product, i.e. 71.755.875 by 9146, we will have*

## ARIST. DE MAGN.







## ET DIST. SOL. ET LVNAE. 136

7845  $\frac{5505}{9146}$ . Itaque cum  $MA$  ad  $AR$ , maiorem habeat proportionem, quam 10125 ad 9146, hoc est quam 7845  $\frac{5573}{9146}$  ad 7085; &  $RA$  ad  $AB$  habeat maiorem, quam 7087 ad 6750: habebit ex aequali  $MA$  ad  $AB$  maiorem proportionem, quam 7845  $\frac{5505}{9146}$  ad 6750. Sed 7845  $\frac{5505}{9146}$  hoc est  $\frac{71755875}{9146}$  ad 6750 est ut 71755875 ad 61735500. quod quidem numeris decussatim multiplicatis perspicuum erit; ex  $\frac{61735500}{9419}$   $\frac{6750}{1}$  tarijs in tertiam propositionem libri Archimedis de circuli dimensione, propositione septima, ut proxime diximus. ergo  $MA$  ad  $AB$  maiorem habet proportionem, quam numerus productus ex 10125 et 7087 ad eum, qui ex 9146 & 6750 producitur.

Habet autem & 71755875 ad 61735500 maiorem proportionem, quam 43 ad 37. Si enim fiat ut 43 ad 37, ita 71755875 ad alium. erit ad 61743427 qui maior est, quam 61735500, ergo 71755875 ad 61735500 maiorem habebit proportionem, quam ad 61743427, hoc est, quam 43 ad 37. 8 quæ  
ii.

## PROPOSITIO. XVI.

*Sol ad terram maiorem quidem proportionem habet, quam 6859 ad 27, minorem vero, quam 79507 ad 216.*

A

B

Sit enim solis quidem diameter A, terræ vero diameter

$7845 + \frac{5505}{9146}$ . So since MA has to AR a ratio greater than that which 10125 has to 9146, that is which  $7845 + \frac{5505}{9146}$  has to 7085, and since RA has to AB a ratio greater than that which 7087 has to 6750, MA will have, ex aequali, to AB a ratio greater than that which  $7845 + \frac{5505}{9146}$  has to 6750. But  $7845 + \frac{5505}{9146}$ , that is  $\frac{71755875}{9146}$ , is to 6750 as 71.755.875 is to 61.735.500, which is certainly clear by multiplying the numbers on cross,

$$61.735.500$$

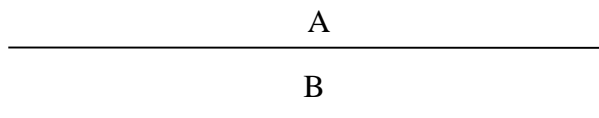
$$\frac{71755875}{9146} \quad \frac{6750}{1}$$

according to what we have shown in the commentaries to the third proposition on the measure of the circle, seventh proposition, as we have said just before. Therefore MA has to AB a ratio greater than the product of 10125 and 7087 has to the product of 9146 and 6750.

O. But 71.755.875 has also to 61.735.500 a ratio greater than that which 43 has to 37. Indeed if it was as 43 is to 37 so 71.755.875 will be to another number, i.e. will be to 61.743.427, which is greater than 61.735.500, therefore 71.755.875 will have also to 61.735.500 a ratio greater than which to 61.743.427, that is than that which 43 has to 37.

PROPOSIZIONE XVI

The sun has to the earth a ratio greater than that which 6859 has to 27, but also less than that which 79507 has to 216.



Let A be the diameter of the sun, while B the diameter

## ARIST. DE MAGNIT.

A

B

\* meter B. demonstratum iam est, vt solis sphaera ad terræ sphaeram, ita esse cubum, qui fit ex diametro solis ad cubum, qui ex diametro terræ, quemadmodum & in luna. ergo vt cubus ex A ad cubum ex B, ita sol est ad terram. cubus autem ex A ad cubum ex B maiorem proportionem habet, quam 6859 ad 27; minorem vero, quam 79507 ad 216; etenim A ad B maiorem habet proportionem, quam 19 ad 3, minorem vero, quam 43 ad 6. Quare & sol ad terram maiorem proportionem habebit, quam 6859 ad 27; minorem vero, quam 79507 ad 216.

