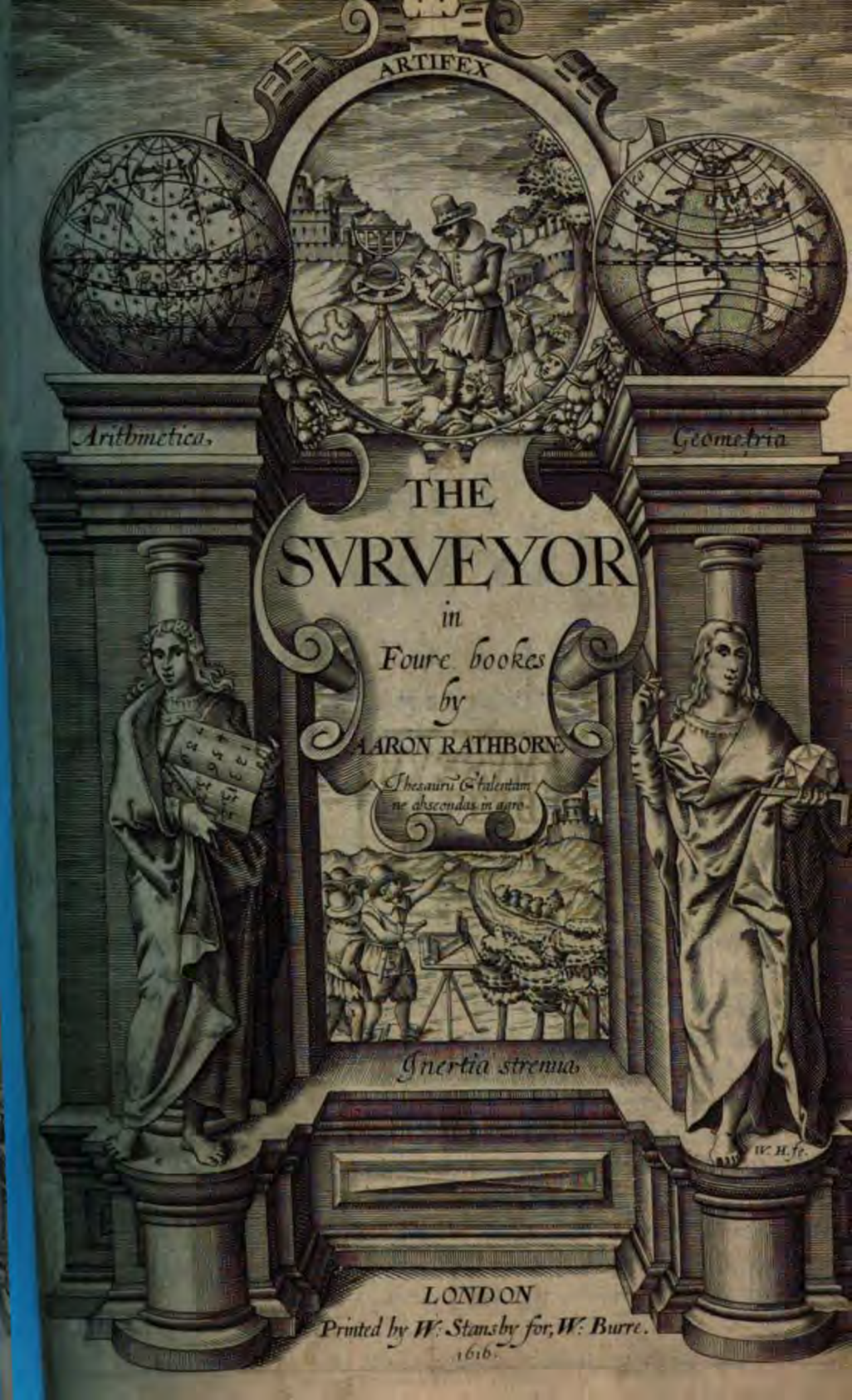

ARTIFEX
Arithmetica.
Geometria
THE
SVRVEYOR
in
Foure bookes
by
AARON RATHBORNE
Thesauri & talentum
ne abscondas in agro.
Gnertia strenua.
W. H. fe.
LONDON
Printed by W: Stansby for, W: Burre.
1616.

TO THE HIGH AND MIGHTY PRINCE *CHARLES*,

Prince of WALES, Duke of CORNWALL, YORKE, ALBANY and ROTHSAY: Marques of ORMONT, *Earle of* ROSSE; *and Baron of* ARMANOCH: High Seneschall of SCOTLAND: Lord of the ILES; and Knight of the *most noble Order of the* GARTER.

IF in former ages (most noble Prince) the studies Mathematicall were held meet for *Princes*; I doubt not but in these, they may implore (by your favourable admittance) the approbation and defence of your gracious patronage; which emboldens me the rather, to presume the dedication of these my labours to your Highnesse protection. Wisedome is defined by CICERO to be *diuinarum atq; humanarum rerum scientia*, of the former part of which definition

finition (being the moſt abſolute) I will leaue to ſpeake vnto thoſe who can better write; yet will thus much auerre, that no man ſhall obtayne the abſolute perfection thereof, being abſolutely ignorant of the rules, rudiments and principles of Mathematicall diſcipline, as the due conſideration of that ſacred and myſticall *Vnitie* and *Trinitie*, may well approue. And how auaileable and important they are, for the attayning to that *humanarum rerum ſcientiam*, in Peace or Warre, is worthily witneſſed by PLATO, VEGETIVS, LIVIVS, and other Authors; who teſtifie of LYCVRGVS, and that famous *Syracuſean* ARCHIMEDES; by the one, what excellent Lawes and Ordinances were eſtabliſhed and miniſtred, in the time of peace; and by the other, what more then wonderfull deuiſes and ſtratagems were wrought againſt the inuincible forces of MARCELLVS, in the time of Warre, which they worthily impute to this their *ſcientiæ mathematicarum*. But ſhould my weakeneſſe here vndertake to illuſtrate the excellency of that worth, which all worthy men admire; and that to your Highneſſe, whoſe iudgement is beſt able to diſcerne; were but to depraue the one and the other, and reſt in mine owne reproch. Wherefore, aſſuring my ſelfe, of your Highneſſe loue and affection to theſe Artes, and your reſpect to the Profeſſors thereof; with your power and abilitie of defence, againſt the malignant courſes of malicious detractors, I preſume in all humilitie to intreate your Patronage of theſe my labours, which in all dutie I proſtrate at your Highneſſe feet; with continuall inuocation to the Prince of Princes, euer to preſerue your Princely dignitie.

Your Highneſſe moſt humble and deuoted,

AARON RATHBORNE.

The Preface.

I Am not ignorant (friendly Reader) that hitherto, in writing, neuer any man pleased all; nor will I expect to be the first. To perswade the courteous, were causelesse, for they are naturally kind; and to dissuade the captious, were bootlesse, for they will not be diuerted: Let the first make true vse of these my Labours, and they shall find much pleasure and profit therein; let the last (if they like not) leaue it, and it shall not offend them. To make apologie or exornation, in defence or commendation of the subiect whereof I treat, were needlesse; it being alreadie, in the worlds opinion, of sufficient habilitie and reputation, both to defend and commend it selfe: Onely of my manner and order in handling the same, I will say somewhat, as briefely as I may, for thy better instruction and vnderstanding thereof.

In generall, I haue disposed and digested the same into foure Bookes; whereof, the two former tend specially to the principles and rules of Geometrie, with performance thereby of many vsefull and necessarie conclusions; and the two later, to matter of Surney, with many instrumentall conclusions, tending as well to that, as diuers other purposes.

More particularly, in my first Booke, I begin with the Matters, Grounds, and Elements of GEOMETRIE, *as the definitions and termes of art belonging thereunto; most fitting first by the Practicioner to be learned and well vnderstood: then next haue I placed therein diuers Geometricall* THEOREMES, *as the foundations, grounds, and reasons whereon the practike part dependeth.*

In the second (hauing formerly laid the foundation) I shew the meanes and practike operation of manie necessarie conclusions and Geometricall PROBLEMES, *as the distinction, application, and diuision of Lines and Angles; and the description, reduction, addition, inscription, transmutation, diuision, and separation of all formes and kinds of superficiall Figures, with their seuerall dimensions. And considering, that as well in the* THEOREMES *of the first Booke, as the* PROBLEMES *in the second, I wholly omit (for breuities sake, and auoiding confusion to the*

the learner) their ſeuerall demonſtrations, vſing onely explication and conſtruction; I therefore expreſſe in the Margent againſt thoſe THEOREMES and PROBLEMES, where, how, and in what place of EVCLID, RAMVS, and other Authors, to find their ſeuerall demonſtrations at large: and likewiſe, at the end of each conſtruction, I haue inſerted the like numbers and notes of reference, from the THEOREMES in the firſt Booke, to the PROBLEMES in the ſecond; and the contrarie: whereby moſt plainely and readily is found, and had, as well the reaſon and ground of any PROBLEME propoſed, as the effect and operation of any THEOREME deliuered.

In the third Booke I begin with the deſcription of the ſeuerall Inſtruments fit and vſuall for Suruey; and of their ſeuerall vſes: wherein ſomewhat haue I ſpoken (though too ſparingly) concerning their abuſe; being now growne ſhamefully generall, by the multitude of ſimple and ignorant perſons (vſing, or rather abuſing, that good plaine Inſtrument, called the Plaine Table) who hauing but once obſerued a Surueyor, by looking ouer his ſhoulder, how and in what manner he directs his ſights, and drawes his lines thereon; they preſently apprehend the buſineſſe, prouide them of ſome caſt Plaine Table, and within ſmall time after, you ſhall heare them tell you wonders, and what rare feats they can performe; yea, and will vndertake (or I will for them) that for tenne groats a day, and their charges defrayed, they ſhall be able to vndoe any man they deale with; or at leaſtwiſe, to doe him ſuch wrong and preiudice, as perhaps he might, with more eaſe, and leſſe loſſe, haue giuen ten pounds a day to one that would haue ſpoken leſſe, and performed more. But what ſhould I ſay more of them then thus, Monoculi inter cæcos oculiſſimi ſunt, and ſo will I leaue the blind, with tumbling the blind into the myre.

I further deſcribe in this third Booke, the compoſition and vſe of an Inſtrument of mine owne, which I call the Peractor, and of a Chayne, which I call the Decimall Chayne, with the diuiſions and parts thereof: which rightly vnderſtood and practiſed (I dare boldly ſay without oſtentation) is farre more vſefull and abſolute for ſpeed and exactneſſe, then any yet euer vſed: And I will maintaine by ſufficient demonſtration, that no man (vſing not the ſame, or the like) ſhall attaine to the ſame or the like perfection, for preciſe exactneſſe in any dimenſion, as I will thereby performe.

And I further ſhew therein, the beſt, ſpeedieſt, and exacteſt meanes, for the ſuruey and inſtrumentall menſuration of a Mannor, or any other ſuperficiall content whatſoeuer, by diuers and ſeuerall meanes; with manie

manie extraordinarie obſeruations and courſes, therein to be had and taken, not vſually knowne or practiſed; as by the argument of that Booke more particularly appeareth.

Wherein by the way I would aduiſe the Reader, who deſireth to make vſe thereof, and to profit himſelfe thereby, in reading and practiſing; to take the Chapters before him as they lye in order; for that I haue ſtriued to place them in ſuch an orderly and methodicall forme, as the one neceſſarily follow the other in vſe and practiſe; well knowing that diſorder and irregularitie in this kinde, breedeth not a little trouble and confuſion to the weake practicioner.

The fourth and laſt Booke, conſiſteth of the legall part of Suruey; wherein I firſt ſhew what a Mannor is and the ſeuerall parts thereof, with the appendants thereunto; how the ſame is created and maintayned, and how and by what meanes deſtroyed and diſcontinued: alſo the ſeuerall ſorts and kindes of eſtates whereby any lands or tenements may be holden, and the ſeuerall tenures, rents and ſeruices depending on thoſe eſtates: I further ſhew therein the order and manner of keeping Courts of Suruey, with the entrie of the tenants euidence and eſtates; and the orderly and artificiall manner of ingroſſing the ſame, with many other neceſſary rules and obſeruations tending to thoſe purpoſes, as more at large alſo appeareth by the argument of the ſame Booke.

And here, as before, would I aduiſe the practicioner, to obſerue the like courſe in reading and practiſing the rules and inſtructions of this Booke, as I haue formerly directed for the third, for that I haue ſtrictly obſerued the like decorum in placing the Chapters each after other, as of neceſſity they are to be vſed and practiſed.

Now might I here much inlarge and protend this Preface, in explicating the wonderfull vſe of the two former Bookes, in the performance of infinite concluſions Geometricall, ſo farre paſſing this ſubiect of Suruey, as it in it ſelfe exceedeth the meaneſt matter of diſpoſe, which (to auoide prolixitie) I will here forbeare, leauing the conſideration thereof to thine owne iudgement, when thou ſhalt finde therein by thy diligent practiſe the ſweet and pleaſing taſte of ſuch ſenſe-beguiling fruit.

And further might I amplifie the ſame, not only in declaring the great and infinite pleaſure, with no leſſe profit, which the true knowledge, vſe, and vnderſtanding of the two later Books may bring (aſwell to Surueyors, as all owners and occupyers of land in generall) but alſo of the antiquitie and neceſſitie of Suruey; howſoeuer ſleighted by many, who will not beſtow a penny in points, or two pence in tape, or the like, but they will number the one, and meaſure the other, before they pay for either,

either, and yet will disburse manie thousands in a purchase, without the certaine knowledge of either quantitie, qualitie, or value thereof: (and these are those which are called penny-wise, &c.) whereby it often happens (as I haue often knowne) that a valuable purchase being made, within few weekes after, the money hath beene raised of the woods, and the lands perhaps immediately sold for much more then the money disbursed; and the same againe vented at the third hand, hath yeelded a double value: and all this vnseene, and vnsurueyed, with what disaduantage to the first vendor, I will leaue to the consideration of my young Master, who hath thus offended in selling all, and resteth now in repentance, with full resolution not to offend in the like. And the like haue I knowne of a purchase made, when a moitie of the charge could scarcely be raised.

But to spend time to this purpose, were to little end, and therefore will I end this purpose; only intreating thee gentle Reader, that as I haue thus imployed mine idle houres, to find thee houres of imployment; if thou reape either pleasure or profit by these my paines, to afford me thy good opinion (for Virtus laudata crescit, & honos alit artes*) which is all I craue.*

AARON RATHBORNE.

From my Lodging, at the house of M. ROGER BVRGIS, *against Salisburie-house-gate in the Strand, this sixt of Nouember,* 1616.

THE SURVEYOR.

The first Booke.

THE ARGVMENT OF THIS BOOKE.

THis first Booke consisteth of two parts; the former whereof intreateth onely of the first Matters, Grounds, and Elements of GEOMETRIE, *as the distinction of Lines, Angles, Triangles, and other Figures, with their* DEFINITIONS, *shewing what they are: The second part containeth diuerse Geometricall* THEOREMES, *tending chiefely and most fitly to the subiect and matter prosecuted in the subsequent Bookes, whereby the ingenious Practitioner may readily conceiue and apprehend the ground and reason of the Precepts, Rules, and Problemes therein deliuered.*

THE FIRST PART.

DEFINITION I.

A Point is that which is the least of all Materialls, hauing neither part nor quantitie.

BEtweene *Vnitie* in ARITHMETIKE, and this *Point* in GEOMETRIE, there is a neere resemblance: but that, more simple and pure; this, materiall; and (although the least that can be imagined) requireth position and place, as this *Point* A. *Euc. 1. Def. 1.*

DEFINITION II.

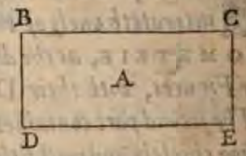
A Line is length, without breadth or thickneſſe.

Euc.1. Def.2. THis is the firſt quantitie in GEOMETRIE, and may be diuided into parts, in reſpect of his length, but admitteth no other diuiſion or dimenſion; and hath for his termes and limits that Geometricall point formerly ſpoken of. And of theſe lines are there two ſorts; namely right, as the line A. and crooked, or ſphericall, as the line B.

DEFINITION III.

A Superficies is that which hath onely length and breadth.

Euc.1. Def.5. THis is the ſecond quantitie in GEOMETRIE, hauing two ſeuerall dimenſions, namely, length and breadth, without depth or thickneſſe (for that belongs to a ſolid or bodie, being the third quantitie in GEOMETRIE, and impertinent to this place, whereunto is attributed all three dimenſions, as length, bredth, and thickneſſe.) And as a line is limited with points, ſo is a Superficies with lines, and a Solid or Bodie with Superficies. As the figure A. being a Superficies, hath for his length B. C. or D. E. and for his breadth B. D. or C. E. which foure lines are the bounds, limits, and termes of the ſame Superficies.



DEFINITION IIII.

An Angle is the congreſsion or meeting of two lines in any ſort, ſo as both make not one line.

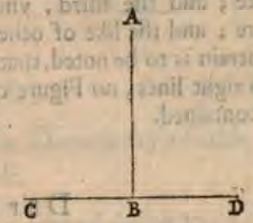
Euc.1. Def.8. GEnerally of Angles (in reſpect of their lines) there are three ſorts; namely, right-lined, ſphericall, and mixed. As the Angle A. is called a right-lined Angle, being compoſed of two right lines; the Angles B. and C. are ſphericall, or crooked Angles; and the Angle D. a mixed Angle, being cauſed of both.

DEFI-

DEFINITION V.

If a right line fall on a right line, making the Angles on either ſide equall, each of thoſe Angles are called right Angles: And the line ereſted is called a Perpendicular line vnto the other.

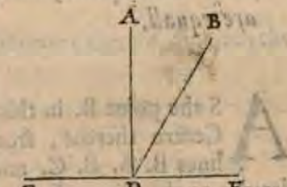
Euc.1. Def.10. AS in generall there are three ſorts of Angles, in reſpect of their lines, as aforeſaid; ſo in particular, of right-lined Angles there are three ſorts, in reſpect of their quantities; namely, an *Orthogonall*, or right Angle; an *Obtuſe*, or blunt Angle; and an *Acute*, or ſharpe Angle: whereof, according to this definition, the line A. B. falling on the line C. D. and making the Angles on either ſide equall, namely, the Angle A. B. C. on the one ſide equall to the Angle A. B. D. on the other ſide; thoſe two Angles are called right Angles: And the line A. B. erected on C. D. without inclination to either ſide, is called a *Perpendicular*, or Plumbe line. *And here note further, that vſually an Angle is deſcribed by three letters; of which, the ſecond or middle letter repreſenteth alwayes the Angle intended.* PROP. 4. 5. 6. 9.



DEFINITION VI.

An Angle which is greater then a right Angle, is an obtuſe Angle.

Euc.1. Def.11. EVerie Angle in generall (not being a right Angle) whether greater or leſſer, is called an *Oblique* Angle: but particularly, if greater then a right Angle, it is called an *Obtuſe* Angle; if leſſer, an *Acute* Angle: As the Angle B. D. C. (being greater then the right Angle A. D. C.) is an *Obtuſe* Angle; for it containeth it, and alſo the Angle A. D. B.



DEFINITION VII.

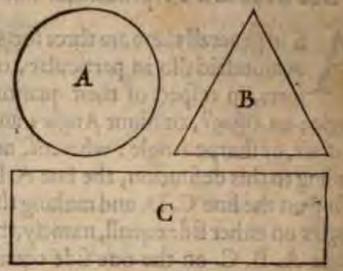
An Acute Angle is that which is leſſe then a right Angle.

Euc.1. Def.12. THis Definition is manifeſt by the former Diagram, wherein the Angle A. D. B. is an *Acute* Angle, being leſſe then the right Angle A. D. E. for the ſame right Angle containeth it, and alſo the Angle B. D. E. being likewiſe an *Acute* Angle.

DEFINITION VIII.

A Figure is that which is contained vnder one or many limits.

Euc.1. Def.14. AS these three figures, A. B. and C. whereof the first is contained vnder one limit; the second, vnder three; and the third, vnder foure; and the like of others. Wherein is to be noted, that of two right lines, no Figure can be contained.



DEFINITION IX.

A Circle is a plaine Figure, and contained vnder one line, which is called the Circumference thereof.

Euc.1. Def.15. Rem.1.15. A Circle, of all other Figures, hath the prioritie, being of all most perfect and absolute; and therefore most fitting first to be defined: as the Figure A. in the last Diagram.

DEFINITION X.

The Centre of a Circle is that point which is in the middest thereof: from which point, all right lines, drawne to the Circumference, are equall.

Euc.1. Def.16. AS the point B. in this Figure is the Centre thereof, from whence the lines B. A. B. C. and B. D. being drawne to the Circumference (and as manie others as are so drawne) are all equall, and are semidiameters to the same Circle. PROB. 34. 1.

DEFINITION XI.

The Diameter of a Circle is a right line, passing by the Centre through the whole Circle, and diuideth the same into two equall parts: Either halfe

halfe of which Diameter, is called the Semidiameter of the same Circle.

AS the line A. B. C. in this circle is the diameter thereof, for that it passeth by the centre B. through the whole circle, as from A. to C. and also diuideth the circle into two equall parts, the one halfe towards D. the other towards E. Either halfe of which Diameter, as A. B. or B. C. is called the Semidiameter of the same Circle. PROB. 34.

Euc.1. Def.17.

DEFIN. XII.

A Semicircle is a Figure contained vnder the Diameter of a Circle, and the semicircumference of the same Circle.

AS supposing the circle A. B. C. the Diagram of the last DEFINITION, to be diuided into two equall parts by the diameter thereof A. C. whereby two Figures are proiected, namely, A. D. C. and A. E. C. Now by this DEFINITION, each of these Figures are *Semicircles*, for that the one of them is contained vnder the diameter of the same circle A. C. and the semicircumference A. D. C. and the other vnder the same diameter, and the semicircumference A. E. C.

Euc.1. Def.18.

DEFIN. XIII.

A Segment, Section, or Portion of a Circle, is a Figure contained vnder a right line, and part of the circumference, either greater or lesse then the Semicircle.

AS the diameter of a circle passing by the centre thereof, diuideth the same into two equall parts; so any right line, drawne from any one part of the circumference to any other part thereof (and not passing by the centre) diuideth the circle into two vnequall parts, which are called *Segments*, *Sections*, or *Portions* of a circle: As in this circle, the figure A. C. B. because it is contained vnder the right line A. B. and the lesser part of the circumference A. C. B. is called a lesser *Segment*, *Section*, or *Portion* of a circle; and the figure A. D. B. because it is contained vnder the right line A. B. and the greater part of the circumference A. D. B. is called a greater *Segment*, *Section*, or *Portion* of a circle. *Here note also, that these parts and such like of the circumference so diuided, are commonly called Arches, or arch lines. And all lines (lesse then the diameter) drawne*

Euc.1. Def.19. 3. Def.5.

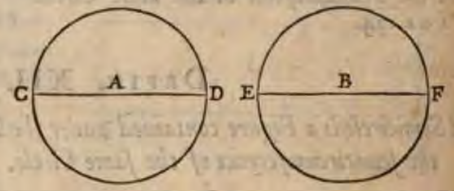
and applied as the line A. B. are called Cordes, or cord lines, of those Arches which they so subtend; or Subtenses, *because they subtend both Segments.* THEOR. 73. PROB. 34.

DEFIN. XIIII.

Equall Circles are such as haue equall Diameters, or whose lines, drawne from their Centres, are equall.

Euc. 3. Def. 1.

AS these two circles A. and B. are equall, their diameters being equall, namely, C. D. and E. F. or their Semidiameters, (which, according vnto this DEFINITION, are lines drawne from the centres vnto their circumference) as A. C. or A. D. and B. E. or B. F.



DEFIN. XV.

A right line is said to touch a circle, which touching it, and being extended or produced, doth not cut the circumference thereof.

Euc. 3. Def. 2.

AS the right line A. B. being drawne by the point C. doth there onely touch the circle, and being produced vnto B. cutteth not the circumference thereof. This line is commonly called a *Tangent*, or *Contingent* line: whereof there is great and infinite vse, in manie Conclusions, Geometricall and Astronomicall, especially in the mensuration and resolution of Triangles, as well right-lined, as spherical, by the Canons and Tables of Synes, Tangents, and Secants, in that behalfe calculated.

DEFIN. XVI.

An angle of a Section, or Segment, is that which is contained vnder a cord line, and the arch line of the same Section.

Euc. 3. Def. 6.

AS the angles A. B. C. and B. A. C. in the lesser segment of this circle, are angles of a Section, because they are contained vnder the cord line A. B. and the arch line A. C. B. Also the angles D. B. A. and

and D. A. B. in the greater Segment are angles of the same Segment, by the like reason. And all angles of this kind are called mixed angles, because they are contayned vnder a right line and a crooked. Of which two Segments, the lesser hath alwaies the lesser angle; and the greater, the greater angle.

DEFIN. XVII.

An angle in a Section, or Segment, is when two right lines are drawne from any point in the arch line, to the ends or extreames of the cord line; the angle in that point of the arch line is called an angle in a Section or Segment.

Euc. 3. Def. 7.

AS the angle A. B. C. in the lesser Segment is an angle in a Section, or Segment, by reason that the two right lines B. A. and B. C. are drawne from the point B. in the arch line to the ends or extreames of the cord line A. C. And also the angle A. D. C. in the greater Segment is an angle in a Section, or Segment, because the two right lines D. A. and D. C. are drawne from the point D. in the arch line to the ends or extreames of the cord line A. C. *And here note, the greater Section hath in it the lesser angle, and the lesser Section the greater angle, contrarie to the mixt angles in the precedent* DEFINITION *mentioned. And here also is to be noted, by the declaration of this and the former* DEFINITION, *the difference betweene an angle of a Segment, and an angle in a Segment; the first being called a mixt angle, and this a right lined angle.*

DEFIN. XVIII.

If two right lines be drawne from any one point in the circumference of a Circle, and receiue any part of the same circumference, the angle contained vnder those two lines is said to belong and to be correspondent to that part of the circumference so receiued.

Euc. 3. Def. 8.

AS the angle B. A. C. contained vnder the right lines A. B. and A. C. drawne from the point A. and receiuing the circumference B. D. C. by this DEFINITION is said to belong, subtend, and pertaine vnto the circumference B. D. C. And if right lines be drawne from the centre

centre to the former points B. and C. then is that angle said to be in the centre of a circle, as the angle B. E. C. Which angle likewise subtendeth the same circumference B. D. C. and is alwayes double in quantitie to the former angle, drawne from the circumference. And the circumference B. D. C. is also the measure of the quantitie or greatnesse of the angle B. E. C. in the centre.

DEFIN. XIX.

A Sector of a Circle is a figure contained vnder two right lines, drawne from the centre of a Circle, and vnder part of the circumference receiued of them.

Euc. 3. *Def.* 9. *Ram.* 16. 3.

AS in the last DEFINITION, the figure B. E. C. is the Sector of a circle, becausse it is contained vnder the two right lines E. B. and E. C. drawne from the centre E. and vnder part of the circumference, namely, B. D. C. receiued of them.

DEFIN. XX.

Right lined figures are such, as are contained vnder right lines, of what number soeuer, aboue two.

Euc. 1. *Def.* 20.

AS those which follow, being contained vnder three, foure, fiue, or more sides, who take their denominations, as well of the number of their angles, as of their sides; so a figure contained vnder three lines, in respect of his sides, is called a three sided figure; and in respect of his three angles is called a Triangle: and so of the rest. *Where is to be noted, that euery right lined figure hath as many angles as it hath sides.*

DEFIN. XXI.

An Equilater Triangle is that, which hath three equall sides.

Euc. 1. *Def.* 24. *Ram.* 8. 8.

AS a Triangle is the first of all right lined figures (for vnder lesse then three right lines can no figure be contained:) So of all Triangles, the Equilaterall Triangle is most simple and absolute, hauing equall lines and equall angles; containing euery of them a Sextans of a Circle, which is 60 degrees. Triangles haue their denominations, differences, and appellations, as well of their angles as their sides: As this Triangle A. in respect of his

his three equall sides, is called an Equilater Triangle; and in respect of his sharpe angles, is tearmed an *Oxigonium*, or acute angled Triangle. But this appellation (in mine opinion) to this kind of Triangle, is needlesse; for that the name of an Equilaterall Triangle doth imply the same, seeing it can containe no other but acute angles: for if in any Triangle there be either a right or an obtuse angle, the sides cannot be all equall, and therefore by this DEFINITION no Equilater.

DEFIN. XXII.

An Isosceles is a Triangle, which hath onely two equall sides.

THis is the second sort of Triangles, and hath two sides onely of one length, the third being either longer or shorter: As these three Triangles A. B. and C. haue euerie of them two equall sides, and are therefore called *Isosceles*. But in respect of their angles, the Triangle A. is called an *Orthigonium*, or right angled *Isosceles*, for that his angle at the point D. is a right angle. Also the Triangle B. is called an *Ambligonium*, or an obtuse angled *Isosceles*, for that his angle at the point G. is a blunt or obtuse angle. And likewise the Triangle C. is called an *Oxigonium*, or acute angled *Isosceles*, because all his angles are acute or sharpe. Also this Triangle is called an *Equicrurall* Triangle, in respect of his two equall sides.

Euc. 1. *Def.* 25.

DEFIN. XXIII.

A Scalenum is a Triangle which hath all his sides vnequall.

THis is the third kind of Triangles, and hath all his sides of seuerall lengths: As these three Triangles A. B. C. haue euerie of them all their sides vnequall, and therefore called *Scalena*. But in respect of their

Euc. 1. *Def.* 26.

their angles, the triangle A. is called an *Orthigonium*, or right angled *Scalenon*, for that his angle at the point D. is a right angle. Also the triangle B. is called an *Ambligonium*, or an obtuse angled *Scalenon*, for that his angle, at the point I. is a blunt or obtuse angle: And lastly, the triangle C. is called an *Oxigonium*, or an acute angled *Scalenon*, because all his angles are acute or sharpe. *It is to be noted generally in all Triangles, that in comparison of any two sides of a Triangle, the third side is called the Base; as of the Triangle A. in respect of the two lines E.D. and E. F. the line D. F. is the base: In regard of the two lines F. D. and F, E. the line E. D. is the base; and in respect of the two lines D.E. and D.F. the line E. F. is the base.*

DEFIN. XXIIII.

A Square, or Quadrat, is a foure sided figure, whose sides are all equall, and angles all right angles.

Euc. 1. *Def.* 30. *Ram.* 12. 2. 2. *Con.* 1.

AS the figure A. B. C. D. is a Square, or Quadrat, because all the lines thereof are equall, and all the angles right angles. These foure sided figures likewise, as well as Triangles, take their appellation partly of their sides, and partly of their angles; as by their seuerall DEFINITIONS hereafter appeareth.

DEFIN. XXV.

A long Square is that whose angles are all right angles, and whose opposite sides onely are equall.

Euc. 1. *Def.* 31. *Ram.* 1. 13.

THis figure differeth little from the Square, or Quadrat, last defined, haning all equall angles like vnto it; but the sides are vnequall. As in this figure A.B. C. D. all the angles are right angles, and the opposite sides onely are equall, as the length A. B. is equall to the length C. D. and the breadth A. C. to the breadth B. D. but compare them otherwise, and they are vnequall.

DEFIN. XXVI.

A Rhombus (or Diamond) is a figure with foure equall sides, but no right angle.

Euc. 1. *Def.* 32. *Ram.* 8. 14.

AS this figure A. B. C. D. is a Rhombus, hauing all his sides equall, and likewise the opposite angles; but the angles at A. and D. are acute angles, and those at B. and C. obtuse. Betweene a Square, or Quadrat, and

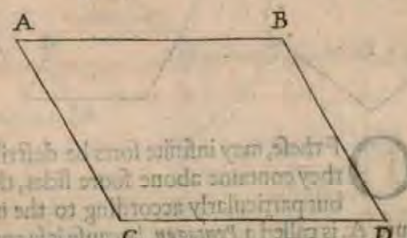
and this figure, is much resemblance, either kind hauing all sides equall; and likewise their angles in generall quantitie; but different in particular qualitie; that hauing foure right angles, this two obtuse; and two acute angles; yet are they in generall quantitie equall to foure right angles: for by how much the two acute angles are defectiue or wanting of two right angles, by so much are the obtuse angles abounding or exceeding. *This figure is described by the connexion of two Equilater Triangles, by any two of their sides, as appeareth by the prickt Diagonall line B.C. which being omitted and left out, this figure remaineth perfect, and hath his acute angles equall to those of an Equilater, namely, 60. degrees, and the obtuse angles double thereunto.* PRO. 57.

DEFIN. XXVII.

A Rhomboydes (or Diamond-like) is a figure, whose opposite sides and opposite angles are onely equall, and hath no right angles.

Euc. 1. *Def.* 33. *Ram.* 9. 14.

AS this figure A. B. C. D. is a Rhomboydes, and hath his sides A. B. and C. D. opposite and equall, and likewise A. C. and B. D. but hath no right angle: For the angles at the points A. and D. are acute, opposite, & equall; and likewise the angles, at the points B. and C. are obtuse, opposite, and equall.



Note here, that the foure figures last before defined, namely, a Square, a figure of one side longer, a Rhombus, and a Rhomboydes, are commonly called Parallelograms; of which foure, the two former are called right angled Parallelograms. PROB. 90.

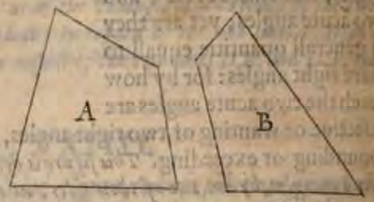
DEFI-

DEFIN. XXVIII.

All other foure lined figures, beſides thoſe formerly defined, are called TRAPEZIA, *or Tables.*

Euc. 1. *Def.* 34. *Ram.* 10. 14.

AS all figures, of foure ſides, which are made at aduenture, without reſpect or regard of equalitie, or inequalitie, or obſeruation of order, either in their lines or angles; which are therefore called irregular figures: as theſe figures A. and B. are.



DEFIN. XXIX.

Manie ſided figures are thoſe which haue more ſides then foure.

Euc. 1. *Def.* 23. *Ram.* 11. 14.

OF theſe, may infinite ſorts be deſcribed, by addition of lines: but if they containe aboue foure ſides, they are generally called *Polygona*, but particularly according to the number of their ſides: As the figure A. is called a *Pentagon*, becauſe it is contained of fiue ſides; the figure B. a *Sexagon*, being contained vnder ſix lines; and C. is called a *Septagon*, becauſe it is contained vnder ſeuen ſides. And the like of others. PROB. 62. 95.

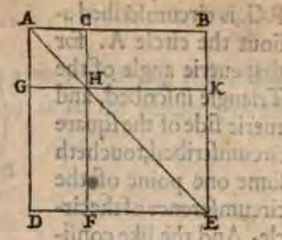
DEFIN. XXX.

Either of thoſe Parallelograms, which are about the diameter of a Parallelogram, together with the two ſupplements, is called a Gnomon.

Euc. 2. *Def.* 2.

RIghtly to conceiue this DEFINITION, it is requiſite firſt to vnderſtand, what thoſe Parallelograms are which are ſaid to be about the diameter of a Parallelogram; and likewiſe, what ſupplements are.

For the firſt, thoſe are ſaid to be parallelograms about the diameter, which haue for their particular diameters part of that which the whole parallelogram hath: And ſupplements are ſuch, as are without the whole diameter, the diameter paſſing betweene them, and cutting them not. As in the parallelogram A. B. E. D. the particular parallelograms H.K. E. F. and A.C. H.G. are ſaid to be about the diameter, becauſe they haue for their particular diameters part of the whole diameter A.E. as A.H. and H. E. And the ſupplements are the two parallelograms C.B.K.H. and G.D.F.H. becauſe they are without the whole diameter A. E. which paſſeth betweene them, and cutteth them not. Now take away either of thoſe particular parallelograms, which ſoeuer it be, and the other remaining, together with the two ſupplements, is that which by this DEFINITION is called a *Gnomon*. PROB. 101. THEOR. 5.

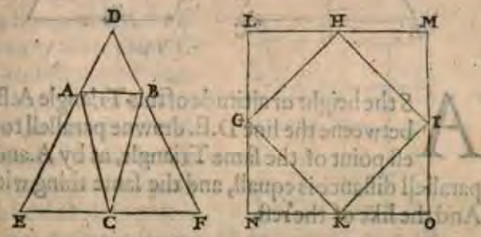


DEFIN. XXXI.

That right lined figure is ſaid to be inſcribed in another right lined figure, which hath euerie angle touching euerie ſide of the figure wherein it is inſcribed.

Euc. 4. *Def.* 1.

AS in theſe two figures, the Triangle A.B.C. is ſayd to bee inſcribed within the Triangle D. E. F. becauſe euerie of his angles A. B. and C. doth touch euerie ſide of the Triangle D.E.F. Likewiſe, the ſquare G. H.I.K. is ſaid to be inſcribed within the greater ſquare L.M.N.O. becauſe euery of his angles G. H.I.K. toucheth euerie ſide of the ſame greater ſquare. The like conſideration is to be had of circumſcribing one right lined figure about another.



Hæc definitio de rectilineis homogeneis, ſiue æquali laterum numero terminatis intelligenda eſt.

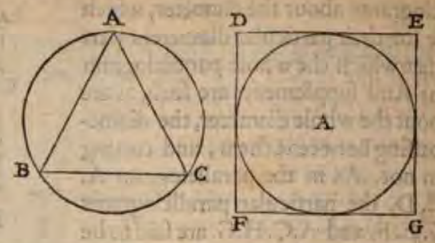
DEFIN. XXXII.

A right lined figure is inſcribed within a circle, when euerie angle of the inſcribed figure toucheth ſome part of the circles circumference.

Euc. 4. *Def.* 3.

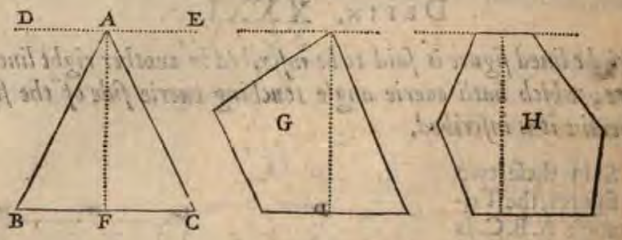
ALL the angles of a regular right lined figure, inſcribed in a circle, or the ſides of the like figure circumſcribed about a circle, may eaſily touch the circumference thereof, by reaſon of the perfection and vniformitie of a circle. As the Triangle A.B.C. is inſcribed in the circle A.B.C.

and alſo the ſquare D.E. F.G. is circumſcribed about the circle A. for that euerie angle of the Triangle inſcribed, and euerie ſide of the ſquare circumſcribed, toucheth ſome one point of the circumference of the circle. And the like conſideration is to be had of circles inſcribed or circumſcribed within or about any right lined figure. PROB. 112. 113.



DEFIN. XXXIII.

The altitude of a figure, is the parallell diſtance betweene the top of a figure and the Baſe.

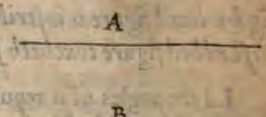


Euc. 6. Def. 4. AS the height or altitude of this Triangle A.B.C. is the ſpace or diſtance betweene the line D.E. drawne parallell to the Baſe B.C. by the higheſt point of the ſame Triangle, as by A. and the ſame Baſe B.C. which parallell diſtance is equall, and the ſame thing with the perpendicular A.F. And the like of the reſt.

DEFIN. XXXIIII.

Parallell lines are ſuch, as being drawne on any plaine Superficies, and produced either way infinitely, doe neuer meet or concurre.

Euc. 1. 35. Ram. 2. 11. 5. 11. AS theſe right lines A. and B. which being produced and drawne forth infinitely, by reaſon of their equall and parallell diſtance the one from the other, will neuer meete or concurre; and therefore are called parallell lines. PROB. 2. 3.

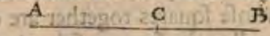


DEFI-

DEFIN. XXXV.

A right line is ſaid to be diuided by extreame and meane proportion, when the leſſer part, or ſegment thereof, is to the greater, as the greater is to the whole line.

AS the line A. B. being ſo diuided in the point C. that the leſſer part, or ſegment, C. B. hath the ſame proportion to the greater part, or ſegment, A. C. as the ſame greater part hath to the whole line A.B. then is the ſame line A. B. diuided by an extreame and meane proportion. The meanes how to diuide a line in ſuch ſort, is hereafter taught by the 20. PROB. of the next booke. This line is of wonderfull and infinite vſe in manie Geometricall operations, as appeareth manifeſtly almoſt through the whole thirteenth booke of *Euclid.* PROB. 20.



DEFIN. XXXVI.

The power of a line is the ſquare of the ſame line, or any plaine figure equall to the ſquare thereof.

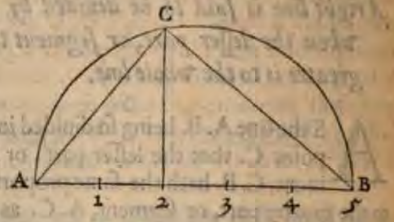
AS the power of the line A. B. is the ſquare of the ſame line, namely, the figure A. B. C. D. or any other plaine figure equall thereunto. And ſo great power and abilitie is a line ſaid to haue, as the quantitie of the ſquare it makes: As this line A. B. containing 4. the power thereof is 16. In this kind is the Diagonall or diameter of a ſquare (as the line A. D.) ſaid to be double in power to the ſide of the ſame ſquare, for that a ſquare made of the Diagonall, is double in quantitie to the ſquare made of the ſide. And likewiſe the line which ſubtendeth the right angle in an Orthigonall Triangle, is ſaid to be equall in power to both the containing ſides: as the line A.D. which ſubtendeth the right angle A. C.D. in the Triangle A.C.D. is equall to both the ſquares made of the two containing ſides, namely of A.C. and C.D. PROB. 23.

DEFIN. XXXVII.

To diuide a giuen line in power, is to finde two other lines, whoſe ſquares together ſhall be equall to the ſquare of the giuen line,

but the ſquare of the one to the ſquare of the other, to be in any proportion required.

AS if A. B. were a line giuen, and it were required to diuide the ſame line in power, according to the proportion of 2. to 3. It is hereby intended to finde two other lines, as C. A. and C. B. whoſe ſquares together are equall to the ſquare of the giuen line A.B. but the ſquare of the one, namely C. A. is to the ſquare of the other C. B. in ſuch proportion, as 2. to 3. that is, the ſquare of C. B. containeth the ſquare of C. A. once and a halfe. The meanes how to performe the ſame, is hereafter taught in the 23. PROB. of the 2. Booke. PROB. 23.



DEFIN. XXXVIII.

To inlarge a line in power, is to find another line, whoſe ſquare ſhall haue any proportion required (of the greater inequalitie) to the ſquare of the giuen line.

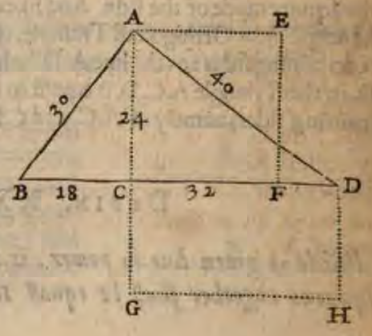
AS ſuppoſe the line 2 B. in the former Diagram were giuen to be inlarged in power, as 3. to 5. It is hereby intended to find out another line, as the line C. B. whoſe ſquare ſhall beare ſuch proportion to the ſquare of the giuen line 2 B. as 5 to 3. which is a proportion of the greater inequalitie, and is called *Superbipartiens tertias:* that is, as 5 containes 3. ſo the ſquare of C. B. the line ſought for, containeth the ſquare of 2 B. $1\frac{2}{3}$. The working whereof is taught in the 24. PROB. of the 2. booke.

These lines are of infinite vſe in many Geometricall Concluſions.

DEFIN. XXXIX.

A meane proportionall line is that, whoſe ſquare is equall to the right angled Parallelogram, or long Square, contained vnder his two extreames.

A Meane proportionall line is ſo tearmed, in reſpect of the relation it hath to two other lines, which are called his extreames; for of a meane without extreames, or extreams without a meane, there is no compariſon. As in this Diagram, the perpendicular A.C. of the right angled Triangle A.B.D. is a meane proportionall line betweene the two ſegments of the



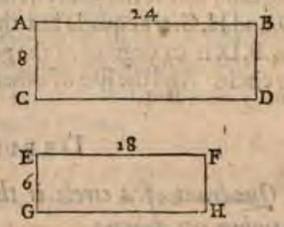
the Baſe B.C. and C.D. his extreames, becauſe the ſquare of the ſame line A.C. namely, A.E.F.C. is equall to the long ſquare, contained vnder the lines B.C. and C.D. (for the line C.G. is equall to the line B.C.) for as B.C. is to A.C. ſo is A.C. to C.D. Alſo the line A.B. is a meane proportionall betweene B.C. the ſegment of the Baſe lying next vnto it, and B.D. the whole Baſe; for as B.C. the leſſer ſegment of the Baſe, is to B.A. ſo is B.A. to B.D. the whole Baſe. And laſtly, the line A.D. is a meane proportionall, betweene C.D. the ſegment of the Baſe, lying next vnto it, and B.D. the whole Baſe; for as C.D. the greater ſegment of the Baſe, is to A.D. ſo is A.D. to B.D. the whole Baſe.

DEFIN. XL.

Like right lined figures are thoſe, which haue equall angles, and proportionall ſides about thoſe equall angles.

AS in theſe two right angled Parallelograms, the angle in the point A. of the greater, is equall to the angle E. of the leſſer; likewiſe the angle B. to the angle F. and C. to G. and D. to H. And moreouer, the ſide A.B. hath that proportion to the ſide A.C. as E.F. hath to E.G. and A.C. to C.D. as E.G. to G.H. and ſo of the reſt: Wherefore theſe two Parallelograms are called like right lined figures: and ſo of Triangles and all other figures, of what kind ſoeuer. PROB. 45.

Euc. 6. Def. 1.



DEFIN. XLI.

Reciprocall figures are ſuch, as haue the ſides of either to other mutually proportionall.

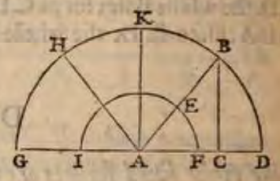
AS the Parallelograms A. and B. haue their ſides mutually proportionall; that is, as the ſide C.D. of A. is to the ſide G.H. of B. ſo is the ſide G.I. of B. to the ſide C.E. of A. and therefore are they called Reciprocalls: for as 20. is to 15. an antecedent of A. to a conſequent of B. ſo is 12. to 9. an antecedent of B. to a conſequent of A.

Euc. 6. Def. 2.

DEFIN. XLII.

The quantitie or meaſure of an angle, is the arch of a circle, deſcribed from the point of the ſame angle, and intercepted betweene the two ſides of that angle.

AS in the Triangle A. B. C. the meaſure or quantitie of the angle B. A. C. is the arch B. D. or E. F. for the circumference of euerie circle (whether greater, or leſſer) is diuided into 360 equall parts, which are called degrees, and euerie degree into 60 ſcruples or minutes, and euerie minute into ſo manie ſeconds, &c. Which parts or degrees are greater or leſſer, as the circles, whoſe parts they are, are greater or leſſer; and thoſe arches which containe the ſame number of parts or degrees in equall circles, are equall; and in vnequall circles, they are called like arches; as the arches B. D. and H. G. are equall; but the arches B. D. and E. F. are like arches: for as B. D. is 50 degrees in the greater circle, ſo is E. F. 50 degrees in the leſſer circle. And the like of others. PROB. 8.



DEFIN. XLIII.

The Quadrant of a circle is the fourth part thereof, or an arch containing 90 degrees.

AS the arch K. B. D. in the former Semicircle is a Quadrant of that whole circle, or a fourth part thereof, and containeth 90 degrees.

DEFIN. XLIIII.

The Complement of an arch, leſſe then a Quadrant, is ſo much as that arch wanteth of 90 degrees.

AS the Complement of the arch B. D. 50 degrees in the former Semicircle, is the arch K. B. 40 degrees.

DEFIN. XLV.

The Exceſſe of an arch, greater then a Quadrant, is ſo much as the ſaid arch is more then 90 degrees.

AS the Exceſſe of the arch H. K. B. D. 130 degrees, is the arch H. K. 40 degrees more then a Quadrant, that is more then K. D.

DEFIN.

DEFIN. XLVI.

The Complement of an arch, leſſe then a Semicircle, is ſo much as that arch wanteth of a Semicircle, or of 180 degrees.

AS the arch H. K. B. D. is an arch leſſe then a Semicircle, and containeth 130 degrees, and the Complement thereof to a Semicircle, is the arch H. G. 50 degrees, which is ſo much as the arch H. K. B. D. wanteth of a Semicircle, or of 180 degrees.

DEFIN. XLVII.

The Complements of Angles are as the Complements of Arches.

AS the arch K. B. is the complement of the arch B. D. to a Quadrant, and the arch B. D. of the arch K. B. So the angle K. A. B. 40 degrees is the complement to a right angle of the Angle B. A. D. 50 degrees; and likewiſe the ſame angle B. A. D. of the ſame angle K. A. B. And in this ſence is the third angle of any Triangle ſaid to be the complement of the other two, to two right angles, or a Semicircle: For the three angles of any Triangle are equall to two right angles; as is hereafter declared.

* * *

THE

The ſecond Part.

Inſtructions concerning this Part.

