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Nicole Oresme and the Medieval Geometry of Qualities and Motions: a treatise on the uniformity and difformity of intensities known as Tractatus de configurationibus qualitatum et motuum (De configurationibus III.vii)

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ymaginetur ens successivum. Unde in Ysaia dicitur, "erit lux lune sicut lux solis, et lux solis erit septempliciter sicut lux septem dierum," quia videlicet lux unius diei septempliciter intensa equalis est luci que per septem dierum spatium extenderetur.

[III.vii] Capitulum 7^m de mensura qualitatum et velocitatum difformium

Omnis qualitas, si fuerit uniformiter difformis, ipsa est tanta quanta foret qualitas eiusdem subiecti vel equalis uniformis secundum gradum puncti medii eiusdem subiecti; et hoc intelligo si qualitas fuerit linearis. Et si fuerit superficialis, secundum gradum linee medie; si vero fuerit corporalis, secundum gradum medie superficiei, semper conformiter intelligendo. Istud ostenditur primo de lineari. Sit igitur una qualitas ymaginabilis per triangulum *ABC* que est uniformiter difformis terminata ad non gradum in puncto *B* [Fig. 21(a)]; et sit *D* punctus medius linee subiective, cuius quidem puncti gradus vel intensio ymaginatur per lineam *DE*. Igitur qualitas que esset uniformis per totum subiectum secundum gradum *DE* ymaginabilis est per quadrangulum *AFGB*, ut patet per 10^m capitulum prime partis. Constat autem per 26^{am} primi Euclidis quod duo parvi trianguli *EFC* et *EGB* sunt

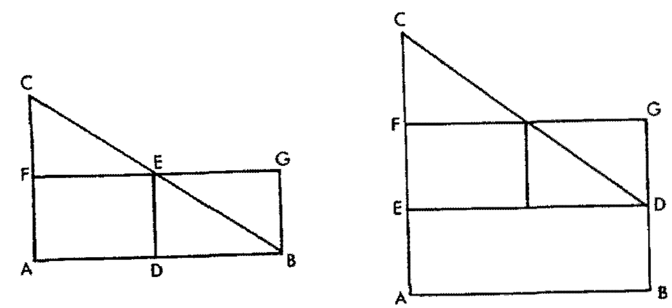
28 ens *B[VAFMPC]* esse *L[SG]* esse ens *[N]*
29–30 videlicet lux *tr. L* lux *[N]*
31 extenditur *L[S]*

III.vii: BL
3–4 ipsa...uniformis *om. [FMP]*
5 si...linearis: qualitate lineari *B*
7 medie superficiei *tr. L[NS]* superficiei *[V]* / semper: secundum hoc *L*
8 ostenditur primo *tr. L[G]* ostenditur *[FMPC]*
11–12 esset *B[VASG]* est *L[NFMPC]*
13–14 Constat autem *B[VSG]* constatque *L[N]* constat et *[FMPC]*
14 EFC: EFG *B[V]*

if it is imagined to be a successive entity. Whence it is said in Isaias:[3] "And the light of the moon shall be as the light of the sun, and the light of the sun shall be sevenfold as the light of seven days," for evidently the light of one day increased intensively by sevenfold is as the light which would be extended through a space of seven days.

III.vii On the measure of difform qualities and velocities

Every quality, if it is uniformly difform, is of the same quantity as would be the quality of the same or equal subject that is uniform according to the degree of the middle point of the same subject.[1] I understand this to hold if the quality is linear. If it is a surface quality, [then its quantity is equal to that of a quality of the same subject which is uniform] according to the degree of the middle line; if corporeal, according to the degree of the middle surface, always understanding [these concepts] in a conformable way. This will be demonstrated first for a linear quality. Hence let there be a quality imaginable by ΔABC, the quality being uniformly difform and terminated at no degree in point *B* [see Fig. 21(a)]. And let *D* be the middle point of the subject line. The degree of this point, or its intensity, is imagined by line *DE*. Therefore, the quality which would be uniform throughout the whole subject at degree *DE* is imaginable by rectangle *AFGB*, as is evident by the tenth chapter of the first part. Therefore, it is evident by the 26th [proposition] of [Book] I [of the *Elements*] of Euclid[2] that the two small triangles *EFC* and *EGB*



(a) (b)

Fig. 21

Figures in *BLSJG*. Figures are rotated through 90° in MS *G*. In figure (b) in MS *L*, there is no center perpendicular. In MS *J*, line *ED* is missing and the center perpendicular is marked *KH*. Both figures are reversed in MS *J*.

[3] *Isaias* 30:26.