FED. COMMANDINVS.

\* Demonstratum iam est, vt solis sphaera ad terræ sphaeram, ita esse cubum, qui fit ex diametro solis ad cubum, qui ex diametro terræ, quemadmodum & in luna ] In decima enim propositione huius demonstratum est vt cubus qui fit ex diametro solis ad cubum qui ex diametro lunæ, ita esse sphaeram solis ad lunæ sphaeram. quod similiter in terra demonstrabitur.

## PROPOSITIO XVII.

*Diameter terræ ad diametrum lunæ in maiori quidem est proportione, quam 108 ad 43.*

A

---

B

---

- \* of the earth. It is already proved that, as the sphere of the sun is to the sphere of the earth, so is the cube on the sun diameter to the cube on the earth's diameter, exactly as for the moon; then, as the cube on A is to the cube on B, so is the sun to the earth, therefore the cube on A to the cube on B has a ratio greater than that which 6859 has to 27, but less than that which 79507 has to 216; indeed A has to B a ratio greater than that which 19 has to 3, but less than that which 43 has to 6. Therefore the sun will have also to the earth a ratio greater than that which 6859 has to 27, but less than that which 79507 has to 216.

*Federico Commandino*

- \* It is previously proved that, as the sphere of the sun is to the sphere of the earth, so the cube on the sun diameter is to the cube on the earth diameter, just as for the moon. *Indeed it is proved in the tenth proposition of this book that as the cube on the diameter of the sun is to the cube on the diameter of the moon, so the sphere of the sun is to the sphere of the moon, which similarly we have shown for the earth.*

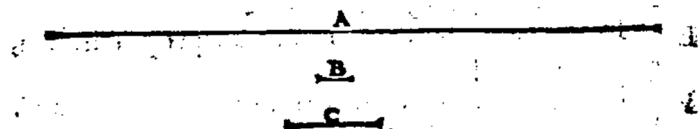
*PROPOSIZIONE XVII*

*The diameter of the earth is to diameter of the moon in a ratio greater than that which 108 has to 43, but less than that which*

## ET DIST. SOL ET LVNAE. 37

43, in minori vero, quam 60 ad 19.

Sit solis quidem diameter A, lunæ diameter B, A  
 terræ vero C. Et quoniam A ad C minorem propor  
 tionem habet, quam 43 ad 6, habebit conuertendó B



C ad A maiorem proportionem, quam 6 ad 43. sed C  
 A ad B maiorem proportionem habet, quam 18 ad 1. ergo ex æquali C ad B maiorem habebit propor  
 tionem, quam 108 ad 43. Rursus quoniam A ad C  
 maiorem proportionem habet, quam 19 ad 3, con  
 uertendo C ad A minorem habebit, quam 3 ad 19.  
 habet autem A ad B minorem proportionem, quã  
 20 ad 1. ex æquali igitur C ad B minorem proportio  
 nẽ habebit, quam 60 ad 19.

## F E D. C O M M A N D I N V S.

Et quoniam A ad C minorem proportionem ha  
 bet, quam 43 ad 6] Ex 14 huius.

Sed A ad B maiorem proportionem habet, quã  
 18 ad 1] Ex 9. huius.

Ergo ex æquali C ad B maiorem proportionem,  
 habebit, quam 108 ad 43] Quoniam enim C ad A maio  
 rem habet proportionem quam 6 ad 43: & A ad B maiorẽ,  
 quam 18 ad 1, fiat vt 18 ad 1, ita 43 ad alium. erit ad  $2\frac{7}{18}$   
 cum igitur C ad A maiorem proportionem habeat, quam 6  
 ad 43, & A ad B maiorẽ, quã 18 ad 1, habebit ex æqua

K li

60 has to 19.