THIS ſecond Part conſiſteth of diuerſe Geometricall THEOREMES, or approued Truths; which are the Foundations, Grounds, and Reaſons, whereon the Practike part dependeth. For as in the generall courſe and tract of all deſignes, before the vndertaking or execution of whatſoeuer action, the fitteſt meanes for an orderly performance, is iudicially to conſider; firſt, the Propertie, Paſsion, Nature, and kind of the intended enterpriſe; then, the beſt and moſt immediate meanes how to effect the ſame, and the Cauſes, Grounds, and Reaſons, why, by thoſe meanes ſuch effects may be wrought; and afterwards, to put in execution: So before we enter into the Practike part, I will firſt here premiſe diuerſe THEOREMES concerning this ſubiect, whereby the ingenious practitioner may moſt euidently conceiue and vnderſtand the ground and reaſon of all the Rules and Problemes in the following Bookes contained. Wherein I vſe onely *Explication* and *Conſtruction*, omitting (for breuitie ſake, and auoiding confuſion to the Learner) their ſeuerall *Demonſtrations*; yet with ſuch ample notes of direction in the Margent, as the Reader may readily find in EVCLID, RAMVS, and other Authors, their Demonſtrations at large. And for their further eaſe and helpe, I haue at the end of euery *Conſtruction* inſerted the like notes of Reference from theſe THEOREMES to the following PROBLEMES, and the like from thoſe to theſe; that hauing here the reaſon or cauſe, hee ſhall there moſt readily find the effect; or ſeeing there the effect, hee may as ſpeedily vnderſtand the cauſe or reaſon thereof, *Scire enim, propriè eſt, rem per cauſam cognoſcere.*

THEO-

THEOREME I.

If any two right lines cut the one the other, the oppoſite or verticall angles are euer equall; and both the angles, on one and the ſame ſide of either line, are either of them right angles, or (being both taken together) are equall to two right angles.

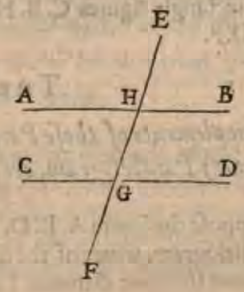
Euc. l.1. p.13.15. Ram.5.8. Con. 2. Ceul.2.9.

Si quotcunque rectæ in eodem puncto mutuo ſeſe interſecent omnes in communi ſectione quatuor rectis æquabuntur.

SVppoſe that B. E. and C. F. are two right lines, which cut the one the other in the point A. Then I ſay, firſt, that the oppoſite or verticall angles are equall, namely, the angle B. A. C. to the angle F. A. E. and the angle B. A. F. to the angle C. A. E. for they are euerie of them right angles: and let the right line D. G. be likewiſe drawne, cutting the line B. E. in A. Then I further ſay, that both the angles, taken together on one and the ſame ſide of either line, is equall to two right angles, as the angles B. A. D. and D. A. E. on the vpper ſide of the line B. E. and alſo the angles B. A. G. and G. A. E. on the nether ſide of the ſame line, are reſpectiuely equall to two right angles; for they conſiſt of the right angles formerly mentioned. And the like of the angles on either ſide of the line D. G. PROB. 114, 117, 118.

THEOREME II.

A right line, falling on two parallell right lines, maketh the outward angles on contrarie ſides of the falling line equall; and likewiſe the inward and oppoſite angles on the contrarie ſides of the ſame line; and alſo the outward angle, equall to the inward and oppoſite angle on one and the ſame ſide of the falling line; and the inward angles on one and the ſame ſide equall to two right angles.



Euc. 1.p.29. Ram.7.9. Pit.1.38.

Lineæ eidem parallelæ inter ſe ſunt parallelæ.

LEt the right line E. F. fall on the two parallell right lines A. B. and C. D. Then ſayth this THEOREME, firſt, that it maketh the outward angles on contrarie ſides of the falling line, namely, the angles A. H. E. and F. G. D. to be equall; and likewiſe the inward and oppoſite angles on the contrarie ſides of the ſame line, as the angles A. H. F. and E. G. D. And alſo, that the outward angle, as A. H. E. is equall to the inward and oppoſite angle, on

on one and the same side of the falling line, namely, to E. G. C. And lastly, that the inward angles on one and the same side, as the angles E. G. C. and A.H.F. are equall to two right angles. PROB. 50.

THEOREME III.

If a right line be diuided into two equall parts, halfe the square of that whole line is double to the whole square of halfe the same line.

SVppose A.B. to be a right line, and let the same be diuided into two equall parts in the point C. Then I say, that halfe the square of that whole line, namely, the Parallelogram A.B. D. E. (for the whole square is A. B. F. G.) is double to the whole square of halfe the same line, namely, to the square A. C. D. H. as is manifest by the Diagram.

THEOREME IIII.

A right line being diuided by chance, the square of the whole line is equall to both the squares made of the parts, and also to two rectangle figures, comprehended vnder the same parts.

Euc.2.4.

LEt the right line A. B. be diuided by chance in the point C. Then I say, that the square of the whole line, namely, A.B.D.E. is equall to both the squares made of the parts, namely, to the squares A.C.G.H. and H.K.F.E. (for H. K. is equall to C. B.) and also to the two rectangle figures, comprehended vnder the same parts, namely, to the rectangle figures C. B. H.K. and G. H. D.F.

THEOREME V.

The Supplements of those Parallelograms which are about the diameter in euery Parallelogram, are alwaies equall the one to the other.

Complementa sunt aqualia. Euc. 1. 43. Ceul. 2. 81.

SVppose the figure A. B. D. E. in the former THEOREME, be a Parallelogram, whereof the diameter is A.E. and let the Parallelograms about the same diameter (according to the declaration of the 30. DEFINITION) be A. C. G. H. and H.K.F.E. Then I say, that the supplements of those Parallelograms, namely, the supplements C. B. H.K. and G.H.D. F. are equall the one to the other. PROB. 18. 87. 88. 105.

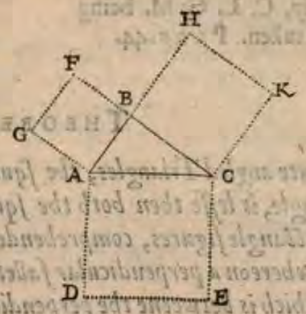
THEOREME VI.

In right angled Triangles, the square of the side subtending the right angle, is equall to both the squares of his containing sides.

LEt the Triangle A. B. C. be a right angled Triangle, whose angle, at the point B. is a right angle; and let the line A. C. be the side subtending the same right angle, and B. A. and B. C. his containing sides. Then I say, that the square of the side subtending the right angle, which is the square A. C. D. E. is equall to both the squares of his containing sides, namely, to the squares A.G. F.B. and B. H. K. C. PROB. 23. 24. 25. 30. 36. 38. 52. 65. 99. 100. 101. 102. 104. 106.

In triangulo rectangulo figura ad basin descripta aquatur figuris ad crura similibus similiterque sitis.

Euc. 1. 47. Pit. 1. 50.



This former THEOREME, *and the two next following, are of infinite and wonderfull vse in most Geometricall Conclusions; especially in* TRIGONOMETRIE, *or the supputation of Triangles, by the Canons thereof; as those excellent Tables of Logarithmes, or those of Synes, Tangents, and Secants, in that behalfe calculated; and therefore especially to be regarded; and the most excellent properties and passions thereof to be well vnderstood and practised.*

Nota.

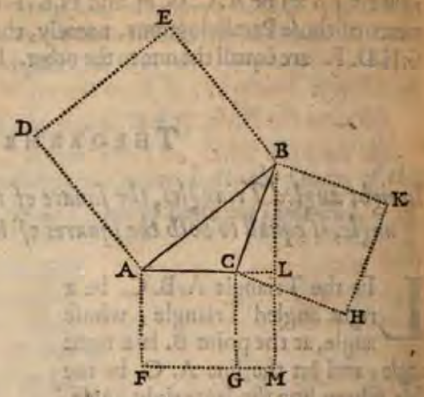
THEOREME VII.

In obtuse angled Triangles, the square of the side subtending the obtuse angle, is greater then both the squares of the containing sides, by two rectangled figures, comprehended vnder one of the containing sides (being continued) and the line of continuation, from the obtuse angle to a perpendicular let fall thereon.

LEt the Triangle A. B. C. be an obtuse angled Triangle, whose angle at the point C. is obtuse; and let the line A.B. be the side subtending the same obtuse angle, and A. C. and C. B. his containing sides; whereof, let A.C. be the side continued, and C. L. the line of continuation from the obtuse angle at the point C. to the perpendicular let fall thereon B.L. Now I say,

In triangulis obtusangulis basis plus potest cruribus duplici rectangulo ex altero crure & eius continuatione ad verticis perpendicularem. E. 2. p. 12.

I ſay, that the ſquare of the ſide, ſubtending the obtuſe angle, namely, A.D.E.B. is greater then both the ſquares of the containing ſides, namely, B.K.C.H. and A.C.F.G. by two rectangle figures, (which is all one, with one twice taken) comprehended vnder one of the containing ſides (being continued) and the line of Continuation, namely, C. L. G. M. being twice taken. PROB.44.



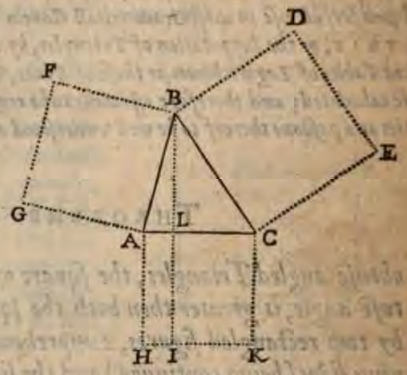
THEOREME VIII.

In acute angled Triangles, the ſquare of the ſide ſubtending the acute angle, is leſſe then both the ſquares of the containing ſides by two rectangle figures, comprehended vnder one of the containing ſides (whereon a perpendicular falleth) and that ſegment of the ſame ſide which is betweene the perpendicular and the acute angle.

Theorema generale eſt ad inueſtigationem perpendicularis intra triangulum cadentis data trium laterum quantitate.

Euc. 2.15. *Ceul.*2.84.

LEt A.B.C. be an acute angled Triangle, hauing the angle at the point A. acute; let B. C. be the ſide ſubtending the ſame angle, and A.B. and A.C. the containing ſides: alſo let B.L. be the perpendicular, A.C. the ſide whereon it falleth, and A. L. the ſegment thereof betweene the perpendicular and the acute angle A. Now I ſay, that the ſquare of the ſide ſubtending the acute angle, namely, B. D. C. E. is leſſe then both the ſquares of the containing ſides, which are F.B.G.A. and A.C.H.K. by two rectangle figures (being all one, with one twice taken) comprehended vnder one of the containing ſides A.C. (whereunto A. H. is equall) and the ſegment A. L. namely, A.L. H.I. twice taken. PROB. 41.



THEO-

THEOREME IX.

In rectangle Triangles, if from the right angle a perpendicular be let fall vnto the Baſe, it ſhall diuide the Triangle into two Triangles, like vnto the whole, and alſo the one like vnto the other.

Euc.6.8. Ram.5.12. 13.

LEt A. B. C. be a recte angle Triangle, whoſe angle at the point B. is a right angle; from whence, let the perpendicular B. D. be let fall to the Baſe A. C. Then I ſay, the perpendicular ſo falling, ſhall diuide the Triangle into two Triangles, that is, A.B.D. and B. C. D. like vnto the whole Triangle A. B. C. and alſo the one Triangle like vnto the other; which is (according to the 40. DEFINITION) with equall angles, and proportionall ſides about thoſe equall angles. PROB. 19. 23. 24. 25. 30. 38.

THEOREME X.

An Iſoſceles, or a Triangle of two equall ſides, hath his angles at the Baſe equall; and the equall ſides being produced, the angles vnder the Baſe are alſo equall.

Euc. 1.5. *Ceul.*2.3.4.

LEt A. B. C. be an Iſoſceles, or a Triangle, whoſe two ſides A. C. and A. B. are equall, and let A. C. be produced to D. and A. B. to E. I ſay then, that his angles at the Baſe, namely, A. B. C. and A. C. B. are equall; and that the angles vnder the Baſe, as E. B. C. and D. C. B. are alſo equall, the one vnto the other. PROB. 40.

THEOREME XI.

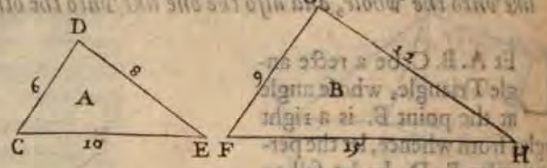
All equiangle Triangles haue their ſides, containing equall angles proportionall,

portionall, and their sides subtending equall angles, are of like proportion.

Hoc Theorema præcipuum est totius Trigonometriæ fundamentum.

Euc.6.4. Ram.5.12. 7,9. Pit.1.46. Ceul.2.62.

SVppose A. and B. to be two equiangle triangles, that is, hauing the angle D. equal to the angle G. and C. to F. and E. to H.



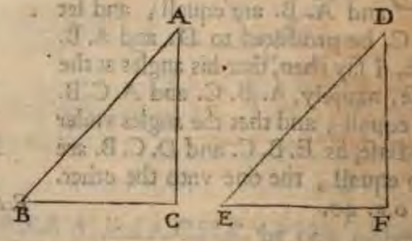
Then I say, they haue their sides, which containe those equall angles proportionall; as D. C. and D. E. in the Triangle A. are proportionall to G.F. and G.H. in the Triangle B. because they containe equall angles, namely, D. and G. for as D.C. is to D.E. so is G.F. to G.H. and the like of the rest: also their sides subtending equall angles, are of like proportion, as D.C. and G.F. subtending equall angles E. and H. and C.E. and F.H. subtending equall angles D. and G. are of like proportion: for as D. C. is to C.E. so is G.F. to F.H. And the like of the other sides and angles. PROB. 30. 38. 45. 65.

THEOREME XII.

In any two Triangles compared, if two sides of the one be equall to two sides of the other, and the Base of the one to the Base of the other; they shall also haue the angles contained vnder their answerable equall sides, the one equall to the other in either Triangle.

Euc.1.8.

LEt A.B.C. and D.E.F. be two Triangles compared, hauing two sides of the one equall to two sides of the other, as A.B. and A.C. of the one, equall to D.E. and D.F. of the other, and also the Base B.C. of the one, equall to the Base E.F. of the other. Now I say, they shall haue their angles contained vnder answerable equall sides (as the angle A. contained vnder A.B. and A.C. equall to the angle D. contained vnder the answerable equall sides D.E. and D.F.) to be equall the one to the other. And the like of the rest.



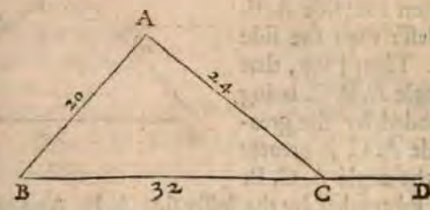
THEO-

THEOREME XIII.

If any side of a Triangle be continued, the outward angle made by that continuation, is equall to the two inward and opposite angles: And the three inward angles of any Triangle are equall to two right angles.

Euc.1.32. Ram.6.9. Pit.1.48.49. Ceul.2.20.

LEt A.B.C. be a Triangle, whereof let any of the sides be produced, as B.C. to D. Then I say, that the outward angle, made by that production or continuation, as the angle A.C.D. is equall to the two inward and opposite angles, namely, the angles C.A.B. and C.B.A. And also, that the three inward angles of any Triangle, as C.B.A. B.A.C. and A.C.B. are equall to two right angles. PROB. 111. 114. 117. 118.



THEOREME XIIII.

In euerie Triangle, two of his angles, which two soeuer be taken, are lesse then two right angles.

AS in the Diagram of the former THEOREME, take any two angles, as those at the points A. and C. or C. and B. or B. and A. and they are lesse then two right angles; for by the same former THEOREME all three of them are equall to two right angles. *Euc.1.17.*

THEOREME XV.

In euerie Triangle, two sides thereof (which two soeuer be taken) are greater (being ioyned together as one line) then the third side remaining.

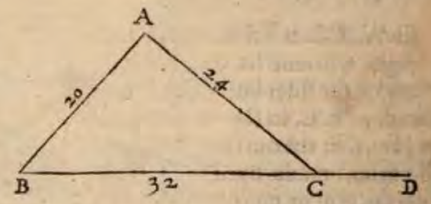
LEt A.B.C. (the Diagram of the 13. THEOREME) be a Triangle, whereof take any two of the sides, as A.B. and A.C. I say, those two sides being taken and ioyned together as one line, are greater then the third side remaining, namely, B.C. And the like of any other two, taken together. Whereby it is manifest, that vnder all three lines (without respect of quantitie) a Triangle cannot be contained. PROB. 42. *Euc.1.20.*

THEOREME XVI.

In all Triangles, the greater side subtendeth the greater angle, and the lesser side subtendeth the lesser angle.

Triangulũ maius latus subtendit maiorem angulum.
Euc. 1.18. 19.
Ram. 6.11.
Euc. 1.47. 48.
Pit. 1.5.
Cenl. 2.19.

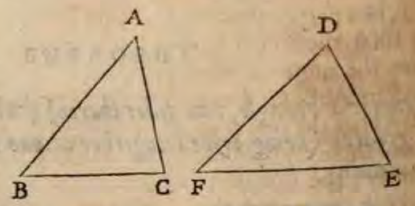
LEt A. B. C. be a Triangle, hauing the side A.C. greater then the side A. B. and lesse then the side B. C. Then I say, that the angle A. B. C. being subtended by the greater side A. C. is greater then the angle A. C. B. being subtended by the lesser side A. B. And also, that the angle A. B. C. being subtended by the lesser side A. C. is lesser then the angle B. A. C. subtended by the greater side B. C.



THEOREME XVII.

If two sides of one Triangle be equall to two sides of another Triangle, and the angle contained vnder the equall sides of the one, be greater then the angle contained vnder the equall sides of the other; then the Base also of the one (namely, of that which hath the greater angle) shall be greater then the Base of the other.

LEt there be two Triangles, A. B. C. and D. E. F. which haue two sides of the one Triangle, as A. B. and A. C. equall to two sides of the other Triangle D. F. and D. E. and let the angle F. D. E. contained vnder the equall sides of the one be greater then the angle B. A. C. contained vnder the equall sides of the other. Then I say, that the Base F. E. of the one (namely, of that which hath the greater angle) is greater then B. C. the Base of the other.



Euc. 1. 24.

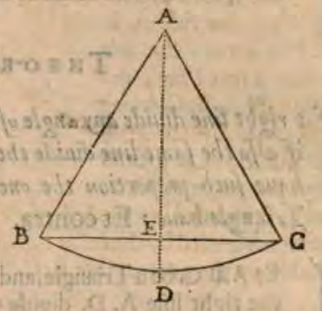
THEO-

THEOREME XVIII.

If a Triangle be equicrurall, or hauing two equall sides; a perpendicular let fall from the angle contained vnder those equall sides to the Base, and continued, shall diuide as well the same Base and angle, as also the measure of that angle, into two equall parts: Et contra.

Pit. 1.23.

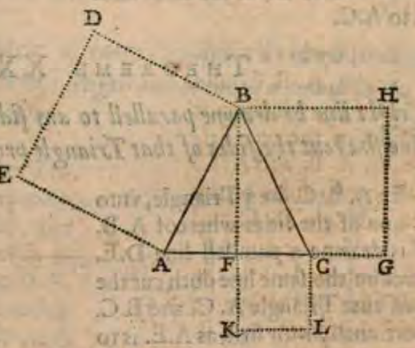
LEt A. B. C. be a Triangle, whose sides A. B. and A. C. are equall, and let fall a perpendicular from the angle, included by those equall sides, as A. E. to the Base B. C. and let the same be continued to D. Now I say, that a perpendicular so let fall, shall diuide as well the same Base B. C. and angle B. A. C. as also the measure thereof, namely, the arch line B. D. C. into two equall parts. PROB. 10.11.40.



THEOREME XIX.

If a Triangle hath two equall sides, the power of one of those equall sides exceedeth the power of the perpendicular let fall on the Base from the angle it subtendeth, by the power of halfe the Base.

LEt A. B. C. be a Triangle, hauing two equall sides, B. A. and B. C. and let B. F. be a perpendicular let fall to the Base A. C. from the angle it subtendeth A. B. C. Then I say, that the power of one of those equal sides, namely, the square A. B. D. E. exceedeth the power of the perpendicular, namely the square B. H. F. G. by the power of halfe the Base, namely, the square F. C. K. L. PROB. 36. 40. 41. 64.



THEOREME XX.

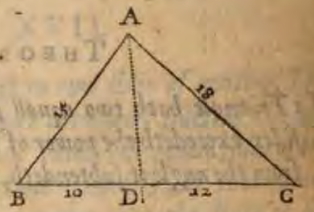
If the power of one side of any Triangle be equall to both the powers of the other two sides, the angle contained vnder those two other sides, is a right angle.

Euc. 1.48. THIS THEOREME is the conuerse of the 6. THEOREME, and therefore the explication and construction thereof serueth here.

THEOREME XXI.

If a right line diuide any angle of a Triangle into two equall parts, and if also the same line diuide the Base, the segments of the Base shall haue such proportion the one to the other, as the other sides of the Triangle haue: Et contra.

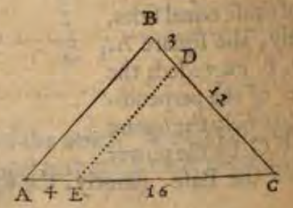
Euc.6.3. Ceul.2.61. LET A.B.C. be a Triangle, and let the right line A. D. diuide the angle B. A. C. of the same Triangle into two equall parts; and also let the same line diuide the Base B. C. Then I say, the segments of the Base, namely, B.D. and D.C. shall haue such proportion the one to the other, as the other sides of the Triangle haue, namely, A.B. and A.C. for such proportion as B. D. hath to D. C. the same hath A.B. to A.C.



THEOREME XXII.

If a right line be drawne parallell to any side of a Triangle, the same line shall cut the sides of that Triangle proportionally.

Euc.6.2. Ram.l.6. p.9.5.p.13. Con.1.2.& 3. Pit.1.47.45. Ceul.2.27. LET A. B. C. be a Triangle, vnto one of the sides whereof A. B. is drawne a parallell line D.E. Wherefore the same line doth cut the sides of that Triangle A. C. and B.C. proportionally: for first, as A.E. is to E.C. so is B.D. to D. C. also, as A.E. is to B.D. so is E.C. to D.C. and as A. C. is to A.E. so is B.C. to B.D. PROB. 12. 13. 14. 15. 16. 22. 98.



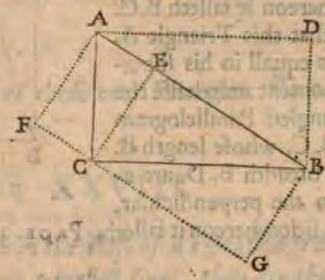
THEO-

THEOREME XXIII.

The superficiall content of euery right angled Triangle, is equall to halfe that right angled Parallelogram, which hath his length and breadth equall to the containing sides of the right angle; or whose length is equall to the subtending side, and breadth to the perpendicular, drawne from the right angle to the same side.

LET A.B.C. be a rectangle Triangle, whose angle at the point C. is a right angle, whereof the containing sides are A. C. and C. B. the subtending side A. B. and the perpendicular drawne from the right angle to the same side, is C.E. Now I say, the superficiall content or *Area* of this right angled Triangle is equall vnto halfe that right angled Parallelogram (namely, A.D.C.B.) which hath his length C. B. and breadth A. C. equall to the containing sides of the right angle; or whose length A.B. is equall to the subtending side, & breadth A.F. to the perpendicular line, drawne from the right angle to the same side, as the Parallelogram A.B. F.G. PROB. 39. 52. 92. 102. 106.

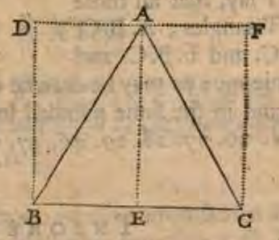
Euc. 1. *Def.*27. *Ram.*8. 2.



THEOREME XXIIII.

The Area or superficiall content of euery Equilater Triangle, is equall to halfe that long square, whose length and breadth is equall to one of the sides and the perpendicular.

LET A.B.C. be an Equilater Triangle, and A. E. the perpendicular thereof. Now I say, that the superficiall content thereof is equall to halfe that long square D. F. B.C. whose length B.C. and breadth B.D. is equall to one of the sides, and the perpendicular. PROB. 37.



THEO-

THEOREME XXV.

All Triangles, of what kind soeuer, are equall in their superficiall content vnto halfe that right angled Parallelogram, whose length and breadth is equall to the perpendicular, and the side whereon it falleth.

LEt A.B.C. be a Triangle, whose perpendicular is A. F. and the side whereon it falleth B.C. I say, that this Triangle A. B. C. is equall in his superficiall content vnto halfe the right angled Parallelogram D. E. B. C. whose length B. C. and breadth B. D. are equall to the perpendicular, and the side whereon it falleth. PROB. 39.41.44.72.76.77.99.

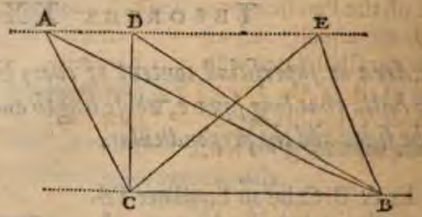
THEOREME XXVI.

Triangles which consist on one and the same Base, or on equall Bases, and in the same parallell lines are equall the one to the other.

Triangula in æquali basi & intra eadem parallelas sunt æqualia.

Euc. 1. 38.

LEt A.B.C. D.B.C. and E.B.C. be three Triangles, consisting on one and the selfe-same Base B. C. (or on equall Bases, which is all one thing) and in the same parallell lines A. E. and C.B. Now I say, that all those three Triangles, A.B.C. D. B. C. and E.B.C. and as manie moe as may be drawne on the same Base, or a Base equall thereunto, and in the same parallell lines, are all equall the one to the other. PROB. 26. 27. 28. 29. 46. 47. 73. 74. 75. 79. 80. 81. 93. 103. 107. 110.

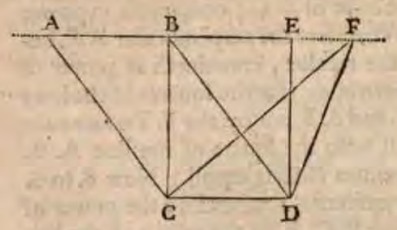


THEOREME XXVII.

If Triangles and Parallelograms haue one and the same Base, or equall

equall Bases, and be in the same parallell lines, the Parallelograms shall be double to the Triangles.

LEt B.C.D. and F.C. D. be two Triangles, and let A.B.D.C. and B. E. D. C. in this same Diagram be two Parallelograms, which Triangles and Parallelograms haue one and the same Base C. D. and are in the same parallell lines A. F. and C. D. Now I say, that either of those two Parallelograms are double to either of those two Triangles. PROB. 76. 77.92.110.

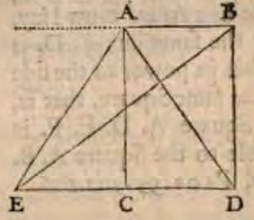


Euc. 1. 41. *Coul.* 2. 25.

THEOREME XXVIII.

If a Triangle hath his Base double to the Base of a Parallelogram, and that they are both in the same parallell lines, then are they both equall the one to the other.

LEt A. B. C. D. be a Parallelogram, whose Base is C.D. and let A. E. D. and B. E. D. be two seuerall Triangles, whose Bases E. D. are double to the Base of the Parallelogram (for E. C. and C. D. are equall) and who are within the same parallell lines with the Parallelogram A. B. C. D. Then I say, that either of those Triangles are equall to the same Parallelogram. PROB. 29. 78. 91. 110.



THEOREME XXIX.

The power of the side of an Equilater Triangle, is to the power of the perpendicular thereof let fall from any angle to the subtendent side, in proportion Sesquitertia, or as 4. to 3.

LEt A.B.C. be an Equilater Triangle, whose perpendicular is A. E. let fall from the angle B. A. C. to the subtendent side B. C. Now I say, that the power of the side of the same Triangle, namely, B. C. G. H. which is the power or square of the side B. C. is to the power of the perpendicular thereof, namely, A. D. E. F. (which is the power or square

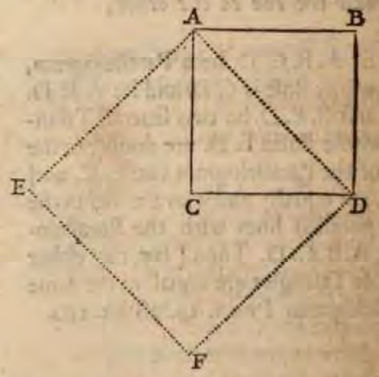
Euc. 13.12.

ſquare of the perpendicular A. E.) in proportion Seſquitertia, or as 4. to 3. For of what parts the line B. C. or B. A. containeth in power 8. of ſuch parts B.E. (which is the halfe of B. C.) containeth in power 2. Wherefore the perpendicular A.E. being the reſidue, containeth in power of ſuch parts 6. (for the ſquares of the lines A. E. and B. E are by the 6. THEOREME equall vnto the ſquare of the line A. B. whereunto B. C. is equall.) Now 8. to 6. is Seſquitertia : wherefore the power of the line B. C. is to the power of the line A. E. in Seſquitertia proportion. So is the ſquare A. D. E. F. $\frac{1}{4}$. of the ſquare B. C. G. H. PROB. 36.

THEOREME XXX.

The Diagonall line, or Diameter of any Square, is double in power to the ſide of the ſame Square.

LEt A. B. C. D. be a Square, whoſe Diagonall line, or Diameter, is the line A. D. Now I ſay, that the ſame line A. D. is double in power to the ſide of the ſame Square, that is, the Square A. D. E. F. is double to the Square A. B. C. D. PROB. 99. 102. 106.



THEOREME XXXI.

A Square, whoſe ſide is equall to the Diameter of any other Square, is double in content or ſuperficiall quantitie to that other Square.

THe explication hereof, is manifeſt by that of the laſt: For let A. D. E. F. in the laſt Diagram be a Square, whoſe ſide A. D. is equall to the Diameter of another Square, as the ſame line A. D. is the Diameter of another Square, namely, A. B. C. D. Wherefore I ſay, that the Square A. D. E. F. is double in content, or ſuperficiall quantitie, to that other Square. PROB. 102. 106.

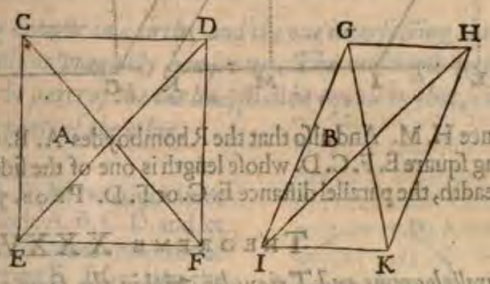
THEO-

THEOREME XXXII.

All parallelograms haue their oppoſite ſides, and angles equall one to another; and their Diameters diuide them into equall parts.

Eu.1.34. Ram.10.6. Cenl.2.25.

AS theſe two parallelograms A. and B. haue their oppoſite ſides and angles, equall one to another, as in the figure A. the ſides C. D. and E. F. are oppoſite & equall, and likewiſe D. F. and C. E. Alſo the angles thereof at the points C. and F. are oppoſite and equall, and likewiſe thoſe at D. and E. And moreouer, their diameters diuide them into equall parts, as the diameters C. F. and D. E. doe either of them diuide the parallelogram A. into two equall parts: And the like explication and conſtruction is to be made of the figure B. PROB. 115. 116.

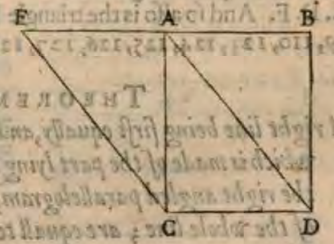


THEOREME XXXIII.

Parallelograms which conſiſt on one and the ſame baſe, or on equall baſes, and in the ſame parallel lines are equall the one to the other.

Eu.1.35,36.

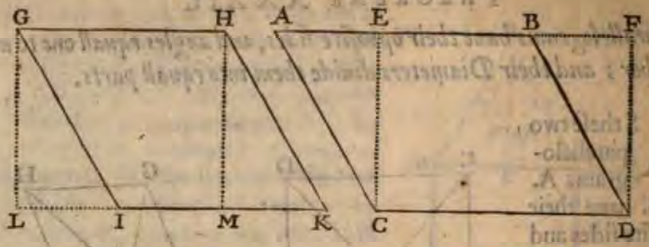
LEt A. B. C. D. and E. A. C. D. bee two parallelograms, which conſiſt on one & the ſame baſe, namely C. D. (or on equal baſes which is one and the ſame thing) and in the ſame parallel lines, namely E. B. and C. B. Now, I ſay, that thoſe two parallelograms are both equall the one to the other. PROB. 89. 90.



THEOREME XXXIIII.

Euery Rhombus and Rhomboydes is equall to the long ſquare, whoſe length is one of the ſides, and breadth equall to the parallel diſtance.

LEt G. H. I. K. be a Rhombus, and A. B. C. D. a Rhomboydes. I ſay, the Rhombus G. H. I. K. is equall to the long ſquare G. H. L. M. whoſe length is one of the ſides G. H. and breadth the parallel diſtance



ſtance H. M. And alſo that the Rhomboydes A. B. C. D. is equall to the long ſquare E. F. C. D. whoſe length is one of the ſides C. D. or A. B. and breadth, the parallel diſtance E. C. or F. D. PROB. 58, 59, 60, 61, 89, 90.

THEOREME XXXV.

Parallelograms and Triangles, within the ſame parallels, are in ſuch proportion the one to the other as their baſes are.

Triangula vel parallelogramma æquealta ſunt vt baſes. Eu.6.1. Ram.10.13. Ceul.2.26.

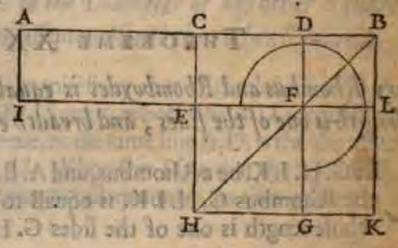
LEt A. B. C. D. and B. E. D. F. be two parallelograms, within the ſame parallel lines A. E. and C. F. and let alſo B. C. D. and B. D. F. bee two triangles within the ſame parallel lines. Then, I ſay, as the baſe C. D. is to the baſe D. F. ſo is the parallelogram A. B. C. D. to the parallelogram B. E. D. F. And ſo alſo is the triangle B. C. D. to the triangle B. D. F. PROB. 29, 110, 123, 124, 125, 126, 127, 128, 129.

THEOREME XXXVI.

A right line being firſt equally, and then vn-equally diuided; The ſquare which is made of the part lying betweene thoſe ſections, together with the right angled parallelogram, contayned vnder the vn-equall parts of the whole line; are equall to the ſquare of halfe the whole line.

Hereby is demonſtrated that equation, of the greateſt and leaſt karectes or numbers, and their equalitie to the middle. Of great vſe is this Prop. in the rules of Algebar. *Eu. 2. 5.*

LEt A. B. bee a right line diuided, firſt equally in the point C and then vn-equally as in the point D. The ſquare, I ſay, which is made of the part lying betweene thoſe ſections C. and D. namely the ſquare E. F. G. H. together



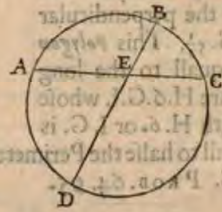
ther with the right angled parallelogram A. D. F. I. contayned vnder the vnequall parts of the whole line as A. D. and D. B. are equall to the ſquare C. B. K. H. being the ſquare of halfe the whole line, as of A. C. or C. B.

THEOREME XXXVII.

Two right lines being drawne in a circle, and the one interſecting the other, either equally or vnequally howſoeuer; The rectangle figure contayned vnder the parts of the one line, ſhall be equall to that, contayned vnder the parts of the other.

The wonderfull properties of a circle here by appeareth. And many ſtrange concluſions Geometricall from hence may be gathered. *Eu.3.35. Ceul.2.50.*

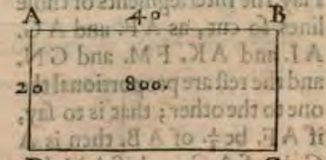
LEt A. C. and B. D. be two right lines drawne in the circle A. B. C. D. and let the one interſect the other vnequally at all aduentures in the point E. I ſay, that the rectangle figure contayned vnder the parts of the one line, namely vnder A. E. and E. C. being the parts of the line A. C. ſhall bee equall to that contained vnder the parts of the other line, namely vnder the parts B. E. and E. D. of the line B. D. And the like if thoſe lines had interſected the one the other equally.



THEOREME XXXVIII.

In all right angled parallelograms, the length thereof being infolded in the breadth, produceth the Area *or ſuperficiall content of the ſame.*

LEt A. B. C. D be a parallelogram right angled, I ſay, the length there of A. B. 40. being infolded in the breadth A. D. 20. produceth the Area or ſuperficiall content of the ſame 800. PROB. 51. 55.



THEOREME XXXIX.

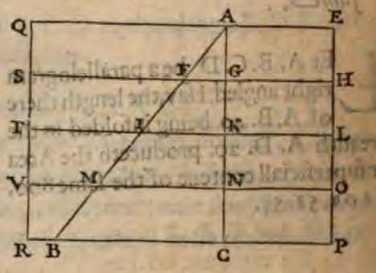
Euery regular Poligon *is equall to the long ſquare, whoſe length and breadth is equall to halfe the perimeter, and a perpendicular drawne from the center to the middle of any ſide of the ſame.*

LEt the Sexagon A.B.C.D.E.F. be a regular *Polygon*, whoſe three ſides (being halfe the Perimeter) contayne 18. and the perpendicular 6. G. $5\frac{1}{7}$. This *Polygon* is equall to the long ſquare H.6.G.I. whoſe length H. 6. or I. G. is equall to halfe the Perimeter, and breadth H. I. or 6. G. to the perpendicular 6. G. PROB. 64. 95.

THEOREME XXXX.

If two or more right lines, are cut by diuers parallel right lines; the interſegments of thoſe lines ſo cut ſhall bee proportionall the one to the other.

*Pit.*1.39.



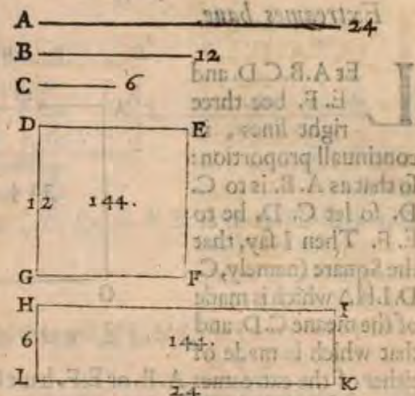
LEt A B. and A C. be two right lines, being cut by diuers parallel right lines as Q E. S H. T L. and the reſt; I ſay, the Interſegments of thoſe lines ſo cut, as A F. and A G. A I. and A K. F M. and G N. and the reſt are proportional the one to the other; that is to ſay, if A F. be $\frac{1}{4}$. of A B. then is A G. $\frac{1}{4}$. of A C. and if A M. bee $\frac{1}{4}$. of A B. then ſhall A N. bee $\frac{1}{4}$. of A C. The reaſon is, becauſe the right line S H. cutteth off $\frac{1}{4}$. of the whole parallelogram Q E P R and the right line V O. $\frac{1}{4}$. thereof; and conſequently the like parts, from all lines drawne ouer-thwart thoſe parallels. And the like conſideration is to bee had of all the other interſegments ſo by thoſe lines cut out.

THEO-

THEOREME XLI.

Three right Lines being proportionall, a Square made of the Meane, is equall to the right angled figure, contained vnder the Extreames.

Euc. 6. 17. & l. 7. 20. *Ram.* 12. 4. *Pit.* 1. 43.



LEt A.B.and C. be three right lines proportionall in continuall proportion, ſo that as A. is to B. ſo let B. be to C. Then I ſay, that the Square, namely, D. E. F. G. made of the Meane B. ſhall be equall to the right angled figure, namely, H. I. K. L. contained vnder the two Extreames A. and C. as appeareth by the Diagram. PROB. 79. 83. 84. 85. 86. 88. 95. 99. 109. 129. 130. 131.

THEOREME XLII.

Foure right lines being proportionall, the right angled Parallelogram, contained vnder the two Meanes, is equall to the right angled Parallelogram, contained vnder the two Extreames.

Euc. 6. 16. *Pit.* 1. 42.

LEt A. B. C. and D. be foure right lines proportionall, ſo that as A. is to B. ſo let C. be to D. Then I ſay, that the right angled Parallelogram, namely, E. F. G. H. contained vnder the two Meanes B. and C. ſhall be equall to the right angled Parallelogram, namely, I. K. L. M. contained vnder the two Extreames A. and D. as appeareth by the Diagram. PROB. 49. 56. 87. 88. 93.

THEOREME XXXIX.

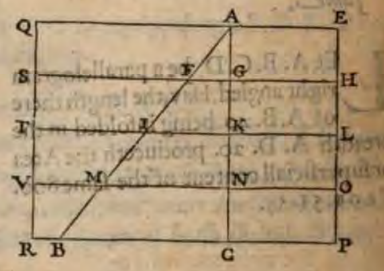
Euery regular Poligon *is equall to the long ſquare, whoſe length and breadth is equall to halfe the perimeter, and a perpendicular drawne from the center to the middle of any ſide of the ſame.*

LEt the Sexagon A.B.C.D.E.F. be a regular *Polygon*, whoſe three ſides (being halfe the Perimeter) containe 18. and the perpendicular 6. G. 5 1/7. This *Polygon* is equall to the long ſquare H.6.G.I. whoſe length H. 6. or I. G. is equall to halfe the Perimeter, and breadth H. I. or 6. G. to the perpendicular 6. G. PROB. 64. 95.

THEOREME XXXX.

If two or more right lines, are cut by diuers parallel right lines; the interſegments of thoſe lines ſo cut ſhall bee proportionall the one to the other.

*Pit.*1.39. LEt A B. and A C. be two right lines, being cut by diuers parallel right lines as QE. SH. TL. and the reſt; I ſay, the Interſegments of thoſe lines ſo cut, as A F. and A G. A I. and A K. F M. and G N. and the reſt are proportional the one to the other; that is to ſay, if A F. be 1/3. of A B. then is A G. 1/3. of A C. and if A M. bee 1/3. of A B. then ſhall A N. bee 1/3. of A C. The reaſon is, becauſe the right line S H. cutteth off 1/3. of the whole parallelogram QEPR and the right line V O. 1/3. thereof; and conſequently the like parts, from all lines drawne ouer-thwart thoſe parallels. And the like conſideration is to bee had of all the other interſegments ſo by thoſe lines cut out.



THEO-

THEOREME XLI.

Three right Lines being proportionall, a Square made of the Meane, is equall to the right angled figure, contained vnder the Extreames.

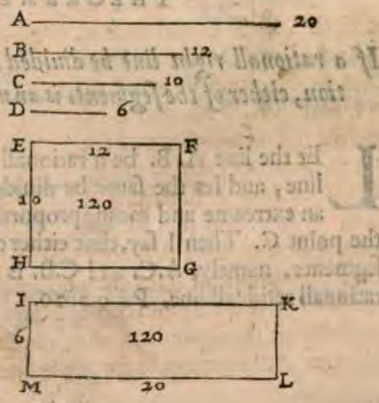
LEt A.B. and C. be three right lines proportionall in continuall proportion, ſo that as A. is to B. ſo let B. be to C. Then I ſay, that the Square, namely, D. E. F. G. made of the Meane B. ſhall be equall to the right angled figure, namely, H. I. K. L. contained vnder the two Extreames A. and C. as appeareth by the Diagram. PROB. 79. 83. 84. 85. 86. 88. 95. 99. 109. 129. 130. 131.

Euc. 6. 17. & l. 7. 20. *Ram.* 12. 4. *Pit.* 1. 43.

THEOREME XLII.

Foure right lines being proportionall, the right angled Parallelogram, contained vnder the two Meanes, is equall to the right angled Parallelogram, contained vnder the two Extreames.

LEt A. B. C. and D. be foure right lines proportionall, ſo that as A. is to B. ſo let C. be to D. Then I ſay, that the right angled Parallelogram, namely, E. F. G. H. contained vnder the two Meanes B. and C. ſhall be equall to the right angled Parallelogram, namely, I. K. L. M. contained vnder the two Extreames A. and D. as appeareth by the Diagram. PROB. 49. 56. 87. 88. 93.



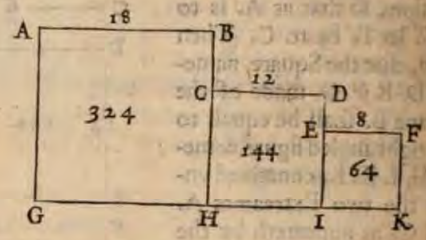
Euc. 6. 16. *Pit.* 1. 42.

THEOREME XLIII.

Of any three proportionall right Lines, the Square which is made of the Meane, and that which is made of either of the Extreames, haue such proportion the one to the other, as the two Extreames haue.

Eu.12.2. D.P.1. Cam.2.75.

LEt A.B.C.D. and E.F. bee three right lines, in continuall proportion: so that as A.B. is to C.D. so let C.D. be to E.F. Then I say, that the Square (namely, C.D.I.H.) which is made of the meane C.D. and that which is made of either of the extreames A.B. or E.F. haue such proportion the one to the other (respectiuely) as those extreames haue: For the same proportion as the greater extreame A.B. hath to the lesser extreame E.F. the same hath the square A.B.G.H. to the square C.D.H.I. and that, to the square E.F.I.K. which in this Diagram is *Dupla sesquiquarta*, as thereby appeareth. And the like consideration is to be had of the proportion of Circles, whose Diameters are so proportionable. PROB. 79. 81. 82. 94. 129. 130. 131.

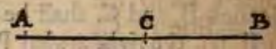


THEOREME XLIIII.

If a rationall right line be diuided by an extreame and meane proportion, either of the segments is an irrationall residuall line.

Eu.13.6.

LEt the line A.B. be a rationall right line, and let the same be diuided by an extreame and meane proportion in the point C. Then I say, that either of the segments, namely, A.C. and C.B. is an irrationall residuall line. PROB. 20.

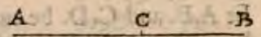


THEO-

THEOREME XLV.

If a right line be diuided by extreame and meane proportion, the whole line hath the same proportion to the greater segment, as the same greater segment hath to the lesser.

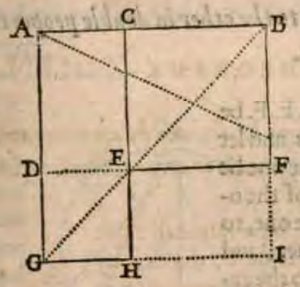
LEt A.B. be a right line, diuided by extreame and meane proportion, as in the point C. I say then, that the whole line A.B. hath the same proportion to the greater segment A.C. as the same greater segment hath to the lesser segment C.B. for as A.B. is to A.C. so is A.C. to C.B. PROB. 20.



THEOREME XLVI.

If a right line be diuided by extreame and meane proportion, the Rectangle figure, comprehended vnder the whole line, and the lesser segment, shall be equall to the Square made of the greater segment.

LEt A.B. be a right line, and let the same be diuided by extreame & meane proportion in the point C. Then, I say, the Rectangle figure, namely, A.C.G.H. comprehended vnder the whole line A.G. (being equall to A.B.) and the lesser segment A.C. shall be equall to the Square, namely, C.B.E.F. made of the greater segment C.B. DEF. 35. PROB. 20.



AB. 10.
AC. 15—18 125.
CB. 18 125—5.

THEOREME XLVII.

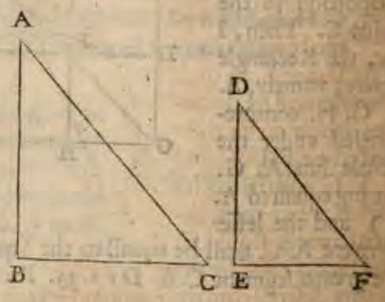
Two right lines being drawne in an equilater Equiangle Pentagon, in ſuch ſort as they ſubtend any two of the next immediate angles, thoſe two lines by their interſections ſhall diuide the one the other by an extreame and meane proportion: and the greater ſegments of either of them ſhall be equall to the ſide of the Pentagon.

Eu.13.8. LEt A.B. and C.D. be two right lines, drawne in the Equilater Equiangles *Pentagon*, A.D.B.E.C. and let the line A.B. ſubtend the angle A.D.B. and the line C.D. the angle C.A.D. being two of the next immediate angles. I ſay then, that thoſe two lines, by their interſection in the point F. ſhall diuide the one the other by an extreame and meane proportion. And the greater ſegments of either of them, as the ſegments F.B. and F.C. ſhall be either of them equall to the ſide of the *Pentagon* A.D.B.E.C. PROB.20.21. 48.62.63.119.120.

THEOREME XLVIII.

Like Triangles are one to the other in double proportion that the ſides of like proportion are.

Eue.6.19. LEt A.B.C. and D.E.F. be two like Triangles, and let the angle A. of the one be equall to the angle D. of the other; the angle B. of the one, to the angle E. of the other; and the angle C. of the one to the angle F. of the other; and as the ſide A.B. is to the ſide B.C. ſo let the ſide D.E. be to the ſide E.F. ſo are B.C. and E.F. ſides of like proportion. Now I ſay, that the proportion of the Triangle A.B.C. vnto the Triangle D.E.F. is double the proportion of the ſide B.C. to the ſide E.F. PROB. 45.

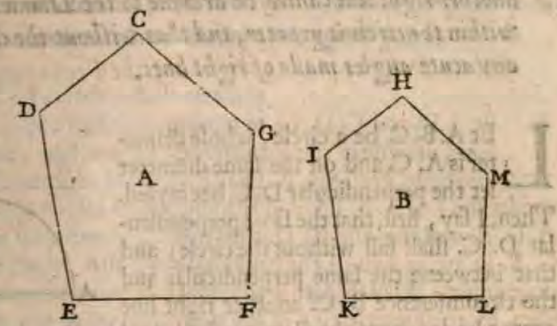


THEO-

THEOREME XLIX.

All like right lined figures whatſoeuer, are the one to the other in double proportion, that the ſides of like proportion are.

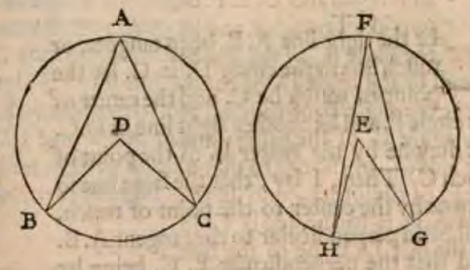
Eue.6.20. LEt A. and B. bee two right lined figures like, hauing the angle at the point C. equall to the angle at the point H. and the angle at the point D. equal to the angle at the point I. the angle E. to the angle K. and ſo of all the reſt. And alſo as the ſide D.E. is to E.F. ſo let I.K. be to K.L. &c. ſo are the ſides E.F. and K.L. ſides of like proportion. Then, I ſay, that the proportion of the figure A. vnto the figure B. is double, the proportion of the ſide E.F. to the ſide K.L. PROB.45.



