

Some Considerations

Of Mr. Nic. Mercator, concerning the Geometrick and direct Method of Signior Cassini for finding the Apogees, Excentricities, and Anomalies of the Planets; as that was printed in the Journal des Scavans of Septemb. 2. 1669: which Considerations are here deliver'd in the Latine Tongue, wherein they were written by the Author, as chiefly regarding the Learn'd in Astronomy, viz.

Clarissimi Cassini Methodus

Investigandi Apogæa, Excentricitates & Anomalias Planetarum, breviter Exposita & Demonstrata.

Supponit Cl. Cassinus, ad Planetam in Ellipsi moventem extendi ab utroque foco duas rectas, quarum altera sit *medii*, altera autem *veri motus* linea. Constructio porro talis est;

<p><i>Fig. II.</i> L est Centrum Concentrici ABCDE. BLD est Diameter. BA, BC, BP, sunt intervalla apparentia. DE, DF, DQ, sunt intervalla medi- orum motuum. BE, BF, BQ; item DA, DC, DP, sunt lineæ rectæ. BE secat DA in H; BF secat DC in G; BQ secat DP in R.</p>	<p>RHG est linea recta. BI est perpendicularis ad RHG. I est Centrum Ellipseos. LI est Excentricitas. IO = LI. O est focus, circa quem ordinatur medius motus; L, circa quem verus. IM = IN = LB. M est Apogæon; N, Perigeon; BLM Anomalia vera.</p>
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Demonstratio.

I. Illustrissimus ac Reverendiss. *Sethus Wardus*, quondam in Celeberr. Acad. Oxon. Professor Astronomiæ Savilianus, nunc Episcopus Sarisburiensis, in *Examine Astronomiæ Philolaica*, edito Oxon. A. 1653. c. 6. docuit Methodum, ex data Anomalia *media* Planetarum, investigandi *veram*; quæ est hujusmodi:

Fig. III. C, est Centrum Ellipseos AEP: F, focus, circa quem ordinatur medius motus. S, focus, circa quem ordinatur verus motus. A, Apogæon. P, Perigeon. E, Ero five Planeta. AFE, Anomalia media. ASE, Anomalia vera. FET, linea recta, ET = SE. ST est linea recta.

In \triangle SFT dantur, 1. SF distantia focorum: 2. FT = FE + ES = AP. 3. AFT, angulus externus, five Anomalia media, æqualis summae angulorum FST & T. Ergo inveniri potest FSE, five Anomalia vera, æqualis differentiæ Angulorum FST & T. Nimirum

Vt

Ut femi-summa laterum FT & FS , ad femi-differentiam eorundem ;
Ita Tangens femi-summæ angulorum FST & T , ad Tangentem femi-differentiæ eorundem.

Sed femi-summa laterum FT & FS invenitur, substituendo pro FT æqualem AP , cujus semis est AC , qui additus CS semissi ipsius FS , facit Semis-summam AS , distantiam Planetæ maximam.

Tum, si ex femi-summa AS auferatur latus minus FS , restat femi-differentia laterum FA , æqualis PS , distantiæ Planetæ minimæ ; ut fit

Regula ex Anomalia Media data inveniendi veram :

Ut AS , distantia Planetæ maxima, ad PS , distantiam minimam ;
Ita Tangens dimidiæ Anomaliæ mediæ, ad Tangentem dimidiæ Anomaliæ veræ.

Corollar. I. Si continuetur SE usque ad U , ita ut EU sit \equiv ipsi FE , & tota SU \equiv Axi AP ; erit $\triangle FSU$ angulus U semis Prosthaphæreseos FES , ideoque æqualis femi-differentiæ angulorum Anomaliæ mediæ & veræ, h.e. ipsorum AFE & ASE ; & externus AU \equiv femi-summæ eorundem AFE & ASE angulorum, ablata scil. femi-differentiâ UFE ex majori AFE . Unde oriuntur duæ Analogiæ :

1. Ut Sinus femi-summæ Anomaliæ mediæ & veræ AU , ad Sinum femi-differentiæ eorundem, U ; Ita SU (\equiv axi transverso AP) ad SF , distantiam focorum.

