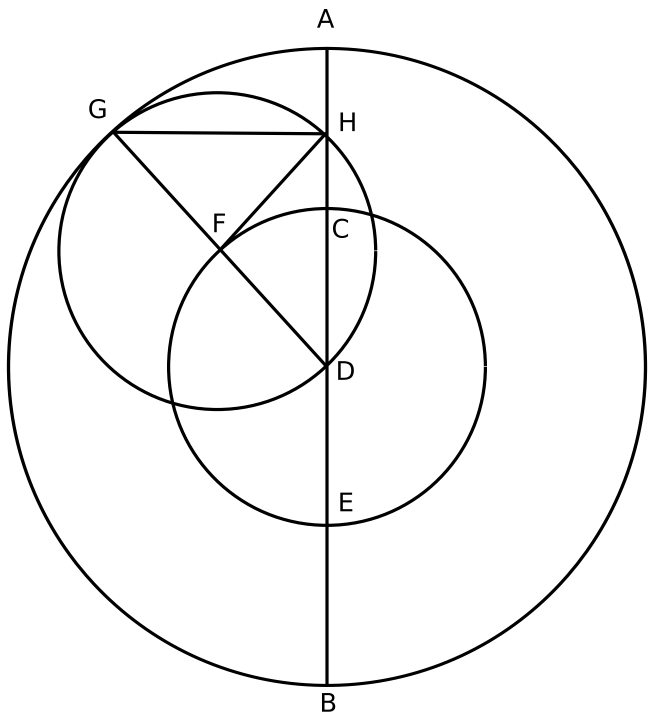
Copernicus Theorem

De revolutonibus book III, ch. IV

Latin text from S. Strabski, *Nicolai Copernici Torunensis de revolutionibus orbium coelestium: libri sex*, Warszawa 1854. English translation by Edward Rosen, *On the Revolutions; translation and commentary*, Baltimore, Johns Hopkins University Press, 1992.



CAPUT IV.

QUOMODO MOTUS RECIPROCUS SIVE LIBRATIONIS EX CIRCULARIUS CONSTET.

Quod igitur iste motus apparentiis consentiat, amodo declarabimus. Interim vero quæret aliquis, quonam modo possit illarum librationum æqualitas intellegi, cum a principio dictum sit, motum coelestem æqualem esse, vel ex æqualibus ac circularibus compositum. Hic autem utrobique duo motus in uno apparent sub utrisque terminis, quibus necesse est cessationem intervenire. Fatebimur quidem geminatos esse, at ex æqualibus hoc modo demonstrantur. Sit recta linea A B, quæ quadrifariam secetur in C, D, E signis, et in D describantur circuli homocentri ac in eodem plano A D B, et C D E, et in circumferentia interioris

CHAPTER IV

HOW AN OSCILLATING MOTION OR MOTION IN LIBRATION IS CONSTRUCTED OUT OF CIRCULAR [MOTIONS].

Now I shall hereafter show that this motion is in agreement with the phenomena. But meanwhile someone will ask in what way these librations can be understood to be uniform, since it was stated in the beginning that a motion in the heavens is uniform or composed of uniform and circular [motions]. In this instance, however, both of the two motions appear as a single motion within the limits of both, so that a cessation [of motion] must intervene. I will indeed admit that they are paired, but [that oscillating motions are formed] from uniform [motions] is proved in the following way. Let there be a straight line AB. Let it be divided into four equal parts at points C, D, and E. Around D, draw the circuli assumatur utcunque F signum, et in ipso F centro, intervallo vero F D, circulus describatur G H D, qui secet AB rectam lineam in H signo, et agatur dimetiens D F G. Ostendendum est, quod geminis motibus circulorum GHD et C F E concurrentibus invicem, H mobile per eandem rectam lineam A B, hinc inde reciprocando repat. Quod erit, si intelligatur H moveri in diversam partem, et duplo magis ipso F. Quoniam idem angulus, qui sub C D F in centro circuli C F E et circumferentia ipsius G H D consistens, comprehendit utramque circumferentiam circulorum æqualium G H duplam ipsi F C ; posito quod aliquando in conjunctione rectarum linearum A C D et D F G mobile H, fuerit in G congruente cum A, et F in C.

Nunc autem in dextras partes per F C motum est centrum F, et ipsum H per G H circumferentiam in sinistras duplo majores ipsi C F, vel e converso; H igitur in lineam A B reclinabitur: alioqui accideret partem esse majorem suo toto, quod facile puto intelligi. Recessit autem a priori loco secundum longitudinem A H retractam per infractam lineam D F H acqualem ipsi A D eo intervallo quo dimetiens D F G excedit subtensam D H. Et hoc modo perducetur ad D centrum, quod erit in contingente D H G circulo, A B rectam lineam, dum videlicet G D ad rectos angulos ipsi A B steterit, ac deinde in B alterum limitem perveniet, a quo rursus simili ratione revertetur. Patet igitur e duobus motibus circularibus, et hoc modo sibi invicem occurrentibus in rectam lineam motum componi, et ex æqualibus reciprocum et inæqualem, quod erat demonstrandum.

E quibus etiam sequitur, quod G H recta linea, semper erit ad angulos rectos ipsi A B : rectum enim angulum in semicirculo D H G linea comprehendent. Et idcirco GH semissis

circles ADB and CDE, with the same center and in the same plane. On the circumference of the inner circle, take any point F at random. With F as center, and with radius FD, draw the circle GHD. Let this intersect the straight line AB at the point H. Draw the diameter DFG. It must be shown that the movable point H slides back and forth in both directions along the same straight line AB, on account of the paired motions of the circles GHD and CFE acting conjointly. This will happen if H is understood to move in the opposite direction from F and twice as far. For, the same angle CDF, being located at the center of the circle CFE and at the circumference of GHD, intercepts as arcs of equal circles both FC and GH, which is twice FC. Assume that at some time when the straight lines ACD and DFG coincide, the movable point H coincides at G with A, while F is at C.

Now, however, the center F moves to the right along FC, and H moves along the arc GH to the left twice as far as CF, or these directions may be reversed. Then the line AB will be the track for H. Otherwise, it would happen that a part is greater than its whole. This is easily understood, I believe. Now, having been drawn along by the broken line DFH, which is equal to AD, H has moved away from its previous position A by the length of AH, this distance being the excess of the diameter DFG over the chord DH. In this way H will be taken to the center D. This will happen when the circle DHG is tangent to the straight line AB, while GD is of course perpendicular to AB. Then H will reach the other limit B, from which it will return again for the same reason. Therefore it is clear that from two circular motions acting conjointly in this way, a rectilinear motion is compounded, as well as an oscillating and nonuniform motion from uniform [motions]. q.e.d.

From this demonstration it also follows that the straight line GH will always be perpendicular to AB, since the lines DH and HG will subtend a right angle in a semicircle. Therefore GH will be erit subtendentis duplam A G circumferentiam, et D H altera semissis subtendentis duplum ejus, quod superest ex A G quadrantis circuli, eo quod A G B circulus, duplus existat ipsi H G D secundum diametrum.

half of the chord subtending twice the arc AG. The other line DH will be half of the chord subtending twice the arc which remains when AG is subtracted from a quadrant, since the circle AGB is twice HGD in diameter.