THEOREME L.

All angles in equall circles, whether they are in the centers or circumferences, haue the ſame proportion one to the other as the circumferences haue wherein they conſiſt: And ſo are the ſectors, which are deſcribed on the centers.

Eue.6.33. LEt A.B.C. and F.G.H. bee two equal circles whereof let D. and E. be their centers; and let the angles which are in their centers be B.D.C. and H.E.G. and the angles which are in their circumferences B.A.C. and H.F.G. and let the ſectors deſcribed on their centers be D.B.C. and E.H.G. Then, I ſay, that the angles B.D.C. and H.E.G. in the centers, and the angles B.A.C. and H.F.G. in the circumferences, haue the ſame proportion one to the other, as the circumferences haue wherein they conſiſt, that is, as the circumference B.C. hath to the circumference H.G. And the ſame proportion alſo hath the ſector D.B.C. to the ſector E.H.G.

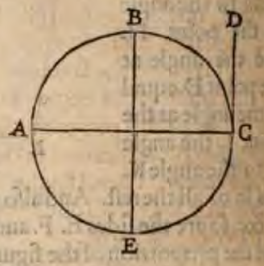


THEO-

THEOREME LI.

If on the end of the Diameter of a circle, a perpendicular bee rayſed, it ſhall fall without the circle, betweene which, and the circumference, another right line cannot be drawne to the Diameter, and the angle within the circle is greater, and that without the circle is leſſer, then any acute angles made of right lines.

Euc. 3.16. LEt A. B. C. be a circle, whoſe diameter is A. C. and on the ſame diameter let the perpendicular D. C. bee rayſed. Then, I ſay, firſt, that the ſame perpendicular D. C. ſhall fall without the circle; and that betweene the ſame perpendicular and the circumference B. C. another right line cannot be drawne to the diameter A. C. And alſo that the angle within the circle, namely A. C. B. is greater, and that without the circle, namely B. C. D. is leſſer then any acute angles made of right lines.



THEOREME LII.

If a right line bee a tangent or touch line to a circle, and another right line bee drawne by the center to the point of touch, it ſhall bee a perpendicular to the tangent: And if a perpendicular bee let fall from the center to the tangent, it ſhall fall in the point of touch.

Euc. 3.18. LEt the right line A. B. bee a tangent, or touch line to the circle D. E. C. let the point of touch be C. and the center of the circle E. and let another right line, as D. C. bee drawne by the center E. to the point of touch C. Then, I ſay, that the ſame line ſo drawne by the center to the point of touch, ſhall bee a perpendicular to the tangent A. B. And that the perpendicular E. C. being let fall from the center E. to the tangent A. B. ſhall fall in the point of touch C. PROB. 31. 33, 114, 115, 116, 117, 118.

THEO-

THEOREME LIII.

If a right line be drawne in a circle and not by the center thereof, another right line byſecting the ſame by right angles ſhall paſſe by the center of the ſame circle. And if from the center a perpendicular be let fall on a right line drawne in the ſame circle not by the center; the perpendicular ſhall diuide the ſame line into two equall parts.

Euc. 3.3. LEt A. B. D. C. be a circle whoſe center is E. and let B. C. be a right line drawne in the ſame circle, and not by the center thereof, and let another right line as A. D. byſect the ſame by right angles in the point F. Then, I ſay, that the ſame line A. D. ſhall paſſe by the center of the circle. Alſo from the center E. let fall the perpendicular E. D. on the right line B. C. drawne in the ſame circle not by the center; Then, I ſay, further that the perpendicular E D. ſhall diuide the ſame line B. C. into two equall parts.

THEOREME LIIII.

If one angle be placed in the circumference of a circle, and another in the center thereof, and are both ſubtended by one part of the circumference. That angle in the center ſhall bee double to that in the circumference.

LEt A. B. C. be a circle, and let one angle bee placed in the circumference thereof, as the angle B. A. C. and another in the center thereof, as the angle B. E. C. and let them both bee ſubtended by one part of the circumference as B. D. C. Then, I ſay, that the angle B. E. C. in the center, ſhall be double to the angle B. A. C. in the circumference.

Angulus in centro duplus eſt anguli in peripheria, in eandem peripheriam inſiſtentis.
Euc. 3.20.

THEOREME LV.

All angles conſiſting in one and the ſame ſegment of a circle are equall the one to the other; If in a ſemicircle, they are right angles; If in a leſſer ſegment, they are greater then a right angle; If in a greater

ſegment

segment, they are lesser. And also the angle of a greater segment, is greater then a right angle, and the angle of a lesser segment is lesse then a right angle.

Anguli in eadem sectione sunt æquales.

LEt A. B. C. D. E. F. bee a circle, and let A. E. be the diameter thereof, which diuideth the same into two semicircles or equall segments; Then, I say, that the angles A. C. E. and A. D. E. consisting in one and the same segment, are equall the one to the other, and being in a semicircle they are both right angles: Let also the line or cord A. C. diuide the same circle into two vnequall segments, as A. B. C. the lesser segment, and A. F. E. D. C. the greater, I say, the angle A. B. C. in the lesser segment is greater then a right angle, and the angle A. E. C. in the greater segment is lesse then a right angle. And also F. A. C. an angle of the greater segment is greater then a right angle, and the angle B. A. C. being an angle of the lesser segment, is lesse then a right angle.

*Eu.*3.21.31

*Ceul.*2.46.

Note here the difference betweene an angle in a segment, and an angle of a segment, See *Def.*16.17.

Prob. 19. 23. 24. 25. 30. 38. 52. 65.

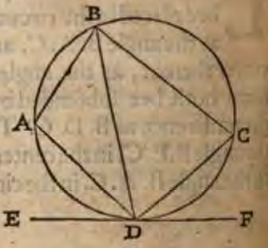
Theoreme LVI.

If a right line be a tangent to a circle, and another right line be drawne from the touch (crossing the circle) to what point soeuer in the circumference; the angles caused by intersection or meeting of those two lines, are equall to the angles consisting in the alternate segments of the circle.

*Eue.*3.32.

*Ceul.*2.47.

LEt A. B. C. D. be a circle, and the right line E. F. a tangent to the same circle; and let another right line as B. D. bee drawne from the touch, namely, the point D. crossing the circle to what point soeuer in the circumference as the point B. Then, I say, the angles caused by intersection or meeting of those two lines E. F. and B. D. are equall to the angles consisting in the alternate segments of the circle; that is, the angle B. D. F. shall be equall to the angle B. A. D. and the angle B. D. E. to the angle B. C. D. in the alternate segments. Prob. 32. 33. 111.

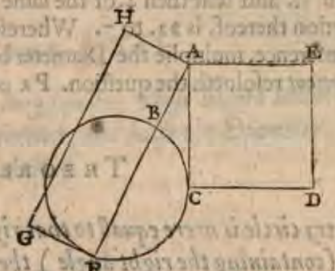


Theo-

Theoreme LVII.

If from a point without a circle, two right lines be so drawne, that the one be a tangent to the circle, and the other diuide the same circle into two equall or vnequall parts: The rectangle figure contayned vnder the whole line which diuideth the circle, and that part thereof lying betweene the vtter circumference and the point, is equall to the square made of the tangent line.

LEt B. C. F. be a circle, and without the same, take a point at all aduentures, as the point A. from whence let two right lines be so drawne, that the one bee a tangent to the circle, as A. C. and the other diuide the same circle, as A. B. F. Then, I say, that the rectangle figure contained vnder the whole line A. F. and that part of the same line, lying betweene the vtter circumference & the point, as B. A. namely, the rectangle figure A. H. G. F. is equall to the square made of the tangent line A. C. namely, to the square A. E. D. C.



Theoreme LVIII.

If from a point without a circle, two right lines be drawne to the concaue circumference of the circle, they shall be reciprocally proportionall with their parts taken without the circle. And another right line drawne from the point as a tangent to the circle, shall bee a meane proportionall betweene either whole line, and the vtter segment thereof.

*Eue.*6.33.

LEt B. E. F. D. be a circle, and without the same circle take a point at all aduentures, as at A. and from that point to the concaue circumference of the circle, draw the two right lines A. E. and A. F. And let another right line be drawne from the same point as a tangent to the circle, as the line A. D. Then, I say, first, that these two lines A. E. and A. F. are reciprocally proportionall with their parts taken without the circle, that is, as A. E. is to A. F. so is A. C. to A. B. And moreouer, that betweene the lines A. F. and A. C. or betweene the lines A. E. and A. B. the tangent A. D. is a meane proportionall.

Theo-

THEOREME LIX.

Euery circumference of a circle, is more then triple his Diameter, by such a proportion as is more then $\frac{22}{71}$. and lesse then $\frac{1}{7}$ of the same, the neereſt rationall proportion whereof is 22. to 7.

Corol: Euc. 12. 1.

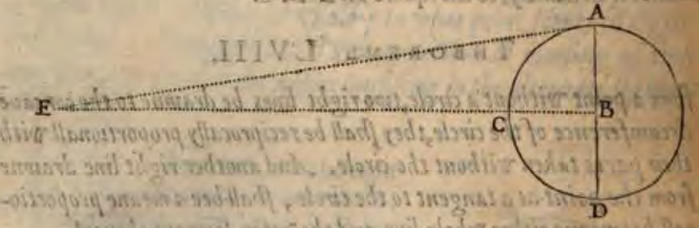
IN the former Diagram, let B. C. D. F. E. be the circumference of a circle, and C. F. the Diameter thereof; I say, the same circumference is more then triple the Diameter C. F. by such a proportion as is more then $\frac{22}{71}$. and lesse then $\frac{1}{7}$. of the same; and that the neereſt rationall proportion thereof, is 22. to 7. Wherefore to know the quantitie of the circumference, multiplie the Diameter by 22. and diuide the *Factus* by 7. the *Quotient* reſolueth the queſtion. PROB. 34. 67.

THEOREME LX.

Euery circle is neere equall to that right angled Triangle, of whoſe sides (containing the right angle) the one is equall to the ſemidiameter, and the other to the circumference of the ſame circle.

Corol. Euc. 12. 1.

The preciſe ſquaring of a circle was neuer yet found out; and therfore in this and the 4. next *Theoremes* following, this word *(Neere)* is vſed. But all Concluſions hereby wrought, are without any apparant error.



LEt A. C. D. be a circle, and A. E. B. a right angled Triangle, whoſe angle at the centre B. is a right angle, and whoſe ſides containing the right angle, namely, A. B. and E. B. the one is equall to the Semidiameter, as A. B. and the other to the circumference, as E. B. Then I ſay, that the Triangle A. E. B. is neere equall vnto the ſame circle. PROB. 68. 68.

THEOREME LXI.

The Square made of the Diameter of a Circle, is in that proportion to

to the circle (very neere) as 14. to 11. And therefore euery circle is neere $\frac{11}{14}$. of the ſquare about him deſcribed.

Corol. Euc. 12. 1.

LEt A. B. C. D. be a circle, and E. F. G. H. a ſquare made of the diameter A. C. or B. D. Then, I ſay, that the ſquare E. F. G. H. is very neere in the ſame proportion to the circle A. B. C. D. as 14. to 11. And theree fore, the circle very neere $\frac{11}{14}$. of the ſame ſquar- about him deſcribed. PROB. 68.

THEOREME LXII.

Euery circle is neere equall to the long ſquare, whoſe length and breadth are equall to halfe the circumference, and halfe the Diameter; or to the whole Diameter, and $\frac{11}{14}$. thereof.

Corol. Euc. 12. 1

LEt A. C. D. be a circle; And let H. A. B. G. be a long ſquare, whoſe length H. A. is equall to halfe the circumference, and breadth A. B. to halfe the diameter; And let alſo K. A. D. E. bee another long ſquare, whoſe length is the whole diameter A. D. and breadth $\frac{11}{14}$. thereof, namely, K. A. Then, I ſay, that either of thoſe two long ſquares are neere equall to the circle A. C. D. PROB. 68.

THEOREME LXIII.

Euery ſemicircle is neere equall to the long ſquare, whoſe length and breadth is equall to halfe the arch line, and the ſemidiameter.

Corol. Euc. 12. 1.

LEt E. B. F. be a ſemicircle, whoſe ſemidiameter is the line B. C. and the halfe of whoſe arch line is equall to the line A. B. or D. C. Then, I ſay, that the long ſquare, namely, A. B. C. D. (whoſe length A. B. is equall to halfe the arch, and

whoſe

whose breadth is B. C. the semidiameter) is neere equall to the semicircle E.B.F. PROB.69.

THEOREME LXIIII.

Euery sector of a circle, is neere equall to that long square, whose length and breadth is equall to the semidiameter, and halfe the arch-line of the same sector; or the halfe semidiameter, and the whole arch line.

Cor. Eu. 12. 1.

LEt B. A. C. bee the sector of a circle, and let D. B. A. E. bee a long square, whose length B. A. or D. E. is the semidiameter or equall thereunto, and whose breadth D. B. or E. A. is equall to halfe the arch-line B. C. And let also H. F. A. G. be another long square, whose length H. F. or G. A. is equall to the whole arch-line B. C. and whose breadth F. A. or H. G. is halfe the semidiameter, or equal thereunto. Then, I say, that either of those two long squares is neere equall to the sector B. A. C. PROB.70.

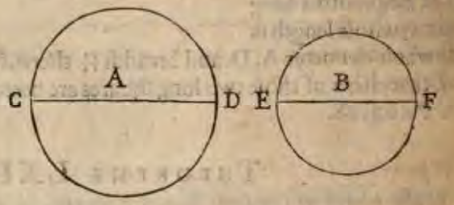
THEOREME LXV.

All circumferences of circles, haue the same proportion the one to the other, as their diameters haue.

This Theor. is of excellent vse in the forming of Mill-wheels, clocks, cranes, and other engines for water-workes, &c.

Cor. Eu. 12. 1.

LEt A. and B. be two circles, wher of let C. D. and E. F. bee their seuerall diameters, I say, that the same proportion that the diameter C.D. of the circle A. hath to the diameter E. F. of the circle B. the same proportion hath the circumference of A. to the circumference of B. PROB.65.66.

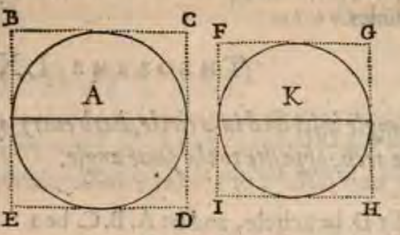


THEOREME LXVI.

Omnes figuræ similes circulis inscriptæ sunt, vt quadrata à diametris circulorum quibus inscribuntur. Euc. 12.2.

All circles haue the same proportion the one to the other, as the squares of their Diameters haue.

LEt A. and K. bee two circles, and let the squares circumscribed about them, bee the seuerall squares of their Diameters. Then, I say, that the circle A. hath the same proportion to the circle K. as the squares of their Diameters haue, namely, as the square B. C. D. E. hath to the square F. G. H. I. PROB. 65, 66, 104. 108.



THEOREME LXVII.

If in a circle be described a quadrilaterall figure, the opposite angles thereof shall bee equall to two right angles: and being intersected with two diagonalls, the right angled figure made of those diagonalls, is equall to the two right angled figures, comprehended vnder the opposite sides of the quadrilaterall figure.

Exempla illustrissima habebis, Pit. lib. 2. p. 32. 33. 35. 36. 37. 38

Anguli oppositi sectionibus æquantur duobus rectis.

Eu. 3. 22. Pit. 1. 54.

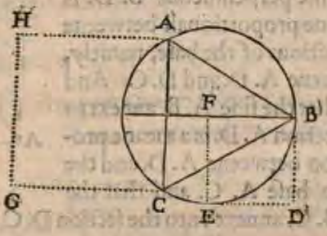
LEt A.B.C.D. be a circle, and let therein bee described the quadrilaterall figure A. B. C. D. let also the same figure be intersected with the two diagonals A. C. and B. D. Then, I say, first, that the opposite angles at the points A. and C. are equall to two right angles, and likewise the opposite angles at the points B. and D. And also that the right angled figure made of the diagonalls A. C. and B. D. is equall to the two right angled figures (taken together) comprehended vnder the opposite sides A. B. and D. C. and vnder A. D. and B. C.

This Prop. is of very great vse in trigonometrie.

THEOREME LXVIII.

The power of the side of an equilater triangle inscribed in a circle, hath to the power of the semidiameter of the same circle triple proportion.

LEt A. B. E. C. be a circle, whereof F. B. is the semidiameter, and let A. B. C. be an equilater triangle inscribed in the same circle. Then, I say, that the power of the side of the equilater triangle A. B. C. namely, the square H. A. C. G. hath to the power of the semidiameter F. B. namely, the square F. B. D. E. triple proportion, that



is, as 3. to 1. For the ſquare H. A. C. G. contayneth the ſquare F. B. D. E. three times.

THEOREME LXIX.

A triangle inſcribed in a circle, hath euery of his angles equall to halfe the arch, oppoſite to the ſame angle.

Pit.1.53.

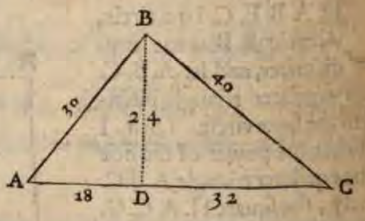
LEt D. be a circle, and let A. B. C. be a triangle, inſcribed at all aduentures in the ſame circle. Then, I ſay, that the triangle A. B. C. hath euery of his angles equall to halfe the arch, oppoſite to the ſame, as the angle at the point A. is equall to halfe the arch B. F. C. oppoſite thereunto, the angle at the point B. is equall to halfe the arch A. G. C. and the angle at the point C. is equall to halfe the arch A. E. B. For, the whole of euery circle is 360. degrees, whereof the halfe is 180. and the three inward angles of euery right lined triangle, is equall to two right angles, which is 180. degrees. THEOR. 13. PROB. 48. 119. 120.

THEOREME LXX.

If in a rectangle-triangle a perpendicular bee drawne from the right angle to the baſe, the ſame perpendicular is a meane proportionall betweene the ſections of the baſe: And the ſide annext to either ſection, ſhall bee a meane betweene the ſame ſection and the whole baſe.

Euc. Coroll. 6. 8. Cenl. 2, 63.

LEt A. B. C. be a rectangle-triangle, right angled at B. from whence let the perpendicular B. D. bee drawne to the baſe A. C. Then, I ſay, that the ſame perpendicular B. D. is a meane proportionall betweene the ſections of the baſe, namely, betweene A. D. and D. C. And alſo that the ſide A. B. annext to the ſection A. D. is a meane proportion betweene A. D. and the whole baſe A. C. and that the ſide B. C. annext vnto the ſection D. C. is a meane proportion betweene the ſame



ſame ſection D. C. and the whole baſe A. C. For, as A. D. is to A. B. ſo is A. B. to A. C. &c. PROB. 17, 19, 23, 24, 25, 30, 38, 43, 65, 66, 109.

THEOREME LXXI.

If in equall parallelograms, one angle of the one, be equall to one angle of the other, the ſides which contayne thoſe equall angles, ſhall bee reciprocall.

LEt A. B. C. D. and E. F. G. C. bee two parallelograms, equall the one to the other, and let the angle B. C. D. of the one bee equall to the angle E. C. G. of the other. Then, I ſay, that the ſides which contayne thoſe equall angles, are reciprocally proportionall, that is, as D. C. to C. G. ſo is E. C. to B. C. PROB. 88. 93.

Parallelogramma equiangula equalia, ſunt lateribus reciproca: & contra.

Euc. 6. 14.

THEOREME LXXII.

In rectangle-triangles, the figure which is made of the ſubtending ſide of the right angle, is equall vnto both the figures made of thoſe ſides, which contayne the right angle, ſo as thoſe three figures are like, and in like ſort deſcribed.

LEt A. B. C. be a triangle, whoſe angle at the point C. is a right angle. Then, I ſay, that the equilater triangle E. B. A. which is made of B. A. the ſubtending ſide of the right angle C. is equall vnto both the equilater triangles, made of the contayning ſides B. C. and C. A. namely, to the triangles B. F. C. and A. C. G. taken together: And the like of ſquares, and all other like figures, in like ſort deſcribed.

Euc. 6. 31.

Cenl. 2. 79.

THEOREME LXXIII.

In all plaine triangles, the ſides are in proportion the one to the other, as the ſubtenſes of the angles oppoſite thereunto; or as the ſines of the angles oppoſite to thoſe ſides.

LEt D. be a triangle, and let there be circumſcribed about the ſame triangle the circle A. B. C. by meanes whereof the ſide A. B. is made the ſubtenſe of the angle A. C. B. that is, of the arch A. E. B. which is oppoſite to the ſame angle A. C. B. Alſo the ſide B. C. is made the ſubtenſe of the angle B. A. C. that is, of the arch B. F. C. which is oppoſite to the ſame angle B. A. C. and laſtly, the ſide A. C. is made the ſubtenſe of the angle A. B. C. that is, of the arch A. G. C. which is oppoſite to the ſame angle A. B. C. Then, I ſay, that the ſide A. B. is in proportion to the ſide B. C. as the ſubtenſe of the angle A. C. B. to the ſubtenſe of the angle B. A. C. for the ſides and ſubtenſes, are one and the ſame. And likewiſe of the ſines of thoſe angles; which ſines are the one halfe of their ſubtenſes, and what proportion the whole hath to the whole, the ſame hath the halfe to the halfe. CHAP. 14. 3.

THEOREME LXXIIII.

Euery right lined figure, or plat, conſiſteth of more ſides by two; then the number of triangles, whereof the ſame figure is compoſed.

Ram. 10. 1.

LEt A. B. C. D. E. F. G. be a right lined figure, and let the triangles, whereof it is compoſed, bee 1, 2, 3, 4, and 5. Then, I ſay, that the ſame right lined figure conſiſteth of more ſides by two, then the number of triangles, whereof it is compoſed. For the ſides thereof are ſeuen, and the triangles fiue; as is apparant by the Diagram. CHAP. 37. 3.

The end of the firſt Booke.

THE VSE AND OPERATION OF THE FORMER THEOREMES.

The ſecond Booke.

THE ARGVMENT OF THIS BOOKE.

THIS *Booke conſiſteth of diuers Concluſions, or Geometricall* PROBLEMES, *here duly placed, by obſeruation of naturall courſe; the cauſe being formerly, in the firſt Booke, amply expreſſed, and here the effect as fully made manifeſt, hauing either to other due relation. This Booke is diuided into foure Parts, wherein moſt plainely, briefely, and methodically, is expreſſed the practicke operation of the precedent* THEOREMES; *as the Diſtinction, Application, and Diuiſion of Lines and Angles, and the Deſcription, Menſuration, Reduction, Addition, Inſcription,*

ſcription, Tranſmutation, Diuiſion, and Seperation of all ſorts and formes of ſuperficiall Figures, according to their ſeuerall kindes.

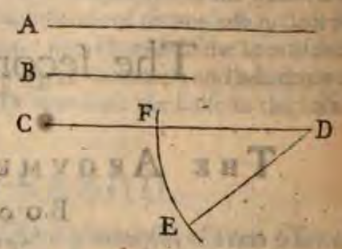
THE FIRST PART.

Of the Properties, Paſsions, Diſpoſitions, Applications, and Diuiſions of Lines and Angles.

PROBLEME I.

Two right lines giuen, being vnequall; to take from the greater a line equall to the leſſer.

Euc. 1. 3. LEt A. and B. be two vnequall right lines giuen, whereof let A. be the greater; from which it is required to take a line equall to the leſſer.

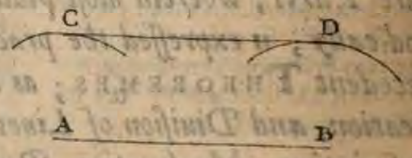


Firſt, ioyne the two giuen lines together in ſuch ſort, as thereby they make any kind of angle, as C. D. E. and making the centre D. and the ſpace D. E. (the length of the line B.) deſcribe the arch line F. E. which ſhall cut off from the greater line, the line F. D. equall to the leſſer line B. which was required to be done. DEF. 10.

PROBLEME II.

To a right line giuen, to draw a parallell line at any diſtance required.

Euc. 1. 31. SVppoſe the right line giuen, to be A. B. vnto which line it is required to haue a parallel drawn: Open your Compaſſe to the diſtance required, and ſetting one foot in the end A. ſtrike an arch line on that ſide the giuen line, whereon the parallell is to be drawne, and

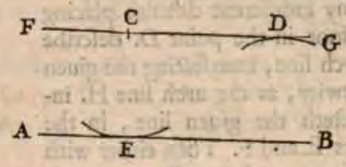


and the like in the end B. as the arch lines C. and D. and by the conuexitie of thoſe arch lines, draw the line C. D. which ſhall be parallell to the giuen line, as was required. DEF. 34.

PROBLEME III.

To performe the former Propoſition at a diſtance required, and by a point limitted.

Euc. 1. 31. LEt A. B. be a right line giuen, whereunto it is required to haue a parallell line drawne at the diſtance, and by the point C. Place one foot in C. from whence take the ſhorteſt extention to the line A. B. as C. E. at which diſtance, place one foot in the end B. and with the other ſtrike the arch line D. by the conuexitie of which arch line, and the limitted point C. draw the line F. G. which ſhall be a parallell to the giuen line A. B. the thing required. DEF. 34.



PROBLEME IIII.

To erect a perpendicular on any part of a right line giuen.

Euc. 1. 11. Cond. 2. 7. LEt A. B. be a right line giuen, and let C. be a point therein, whereon it is required to erect a perpendicular. Open the Compas to any conuenient diſtance, and ſetting one foot in the point C with the other marke on either ſide thereof, the equall diſtances C. E. and C. F. Then opening the Compas to any conuenient wider diſtance, with one foot placed in the points E. and F. ſtrike two arch lines, croſſing each other, as in D. from whence draw the line D. C. which ſhall be the perpendicular required. DEF. 5.

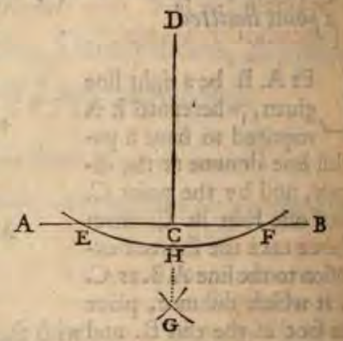
PRO-

PROBLEME V.

To raiſe or let fall a perpendicular to a line giuen, from a point either aboue or beneath the ſame line.

Euc.1.11.

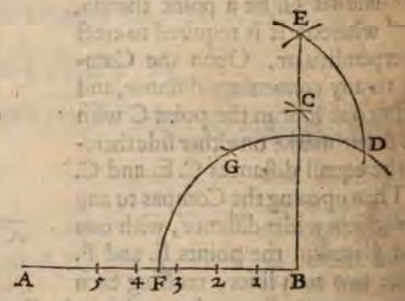
LEt A. B. be a line giuen, and let D. be a point aboue the ſame line: It is required from the point D. to let fall a perpendicular line to the giuen line A. B. At any indifferent diſtance placing one foot in the point D. deſcribe an arch line, interſecting the giuen line twice, as the arch line H. interſecteth the giuen line, in the points E. and F. Then either with the ſame, or ſome other conuenient diſtance, by placing the one foot in thoſe points E. and F. ſtrike two arch lines, croſſing each other, as in G. By which point, and the giuen point D. draw the line D. C. which ſhall be a perpendicular to the giuen line. And the like conſtruction is to be vſed, if the point were beneath the giuen line. DEF. 5.



PROBLEME VI.

Vpon the end of a line giuen to raiſe a perpendicular.

LEt A. B. be a right line giuen, and let B. be the end thereof, whereon it is required to rayſe a perpendicular line. Open your Compas to a conuenient diſtance, and with one foot in B. draw the arch line F. G. D. Then placing one foot in F. at the ſame diſtance marke the arch in G. and on G. draw the arch E. D. Then on D. croſſe the laſt arch in E. ſtill keeping the ſame diſtance; from which interſection draw the line E. B. which ſhall be the perpendicular required. DEF. 5.



To

To performe the ſame another way.

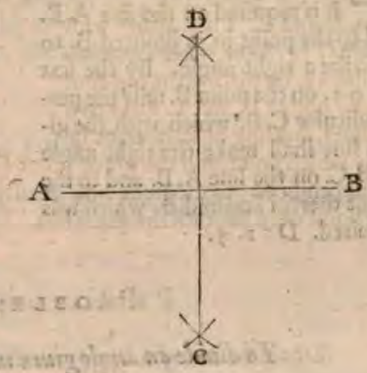
LEt A. B. in the former Diagram be a right line giuen, and B. the end thereof, whereon a perpendicular is to be rayſed. From the end B. pricke out any fiue equall diſtances, and opening the Compas to 4. of them, with one foot in B. ſtrike an arch line towards C. Then opening the Compas to all 5. Diuiſions, with one foot in the third Diuiſion, croſſe the ſame arch line in C. from whence draw the line C. B. which ſhall be the perpendicular required.

PROBLEME VII.

To diuide a right line giuen, into two equall parts.

Euc.1.10. Ceul.2.6.

LEt A. B. be a right line giuen, which is to be diuided into two equall parts: Open the Compas to more then halfe of the giuen line, and placing one foot thereof in either of the ends A. or B. with the other ſtrike an arch line towards D. and another towards C. then place one foot in the other end of the giuen line, and with the ſame diſtance croſſe the two former arches in D. and C. by which interſections, draw the line D. C. which ſhall diuide the giuen line A. B. as was required.



PROBLEME VIII.

Vpon a right line giuen, on a point therein limited, to make an angle equall to an angle giuen.

LEt A. B. be a right line giuen, and C. a point therein limited, and let H. E. G. be an angle giuen: It is required on the right line A. B. and on the point therein C. to deſcribe an angle

Euc. 1. 23. angle equall to the angle giuen H.F.G. At any conuenient distance setting one foot in F. the giuen angle, strike the arch line H. G. and at the same distance placing one foot in the limitted point C. make the arch line D. E. Then take the distance from G. to H. and place that distance on the last drawne arch line from E. which endeth in D. by which point draw the line D. C. which shall include the angle D. C. E. vpon the giuen line A.B. on the point therein limitted C. being equall to the giuen angle H.F.G. the thing required. DEF. 42.

PROBLEME IX.

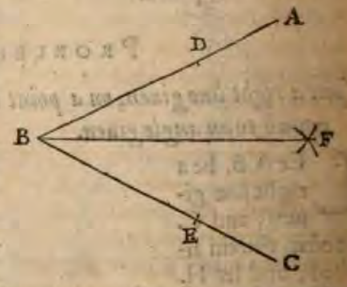
To make a right angle vpon a line giuen, and on a point in the same line limitted.

LET A. B. be a line giuen, and let B. be a point therein limitted. It is required on the line A. B. and to the point in it limitted B. to describe a right angle. By the sixt PROB. on the point B. raise the perpendicular C. B. which with the giuen line shall make the right angle A. B. C. on the line A. B. and to the point therein limitted B. which was required. DEF. 5.

PROBLEME X.

To diuide an angle giuen into two equall parts.

Euc. 1. 9. Ceul. 1. 5. LET A. B. C. be an angle giuen, to be diuided into two equall parts. Hauing opened the Compas to any conuenient distance, place one foot in B. and with the other crosse the two lines B. A. and B. C. in the points D. and E. vpon which two points, strike two arch lines, at any equall distance, crossing one the other, as at F. From whence to the angle B. draw the right line B. F. which shall diuide the giuen angle into two equall parts, as was required. THEOR. 18.



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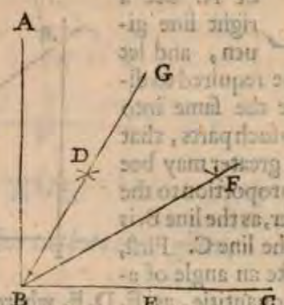
PROBLEME XI.

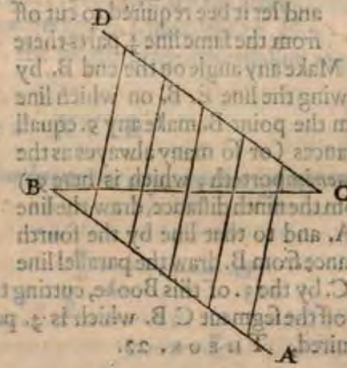
To diuide a right angle giuen into three equall parts.



LET A. B. C. be a right angle giuen, to be diuided into three equall parts. At any conuenient distance, with one foot in B. crosse the line B.C. as at E. and at the same distance on the points B. and E. strike two arch lines, crossing one the other in the point D. by which point, and the angle B. draw the line B. G. Then, by the tenth last before going, diuide the angle G.B.C. into two equall parts, with the line F. B. So shall those two lines F. B. and G. B. diuide the right angle giuen into three equall parts; which was the thing required. DEFINITION 21. THEOREME 18.

PROBLEME XII.

To diuide a right line giuen into diuers equall parts, as many as shall be required.



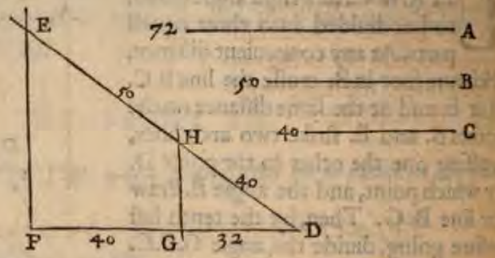
LET B. C. be a right line giuen, and let it be required to diuide the same line into sixe equall parts. First from B. draw a line at all aduentures, making an angle of any quantitie with the giuen line, as the line B. A. making the angle A. B. C. Then by the 8. of this booke make the angle D. C. B. equall to the angle A. B. C. and from B. towards A. and likewise, from C. towards D. at any conuenient distance, make 5. equall spaces (that is, one alwayes lesse then the number of parts required) and from point to point respectiuely draw lines, intersecting the giuen line: So shall you diuide the same into sixe equall parts required. THEOR. 22.

PROBLEME XIII.

To diuide a right line giuen proportionally, according to any proportion required.

Euc.6. 10, 11, 12. Ceul.2.67.

LEt A. bee a right line giuen, and let it be required to diuide the same into two such parts, that the greater may bee in proportion to the lesser, as the line B. is to the line C. First, make an angle of any quantitie, as E. D. F. whereof make the side F. D. equall to the giuen line A. then place on the other side the line C. from D. to H. and the line B. from H. to E. from E. to F. draw the line E. F. and lastly, by the 3. of this Booke, draw a parallel line to E. F. by the point H. as H. G. cutting F. D. in G. So shall you diuide F. D. (being equall to the giuen line A.) in the point G. in such sort that the greater segment F. G. hath the same proportion to the lesser G. D. as the line B. hath to the line C. which was required. THEOR. 22.



PROBLEME XIIII.

From a right line, giuen to cut off any parts required.

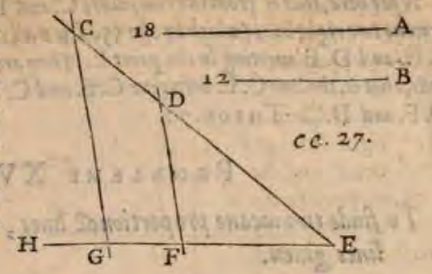
Euc.6.9. Ceul.2.66.

LEt A. B. bee a right line giuen; and let it bee required to cut off from the same line $\frac{4}{9}$. parts there of. Make any angle on the end B. by drawing the line E. B. on which line from the point B. make any 9. equall distances (or so many alwayes as the *Nomen* importeth, which is here 9.) From the ninth distance, draw the line E. A. and to that line by the fourth distance from B. draw the parallel line D. C. by the 3. of this Booke, cutting the giuen line A. B. in C. So haue you cut off the segment C. B. which is $\frac{4}{9}$. parts of the giuen line A. B. the thing required. THEOR. 22.

PROBLEME XV.

To finde a third line in continuall proportion vnto two lines giuen.

LEt A. and B. be two lines giuen; and let it be required to finde a third line, to be in such proportion to A. as A. is to B. Make an angle of any quantitie, as H. E. C. then place the line A. from E. to D. and the line B. from E. to F. and draw the line D. F. place also the line A. from E. to G. and lastly, by the 3. of this Booke, by the point G. draw the line G. C. parallel to F. D. So shall E. C. bee a third proportionall line to the two giuen lines, the thing required. THEOR. 22.

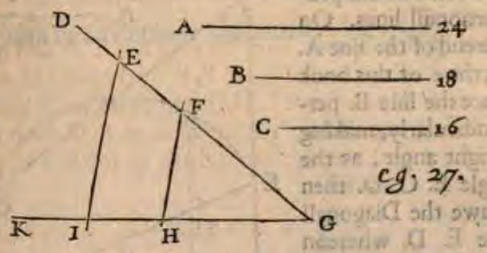


Euc.6.11. Ceul.2.68.

PROBLEME XVI.

To finde a fourth proportionall line to three lines giuen.

LEt A. B. and C. bee three lines giuen; and let it be required to find a fourth line, hauing such proportion to A. as B. hath to C. Make an angle of any quantitie, as D. G. K. And seeing it is the greater extreme, which is sought, place first the lesser extreme C. from G. to H. and the lesser meane B. from G. to F. then draw the line F. H. and place the greater meane A. from G. to I. by which point I. draw the line E. I. parallel to F. H. which cutteth D. G. in E. So haue you E. G. the fourth proportionall line required. THEOR. 22.

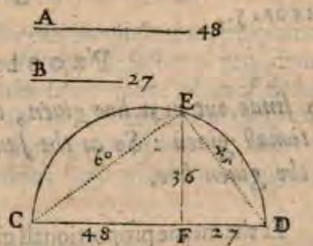


Euc.6.12. Ceul.2.69.

PROBLEME XVII.

To finde a meane proportionall line betweene any two lines giuen.

LEt A. and B. be two lines giuen, betweene which it is required, to finde a meane proportionall line. First, ioyne the two giuen lines together, so as they make both one right line, as C. F. D. meeting in the point F. then describe thereon the semicircle C. E. D. and on the point F. by the 5. of this Booke erect a perpendicular to cut the circumference in E as F. E. which shall be the meane proportionall required. DEF. 39. THEOR. 70.



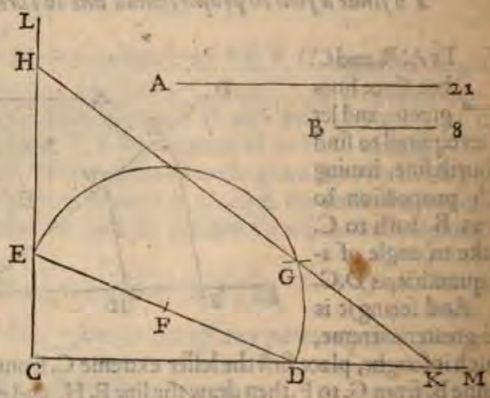
Euc.2.14.& 6.13. Ram.16.19. Ceul.2.64.

Note here, that if from the two points C. *and* D. *to any one point in the limbe be drawne two right lines (which by the* 55. THEOR. *make a right angle) as the lines* C. E. *and* D. E. *meeting in the point* E. *Then are those two lines meane proportionalls, that is, the line* C. E. *betweene* C. F. *and* C. D. *and the line* D. E. *betweene* D. F. *and* D. C. THEOR. 70.

PROBLEME XVIII.

To finde two meane proportionall lines, betweene any two right lines giuen.

Euc. 1. 43. LEt A. and B. be two right lines giuen, between which it is required to finde two meane proportionall lines. On the end of the line A. by the 6. of this book place the line B. perpendicularly, making a right angle, as the angle E. C. D. then drawe the Diagonall line E. D. whereon deſcribe the ſemicircle E. G. D. making F. the center, then inlarge the lines C. E. and C. D. towards L. and M. and taking in your compaſſe the giuen line B. the leſſer extreme, place one foot in D. and with the other ſtrike through the limbe of the ſemicircle in G. and on the point G. lay your ruler, turning it vp and downe on that point till by drawing the line H. K. you may cut the two lines C. L. and C. M. equidiſtantly from the center F. So ſhall E. H. and D. K. bee two proportionall lines, betweene the giuen lines A. and B. as was required. THEOR. 5.

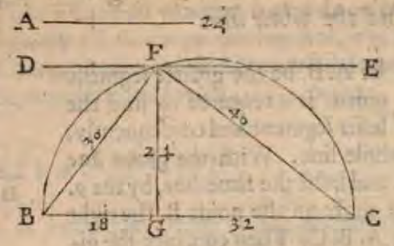


PROBLEME XIX.

To finde out in a line giuen, the two extremes of a meane proportionall giuen: So as the ſame meane bee not greater then halfe the giuen line.

LEt the meane proportionall giuen be A. and the line giuen B. C. It is required in the line B. C. to finde two extremes, betweene which the line A. ſhall bee a meane proportionall. Vpon the giuen line B. C. deſcribe the ſemicircle B. F. C. then at the diſtance of the giuen meane, by the

ſecond of this booke draw a line parallel to B.C. (which of neceſſity muſt either touch or cut the ſemicircle) as the line D. E. cutting the ſemicircle in F. From which point F. by the 5. of this booke, let fall the perpendicular F. G. which ſhall ſo diuide the giuen line B. C. in the point G. that the line giuen A. ſhall be a meane proportionall betweene the two ſegments B. G. and G. C. the thing required. THEOR. 9. 55. 70. PROB. 83.



PROBLEME XX.

To diuide a line giuen by an extreme and meane proportion.

Euc. 2. 11. 6. 30. *Ram.* 14. 10. *Ceul.* 2. 36.

LEt A. B. bee a line giuen to be ſo diuided. By the 9. PROB. make of the giuen line A. B. a right angle, as A. B. C. ſetting C. B. equall to A. B. then increaſe the giuen line by halfe the length thereof to D. and opening the compaſſe to the diſtance C. D. with one foot in D. ſtrike through the giuen line at E. which ſhall diuide the ſame line by extreme and meane proportion, whereof the greater ſegment is E. B. and the leſſe A. E. As was required. DEF. 35. 1. THEOR. 44, 45, 46, 47.

AB. 12.

CB. 12.

BD. 6.

EB. √ 180.—6.

AE. 18— √ 180.

To performe the former Prob. *arithmetically.*

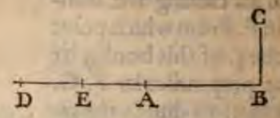
LEt the number giuen to be diuided by extreme and meane proportion be 12. Firſt, infold the ſquare thereof in 5. the factus is 720. diuide that by 4. the quotus is 180. from the ſquare roote whereof deduct halfe the giuen number, the remainder is √ 180—6. and this is the greater portion or ſection, which being deducted from the giuen number, there remayneth 18—√ 180. for the leſſer portion; both which taken together makes 12. the giuen number.

PROBLEME XXI.

To find the leſſer ſegment of a line, diuided by extreame and meane pro-

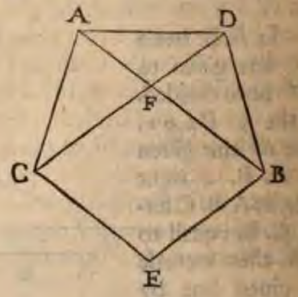
proportion, when onely the greater is giuen; and consequently, to find the whole line.

*Euc.*12.2. LEt A.B. be the greater segment giuen. It is required to find the lesser segment, and consequently, the whole line. With the giuen line A.B. and halfe the same line, by the 9. PROB. make on the point B. the right angle A.B.C. Then continue the giuen line infinitely towards D. and at the distance A.C. with one foot in A. cut the continued line in D. from whence cut off D.E. equall to halfe the giuen line: So is E.A. the lesser segment, and consequently, E.B. the whole line; as was required.



Or otherwise, thus.

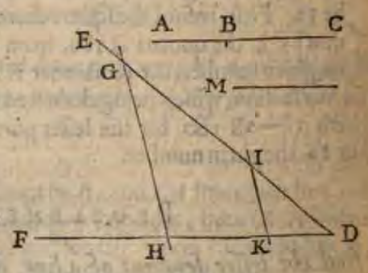
LEt A.D. be the greater segment giuen, it is required to finde out the lesser, and consequently, the whole line. On the giuen line A.D. by the 63. PROB. hereafter expressed, describe the *Pentagon* A.D.B.E.C. and against any two, the next immediate angles, draw subtending lines, which shall intersect the one the other, as the lines A.B. and D.C. in the point F. So shall F.A. or F.D. be the lesser segment; F.B. or F.C. the greater; and consequently, A.B. or D.C. the whole line, which was required. THEOR.47.



PROBLEME XXII.

Hauing the greater or lesser segment of a line diuided by extreame and meane proportion giuen, to find the other segment, and so the whole line.

*Euc.*6.2. LEt M. be the lesser segment of such a line giuen; It is required to find the other segment, and so the whole line. First, by the 20. PROB. diuide any line by extreame and meane proportion, as the line A.B.C. Then make an angle of any quantitie, as E.D.F. and place the lesser segment of the diuided line A.B. from D. to K.

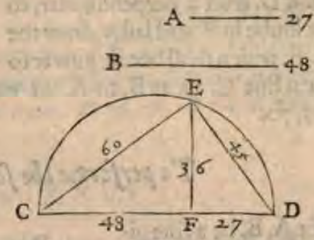


K. and the greater B.C. from D. to I. and draw the line I.K. Then place the lesser segment giuen M. from K. to H. and so working forwards, as by the 16. PROB. is taught, you shall produce I.G. the greater segment, which added to K.H. makes the whole line required. And the like course is to be held if the greater segment were giuen, and the rest sought. THEOR. 22.

PROBLEME XXIII.

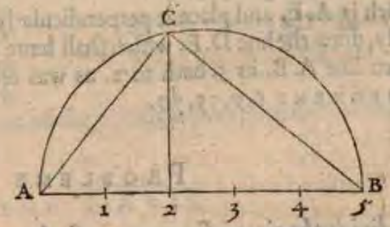
To diuide a right line giuen in power, according to any proportion giuen in two right lines.

*Eu.*1.47. 3.31. 6.4. 6.8. 6.20. *Cor.*2. LEt the right line giuen be C.D. and the proportion giuen, that betweene the two right lines A. and B. It is required to diuide C.D. in power, according to the proportion of A. to B. First, by the 13. PROB. diuide the giuen line C.D. in the point F. proportionally, as A. to B. Then on the same giuen line describe the semicircle C.E.D. and from the point F. rayse a perpendicular, to cut the lymbe in E. from which point draw the lines E.C. and E.D. which two lines together, shall be equall in power to the giuen line, and the power of the line E.D. shall be in such proportion to the power of the line E.C. as A. to B. which was required. DEF. 36.37. THEOR. 6.9.55.70.



To performe the same another way, according to any proportion required, betweene two numbers giuen.

LEt A.B. bee a right line giuen, and let it be required to diuide the power thereof in proportion, as 2. to 3. First, adde the two giuen termes together, which make 5. wherefore diuide the giuen line A.B. into 5. equall parts, then describe thereon the semicircle A.C.B. and on the second part erect the perpendicular 2.C. to cut the limbe in C. from which point draw the line C.A. which shall be $\frac{2}{5}$. parts of the power of the giuen line; and the line C.B. which shall be $\frac{3}{5}$. parts of the power of the same giuen line A.B. which was the thing required. DEFIN. 36, 37. THEOR. 6, 9, 55, 70.



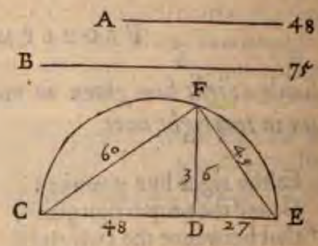
PRO-

PROBLEME XXIIII.

To inlarge a line in power, according to any proportion required.

*Eu.*1.47. 3.31. 6.4. 6.8. 6.20. *Cor.*2.

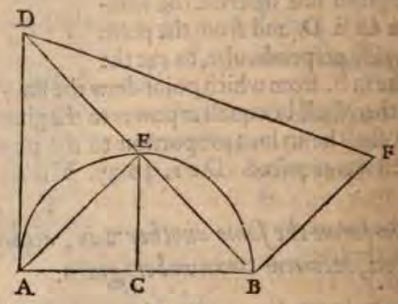
LEt C. D. bee a line giuen, to bee inlarged in power, according to the proportion of A. to B. Seeke first by the 16. PROB. a line, which shall beare the same proportion to the giuen line C. D. as B. to A. which will be found to be C. E. and thereon describe the semicircle C. F. E. and, on the point D. erect a perpendicular, to cut the limbe in F. and lastly, draw the line C. F. which shall bee in power to the giuen line C. D. as B. to A. as was required. DEFIN. 38. THEOR. 6, 9, 55, 70.



To performe the same another way.

Euc. 10. *Def.*5.1.47.

LEt A. B. be a line giuen; and let it be required, to encrease the same line A. B. in power, as 2. to 5. By the ninth PROB. with the giuen line make the right angle D. A. B. placing D. A. equall to A. B. Then draw the line D. B. and by the 23. PROB. before going, take halfe the power of the giuen line, which is A. E. and place it perpendicularly on the line D. B. as B. F. And lastly, draw the line D. F. which shall haue such proportion in power to the giuen line A. B. as 5. hath to 2. as was required. DEFINITION 38. THEOREME 6, 9, 55, 70.



PROBLEME XXV.

To diuide the circumference, or find out all the cord lines of a circle, not exceeding the tenth.

LEt A. B. C. D. be a circle giuen; whereof it is required to find the cord lines. First, the Diameter A. B. being drawne, diuideth the circle into two equall parts: The next is found by opening the Compas to the semi-

semidiameter, and with one foot in A. strike through the lymbe at F. and E. and draw the line F. E. which will diuide the circumference into three equall parts. Then draw the line C. D. diuiding the Diameter A. B. into two equall parts at right angles, and draw the line C. A. which shall be the side of an inscribed square. Then setting one foot in I. and at the distance I. C. crosse the Diameter in G. and draw the line C. G. which shall be the fift part, or the side of a *Pentagon*. The sixt part, or the cord of a *Sextans*, is the semidiameter. The seuenth part, or the side of an inscribed *Septagon*, is halfe the third, as F. I. or I. E. The eight being the side of an inscribed *Octogon*, is the line B. H. which is the cord of halfe the Arch or Quadrant B. H. D. The ninth is a cord of the third part of the arch F. L. A. E. as F. L. And the tenth is the line K. G. which is the greater segment of the semidiameter, diuided by extreame and meane proportion. THEOR. 6, 36, 55. PROB. 118, 119, 121.