2. Ut Sinus femi-summæ Anomaliæ mediæ & veræ, AFV , ad Sinum Anomaliæ veræ FSU ; Ita SU (vel axis AP) ad FU , subtensam Anomaliæ veræ : Ita quoque femi-axis AC , ad femi-subtensam UX , vel FX .

Corollar. II. Si in eodem Triangulo FSU , ex subtensæ FU puncto medio X , erigatur perpendicularis XE ; secabit illa SU in duas partes, quarum altera UE \equiv est lineæ mediæ motûs FE , altera verò SE est ipsa lineæ veri motûs.

II. Fig. IV. Sit a Centrum Concentrici $chfi$.
 cad , Diameter, eadêmeque lineæ Apfidum.
 cb , Arcus Anomaliæ veræ, cui respondet
 di , Arcus Anomaliæ mediæ. Itaque

cdh , est Angulus dimidiæ Anomaliæ veræ, &
dci , Angulus dimidiæ Anomaliæ mediæ.
ci & dh sunt lineæ rectæ, secantes se mutuò in g .

Ab Intersectionis puncto g demittatur ad cd perpendicularis gb . Erit igitur,

$db.bg ::$ Radius ad tang. bdg vel cdh .

Et $cb.bg ::$ Rad. tang. bcg vel dci .

Ergo

Ergo $db \times \text{tang. } cdh = bg \times \text{Rad.} = cb \times \text{tang. } dci$.

Quare $db \cdot cb :: \text{tang. } dci \cdot \text{tang. } cdh$; hoc est, db erit ad cb , ut tangens dimidiæ Anomalix mediæ ad tangentem dimidiæ Anomalix veræ; adeoque (per Regulam supra expositam) ut distantia Planetæ maxima, ad distantiam minimam. Quamobrem $db =$ erit distantia Planetæ maxima, & cb , minima, & ab , excentricitati.

Cumque idem eodem modo demonstretur de cæteris omnibus Interfectionum punctis, nimir. Perpendiculares ab ipsis ad cd lineam incidere in punctum b ; oportet, ut recta, jungens ipsas Interfectiones, congruat perpendiculi bgf .

III. Ductâ diametro hak , fiat arcus $kl =$ arcui id , & ducantur kc & hl , secantes se mutuò in p . Ab h in bgf demittatur perpendicularis hr , eadêmque parallela Apsidum lineæ ca ; erit angulus rhs semi-differentia arcuum Anomalix veræ ch , & mediæ di . Tum ab eodem h puncto ducatur recta hb , faciens cum kh angulum $=$ angulo rhs , & occurrens lineæ Apsidum in β . Erit $\Delta i a \beta h$ angulus βah mensura arcûs ch , sive Anomalix veræ, & βha semi-differentia Anomalix veræ & mediæ (ex Constructione;) & externus $c \beta h$ (æqualis duobus internis & oppositis βah & βha , adeoque compositus ex Anomalia vera & semi-differentia ejus à media) erit semi-summa Anomalix veræ & mediæ. Ergo, per Corollarii I^{mi} Analogiam priorem; Vt Sinus $c \beta h$, ad Sinum βha ; ita Radius ah , ad Excentricitatem a^2 . Sed supra demonstravimus quoque ab æqualem Excentricitati. Ergo punctum β congruit puncto b .