Let now A be the diameter of the sun, let B be the diameter of the moon, while C that of the earth. Since A has to C a ratio less than that which 43 has to 6<sup>A</sup>, therefore, inversely, C will have to A

$$\frac{A}{\frac{B}{C}}$$

A ratio greater than that which 6 has to 43. But A also has to B a ratio greater than that which 18 has to 1<sup>B</sup>, therefore, ex aequali, C will have to B a ratio greater than that which 108 has to 43<sup>C</sup>. Again, since A has to C a ratio greater than that which 19 has to 3<sup>D</sup>, for inverse proportionality, C will have to A than that which 3 has to 19, then A to B has a ratio less than that which 20 has to 1,<sup>E</sup> and for direct proportionality, also C will have to B a ratio greater than that 60 has to 19<sup>F</sup>.

*Federico Commandino*

- A. Since A has to C a ratio less than that which 43 has to 6. *From 14<sup>o</sup> proposition of this book.*
- B. But A also has to B a ratio greater than that which 18 has to 1. *From 9<sup>o</sup> proposition of this book.*
- C. therefore, ex aequali, C will have to B a ratio greater than that which 108 has to. Indeed, since C has to A a ratio greater than that which 6 has to 43 and A has to B a ratio less than that which 18 has to 1, let it be as 18 is to 1, so 43 is to another unknown which will be  $2 + \frac{7}{18}$ , since C to A has a ratio greater than that which 6 has to 43 and A has to B a ratio greater than that which 43 has to  $2 + \frac{7}{18}$ , A will have to B, by direct proportionality,

**A R I S T. D E M A G N.**

li *A* ad *B* maiorem proportionem quàm 6 ad 2  $\frac{7}{18}$  hoc est, quàm 108 ad 43, quod numeris decussatim  $\frac{108}{1}$  multiplicatis manifeste constat, ex ijs, quæ superius dicta sunt.  $\frac{6}{1} \frac{43}{18}$

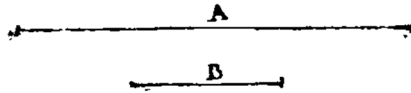
**D** Rurfus quoniam *A* ad *C* maiorem proportionem habet, quàm 19 ad 3] *Ex 14 huius.*

**E** Habet autem *A* ad *B* minorem proportionem, quàm 20 ad 1] *Ex 9. huius.*

**F** Ex æquali igitur *C* ad *B* minorem proportionem habebit, quàm 60 ad 19] *Fiat vt 20 ad 1, ita 19 ad alium. erit ad  $\frac{19}{20}$ . quare cum *C* ad *A* minorem proportionem habeat, quàm 3 ad 19, & *A* ad *B* minorem, quàm 19 ad  $\frac{19}{20}$ , ex æquali *C* ad *B* minorem habebit proportionem, quàm 3 ad  $\frac{19}{20}$  hoc est, quàm 60 ad 19.  $\frac{60}{1} \frac{19}{20}$*

P R O P O S I T I O. X V I I I.

*Terra ad lunam in maiori quidem est portione, quàm 1259712 ad 79507, in minori vero, quàm 216000 ad 6859.*



Sit enim terræ diameter *A*, lunæ vero *B*. quare *A* ad *B* maiorem quidem proportionem habet, quàm 108 ad 43, minorem vero, quàm 60 ad 19. ergo & qui fit ex *A* cubus ad cubum qui ex *B* maiorem proportionem habet, quàm 1259712 ad 79507, minorem vero

A ratio greater than that which 6 has to  $2 + \frac{7}{18}$ , that is, which 108 has to 43, as clearly seen  
 by multiplication in cross in croce the numbers  
 according to what was said before  $\frac{6}{1} \frac{43}{18}$

D. Again, since A has to C a ratio greater than that which 19 has to 3. From 14° proposition of this book.

E. Then A to B has a ratio less than that which 20 has to 1. From 9° proposition of this book.

F. And for direct proportionality, also C will have to B a ratio greater than that 60 has to 19. As 20 is to 1 19 will be to another number which will be  $\frac{19}{20}$ , therefore, since C has to A a ratio greater than that a ratio less than that which 3 has to 19 and A has to B less than that 19 has to  $\frac{19}{20}$ .