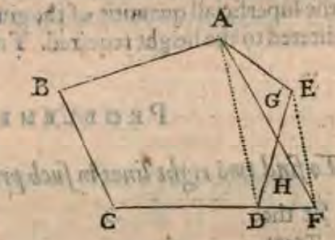
*Euc.*1.47. 2. 6. 4. 6. 4. 15. 13. 9, 10.

PROBLEME XXVI.

To draw a line from an angle in a Plot giuen, which shall take in as much as it cuts off.

LEt A. B. C. D. E. be a Plot giuen. It is required by a line drawne from an angle, in the same Plot, to take in as much as shall be cut off by the same line. Increase the line C. D. at pleasure towards F. Then from the point A. draw the line A. D. making the Triangle A. E. D. and by the point E. draw the line E. F. parallell to A. D. cutting the increased line in F. from whence draw the line F. A. which shall take in the Triangle H. and cut off the Triangle G. each equall to other, as was required. THEOR. 26.

*Euc.*1.37.



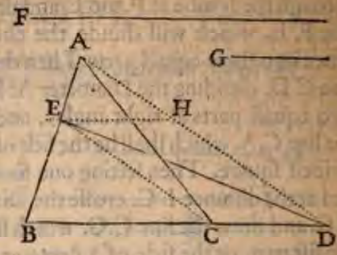
PROBLEME XXVII.

To draw a line in such sort, as to retaine the superficiall quantitie of a giuen Triangle, and yet alter the Base to any possible length required.

LEt A. B. C. be a Triangle giuen, and let it be required to draw a line in such sort, as to retaine the superficiall quantitie of the same Triangle, and yet alter the Base to the length of the line F. First, increase the Base

*Euc.*1.37.

Baſe B.C. to D. making B. D. equall to the giuen line F. Then draw the line A. D. and by the 3. PROB. by the point C. draw a parallell line to A. D. as E.C. cutting the ſide A.B. in E. And laſtly, draw the line E.D. including the Triangle E.B.D. which retaineth the ſuperficiall quantitie of the giuen Triangle A.B.C. and yet the Baſe altered, to the length required. THEOR.26. PROB.47.74.



PROBLEME XXVIII.

To draw a line in ſuch ſort, as to retaine the ſuperficiall quantitie of a giuen Triangle, and yet alter the altitude to any poſsible height required.

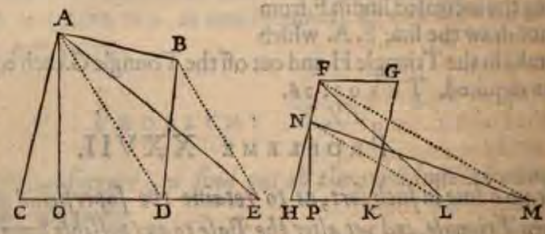
Euc.1.37. LET A.B.C. in the former Diagram be a Triangle giuen; and let it be required to draw a line in ſuch ſort, as to retaine the ſuperficiall quantitie of the ſame Triangle, and yet alter the altitude to the height of the line G. At the diſtance of G. draw the line E. H. parallell to the Baſe B.C. which ſhall cut the ſide A. B. in E. from which point draw the line E.C. Then continue the Baſe at pleaſure towards D. and from the point A. draw a line parallell to the line E.C. as A.D. cutting the line of continuation in D. from which point draw the line E.D. which ſhall make the Triangle E.B.D. retaining the ſuperficiall quantitie of the giuen Triangle A.B.C. and yet the altitude altered to the height required. THEOR.26.

PROBLEME XXIX.

To find two right lines in ſuch proportion as two figures giuen.

Euc.1.17.
6. 1.
1. 38.
1. 41.

LET the *Trapezium*, A.B.C.D. & the Parallelogram F.G.K.H. be two figures giuē. It is required to finde 2. right lines in ſuch proportion the one to the other, as thoſe two giuen figures are. By the 26. PROB. reduce the *Trapezium* A.B.C.D. into the Triangle A. C. E. and let fall the perpendicular A.O. Then increaſe the Baſe of the Parallelogram at pleaſure



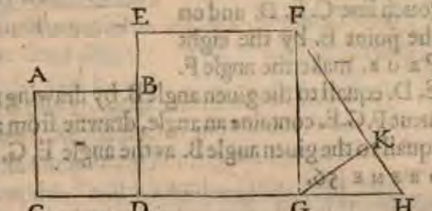
pleaſure towards M. and place on that increaſed line K.L. equall to the Baſe K.H. and draw the line F. L. including the Triangle F. L.H. equall to the Parallelogram F.G.K.H. Then by the 27. PROB. reduce the Triangle F. L.H. to the Triangle N.M.H. making the Baſe thereof M.H. equall to the Baſe C.E. of the firſt reduced Triangle; and laſtly, let fall the perpendicular N.P. So haue you the two perpendiculars N. P. and A. O. in ſuch proportion the one to the other, as the Parallelogram to the *Trapezium* giuen. THEOR.35,26,28.

PROBLEME XXX.

To find two right lines in ſuch proportion the one to the other, as two giuen Squares.

Euc.6.4.8.
Ac Cor.19.
Euc.12.2.
This *Prob.* is generall for all figures reduced into Squares. Which may alſo be thus wrought. Seeke a third proportionall to the ſides C. D. and D.G. which ſhall haue ſuch proportion to either of them, being the other extreame, as the ſquares haue the one to the other. *Euc.12.2.*

LET A.B.D.C. and E.F. G. D. be two Squares giuen. It is required, to find two right lines in ſuch proportion the one to the other, as the two giuē ſquares. Continue the ſide D. G. of the greater ſquare giuen to H. making G. H. equall to the ſide of the leſſer ſquare giuen: Then draw the line F. H. ſubtending the right angle F.G.H. from which right angle let fall a perpendicular, cutting the line F.H. in K. So ſhall H.K. and K.F. be two lines in ſuch proportion, as the two giuen ſquares, as was required. THEOR. 6,9,11,55,70.

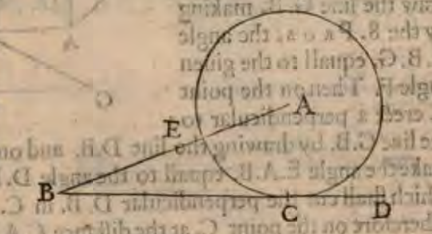


PROBLEME XXXI.

To draw a touch line to a circle giuen, from a point aſsigned.

Euc.3.17.

LET A. be the circle giuen, and B. the point aſsigned. It is required from the poimt B. to draw a touch line to the circle A. Draw the line A.B. from the centre to the point aſsigned, and diuide the ſame into two equall parts in the point E. and at the diſtance E.A. or E. B. croſſe the lymbe in C. by which point and the point aſsigned B. draw the line B.D. which ſhall be a touch line to the circle A. as was required. THEOR.32.



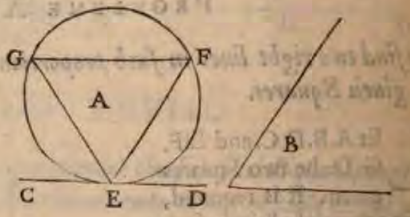
PROB.

PROBLEME XXXII.

To apply a line vnto a circle giuen, in ſuch ſort, as thereby to cut off a ſegment, wherein may be placed an angle, equall to an angle giuen.

Euc.3.34. Ceul.2.48. 49.

LEt A. be a circle giuen. It is required, to apply thereunto a line in ſuch ſort, as to cut off a ſegment from the ſame circle, wherein may be placed an angle equall to the angle B. By the PROB. laſt before going, draw the touch line C. E. D. and on the point E. by the eight PROB. make the angle F. E. D. equall to the giuen angle B. by drawing the line F.E. So ſhall the ſegment F.G.E. containe an angle, drawne from any point in the arch thereof, equall to the giuen angle B. as the angle E. G. F. the thing required. THEOREME 56.

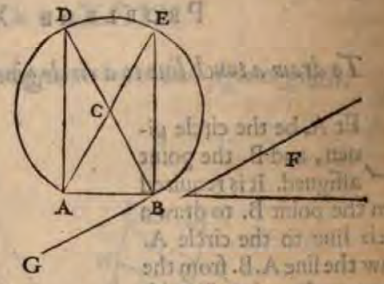


PROBLEME XXXIII.

To deſcribe, vpon a line giuen, ſuch a ſegment of a circle, as ſhall containe an angle, equall to an angle giuen.

Euc.3.33.

LEt the line giuen be A. B. and it is required to deſcribe thereon ſuch a ſegment of a circle, as ſhall containe an angle equall to the giuen angle F. To the end B. of the giuen line A.B. draw the line G. B. making by the 8. PROB. the angle A.B.G. equall to the giuen angle F. Then on the point B. erect a perpendicular to the line G.B. by drawing the line D.B. and on the end A. of the giuen line make the angle E.A.B. equall to the angle D.B.A. and draw the line A.E. which ſhall cut the perpendicular D. B. in C. which ſhall be the centre: Therefore on the point C. at the diſtance C.A. or C.B. deſcribe the arch A. D. E. B. which with the giuen line ſhall make the ſegment of a circle, containing an angle equall to the giuen angle F. For if two lines be drawne from any



any one part of the circumference to the ends of the giuen line, they ſhal containe ſuch an angle, as thoſe at the points D. and E. which was required. THEOR. 52. 56.

PROBLEME XXXIIII.

A ſegment of a circle being giuen; to find out the centre, and conſequently the diameter and the whole circle.

LEt A. B. C. be the ſegment of a circle giuen. It is required to find out the center thereof. Take a point at pleaſure with moſt conueniencie in the arche A. B. C. as B. and on the point B. at any meete diſtance deſcribe the arch E.F. alſo one towards G. and another towards H. then remoue the compaſſe to A. and with the ſame diſtance croſſe the next two arches in G. and E. and with the ſame diſtance on the point C. croſſe the two next arches in H. and F. And laſtly, by thoſe interſections, draw the lines G. P. and H. O. interſecting in D. which ſhall be the centre required; and conſequently B. M. the Diameter, and A. B. C. M. the whole circle. DEF. 10. 11. 13.

Eu.3.25.

To find out Arithmetically the diameter of the whole circle, (the ſegment A. B. C. being giuen) and conſequently the other parts; worke thus: Suppoſe the corde line A. C. to be 12. and the perpendicular B. 2. 4. Square halfe the corde line, which makes 36. which deuided by the perpendicular 4. quoteth, 9. whereunto adde the ſame perpendicular, which makes 13. the length of the whole diameter, whereby the reſt of the parts are eaſily knowne.

To finde the extention of the arche line A. K. B. C. and to deliuer the ſame in a right line, worke thus; Deuide the corde A. C. into foure equall parts, and place one of thoſe parts on the arche from A. to K. and from K. draw a line to the third part in the corde line, as K. 3. which taken double, ſhall be equall to the arche line, A.K. B.C. THEOR. 59.

The second Part.

OF the making and description of all sorts of superficiall figures, with their seuerall and particular mensurations.

PROBLEME XXXV.

To make an equilater triangle, the side thereof being giuen.

Euc. 1. 1.

LEt A B. be a right line giuen, and it is required to make an equilater triangle, whose side shall be equall to the same line. At the distance A. B. setting one foot in A. strike an arche line towards D. and at the same distance with one foot in B. crosse the same arche line in D. and from the intersection draw the lines D. A. and D. B. which with the giuen line A. B. shall make the equilater triangle A.B.D. as was required. DEF. 21. PROB. 36.

PROBLEME XXXVI.

To find the perpendicular of an equilater triangle Arithmetically, the side being giuen.

By this Prob. the perpendicular of an Isosceles is also found, the side and base being giuen.

IN the former Diagram let the side be ginen 8. It is required to find the perpendicular. Square the side 8. makes 64. then square the halfe base, 4. makes 16. which deduct from 64. rests 48. whose square roote √48. 48. neere rationall 6.$\frac{12}{13}$ is the length of the perpendicular D C. required. THEOR. 6. 19. 29.

PROBLEME XXXVII.

The perpendicular and side of an equilater triangle being giuen, to finde the Area or superficiall content.

IN the former Diagram the perpendicular √48. 48. and the side 8. is giuen, and the Area is required, Multiplie the whole of eyther by halfe, the other as √48. 48. by 4. the product is √768. neere rationall, 27.$\frac{12}{13}$ the superficiall content required. THEOR. 24.

Or

Or thus, without the perpendicular.

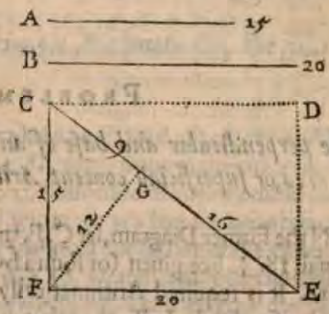
MVltiply 4. the halfe of one of the sides squarely, it makes 16. and the same product by the former halfe, makes 64. and that by halfe the perimeter which is 12. the product is 768. from whence extract the square roote, which is neere rationall 27.$\frac{12}{13}$. the superficiall content as before.

Ram. 8. 8.

PROBLEME XXXVIII.

To make a right angled triangle, the two containing sides being giuen.

LEt A. and B. bee two right lines giuen, for the containing sides of a right angled triangle required to bee made. By the 9. PROB. of the two giuen sides A. and B. make a right angle, as the angle C. F. E. then draw the subtending line C. E. So haue you included the right angled triangle C. F. E. with containing sides equall to the giuen lines A. and B. which was required. THEOR. 9. 6. 11. 55. 70.



Euc. 3. 31.

PROBLEME XXXIX.

The perpendicular and base of a right angled triangle giuen to find the superficiall content.

IN the former Diagram the perpendicular F. G. 12. and the base C. E. 25. is giuen, and the content required. Multiplle the whole of eyther by halfe the other, as 12. by 12. $\frac{1}{2}$. or 25. by. 6. the product is 150. the superficiall content required. Or multiplie the whole by the whole, the Product is 300. whereof take halfe being 150. as before. THEOREME. 23. 25.

Or thus, without the perpendicular.

MVltiply the containing sides 15. by 20. the product is 300. whereof take halfe for your demaund. Or multiply the halfe of the one in the whole of the other, the Product is 150. as before. THEOREME. 23.

PROBLEME XL.

To make an Isosceles triangle on a right line giuen.

LEt the right line giuē be A.B. wheron it is required to describe an Isosceles triangle. Open the compasse at pleasure, and placing one foote in A. with the other strike an arch towards C. and at the same distance placing one foote in B. crosse, the former arch in C. and draw the lines C. A. and C. B. which shall include the Triangle required. THEOR. 10. 18. 19.

Euc. 1. *Def.* 25.

PROBLEME XLI.

The perpendicular and base of an Isosceles Triangle giuen to find the area, or superficiall content Arithmetically.

IN the former Diagram, let C. E. the perpendicular √ .336. neere rationall 18. ½. bee giuen (or found by PROB. 36.) and let the base giuen be 16. It is required Arithmetically to finde the content. Multiplie the whole of eyther by halfe, the other as √ .336. by 8. the production is √ . 21504. neere rationall, 146. 47/97. the superficiall content required. Or multiplie the whole by the whole, as √ 336. by 16. the Product. is √ 86016. whereof take the halfe which is √ . 21504. and neere rationall 146. 47/97. as before. THEOR. 8. 19. 25.

Or otherwise without the perpendicular, thus.

IN the same former Diagram. Add all three sides together, which makes 56. whereof take halfe which is 28. then take the difference of each side from that halfe, as 8. 8. and 12. And infold those 3. each in other makes, 768. which multiplie by 28. the former halfe, the Product is, 21504. whereof take the square roote, which is neere rationall, 146. 47/97. for the superficiall content as before, which rule is generall for all right lined Triangles whatsoeuer.

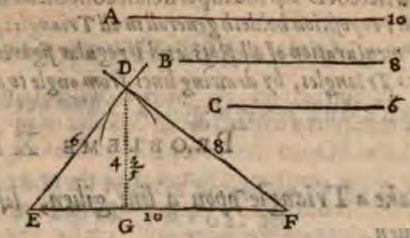
PROBLEME XLII.

To make a Triangle of three vnequall sides, the lines being giuen, so as the two shortest together bee longer then the third line.

Euc. 1. 22.

LEt A. B. and C. bee three lines giuen, whereof a Triangle is required to bee made. Place the line A. from E. to F. then taking in the compasse, the line B. with one foot in F. make an arch towardes D. and at

at the distance of the third line, and with one foote in E. crosse the arch line in D. from which intersection to E. and F. draw the lines D. E. and D. F. So shall you include the Triangle D. E. F. whose sides are equall to the giuen lines A. B. and C. as was required. THEOR. 15.



PROBLEME XLIII.

To finde the perpendicular of any Triangle Arithmetically, the sides being giuen.

IN the former Diagram let the sides giuen be E. D. 6. D. F. 8. and F. E. 10. It is required to finde the perpendicular. Square the three sides seuerally, which make 36. 64. and 100. then adde the square of the base, E. F. 100. to the square of one of the sides, as to 36. the square of the side F. D. which makes 136. from whence subtract the square of the other side D. F. 64. rests 72. whereof take the halfe 36. which deuide by the base 10. producing 3. ½. for the lesser segment of the base E. G. The square of which segment 12 ¼. being deducted from the square of E. D. 36. first added, the remainder is 23. ¾. whose radix is 4. ¾. the length of the perpendicular D. G. required. THEOR. 70.

Euc. 1. 47.

PROBLEME XLIIII.

The perpendicular and base of any Triangle being giuen, to finde the area or superficiall content thereof Arithmetically.

IN the same former Diagram let the perpendicular D. G. 4. ¾. & the base E. F. 10. be giuen, and let it be required to find the Area or superficiall content of the Triangle D E. F. Multiply the whole of eyther by halfe the other, as the whole perpendicular 4. ¾. by the halfe base 5. the Product shall bee 24. the superficiall content required. Or multiplie the whole by the whole, as 4. ¾. by 10. the Product is 48. whereof take halfe, which is 24. as before the superficiall content. THEOR. 25. 7.

Or thus without the perpendicular.

ADde the three sides together 6. 8. and 10. making 24. whereof take 12. the halfe, and then the difference of each side from that halfe, as 6. 4. and 2. and infold those differences each into other, which bring-

bringeth 48. that multiplied by the former halfe 12. produceth 576. The radix whereof is 24. the superficiall content as before.

Regula generalis. *This Proposition holdeth generall in all Triangles, and is the fittest and most meete for the mensuration of all plots and irregular figures whatsoeuer, being first reduced into Triangles, by drawing lines from angle to angle after the vsuall manner.*

PROBLEME XLV.

To make a Triangle vpon a line giuen, like vnto another Triangle giuen.

LEt the Triangle A. B C. and the line E. F. be giuen. It is required on the line E. F. to make a Triangle like vnto the Triangle giuen. Vpon the point E. by the 8. PROB. describe an Angle equall to the Angle A. B. C. and on the point F. describe another Angle equall to the Angle A. C. B. in the giuen Triangle, whereby shall bee included the Triangle D. E. F. vpon the line giuen E. F. like vnto the Triangle giuen A. B. C. that is with equall angles and lines proportionall, as was required. DEF. 40. THEOR. 11. 49.

Euc. 1. 37. Ceul. 2. 78.

PROBLEME XLVI.

To make a Triangle equall to another Triangle giuen, vpon the same Base, hauing an Angle equall to an Angle giuen.

LEt A. B. C. be a Triangle giuen, whose base is B. C. and let the Angle giuen be D. It is required vpon the base B. C. to describe a Triangle equall to the Triangle giuen A. B. C. hauing an Angle equall to the giuen Angle D. By the point A. by the 3. PROB. draw a parallel line to the base B. C. as E. A. and on the point C. describe an Angle equall to the Angle D. whereof the base to be one of the containing sides, and draw the line E. C. till it intersect, the parallel line in E. And lastly, from the point E. draw the line E. B. which shall include the Triangle E. B. C. equall to the giuen Triangle A. B. C. vpon the same

Euc. 1. 28. 1. 37.

same base, and hauing the Angle thereof E. C. B. equall to the giuen Angle D. as was required. THEOR. 26.

PROBLEME XLVII.

To make a Triangle: equall to another Triangle giuen, with a base or perpendicular limited.

WOrke this Probleme in all respects according to the doctrine taught in PROB. 27. and 28. THEOR. 26. Euc. 1. 37.

PROBLEME XLVIII.

To make an Isosceles Triangle vpon a line giuen, whose Angles at the base, shall be either of them double to the third Angle.

LEt A. B. be a line giuen, whereupon it is required to describe a Triangle, whose Angles at the base shall be either of them double, to the third Angle. Suppose the giuen line A. B. to be the greater segment of a line deuided by extreame and meane proportion, and by the 21. PROB. finde out the whole line, at the distance of which line so found, with one foot in A. strike an arch line towards C. and at the same distance with one foot in B. crosse that arch line in C. from which intersection, draw the lines C. A. & C. B. which shal include the Triangle required. THEOR. 47. 69.

Euc. 4. 10.

PROBLEME XLIX.

To make a Triangle equall to a Parallelogram giuen, vpon a line limited, and with an Angle equall to an Angle giuen.

LEt the Paralelogram giuen bee A. B. C. D. the line giuen E. C. & let the Angle giuen be M. It is required vpon the line giuen to make a Triangle equall to the parallelogram giue, hauing an Angle equall to the giuen Angle M. Take the giuen line E. C. for the

Euc. 1. 23. 6. 12. 6. 16.

the base, and by the 16. PROB. reason thus reciprocally. If halfe the giuen line E.C. yeeld H. D. the bredth of the parallelogram: what giues A.B. the length thereof: The answere shall bee F. G. the perpendicular of the Triangle to be made; at which distance by the 2. PROB. draw the line K. F. parallel to the base E. C. and on the end E. by the 8. PROB. describe an Angle equall to the giuen Angle M. and draw the line E. F. which shall cut the parallel line in F. from which point of intersection draw the line F.C. which shall include the Triangle E. F. C. equall to the parallelogram giuen, vpon the line E. C. giuen and hauing the Angle F. E. C. thereof equall to the giuen Angle M. as was required. THEOR. 42.

PROBLEME L.

To make a Square vpon a line giuen for the side thereof.

LEt C. D. be a line giuen, whereon it is required to describe a Square. By the 6. PROB. on the end of the giuen line C. erect the perpendicular B. C. equall to the giuen line C.D. at which distance, with one foote in B. strike an arch line towards A. then with one foote in D. crosse that arch line in A. And lastly, draw the lines A. B. and A. D. which shall include the square A. B. C. D. vpon the line giuen for the side thereof C.D. as was required. THEOR. 2.

En.1.46.

PROBLEME LI.

The side of a Square being giuen, to finde the Area or superficiall content Arithmetically.

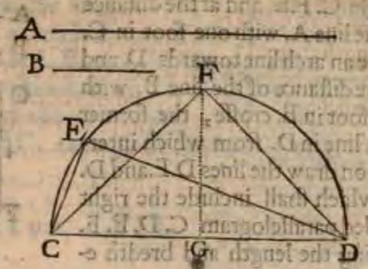
LEt A. B. 16. be the side of a square giuen, whereof the superficial content is required. Multiplie the line giuen 16. in it selfe, the product is 256. the superficiall capacitie of the Square A. B. C. D required. THEOR. 38.

PROBLEME LII.

To make two Squares which shall be equall the one to the other; and also to two vnequall Squares giuen.

LEt the right lines A. and B. be the two sides of two vnequall squares giuen; and let it be required to make two other squares, which shall bee equall vnto them, and also the one of them equall to the other. By the

the 9. PROB. of the two giuen lines A. and B. make a right Angle, as the Angle C. E. D. and draw the subtending line C. D. on which line describe the semicircle C. E. F. D. and on the middle of C. D. erect the perpendicular F. G. to cut the lymbe in F. From which point draw the two lines F. C. and F. D. which shall be the two sides of two squares, equall to the two giuen squares, and also the one of them equall to the other; as was required. THEOR. 6. 23, 55.

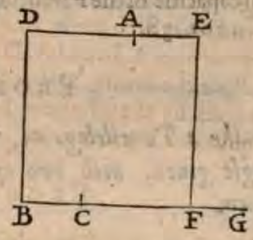


Euc.1.4. 1.32.

PROBLEME LIII.

To describe a Square in such sort as it shall passe by any three points giuen.

LEt A. B. and C. be three points giuen, by which it is required to make a square to passe. First, by the two neerest points, as B. and C. draw a line at length as the line B. G. then by the third point A. by the 3. PROB. draw the line D. E. parallel to the line B. G. and on the point B. raise the perpendicular B. D. to cut the line D. E. in D. then at the distance D B. marke the points E. and F. betweene which draw the line E. F. which shall include the square D. E. F. B. passing by the three giuen points, as was required. PROB. 3. 6.



Euc.1.12. 1.31.

PROBLEME LIIII.

To make a long Square or right angled Parallelogram, the length and bredth being giuen.

LEt A. and B. be two right lines giuen for the length and bredth, it is required to make a right Angled parallelogram, whose length shall be A. and bredth B. By the 9. PROB. of the two giuen lines A. and

and B. make a right Angle, as the Angle C. F. E. and at the distance of the line A. with one foot in C. make an arch line towards D. and at the distance of the line B. with one foot in E. crosse, the former arch line in D. from which intersection draw the lines D. E. and D. C. which shall include the right angled parallelogram C. D. E. F. hauing the length and bredth equall to the giuen lines; as was required. THEOR. 55.

PROBLEME LV.

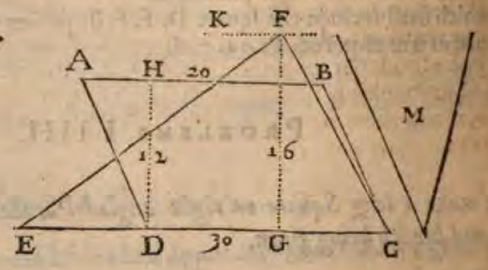
The length and breadth of a right angled Parallelogram or long Square being giuen, to finde the Area or superficiall content thereof Arithmetically.

IN the former Diagram let the length giuen be A. 20. and the bredth B. 10. Multiplie 20. by 10. the Product will bee 200. for the Area or superficiall capacitie of the Parallelogram, C. D. E. F. which is the thing required. THEOR. 38.

PROBLEME LVI.

To make a Parallelogram, whose length is limited, equall to a Triangle giuen, with two opposite Angles each equall to an Angle giuen.

LEt the Triangle giuē be F. E. C let the length limited be D. C. & let the Angle giuen be M. It is required vppon the giuen line to make a Parallelogram equall to the Triangle giuen, hauing two opposite Angles each equall to the Angle giuen. By the 16. PROB. reason thus reciprocally; If the giuen line D. C. yeeld the perpendicular of the Triangle F. G. what giues halfe the base E. C. the answere shall be H. D. the bredth of the Parallelogram to be made; at which distance draw



Euc. 1. 23. 6. 12. 6. 16. *Ceul.* 2. 82.

draw the line A. B. Parallel to the giuen line D. C. then on the point C. by the 8. PROB. describe an Angle as the Angle B. C. D. equall to the giuen Angle M. and draw the line B. C. which shall cut the Parallell line A. B. in B. from whence marke out the line A. B. equall to the giuen line D. C. and lastly draw the line A. D. which shall include the Parallelogram, A. B. C. D. equall to the Triangle giuen vpon the line D. C. giuen, and hauing two opposite Angles, namely, A. and C. each equall to the Angle giuen M. as was required. THEOREME 42.

PROBLEME LVII.

To make a Rhombus, the side being giuen.

LEt the line giuen be A. B. wheron it is required to describe a Rhombus. At the distance A. B. with one foote in B. describe the arch line D. C. & at the same distance setting one foot in A. Crosse, the Arch line in D. on which point placing the compasse at the former distance crosse the arch line in C. And lastly, draw the lines D A. D C. and C B. which shall include the Rhombus, A. B. C. D. on the giuen line A. B. as was required. DEFINITION 26.

Euc. 1. 1.

PROBLEME LVIII.

The side of a Rhombus being giuen to finde out the Area or superficiall content thereof Arithmetically.

IN the former Diagram, let the side A B. or D C. 16. be giuen, and let it be required to find the Area or superficiall content thereof. By the 36. PROB. finde out the perpendicular D. E. $15\frac{1}{13}$. 192. and neere rationall, 13. $\frac{11}{13}$. and multiply the same by the giuen side, 16. the Product shall be $\frac{1}{13}$ 49152. and neere rationall, 221. $\frac{111}{113}$. for the superficiall content required. THEOR. 34.

PROBLEME LIX.

To make a Rhomboydes the length and bredth being giuen in two right lines.

LEt the length giuen bee the line D. C. and the bredth, the line G. of which length and bredth it is required to describe a Rhomboydes. At the distance of the giuen bredth G. and from one of the ends of the giuen

giuen length, as from C. chooſe a point as B. and at the ſame diſtance with one foot on the other end of the giuen length, as on D. ſtrike an arch towardes A. then at the diſtance of the giuen length with one foot in the point B. croſſe the former arch in A. And laſtly, draw the lines A. D. A. B. and B. C. which ſhall include a Rhomboydes of the length and bredth giuen. PROB. 3.

Euc. 1. 31.

PROBLEME LX.

To make a Rhomboydes with lines limited, hauing two oppoſite Angles, eqnall to an Angle giuen.

LEt the limited lines for the length & bredth be D.C. & G. as in the former Diagram, and let the Angle giuen be F.C.B. and let it be required to make a Rhomboydes of ſuch length and bredth, and with two oppoſite Angles equall to that giuen. On the end C. of the giuen length D.C. by the 8. PROB. protract an Angle equall to the giuen Angle, as D.C.B. making the line B.C. equall to the giuen bredth G. And ſo worke forward in all reſpects as in the former Probleme. PROB. 3.8.

Euc. 1. 23. 1. 31.

PROBLEME LXI.

A Rhomboydes giuen to finde the ſuperficiall content Arithmetically.

LEt the Rhomboydes giuen bee that in the former Diagram, It is required to find the ſuperficiall content thereof. Take the giuen length D.C. or A.B. 20. and ſeeke out (as hath beene formerly taught) the parallel diſtance or perpendicular B.E. 12. which multiply the one by the other, the Product is 140. the Area of the giuen Rhomboydes required. THEOR. 34.

PROBLEME LXII.

To deſcribe a Pentagon, hauing ſides and Angles equall.

LEt any obſcure line be drawne as the right line A.B. and at any conuenient diſtance place thereon foure equall parts or diuiſions, as from C. to 4. and at the diſtance of two of them, on the ſecond part, as a centre

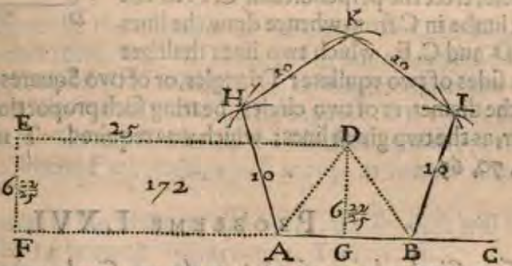
tre, deſcribe an obſcure circle, on which centre rayſe the perpendicular D.2. to cut the limbe in D. then at the diſtance D. 1. with one foot in 1. croſſe the line in K. and with the diſtance D. K. marke the limbe of the Circle in the points D. E. F. G. and H. And laſtly, draw lines from point to point, which ſhall include the Pentagon required. DEF. 29. THEOR. 47. PROB. 20. 21. 25.

PROBLEME LXIII.

To deſcribe a Pentagon vpon a line giuen.

LEt A.B. be a right line giuen, wherevpon it is required to deſcribe a Pentagon. Suppoſe the line giuen, to bee the greater ſegment of a right line diuided by extreame and mean proportion. And by the 21. and 22. PROB. finde the whole line; which let be A.C. and at the diſtance of A.C. with one foot in B. ſtrike an arch towards H. and another towards K. and with the foote in A. ſtrike one towards L. then take the diſtance of the giuen line, and on A. and B. croſſe the Arches at H. and L. and on H. or L. croſſe the Arch in K. And laſtly, draw lines from each interſection to other, which ſhall incloſe the Pentagon, as was required. THEOR. 47. PROB. 20. 21, 22, 25.

Euc. 13. 8.



PROBLEME LXIIII.

The ſide of a Pentagon being giuen, to finde the ſuperficiall content Arithmetically.

IN the former Diagram, let the giuen ſide be 10. It is required to finde the Area of that Pentagon. By the 36. PROB. (ſuppoſing an Iſoſceles deſcribed on any ſide of the Pentagon, whoſe top is the centre, as A.D.B.)

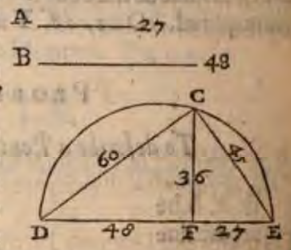
seeke the perpendicular D. G. 6. $\frac{21}{25}$. which multiplied in halfe the perimetrie 25. produceth 172. the Area required. This rule is generall in all kind of regular polligons, of how many sides so euer; aswell for their superficiall content, as finding their perpendicular. THEOR. 19. 39. PROB. 36.

A generall Rule.

PROBLEME LXV.

To make two like Figures, bearing the one to the other, any proportion assigned in two right lines.

LEt A. and B. be two right lines giuen, and let it be required to make two like Triangles, Squares, Circles or other like figures, hauing such proportion the one to the other, as A. to B. make of the two giuen lines one right line, as D. E. and describe thereonthe Semicircle C.D.E. and on the point F. where the 2. giuen lines meete, erect the perpendicular C. F. to cut the limbe in C. from whence draw the lines C. D. and C. E. which two lines shall bee the sides of two equilater Triangles, or of two Squares, or other like figures or the diameters of two circles, bearing such proportion the one to the other, as the two giuen lines; which was required. THEOR. 6. 11, 55, 66, 70, 65.

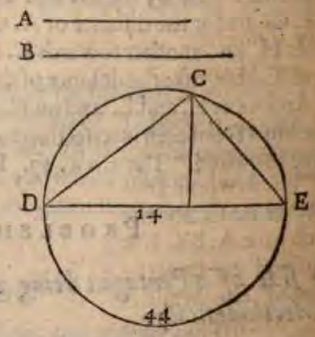


Eue. 6. 4. 6. 8.

PROBLEME LXVI.

Two Circles being giuen, to make one Circle equall to them both.

LEt A. and B. be the Diameters of two Circles giuen. It is required to make one Circle equall to them both. With the lines A. and B. by the 9. PROB. make a right Angle, as D. C. E. then draw the subtending line D. E. And lastly, on the line D. E. describe the Circle D. C. E. which shall bee equall to the two giuen circles as was required. THEOR. 65. 70, 66.



PROB.

PROBLEME LXVII.

The Diameter of a Circle being giuen, to find the circumference thereof Arithmetically.

IN the former Diagram, let the Diameter giuen be 14. It is required to finde the circumference thereof. Multiply the Diameter giuen 14. by 22. the Product is 308. which diuided by 7. bringeth 44. the circumference required. Or multiply 14. the Diameter by 3 $\frac{1}{7}$. the Product is 44 as before. THEOREME. 59.

If the circumference bee giuen, and the Diameter required, It appeareth by this rule, that the circumference 44. being multiplied by 7. and the product diuided by 22. bringeth 14. the Diameter.

PROBLEME LXVIII.

The Diameter and Circumference of a Circle being giuen, to find the Area, or superficiall content thereof Arithmetically, diuers wayes.

IN the former Diagram let the Diameter of the Circle D. C. E. be 14. and the Circumference thereof 44. It is required to find the superficiall content. Multiply the Semicircumference 22. by the Semidiameter 7. the Product will be 154. the superficiall content required. THEOR. 62.

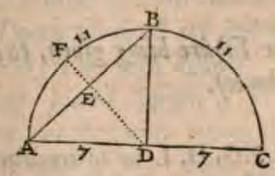
Or multiplie the whole Circumference 44. by the Semidiameter 7. the Product will be 308. whereof take halfe, which is 154. as before. THEOREME. 60.

Or multiply the square of the Diameter 196. by 11. the Product will be 2156. which diuided by 14 bringeth 154. as before. THEOR. 61.

PROBLEME LXIX.

The Diameter and Arch-line of a Semicircle giuen, to find the Area thereof.

LEt A. B. C. be a Semicircle giuen, whose Diameter is A. C. and the Arch line A. B. C. It is required to finde the Area of the Semicircle. Multiplie halfe the arch line 11. by the Semidiameter 7. The Product will be 77. for the Area required. THEOREME. 63.



AB. 13. 98.

A. E. 13. 24. $\frac{1}{2}$.

E. D. 13. 24. $\frac{1}{2}$.

F. E. 7. 13. 24. $\frac{1}{2}$.

PROBLEME LXX.

The Semidiameter and Arch line of a Sector of a Circle giuen to find the Area.

IN the former Diagram, let B. C. D. be the Sector of a Circle, whose Semidiameter is D. C. or D. B. and the arch line B. C. and it is required to finde the Area. Multiply the Semidiameter 7. by halfe the arch line B. C. 5. ½. the Product is 38. ½. for the Area required. THEOR. 64.

PROBLEME LXXI.

Any Segment or part of a Circle being giuen, to finde the superficiall content thereof.

IN the former Diagram, let A. F. B. E. be the Segment of a Circle, the content whereof is required. By the 34 PROB. finde out the Centre, and then draw the lines D. A. and D. B. and cast vp the whole Figure A. F. B. D. as in the last Probleme which will be 38. ½. then finde the superficiall content of the Triangle, A. B. D. by the 41. PROB. which is 24. ½. and deduct the same out of the whole content 38. ½ resteth 14. for the superficiall content of the giuen Segment as was required.

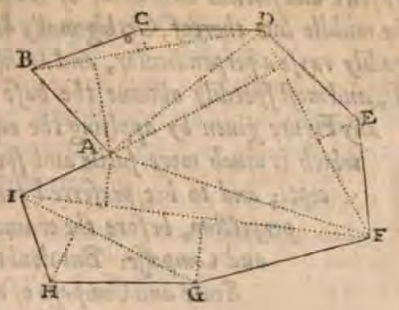
By this rule (obserued with discretion) may all manner of Segments or parts of a Circle, whether greater or lesser then a Semicircle, be easily measured without further instruction.

Note. *But here is to bee noted, that the precedent rules concerning the mensuration of Circles, and their seuerall parts, are not exactly true: for that the proportion betweene the Diameter and circumference is irrationall; and the squaring of a Circle or the meanes thereof (other then mechanically) not yet discouered or found out; yet of such sufficient preciseneſſe as no notable or apparant error can be made or found in the conclusions thereby wrought.*

PROBLEME LXXII.

An irregular plotte or Figure being giuen, to finde the Area or superficiall content thereof.

LEt A. B. C. D. E. F. G. H. I. be an irregular plotte or Figure, whose superficiall capacitie is required. Reduce the same into as many Trapezias as it will containe, as first the Trapezium A. B. C. D. Secondly, A. D E F. Thirdly, A. F. G. I. and there remaineth the Triangle, I. G. H. In which three Trapezias draw the Diagonals B D. D F. and F I.



F. I. which shall serue as the common bases to each Triangle on eyther side, on which bases let fall the perpendiculars from the seuerall Angles at A. C. E. and G. then in euery Trapezium take the length of the base by it selfe, and the length of the two perpendiculars theron falling, ioined together in one number by it selfe, then multiply the halfe of the one in the whole of the other, the Product is the Area of that Trapezium, which reserue by it selfe, and working in the like sort with the rest: And lastly, the Triangle I. G. H. collect all their Products together, which shall shew the superficiall content required. PROB. 44. THEOR. 25.

This I hold the best manner of Mensuration of plots, aswell for expedition, as exactnes in auoyding errours, often happning by multiplicitie of numbers, and many multiplications.

THus in this second part, haue I taught the Description and Mensuration of all manner right lined superficiall Figures, according to the strict and precise rules and precepts of absolute Arte: yet seeing that dispatch and expedition in businesse of import, is much more requisite then needlesse niceneſſe; I would not haue my Surueyor ignorant or vnfurnished of such other ready and perfect helpes (though more mechanike) as may yeelde him ease, and saue much labour in furthering his intents. To which end, for the speedie and exact mensuration of all superficiall figures, I would haue prouided a Protractor in Brasse, whose Scale should containe in length about 8. or 10. ynches with equall Diuisions on the edge of eyther side, of 12 in an ynch on the one side, and 11. on the other, being numbred by tennes after the vsuall manner of those kind of works (which for mine own part is the Scale, I neuer vse in all my first drawne plots, whether the quantitie be small or great, well knowing the inconuenience of smaller Scales) hauing placed thereon a Sextans of a Circle most excellent for many vses, as the speedy laying downe of any Angle required, or the ready finding of any Angle giuen, &c. The order and making whereof is well knowne to Master Elias Allen, *who for*

my ſelfe and friends hath made of them. By this Scale with helpe of the middle line thereof, Orthigonally drawne to the edge; you ſhall readily rayſe a perpendicular, and as inſtantly receiue the length thereof, and moſt ſpeedily obtaine the baſe of any Triangle, or the ſide of any Figure giuen by applying the edge of the Scale thereunto: which is much more facile and ſpeedy then the former Precepts; and to bee preferred for exactnes, ſpeede and perfection, before the ordinarie courſe with Scale and Compaſſe. But doubting to exceede the Scale and Compaſſe of my intended purpoſe, I will here conclude the ſecond part of this my ſecond Booke.

The

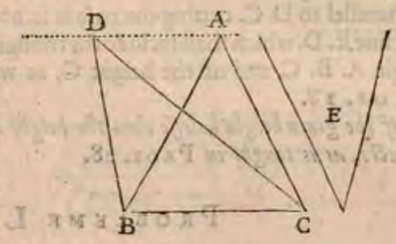
The third Part.

OF the Reduction and Tranſlation of all manner of ſuperficiall figures, from one forme vnto another, retayning ſtill their firſt quantitie.

PROBLEME LXXIII.

To reduce one triangle into another, on the ſame baſe, but hauing an angle equall to an angle giuen.

Euc.1.37.

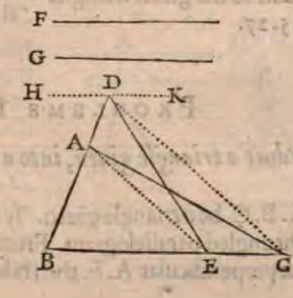


LEt A. B. C. be a triangle giuen, and let the angle giuen be E. and the baſe of the giuen triangle B. C. on which baſe it is required to reduce the giuen triangle to another, hauing an angle equall to the angle E. From the point A. by the 3. PROB. draw a parallel line to the baſe B. C. as the line A. D. then on the point C. by the 8. PROB. make the angle D. C. B. equall to the giuen angle E. and draw the line D. C. cutting the parallell line in D. and laſtly, draw the line D. B. which ſhall include the triangle D. B. C equall to the giuen triangle A. B. C. vpon the ſame baſe B. C. and hauing an angle equall to the giuen angle E. as was required. THEOR. 26.

PROBLEME LXXIIII.

To reduce one triangle into another, vpon a baſe equall to a baſe giuen.

Euc.1.37.



LEt the triangle giuen be A. B. C. and F. the giuen baſe, whereon it is required to reduce the giuen triangle. Take the giuen baſe F. and place it from B. to E. and from the point E. to the top of the giuen triangle A. draw the line A. E. then increaſe the ſide A. B. of the giuen triangle towards D. and from the point C. by the 3. PROB. draw a parallel line to

to A. E. as D. C. cutting the increaſed ſide in D. and laſtly, draw the line D. E. which ſhall include the triangle D. B. E. equall to the giuen triangle A. B. C. vpon the baſe B. E. equall to the giuen baſe, as was required. THEOR. 26. PROB. 27.

If the giuen baſe be greater then the baſe of the giuen triangle, worke in all reſpects, as is taught in PROB. 27.

PROBLEME LXXV.

To reduce one triangle to another, of any poſſible height required.

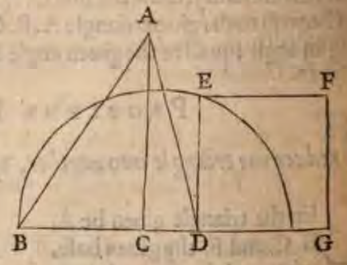
Ceul.3.5. LEt the triangle A. B. C. in the former Diagram be giuen, and let the height required be the line G. of which height it is required to reduce the giuen triangle into another of the ſame quantitie. At the diſtance of the giuen height G. by the 2. PROB. draw the line H. K. parallel to the baſe B. C. then increaſe the ſide A. B. till it cut the parallel line H. K. in D. from which point draw the line D. C. then by the point A. draw the line A. E. parallel to D. C. cutting the baſe in E. and laſtly, from the point E. draw the line E. D. which ſhall include the triangle D. B. E. equall to the giuen triangle A. B. C. and of the height G. as was required. THEOR. 26. PROB. 28.

If the giuen height be leſſe then the height of the giuen triangle, worke in all reſpects, as is taught in PROB. 28.

PROBLEME LXXVI.

To reduce a triangle giuen into a ſquare.

Euc.1.31. LEt A. B. D. be a triangle giuen. It is required to reduce the ſame into a Geometricall ſquare. By the 17. PROB. finde out a meane proportionall line between the baſe B. D. and halfe the perpendicular A. C. which ſhall be the line E. D. on which line by the 50. PROB. deſcribe the ſquare E. F. G. D. which ſhall be equall to the giuen triangle. THEOR. 25. 27.



PROBLEME LXXVII.

To reduce a triangle giuen, into a right angled parallelogram.

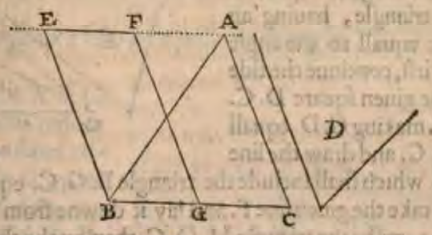
Euc.1.42. Ceul.2.28. & 2.80. LEt A. B. C. be a triangle giuen. It is required to reduce the ſame into a right angled parallelogram. From the angle A. let fall to the baſe B. C. the perpendicular A. F. then take halfe thereof for the breadth, and the

the whole baſe B. C. for the length, with which breadth and length by the 54. PROB. deſcribe the right angled parallelogram D. E. B. C. which ſhall be equall to the giuen triangle, as was required. THEOR. 25.

PROBLEME LXXVIII.

To reduce a triangle giuen, into a parallelogram, hauing an angle equall to an angle giuen.

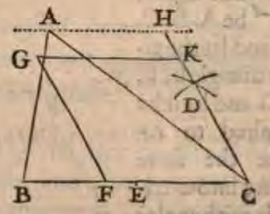
Euc.1.42. LEt A. B. C. be a triangle giuen, and let the angle giuen be D. It is required to reduce the ſame triangle into a parallelogram, hauing an angle equall to the angle D. By the 3. PROB. from the point A. draw the line E. A. parallel to the baſe B. C. then diuide the baſe B. C. into two equall parts in the point G. on which point by the 8. PROB. deſcribe the angle F. G. B. equall to the giuen angle D. and draw the line F. G. cutting the parallel line in F. from whence draw the line F. E. equall to G. B. and laſtly, draw the line E. B. which ſhall include the parallelogram E. F. G. B. equall to the giuen triangle, hauing an angle F. G. B. equall to the giuen angle D. as was required. THEOR. 28.



PROBLEME LXXIX.

To reduce a triangle giuen into a Rhombus.

Euc.1.37. Cor.6.19. LEt the triangle giuen be A. B. C. and it is required to reduce the ſame into a Rhombus. By the 3. PROB. draw the line A. H. parallel to the baſe B. C. then diuide the baſe B. C. into two equall parts in the point E. on which point at the diſtance E. B. or E. C. ſtrike an arch towards D. and on the point C. at the ſame diſtance croſſe the former arch in D. by which interſection



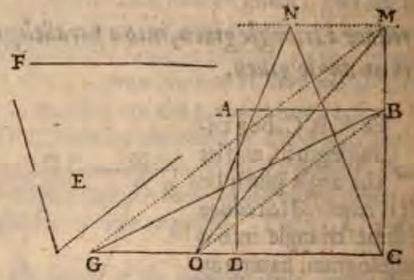
and

and the point C. draw the line H. C. to cut the parallel line in H. then by the 17. PROB. find out a meane proportionall line betweene C. D. and C. H. which is C. K. vpon which line C. K. by the 57. PROB. deſcribe the Rhombus G. K. C. F. which ſhall be equall to the triangle giuen, as was required. THEOR. 26.41.43.

PROBLEME LXXX.

To reduce a ſquare giuen into a triangle, hauing an angle equall to an angle giuen, and that on a line giuen.

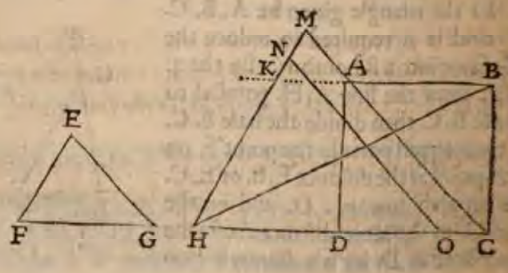
Euc.1. 37. LEt the ſquare giuen be A. B. C. D. the angle giuen E. and let the giuen line be F. On which line it is required to reduce the giuen ſquare in to a triangle, hauing an angle equall to the angle E. Firſt, continue the ſide of the giuen ſquare D. C. to G. making G. D. equall to D. C. and draw the line G. B which ſhall include the triangle B. G. C. equall to the giuen ſquare; then take the giuen line F. and lay it downe from C. to O. and by the 74. PROB. make the triangle M. O. C. then by the third PROB. draw the line M. N. parallel to the baſe G. C. and on the point C. protract an angle equall to the giuen angle E. as N. C. O. and draw the line C. N. to cut the parallel in N. and laſtly, from the point N. draw the line N. O. which ſhall include the triangle N. O. C. equall to the giuen ſquare, hauing an angle as N. C. O. equall to the giuen angle, and that on the line O. C. equall to the giuen line F. as was required. THEOR. 26.