Tum ex b excitetur ipsi hb perpendicularis bt ; Aio, hanc continuatam incidere in punctum Interfectionis p . Nam Triangula rhs & bht sunt similia, ex Constructione; quemadmodum & $\Delta^m hpk$ simile est $\Delta^o hgi$, cum eidem peripheriæ cb insistentes anguli pkh & gih sint æquales, nec non æqualibus peripheriis kl & id insistentes anguli phk & ghi æquales; quare & tertius hpk æqualis est tertio hgi . Et ex æqualibus phk & ghi ablati æqualibus bht & rhs , restant æquales phb & ghr . Vnde sic arguo: $srh = tbb$, & $rhs = bht$, Ergo $hsr = htb$; ergo & Complementa horum ad semi-circulum sunt æqualia, nimir. $rsi = btk$; & $sig = tkp$, Ergo & $igs = kpt$, quibus ablati ex æqualibus igh , & kph , restat $hgs = hpt$; & $ghr = phb$, Ergo & $hrh = hbp$. Sed hrh est rectus, Ergo & hbp rectus est. Cum verò & hbt rectus sit ex Constructione, erit tb in directum ipsi bp . Cumque idem eodem modo demonstretur de quavis alia Interfectione linearum ab h & k ad congruentiâ Anomalix veræ & mediæ puncta ductarum; patet, non modo rectam, jungentem interfectiones, transcurram per b punctum; sed & hb , lineam perpendicularem fore ad eandem Jungentem, q. e. dem.

Corollarium. Si à quovis puncto Anomalix veræ, puta b , ad respondens punctum Anomalix mediæ ducatur recta bi ; excitata è Centro Excentrici b , ipsi cbd perpendicularis bf secabit ipsam bi in s eâ ratione, quam linea mediæ motûs obtinet ad lineam veri motûs.

Nam per *Corollarii* I^{mi} Analogiam posteriorem, hb est semi-subtensa; Ergò per *Corollarium* II^{um}, perpendicularis erecta ex b , nimir. bt , secat diametrum hk in t eâ ratione, quam linea mediæ motûs obtinet ad lineam veri motûs. Ergò & rs (sive bf) secat bi lineam eadem ratione in s ; propter demonstratam modò figurarum $tbbkphb$ & $srhighb$ similitudinem.

Cæterum ex laudata superius Reverendiss. *Wardi* Methodo inveniendi primam inæqualitatem, non est difficile, alium adhuc modum investigandi Apogæa & Excentricitates, non minus directum & Geometricum, & Observationes quovis admittentem, producere; quem & paucis exponam. Plures modos invenient Astrophili in Reverendiss. Viri *Astronomia Geometrica*, edita *A.* 1656, ad quam eos remitto. Interim

Fig. V. Sint l & d duo foci Ellipseos; t & u duo puncta veri motûs Planetæ; arcus Ellipseos tn ex l spectatus sub angulo tlu , & ex d , sub angulo tdu ; item distantia focorum ld ex t spectatus sub angulo dtl , & ex u , sub angulo dul : Aio, differentiam angulorum tlu , tdu , a qualem esse differentiam angulorum dtl & dul .

Cùm enim trianguli lux tres anguli simul sumpti æquales sint trianguli dtx tribus angulis simul sumptis; si auferantur utrinque æquales lxu & dxt , reliquorum duorum summa $ulx + lux$ erit = summæ reliquorum $tdx + dtx$, & ab his æqualibus summis si auferantur inæquales, v. g. ulx ex priori, & tdx ex posteriori; reliquorum, lux & dtx , differentia = est differentie ablatorum ulx & tdx ; quod erat propositum.

Centro l , intervallo axis transversæ mn , describatur Circulus abc , cujus arcus ab rursus ex l spectatur sub angulo alb , & ex d , sub angulo adb ; item distantia focorum ld ex a spectatur sub angulo lad , & ex b , sub angulo lbd . Ergò rursus differentia angulorum alb & adb = est differentie angulorum lad & lbd . Sed per *Coroll. I.* angulus lad semis est anguli lad , & angulus lbd semis anguli ltd . Ergò horum angulorum lad & lbd differentia = est semi-differentie angulorum lad & ltd ; ergò & angulorum alb & adb differentia = est semi-differentie angulorum ult & udt , quorum prior est intervallum apparens duarum Observationum, posterior autem, intervallum motûs mediæ. Datâ igitur horum intervallorum differentia, datur quoque hujus (*differentia*) semis, nimir. differentia angulorum alb & adb . Sed alb idem est cum ult dato; Ergò datur quoque adb angulus, sub quo periphæria ab spectatur ex d .