III.vii
[1] See the Commentary, III.vii, lines 3–5.
[2] *Ibid.*, line 14.

equales. Ergo maior triangulus *BAC* qui designat qualitatem uniformiter difformem et quadrangulus *AFGB* qui designaret qualitatem uniformem secundum gradum puncti medii sunt equales. Ergo qualitates per huiusmodi triangulum et quadrangulum ymaginabiles sunt equales. Et hoc est propositum.

Eodem modo potest argui de qualitate uniformiter difformi terminata utrinque ad certum gradum, sicut esset qualitas ymaginabilis per quadrangulum *ABCD* [Fig. 21(b)]. Protrahatur enim linea *DE* equedistans basi subiecte et fieret triangulus *CED*. Deinde protrahatur per gradum puncti medii linea *FG* equalis et equedistans basi subiecte, et protrahatur etiam linea *GD*. Tunc sicut prius probabitur quod triangulus *CED* et quadrangulus *EFGD* sunt equales. Ergo addito utrobique quadrangulo communi *AEDB* fient duo tota equalia, scilicet quadrangulus *ACDB* qui designat qualitatem uniformiter difformem et quadrangulus *AFGB* qui designaret qualitatem uniformem secundum gradum puncti medii ipsius subiecti *AB*. Igitur per capitulum 10^m prime partis qualitates per huiusmodi quadrangulos designabiles sunt equales.

Conformiter potest argui de qualitate superficiali ac etiam de corporali. De velocitate vero omnino dicendum est sicut de qualitate lineari, dum tamen loco puncti medii capiatur instans medium temporis velocitatem huiusmodi mensurantis. Sic itaque patet cui qualitati aut velocitati uniformi adequatur qualitas sive velocitas uniformiter difformis. Proportio autem qualitatum et velocitatum uniformiter difformium est sicut proportio qualitatum et velocitatum simpliciter uniformium quibus adequantur. Et de mensura et proportione illarum uniformium dictum est in capitulo precedenti.

Si autem qualitas seu velocitas fuerit difformiter difformis, tunc, si componatur ex partibus uniformibus aut uniformiter difformibus, ipsa poterit mensurari per suas partes, de quarum mensura dictum est ante. Si vero qualitas fuerit alio modo difformis, sicut difformitate illa que per curvitatem designatur, tunc oporteret recurrere ad mensurationem figurarum curvarum inter se aut earum cum rectis figuris; et hoc est alterius speculationis. Sufficiant ergo que dicta sunt.

21 utrinque *B[SG]* *om.* *[C]* utriusque *L[A]* utrobique *[VN]* uterque *[FMP]*
23–24 et...et² *om.* *L*
26 sunt *B[VANSG]* fient *L* erunt *[FMPC]*
26–27 equales...fient *B[VANSG]* *om.* *[FMPC]* equales quare *L*
27–28 ACDB...quadrangulus *om.* *L*
28 designaret *B[AVS]* designat *L[FNM ?P, ?C, ?G]*
33 De¹ *om.* *L[N]*
34 capiatur *B[VSG]* *om.* *[FMP]*, *tr.* *L[AN]* *post* temporis / instans: instantis *L* infert *[FMP]*
36 qualitatis aut velocitatis *L*
37 et: aut *L[N]* sive *[A]*
38 Et *om.* *L[AN]*
39 et: et de *L[VMP]* / uniformium *om.* *L[N]*
41 qualitas...velocitas: velocitas seu quali-

are equal. Therefore, the larger ΔBAC, which designates the uniformly difform quality, and the rectangle *AFGB*, which designates the quality uniform in the degree of the middle point, are equal. Therefore the qualities imaginable by a triangle and a rectangle of this kind are equal. And this is what has been proposed.

In the same way it can be argued for a quality uniformly difform terminated in both extremes at a certain degree, as would be the quality imaginable by quadrangle *ABCD* [see Fig. 21(b)]. For let line *DE* be drawn parallel to the subject base and ΔCED would be formed. Then let line *FG* be drawn through the degree of the middle point which is equal and parallel to the subject base. Also, let line *GD* be drawn. Then, as before, it will be proved that $\Delta CED = \square\, EFGD$. Therefore, with the common rectangle *AEDB* added to both of them, the two total areas are equal, namely quadrangle *ACDB*, which designates the uniformly difform quality, and the rectangle *AFGB*, which would designate the quality uniform at the degree of the middle point of the subject *AB*. Therefore, by chapter ten of the first part, the qualities designatable by quadrangles of this kind are equal.