PROBLEME LXXXI.

To reduce a ſquare giuen into a triangle, with angles equall, and lines proportionall to a triangle giuen.

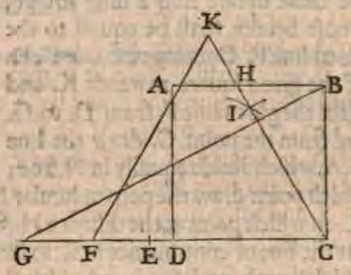
Euc. 1.37. Cor.6.19. LEt the giuen ſquare be A. B. C. D. and let the giuen triangle be E. F. G. and let it be required to reduce the ſame ſquare into a triangle, with angles equall, and lines proportionall to the giuen triangle. According to the firſt Part of the laſt PROB. make the triangle B. H. C. equall to the giuen ſquare, then continue the ſide A. B. of the giuen ſquare towards K. and on the point H. protract the angle M. H. D. equall to the angle F. in the giuen triangle, drawing the line M. H. at length to cut the continued ſide A. B. in K. then on the point C. protract the angle M. C. H. equall to the angle G. in the giuen triangle, and draw the line C. M. to cut the line M. H. in M. which ſhall include the triangle M. C. H. with equall angles to the giuen triangle, but of greater content then the giuen ſquare; wherefore by the 17. PROB. finde out a meane proportionall line betweene H. K. and H. M. which is H. N. and from the point N. by the 3. PROB. draw the line N. O. parallel to M. C. which ſhall include the triangle N. O. H. equall to the giuen ſquare, and hauing equall angles and lines proportionall to the giuen triangle, as was required. THEOR. 26.43.



PROBLEME LXXXII.

To reduce a ſquare into an equilater triangle.

Euc.1.37. Cor.6.19. LEt the ſquare giuen be A. B. C. D. and it is required to reduce the ſame into an equilater triangle. Double the ſide D. C. by increaſing the ſame to G. and draw the line G. B. to include the triangle B. G. C. equall to the giuen ſquare, then at the diſtance of the ſide of the ſquare, with one foot in C. ſtrike an arch towards I. and at the ſame diſtance with one foot in D. croſſe the ſame arch in I. and by the interſection and the point C. draw the line K. C. at length to cut A. B. in H. and take C. H. and place the ſame from C. to E. then by the 17. PROB. finde out the meane proportion betweene C. E. and C. G. which is C. F. at which diſtance deſcribe the equilater triangle K. F. C. which ſhall be equall to the giuen ſquare, as was required. THEOR. 26. 35.43



PROBLEME LXXXIII.

To reduce a ſquare giuen, into a right angled parallelogram or long ſquare, the length and bredth being limited in a right line: So as the ſide of the ſquare exceede not halfe the line giuen.

Euc.1.47. 6.13. LEt the ſquare giuen be A. B. C. D. and let the right line giuen be F. C. It is required to reduce the ſame ſquare into a long ſquare, whoſe length and bredth together ſhall be equall to F. C. Vpon the giuen line F. C. place the giuen ſquare, as in the Diagram, then deſcribe the ſemi-

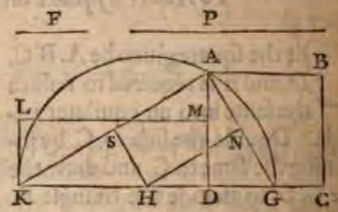
circle

circle F.E.C. to cut the ſide A. B. of the giuen ſquare in E. from which point let fall the perpendicular E.G. to cut the giuen line in G. So ſhall F. G. be the length, and G.C. the bredth of the long ſquare to be made, of which length and bredth by the 54. PROB. deſcribe the parallelogram F.G. H. K. which is equall to the giuen ſquare, and of the length and bredth required. THEOR. 41. PROB. 19.

PROBLEME LXXXIIII.

To reduce a ſquare giuen into a long ſquare, whoſe bredth is limited in a right line giuen.

*Euc.*1.47, 6, 13. LEt the ſquare giuen be A. B. C. D. and let F. be the right line giuen. It is required to reduce the ſame ſquare into a long ſquare, whoſe bredth ſhall be equall to the giuen line F. Continue the ſide C. D. of the giuen ſquare towards K. and place the giuen line F. from D. to G. and from the point G. draw the line G. A. which diuide equally in N from which point draw the perpendicular N. H. to cut the line of continuance in H. on which point at the diſtance H. G. deſcribe the ſemicircle K. A. G. to cut the line of continuance in K. ſo ſhall K. D. be the length ſought for, with which length, and the giuen bredth F. or D. G. by the 54. PROB. deſcribe the parallelogram L. M. D. K. which ſhall be equall to the giuen ſquare, as was required. THEOR. 41. PROB. 19.



PROBLEME LXXXV.

To reduce a ſquare giuen into a long ſquare, whoſe length is limited in a right line giuen.

*Euc.*1.47, 6, 13. IN the former Diagram, let that ſquare be the ſquare giuen, and the length giuen the right line P. Firſt, continue D. C. as before towards K. and make K. D. equall to the giuen line P. and draw the line K. A. vpon the middle whereof S. raiſe the perpendicular S H. to cut the line of continuance in H. on which point deſcribe the ſemicircle, as before, to cut D. C. in G. ſo ſhall D. G. be the bredth ſought, of which bredth and the giuen length, make the long ſquare, as before. THEOR. 41. PROB. 19.

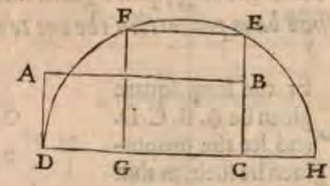
PRO-

PROBLEME LXXXVI.

To reduce a long ſquare giuen into a geometricall ſquare.

LEt the long ſquare giuen be A. B. C. D. and it is required to reduce the ſame into a geometricall ſquare. Continue the ſide D. C. of the long ſquare giuen towards H. and let the bredth B. C. of the long ſquare be placed on the line of continuation from C. to H. then on D. H. deſcribe the ſemicircle D. F. E. H. and increaſe the bredth of the long ſquare C. B. till it interſect the limbe in E. ſo ſhall E. C. (being the meane proportionall betweene D. C. and C. H.) be the ſide of the ſquare ſought, wherefore, on the line E. C. by the 50. PROB. deſcribe the geometricall ſquare F. E. C. G. which ſhall be equall to the long ſquare giuen, as was required. THEOR. 41. PROB. 19.

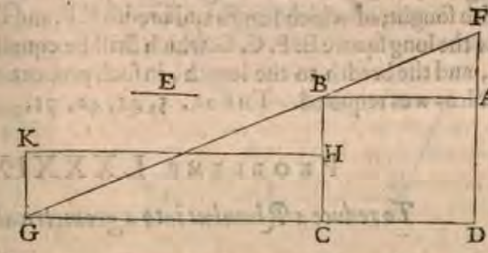
*Euc.*2.14. *Cenl.*2.37.



PROBLEME LXXXVII.

To reduce one long ſquare giuen into another, whoſe length or bredth is limited in a right line giuen.

*Euc.*1.43. LEt the long ſquare giuen be A. B. C. D. and let the bredth giuen be E. and let it bee required to reduce the long ſquare giuen, into another long ſquare of the giuen bredth E. Continue the bredth of the giuen ſquare D. A. towards F. making A. F. equall to the giuen bredth E. alſo continue the length D. C. of the giuen ſquare towards G. and by the point F. and B. draw out the line F. G. to cut the line of continuance laſt drawne in G. ſo ſhall G. C. be the length ſought for, with which length and the giuen bredth E. by the 54. PROB. make the long ſquare K. H. C. G. which ſhall be equall to the giuen long ſquare, and of the limited bredth, as was required. THEOR. 5.



Or otherwiſe, thus.

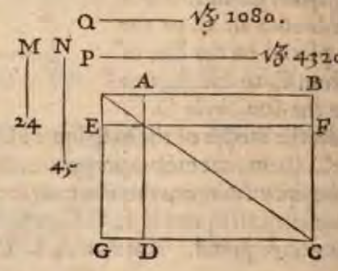
*Euc.*6.12. IN the former Diagram, let it be required to reduce the long ſquare there giuen, into another long ſquare, whoſe bredth ſhall be the giuen line E. By the 16. PROB. reaſon thus. If E. the giuen bredth giue A. D. the bredth of the giuen ſquare, what giues A. B. the length thereof, the anſwere

ſhall be G. C. or K. H. the length ſought for, with which length and the giuen bredth, make the long ſquare K. H. C. G. as before. THEOR. 42.

PROBLEME LXXXVIII.

To reduce one long ſquare giuen into another, whoſe length and bredth ſhall haue proportion the one to the other, as two giuen lines.

Euc.6.12. 13.14. LEt the long ſquare giuen be A. B. C. D. and let the proportion giuen be ſuch, as that betweene the two right lines M. and N. It is required to reduce the ſame long ſquare into another long ſquare, whoſe length and bredth ſhall haue proportion the one to the other, as thoſe two giuen lines. By the 17. PROB. ſeeke out the meane proportion betweene the two giuen lines M. and N. which is Q. ſeeke alſo the meane proportion betweene A. D. and A. B. the bredth and length of the long ſquare giuen, which is the right line P. then by the 16. PRO. reaſon thus. If Q. giues P. what giues N. the anſwere ſhall be E. F. for the length ſought; and againe, if Q. giues P. what giues M. the anſwere ſhall be E. G. for the bredth ſought; of which length and bredth E. F. and E. G. by the 54. PROB. make the long ſquare E. F. C. G. which ſhall be equall to the long ſquare giuen, and the bredth to the length, in ſuch proportion as the line M. to the line N. as was required. THEOR. 5, 41, 42, 71.

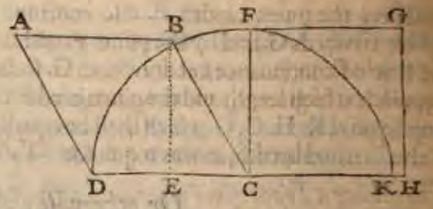


A B. 72.
B C. 60.
E F. 90.
E G. 48.

PROBLEME LXXXIX.

To reduce a Rhombus into a geometricall ſquare.

Euc.1.36. LEt the Rhombus giuen be A. B. C. D. and let it be required to reduce the ſame into a geometricall ſquare. Firſt, by the 17. PROB. finde out a meane proportionall line betweene D. C. the ſide of the giuen Rhombus, and the parallel diſtance, or perpendicular line B. E. which ſhall be the line F. C. vpon which line, by the 50. PROB. deſcribe the geometricall ſquare F. G. H. C. which ſhall be equall to the giuen Rhombus A. B. C. D. as was required. THEOR. 33, 34.



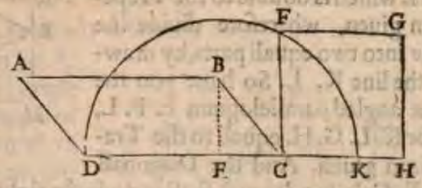
PRO-

PROBLEME XC.

To reduce a Rhomboydes giuen, into a Geometricall Square.

LEt the Rhomboydes giuen be A. B. C. D. and it is required to reduce the ſame into a Geometricall Square. Let fall the perpendicular B. E from the Angle B. to the Baſe D. C. betweene which Baſe and Perpendicular, by the 17. PROB. finde out a meane proportionall line, which ſhall be F. C. vpon which line by the 50. PROB. deſcribe the Square F. G. H. C. which ſhall be equall to the giuen Rhomboydes as was required. DEF. 27. THEOR. 33.34.

Euc.1.36.

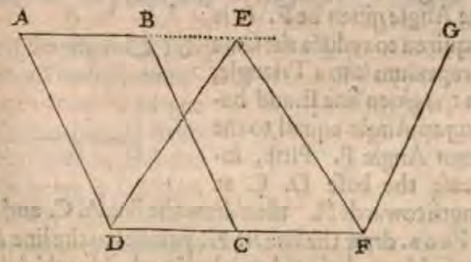


PROBLEME. XCI.

To reduce a Rhomboydes giuen into a Triangle, haning an Angle equall to an Angle giuen.

LEt the Rhomboydes giuen be A. B. C. D. and let the Angle giuen be E. F. G. It is required to reduce the ſame Rhomboydes into a Triangle, hauing an Angle equall to E. F. G. Firſt, increaſe the line A. B. towards E. and alſo the baſe D. C. towards F. and make C. F. equall to D. C. then on D. protract the Angle E. D. F. by the 8. PROB. equall to the giuen Angle E. F. G. and draw the line D. E. to cut the increaſed line in E. And laſtly, from E. draw the line E. F. which ſhall include the Triangle E. D. F. equall to the Rhomboydes giuen, and hauing an Angle equall to the giuen Angle as was required. THEOR. 28.

En.1.41.



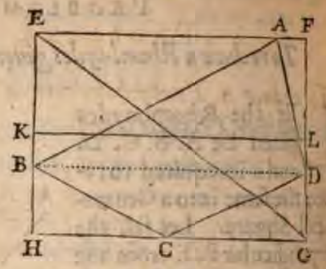
PROBLEME XCII.

To reduce a Trapezium giuen into a right angled Parallelogram, or into a right angled Triangle.

LEt the Trapezium giuen be A. B. C. D. which is to be reduced into a right angled Parallelogram, or into a right angled Triangle. Firſt, draw the Diagonall line B. D. then by the 2. PROB. by the points A. and C. draw

Euc.1.41. Cond.2.29.

draw the lines E.F. and H.G. Parallel to B.D. and by the point B. and D. draw E.H. and F.G. to cut the two last lines Orthigonally, so shal you include the Parallelogram E.F.G.H. which is double to the Trapezium giuen, wherefore diuide the same into two equall parts, by drawing the line K.L. So haue you the right angled parallelogram E.F.L.K. or K.L.G.H. equall to the Trapezium giuen. And the Diagonall line E.G. being drawne, shall include the right angled Triangle, E.H.G. or E.F.G. likewise equall to the same Trapezium as was required. THEOREME 23. 27.

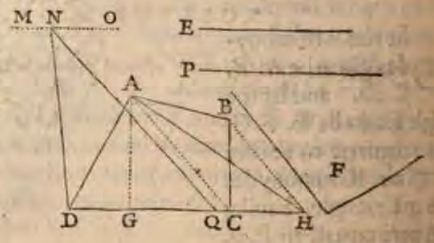


PROBLEME XCIII.

To reduce a Trapezium giuen into a Triangle, vpon a line giuen, and hauing an Angle equall to an Angle giuen.

Euc. 1. 23.
1. 13.
1. 37.
1. 44.
6. 12.

LEt the Trapezium giuen be A.B.C.D. the giuen line E. and let the Angle giuen be F. It is required to reduce the same Trapezium into a Triangle, on the giuen line E. and hauing an Angle equall to the giuen Angle F. First, increase the base D.C. at length towards H. then draw the line A.C. and from the point B. by the 3. PROB. draw the line B.H. parallel to the line A.C. to cut the increased line in H. and then draw the line A.H. which shall include the Triangle A.D.H. equall to the Trapezium giuen, but not hauing the Angle nor Base required; wherefore take the giuen Base E. and place it from D. to Q. and by the 16. PROB. reason thus; if D.Q. the giuen Base giues D.H. what giues A.G. the perpendicular; the answere will be the line P. for the perpendicular of the Triangle sought, at which distance draw the line M.O. parallel to the line D.H. then vpon the point D. protract an Angle equall to the giuen Angle F. as N.D.Q. and draw the line D.N. to cut the parallel line in N. And lastly, draw the line N.Q. which shall include the Triangle N.D.Q. equall to the Trapezium giuen, vpon a line giuen, and hauing an Angle equall to an Angle giuen, as was required. THEOREME 26. 42. 71. PROBLEME 3. 8. 16. 74.



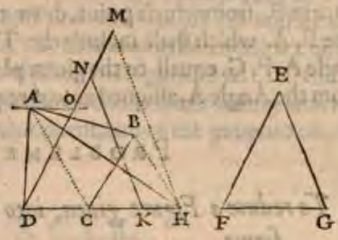
PROB.

PROBLEME. XCIIII.

To reduce a Trapezium into a Triangle, which shall be like vnto another Triangle giuen.

LEt the Trapezium giuen be A.B.C.D. and let the Triangle giuen be E.F.G. It is required to reduce the same Trapezium into a Triangle, which shall be like vnto the giuen triangle E.F.G. First, by the 93. PROB. last before going; reduce the Trapezium giuen into the triangle A.D.H. which is equall thereunto, then by the 81. PROB. reduce the same triangle A.D.H. into the triangle N.D.K. which shall be equall to the Trapezium giuen, and like vnto the giuen triangle E.F.G. as was required. THEOR. 26. 43. PROB. 38. 16. 93.

Euc. 1. 37.
1, 23.
Cor. 6. 19.
Ceul. 3. 1.



PROBLEME XCV.

To reduce an equiangled Poligon giuen, into a Geometricall Square.

LEt A.B.C.D.E. be a Pentagonall Poligon giuen, to be reduced into a Geometricall square. By the 17. PROB. find out the meane proportionall line betweene halfe the perimetrie of the giuen Poligon, and the perpendicular thereof M.N. being let fall from the Centre to the middle of any side, which meane proportionall is the line G.H. whereon by the 50. PROB. describe the square F.G.H.K. which shall be equall to the giuen Poligon, as was required. DEFINITION. 29. THEOREME 39. 41.

Euc. 2. 14.
Ceul. 2. 30.

This rule is generall for the reducing of all rectangle poligons.

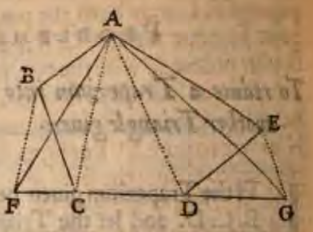
PROBLEME XCVI.

To reduce a plotte giuen into a Triangle, with lines drawne from an Angle assigned.

LEt A.B.C.D.E. be a plotte giuen, and let the Angle assigned be A. It is required from the Angle A. to reduce the same plot into a Triangle. First, increase the side C.D. of the giuen plot, of conuenient length

Cæterorum polygonorum rectangulorum reductio & demonstratio huic est similima: semper enim hac reductione figillat im vnum latus detrahitur. Eue.1.37. Ceul.3.1.2.

length both wayes towards F. and G. then draw the line A. D. and by the 3. PROB. by the point E. draw the line E. G. parallel to the line A. D. to cut the continued line in G. from which point, draw the line G. A. then draw the line A. C. and by the point B. make B.F. parallel to A. C. to cut the line of continuance in F. from which point, draw the line F. A. which shall include the Triangle A. F. G. equall to the giuen plot, with the lines A. F. and A.G. drawn from the Angle A. assigned as was required. THEOR. 26.



PROBLEME XCVII.

To reduce a Figure giuen, into a Lunula or Figure of a Lunular forme.

LEt A. B. C. D. be a square giuen, and let it be required to reduce the same into a Lunula. Draw the Diagonall A. C. and on C. the end thereof by the 6. PROB. erect the perpendicular E. C. equall to A. C. then continue the side A. B. to E. and on the point B. at the distance B. A. or B. E. describe the Semicircle A. F. E. And lastly, on the point C. at the distance C.A. or C.E. describe the Arch line A.G.E. which shal include the Lunula A.F.E.G. equall to the giuen square, as was required.

PROBLEME XCVIII.

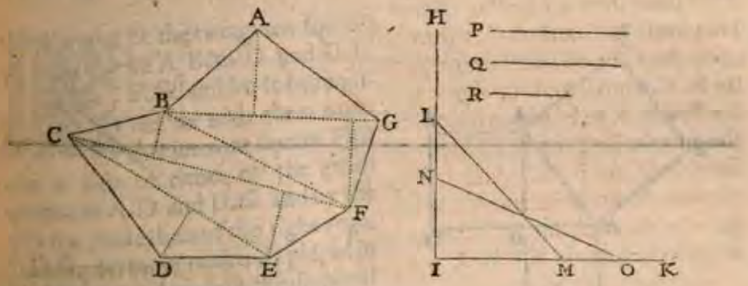
To reduce an irregular Figure giuen, into a greater or lesser forme, according to any giuen proportion.

LEt A.B. C.D.E.F. be an irregular Figure giuen, and let the proportion giuen bee that betweene M. and N. It is required to reduce the same Figure into a lesser, to be in such proportion to that giuen as M. to N. First reduce the giuen Figure into Triangles, by drawing right lines from any one angle, as from F. to all the opposite Angles, as B.C. and D. then by the

23. PROB. diuide one of the sides as F.E. in power, as M. to N. so that the power of F. L. may be to the power of F. E. as M. to N. Then by the point L. draw the line L. K. parallel to E. D. to cut F. D. in K. and in like sort proceede with the rest, as K. I. I. H. and H.G. drawing them parallel to their answerable sides; so shall you include the Figure F. G.H. I.K.L. being like vnto the Figure giuen, and in proportion to it, as the line M. to N. as was required. But suppose the lesser plot were giuen, and let it bee required to reduce the same into a greater, according to the proportion of N. to M. then increase all the lines from F. towards A. B. C. D. and E. and by the 24. PROBLEME inlarge the line F. L. in power as N. to M. which set from F. to E. and by the point E. draw the line E. D. parallel to L.K. to cut F. D. in D. and in like sort proceede with the rest. So shall you include the irregular Figure A.B.C.D.E.F. like to that giuen, and of the proportion, as was required. THEOREME. 22.

PROBLEME XCIX.

To reduce an irregular Figure giuen, into a Geometricall Square.



LEt A.B.C.D.E.F.G. bee an irregular Figure giuen, to bee reduced into a Geometricall Square. First, draw the lines B. F. and C. E. diuiding the giuen Figure thereby into two Trapezias, and one Triangle, namely, A.B.F.G. B.F.E.C. and C.D.E. then crosse those Trapezias with the Diagonall lines B. G. and C. F. and let fall perpendiculars thereon from the Angles A. F. E. and B. and likewise from D. to the Base of the Triangle, then by the 17. PROBLEME finde out the meane proportionall, betweene halfe the Diagonall B. G. and the two perpendiculars thereon falling, which shall be the line P. Also the meane proportionall betweene halfe the Diagonall C. F. and the two perpendiculars thereon falling, which shall be the line Q. and likewise the meane proportionall betweene halfe the Base C. E. and the perpendicular thereon falling from D. which shall be the line R. then by the 9. PROBLEME describe a right Angle at pleasure, as H. I. K. and take the line P. and place the same, from I. to L. and also the line

Eue.2.14. 6. 13. 1. 47.

line Q. from I. to M. and draw the line L. M. which line place from I. to O. and alſo the line R. from I. to N. And laſtly, draw the line N.O. which ſhall be the ſide of a Square, equall to the giuen Figure as was required. THEOREME 6. 25. 41. 30.

Here might I fitly inſert the Reduction and manner of tranſlation of large and ſpacious plots, from one Scale to another, diuers wayes, with many other works of this nature, fitte to bee knowne, which for ſome ſpeciall reaſons, I will referre vnto the later end of my next Booke. And in the meane ſpace will here conclude the third part of this Second Booke.

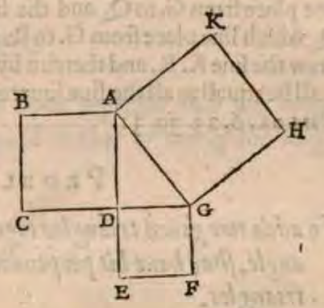
The fourth Part.

HOw diuers ſuperficiall figures, of ſeuerall formes, are brought into one figure, and one forme: Alſo to ſubtract one figure from another, and thereby to know how much the one exceedeth the other in quantitie; and likewiſe, hereby is taught, the inſcription and circumſcription of one figure within and without another; and the diuiſion and ſeparation of figures, into any parts required.

PROBLEME C.

Two Geometricall ſquares being giuen, to adde them together into one ſquare.

LEt the two giuen ſquares be A. B. C. D. and D. E. F. G. and let it be required to adde them together into one ſquare. Firſt take a ſide of either of the giuen ſquares, as A. D. and D. G. and by the 9. PROB. make thereof the right angle A. D. G. (as they are already placed in this Diagram) then draw the diagonal line A. G. and on that line by the 50. PROB. deſcribe the ſquare A. K. H. G. which ſhall be equall to the two giuen ſquares, as was required. THEOR. 6.

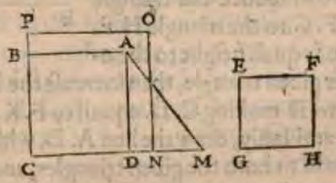


Euc.1.47.

PROBLEME CI.

Two Geometricall ſquares being giuen, to adde them together in ſuch ſort, as the one ſhall be a Gnomon vnto the other.

LEt the two giuen ſquares be A. B. C. D. and E. F. G. H. and let it be required to adde them together, in ſuch ſort that the ſquare E. F. G. H. ſhall be a Gnomon vnto the other. Increaſe the ſide C. D. of the greater ſquare to M. making D. M. equall to the ſide of the leſſer ſquare,



Euc.1.47. Cond.2.38.

square, then draw the subtending line A.M. which take and lay downe from C. to N. and thereon by the 50. PROB. describe the square O.P.C.N. which shall performe what was required. DEF.30. THEOR. 6.

PROBLEME CII.

To adde diuers squares together into one geometricall square.

*Euc.*1.47. 6.31.

Diuers figures of what forme or kinde soeuer, being by the former rules reduced into squares, may hereby instantly be added together into one.

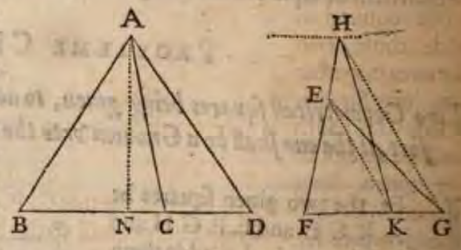
LEt A. B. C. D. and E. be the sides of fiue squares giuen, and let it be required to adde them together into one geometrical square. Firſt, by the 9. PROB. make a right angle at pleasure, as F. G. H. then (beginning with the least sides firſt) take the line E. and place it from G. to N. and the line D. from G. to O. and draw the line N.O. whose square shall be equall to both the squares of E. and D. then take N. O. and place it from G. to P. and the side C. from G. to M. and draw the line M. P. which line place from G. to Q. and the side B. from G. to L. and draw the line L. Q. which line place from G. to R. and the line A. from G. to K. and lastly, draw the line K. R. and thereon by the 50. PROB. describe a square which shall be equall to all the fiue squares, whose sides were giuen, as was required. THEOR. 6. 23. 30. 31.

PROBLEME CIII.

To adde two giuen triangles together into one, which new composed triangle, shall haue his perpendicular, equall to that of one of the giuen triangles.

*Euc.*1.37. 1.38.

LEt the two giuen triangles bee A. B, C. and E. F. G. and let it be required to adde those 2. triangles into one, which shall haue his perpendicular equall to that of the triangle A. B. C. By the 75. PROB. reduce the triangle E. F. G. to the triangle H. F. K. of equall height to the other giuen triangle, then increase the base B. C. of the triangle A. B. C. from C. to D. making C. D. equall to F. K. the base of the reduced triangle H. F. K. and lastly, draw the line A. D. which shall include the triangle A. B. D. equall to both the giuen triangles, and hauing the same perpendicular A. N. as the giuen triangle A. B. C. as was required. THEOR. 26. PROB. 28.



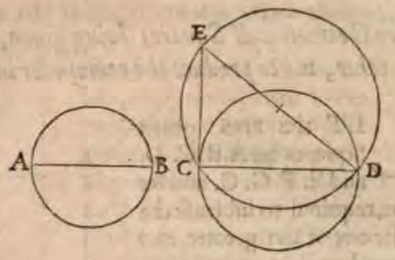
PRO-

PROBLEME CIIII.

Diuers Circles being giuen, to adde them together into one Circle.

*Euc.*1.47. 12. 2.

LEt A. B. and C. D. bee two Circles giuen, and let it be required to adde them both into one Circle, or to make one Circle, which shall be equall to them both. Take the Diameter A.B. and by the 6. PROB. rayse it perpendicularly on the end of the other Diameter C. D. as E. C. then draw the subtending line E. D. on which line as a Diameter describe the Circle E. D. which shall bee equall to the two giuen Circles as was required. And in like sort, by helpe of the 102. PROB. may be added as many Circles as shall be required; For Circles are added by their Diameters, as Squares by their sides. THEOREME 6. 66.

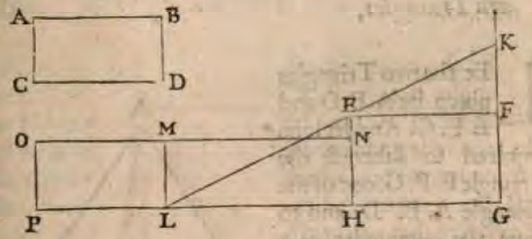


PROBLEME CV.

Two long Squares being giuen, to adde them together into one long Square, whose breadth shall be equall to that of one of the long Squares giuen.

Euc. 1.43.

LEt the two giuen long Squares be A.B.C. D. and E. F. G. H. and let it bee required to adde those two Squares together into one Square, whose breadth shall be equall to the giuen long Square A.B.C.D. Firſt, increase the side G. F. of the greater long Square giuen towards K. making F. K. equall to the breadth of the lesser giuen Square, and so working on by the 87. PROB. reduce the giuen long square E. F. G. H. into the long square M. N. H. L. then on the Line M. L. by the 54. PROB. describe the long square O. M. L. P. equall to the giuen long square A. B. C. D. So shall the long Square O. N H. P. bee equall to the two



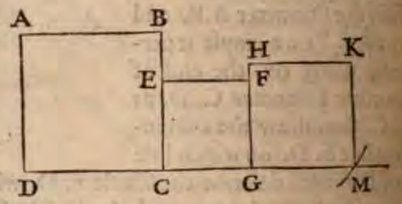
two giuen long Squares, and the breadth thereof O. P. or N. H. equall to the breadth of the leſſer long Square giuen, as was required. Theoreme. 5.

Probleme CVI.

Two Geometricall Squares being giuen, to ſubtract the one out of the other, and to produce the remainder in a third Square.

Euc. 1. 47. 6. 31.

LET the two giuen Squares be A.B.C. D. and E. F. G. C. and let it be required to ſubtract the leſſer out of the greater, and to produce the remainder in a third ſquare. Continue out at length the ſide C. G. of the leſſer giuen ſquare towards M. and at the diſtance of the ſide of the greater giuen Square with one foot in the Angle F. of the leſſer ſquare ſtrike an Arch line through the line of continuance in M. And laſtly, by the 50. Prob. on the line G.M. deſcribe the Square H. K. M. G. which ſhall be the remainder of the greater giuen Square, the leſſer being ſubtracted from the ſame, as was required. Theoreme. 6. 23. 30. 31.

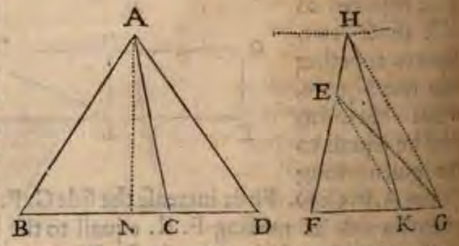


Probleme CVII.

Two Triangles being giuen to ſubtract the one out of the other, and to leaue the remainder in a Triangle of equall height to one of the giuen Triangles.

Euc. 1. 37. 1. 38.

LEt the two Triangles giuen be A.B.D. and E. F. G. And let it be required to ſubtract the Triangle E. F. G. out of the Triangle A. B. D. and to leaue the remainder in a Triangle of equall height to the Triangle A. B. D. By the 75. Prob. reduce the Triangle E. F. G. to the triangle H. F. K. of equall height to the other giuen triangle, then take the Baſe F. K. of the ſame reduced triangle, and place it from D. to C. And laſtly, draw the line A. C. which ſhall include and ſubtract the Triangle A. C. D. (equall to the leſſer giuen triangle E. F. G) from the



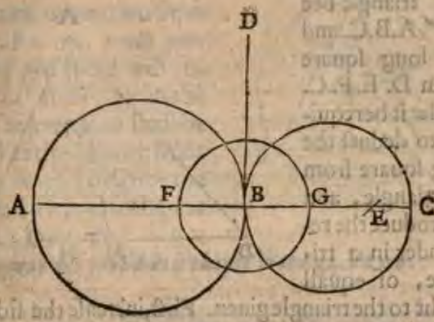
the greater giuen triangle A. B. D. and leaue the remainder in the triangle A. B. C. of the ſame height of the giuen triangle A. B. D. as was required, Theor. 26. Prob. 28.

Probleme CVIII.

Two circles being giuen, to ſubtract the one out of the other, and to produce the remainder in a third circle.

Euc. 1. 47. 12. 2.

LEt the two circles giuen be A. B. and B. C. and let it be required to ſubtract the circle B. C. out of the circle A. B. and to produce the remainder in a third circle. Take the diameter B. C. and by the 6. Prob. raiſe it perpendicularly on the point B. as D. B. then at the diſtance of the diameter A. B. with one foot in D. ſtrike an arch through the diameter B. C. in E. then at halfe the diſtance of B. E. deſcribe the circle F. G. on the point B. So haue you ſubtracted the circle B. C. out of the circle A. B. and produced the remainder in a third circle F. G. as was required. Theor. 6, 66.

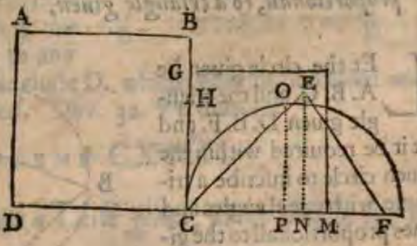


Probleme CIX.

A geometricall ſquare and a triangle being giuen, to ſubtract the triangle from the ſquare, and to produce the remainder in a ſquare.

Euc. 1. 47. 2. 14. 6. 18.

LEt the Geometricall ſquare giuen be A. B. C. D. and let the triangle giuen be E. C. F. and let it be required to ſubtract the triangle from the ſquare, and to produce the remainder in a ſquare. By the 17. Prob. find out the meane proportionall, betweene the perpendicular of the giuen triangle E. N. and halfe the baſe C. F. which ſhall be the line O. P. which place from C. to H. on which point H. at the diſtance of the ſide of the giuen ſquare, ſtrike an arch through the baſe C. F. as at M. and laſtly, vpon the line C. M. deſcribe by the 50. Prob. the ſquare G. K. M. C. So haue you ſubtracted the giuen triangle

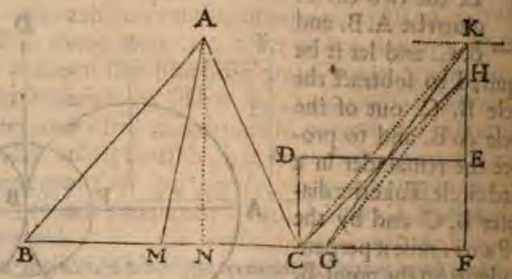


triangle E.C.F. from the giuen ſquare A.B.C.D. and produced the remainder in the ſquare G.K.M.C. as was required. THEOREME 6, 41, 70.

PROBLEME CX.

A triangle and a long ſquare being giuen, to ſubtract the long ſquare from the triangle, and to produce the remainder in a triangle of equall height, to the triangle giuen.

Euc. 1. 38. 1. 41. 6. 1.



LEt the giuen triangle bee A.B.C. and the long ſquare giuen D.E.F.C. and let it berequired to deduct the long ſquare from the triangle, and to produce the remainder in a triangle, of equall height to the triangle giuen. Firſt, increaſe the ſide F.E. of the long ſquare towards K. and placing E.F. from E. to H. draw the line H.C. including the triangle H.C.F. equall to the long ſquare giuen; which triangle by the 75. PROB. reduce into the triangle K.G.F. of equall height to the giuen triangle A.B.C. then take the baſe G.F. of the laſt found triangle, and place it from C. to M. on the baſe of the giuen triangle; and laſtly, draw the line A.M. to include and ſubtract the triangle A.M.C. (equal to the giuen long ſquare) from the giuen triangle A.B.C. & producing the remainder in the triangle A.B.M of equall height to the triangle giuen, as was required. THEOR. 26, 27, 28, 35.

PROBLEME CXI.

Within a circle giuen to inſcribe a triangle, with angles equall, and lines proportionall, to a triangle giuen.

Euc. 3. 32. 4. 2. *Ceul.* 2. 53.

LEt the circle giuen be A.B.C. and the triangle giuen D.E.F. and let it be required within the giuen circle to inſcribe a triangle, with equal angles and lines proportionall to the giuen triangle. By the 31. PRO. draw the giuen circle, the right line G.H. touching the ſame in the point C. vpon which point vnto the line C.H. deſcribe the angle A.C.H. equall to the angle D.E.F. and likewiſe on the ſame point, to the line G.C. deſcribe the angle B.C.G. equall to the

the angle E.D.F. and laſtly, draw the line B.A. which ſhall include the triangle A.B.C. inſcribed within the giuen circle, with equall angles and lines, proportionall to the triangle giuen, as was required. THEOR. 56, 13.

PROBLEME CXII.

To deſcribe a Circle about a Triangle giuen.

Euc. 4. 5.

LEt the Triangle giuen be A.B.C. about which it is required to deſcribe a Circle, vpon the middle point of any two ſides of the Triangle by the 5. PROB. erect perpendiculars, which being produced will interſect each other, as E.D. and F.D. in the point D. which point of interſection ſhall be the Centre; whereupon at the diſtance from thence to any one of the Angles deſcribe the Circle A.B.C. which ſhall circumſcribe the Triangle as was required. DEF. 32.

Or otherwiſe the Centre may bee found as is taught in the 34. PROB.

PROBLEME CXIII.

To inſcribe a Circle within a Triangle giuen.

Euc. 4. 4. *Ceul.* 2. 55.

LEt the Triangle giuen be A.B.C. within which Triangle it is required to inſcribe a Circle. By the 10. PROB. diuide any two Angles of the giuen Triangle into two equall parts as A.B.C. and A.C.B. by drawing the lines B.D. and C.D. interſecting in D. which point of interſection ſhall be the Centre, whereon at the neereſt diſtance from thence to any ſide of the Triangle deſcribe the circle D. which ſhall be inſcribed within the Triangle, as was required. DEF. 32. PROB. 10.

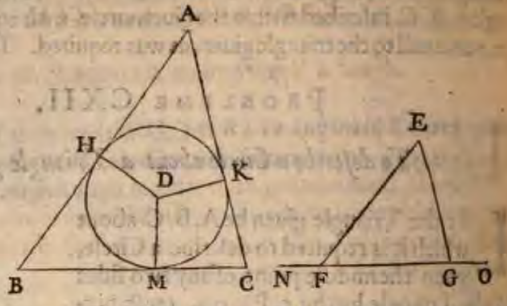
PROBLEME CXIIII.

To deſcribe a Triangle about a Circle giuen, which ſhall be like vnto a Triangle giuen.

Euc. 4. 3. *Ceul.* 2. 54.

LEt the Circle giuen be H.K.M. and let the Triangle giuen be E.F.G. It is required to deſcribe a triangle about the giuen Circle, like vnto the giuen triangle. Firſt, continue the Baſe F.G. of the giuen tri-

Triangle both wayes towardes N. and O. making the two outward Angles E. F. N. and E. G. O. then from the centre D. of the giuen circle draw to any part of the lymbe a semidiameter as D. M. to



which line vpon the centre D. describe the angle H. D. M. equall to the angle E. F. N. and also the Angle K. D. M. equall to the angle E. G. O. then by the points H. K. and M. draw right lines, (making right angles with the three semidiameters) which will intersect each other in the points A. B. and C. including the triangle A. B. C. like vnto the giuen triangle, and circumscribed about the giuen circle, as was required. THEOR. 1. 13. 52.

PROBLEME CXV.

To describe a Square about a Circle giuen.

Euc. 4. 7. Cenl. 2. 57.

LEt the circle giuen be A. B. C. D. and let it be required to describe a square about the same circle. Draw the two Diameters A. C. and B. D. cutting each other at right angles in the centre 1. then by the 3. PROB. by the points A. and C. draw parallel lines to the Diameter B. D. And likewise by the points B. and D. draw parallel lines to the Diameter A. C. which shall intersect each other in the points E. F. G. H. and include the square as was required. THEOR. 32. 52.

PROBLEME CXVI.

Within a Square giuen to inscribe a Circle:

LEt the square giuen be E. F. G. H. in the former Diagram, within which it is required to inscribe a circle. Draw the Diagonall lines E. G. and F. H. intersecting each other in 1. the center, on which point at the distance of the shortest extention to any side, describe the circle A B C D. within the square as was required. THEOR. 32. 52.

PROB.

PROBLEME CXVII.

About a Square giuen to circumscribe a Circle.

LEt the Square giuen be A. B. C. D. in the former Diagram, about which it is required to circumscribe a Circle. Draw the Diagonall lines A. C. and B. D. intersecting each other at right Angles in the point I. the centre, on which point, at the distance from thence to any of the points A. B. C. or D. describe the Circle A. B. C. D. which shall circumscribe the Square as was required. THEOREME 1. 13. 52. *Euc. 4. 9.*

PROBLEME CXVIII.

To inscribe a Square within a Circle giuen.

LEt the Circle giuen be A. B. C. D. in the former Diagram, and let it be required to inscribe a square within the same Circle. Draw the Diameters A. C. and B. D. crossing each other at right Angles in the centre I. then betweene the points A. B. C. and D. draw the right lines A B. B C. C D. and D A. including and inscribing the square A. B. C. D. within the giuen Circle as was required. THEOREME. 1. 13. 52. PROBLEME 25. *Euc. 4. 6.*

PROBLEME CXIX.

To inscribe a Pentagon, within a Circle giuen.

LEt A. B. C. D. E. be a Circle giuen, within which it is required to inscribe a Pentagon. By the 25. PROBLEME Finde out the fift corde line of a Circle, at which distãce passing through the limbe of the circle note fiue marks as at the points A. B. C. D. and E. And lastly, frõ point to point draw fiue right lines, which shall include and inscribe the Pentagon A. B. C. D. E. as was required. THEOR. 47. 69. PROB. 48. *Euc. 4. 11. Cenl. 2. 58.*

PROBLEME CXX.

About a Circle giuen to circumscribe a Pentagon.

LEt the Circle giuen be A. B. C. D. in the former Diagram, about which, it is required to circumscribe a Pentagon. Let first a Pentagon be inscribed as before, and from the Centre N. draw right lines to euerie

Euc.4.12. Angle of the inscribed Pentagon, as to A.B.C. D. & E. on which fiue points, draw lines Orthigonally to those lines issuing from the centre, which will intersect each other in the points F. G. H. I. K. and circumscribe the Pentagon about the giuen circle as was required. THEOR. 47. 69.

PROBLEME CXXI.

To inscribe a Sexagon within a circle giuen.

Euc.4.15. Ceul.2.63. LEt the circle giuen be A. B. C. D. E. F. within which it is required to inscribe a Sexagon. By the 25. PROB. finde out the sixt corde of a Circle, which is alwayes the semidiameter of the same circle; wherefore at the distance of the semidiameter; Diuide the limbe of the circle into sixe equall partes, as in the points A.B.C.D.E. and F. and then from point to point, draw right lines, which shal include and inscribe the Sexagon A.B. C. D.E.F. within the giuen Circle, as was required. PROB. 25.

PROBLEME CXXII.

To circumscribe a Sexagon about a Circle giuen.

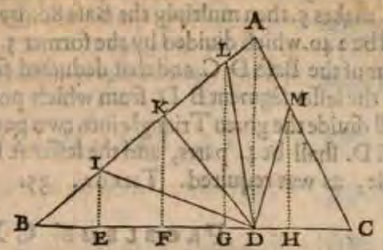
LEt the Circle giuen be A.B.C.D.E.F. in the former Diagram, about which it is required to circumscribe a Sexagon. First, diuide the limbe of the Circle into sixe parts, as was taught in the last PROB. in the the points A. B. C. D. E. and F. and draw Diameters from each opposite point to other, making in all three Diameters, then at euery end of those Diameters draw lines Orthigonally vnto them, which will intersect each other in the points G.H.I. K. L. and M. and include the Sexagon circumscribed about the giuen circle as was required. PROB. 25.

PROBLEME. CXXIII.

To diuide a right lined Triangle giuen, into any number of equall parts required, from a point limited in any side of the same Triangle.

LEt A. B. C. be a right lined Triangle giuen; let the limited point be D. in the Base B. C. and let it be required from the same limited point D. to diuide the giuen triangle into fiue equall parts. First, diuide the Base B. C. into fiue equall parts, as in the points E. F. G. and H. (or into as

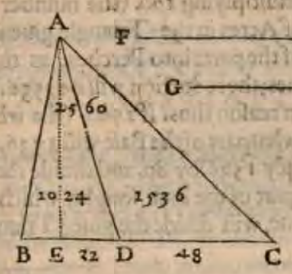
many as shall bee required) then from the limited point to the opposite angle, draw a right line as A. D. vnto which line, by the points E.F.G. and H. draw Parallel lines, as E I. F K. G L. and H M. And lastly from the points I. K. L. and M. to the limited point D. draw the lines I D. K D. L D. and M D. which shall diuide the giuen triangle into fiue equall parts from the limited point D. as was required. THEOREME. 26.35.



PROBLEME CXXIIII.

To diuide a giuen Triangle by a line issuing from an angle assigned, in any proportion required.

Euc.6.1. Ram. 10.13 Ceul.3.8. LEt the Triangle giuen be A.B.C. the angle assigned A. and the proportion that betweene the two right lines F. and G. It is required to diuide the same triangle into two parts by a line issuing out of A. the one part hauing proportion to the other, as F. to G. By the 13. PROB. diuide the Base B C. as F. to G. the point of which diuision will fall in D. From which point draw the line D. A. So is the giuen Triangle diuided into two parts, hauing proportion the one to the other, as F. to G. For as the line F. is to the line G. so is the triangle A. C. D. to the Triangle A. B. D. as was required. THEOR. 35. PROB. 13.



PROBLEME. CXXV.

A Triangle being giuen, and the Base thereof known, to diuide the same into two parts by a line from an angle assigned, according to any proportion giuen in two numbers.

LEt the triangle giuen be A.B. C. in the former Diagram, whose Base is B.C. 80. and the angle assigned A. and let it be required to diuide the same into two parts, the one in proportion to the other *Sesquialtera*, that

that is, as 3. to 2. First, adde together alwayes the *Termini rationis*, which is 5. makes 5. then multiply the Base 80. by 3. the greater terme, the *factus* will be 240. which diuided by the former 5. quoteth 48. for the greater segment of the Base D C. and that deducted from 80. the whole Base resteth 32. the lesser segment B D. from which point D. draw the line D A. which shall diuide the giuen Triangle into two parts, as 3. to 2. that is, the greater A C D. shall be $\frac{3}{5}$. parts, and the lesser A B D. $\frac{2}{5}$. of the whole giuen Triangle, as was required. THEOR. 35.

Euc.6.1. *Ra.10.13.*

PROBLEME CXXVI.

To diuide a Triangle of knowne quantitie giuen, into any two parts, from an Angle assigned, according to any number of Acres, Roodes and Perches required.

LEt the Triangle be A B C. in the former Diagram, whose quantitie is 16. Acres; let the Angle assigned be A. and let it be required to diuide the same into two parts twixt H. and I. viz. to H. 9. Acres. 2. Roodes, 16. Perches: and to I. 6. Acres, 2. Roodes, 24. Perches. First, measure the Base B C. 80. Perches; then reduce the whole quantitie of the Triangle into Perches, by multiplying 160. (the number of Perches in an Acre) by 16. (the numbet of Acres in the Triangle giuen) the Product will be 2560. Reduce also one of the parts into Perches, as the greater part 9. Acres, 2. Roodes, 16. Perches; the reduction will be 1536. Perches. And then by the rule of proportion reason thus. If 2560. (the whole quantitie) require 80. (the whole Base; what part of the Base will 1536. Perches (being the part of H.) require. Multiply 1536. by 80. and diuide the Product by 2560. the *quotus* will be 48. the part of the Base sought, which placed from C. to D. and the line D A. drawne, will diuide the giuen Triangle into the parts required. THEOR. 35.

Euc.6.1. *Ra.10.13.*

Or to lay out one of the parts giuen (whereby the other is knowne) worke thus.

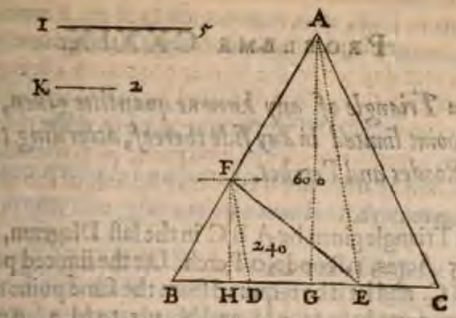
LEt it be required to lay out the lesser part, which containeth 1024. perches, diuide that number 1024. by halfe, the perpendicular A E. 32. the *quotus* will be 32. for the part of the Base to be cut off for that part; which placed from B. to D. and the line A. D. drawn, performeth the worke. Or double the quantitie giuen 1024. and diuide that double by the whole Base 64. the worke will be the same.

PROBLEME CXXVII.

To diuide a Triangle giuen into two parts by a line drawn, from a point limited in one of the sides, in any proportion required.

LEt A B C. be the Triangle giuen, the point limited E. in the Base B C. and let the proportion be that betweene I. and K. It is required from the point E. to draw a line, which shall diuide the same Triangle into two

two parts, hauing proportion the one to the other, as I. to K. First, from the giuen point E. to the opposite angle A. drawe a right line, as A. E. then by the 13. PROB. diuide the Base B. C. as I. to K. the point of which diuision will fall in D. from whence draw the line D F. parallel to A. E. cutting the side A B. in F. And lastly, from thence draw a right line to the limited point E. as F E. which shall diuide the giuen Triangle into two parts, and include and separate the Triangle F E B. from the Trapezium A F. E C. hauing such proportion one to the other, as the two giuen lines I. and K. as was required. THEOR. 35.