Simili modo ostendetur, differentiam angulorum tly & tdy æqualem esse summæ angulorum ltd & lyd ; nec non differentiam angulorum bld & bdc = esse summæ angulorum lbd & lcd . Cùmque lbd femis sit ipsius ltd , & lcd femis ipsius lyd ; erit sanè summa ipsorum lbd & lcd = semi-summæ angulorum ltd & lyd , hoc est, differentia angulorum bld & bdc = erit semi-differentiæ angulorum tly & tdy , quorum prior est intervallum apparens duarum Observationum, posterior autem, intervallum motûs medii. Quare, datâ horum intervallorum differentiâ, datur quoque hujus femis, nimir. differentia angulorum bld & bdc . Sed bld idem est cum tly dato; Ergò datur quoque bdc angulus, sub quo periphæria bc spectatur ex d .

Unde liquet, ex datis intervallis Observationum mediis & apparentibus, dari angulos, sub quibus ex d spectantur Circuli abc periphæriæ quotvis, interceptæ à lineis veri motûs. Ergò, per *Herigoni Theor. Plan. l. 1. c. 3. Prop. 12. Schol. 1.* totidem Circuli segmenta describi possunt, capacia angulorum, sub quibus isti arcus conspiciuntur ex d , quæ segmenta omnia se mutuò interfecabunt in d . Possunt igitur & hac Methodo inveniri Apogæa & Excentricitates Planetarum, delineatione Geometricâ, adhibitis Observationibus quotvis; nec difficilius est, Circulos ducere, quàm lineas rectas.

Sed ut demus id, quod verum est, Clarissimi *Cassini* delineationem Geometricam non-nihil expeditiorem esse; verendum est interim, ne, si *αξιβειν* Astronomis expetitam sectemur, Diagrammata requirat enormis magnitudinis, adeoque operosior evadat, quàm ipse Calculus. Ad hunc autem accedentes, utramque Methodum æquipollere deprehendemus.

Adhibeamus enim ex Observationibus *Tychonicis* tres, quæ *Dom. Cassini* Diagrammati quodammodo consentiant; nim. Observationem A, cùm *An. 1604, Mart. 28 d. 16 h. 23 m. Mars* observatus fuit in $\approx 18 g. 37 m. 10 s.$ B, cum *An. 1587, Mart. 6 d. 7 h. 23 m.* idem Planeta visus fuit in $\approx 20 g. 43 m. 0 s.$ Denique C, cùm *An. 1600 Fan. 18 d. 14 h. 2 m.* deprehenderetur in $\approx 8 g. 38 m. 0 s.$ Est igitur inter A & B intervallum apparens $22 g. 54 m. 10 s.$ & huic respondens medium $25 g. 58 m. 40 s.$; at inter B & C intervallum apparens $47 g. 5 m. 0 s.$ & medium $56 g. 21 m. 57 s.$ Itaque

Methodo

(1173)

Methodo Cassini, Fig. II.