By direct proportionality C will have  $\frac{3}{1} \frac{19}{20}$

to B a ratio less than that which 3 has to  $\frac{19}{20}$  i.e. which 60 to 19.

#### PROPOSIZIONE XVIII

The earth has to the moon a ratio certainly greater than that which 1.259.712 has to 79.507, but surely less than that which 216.000 has to 6859.<sup>5</sup>

A

---

B

---

Indeed let A the diameter of the earth, while B that of the moon; therefore A has to B a ratio greater than that 108 has to 43, but less than that which 60 has to 19; therefore also the cube on A has to the cube on di B a ratio greater than that which 1259712 has 79507, but less than that which



ET DIST. SOL. ET LVNAE. 39  
 vero, quàm 216000 ad 6859. Sed vt cubus ex A ad  
 cubum ex B, ita est terra ad lunã. terra igitur ad lu-  
 nam maiorem quidem proportionem habet, quàm  
 1259712 ad 795971 minorem vero, quàm 216000  
 ad 6859.

F I N I S.

P I S A V R I.

*Apud Camillum Francischinum.*

M D L X X I I.

216000 has to 6859. But as the cube on A is to the cube on B, so is the earth to the moon, therefore the earth has to the moon a ratio greater than that which 1259712 has to 795071, but yet less than that which 216000 has to 6859.

The End

PESARO

*By Camillum Franceschinum*

M D L X X I I

## NOTE

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<sup>1</sup> We mean the distance AC, as is reported in the manuscript of the Cod.Vat.Gr.204 and Vat.Gr.191

<sup>2</sup> In the text *maior*. Obvious error.

<sup>3</sup> In the latin text *quam 379 ad 1125*. Obvious error.

<sup>4</sup> S is missing in the latin text .

<sup>5</sup> Numbers completely different from those of the next time translators who have had access to the manuscripts (Commandino, Wallis, Fortia d'Urban, Heath) are often reported in the first Latin translation of the Aristarchus's treatise by Giorgio Valla. For instance, in the proposition 11° in the place of 1/30 is written 30; in the proposition 12° rather than 89 is written 890; in the proposition 13° rather than 225 is written 25, in the place of 979 is written 379 and in the place of 10125 is written 41125. Different numbers are reported also in the propositions 16 and 18. Since Valla not touch upon the sources from which he has taken his translation, we can not know if the variances are due to printing error, to corrupted sources or, unlikely thing, to translation errors. Finally Valla's work is not very reliable. Perhaps for this reason Commandino does not mention it in his work.

*Giorgio Valla Placentino interprete: Hoc in volumine haec continetur Nicephori logica etc... Aristarchi Samii de Magnitudinibus et Distantiis Solis & Lunae etc... Venetiis: Per Simone[m] Papiensem dictum Beuilaquam., 1498. Die ultimo Septembris.*

## WORKS OF FEDERICO COMMANDINO

1558 Archimedis Opera Non Nulla a Federico Commandino Vrbinate nuper in Latinum conuersa, et commentariis illustrata. Quorum nomina in sequenti pagina leguntur. Cum privilegio in annos X. Venetiis, apud Paulum Manutium, Aldi F. M D LVIII.

Ranutio Farnesio, Cardinali Amplissimo et Optimo.

1558 Ptolemaei Planisphaerium. Iordani Planisphaerium. Federici Commandini Vrbinatis In Ptolemaei Planisphaerium Commentarius. In quo uniuersa Scenographices ratio quam breuissime traditur, ac demonstrationibus confirmatur. Venetiis: Aldus. M D LVIII.

Ranutio Farnesio Cardinali Amplissimo et Optimo

Claudii Ptolemaei Sphaerae A' planetis Proiectio in Plano.

1562 Claudii Ptolomaei Liber De Analemate, a Federico Commandino Vrbinate instauratus & commentariis illustratus, qui nunc primum eius opera e tenebris in lucem prodit. Eiusdem Federici Commandini liber de horologiorum descriptione. Romae A.D. M.D.LXII apud Paulum Manutium Aldi F.