A G. 40.
B C. 42.
B D. 12.
D C. 30.
B E. 30.
F H. 16.

Euc.6.1. *Ram.10.13.* *Ceul.3.9.*

PROBLEME CXXVIII.

To diuide a Triangle giuen into two parts, according to any proportion giuen in two numbers from a point limited in any side thereof, Arithmetically.

LEt the Triangle giuen bee A B C. in the former Diagram. Let the point limited be E. in the Base B C. and let it be required to diuide the same into two parts, in proportion one to the other, *dupla sesquialtera*, which is, as 5. to 2. First, let the Base B. C. be diuided according to the proportion giuen thus; Adde together the two giuen termes of the proportion 5. and 2. makes 7. then multiply the Base of the Triangle B. C. 42. by 2. the lesser terme, the Product is 84. which diuided by 7. the summe of the termes quoteth 12. for the lesser Segment of the Base B. D. which deducted from 42. the whole Base resteth 30. the greater segment D. C. then (considering the lesser part is to bee layde towards B.) measure the distance from the giuen point E. to B. which admit 30. and by the rule of Proportion reason thus: If the distance E. B. 30. giues B. D. 12. the lesser segment what giues A G. 40. the perpendicular of the giuen Triangle, and multiplying 40. by 12. and diuiding the Product by 30. the answere will be 16. at which distance draw a parallel line to B E. cutting the side A B. in F. from which point draw the line F E. which shall diuide the giuen Triangle in such sort that the Triangle F B E. shall be $\frac{2}{5}$. parts, and the Trapezium A F. E C. $\frac{3}{5}$. parts thereof, that is the Trapezium, containing the Triangle F B E. twice and a halfe, according to the proportion required. THEOR. 35.

Euc.6.1. *Ram.10.13.*

PROB.

PROBLEME CXXIX.

To diuide a Triangle of any knowne quantitie giuen, into two parts, from a point limited in any side thereof, according to any number of Acres, Roodes and Perches.

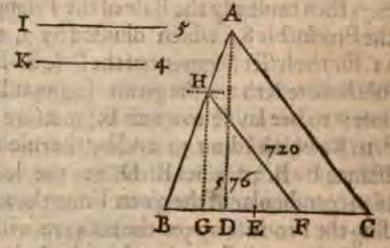
LEt the Triangle giuen be A B C. in the laſt Diagram, whoſe quantitie let be 5. Acres, 1. Roode, 0. Perch. Let the limited point bee E. in the Baſe B C. and let it be required from the ſame point to diuide the Triangle into two parts betweene M. and N. viz. to M. 3. Acres, 3. Roodes, 0. Perches thereof, and the reſidue to N. 1. Acre, 2. Roods, 0. Perch. Firſt, reduce the quantitie of N. being the leſſer, 1. Acre, 2. Roods, 0. Perch, into Perches, which makes 24. Perches, then (conſidering on which ſide of the limited point this part is to bee layde, as towards B.) meaſure that part of the Baſe from E. to B. 30. Perches, wherof take halfe, which is 15. and thereby diuide 240. the part of N. the *quotus* will be 16. the length of the perpendicular F. H. at which parallel diſtance from the Baſe B C. cut the ſide A B. in F. from whence draw the line F E. which ſhall include the Triangle, F. B. E. containing 1. Acre, 2. Roods, 0. Perch, the part of N. and ſo ſhall the Trapezium A F E C. containe the reſideue, namely, 3. Acres, 3. Roodes, 0. Perch, the part of M. as was required. THEOR. 35.

Euc. 6. 1. Ra. 10. 13.

PROBLEME CXXX.

To diuide a giuen triangle by a parallel line, to one of the ſides, according to any proportion giuen.

LEt A. B. C. be a triangle giuen, and the proportiõ that between I. and K. and let it be required to diuide the ſame triangle into 2 parts, by a line drawne parallel to the ſide A. C. the one to be in proportion to the other, as the line I. to the line K. By the 13. PROB. diuide the line B. C. in E. as I. to K. then by the 17. PROB. finde the meane proportion betweene B. E. and B. C. which let be B. F. from which point by the 3. PROB. draw the line F. H. parallel to the ſide A. C. cutting the ſide A. B. in H. which line ſhall diuide the triangle giuen into two parts



A D. 48.
B C. 54.
B E. 24.
B F. 36.
E C. 30.
H G. 32.

Euc. 6. 10. 6. 13. Cor. 6. 19. Ceul. 3. 10.

parts, the trapezium A. H. F. C. hauing ſuch proportion to the triangle H. B. F. as the line I. to the line K. which was required. THEOREME 43, 41. PROBLEME 13, 17.

PROBLEME CXXXI.

To diuide a giuen triangle by a parallel line, to one of the ſides, according to any proportion giuen in two numbers Arithmetically.

LEt the triangle giuen be A. B. C. in the former Diagram, and let it be required to diuide the ſame by a parallel line, to one of the ſides into two parts, to be in proportion the one to the other, *Seſquarta*, that is, as 5. to 4. Firſt, let the baſe B C. 54. be diuided, according to the proportion giuen, as is taught in the 127. PROB. ſo ſhall the leſſer ſegment be B E. 24. and the greater ſegment E C. 30. then finde out a meane proportionall betweene B E. 24. and the whole baſe B C. 54. by multiplying 54. by 24. whoſe product will be 1296. the ſquare roote whereof is 36. the meane proportionall ſought, which in the former Diagram is B F. then by the rule of proportion, reaſon thus: If B F. 36. gaines B E. 24. what A D. 48. the anſwere is H G. 32. at which diſtance draw a parallel line to the baſe, to cut the ſide A B. in H. from whence draw the line H F. parallel to A C. which ſhall diuide the giuen triangle into two parts, in ſuch ſort, as the trapezium A. H. F. C. ſhall be $\frac{5}{4}$. parts, and the triangle H. B. F. $\frac{4}{4}$. thereof, that is the trapezium, contayning the triangle H. B. F. once and a quarter, as 5. doth 4. which was required. THEOR. 43, 41. PROB. 13, 17.

Euc. 6. 10. 6. 13. Cor. 6. 19.

PROBLEME CXXXII.

To diuide a triangle of any knowne quantitie, giuen into two parts, by a parallel line, to one of the ſides, according to any number of Acres, Roodes, and Perches required.

LEt the triangle giuen be A. B. C. in the laſt Diagram. whoſe quantitie is 8. Acres, 0. Roods, 16. Perches, and let it be required to diuide the ſame (by a parallel line to one of the ſides, as the ſide A. C.) into two vnequall parts, betweene M. and N. *viz.*) to M. 4. Acres, 2. Roods, 0. Perches, thereof, and the reſidue to N. being 3. Acres, 2. Roods, 16. Perches. Firſt, reduce both quantities into perches, which will be 720. and 576. then reduce both thoſe numbers by abbreuiation into their leaſt proportionall termes, which is $\frac{5}{4}$. and according to that proportion diuide the baſe B C. 54. of the giuen triangle, as is taught in the two laſt Problemes, which will be in E. then ſeeke the meane proportionall betweene B E. and B C. as is taught in the laſt Probleme, which is B F. 36. of which 36. take the halfe, and thereby diuide 576. the leſſer quantitie of perches. the quotus will be H G. 32. at which parallel diſtance from the baſe, cut the line A B. in H. from whence draw the line H F. parallel, to the ſide A C. which ſhall diuide the triangle giuen into two parts; the trapezium A. H. F. C. contayning the part of M. and the triangle H. B. F. the part of N. as was required. THEOR. 41, 43.

Here

HEre might I now much inlarge and amplifie this latter part, for the diuiding of superficiall figures of all formes and kindes: But seeing that all irregular figures and plots are most conueniently to be reduced into triangles, before the contents thereof can be had, or any diuision thereof made; and generally in matter of Surney (whereunto my purposes chiefly tend) all figures are found irregular; I will content my selfe (and intreat my Surueyor to be likewise satisfied) with these few former instructions, which being well vnderstood, with due obseruation of the precedent rules, will serue his turne to whatsoeuer purpose can be required. But who so desireth further satisfaction, and more varietie in this kinde, I referre him to M. Iohn Speidels *Booke, intituled his Geometricall Extraction, lately by him diuulged; (wherein he hath taken more paynes to excellent purpose, then this age, I feare, can afford him recompence) and to himselfe* M. Henry Brigs, M. Thomas Bretnor, M. Io. Iohnson, *and others, who are here amongst vs Professors, and excellent Teachers of these Arts. And thus, I conclude, this second Booke.*

The end of the second Booke.

THE EXACT OPERATION OF INSTRVMENTALL DIMENSIONS BY DIVERS MEANES.

The third Booke.

THE ARGVMENT OF THIS BOOKE.

THis Booke tendeth chiefly to matter of Surney, wherein is first described and declared the seuerall Instruments, fit for that purpose (with their vse in practise) as the Theodelite, *the* Playne table, *and* Circumferentor, *whereunto I haue added an absolute Instrument, which I call the* Peractor, *together with the making and vse of the* Decimal Chayne, *vsed only by my selfe; then is taught the vse of a necessarie Field-booke; the taking, protracting, and laying downe of angles diuers wayes; the reducing of customarie measures*

into Statute meaſure, and the contrarie, ſhewing their difference; the vſe of the table of Synes, and the diuided ſights on the Circumferentor, withſupply of thoſe defects in the ordinary vſe of the Playne table, by ignorant perſons; the meanes to take Altitudes, Longitudes, Latitudes, and inacceſsible Diſtances, aſwell by ſynicall computation, as diuers other meanes; the Dimenſion and plotting Inſtrumentally of all manner ſuperficiall figures, and irregular plots, by diuers and ſundrie wayes, with their ſeuerall protractions accordingly: how with the Playne table exactly to take a plot of the largeſt Forreſt on one ſheet of paper, without altering thereof: the means of Survaying and plotting of a Lordſhip or Mannor, with the orderly handling of the ſame: the wayes and meanes Inſtrumentally, to reduce Hypothenuſall, to Horizontall lines, and the contrarie: with the beſt and exacteſt courſes to be held in the dimenſion, and plotting of Mountaynous, and vn-euen grounds: the manner of incloſing, diuiding, and laying out of Commons, waſts, or common Fields, into any parts required: the ordering of a plot after the protraction thereof: the reducing of plots from a greater to a leſſer forme, and the contrarie: and laſtly, the ſpeedie reduction of perches into Acres, and thoſe againe into perches: Moſt exactly and artificially wrought, by the beſt and moſt immediate meanes for thoſe purpoſes.

CHAP.

CHAP. I.

Of the ſeuerall Inſtruments in vſe, meete for Suruaie; which of them are moſt fit for vſe, and ſomewhat concerning their abuſe.

BEfore we enter the fieldes to ſuruaie, I hold it neceſſarie wee prouide vs of fitting furniture for the purpoſe, leſt by our neglect therein, thoſe by whom wee haue imployment receyue no leſſe loſſe and preiudice, then our ſelues ſhame and reproch: Wherefore let vs firſt conſider what Inſtruments are moſt vſuall, and then of thoſe, what moſt fit for our preſent purpoſe. The Inſtruments now moſt in vſe are the *Theodelite*, *Plaine-table* and *Circumferentor*, whereunto I will adde one more, which I call the *Peractor*, vſed onely by my ſelfe, and certaine friends by my directions; Of all which I will hereafter make briefe and particular deſcriptions, aſwell concerning their ſeuerall parts and compoſition, as of their vſe in practiſe. Nor will I exclude or wholly neglect the *Familiar Staffe* of *M. John Blagraue*, and the *Geodeticall ſtaffe* and *Topographicall glaſſe* of *M. Arthur Hopton* (though now together dead) or any other Inſtrument which are, or hereafter may be by the art or induſtry of any man, artificially inuented or compoſed for his owne, or others vſe. For, as I tye not my ſelfe to the vſe of any one Inſtrument, at all times, nor on all occaſions, but for a large and ſpacious buſineſſe vſe the *Circumferentor* or *Peractor* (as for many reaſons moſt neceſſary and conuenient) and for a leſſer (where many ſmall Incloſures and Town-ſhips are) the *Plaine Table*; although eyther of the other will well ſerue for performance of eyther kind (and therefore if poſſibly you may, in one and the ſame buſineſſe, vſe euer one and the ſame Inſtrument, for auoyding many inconueniences:) So will I not limit my Surueyor to the vſe of any one Inſtrument, but referre him to all or any at his pleaſure, well knowing they are all compoſed and framed on one and the ſame Theoricall ground: and although in performance and diſpatch, one may be more ſpeedy then another (wherein I finde much difference, with the ſame exactneſſe) yet all or any of them artificially handled, are to excellent vſe, aſwell in ſuruey of lands, as the performance of many other excellent concluſions Geometricall. Wherein I cannot by the way but condemne the folly of diuers, who (deeming themſelues more wiſe and skilfull, then any other ſhall haue iuſt cauſe to conceiue) hauing ſome ſmall ſuperficiall vſe or inſight into ſome one of theſe Inſtruments, are onely wedded to that, and ignorant of the others vſe, will condemne them as vnmeet and inſufficient, the defect conſiſting in their owne vnderſtanding. But I muſt needs acknowledge (which could I as eaſily reforme, I ſhould deſerue well at the hands of many, who pay deerely for it) that by the ignorance of diuers, vſing (or abuſing) theſe inſtruments, infinite groſſe and palpable errors and abuſes are dayly committed, to the great loſſe and preiu-

dice of many, who receiue ſecret and inſenſible blowes (found in their eſtates, though vnfelt in themſelues) who for my part ſhall paſſe vnpittied (ſaue only for their weakeneſſe) the fault being chiefly their owne, when out of a penurious ſparing, to yeeld better ſatisfaction to thoſe which better can; they can be well contented blindly to ſwallow frogges for flyes, and to pay treble damage (nay perhaps ten fold) another way, ſo they neyther feele nor find it in their open view. And thus much concerning the ſeuerall Inſtruments in generall. Next of their Definitions, Parts, and Compoſitions particularly.

Chap. II.

Of the Theodelite and his ſeuerall parts, with the Deſcription and Compoſition thereof.

THis Inſtrument conſiſteth of foure ſeuerall parts; As firſt, the *Planiſphere* or Circle, whoſe limbe is diuided into 360. equall parts or diuiſions, called degrees, without which it is fitting equidiſtantly to draw and deſcribe ſixe concentricke lines or circles with croſſe Diagonals, by whoſe interſections are had the parts of a degree: vpon which *Planiſphere*, and within the diuiſions before ſpecified, there is deſcribed the *Geometricall ſquare*, being the ſecond part thereof both which together, or eyther of them ſeuerally ſerue to excellent purpoſe, for the dimenſion of lengthes, bredthes and diſtances. The third part is a *Semicircle* or *Quadrant* perpendicularly rayſed, and artificially placed on the former *Planiſphere* (or more properly on the Index thereof) to be moued about circularly at pleaſure on all occaſions; which ſemicircle or quadrant hath the limbe thereof equally diuided into parts or degrees, with like concentricke Circles and Diagonals to thoſe of the *Planiſphere*: And the fourth and laſt part is a *Scale*, deſcribed within the ſame Semicircle or Quadrant, whoſe ſides are diuided into diuers equall parts, the more the better, and to beſt purpoſe; which two later parts ſerue chiefly for the menſuration of altitudes and profundities; All which together compoſed, make an excellent Inſtrument meete for many purpoſes, eſpecially for the deſcription of Regions and Countries, or other ſpacious workes. This Inſtrument would aske a farre more exact and particular deſcription, which for three principall reaſons I will here omit; Firſt, for that I hold it (although a generall and fit Inſtrument for all menſurations, yet in particular) for this our buſineſſe of Suruey, not altogether ſo fitting and commodious as the reſt before named, by reaſon of the multiplicity of Diuiſions therein contained, which will bee ſo much the more troubleſome in vſe and protraction: Secondly, for that M. *Thomas Digges* in his *Pantometria*, hath made a large and particular deſcription thereof: And thirdly and laſtly, for that M. *Allen*, who makes of theſe and all other Geometricall Inſtruments in mettall, is ſo well acquainted with the parts and compoſition thereof, that whoſoeuer purpoſeth to vſe the ſame, needeth only to beſpeake it of him, without further inſtruction or direction to him. The vſe and imployment whereof ſhall

ſhall be hereafter touched. And thus much for this Inſtrument and the deſcription thereof.

Chap. III.

The Playne table and his ſeuerall parts, with the deſcription and compoſition thereof.

THis Inſtrument for the playneneſſe and perſpicuitie thereof, and of his eaſie vſe in practiſe, receiueth aptly the name, and appellation of the *Playne Table*. A moſt excellent and abſolute Inſtrument, for this our purpoſe in Suruey; but with all, by reaſon of this his playneneſſe (offering it ſelfe at firſt view, in ſome meaſure, to the weake vnderſtanding of meaneſt capacities, inciting them thereby to the practiſe thereof) is more ſubiect to abuſe, then all, or any of the reſt: For notwithſtanding that theſe, by the common and ordinary vſe and practice of this Inſtrument, may eaſily attayne to a reaſonable truth in Dimenſion and plotting of regular and euen Playnes; yet, if they come to irregular and vn-euen formes, as Hills and Dales, they are ſo farre vnfitting for the true menſuration thereof, that many vſing this Inſtrument, neglect the meanes, and thoſe proper parts of the ſame Inſtrument (being the ſights hereafter ſpecified, whereof they know no vſe) which is their onely helpe and aide in this kinde. But, leſt this relation ſhould be held digreſſion, lets returne to the purpoſe. This Table it ſelfe is diuided into fiue parts, or ſmall bords, whereof three are in the bredth, and the other two imployed as ledges in the length, to keepe the reſt together, whereunto a ioynted frame is artificially applyed, for the faſtning and keeping playne thereon, an ordinarie ſheet of paper for vſe in the fields; of which length and bredth, or rather leſſe, as 14½. inches in length, and 11. in bredth, the whole Table together ſhould conſiſt. But for my purpoſe, I would haue made of theſe three boords in bredth, with helpe of ledges, to be thereon glued, to the back-ſide thereof, and ſtrong ioynts or gemmowes, faſtning them together, an artificiall boxe; which at any inſtant being opened, and the ledges faſtned on, is fit for vſe in the Fields, and afterwards thoſe ledges taken away, may be as inſtantly turned backwards, and incloſed as before, fit for the keeping of looſe papers and ſmall tooles, till further occaſion. Which if any deſire to vſe, *M. Iohn Thomſon.* in *Hoſier*-Lane, will artificially fit him. To this Inſtrument doth alſo belong a Ruler with two ſights thereon, which by diuers men are vſed of diuers kindes, but by the beſt Playne Table men (as occaſion ſerues) thoſe of M. Iohn Goodwyns *inuention, that excellent and honeſt Artiſt, whoſe liuing Name (though himſelfe be dead) I cannot remember without good reſpect.* This Ruler is to contayne in length about 16. inches, or as long or longer then the table, for drawing parallel lines on the paper faſtned thereon, by the equall and oppoſite diuiſions on the frame; it is likewiſe to contayne in bredth about two inches or vpwards, and in thicknes halfe an inch; the ſights thereof are double in length the one to the other, the longer contayning about 12. inches, and the ſhorter halfe as much; on the head or top

of which ſhorter ſight, muſt be placed a wyer or braſſe pin; and to this ſight there muſt be faſtned a thred and plummet, to place the Inſtrument Horizontally; through the longer ſight muſt be made a ſlit, extending almoſt the whole length of the ſight. Theſe two ſights thus prepared, are to be placed perpendicularly on the Ruler, by ſquare morteſſes, made to that purpoſe through the ſame, in ſuch ſort as the braſſe pin on the ſhorter ſight, and the ſlit through the longer ſight, be preciſely ouer the fiduciall edge of the Ruler; either ſight being equi-diſtantly placed from each end of the Ruler, and the ſpace betweene the ſights to be exactly the iuſt length of the longer ſight, or to ſpeake more properly of the diuided part of the ſame ſight; *(which is alwayes to be vnderſtood when I ſpeake of the length thereof.)* Vpon this longer ſight there is to be placed a vane of braſſe, to be remoued vp or downe at pleaſure; through which a ſmall ſight hole is to be made, anſwerable to the ſlit in the ſame ſight, and the edge of the vane.

By theſe ſights thus placed on the Ruler, there is proiected a Geometrical ſquare, whoſe ſide is the diuided part of the long ſight, or the diſtance betweene the two ſights. In the middle of which long ſight, ouerthwart the ſame, there is drawne a line called the line of leuell, diuiding the ſide of the proiected ſquare into two equall parts, alſo the ſame ſide is on this ſight diuided into 100. equall parts, which are numbred vpwards and downewards, from the line of leuell, by fiues and tens to 50. on either ſide, which diuiſions are called the Scale.

There is alſo on the ſame ſight expreſſed another ſort of diuiſion, repreſenting the Hypothenuſall lines of the ſame ſquare, as they increaſe by vnits, and are likewiſe numbred vpwards and downewards from the line of leuel, from one to 12. as 1, 2, 3, &c. ſignifying 101, 102, 103, &c. which declare how much an Hypothenuſall or ſlope line, drawne ouer the ſame ſquare (that is, from the pinnes head to any ſuch diuiſion) exceedeth the direct horizontall line, being the ſide of the ſame ſquare.

There is moreouer a third ſort of diuiſions on this ſight, repreſenting the degrees of a quadrant (or as many as can well be expreſſed on the ſame ſight being 25.) which are (as thoſe before) numbred, from the line of leuell vpwards and downewards, by fiues and tens to 25. which diuiſions are called the quadrant.

Likewiſe there may be placed on the ſurface, or vpper part of this Ruler, the table of Synes, mentioned in the deſcription of the Circumferentor, next hereafter following; very neceſſary for vſe, as ſhall hereafter partly appeare.

Yet would I further aduiſe concerning this Inſtrument; that in playne and leuell grounds, where is no vſe of reducing Hypothenuſall lines; inſtead of thoſe long ſights formerly expreſſed, to haue vſed ſuch double ſights as are hereafter mentioned in the deſcription of the *Peractor*, which are farre more readie, and leſſe cumberſome for vſe, eſpecially in rough and boyſterous weather. And likewiſe, when occaſion ſhall be offered, by irregular and vn-euen grounds, to reduce thoſe Hypothenuſall lines, to vſe in ſtead of thoſe long ſights, the quadrant hereafter likewiſe ſpecified in the ſame deſcription, which when need requires may be eaſily fixed to the Ruler; and as ſoone laid by, hauing no further vſe, for of all other meanes in taking of heights, and eſpecially for reducing of thoſe Hypothenuſall lines, I hold that

that quadrant artificially handled to be moſt readie and exact, all concluſions being ſpeedily wrought therewith without Arithmetick, or other collaterall computation whatſoeuer.

To this Inſtrument belongeth diuers other ordinary parts, whereof I ſhall not neede particularly to ſpeake, ſeeing moſt men (if not too many) already know them, being of ordinarie vſe; as the Socket, the Boxe and Needle with the ſtaffe or foote thereof, &c.

Chap. IIII.

The Circumferentor with his parts, deſcription, and compoſition.

THis Inſtrument for expedition and portabilitie, exceedeth ſir the reſt, and nothing inferior to any for exactneſſe, if care and arte be vſed; but not ſo vulgarly vſed (though much more generall for vſe) as the playne Table is; the full and perfect vſe thereof, not lying ſo open and apparant to all mens vnderſtanding, as the other is.

It is made and framed of well ſeaſoned boxe, contayning in length about eight inches, in bredth halfe as much, and in thickneſſe about ¼. of an inch; the left ſide whereof is beſyled, and diuided into diuers equall parts, moſt fitly of 12. in an inch, to be vſed as the Scale of a Protractor, the Inſtrument it ſelfe ſeruing well to protract the plat on paper, by helpe of the needle, and the degrees of angles and lengths of lines, taken in the field, and entred into your field Booke, as ſhall be hereafter ſhewne.

About the middle in the ſurface thereof, a round hole is to be turned of the depth of halfe an inch, whereof the Diameter to be about 3¼. inches, to place a carde and needle therein, to be couered ouer with cleere glaſſe. The beſt carde for this purpoſe is that, diuided in the limbe into 120. equall parts or degrees, with a Dyall according to the *Azimuths* of the Sunne, wherein the houres are numbred, and the moneths named, ſeruing very aptly to ſhew the time of the day.

Beſides, on the ſurface hereof is placed the table of Synes, calculated from the quadrant of a circle ſo diuided, as the carde before ſpecified; the arch of this quadrant being 30. degrees, and the ſemidiameter or totall ſyne thereof, is diuided into 1000. equall parts, and numbers placed accordingly, anſwering to euery degree and halfe degree, ſeruing to expreſſe the length of euery right ſyne for the Dimenſion and Supputation of Triangles, as ſhall be partly hereafter ſhewne, and in the meane ſpace the Table is here expreſſed.

Tabula

Tabula Sinuum.

½	26		334		609		824		959
1	52	7	358	13	629	19	839	25	969
	78		383		649		853		972
2	104	8	407	14	669	20	866	26	978
	130		430		688		879		983
3	156	9	454	15	707	21	891	27	987
	182		477		725		902		991
4	208	10	500	16	743	22	913	28	994
	233		522		760		923		997
5	259	11	544	17	777	23	933	29	998
	284		566		793		943		999
6	309	12	588	18	809	24	951	30	1000

There is alſo hereunto belonging two ſights, double in length, the one vnto the other, the longer containing about ſeuen inches or vpwards, being placed, and diuided in all reſpects, as thoſe formerly mentioned in the deſcription of the playne Table; the ſhorter ſight of theſe hauing one propertie and vſe, which that (as needleſſe) hath not, being this, in the edge thereof, towards the vpper part is placed a ſmall wyer, repreſenting the center of a ſuppoſed circle, the ſemidiameter whereof is that part of the ſame ſight, betweene the wyer, and a perpendicular point on the edge of the Inſtrument vnderneath the ſame; which part is imagined to be diuided into 60. equall parts, and according to thoſe diuiſions is the right edge of the Inſtrumant, diuided and numbred from the perpendicular point by fiues and tens, as 5. 10. 15. &c. And alſo from the ſame point on the ſurface and vpper edge of the Inſtrument is perfected, the degrees of a Quadrant ſupplying the reſidue of thoſe which could not be expreſſed on the long ſight from 25, to 90. by tens, &c. For the vſe of theſe Diuiſions is there alſo belonging hereunto an Index or ſmall Rule, at the one end whereof is a Centre hole to place on the Wyer in the edge of the ſhorter ſight, and at the other end a ſight is placed, anſwerable to the fiduciall edge of the ſame Index, which edge is likewiſe diuided according to thoſe diuiſions on the edge of the Inſtrument. This ſhort ſight is to haue a plummet of lead hanging in a fine thred, ſeruing to place the Inſtrument horizontally. Where note, that theſe ſights, and their ſeuerall diuiſions ſerue onely for Altitudes, Profundities, and the reducing of Hypothenuſall lines to horizontall, which is to excellent purpoſe, and full of vſe. But when there is no occaſion or vſe of theſe (as ſeldome there is in reſpect of other vſe) I would alwayes haue ready, ſuch double ſights as are hereafter expreſſed in the deſcription of the *Peractor*, which doubtleſſe are of excellent vſe, as I there explaine; with this caution, that you alwayes carefully keepe one and the ſame part of your inſtrument forwards, and reccon euer your degrees in one and the ſame end of your Needle.

The foot of this Inſtrument is that with three ſtaues ioynted in the head, and

and to be taken a ſunder in the middle with braſſe ſockets, according to the vſuall order, moſt fitte for all Inſtruments, except in ſuch caſes, as in the deſcription of the *Peractor* is excepted. And theſe are the ſeuerall parts of this Inſtrument, and thus is it compoſed.

CHAP. V.

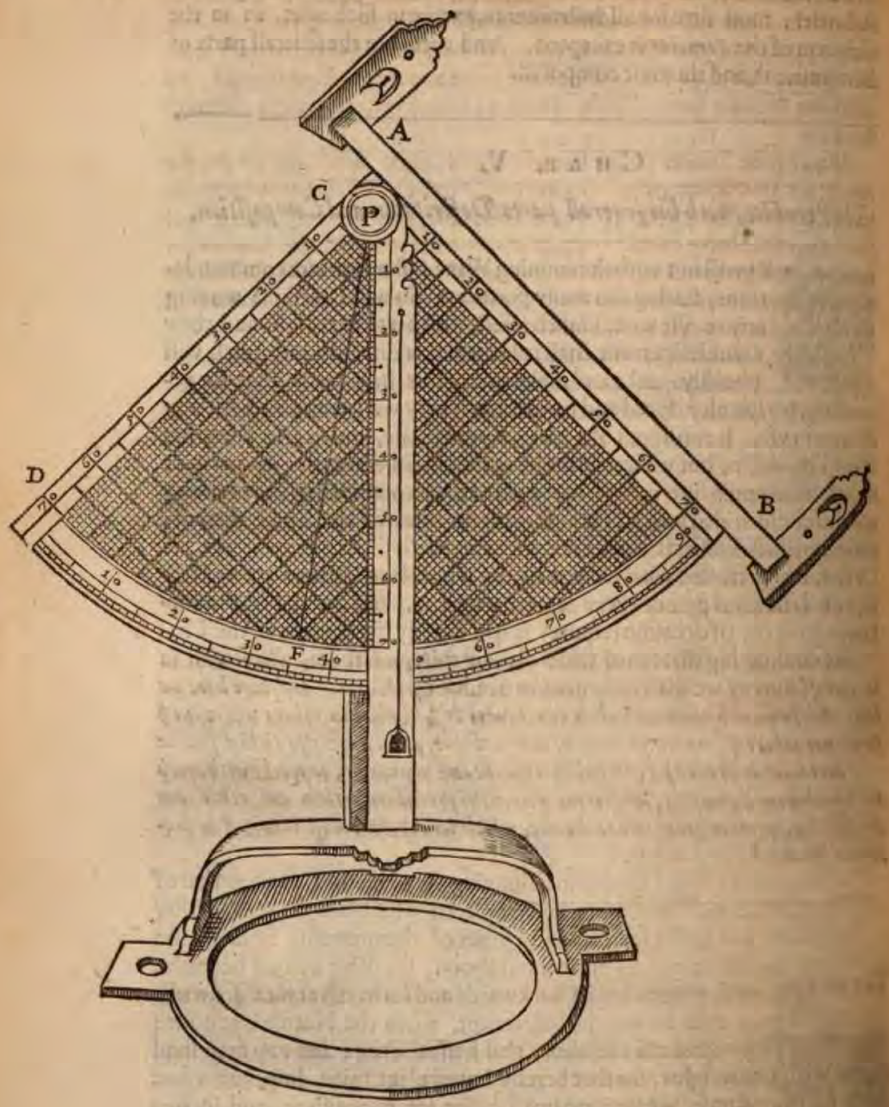
The Peractor, with his ſeuerall parts Deſcription and Compoſition.

AS I will not with the cunning Wine-taſter forbeare commendations, fearing too many partners; So will I refraine wooing any to vſe what I much affect, further then reaſon, and their owne iudgement ſhall rule them therein. But thus much will I boldly ſpeake and maintaine of this Inſtrument, that for generall vſe, perſpicuity, ſpeed and perfection, it may well compare with any hitherto in vſe. It conſiſteth of a *Planiſphere* in braſſe, much like vnto that of the Theodelite, but where the limbe of that is diuided into 360. parts or degrees; this is only into 120. (ſo that each of theſe containeth three of thoſe) and theſe ſubdeuided into halfes and quarters towards the limbe thereof, without which diuiſions, there are drawne and deſcribed three concentricke Circles, being croſſed with Diagonals, by whoſe interſections are exactly expreſſed the third part of euery degree; whereby, and by tripling the former degrees cut (if occaſion require) is had exactly the degrees of the Theodelite conſidering that ten of theſe contain thirty of thoſe, wherewith in matter of Suruey we ſhall little need to trouble our ſelues. *And here haue we large and ſpacious degrees with their exact parts to ½ (which in others wee want) by meanes whereof, and with helpe of ſuch a chaine, as I alwayes vſe (which ſhall be next hereafter expreſſed) I will boldly approue and maintaine, to worke with much more facilitie and exactnes, and come neerer the preciſe truth then any other can poſſibly doe, not vſing the ſame or the like, which will appeare moſt manifeſt in practiſe to all mens vnderſtanding.*

There is alſo an Index hereunto belonging, fixed on the Centre as that of the Theodelite, with two ſights thereon placed, with ſliding loopes, eyther of them alike, and of like length, and eyther of them double ſighted, the one hauing a ſlitte beneath, and a thred aboue, the other a thred beneath, and a ſlit aboue, ſeruing to looke backwards and forwards at pleaſure, without turning about or ſtirring the Inſtrument, when the Needle is at quiet; whereby I ſaue neere halfe the labor, and halfe the time that any man ſhall ſpend with other ſights, for that hereby I need plant mine Inſtrument but at each other Angle, which is no ſmall helpe for expedition, and ſuch a meanes for exactneſſe rightly handled, as few will imagine without due proofe; and that without trouble of ſending one before, and leauing another behind, as is vſually accuſtomed. Neyther vſe I theſe ſights with this Inſtrument onely, but with all others as the Theodelite, Plaine-Table, and Circumferentor.

Theſe ſights I alwaies vſe in plain and euen grounds; but if occaſion ſerue for the reducing Hypothenuſall, to Horizontall lines; I then euer vſe this

Qua-



Quadrant here expreſſed moſt fitte for the ſpeedy taking of all maner of altitudes and profundities, and the ſuddaine reduction of thoſe lines without Arithmeticall calculation, or other collaterall account, as is manifeſt in vſe. This Quadrant (the other ſights taken away) is on any occaſiou ſpeedily placed on the Index with ſcrue pinnes, and as ſuddainely taken off, if no further vſe, and the ſights replaced.

Then

Then is there alſo hereunto belonging other vſuall parts, as a boxe of braſſe on the Centre to containe a Carde and Needle therein, ſuch as is formerly expreſſed for the Circumferentor, to be likewiſe couered ouer with cleere glaſſe, and cloſe ſtopped with red waxe about the edge thereof, to defend the Needle from Winde, Wether, and Ayre, the onely enemies thereunto.

Alſo a braſſe Socket to bee ſcrued on with foure ſcrue pinnes on the backe of the Inſtrument, which Socket ought to be preciſely turned, and the head of the ſtaffe therewith, (I meane the braſſe part thereof) which will neuer otherwiſe turne euenly and nimbly about as it ought, the one within the other, without iercking and ſtarting, which much troubleth the Needle in finding his naturall point and place of reſt. And if any doubt the truth of his Needle, let him take backe ſights for his better ſatisfaction therein.

And laſtly, for this as for the reſt the like ſtaffe is to be prouided as before is ſpoken of, which for all purpoſes is the abſolute beſt, except onely for water leuels, and the works thereunto belonging, wherein it is neceſſary at all times, and at each ſeuerall ſtacion to keepe the inſtrument at one and the ſame horizontall diſtance, which otherwiſe may breede much cumber, and no leſſe incertainety in thoſe concluſions; wherefore for thoſe and the like occaſions, a foot with one ſtaffe, hauing three iron pikes therein, after the old order is beſt, and to beſt purpoſe.

The making of this Inſtrument and the reſt in braſſe are well knowne to M. ELIAS ALLEN *in the Strand; and of thoſe in wood to M.* IOHN THOMPSON *in Hoſyer Lane.*

And thus haue I briefly deſcribed theſe ſeuerall Inſtruments with their particular parts, laying them before my Surueyor to take his choyſe as his fancie leades him; But in mine opinion all are better then any; ſo ſhall hee beſt know what is beſt for his purpoſe.

And now let vs conſider, what other neceſſaries are yet to bee prouided, before wee beginne our buſineſſe, for feare wee are to ſeeke when occaſion ſerues for vſe. As the Chaine, Protractor, Field-booke, and the Scale and Compaſſe whereof we will further ſpeake.

CHAP. VI.

The making and diuiſion of a Chaine, called the Decimall Chaine.

THis is the chaine before ſpoken of in the *Peractors* deſcription; which for conueniencie in carryage, and auoyding caſualties often happening to breake it (though made of a full round wyer) I would aduiſe ſhould containe in length but onely two ſtatute Poles or Perches, or three if you pleaſe at the moſt. In the diuiding whereof it is to bee conſidered, that the ſtatute Perch or Pole, (which here we call an vnite, or (*Comencemente*) containeth in length 16 $\frac{1}{2}$ feete. which is, 198. ynches: This quantitie is firſt to be diuided into 10. equall parts called *Primes*, ſo ſhall euery of theſe *Primes* containe in length 19. ynches, and $\frac{4}{5}$. of an ynch: And then theſe *Primes* to bee euery of them

ſub-

ſubdiuided into other 10. equall parts, which wee will call *Seconds*: and ſo euery of theſe *Seconds* ſhall containe in length one ynch, and $\frac{1}{10}$. parts of an ynch. And thus is the whole Perch *vnite* or comencement diuided into 100. equall parts or linkes called *Seconds*.

Which Chaine ſo diuided is thus to bee diſtinguiſhed and marked: Firſt, at the end of euery fifth Prime, or fiftieth *ſecond* or lincke, which is the end of euery halfe Pole, let a large curtaine ring be faſtned, ſo ſhall you haue in the whole Chaine (if but two Poles) three of thoſe rings; the middlemoſt being the diuiſion of the two Poles, which in a Chaine of this length is eaſily and readily diſcerned from thoſe rings of the halfe Poles, though all of one greatnes. Then at the end of euery *Prime*, that is, at the end of euery tenth *ſecond*, or linke, let a ſmall curtaine ring be placed, and not thoſe rings of braſſe wyer, as is vſuall in other chaines, which, with euery buſh and twig are continually broken off, and loſt.

By thoſe diſtinctions this Chaine is now diuided into theſe three termes, *Vnites*, *Primes* and *Seconds*, whoſe Characters are theſe 0.1.2. So that if you would expreſſe 26. *Vnites*, 4. *Primes*, and 5. *Seconds*, they are thus to be written $26^{\circ}.4^{'}.5^{''}$. or together thus, $26^{\circ}4^{'}5^{''}$. or more briefly thus, $26.4.5$. making prickes or points onely ouer the Fractions, whereby the reſt may be conceyued to be Vnites, or Intigers, and the firſt point *Primes*, and the next *ſeconds*.

But beſides theſe diuiſions for mine owne vſe, I alwayes at the end of euery 2 $\frac{1}{2}$. *Primes*, which is the $\frac{1}{4}$. of a Pole, ſowe on a ſmall red cloth, or the like, (thruſt through the ring of the chaine, and at euery 7 $\frac{1}{2}$. *Primes* being the $\frac{3}{4}$. of a Pole; the like of yellow, or ſome other apparant colour, where with being once acquainted, and thereunto inured, you ſhall moſt ſpeedily at the firſt view reckon the quantitie of euery ring, remembring that if it bee the next ring, ſhort of the red, it is two *Primes*, if the next ouer, three, if the next ſhort of the yellow, it is 7. *Primes*, if the next ouer, 8. if the next ſhort of a great halfe ring, it is 4. the next ouer, 6. And laſtly, if the next ſhort of the middle great ring, it is 9. and if the next ouer, 1. and ſo of the reſt; *Wherin is to bee noted that your Chaine thus marked, is alwayes to be vſed with one and the ſame end forwards.*

This Chaine thus diuided and marked, you haue euery whole Pole equal to 10. *Primes*, or 100. *ſeconds*, euery $\frac{1}{2}$. of a Pole equall to 7 $\frac{1}{2}$. *Primes*, or 75. *ſeconds*, which is $\frac{3}{4}$. of 100. euery halfe Pole equall to 5. *Primes*, or 50. *ſeconds*, which is $\frac{1}{2}$. of 100. and laſtly euery $\frac{1}{4}$. of a Pole equall to 2 $\frac{1}{2}$. *Primes*, or 25. *ſeconds*, which is $\frac{1}{4}$. of 100.

And here is to bee noted, that in the ordinarie vſe of this Chaine for meaſuring and platting; I obſerue onely *Vnites* and *Primes* (but on neceſſity) which is much more exact then the ordinary vſe; but hauing occaſion to make diuiſion or ſeparation of lands, or for the dimenſion of common fields in their ſeuerall parts by furlongs or wents and rigges, I vſe my *Seconds*; wherein, what exactnes and moſt excellent vſe I find, I will referre to thoſe who can deſcerne the difference betweene a portion leſſe then two ynches, the length of my *ſecond*, and that of 6. ynches, and $\frac{1}{11}$ of an ynch, the leaſt part of the beſt and exacteſt Chaine now commonly vſed; *but with thoſe of the laſt of long twelues I will not meddle.*

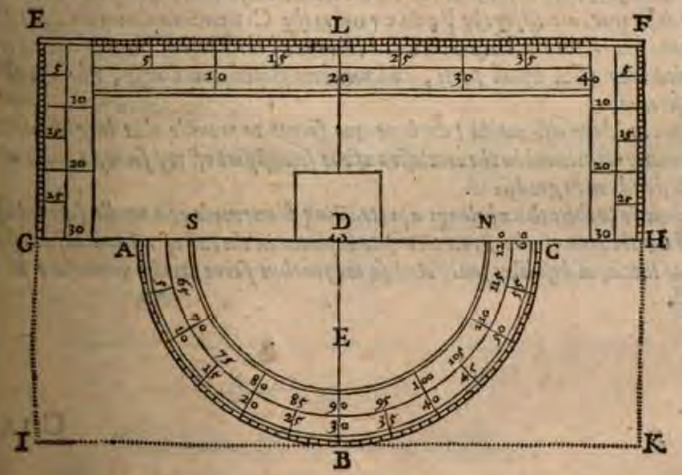
But

But here me thinkes I heare the Aduerſarie queſtion, to what purpoſe ſerues this niceneſſe of ynches in Inſtrumentall obſeruation, when comming to your protraction with a ſmall Scale, you are not able to diſtinguiſh feet? I anſwere (and to purpoſe) thus: If by your ordinary Chaine you take obſeruation in your Field-bookes of $\frac{1}{2}$. $\frac{1}{4}$. and $\frac{1}{8}$. and few or none otherwiſe, (or if they doe, to ſmall purpoſe, as they afterwards handle the matter) then I ſay, I taking my obſeruation of 1.2.3. or 4. *Primes*, or of 6. 7. 8. or 9. *Primes*, can in my Protraction with a ſmall Scale and Protractor (yet mine I muſt confeſſe is none of the leaſt) eaſily diſtinguiſh and expreſſe how much leſſe or more then $\frac{1}{2}$. $\frac{1}{4}$. or $\frac{1}{8}$. thoſe quantities are, as may eaſily appeare, with due obſeruation of my former notes. Yet may it bee further ſayd, What is all this to purpoſe, if there be not as exact a meanes to obtaine or get the true ſuperficiall content in caſting vp the plat, it being thus exactly layde downe? I may anſwere againe, Better one miſchiefe then many; neyther will I ſuffer this; for be well aſſured, I will not be ſo carefull in that, and altogether careleſſe in this; the meanes whereof in due time I may hereafter ſhew, being vnfit for this place; hauing already inlarged my Chaine in length more by a Pole, then firſt I meant; and therefore purpoſe now to be no longer chained therein.

The making of this Chaine is well knowne to M. CHRISTOPHER IACKSON *at the Signe of the Cocke in Crooked-Lane, who by my directions hath made of them for me, and hath the ſcantling thereof.*

CHAP. VII.

Of the Protractor and the Scale thereof.



PRouide for this *Protractor* a fine thinne piece of braſſe well poliſhed, in forme of a long ſquare, as the Figure E F K I. which (for conueniencie in vſe) ought to containe in length from G. to H. about 5 $\frac{1}{2}$. inches, and in bredth from L. to B. ſomewhat better then

3 ½ ynches, whereupon draw two lines as G H. and L B. cutting each other preciſely at right Angles in the point D. diuiding the Square into foure equall parts, then on the point D. as a Centre, at the diſtance of D L. or D B. deſcribe the Semicircle A B C. (for it is not materiall, or of neceſſitie, that the Diameter thereof ſhould agree with the Diameter of the Carde in the Inſtrument, as *M. Hopton* would haue it in the 62. Chap. of his *Top-glaſſe*) then diuide the limbe of the Semicircle A B C. into 60. equall parts or degrees, numbring them by fiues and tens in the outward ſpace to 60. and in the inward ſpace from 60. to 120. as in the figure, the firſt numbers ſeruing for the Eaſt ſide, and the later (being the oppoſite degrees) for the Weſt ſide of the whole Circle, ſo is a labour ſaued of diuiding the other ſide which ſerues to no purpoſe; then let the edges of the Scale as E G. E F. and F H. be ſomwhat beſiled, and made very ſmooth, and preciſely parallel to the firſt drawne lines reſpectiuely, and aboue the reſt, let care be had that the line L B. bee made exactly perpendicular to the edge E F. of the Scale, or otherwiſe great errors may inſue in the vſe; then diuide the Parallel degrees at eyther end of the Scale, betweene E G. and F H. And let the Scale of 12. bee placed on the edge E F. and the ſale of 11. on the edge of the backe ſide, which are moſt neceſſarie and meeteſt for vſe of any other; and laſtly, cut out the ſquare about the Centre D. and likewiſe that between the Semicircle & the pricked lines, hauing care that the line G H. be left perfect, and euen with the Diameter A C. being the meridian line, and the guide of the reſt. And ſo is this worke finiſhed.

Yet would I haue beſides in ſome ſpare place of this Protractor, or on the backe ſide thereof, the *Sextans* deſcribed, which is mentioned in the next Chap.

Here is it to be noted, that this PROTRACTOR *ſerueth without alteration or any difference, aſwell for the* PERACTOR *as the* CIRCVMFERENTOR. *But if you would haue it for the* THEODELITE, *then muſt the limbe of the Semicircle bee diuided into* 180. *equall parts, and numbers placed accordingly, which is all the difference.*

And here alſo would I not haue you forget to prouide that long Protractor formerly mentioned in the concluſion of the ſecond part of my ſecond Booke, which will ſtand you in good ſtead.

Alſo to theſe there belongs a protracting pinne made of a needle (according to the Centre hole of the Protractor) to be placed in the end of a ſmall turned ſticke, or of Iuorie, as beſt likes you. And ſo are you thus farre fitted: wherefore to the reſt.

CHAP.

CHAP. VIII.

Of the ordinarie Scale with the Sextans thereon deſcribed, very neceſſarie for vſe.

FOr this purpoſe let a Ruler of Braſſe or Boxe (but braſſe the better) be prouided, as the Figure A B C D. which let containe in length about 7. or 8. ynches, and in bredth about two ynches, or ſomewhat leſſe, whereupon on the one ſide let bee placed two Scales, the one of 11. the other of 12. in an ynch; and on the ſame ſide, let there be alſo deſcribed a *Sextans* or the ſixt part of a Circle, whoſe chorde E F, (which is alwayes equall to the Semidiameter of the ſame Circle) let containe in length about two ynches or leſſe, and let the limbe be diuided into 60. equall parts or degrees, and numbred by fiues and tens, as in the Figure. On the other ſide thereof there may be placed (after the order of theſe) diuers other Scales, as of 16. 20. 24, &c. as you thinke fitting. So haue you a neceſſary Inſtrument for many purpoſes. And this *Sextans* alſo would I haue deſcribed on ſome ſpare place of your *Protractor*.

To this muſt you haue prouided a neate payre of Compaſſes of braſſe, with fine ſteele points, which muſt alwayes bee ready ſeruing for infinite occaſions.

Beſides theſe ordinary Compaſſes, it is very fitting to bee alſo prouided of a payre of Callem Compaſſes, with ſcrues to alter the one legge at pleaſure, wherein to faſten a penne, blacke leade, a ſteele point, or the like, very fit for many purpoſes.

CHAP. IX.

Of a Ruler, for the reducing of Plats.

ALthough wee are not as yet fitte for the vſe of this Rule, yet ſeeing our buſineſſe now in hand, is to prouide vs of neceſſaries: It is no ill rule to take our buſineſſe before vs: Wherefore repayre to Maſter IOHN THOMPSON in *Hoſier lane*, who without further In-

ſtructions will furniſh you, onely this before you goe: Let the Ruler bee made of drie boxe, if you may, of a yard in length, and let the equall diuiſions thereon bee of 12. in an ynch, to bee numbred with double numbers, as he vſeth for me. So will it ſerue you to good purpoſe, aſwell for caſting vp of large plats. &c.

CHAP. X.

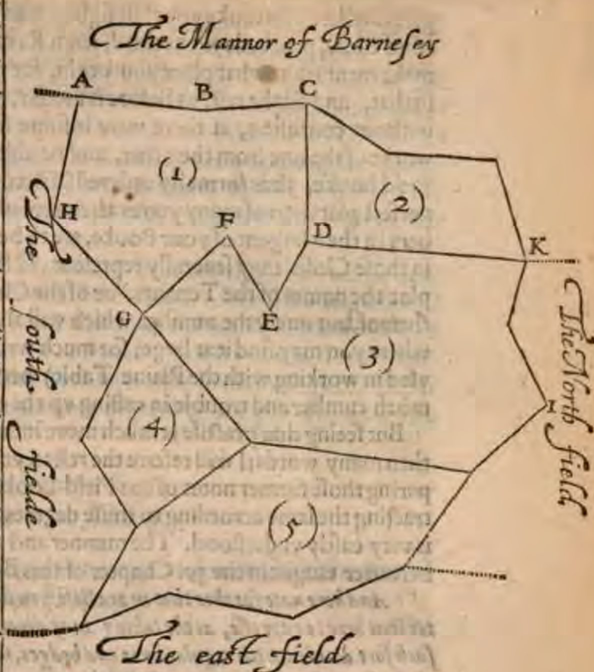
The order of making of a neceſſary and fitting Field-booke, ſeruing aſwell for the Peractor and Circumferentor, as for the Theodelite, with the ordering and vſe thereof in the Fields.

THis Booke may conſiſt of halfe a quire of paper, to bee bound (moſt aptly for vſe) in a long *Octauo*: Let it be ruled towards the left margent of euery ſide, with foure lines, ſo ſhall you deſcribe three Collums, the firſt ſeruing for the degrees; the ſecond (according to my Chaine) for Vnits: and the third and laſt for Primes; or according to the accuſtomed vſe, for degrees, poles, and parts of a Pole.