1. In Triangulo DBH,
 Dantur DB 10, 00000
 DBH 12 | 99
 BDH 11 | 45
 Queritur BH 9, 68106

2. In Triangulo DBG.
 Dantur DB 10, 00000
 DBG 28 | 18
 BDG 23 | 54
 Quer. BG 9, 70653

3. In Triangulo HBG.
 Dantur BH 9, 68106
 BG 9, 70653
 HBG 41 | 17
 Quer. BGH 64 | 95
 Cujus Compl. GBI 25 | 05
 Si auferas ex GBD 28 | 18
 Restat IBD vel IBL 3 | 13

4. In Triangulo GB I.
 Dantur BG 9, 70653
 GIB 90
 GBI 25 | 05
 Quer. BI 9, 66363

5. In Triangulo IBL.
 Dantur BI 9, 66363
 BL (semis τ BD) 9, 69897
 IBL 3 | 13
 Quer. BLI 32 | 31, An. vera, & LI, 8, 67284, Excentricitas.

Methodo Herigoni, Fig. V.

1. In Triangulo dbb,
 Dantur db 10, 00000
 adb externus 24 | 44
 bbd 11 | 45
 Quer. bb 10, 31894

2. In Triangulo dbg,
 Dantur db 10, 00000
 cdb externus 51 | 72
 bgd 23 | 54
 Quer. bg 10, 29347

3. In Triangulo hbg,
 Dantur bh 10, 31894
 bg 10, 29347
 hbg 41 | 17
 Quer. hbg (vel hbi) 64 | 95 = bsg
 Et hbi = sgb = 90:
 Ergo hbi = gbs = 25 | 05
 Ex gbi = gbs + sbi (= hbg - hbi) = 16 | 12
 Aufer dbb = hbi - dbi = 12 | 99
 Restat gbs + sbi - hbi + dbi = sbd (vel dbl) 3 | 13

4. In Triangulo gbs
 Dantur bg 10, 29347
 bgs 90
 gbs 25 | 05
 Quer. bs 10, 33637

5. In Triangulo dbl,
 Dantur bd 10, 00000
 bl (semis τ bs) 10, 03534
 dbl 3 | 13
 Querit. bld 32 | 31 Anom. vera
 Et ld 9, 00926 Excentricitas.

Nimir. Ut Fig. II. BL 9, 69897, ad LI, 8, 67284;
 Ita Fig. V. bl 10, 03534, ad ld 9, 00926.

Ex loco apparenti secundæ Observationis	s.	g.	m.	sec.
auferatur angulus Anomalix veræ B L I	5	25	43	0
Restat locus Apogei	1	2	18	36
	4	23	24	24

Erat autem reverà ævo *Tychoñis* Apogeon *Martis* in Ω $28\frac{1}{2}$ d., à quo deficit iste locus, calculo inventus, solidis quinque gradibus. Porrò, Ut B L 9, 69897, } Ita 5, 18290 Log-us 152369 distantia med. δ tis, ad L I 8, 67284; } ad 4, 15677 Log-um 14347 Excentricitatis δ tis.

Est autem vera Excentric. δ tis 14179, quam ista, calculo inventa, excedit $\frac{168}{14179}$ particulis.

Cæterum in ratiocinio secundum utramque Methodum instituto notare licet non modò perpetuam Triangulorum similitudinem, sed & Epilogismi congruentiam; ne quis Apogei & Excentricitatis sic inventæ à vero discrepantiam censeat errori Calculi imputandam. Sed nec Observationum vitio contingit; quas in dubium vocare nil aliud foret, quàm principia in Astronomia negare. Itaque restat, ut Hypothesin excutiamus.