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1565 Archimedis De Iis Quae Vehuntur In Aqua Libri Duo. A Federico Commandino Vrbinate in Pristinum Nitorem Restituti, Et Commentariis Illustrati. Cum Privilegio in Annos X. Bononiae ex Officina Alexandri Benacii M D LXV.

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1565 Federici Commandini Urbinatis Liber De Centro Gravitatis Solidorum. Cum Privilegio in annos X. Bononiae ex Officina Alexandri Benacii M D LXV.

Alexandro Farnesio Cardinali Amplissimo et Optimo.

1566 Apollonii Pergaei Conicorum Libri Quattuor. Una cum Pappi Alexandrini Lemmatibus, et Commentariis Eutocii Ascalonitae. Sereni Antinsensis Philosophi Libri Duo nunc primum in lucem editi. Quae omnia nuper Federicus Commandinus Vrbinas mendis quamplurimis expurgata è Graeco conuertit, & commentariis illustrauit. Bononiae ex officina Alexandri Benatii M D LXVI.

Vol 2. Sereni Antinsensis Philosophi Libri Duo. Vnus de sectione cylindri, alter de sectione cono. A Federico Commandino vrbinate e Graeco conuersi, et commentariis illustrati. Bononiae: ex officina Alexandri Benatii, M D LXVI.

1570 De Superficierum Divisionibus Liber Machometo Bagdedino Ascriptus nunc primum Joannis Dee Londinensis et Federici Commandini Vrbinate opera in lucem editus. Federici Commandini de eadem re libellus Pisauri Apud Hyeronimus Concordiam Licentia Superiorum M D LXX. Illustrissimo atque Excellentissimo Francisco Maria II Vrbinate Principi. Federico Commandino Vrbinate Ioannes Dee Londinensis S.P.D.

1570 Libro Del Modo Di Dividere Le Superficie Attribuito A' Machometo Bagdedino. Mandato in luce la prima volta da M. Giovanni Dee da Londra, e da M. Federico Commandino da Vrbino. Con vn breve trattato intorno alla stessa materia del medesimo M. Federico. Tradotti di latino in volgare da Fvlvio Viani de' Malatesti da Montefiore Academico Vrbinate e novamente dati in luce. In Pesaro del M D LXX. Presso Girolamo Concordia con licentia de' Superiori All' Illustrissimo et Excellentissimo Signore il Sig. Francesco Maria II Principe D' Vrbino.

1572 Euclidis Elementorum Libri XV. Vna cum scholijs antiquis. A' Federico Commandino Vrbinate nuper in latinum conuersi, commentarijsque quibusdam illustrati. Pisauri M D LXXII Cum Privilegio Pont. Max. Iacobus Chriegher German. (Finis: Pisauri cum licentia Superiorum: apud Camillum Francischinum, MDLXXII). Illustrissimo atque Excellentissimo Francisco Mariae II Vrbinate Principi.

1572 Aristarchi De Magnitudinibus et Distantiis Solis et Lunae Liber.

1575 Heronis Alexandrini Spiritalium Liber à Federico Commandino Vrbinate, ex Graeco in Latinum conuersus. Cum privilegio Gregorij XIII. Pont. Max. Urbini M D LXXV. Illustrissimo ac Reuerendissimo Iulio Ruerio Sanctae Ro. Eccl. Cardinali Amplissimo. Valerius Spaciolus. S.D.

1575 De Gli Elementi D'Euclide Libri Quindici. Con gli scholii antichi. Tradotti prima in lingua latina da M. Federico Commandino da Urbino, & con commentarij illustrati, et hora d'ordine dell'istesso trasportati nella nostra vulgare, & da lui riueduti. Con privilegio. In Urbino: appresso Domenico Frisolino. MCLXXV con licentia de' Superiori.  
Finis: In Urbino in casa Di Federico Commandino con Licentia de' Superiori M D LXXV.

1589 Pappi Alexandrini Mathematicae Collectiones a Federico Commandino Vrbinatate in latinum conuersae, et commentariis illustratae Venetiis apud Franciscum De Franciscis Senensem M D LXXXIX Finis Pisauri: apud Hieronymum Concordiam, M D LXXXVIII.  
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