It can be argued in the same way regarding a surface quality and also regarding a corporeal quality. Now one should speak of velocity in completely the same fashion as linear quality, so long as the middle instant of the time measuring a velocity of this kind is taken in place of the middle point [of the subject].[3] And so it is clear to which uniform quality or velocity a quality or velocity uniformly difform is equated. Moreover, the ratio of uniformly difform qualities and velocities is as the ratio of the simply uniform qualities or velocities to which they are equated. And we have spoken of the measure and ratio of these uniform [qualities and velocities] in the preceding chapter.

Further, if a quality or velocity is difformly difform, and if it is composed of uniform or uniformly difform parts, it can be measured by its parts, whose measure has been discussed before. Now, if the quality is difform in some other way, e.g. with the difformity designated by a curve, then it is necessary to have recourse to the mutual mensuration of the curved figures, or to [the mensuration of] these [curved figures] with rectilinear figures; and this is another kind of speculation.[4] Therefore what has been stated is sufficient.

3 *Ibid.*, lines 33–35.

4 *Ibid.*, line 46.

tas *L[N]* difformitas sive qualitas *[A]*
44 sicut *om.* *[C]* sicut de *L[N]*
47 Sufficiant...sunt *BL[VS]* *om.* *[ANFMPCG]*

[III.viii] Capitulum 8m de mensura et intensione in infinitum quarundam difformitatum

Superficies finita potest fieri quantumlibet longa vel alta per variationem extensionis absque eius augmento. Nam talis superficies habet longitudinem et latitudinem et possibile est ipsam secundum unam dimensionem quantumlibet augeri ipsa tamen non augmentata simpliciter dummodo secundum aliam dimensionem proportionaliter minuatur, et ita est etiam de corpore. Verbi gratia de superficie [Fig. 22]: accipiatur superficies quadrata pedalis, cuius basis sit linea *AB*; et sit alia superficies similis et equalis, cuius basis sit

III.viii: BL
1 intensione *BL[V]* extensione *[FCG]*
6 tamen *om. L[ANS]*
7 proportionabiliter *V* / diminuatur *[VAN C]* / ita est etiam *B[VS]* ita est *[FMP C]* ita etiam *L[ANG]*

III.viii On the measure and intension to infinity of certain difformities

A finite surface can be made as long as we wish, or as high, by varying the extension without increasing the size. For such a surface has both length and

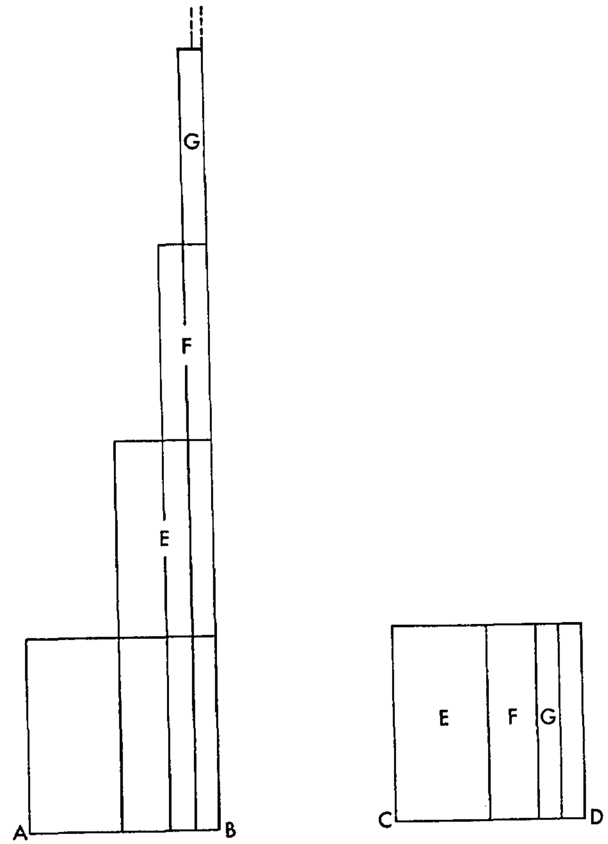


Fig. 22

Figures in MSS *BLJG*. MS *L* reverses the left drawing and adds another "foot" to the left of E on the right drawing. MS *B* makes the base of the left drawing CD and that of the right drawing *AB*. MS *G* reverses both drawings.

breadth and it is possible for it to be increased in one dimension as much as we like without the whole surface being absolutely increased so long as the other dimension is diminished proportionally, and this is also true of a body. For example[1] [see Fig. 22], in the case of a surface, let there be a surface of one square foot in area whose base line is *AB*; and let there be another surface, similar and equal to it,

III.viii
[1] See the Commentary, III.viii, lines 8–28.