Et *Ellipticæ* quidem Orbitæ Inventio sine controversia *Keplero* debetur; sed quibus Accelerationis & Retardationis gradibus incedant Planetæ, definire, non minùs pertinet ad integrandam Hypothesin, quàm ipsius Orbitæ determinatio. Quanquam autem ex Cl. *Cassini* (vel Interpretis ejus) sermone id nusquam apparet; attamen ex Constructione Problematis, & ejus Analyfi, manifestum est, eum supponere, Planetam ex foco superiori videri prorsus æquabili motu incedere. Fuit sanè, cum idem existimaret *Keplerum*, quod ejus Scripta evolventibus liquere potest. Sed cum id Observationibus nequaquam congruere animadverteret, mutavit sententiam, & lineam veri motùs Planetæ æqualibus temporibus æquales areas Ellipticas verrere professus est: Punctum autem, ex quo Planeta exactè æquabili motu procedere videtur, nullum omnino extare in hoc Universo, nisi id libratile statuere libeat. Nulli interim puncto propriùs æquabilem videri incessum Planetæ, quàm ipsi foco superiori Ellipseos. Neque inventus fuit hæctenus, qui areas *Kepleri* phænomenis satisfacere posse negaret; sed, cum eas Calculo directo exhibere nec ipse nec post eum quisquam potuerit, causati sunt nonnulli, *Keplerum*, nimis indulgentem causis *Physicis*, à *Geometria* diversum abiisse; quasi causæ physicæ repugnent *Geometricæ*, aut minus *Geometricum* sit Problema, quod, nullâ injectâ physicarum causarum mentione, sic proponitur: *Data area Trilinei, inter lineas absidum, & veri motus, nec non peripheriam Ellipticam intercepti, invenire Angulum ad Solem.* Habent igitur à *Keplero* responsum, qui illi ἀγεωστρίαν objiciunt; nim. *Eant ipsi & Schema solvant.*

Quamvis autem religio fuerit *Keplero*, ab Hypothesi, quam *Naturalem* esse planè persuasum habebat, recedere; quidni liberum foret aliis periculum facere, num via quævis alia detur, inæqualitatem Planetarum primam directo Calculo investigandi? Ideoque Vir Clariss. *Ism. Bullialdus* aggressus est ratiocinio *Geometrico* indagare, quâ semitâ, & quibus intentionis ac remissionis gradibus conveniret Planetas ferri, ut ab æquabili incessus norma, Astronomis ante *Keplerum* assumptâ, ad eam, quam spectamus, Inæqualitatem perduceremur. Perennant Illustrissimi viri
monu-

monumenta , unde omnem hujus Inventi rationem haurire licet Astrophiliis. Amplexus eandem Reverendis. *Seb. Wardus*, primum ostendit, paria facere cum linea æquabilis motus circa alterum Ellipseos umbilicum gyrata; deinde & Calculi directi methodo ornavit eam, quam paulò antè recitavimus: Ita ut nil amplius desiderari posset, quàm ut *Urania* felicibus cæptis annueret. Cujus quidem nomine suscipere ausus fuit Illustris. Comes *Paganus*, edito, *biennio post*, ejusdem ferè tenoris Scripto, adeò veram esse Hypothesin, ut deprehensam circa Octantes discrepantiam, Astronomorum inficitæ tributam mallet. At Cl. *Bullialdus*, audiendam potius ipsam Astronomiam ratus, Observatorum ore loquentem, secundis curis, adhibita prioribus Inventis limitatione quadam, discrepantiam illam exterminavit. Unde porrò intelligitur, Hypothesin illam, cui Cl. *Cassinus* investigationem Apogeorum & Excentricitatum superstruit, tantundem ferè deficere à vero, quantum Cl. *Bullialdi* limitatio poterat, atque ab illo defectu pullulare eum quem supra notavimus, Calculi à Cælo dissensum.

Tantum vero abest, ut de Eximii Viri Inventione vel minimum delibatum velim, ut quicquid hujus lucubratiunculæ non hausi ex Reverendiss. *Wardo*, vel *Herigono*, id omne Ipsi libentissimè acceptum referam, qui ansum nobis præbuit hæc altius considerandi. Nec dubitamus, quin omnia ista multò uberius ac luculentius in promisso *Tractatu* exposita propediem reperturi simus, cujus Editionem maturam, pro eo quo flagramus divinissimæ Scientiæ amore, perquam avidè exspectamus.

An Account of Three Books.