The order of vſing it is thus: Suppoſe you are to ſuruey the Mannor of *Beauchampe*, and are to beginne with theſe fiue ſeuerall parcels numbred in this plat or figure, with 1. 2. 3. 4. 5. being ſeuerall grounds of ſeuerall Tenants, and of ſeuerall natures, whereof you are to make ſeuerall obſeruation, as appeareth. Firſt, for the title of your Booke begin thus: *Maner. de Beauchampe in Com. Ebor. Pro Rege incip.* 24. *Iunij*, 1616.

Then begin with the firſt field, at A. writing the Tenants name, the name of the field, of what nature, and of what Tenure thus: *Io: Iackſons Hall Cloſe, Meadow, Free*: and expreſſe in the Margent of your Booke *No*(1) ſignifying the firſt Cloſe, then hauing placed your Inſtrument at A. directing your ſight to B. you finde the degree cut 65. which place in the firſt Collum towards the left hand, then meaſuring the diſtance betweene A. and B. you ſhall finde 20. Vnites, and 2. Primes, or 20. Poles, and a little leſſe then a quarter, which place ſeuerally in the two next Collums towards the right hand; then place your Inſtrument at B. and directing your ſight to C. obſerue and expreſſe the degrees and length there found, as 68. 16. 6. and conſidering that at C. you are to leaue the bounder you formerly went againſt, ſtrike there a ſingle line ouerthwart your booke, and aboue that line againſt the degrees and quantities taken, write what was the bounder you went againſt, whether it be of this or any other Mannor, as here in this example thus, the Mannor of *Barnſey*; and thus proceed with the reſt of this Field, till you come to incloſe at A. where you firſt began; and then ſtrike a double line, and place this marke ⊕ or the like in your booke, at the end of the incloſing line, ſignifying to incloſe. And ſo is that Field finiſhed. Then conſider which Cloſe is next fitting to be taken in hand, which let be (2.) and withall at what Angle thereof it is meeteſt to begin, which let bee at C. and here (for your helpe when you come to protraction) you muſt expreſſe in the Title of this ſecond Cloſe, at what Angle you begin the ſame (vnleſſe you

	d	o	I	
	Maner. de Beauchamp. in Com. Ebor. pro Rege incip. 14. Iunij. 1616.			
	Iohn Iackſons Hall, Cloſe, Mead. Free.			
(1)	65	20	2	The Mannor of Barnſey.
	68	16	6	(1)
	36½	22	5	North Breading. (2)
	27½	12	3	Vpper barne Cloſe. (3)
	106	14	1	
	21⅓	18	2	
	112	21	--	South-Field.
	32¾	20	2½	⊕ Where began.
(2)	*William Benſons* North-breading, Cloſe, Paſture, Cop. from No. (1.)			
	55½	14	5	The Mannor of Barnſey.
	65	18	9	
	41½	16	2	
to	5¼	35	4	⊕ Vpper Barne Cloſe, at (2.)
(3)	*Thomas Brownes* vpper Barne Cloſe, arr. Leaſe for yeeres.			
	31½	10	3	North Field.
	44¾	14	5	
	20	16	2	
	4¾	34	6	Oake Cloſe.
	46¾	27	3	⊕ At (3.) Eaſt garth.
(4)	His Eaſt garth, Meade, Free.			
	28	22	2	South Field.
	46½	16	6	
to	78½	23	2	⊕ Oake Cloſe.
(5)	His Oake Cloſe-Paſture, Leaſe for three liues.			
	26¾	18	5	Southfield.
	74	15	---	Eaſt Field.
	63	20	4	
	75	19	5	
	84¾	19	--	North Field. ⊕ On vpper barn cloſe.



you had begunne it where you ended the laſt, and then it is not materiall) wherefore ſeeing now you are to begin at C. looke in your booke on the worke of your laſt Cloſe, at what place the line B C. ended, as at the end of 68. degrees, 16. 6. and there expreſſe No. (1.) on the right ſide of your down right lines, & then write your title for this Cloſe thus: *W. Benſons north breading cloſe Paſture Copie from No.* (1.) ſo ſhall you readily know when you come to Protraction, where to begin with this Cloſe, and in the Margent place N. (2) for the number of this your ſecond Cloſe; and then worke on as before is taught for the laſt Cloſe, till you come to K. where noting, that you want but one line as K D. to incloſe this ſecond Cloſe, and alſo that this Angle K. is the fitteſt place to begin your third cloſe at, placing here your Inſtrument, and directing your ſight to D. where you are to incloſe, write in the margent of your Booke againſt the degree here taken, this word (*to*) as thus, *to* 5¼. degrees, 35. 4. which ſerues to put you in mind, when you come to Protraction, that you are to ſeeke no other place, to begin your third Field at, but where now you are at the An-

gle K. where you tooke your laſt ſight. And then hauing incloſed this ſecond Cloſe, proceede to the third, from K. in the title whereof you need not make mention at what place you begin, for the former reaſon, but working in that, and all the reſt, as before is taught, you ſhall with great eaſe, and without confuſion, if there were infinite ſeuerall parcels, diſtinguiſh the worke of the one from the other, and be able by the onely helpe of your Field booke, thus formally ordered (if need were) to protract, and draw a perfect plat thereof many yeeres after: remembring alwayes that thoſe numbers in the Margent of your Booke, are to be placed ſeuerally in your platte, in thoſe Cloſes they ſeuerally repreſent; ſo ſhall you not need to write in the plat the names of the Tenants, or of the Cloſes, nor the quality or tenure thereof, but onely the number, which will alwaies direct you to your booke, where you may find it at large; for much writing in your plat (as is alwayes vſed in working with the Plaine Table) breedeth confuſion, and cauſeth much cumber and trouble in caſting vp the contents.

But ſeeing that practiſe is much more inſtructiue (in works of this nature) then many words; I will referre the reſt to your owne trauell; which by comparing thoſe former notes of the Field booke with the plat, and often protracting the ſame according to thoſe degrees and lengthes, the whole courſe is very eaſily vnderſtood. The manner and order of which protraction is hereafter taught in the 39. Chapter of this Booke.

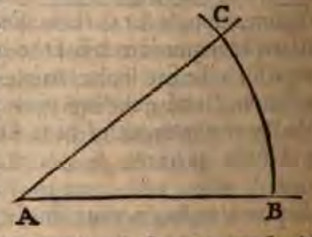
And here note further that in practiſe you ſhall find many helpes, which are too tedious here to expreſſe, as the taking in of diuers ſeuerals together, when they lie in ſuch ſort diuided with regular lines and hedges, that by onely taking true notice of their ſeuerall ends, as you paſſe by them, you ſhall moſt eaſily and ſpeedily ſeuer them on your plat: All which with many others (to auoide prolixitie) I muſt refer to your owne finding out by diligence and practiſe.

And thus are we now reaſonably well furniſhed of neceſſary implements for our purpoſe, and therefore fitting to prepare vs to practiſe: but yet before wee goe into the Fields, we will conſider of ſome neceſſary concluſions and obſeruations, fit to bee knowne and remembred.

CHAP. XI.

To lay downe an Angle of any quantitie required; or to find the quantitie of any Angle giuen, by the Sextans and the Scale.

SVppoſe it be required to lay downe an Angle of 40. degrees. Firſt draw any line at pleaſure, as A B. then opening the Compaſſe to the diſtance E F. the chorde of your *Sextans* (deſcribed in the 8. Chapter) and placing one foot in A. with the other, deſcribe the Arch C B. cutting the line A B. in B. then extend the Compaſſe on the Sextans to 40. degrees, and with one foot in B. croſſe the Arch line in C. and draw the line A C. So ſhall you deſcribe the Angle C A B. containing 40. degrees, as was required.



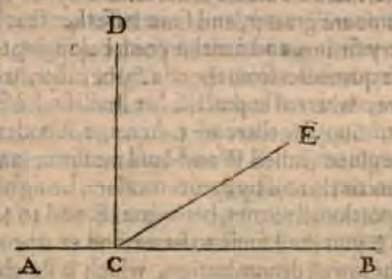
Againe, ſuppoſe C A B. be an angle giuen, & let it be required to know the quantitie thereof. Extend the Compaſſe to the chorde of the Sextans as before, and at that diſtance with one foot in A. deſcribe the Arch line C B. to cut both ſides of the giuen Angle, as in C. and B. then opening the Compaſſe to C B. and applying them at the ſame diſtance, to the degrees in the Sextans. It will appeare that the quantitie of the Angle is 40. degrees, the thing required.

If the Angle giuen or required happen to be more then the whole Sextans, or aboue 60. degrees, yet take ſtill the chorde of the ſame Sextans, and deſcribe the Arch line as before; and firſt place the whole Sextans, (which is the chorde thereof) on the Arch line from B. ſo farre as it will extend beyond C. and thereunto on the ſame Arch line, adde ſo many degrees more as the Angle giuen or required, containeth degrees aboue 60. So ſhall you performe what was required.

CHAP. XII.

To lay downe an Angle of any quantitie required, or to finde the quantitie of any Angle giuen, by the Protractor.

SVppoſe it be required to lay downe an Angle of 30. degrees with the Protractor. Firſt, draw any right line at length, as A B. then on any point thereof, as on C. place the Centre of the Protractor, on which point moue it about, by helpe of the protracting pinne held in the Centre, till the Meridian line of the Protractor lye preciſely on the line A B. (the ſemicircle of the Protractor being vpwards) and by the edge of the Semicircle at the diuiſion of 30. degrees, marke with the protracting pinne the point D. and draw the line D C. which ſhall include the Angle D C B. containing 30. degrees as was required.



Againe, ſuppoſe D C B. in the former Diagram bee an Angle giuen, and let it be required to know the quantitie thereof. Place the Centre of the Protractor as before in the Angle C. and the Meridian line thereof on the line C B. and hauing the ſemicircle vpwards, note what degree on the edge of the Protractor is cut by the line D C. which you ſhall find to be 30. Shewing that the giuen Angle D C B. containeth 30. degrees, the thing required.

But here is to bee noted, that theſe degrees thus taken by the Protractor belonging to the *Peractor* or *Circumferentor*, are not the true degrees of a Cir-

Circle; for one degree of a Circle, is but the 360. part thereof, and one of these degrees thus taken are the 120. part, so that one of these containeth three of those; Wherefore if you are to take the quantity of an Angle (according to the degrees of a Circle) by those Protractors, take alwayes a third part vpon the Semicircle, of the number giuen or required; as in the former example, where 30. is giuen, take 10. and so shall you finde the Angle E C. B. in the last Diagram, to be an Angle of 30. degrees, and to be a third part of the Angle D C B. As may be proued, if you apply thereunto a Protractor belonging to the *Theodelite*; yet notwithstanding these Protractors and degrees in all our occasions in the vse of the Circumferentor and Peractor are alwayes to bee vsed, which will tend to one and the same purpose.

CHAP. XIII.

The reducing of statute measure into Acres of any customary measure required, and the contrary, shewing the difference betweene them.

BY the Statute of 33. *Ed.* 1. It was ordained that an Acre of ground should containe 160. square Perches, to be measured by the Pole of 16½. feete, which is the measure now receyued, and generally allowed of, and is commonly called Statute-measure: yet notwithstanding in many places of this Kingdome, there are diuers other sorts retayned and claimed as customary, whereof some are greater, and some lesse then that by Statute. Wherefore I hold it very fitting, and a maine point belonging to a Surueyor, readily to reduce these quantities from the one to the other, whereby the difference may appeare; whereof in practise hee shall find often vse; which to effect worke thus. Suppose there are 5. Acres, 2. Roodes, 20. Perches, of 18. feet to the Pole giuen (called Wood-land measure; and let it be required to know the quantitie thereof by statute measure, being of 16½. First, finde out the least proportionall termes, betweene 18. and 16½. which by their abbreuiation, by 1½. you shall finde to be 12. and 11. then reduce your giuen quantity into the lowest denomination, which is Perches, so shall your 5. Acres, 2. Roodes, 20. Perches, be 900. Perches. And considering that the same proportion which the square of 12. bears to the square of 11. the like proportion beares the Acre of 18. foot Pole to that of 16½. therefore square those two termes 12. and 11. which produceth 144. and 121. then multiply the giuen quantitie 900. Perches by 144 the greater square (because the greater measure 18. is to be reduced into the lesser 16½. the Factus is 129600. which diuided by the lesser square 121. quoteth 1071 $\frac{9}{121}$. Perches; which reduced into Acres, is 6. Acres, 2. Roodes, 31. Perches, and $\frac{9}{121}$. parts of a Perch; for the quantitie required in statute measure, whose difference by deducting that from this, appeareth to be 1. Acre, 0. Roode, 11. Perches $\frac{9}{121}$.

But suppose the giuen quantitie had beene statute measure, and the same required to be reduced into Wood-land measure; then should you haue multiplied the 900. Perches giuen by 121. the lesser square (because the lesser measure 16½. were to be reduced into the greater 18.) whereof the Product is 108900. which diuided by 144. the greater square quoteth 756 $\frac{1}{4}$. Perches, which reduced into acres, is 4. Acres, 2. Roodes, 36½. Perches, for the quantitie by Wood-land measure; whose difference by deducting this from that appeareth to be 0. Acre, 3. Roode, 23 $\frac{3}{4}$. Perches.

And the like course is to be held in all respects, with all other quantities of what proportion soeuer; as those of 12. 20. 24. 24½. and 28. foot to the Pole, of all which seuerall sorts I haue found in diuers places, whose difference in euery Acre, from that of 16½. appeareth by this Breuiat following.

An Acre measured by the Pole of these feet,		*Containeth of Statute measure*
	12	0 — 2 — 4 $\frac{75}{121}$.
	18	1 — 0 — 30 $\frac{11}{121}$.
	20	1 — 1 — 35 $\frac{33}{121}$.
	24	2 — 0 — 18 $\frac{99}{121}$.
	24½	2 — 0 — 32 $\frac{113}{121}$.
	28	2 — 3 — 20 $\frac{1}{4}$.

And here is it not amisse to note the benefite and vse of your two Scales of 11. and 12. in an inch formerly described in the 8. Chapter, which will serue you now to purpose. For if in your Surueyes (as often hapning) you meete with Wood-land grounds, whose quantities are required to be of the Acre of 18. foot Pole, and yet platted with the rest: In such case you may measure those Wood-lands with the Pole of 16½. and likewise plat the same with the Scale of 12. as the rest, but to cast vp the contents of those Wood-land grounds by the Scale of 11. which will produce the desired quantitie; By reason that if 11. Perches be measured in a right line with the 18. foote pole, the same length containeth 12. Perches measured with the 16½. foote pole. But if you are constrained in the measuring of your Wood-lands, to vse the Pole of 18. foot; then must you protract and lay downe the same in your plat by the Scale of 11. which otherwise will not ioyne with your other works; and the same likewise to be cast vp by the same Scale of 11. as before. So shall you obtaine the true quantitie thereof in Acres, after the measure of the 18. foot pole required.

CHAP. XIIII.

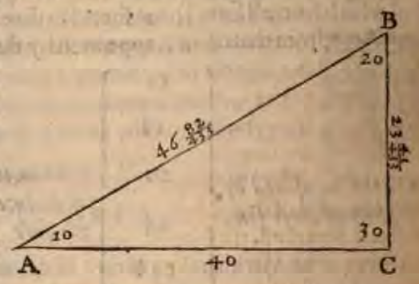
Of the Table of Sines expressed on the Circumferentor.

THis Table (as is specifyed in the description of the Circumferentor (Chap. 4.) serueth for the calculation, resolution and dimension of Triangles; not in respect of the Area or superficiall content thereof; but for the finding out of the vnknown sides and angles of the same; by meanes whereof, all manner of quantities in mensuration of altitudes, profundities, longitudes and latitudes are exactly knowne and discouered, considering that none of these can be had or obtained instrumentally, without description of Triangles.

Where-

Wherefore let it firſt bee conſidered, that by the 73. THEOREME of the firſt booke, the ſides in all plaine Triangles are in proportion the one to the other, as the Sines of the Angles oppoſite to thoſe ſides.

And then that in euery Triangle, there are ſixe termes, that is, 3. ſides and 3. angles, whereof any three being knowne (ſo one be aſide) the other three are had, by meanes of this Table, and the rule of proportion thus.



Suppoſe B C. in the Triangle A B C. to be a Tower or perpendicular altitude giuen, and let it be required to finde the height thereof, and the length of the Hypothenuſall line A B. Firſt, meaſure the diſtance from A to C. 40. then by any Inſtrument planted at A. take the quantitie of the Angle B A C. which let be 10. degrees, then conſequently by the 13. THEOREME of the Firſt, the Angle A B C. ſhall be 20. degrees, for that the Angle A C B, is a right Angle: So is there here alreadie had foure parts or termes of the ſixe before mentioned, namely, the three Angles, and the length of the line A C. Wherefore now repayre to the table, and find there the Sines of thoſe Angles which are theſe, of the Angle A B C. 20. degrees, the Sine is 866. of the Angle B A C. 10. degrees, the Sine is 500. and of the Angle A C B. 30. degrees the Sine is 1000. the totall Sine: Then by the rule of proportion reaſon thus. If A C. 866. the Sine of the Angle A B C. giues B C. 500. the Sine of the Angle B A C. what giues A C. 40, and multiplying 500. by 40. the Product is 20000. which diuided by 866. quoteth 23 2/3. for the height of A C. required.

Again, if A C. 866. the Sine of the Angle A B C. giues A B. 1000. the Sine of the Angle A C B. what giues A C. 40. and multiplying 1000. by 40. the Product is 40000. which diuided by 866. quoteth 46 2/3. for the length of A B. the Hypothenuſall line, as was required.

And thus much for a ſmall taſte onely of this little Table, which may ſerue to induce and incite a willing minde, not onely to the vſe and exerciſe thereof; but to the further conſideration and practice of the infinite vſe of thoſe moſt excellent Tables and workes de BARTHOLOMAEO PITISCO GRVNBERG. *now partly tranſlated into Engliſh by M.* RAPH HANDSON; *and of thoſe Tables, and more then admirable inuention of* LOGARITHMES, *by that diuine and noble Writer, the Lord* MARCHISTON, *whoſe name and honour will neuer out.*

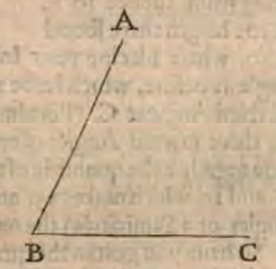
CHAP.

CHAP. XV.

Of the congruitie in vſe betweene the Peractor and Circumferentor; and the meanes to find the quantitie of an Angle by eyther of them.

THeſe two Inſtruments in vſe differ little or nothing, conſidering the degrees of eyther are equally numbered, although thoſe of the Circumferentor are placed on the Carde, and theſe of the *Peractor*, on the limbe of the Planiſphere, whereby they are ſo much the larger, and thereby the fitter for vſe: onely herein they differ, the degrees obſerued and taken by the *Peractor*, are euer cut by the edge of the Index, moued about till through the ſights thereon, the obiect be found, the Needle being alwayes kept on one degree, and that moſt fitly on the Meridian line in the Carde, the North end (being that with the Croſſe) lying euer ouer the Flower deluce, and the ſouth end pointing to the beginning of the degrees; and the degrees obſerued and taken by the *Circumferentor*, are alwayes cut in the Carde by the South end of the Needle, playing about at pleaſure, whileſt the Inſtrument and the ſights thereof are directed to the purpoſed marke. By meanes of which diuerſitie, there is a diuers meanes to be vſed, in taking the true quantitie of an Angle, by theſe two Inſtruments, as followeth.

By the 49. DEF. of the Firſt. The quantitie or meaſure of an Angle, is the Arch of a Circle, deſcribed from the point of the ſame Angle, and intercepted betweene the two ſides of that Angle, which is found by the Circumferentor thus.



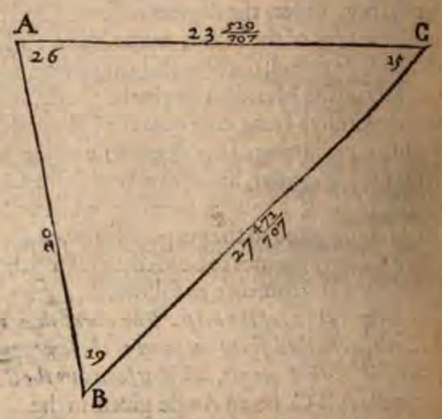
Suppoſe A B C. be an Angle giuen in the Fields, and let A B. and B C. be two hedges or other lines, containing the ſame Angle; and let it be required, to take the quantitie thereof by the *Circumferentor*. Firſt, place your Inſtrument in the Angle at B. and turning the ſame about on the ſtaffe, direct your ſight towards A. to bee alwayes parallell to the line B A. where obſerue what degree the ſouth end of the Needle cutteth, which let be 40. degrees, then direct your ſight towards C. and there making like obſeruation, let the degree cut bee 18. But yet haue you not the quantitie of this Angle, but onely the degrees cut at each obſeruation. Wherefore now you are to deduct 18. the leſſer from 40. the greater terme, the remainder will bee 22. the true quantitie of the giuen Angle. But had this remainder exceeded 60. (which is two right Angles, or a Semicircle) then muſt you haue deducted that remainder out of 120. the whole circle, and the remainder of that laſt deduction had beene the quantitie required; which circumſtance in the *Peractor* needeth not, wherewithall worke thus.

Place your Inſtrument at B. in the former Diagram. (the Index ſtanding on the Diameter where the degrees commence) then turne about the Inſtrument

ment on the ſtaffe (the Index remayning) towards A. till your ſight bee parallel to the line B A. and there your Inſtrument fixed, remoue the Index, directing your ſight towards C. to be likewiſe parallell to B C. where obſerue what degree the edge of the Index cutteth, which will be 22. the quantitie required. And here note an exquiſite diſpatch.

CHAP. XVI.

To take any horizontall diſtance at two ſtacions, by Sinicall computation.



SVppoſe A and B. be two places giuen, & let it be required to know the diſtance from eyther of them to C. Firſt, place your Inſtrument at A. where directing your ſight firſt to C. and then to B. take the quantitie of that Angle, as was taught in the laſt Chap. which ſuppoſe to be 26. degrees, then meaſuring from thence to B. let the length there found be 20. where placing your Inſtrument, take likewiſe the quantitie of that Angle as before, which let be 19. degrees. Now to finde the quantitie of the third Angle at C. (Foraſmuch as by the 13. THEOREME of the firſt, the three inward Angles of euery Triangle is equall to two right Angles) adde together the quantitie of thoſe two Angles at A. and B. already found, 26. and 19. which makes 45. and that deducted from 60. (which is two right Angles or a Semicircle) the remainder is 15. the quantitie of the Angle at C. So haue you gotten the quantitie of euery Angle, and the length of one of the ſides, namely, the Stationary diſtance A B. Now to euery of thoſe Angles in the Table of Sines, finde out their ſeuerall Sines, whereof make collection in your Field booke, or otherwiſe thus.

	d	s
A.	26	978.
B.	19	839.
C.	15	707.
A B.	20. Perches.	

Then by the Rule of Proportion, reaſon thus. If A B. 707. the Sine of 15. degrees yeelde 20. the ſtationary diſtance, what A C. 839. the Sine of B. 19. degrees, and multiplying 839. by 20. and diuiding the Product by 707. the quotus will bee 23. $\frac{730}{707}$. for the diſtance A C. And againe, if A B. 707. the Sine of C. 15. degrees, yeeld 20. the ſtationary diſtance, what B C. 978. the Sine of A. 26 degrees, and multiplying 978. by 20. and diuiding the Product by 707. the quotus will bee 27 $\frac{477}{707}$. the diſtance B C. required.

The Theoricall ground and reaſon of this worke dependeth on the 13. *and* 73. THEOREMES *of the firſt booke.*

Where note in all works of this nature, that if any of the three Angles bee an obtuſe Angle, containing aboue 30. *degrees, then (ſeeing the Table of Sines exceedeth not* 30.) *deduct the exceſſe of the obtuſe Angle aboue* 30. *out of* 30 *(as if it were* 44. *the exceſſe whereof aboue* 30. *is* 14. *which deduct out of* 30. *there remaineth* 16.) *and of that remainder ſeeke the Sine in the Table, which ſerues the turne. The reaſon hereof is, becauſe the right Sine of the Arch in the greater or leſſer Quadrant are all one and the ſame thing.*

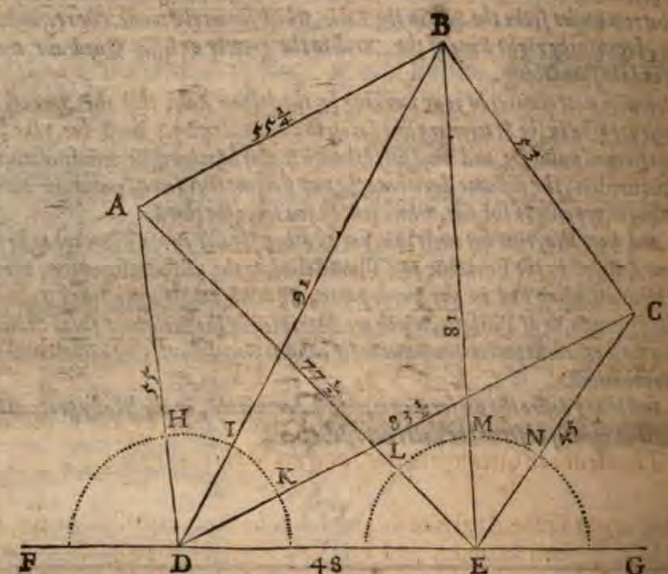
Likewiſe note alwayes in your working by the golden Rule, that the Sine of the Angle oppoſite to the Stacionary line (as in this example 707.) *muſt bee your firſt proportionall number; and moſt fitly (though it may be otherwiſe,* tranſpoſitis terminis medijs) *the diſtance betweene the two ſtacions the ſecond; and the Sine of the Angle, oppoſite to the ſide, whoſe length you ſeeke the third.*

And note alſo, that not onely this, but all other the like Propoſitions are to be performed, aſwell by the Peractor *and* Theodelite, *as the* Circumferentor, *the Table of Sines being had in any voyde paper, or much rather thoſe ſmall Tables of* Logarithmes, *or of* Pitiſcus, *which are imprinted by themſelues in ſmall volumes, being moſt excellent pocket-companions for infinite Concluſions, aſwell Geometricall as Aſtronomicall.*

And if any deſire the performance of this Propoſition, or the like by protraction; let him diligently obſerue the doctrine of the next.

Chap. XVII.

To take the distance aswell betweene diuers seuerall places remote from your place of being, as betweene your being, and those seuerall places, by the helpe of two stacions.



SVppose A.B. and C. bee three places giuen remote from your place of being, which let be at D. and let it bee required at D. to finde the seuerall distances, aswell betweene A B. and B C. as betweene D A. D B. and D C. First place your Instrument at D. and directing your sight to A. obserue what degree is there cut, eyther by the Needle of the *Circumferentor*, or by the Index of the *Peractor*, which let be 32 ½. degrees, to be noted for your first obseruation, thē turning your sight to B. make the like, where you finde 21. degrees, and the like towards C. obseruing 15. degrees. Then your second Stacion, (not being limited) make choyse thereof with such discretion (if the place will affoord it, as at E.) that your Stationary distance bee no lesse at the least then ¼. of the other distances from you, how much greater (with reason) makes no great matter; and as neere as you may, let it make a right Angle with the first obseruation of your first Stacion, then for the last worke of that stacion direct your sight to E. obseruing the degrees cut 120. then take vp your Instrument, and leauing a marke at D. measure from D. to E. the stationary distance, which suppose 48. then at E. plant your Instrument precisely as at D. vsing the helpe both of your Needle and backe sights herein, looking backe to your marke at D. whereof speciall care is to bee had, or maine

maine errors may ensue: which done, direct your sight first (as at the first stacion) to A. obseruing the degree there cut 45. the like to B. 31 ½. degrees, And lastly, to C. 15. degrees. So haue you finished; if you omit not the collection of your seuerall obseruations, which in your Field Booke or otherwise are thus to be expressed.

Then prouide a cleane sheete of paper, and according to these collections layde before you, protract the seuerall angles or degrees here obserued, as is taught in the next.

			d
Obs.	1. St.	1 —	32
		2 —	21.
		3 —	9 ¼.
		4 —	120.
	dist.		p 48.
	2. St.	1 —	45.
		2 —	31 ½.
		3 —	15.

Chap. XVIII.

To protract any number of Angles or degrees taken by the Peractor, Theodelite or Circumferentor, at seuerall obseruations.

LEt the Angles or degrees taken be those expressed in the former Chapter, and let it bee required to protract the same, whereby the quantitie of each seuerall distance there sought for, may appeare. First, on your paper prouided, draw a right line at pleasure, as F G. in the former Diagram; then laying your Field-Booke before you, with the former obseruations, make choyse of any point in the line F G. to represent your first Stacion, as at D. then applying the Scale of your Protractor to that line, lay downe your stacionary distance 48. Perches from D. to E. representing the place of your second stacion; and placing your Protractor with the Centre on the point D. (the Semicircle vpwards) turne it about thereon, till that degree on the Protractor which was taken from the first to the second stacion (which in this example is 120.) lye precisely on the line F.G. and then looke in your Field-Booke for the degrees obserued at your first stacion, which were 32 ½. 21. and 9 ¼. (for the fourth 120. that is supposed alwayes to fall on the first drawn line F G.) and against those seuerall degrees on the limbe of your Protractor, by the edge thereof with your protracting pinne, make seuerall pricks or points, as at H. I. and K. then by the point D. and those three seuerall pricks with the scale of your Protractor, and protracting pinne, draw out at length the lines D H. D I. and D K. so haue you finished your first obseruations; then place your Protractor on the point E. in all respects as before, at D. and there mark the degrees of your second obseruations, as 45. 31 ½. and 15. as before, at the points L. M. and N. whereby, and by the point E. draw out at length the lines

lines E L. E M. and E N. till they interſect the three former lines, drawne from D. as in the points A. B. and C. by which interſections from point to point, draw the lines A B. and B C. So haue you finiſhed your Protraction. And by applying the ſcale of your Protractor, (whereby the ſtacionary diſtance was laide downe) to any line or diſtance, the ſeuerall quantities will appeare to be as they are expreſſed in the Diagram, on the ſeuerall lines thereof, as was required.

But here is to be noted, that if thoſe former obſeruations were made and taken by the Theodelite, *then this Protraction is to be made and layde downe by the Protractor belonging to the* Theodelite, *being diuided into* 360. *degrees, as is before mentioned, which is to be performed in all reſpects, according to the rules and inſtructions before deliuered.*

CHAP. XIX.

To take any acceſsible altitude by the Circumferentor or Plaine Table with the diuided ſights.

SVppoſe A B. to bee a perpendicular height, & let it bee required from C. (whoſe diſtance to B. is acceſſible) to know the altitude thereof. Firſt, place your Inſtrument at C. preciſely horizontall, by helpe of the plummet hanging on the ſhorter ſight; whereunto great care muſt bee had aſwell in this, as all other works of this nature, or maine errors will ariſe; then moue the vane on the longer ſight vpwards and downwards, till through the hole therein, and by the pinnes head on the toppe of the ſhorter ſight, you eſpie the Summitie of the giuen height at A. where note the equall diuiſions cut on the longer ſight by the edge of the vane, which ſuppoſe to be 40. then meaſure the diſtance from C. to B. which let be 110. And the ſame proportion which 40. the part cut hath to 100. the ſide of the ſquare proiected on the Inſtrument, the like hath the altitude A. B. to the meaſured diſtance, 110. Wherefore multiply 110. the diſtance by 40. the parts cut, and diuide the Product by 100. the quotus will be 44. the altitude required.

But it hapneth oftentimes that the altitude required is of that height, that you cannot produce the vane low inough, to ſee the ſummitie of the height, as before. In which caſe you are to vſe the Index to be placed on the wyer-pinne in the edge of the ſhorter ſight, and turning it vp and downe cloſe by the right edge of the Inſtrument, till through the ſight thereof, and by the wyer pinne you eſpie the ſummytie of the giuen height, and then note the parts cut on the ſame edge of the Inſtrument, by the fiduciall edge of the Index. For the ſame proportion which the parts cut, beare to 60. (the imagined parts on the edge of the ſhorter ſight) the like hath the meaſured diſtance to

to the altitude required. Wherefore, multiply the ſame meaſured diſtance by 60. and diuide the Product by the parts cut, the quotus ſheweth your demand. And if you deſire to know the Viſuall or Hypothenuſall line, multiply the meaſured diſtance by the parts cut on the edge of the Index, and diuide the Product by the parts cut on the edge of the Inſtrument; the quotus ſheweth what you deſire. For what proportion the parts cut on the edge of the Inſtrument, beare to thoſe cut on the edge of the Index, the like doth the meaſured diſtance to the Viſuall line.

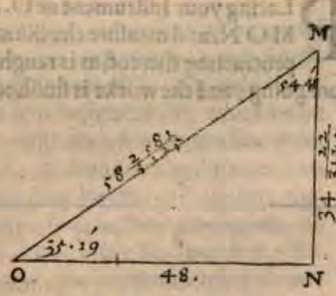
And here is to be noted, that of this later worke the plaine Table *hath no vſe; and therefore of all other Inſtruments moſt vnfit for theſe purpoſes of Altitudes and Profunities, without helpe of the quadrant ſpecified in the deſcription thereof,* CHAP. 3.

Or with the Circumferentor, by Protraction, thus.

PLace your Inſtrument at C. as before, and there obſerue the quantitie of the Angle of altitude, which being gotten, protract and lay downe the ſame as hath beene taught, and on the baſe line from C. to B. lay downe the meaſured diſtance 110. at the end whereof, as on the point B. either by the 6. PROBLEME of the ſecond Booke, or with helpe of your Protractor erect a perpendicular line as A B. to cut the other ſide of the protracted Angle, as in A. and with applying your Scale thereunto, the altitude appeareth, as was required.

CHAP. XX.

To take any acceſsible altitude diuers wayes, by the Peractor and the Quadrant thereof.



SVppoſe M N. to be a perpendicular height giuen; and let it be required from O. to find the Altitude thereof. Place your Inſtrument preciſely Horizontall at O. as before is taught, then moue your Quadrant vp and downe, till through the ſmall round hole, in the end of the ſight towards you at B. on the Quadrant (as it is deſcribed in the 5. Chapter) and by the pin in the great round hole of the other end at A. you eſpie the Summytie M. of the giuen height, where letting your quadrant reſt, meaſure the diſtance O N. which ſuppoſe to be 48. then looke on the ſide C D. of the quadrant, for the 48. line, reckoning from the Centre P. and paſſing downe by that line to the edge of the handle or Index (which ſuppoſe to ſtand now on the line P F. drawne from the Centre of the quadrant)

drant) note what line (passing from the other side A.B. of the quadrant) the former line 48. meeteth and intersecteth on the edge of the Index, supposed as before the line P. F. and you shall find it somewhat more then 34. wherefore I conclude, that the altitude A B. is so much: and noting what part of the Index is there cut, you shall find it somewhat more then 58 ¾. the length of the visuall line, or hipothenusall O. M. Where is to be noted, that in all workes wrought with this quadrant, the side thereof A. B. representeth the perpendicular height, the side C. D. the horizontall distance, and the Index or handle, the hipothenusall or visuall line.

Or Sinically thus.

HAuing placed your Instrument as before at O. By the degrees on the limbe of the quadrant, obserue the angle of altitude M O N. 35. degrees 1′9. and measuring the distance O N. 48. as before (by the helpe of *Pitiscus*, or any other Canon) Reason thus: If O N. the radius 100000. yeeld 48. the measured distance; what M N. 70848. the tangent of the Angle M O N. 35. degrees, 1′9. and multiplying the tangent 70848. by 48. the measured distance, you shall produce 3400704. which parted by the radius 100000. quoteth 34 $\frac{704}{1000}$. or in lesser termes, 34 $\frac{88}{125}$. the altitude M N required.

Againe, if O N. the radius 100000. giues 48. the measured distance, what O M. 122554. the secant of the Angle M O N. 35. degrees, 1′9. and multiplying the same secant 122554. by 48. and parting the Product by the radius 100000. you haue 58 $\frac{8592}{10000}$. or in lesser termes, 58 $\frac{537}{625}$. being somewhat more then ¾. the length of the visuall or hipothenusall line O.M. as before.

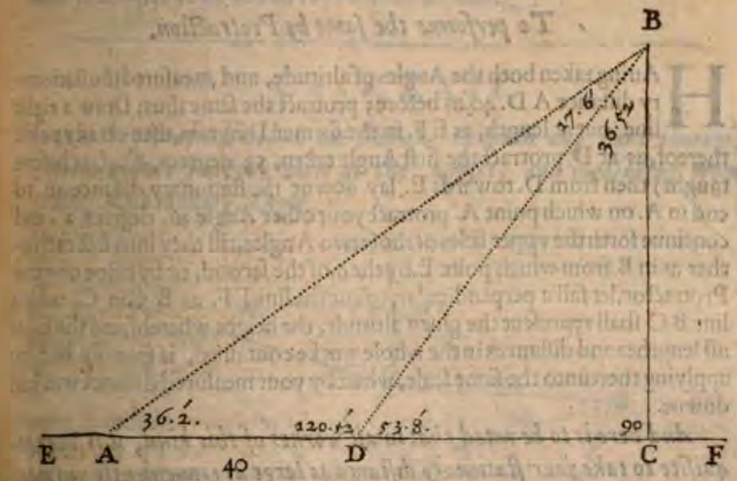
Or by Protraction, thus.

PLacing your Instrument at O. as before, obserue the Angle of altitude M O N. and measure the distance from O. to N. And then proceed to protracting thereof, as is taught in the later part of the last Chapter before going; and the worke is finished.

CHAP.

CHAP. XXI.

To find out any inaccessible height by the Peractor, Theodelite, or Circumferentor.



IT may oftentimes happen that inaccessible heights may be required, when by reason of waters, trenches, danger of shot, or many other impediments, a man cannot approch to the Base of the altitude required; yet of necessity to bee had and knowne, which to performe, in a most absolute and exact manner, worke thus.

Suppose B C. to be a perpendicular height giuen, vnto the Base, whereof C. (by some impediment) you may not approch neerer then D. yet the altitude is required; wherefore place your Instrument at D. precisely horizontall, and obserue the Angle of altitude, as is before taught, which let be 53. degrees, 8′. then looking backwards, make choyse in a right line from C. by D. of a second station, which let be A. and measure the distance from D. to A. which suppose 40. then at A. place your Instrument as before, and likewise obserue there the Angle of altitude, which suppose 36. degrees, 2′. so is your Instrumentall worke already finished. Then repayring to your *Canon of Triangles*, finde the complements of the Tangents of those two Angles taken, which of 53. degrees, 8′. the angle first obserued, is 74991. and of 36. degrees, 2′. the Angle of your last obseruation, is 137470. betweene which two complements take the difference, by deducting the lesser from the greater, which will bee 62479. and then (for as much as the same proportion which the difference of the complements 62479. beareth to the radius 100000. the like hath the measured distance betweene your two stations D A. 40. and the required altitude) multiply the radius 100000. by 40. the

the measured distance, the Product is 4000000. which parted by 62479. the difference of the complements quoteth 64 for the required altitude.

And if it bee required, to haue the length of a scaling ladder to extend from D. to B. or the length of the visuall line A B. or the inaccessible distance betweene D. and C. by respectiue obseruation of what was taught in the last Chapter, they are easily resolued.

To performe the same by Protraction.

HAuing taken both the Angles of altitude, and measured the stationary distance A D. 40. as before; protract the same thus; Draw a right line out at length, as E F. in the former Diagram, then on any point thereof, as at D. protract the first Angle taken, 53. degrees, 8′. (as before taught) then from D. towards E. lay downe the stationary distance 40. to end in A. on which point A. protract your other Angle 36. degrees, 2′. and continue forth the vpper sides of those two Angles, till they intersect each other as in B. from which point B. by the 6. of the second, or by helpe of your Protractor, let fall a perpendicular, to cut the line E F. as B C. in C. which line B C. shall represent the giuen altitude, the height whereof, and the seuerall lengthes and distances in the whole worke contained, is speedily had by applying thereunto the same scale, whereby your measured distance was laid downe.

And here is to be noted, that in all workes of this kind, it is very requisite to take your stationary distance as large as conueniently you may, for that otherwise by reason of the acuitie of the Angle, as here of A B D. you shall hardly discerne the true point of intersection by the lines B A. and B D. whereby, or from whence you may precisely let fall the perpendicular B C. as before in his due place: by neglect whereof mayne errors may insue.

Wherefore a most excellent, absolute and exact course is that in the former part of this Chapter, for the performance of all manner of conclusions of this kind, and to be preferred before all others.

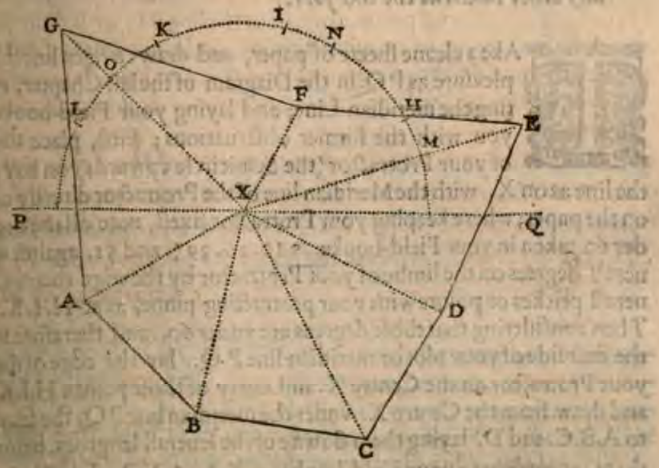
And here now might I much inlarge this worke, by inserting seuerall Propositions for the taking and finding out of distances in heights, with the mensuration of profundities diuers wayes; all which and infinite other conclusions are fully included within the limits of these few former instructions, and with diligent obseruation and practice thereof may bee well vnderstood and performed; for whoso can take one height artificially, may performe another, and by deducting the one from the other, may decerne the difference: and he that can skilfully take an altitude, by the same rule may performe a profunditie, being the one a direct conuersion of the other, without alteration or any difference, either in the Theoricall ground, or practike operation thereof: wherefore to make great shewes, or accumulation of needelesse varieties to one and the

the same purpose, were but expence of time vnto my selfe, and cause of confusion to the learner, seeing fewest Precepts (so effectuall) are fittest, aswell for apprehension as retention.

But before I passe further, let this bee remembred, that in all the former obseruations in taking of heights: the height of your Instrument is alwayes to be added to the altitude taken.

CHAP. XXII.

To take the plot of a Field at one stacion; taken in any part thereof, from whence you may view all the Angles, and measuring from the stacion to euery Angle.



SVppose A B C D E F G. to be a Field, whereof it is required to take the Plot. First, cause papers or other markes to be placed directly in euery Angle; and then make choise of some such conuenient place within the same, as from whence you may best view the seuerall Angles thereof, and there as at X. Plant your Instrument; if it be the *Peractor*, *Theodelite*, or *Plaine-Table*, fasten the Instrument to the staffe with the screw-pinne, that it stirre not till your worke be finished, the needle standing on the Meridian line of the Carde, if the *Circumferentor*, that care is already taken; but admit the *Peractor*; then direct your sight, by turning the Index to any one Angle at your pleasure, as first to A. and obserue the degree there cut by the edge of your Index, which let be 10. and with your Chaine measure from your station to that Angle, which suppose 30. then direct your sight to B. and performe the like, and so to C. D. E. F. and G. till you haue finished; still entering as you passe your seuerall obser-

obſeruations, aſwell of degrees as lines into your Field-booke, as was formerly taught in Chap. 10. which when you haue finiſhed ſhall appeare to bee thus.

d	o	1
10	30	—
26	33	2
39 1/2	41	—
51	36	—
66	47	5
81	18	8
105 1/2	41	5

Which being layde before you, ſhall moſt ſpeedily and exactly be protracted and layde downe, as is taught in the next.

CHAP. XXIII.

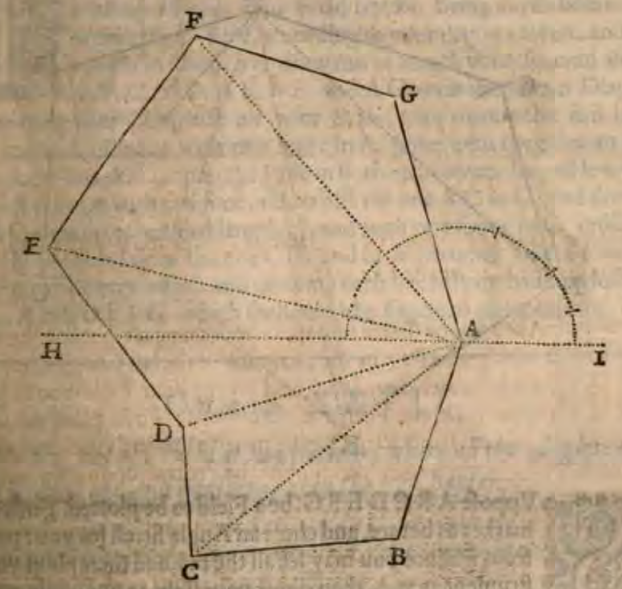
To protract and lay downe the obſeruations made in the laſt Chapter, or any other taken in the like ſort.

TAke a cleane ſheete of paper, and draw a right line thereon at pleaſure as P Q. in the Diagram of the laſt Chapter, repreſenting the meridian Line; and laying your Field-booke before you with the former obſeruations; Firſt, place the Centre of your Protractor (the Semicircle vpwards) on any point of the line as on X. with the Meridian line of the Protractor directly ouer that on the paper; where keeping your Protractor fixed, note all the degrees vnder 60. taken in your Field-booke, as 10. 26. 39 1/2. and 51. againſt which ſeuerall degrees on the limbe of your Protractor by the edge thereof, make ſeuerall prickes or points with your protracting pinne, as at H. I. K. and L. Then conſidering that thoſe degrees are vnder 60. and therefore to lye on the Eaſt ſide of your plot or meridian line P Q. lay the edge of the ſcale of your Protractor on the Centre X. and euery of thoſe points H. I. K. and L. and draw from the Centre X. vnder the meridian line P Q. the ſeuerall lines to A. B. C. and D. laying them downe of the ſeuerall lengthes, belonging to them, according to your Field-booke, as X A. 30° X B. 33° 1/2. X C. 41°. and X D. 36°. making prickes or points at the end of euery ſeuerall length, as at A. B. C. and D. and then from point to point, draw the lines A B. B C. and C D. ſo haue you finiſhed the worke on the Eaſt ſide of your Meridian. Then place againe your Protractor in all reſpects as before, and note all the other degrees being aboue 60. as 66. 81. and 105 1/2. which by the edge of the Semicircle marke out as before, as at M. N. and O. and ſeeing they belong to the Weſt ſide of your worke, draw your lines from the Centre X. vpwards towards thoſe three ſeuerall points, laying them downe with their ſeuerall lengthes obſerued in your booke, as X E. 47° 1/2. X F. 18° 1/8. and X G. 41° 1/4. making points as before at the end of euery length; and laſtly from point to point draw the lines A G. G F. F E. and E D. So ſhall you incloſe the Figure A B C D E F G. with equall Angles and proportional lines to the meaſured field as was required.

CHAP.

CHAP. XXIIII.

To take the plot of any Field at one ſtacion in any one Angle thereof, from whence may bee ſeene all the other Angles of the ſame Field; and meaſuring from the ſtation to euery Angle.



SVppoſe A B C D E F G. to be a field, the plat whereof is required to be taken. Firſt, cauſe whites or markes to be placed directly in euery Angle, then make choyſe of the moſt conuenient Angle, from whence you may beſt view all the reſt, as at A. where place your Inſtrument as before is taught, and directing your ſight to one of the next Angles on eyther hand as to B. obſerue the degrees cut by the edge of the Index, which let bee 24 1/2. degrees and meaſure that line A B. 33° 1/4. then turning your Index to the next, as to C. make the like obſeruation of 13 1/4. degrees. and meaſure the length A C. 55° 1/2. and in like manner proceed to the reſt, as to D. E. F. and G. ſtill expreſſing in your Field-booke your ſeuerall Angles and Lines as before is taught, which hauing finiſhed will thus appeare.

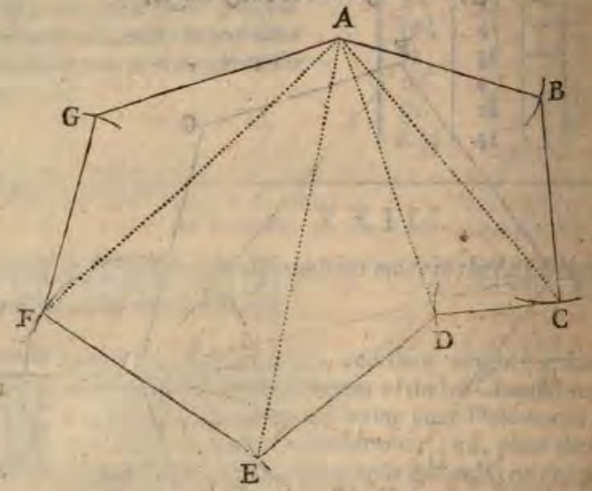
d	o	1
24 1/2	33	4
13 1/4	55	2
6	47	—
116	69	2
104	65	6
95 1/2	41	6

And then protract, and lay downe the ſame in all reſpects, according to the inſtructions of the laſt Chapter. The order whereof appeareth by the Diagram,

CHAP.

CHAP. XXV.

To take the Plot of a Field at one ſtation in any Angle, from whence the reſt may be ſeene, and by meaſuring the ſides of the Perimeter.