I. *Esperienze intorno alla Generazione Degli' Insetti, fatte da Francisco Redi, Accademico della Crusca. In Firenze, A. 1668. in 4o.*

THe Learned and Ingenious Author of this Book, lately come to the Publishers hands, though not yet (which is much disliked by the curious) into our Stationers Shops, doth with much industry undertake therein to evince, that there is no such thing as *Æquivocal Generation* but that every Animal is generated by the seed of another Animal, (its parent,) or, at least, from some Living and un-corrupted Plant, as out of Oak-Apples, and several Protuberances and Excrecencies of Vegetables.

First then, in the asserting of the *Universal* and true Generation of Insects by a peculiar and paternal Seed, the Author positively affirms, that he could never find, by all the Experiments and Observations, he ever made (of which he relateth a great number, by himself made upon all sorts of Animals) that ever any Insects were bred from Flesh, or Fish, or *putrified* Plants, or any other Bodies, but such, as Flies had access unto, and scatter'd their seed upon; he having taken extraordinary care and pains to observe, that alwayes on the Flesh, before it did verminate, there late Flies of the self same kind with those, that were afterwards produc'd thence; and again, that no Worms would ever come from any Flesh in Vessels well cover'd, and defended from the access of Flies; so that to him there is no generation of Insects from any dead Animals, but such as have been fly-blown.

And least it should be objected, that the reason, why in vessels exactly clos'd, no Insect breeds, is the want of Air, necessary to all Generation, He hath carefully covered several vessels with very fine Naples-vaile, for the Air to enter, though Flies could not; but that no worms at all were bred there, notwithstanding that many Flies swarmed about them, invited by the smell of the Flesh inclosed therein.

Secondly, to make out the other part of his Position. *viz.* That these Animals that are not bred by the seed of other Animals, are produced from some live Plant, or its

Excre-

Fig. II.

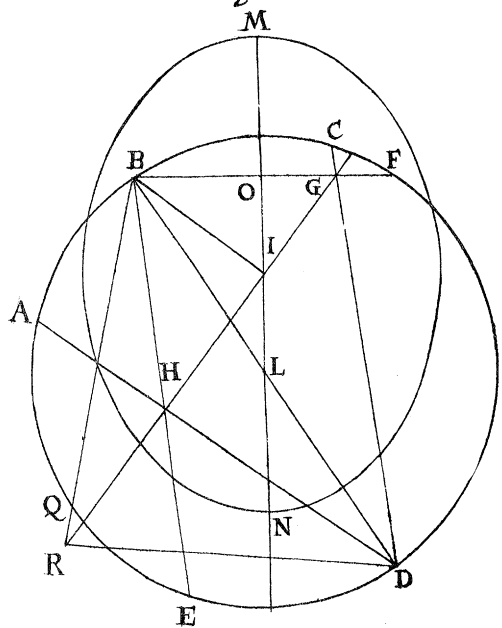


Fig. III.

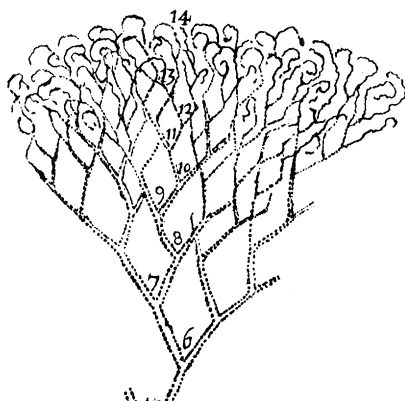
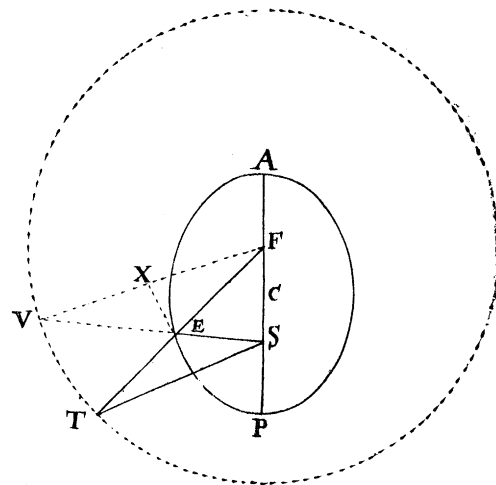


Fig. I.

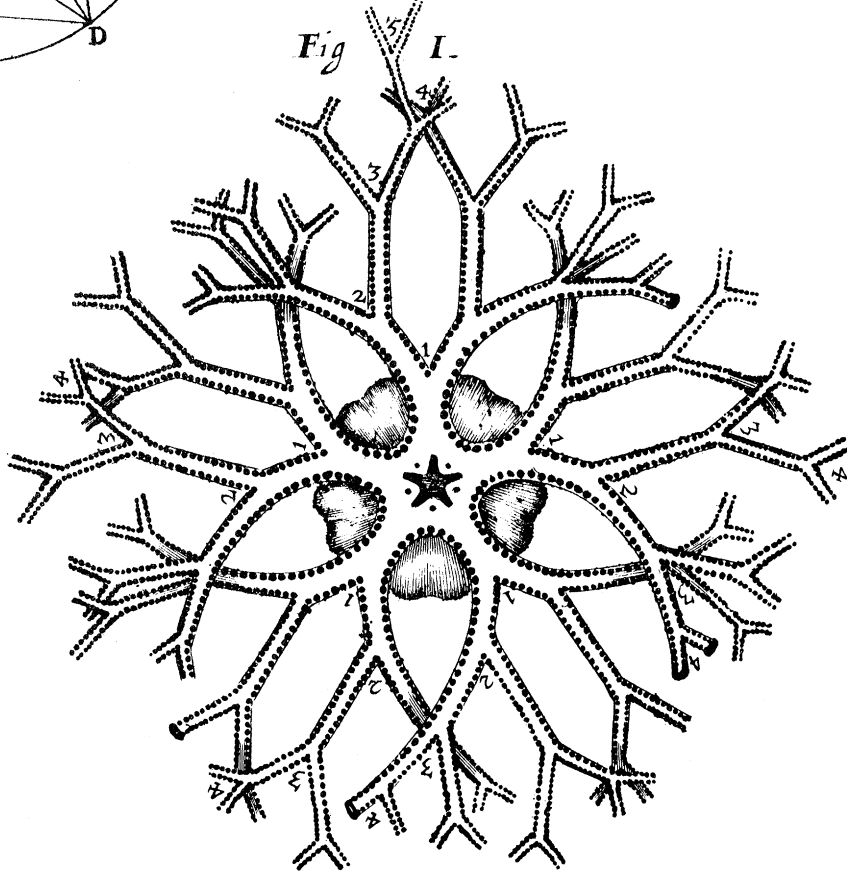


Fig. IV.

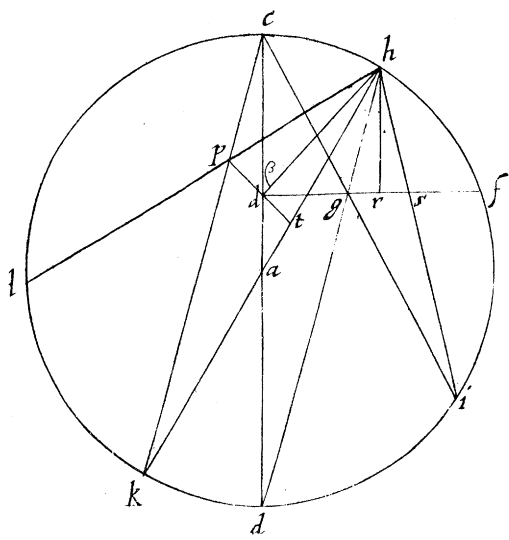


Fig. V.