SVppoſe A B C D E F G. be a Field to be plotted. Firſt, ſet vp markes as before, and chuſe an Angle fitteſt for your purpoſe, from whence you may ſee all the reſt, and there plant your Inſtrument as at A. then direct your ſight to one of the next Angles, on eyther hand, as to B. and note the degree there cut, 24 ½. and meaſure the length of that line A B. 33. ½. then direct your ſight to C. and note the degree there cut 13 ¼. and meaſure the line from the Angle B. to the Angle C. 33. ½. and in like manner worke forwards to D. E. and F. and then note (hauing finiſhed at F.) that you haue yet remayning two lines to meaſure, namely, F G. and G A. and but one degree to bee taken, as from A. to G. (The reaſon whereof dependeth on THEOR. 74. 1.) wherefore meaſure the line F G. 33. ½. and expreſſe the ſame in your Booke without any degree; and laſtly, directing your ſight to G. obſerue the degree cutte 95 ½. and meaſuring the line A G. place the length thereof in your Booke 41. ½. againſt the laſt degree taken. So haue you finiſhed your Field-worke, and your obſeruations ſtand thus.

d	o	1
24 ½	33	4
13 ¼	33	—
6	21	—
116	36	5
104	41	8
—	33	5
95 ½	41	6

Which are to be protracted and layde downe as is taught in the next.

CHAP.

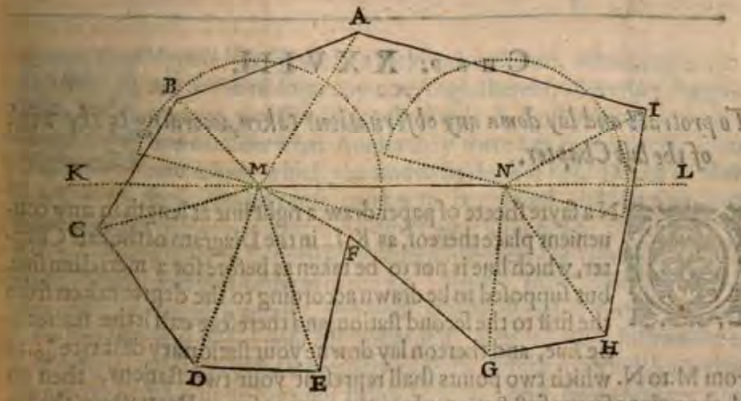
CHAP. XXVI.

To protract and lay downe the obſeruations had, according to the worke in the laſt Chapter, or any other taken by the like meanes.

THE ſeuerall degrees and lengthes ſo had and taken as before, and expreſſed in your Field booke, being layde before you, worke thus. Firſt, according to your degrees taken, and as is taught in Chap. 23. draw out at length your ſeuerall lines A B. A C. A D. A E. A F. and A G. as in the former Diagram, then opening your Compaſſe on your Scale, take therein the firſt length 33. ¼ at which diſtance with one foote in A. ſtrike with the other an Arch through the line A B. cutting the ſame in B. then take your ſecond length 33. at which diſtance with one foot in B. croſſe the line A C. in C. and draw the line B C. then take the third length 21. and with one foote in C. croſſe the line A D. in D. and draw the line C D. and in this manner worke forwards, laying downe euery length, and drawing each line till you haue incloſed the Figure A B C D E F G. which ſhall be a like Figure to the meaſured Field.

CHAP. XXVII.

To take the plot of a Field at two ſtations, where all the Angles cannot be ſeene at one, and meaſuring as in the 22. Chapter.



SVppoſe this Figure be a Field to bee plotted, which lyeth in ſuch ſort, as from no one place all the Angles thereof can be ſeene. In ſuch caſe make choyſe of a place for your firſt ſtation, where may be viewed as many Angles thereof as poſſibly you may, which let be M. where you may ſee the ſeue-

rall Angles at A. B. C. D. E. and F. then plant your Instrument in M. and there obserue all those Angles, and measure the seuerall lines, beginning from M. to A. and ending from M. to F. as is taught in the 22. Chapter, so haue you finished the worke of your first station. Then (before you remoue your Instrument) make choice of some other conuenient place for your second station, from whence you may see all the other Angles not formerly seene, as those at I. H. and G. which let be N. vnto which place direct your sight, and obserue the degree cut 65. then measure the stationary distance M. N. 40°. and leauing a marke at M. remoue now your Instrument to N. where place it precisely as it stood at M. with helpe of your needle and backe sight, then obserue your seuerall degrees, and measure the seuerall lengthes from N. your second station to I. H. and G. as before, and your Field-worke is finished. So as you remember alwayes to expresse your obseruations in your Field-booke, which shall thus appeare.

To be protracted and layde downe as is taught in the next.

	d	o	1
	83 ½.	29	—
	109 ½.	19	2
1. *Sta.*	10 ½.	26	8
	28 ½.	30	8
	41 ½.	31	5
	55 ½.	16	4
Sta. dist.	65	40	—
	74 ½.	26	—
2. *Sta.*	46 ½.	29	—
	33 ½.	27	5

CHAP. XXVIII.

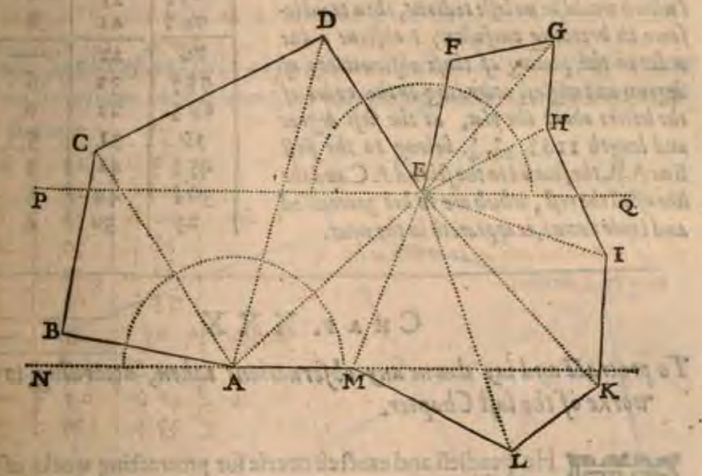
To protract and lay down any obseruations taken, according to the work of the last Chapter.

IN a fayre sheete of paper draw a right line at length in any conuenient place thereof, as K. L. in the Diagram of the last Chapter, which line is not to be taken as before for a meridian line, but supposed to be drawn according to the degree taken from the first to the second station; and therefore call it the stationarie line, and thereon lay downe your stationary distance $^{\circ}_{40}$. as from M. to N. which two points shall represent your two stations, then on M. the point of your first station, place the centre of your Protractor (the Semicircle vpwards) turning it about till the degree 65. on the limbe of your Protractor (being the degree taken from the first to the second station) cut precisely the stacionary line drawne, and there keeping it firme and immoueable, marke out the seuerall degrees of your first stacion; according to your Field-booke; and so worke on in all respects as is taught in Chap. 23. which effected, remoue your Protractor to N. the point of your second station,

tion, where placed precisely, as at the first, worke forwards with the degrees and lines of your second station, as before; and so haue you finished.

CHAP. XXIX.

To take the Plot of a Field at diuers stacions in diuers Angles, where all cannot be seene from one, and to measure as in the 24. Chapter.



SVppose this Figure be a Field to be plotted, whose angles cannot bee seene from any one Angle thereof, wherefore imagine you are now standing in the Angle A. from whence you view and consider what Angles may there bee conueniently seene and taken, which you find to be those at B. C. D. and E. then directly in those Angles cause markes to bee placed, and planting your Instrument as before is taught in A. direct your sight first to B. then to C. after to D. and lastly to E. noting the seuerall degrees cut towards each seuerall Angle, and measuring as in the 24. Chapter, from your station to euery of those Angles seuerally, and your worke of that station is finished. Now for that you ended your last worke at E. remoue your Instrument to that Angle, and there plant it precisely, as at the first stacion, vsing both your needle and backe-sight for your helpe therein; And here consider what Angles from hence may be perfectly seene and taken, which on view had, you finde to be all the residue not formerly taken, as F. G. H. I. K. L. and M. wherefore hauing your markes placed, take your seuerall obseruations and measure your seueral lines to euery of these Angles, as to those of the first station, taking them in order as they lye, and you haue finished. But suppose at this station, you could haue seene onely those Angles at F. G. H. and I.

then here muſt you haue finiſhed thoſe, and remoued your Inſtrument to I. for a third ſtation, and there to haue performed the reſt, or as many as there you might, and if any remaining, to take a fourth, and a fift ſtation, &c. till you haue finiſhed, wherein many words are needleſſe, the matter being apparant. Your obſeruations of this worke are theſe.

A generall Note.

And let it be noted, that where for breuitie ſake in mine inſtructions, aſwell here as elſe where, I omit to expreſſe particularly, the ſeuerall degrees and lengthes obſerued and taken betweene each ſtation and the ſeuerall Angles, (which would be no leſſe tedious, then troubleſome in breeding confuſion) I obſerue a due order in the placing of theſe obſeruations of degrees and angles, according to the order of the letters about the plot, as the firſt degree and length 116½. 28. ¼. belong to the firſt line A B. *the ſecond to the ſecond* A C. *and the like of all the reſt, which are to bee protracted and layde downe, as appeareth in the next.*

d	o	1
116½	28	4
101	41	8
85¼	55	8
74¼	41	8
86	22	
75½	32	8
69½	22	6
59	31	5
45½	42	5
36½	44	4
23	30	4

CHAP. XXX.

To protract and lay downe any obſeruations taken, according to the worke of the laſt Chapter.

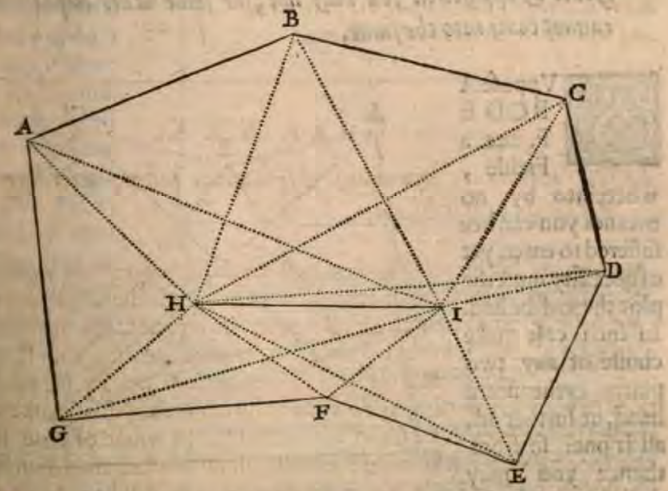
THe ſpeedieſt and exacteſt courſe for protracting works of this nature, conſiſting of diuers ſtations is thus. Firſt, draw a right line at length on your paper, to repreſent the meridian line, as N O. in the laſt Diagram, whereon placing your Protractor, worke in all reſpects as is taught in Chap. 23. for the obſeruations of your firſt ſtation; ſo ſhall you finiſh as much of this worke as is included by the lines A B. B C. C D. and D E. the worke of your firſt ſtation; then by the point E. where you left, draw another meridian line as P Q. which (by PROB. 3. 2.) make Parallel to the firſt line, N O. and then on the point E. place your Protractor in all reſpects, as at the firſt, & worke with the reſt as before, whereby you ſhall finiſh the worke of your ſecond ſtation, and perfect the Figure A B C D E F G H I K L M. with equall Angles, and proportionall lines to the meaſured field. And if there were more ſtations to be vſed in the Field-worke, then at the point where the worke of each ſtation endeth, you are to draw another meridian line parallel to the reſt. Or before you begin your protraction, you may draw diuers parallell lines on your paper, repreſenting ſo many meridians, and by helpe of your parallel diuiſions, placed at eyther end of the Scale of your Protractor, you ſhall on any point falling either vpon or beſides thoſe Meridians place your Protractor parallel as you pleaſe. And this kind of protraction may be vſed in ſtead of that taught in the 28. Chapter, as the better, though eyther will ſerue, and both tending to one end.

Hither-

Hitherto haue I taught after a perfect and exact manner the menſuration of ſeuerals (by diuers meanes) where one field or cloſe onely is to bee taken by it ſelfe: But if many ſeuerals (as a whole Lordſhip or Mannor) were to bee meaſured and plotted together: I hold not theſe former courſes the fitteſt: but rather thoſe which ſhall bee hereafter taught. But firſt I will deliuer ſome few directions and examples, for the dimenſion of ſeuerals after another order, by interſection of lines at ſeuerall ſtacions as followeth.

CHAP. XXXI.

To take the plot of any field at two ſtations, ſo as all the Angles may be ſeene from both ſtacions, by meaſuring onely the ſtationarie diſtance.



SVppoſe A B C D E F G. be a Field, the plot whereof is required to be taken. Firſt, make choice of two ſuch conuenient places for your Stations, as from whence you may ſee all the Angles about the Field; with theſe further conſiderations, that the diſtance betweene your ſtations bee of conuenient length, the longer the better, that they lye towards the middle of the field; and that neyther of them lye interpoſed in a right line betweene the other, and any Angle of the Field; but to be choſen with ſuch diſcretion, as all lines drawne from eyther ſtation to the ſeuerall Angles, may interſect ech other with as large angles as you may, which let be the two points H. and I. and cauſing marks to be placed in euery Angle, plant your Inſtrument at H. as is before taught, and directing your ſight to A. obſerue the degree there cut; and the like to B. C. D. E. F. and G. and alſo to I. the ſecond ſta-

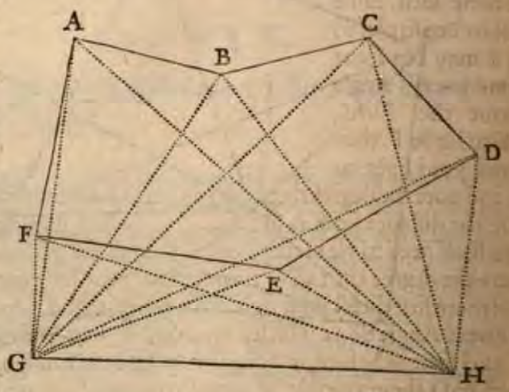
 tion,

tion, then take vp your Instrument, leauing a marke at H. from whence measure the stationarie distance to I. where placing your Instrument precisely as at H. obserue likewise all the degrees cut by your Index, directed to each seuerall Angle as before: Of all which seuerall obseruations keepe notice in your Field-booke as hath beene often mentioned; wherewith on a cleane sheete of paper by the directions of the 18. and 30. Chapters, the plot thereof is speedily protracted, and your businesse fully finished.

And here note the accuitie of diuers of those Angles in the Diagram, caused by the intersection of the pricked lines, notwithstanding all care had therein; and what inconueniences may hereby grow, without good regard; and yet are these Angles vsually drawne by many, who make a poore shift therewith.

CHAP. XXXII.

To take the plot of any Field remote from you at two stations, when eyther by opposition you may not, or some other impediment you cannot come into the same.

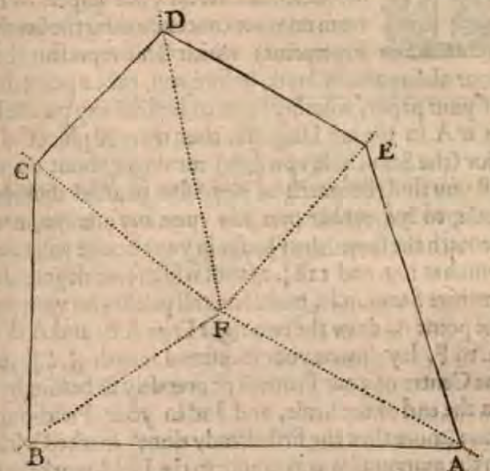


SVppose A B C D E F. bee a Fielde, whereinto by no meanes you can bee suffered to enter, yet of necessity must the plot thereof be had. In such case make choise of any two places, eyther neere hand, or further off, all is one; so from thence you may well decerne the seuerall Angles of the same Field; and let your stationary distance bee the full length of the Field, at the least if possibly you may; which two places let be G. and H. First plant your Instrument at G. and by directing your sight in order one after other to A.B.C.D.E. and F. the seuerall Angles of the Field, obserue the seuerall degrees there cut, as is before taught; then turne your sight to H. your second station, and note the degree there cut; which done, take vp your Instrument, leauing a marke at G. and measure from thence to H. your stationary distance, and there plant your Instrument in all respects as before, and make the like obseruations to all the seuerall Angles of the Field, as formerly at G. So haue you finished your Field-worke, which is to be protracted and layde downe according to your Instructions of the 18. Chapter.

And here note, by reason of the length of the stationary distance, how excellently the lines issuing from thence, intersect each other, which of necessitie makes the conclusion absolute.

CHAP. XXXIII.

To take the Plot of any Field by making obseruation at euery Angle, and measuring onely one line, but no part of the perimeter.



SVppose A B C D E. bee a Field, & it is required to plot the same as before. First, place your Instrument at A. and obserue some notable mark towards the middle of the Field; if there be none such, cause one to bee so placed as it may bee seene from euery Angle about the Field, which let be F. then direct your sight to F. and note the degree there cut 109. and (your Instrument remaining) measure the distance from A to F. 21°. $7\frac{1}{2}$. (which shall bee all the mensuration you shall need to vse in this worke) then direct your sight to B. obseruing there the degree cut $118\frac{1}{2}$. then remoue your Instrument to the Angle at B. and there first direct your sight to F. taking that degree $10\frac{1}{2}$. and then to C. the next Angle $88\frac{1}{2}$. which done, remoue your Instrument to the Angle at C. and there as before, first direct your sight to F. taking that degree 106. and then to D. the next angle $74\frac{1}{2}$. and so proceed from angle to angle, first taking your sight to F. and then to the next angle, till you haue finished, wherein by the way obserue this course; when you take your degrees to F. reckon those on the North end of your needle, and when you expresse them in your Booke, make in the margent against them a pricke, or some other marke, whereby it may bee apparant, when you come to Protraction which are those degrees, from the rest, which are to bee reckoned on the South end of the Needle, after the vsuall manner, and belong to the perimeter: so haue you very exactly finished your field-worke, and your obseruations are these.

Or take here the right degrees and protract the opposite.

	d	o	I
.	109	21	$7\frac{1}{2}$
	$118\frac{1}{2}$		
.	$10\frac{1}{2}$		
	$88\frac{1}{2}$		
.	106		
	$74\frac{1}{2}$		
.	93		
	49		
.	$75\frac{1}{2}$		
	$35\frac{1}{2}$		

Which is to be protracted, as is taught in the next.

CHAP.

CHAP. XXXIIII.

To protract and lay downe any obſeruations taken, according to the worke of the laſt Chapter.

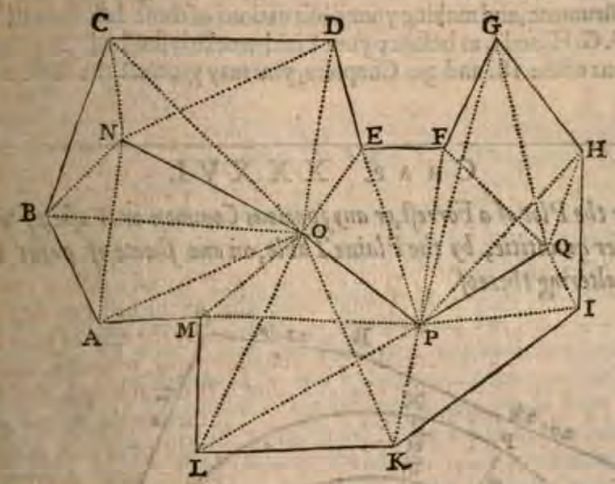
THis kinde of protraction is ſomewhat different from all the reſt formerly taught, wherefore obſerue it thus. Firſt, draw diuers parallel lines ouer all your paper, of conuenient diſtance one from another (not exceeding the bredth of the Scale of your Protractor) which ſhall repreſent the Meridians; then with your obſeruations layde before you, take a point in any conuenient place of your paper, whether vpon or beſides any parallel line, it is not materiall, as at A. in the laſt Diagram, then thereon place the Centre of your Protractor (the Semicircle vpwards) turning it about on your protracting pinne, till you find the match or oppoſite parallel diuiſions on eyther end of the ſcale, to lye eyther preciſely vpon any one line, or equally diſtant ouer or beneath the ſame; then looke in your booke what are the firſt two degrees, which is 109. and 118½. againſt which two degrees, by the edge of your Protractors Semicircle, make ſeuerall prickes on your paper, whereby, and by the point A. draw the two right lines A F. and A B. out at length, and from A. to F. lay downe your meaſured length 21°. 17'. then on the point F. place the Centre of your Protractor preciſely as before, by helpe of your diuiſions on the end of the Scale, and find in your Field-booke what degrees you haue (more then the firſt already done) marked with points or other markes in the margent (as was taught in the Field-worke) which are 10 ½. 106. 93. & 75½. againſt all which degrees on your Protractor make ſeuerall prickes as before, whereby, and by the point F. draw out at length the ſeuerall lines F B. F C. F D. and F E. remembring (as you are taught in Chap. 23.) alwayes to draw thoſe lines proceeding from all the degrees vnder 60. downwards or towards you from the point F. and thoſe aboue 60. vpwards from the point F. Then note, that by drawing out the line F B. you haue interſected the line A B. (formerly drawne) in the point B. on which point now place your Protractor as before, and finde in your Booke the ſecond degree vnmarked in the margent (for the firſt A B. is alreadie done, and likewiſe all thoſe which are marked) which is 88½. againſt which, on your Protractor make a pricke, and thereby, and by the point B. draw the line B C. till it interſect the line F C. in C. then place your Protractor on the point C. as before, and finde in your booke the next degree vnmarked, which is 74½. and againſt that degree on your Protractor make a pricke, whereby, and by the point C. draw out at length the line C D. to cut the line F D. in D. and in like manner proceed with the reſt; ſo ſhall you include the Figure A B C D E. like vnto the meaſured Field.

Where note, that now the points in the margent ſerue you to purpoſe, at an inſtant diſtinguiſhing thoſe degrees taken at each angle towards the point F. from the others vnmarked, repreſenting thoſe of the Perimeter.

This kind of worke well handled, is very exact and artificiall.

CHAP. XXXV.

To take the Plot of any Field at diuers ſtations, meaſuring onely the ſtacionary diſtances.

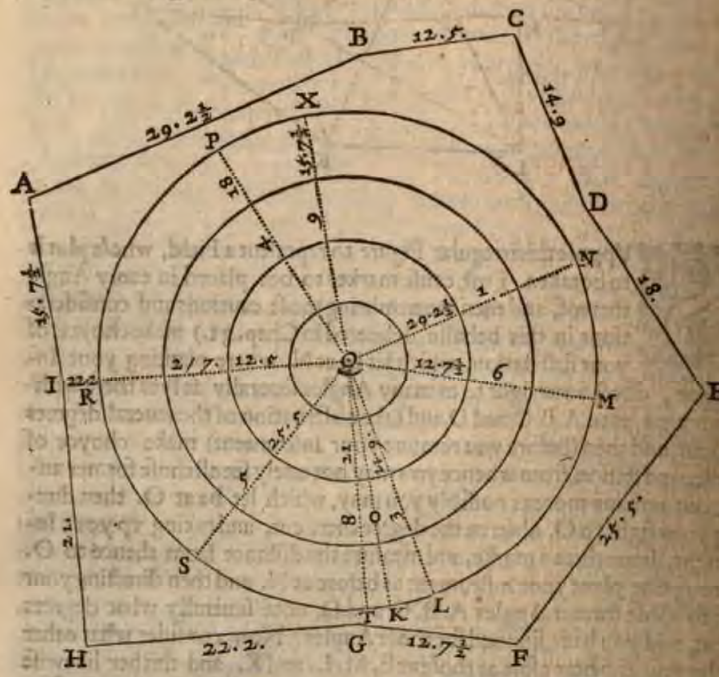


SVppoſe this irregular Figure to repreſent a Field, whoſe plot is to be taken. Firſt, cauſe markes to bee placed in euery Angle thereof, and then (remembring thoſe cautions and conſiderations in this behalfe deliuered in Chap. 31.) make choyce of your firſt ſtation, which let be at N. where planting your Inſtrument, direct your ſight to as many Angles ſeuerally as lyes there within your view, as to A. B. C. and D. and take obſeruation of the ſeueral degrees there cut, and then (before you remoue your Inſtrument) make choyce of your ſecond ſtation, from whence you may not onely ſee all thoſe former angles, but as many more as poſſibly you may, which let be at O. then directing your ſight to O. obſerue the degree there cut, and taking vp your Inſtrument, leaue there a marke, and meaſure the diſtance from thence to O. where againe plant your Inſtrument as before at N. and then directing your ſight to thoſe former Angles A. B. C. and D. note ſeuerally what degrees are cut, and you haue finiſhed for thoſe Angles. Now conſider what other Angles you can here eſpie as thoſe at E. M. L. and K. and thither likewiſe direct your ſight ſeuerally, and make your ſeuerall obſeruations as before, which done (your Inſtrument remayning) make choyce of your third ſtation, (from whence you may not onely ſee thoſe Angles at E. M. L. and K. but as many other vnfiniſhed Angles as you may) which let be at P. then directing your ſight to P. obſerue your degree thither, leaue a marke at O. take vp your Inſtrument, and meaſure from O. to P. where againe plant your In-

Inſtrument, and make your obſeruations of thoſe former Angles E. M. L. and K. ſo haue you thus farre wrought. And now againe conſidering what other Angles you can here eſpie, you ſhall finde within your view F. G. H. and I. being all the reſidue vnfiniſhed; wherefore here alſo make your ſeuerall obſeruations of theſe laſt Angles, and choyſe of your laſt ſtation, as at Q. whither directing your ſight, and making obſeruation, take vp your Inſtrument, and with a marke at P. meaſure the diſtance to Q. where laſtly plant your Inſtrument, and making your obſeruations of thoſe laſt ſeuerall Angles at F. G. H. and I. as before; your Field-worke is finiſhed. And by the directions of the 18. and 30. Chapters, you may protract the ſame accordingly.

CHAP. XXXVI.

To take the Plot of a Forreſt, or any ſpacious Common or Waſte, of whatſoeuer quantitie, by the Plaine Table, on one ſheete of paper without altering thereof.



SVppoſe A. B. C. D. E. F. G. H. I. to bee ſome large irregular ground, and it is required to plot the ſame. Firſt, a ſheete of paper being placed on your Plaine Table after the vſuall manner, Take a point at all aduenture about the middle thereof as at Q. in the Diagram, and thereon deſcribe foure concentricke Cir-

Circles of conuenient diſtance, the vttermoſt extending neere the bredth of the Table, whereby you ſhall produce three ſeuerall circular ſpaces, which are thus to bee employed; In the vttermoſt, expreſſe the ſeuerall lengthes of all ſuch lines, which in paſſing forward in your worke ſhall bee found declining or extending outwards, as the lines D E. G H. and I A. which lines alwayes iſſue from an Angle greater then a Semicircle, the inclination whereof cauſeth the declination of the line: the ſecond which is the middlemoſt ſpace, let ſerue for the number of each line; and in the third and innermoſt ſpace, expreſſe the ſeuerall lengthes of all ſuch lines, as in paſſing forwardes ſhall be found inclining or extending inwards, as all the other lines in the figure not formerly mentioned.

And theſe thus vnderſtood, proceede forwards in this manner. Plant your Inſtrument after the vſuall order in the Angle, where you purpoſe to begin, which let be A. and let the Centre Q. on your Table, alwaies in your whole worke repreſent your place of ſtanding, then lay your Ruler on the Centre Q. and turning it about, thereon direct your ſight to I. and by the edge of the Ruler, draw the line Q K. (which ſhall be your incloſing line) extending it to the vttermoſt Circle, and in the middle ſpace, on that line (which is to beare no number) place the Cipher o. then keeping ſtill the Centre point Q. turne about your Ruler, and direct your ſight to B. and by the edge of your Ruler draw the line Q N. and in the middle ſpace on that line expreſſe the Figure 1. the number of the firſt line you goe on, ſo haue you on the Table the Angle K Q N. equall to the Angle I A B. in the field, then take vp your Inſtrument, and meaſure the line A B. $\frac{*}{20}$. $\frac{1}{2}$ $\frac{1}{4}$. which length expreſſe on your firſt line Q N. and for as much as the line is inclining, place the ſame in the innermoſt ſpace, as in the Diagram; then place your Inſtrument preciſely at B. and turne it about on the ſtaffe (your Ruler lying on your firſt line Q N. till you finde the ſame line to lye parallel with the line A B. of the Field, hauing Q. towards you, and N. towardes the Angle A. (for the Centre Q. in euery Angle muſt repreſent the point of the ſame Angle) then your Table there fixed, direct your ſight to C. and draw your line which ſhall bee the line Q R. and expreſſe thereon in the middle ſpace the figure 2. for the ſecond line, ſo haue you alſo the Angle N Q R. on the Table, equall to the ſecond Angle A B C. in the Field: then take vp your Inſtrument, and meaſure the line B C. $\frac{*}{12}$. $\frac{1}{4}$. which place on the ſecond line Q R. in the innermoſt ſpace, and planting your Inſtrument at C. direct your laſt line Q R. towards B. as you did, the firſt towards A. and then take the quantitie of this Angle, as before, and you ſhall haue the Angle R Q L. on your Table, equall to B C D. in the Field. And thus proceede from angle to angle, making alwayes the laſt ſide of the laſt Angle to bee the firſt of the next, with all their points concurring in the Centre Q. and meaſuring and expreſſing the ſeuerall lengthes of each line, as before; you ſhall obtain the quantitie of euery Angle, and the length of euery line throughout the whole worke: whereby you may ſpeedily protract and lay downe the ſame, as is taught in the next.

But in the meane ſpace it is to be noted, that if in your former worke it happen at any time, that one line fall directly on any other, formerly drawn on your Table (as in the former Diagram, the ſeuenth line Q R. falleth on the

the ſecond line formerly drawne) then in ſuch caſe expreſſe the number of the ſame laſt line in the middle ſpace, where the firſt is numbred, with a ſtroke betweene them; but place the numbers, expreſſing the length of the ſame laſt line, without the vttermoſt Circle, if it be declining (as in the former example $_{22}^{\circ}.\ _{2}^{1}.$) and within the innermoſt, if it be inclining.

This kind of menſuration of ſpacious works with the Plaine Table (which likewiſe may be wrought with any other Inſtrument according to Chapter 15.) is wonderfull neceſſary both for ſpeed and exactneſſe, if artificially handled: but if it be required to haue notice taken of the ſeuerall lands and grounds abutting and confining hereon, you muſt then haue prouided a Field-booke for that purpoſe.

CHAP. XXXVII.

To protract and lay downe any obſeruations taken, according to the worke of the laſt Chapter.

HAuing before you the paper of your Field-worke as you wrought on the Table: If you imagine that one ſheete of paper will not ſerue the turne, you may with mouth-glue, lay as many together as you pleaſe; and then (conſidering which way your worke will extend) draw a right line accordingly on your paper, whereon, with your Scale and Compaſſe, lay down the length of your firſt line Q N. $_{29}^{\circ}.\ _{2}^{1}.\ _{4}^{1}.$ as the line A B. in the Diagram of the former Chapter, and then on the end B. of that line, by PROB. 8. 2. protract an Angle, equall to the Angle N Q R. as the Angle A B C. and on the ſide B C. of that Angle, place by your Scale the length of your ſecond line R Q. $_{12}^{\circ}.\ _{4}^{1}.$ from B. to C. and on the point C. where your laſt length ended, protract another Angle, equall to the Angle R Q L. your third Angle taken, as the Angle B C D. and on the ſide C D. extended, place the length of your third line L Q. $_{14}^{\circ}.\ _{9}^{1}.$ from C. to D. And ſo proceede from Angle to Angle, protracting your Angles equal (and in order by the number of lines) to thoſe anſwerable in your concentricke Circles, and laying downe duly by your Scale on each line, the length thereunto belonging, you ſhall produce the Figure A B C D E F G H I. like vnto the meaſured quantitie.

And hauing thus finiſhed; if you doubt or make queſtion, whether you haue wrought exactly or not, and deſire to be reſolued therein, make approbation thus. Collect the quantitie of all your Angles in your whole worke, and adding them together, note the totall thereof; which in this former worke is 1260. then multiply 180. (the number of degrees in a Semicircle) by a number leſſe by 2. then the number of Angles in your worke, which here is 7. (for the number of Angles is 9. as appeareth by the line O Q. which ſheweth the number of the laſt line, and conſequently of the Angles) and if the product of that multiplication agree with the former totall; then by THEOR. 74. 1. you haue done rightly, otherwiſe not; as the Product of 180. by 7. is 1260. agreeing with your firſt number; and therefore may you confidently affirme to haue wrought exactly, which rule is generall for all other plottes, and ſuperficiall figures whatſoeuer.

If your degrees be thoſe of 120. as obſerued by the Peractor, or Circũferentor, then in ſtead of 180. you muſt take 60.

Thus

Thus hitherto haue wee dealt in the plotting and dimenſion of ſeueralls; and that by ſuch ſeuerall, exact and artificiall wayes and meanes, as may moſt ſufficiently ſerue aſwell for the abſolute performance thereof, as (if well vnderſtood and practiſed) of many other excellent concluſions. But were you to ſurney and plot great quantities, and many ſeuerals together as a whole Lordſhip or Mannor, or to deale in menſuration of impaſſible wood-grounds, wherein you are debarred from croſſing ouer or working within the ſame; I cannot aduiſe you therein to the vſe of theſe former Precepts, (though otherwiſe to excellent purpoſe) but rather to vſe and obſerue the meanes and courſes preſcribed and taught in the next following Chapter, which of all other is the moſt generall, abſolute and exact, for the menſuration of all manner ſuperficiall Figures, of what forme, quantitie, or number ſoeuer; and therefore to bee obſerued with good reſpect.

CHAP. XXXVIII.

To take the plot of a Lordſhip or Mannor, conſiſting of diuers ſeuerals, of what nature or kind ſoeuer, whether Wood-grounds or other.

THe precepts and inſtructions taught, and deliuered in the 10. Chapter of this booke, concerning the deſcription and vſe of a neceſſarie Field-booke, might well ſerue with diligent obſeruation for the performance of this worke: But ſeeing that there (according to the propoſed matter) my chiefe indeuours tended rather to the explanation thereof, then to the forme and order of menſuration, wee will here make vſe of the Figure there expreſſed; and by inſerting certaine neceſſarie obſeruations there omitted (as needleſſe to that purpoſe) referre you for a full ſatisfaction, to the conſideration and due obſeruation of thoſe, and theſe conioyned. Wherefore ſuppoſe that the figure or Diagram there expreſſed, were a Mannor, or part of a Mannor to bee meaſured and plotted. Firſt, write your Title, as there is mentioned, then planting your Inſtrument in A. direct your ſight to B. and hauing obſerued the degree there cut, take vp your Inſtrument, and meaſure to B. entring your degree and length into your booke, then plant not your Inſtrument at B. but onely meaſure from thence to C. and there place your Inſtrument, & direct your ſight backwards to B. obſeruing your degree; but with this ſpeciall regard, that in taking your backe ſights, you alwayes reckon the degree cut by one and the ſame end of the Index, as you reckon on, when you direct your ſight forwards; or otherwiſe you take the oppoſite degree to that you ſhould, which will much trouble you in protraction: then here conſider, that you are to leaue the bounder, which you went againſt from A. where you began, to this place, & therfore draw a ſingle line, and as you are

there taught, write the bounder paſt, as in the example of your booke; then direct your ſight to D. and obſeruing your degree, meaſure thither, which hauing entred, make there another ſingle line, for that here you leaue that bounder alſo, which let be expreſſed; then meaſure from D. to E. and there plant your Inſtrument, and as before direct your ſight backewards to D. and obſerue the degree with the former caution, which done, turne your ſight to F. and hauing your degree, meaſure from E. to F. and likewiſe from F. to G. expreſſing in your Booke thoſe lengthes ſeuerally, then plant your Inſtrument at G. and taking your degree from thence backwards to F. as before, here ſtrike a ſingle line, and write your third bounder, then take your degree to H. and meaſure thither, where alſo (that being your laſt Angle) you muſt plant your Inſtrument, and worke as before to A. where you began, and then ſtrike a double line, ſignifying you haue finiſhed that Field. And in like manner proceed with all the reſt from one Cloſe to another, till you haue finiſhed the whole worke, as you are moſt plainely directed in the 10. Chapter, remembring alwayes to meaſure euery line; and to place your Inſtrument at each other Angle, taking your backe-ſights to that very point or marke, whereunto you directed your ſight laſt before. So ſhall you moſt exactly, and with great expedition performe your deſire. *And your worke is to bee protracted as is taught in the next.*

CHAP. XXXIX.

To protract and laye downe a Plot of many ſeuerals, of what quantitie or number ſoeuer.

ACcording to the quantitie of your plot, or the largeneſſe you ſuppoſe it will be of, glue papers together; but if very large, lay firſt together but 4. or 8. ſheetes onely, and rule them all ouer with parallel lines, repreſenting Meridians of ſuch conuenient diſtance, as they exceede not the bredth of your Protractors Scale. Then laying your Field-booke before you, ſuppoſe you are to protract the obſeruations mentioned in the tenth Chapter, and conſidering towards what point of the Compaſſe your worke will moſt incline or extend, begin your protraction accordingly; as in that example; it inclineth towards the Eaſt, and North-eaſt from the place of beginning; wherefore beginne your protraction towards the Southweſt part of your plot; and there make a point, whereon place the Centre of your Protractor (with the Semicircle eyther vpwards or downewards, as you beſt fancie) and holding your protracting pinne in that point, moue about your Protractor thereon, till you finde one and the ſame parallel diuiſion on eyther end of your Protractors Scale, to lye eyther directly vpon any one parallel line, or equidiſtantly aboue or beneath the ſame; and there, with your left hand keepe firm your Protractor, whileſt you finde in your Field-booke the firſt degree 65. againſt which, on the limbe of your Protractor place the point of your protracting pinne, and there keepe it, bringing the edge of your Protractors Scale thereunto,

unto with the firſt diuiſion of the Scale on your choſen point, and then draw a line by the edge of your Scale of your firſt length in the booke $\frac{\circ}{10}\cdot\frac{1}{2}$ as the line A B. But with this reſpect, that (as before is taught) the lines belonging to euery degree vnder 60. bee drawne from the Centre point downewards, or inclining towards you, and the lines belonging to euery degree aboue 60. (as the laſt line A B.) bee drawne from the ſame point vpwards, or reclining from you: Then place your Protractor on the point B. (being the end of your laſt line) in all reſpects as before at A. and finding your next degree and length in your booke to bee 68. $\frac{\circ}{16}\cdot\frac{1}{6}$ againſt 68 degrees on your Protractor, place the point of your protracting pinne, and applying the Scale of your Protractor thereunto, with the beginning of the diuiſions thereof on the point B. draw your line of the length $\frac{\circ}{16}\cdot\frac{1}{6}$ as B C. and here (conſidering you are to leaue the bounder you went againſt) make a ſmall ſtroke or marke at C. with your penne, and finding in your Booke, at the end of your laſt length the figure (1) place that at C. with blacke lead (the vſe whereof ſhall partly appeare) then place your Protractor on the point C. (the end of your laſt line) as before, and find your next degree and length $36\frac{1}{2}\cdot\frac{\circ}{22}\cdot\frac{1}{5}$ and againſt that degree on your Protractor, place the point of your protracting pinne, and bringing the edge of your Protractor thereunto as before, from the point C. draw the line C D of the length $\frac{\circ}{22}\cdot\frac{1}{5}$ which ſeruing to a degree vnder 60. is to bee drawne from the point C. downwards as before. And ſo proceede with your ſeuerall degrees and lines, in order as you finde them in your booke, till you come to the point A. where you firſt began, and hauing wrought truly, you ſhall there iuſtly incloſe your firſt ſeuerall. Then looke in your Booke where you are to beginne your next incloſure; and you ſhall be thereby directed to beginne from N°. (1.) Wherefore ſeeke in your laſt protraction where you placed that number, which you ſhall finde at C. and there you are to beginne your ſecond parcell; wherewith, and with the reſt proceed in all reſpects as with the firſt. Small practice with good obſeruation (whereunto I will leaue you) is much more availeable then many words. And therefore will I ceaſe to ſpend further time herein.

CHAP. XL.

The order and meanes of meaſuring and taking the ſeuerall and particular quantities in common fields, with a briefe inſtruction concerning the Vſe of my Chaine.

THe whole plot and quantitie of common fields are to be taken and plotted as they lye among other the adiacent grounds, according to the directions of the 38. Chapter, without regard of the ſeuerall and particular quantities therein contained; which afterwards are to be had and obtained after this maner.

Let a Booke bee purpoſely prouided, which call your Common-Field-Booke to bee ruled as in the example, containing eight Collums. The firſt

towardes the left hand, ſeruing for the Tenãts names and the tenure whereby they hold the ſame lands; the next three for the bredth of euery parcell intituled with theſe Signes, or Characters, 0. 1. 2. ſignifiing Vnites, Primes and Seconds, as is taught in the 6. Chapter of this Booke; the next three for the length with the like Title; and the eighth or laſt towards the right hand, for the content of each ſeuerall parcell, the length and bredth being multiplied together. In this worke there is no vſe of any other Inſtrument, then your chaine onely: And beginning with any one furlong or went, expreſſe firſt in your booke the name of the field, & then of the ſame your firſt furlong, and ſo the reſt of the Title, as in the example, then in the firſt Collum write the Tenants name, whoſe land you firſt meaſure, & withall from what place you begin, & on what point of the compaſſe you paſſe from thence, wherby you ſhalbe able afterwards (obſeruing the ſame courſe in the beginning of euery furlong) to abut and bound euery parcell if need require, & likewiſe in the ſame firſt collum, expreſſe by what tenure it is held, thẽ cõſider how the whole furlong lyeth, if al of one length, then need you take the length but once for all, although there were twentie Tenants lands in the ſame; but if irregularly, as in ſome places ſhorter, and others longer; then at euery ſecond or third bredth, (or oftener if occaſion require) take the length thereof, and expreſſe the ſame vnder your title of length, as for the ſeuerall bredthes, you may onely croſſe ouer the whole furlong about the middle therof, taking euery mans bredth, and entring the ſame as you paſſe, vnleſſe you finde extraordinary difference betweene the bredthes at eyther end; if ſo, then meaſure the bredth of both ends, adding thoſe two bredthes together, whereof take halfe for your bredth & enter it in your booke, or you may enter both bredthes, and take halfe thereof when you caſt vp the contents. And thus proceede from one furlong to another, till you haue finiſhed the whole field. And when you haue done (or at any time after at your pleaſure) by multiplying thoſe lengthes and bredthes together (which is moſt ſpeedily and exactly performed, as hereafter followeth according to the order of decimall multiplication) you haue your ſeuerall contents to bee expreſſed in the laſt Collum. And laſtly, number all the ſeuerall parcels in the whole booke by Figures in the margent, from 1. forwards as in the example, which will ſerue you to good purpoſe, in the collecting of euery mans parcels together, as ſhall be hereafter declared.

The Weſt field arr.

Broad furlong.

	Tenants names.	Bredth. 0	1	2	Length. 0	1	2	Quantity a. r. p.
(1)	*Io. Woods* from the Church lane eaſt wards free.	1	3	2	16	2	—	0-0-21
(2)	*wil. Browne* by Copie.	6	8	2	16	2	—	0-2-30-
(3)	*Fra. Jackſons* for 3. liues.	8	4	1	14	2	3	0-3-0
(4)	*Tho. Coakes* for yeeres.	7	5	2	15	4	2	0-2-36
(5)	*wil. Iones* at will.	5	6	3	15	4	2	0 2-7

And here ſhal you find (and in all other workes of this nature) moſt excellent vſe of my decimall chain deſcribed in the ſixt chapter of this booke.

But leſt you ſhould bee abſolutely ignorant of the manner and order of caſting vp of the ſeuerall contents, according to the lengthes and bredths ſo taken and obſerued as before, and conſequently the chaine with the ſeuerall parts and fractions thereof may ſtand you in little ſtead, I will here briefly touch the order thereof, in two examples thus.

Suppoſe your length taken to bee $\overset{0}{16}.\ \overset{1}{2}.$ and your bredth $\overset{0}{1}.\ \overset{1}{3}.\ \overset{2}{2}.$ being thoſe firſt ſpecified in the former example. Firſt, let your numbers bee placed in all reſpects, as if they were whole numbers to bee multiplied the one by the other thus; but ouer euery Fraction of your multiplicand, place a pricke or point, being in this example onely one, as that ouer the figure 2. and at the end of your multiplier, place as many prickes or points as there are Fractions in that number, being in this example two, then multiplie the one number by the other after the vſuall manner, as if they were whole numbers, and your worke will ſtand thus; The Product of your multiplication being 21384. and conſidering there are belonging to your two firſt numbers three prickes, repreſenting ſo many fractions, you are therefore to cut off from the Product of your multiplication, with a ſtroke, three Figures towards your right hand, which ſhall bee the Numerator of a Fraction, whoſe denominator is ſo many Ciphars, with an Vnite placed before them, and the other two figures towards your left hand are the Intigers of your multiplication: So ſhall the Product thereof (being the content ſought for) be 21. Perches, and $\frac{384}{1000}$. parts of a Perch, which is ſomewhat more then $\frac{3}{8}$. and your worke ſtandeth thus.

```
  16̇2
  132..
  ----
   324
  486
 162
 -----
 21|384
```

But to expreſſe the quantitie of theſe fractions, which you find in the Product of your multiplication, were needleſſe niceneſſe, in buſines of this nature; yet hauing wrought your multiplication, if you find your fraction to bee neere an vnite, increaſe your intire number by an Vnite, and let paſſe the Fraction as not to bee regarded.

```
  16̇2
  132..
  ----
   324
  486.
 162.
 ------
 21|384
   1000
```

Againe for your better practice, let your meaſured length be $\overset{0}{15}.\overset{1}{4}.\overset{2}{2}.$ and your bredth $\overset{0}{7}.\overset{1}{5}.\overset{2}{2}.$ being the fourth ſort expreſſed in your former example in the beginning of this Chapter. Of which length & bredth you deſire the content by multiplication: firſt, as before, place your numbers, as if they were intigers to bee multiplied, the one by the other thus, as in this exãple: The product whereof is 1159584. and conſidering there are foure points or prickes belonging to the two firſt numbers, that is, to eyther of them two, ſignifying

```
    15̇4̇2
     752..
    -----
    3084
   7710
 10794
 ---------
 115|9584.
    10000.
```


ſo

ſo many fractions; you are therefore to cut off foure Figures from the Product towards the right hand, which is the numerator of your fraction as before, and thoſe three Figures towards your left hand are ſo many Perches: ſo ſhall the Product of your multiplication (being the content ſought for) bee 115. Perches, and [illegible] parts of a Perch, which being very neere an Vnite, I therefore adde an Vnite to the former number of Perches, which makes 116. Perches; that is, by reduction 2. roodes. and 36. Perches.

And after this manner (with due obſeruation) may you moſt eaſily and aptly apply this chaine, and the ſeuerall parts and fractions thereof to all the ordinarie rules of Arithmetike, as Addition, Subtraction, Multiplication, and Diuiſion, working any dimenſion thereby, as if they were Intigers, or whole numbers.

And thus much for a taſte onely of the neceſſarie and infinite vſe of this Chaine thus diuided.

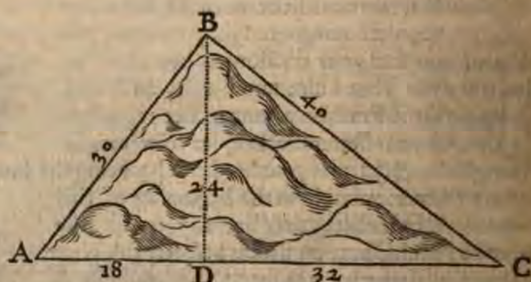
All this time hitherto in our former menſurations haue wee walked in plaine and euen leuelles, wherein the Plaine Table *artificially handled, (whereof many vſing it, are to ſeeke) is an excellent Inſtrument. But ſuppoſe wee are now trauelling into* Wales, *or any other place where are mountainous and vneuen grounds; then muſt wee of neceſſitie, eyther leaue that Inſtrument behind vs, or vſe thoſe meanes, or the like expreſſed in the deſcription thereof,* Chap. 3. *Vnleſſe we haue inſight in that excellent art, which many plaine plaine Tablemen haue (wanting thoſe meanes) at an inſtant to conuert the higheſt mountains to plaine and leuel grounds, preſſing them downe, and inforcing them on a Plaine ſheete of paper to lye leuell with the reſt; which they eaſily performe by onely thruſting out their bordering grounds from their due and naturall place, where,* ab initio *they haue remained.*

Yet let vs conſider of ſome better meanes for the performance thereof, which ſhall be hereafter taught.

Chap. XLI.

To reduce Hipothenuſall to Horizontall lines by the Peractor.

SVppoſe A B C D. be a hill, or mountaine to be protracted and layde downe in your plotte amongſt your other grounds: It is apparant by



the Figure, that the hipothenuſall lines A B. and B C. cannot be layd down exactly in a right line betweene the other grounds which bounder on this hill at the points A. and C. Wherefore we are to find the true leuell and horizontall diſtance betweene A. and C. which is a right line, extending ouerthwart

thwart the ground whereon the hill ſtandeth. Which to performe, worke thus. Plant your Inſtrument at A. the foot of the hill preciſely horizontall, by help of your plummet (wherin great care muſt be had) then cauſe a marke to be placed on the top of the hil at B. to be of equal height from the ground, with the Centre of your Quadrant, whereunto direct your ſight, mouing the Quadrant vp and downe, till you perfectly decerne the ſame, where letting it ſtand, meaſure the Hipothenuſall line A B. which ſuppoſe to bee 30. then ſeeke 30. on the Index of your quadrant, and note what line iſſuing from the left ſide C D. of the Quadrant is cut by the ſame diuiſion or number of 30. on the edge of the Index, which you ſhall finde to be 18. and that number is to be obſerued, and kept for the horizontall line A D. to be protracted and layde downe in ſtead of the hipothenuſall A B. And if the ſame hill from B. continue not plaine and horizontall, but deſcendeth againe on the other ſide, as this from B to C. then muſt that hipothenuſall line B C. bee likewiſe taken, by planting your Inſtrument at B. and cauſing a marke to be placed at C. as before, and then direct your ſight to the marke, and meaſure the hipothenuſall line B C. which ſuppoſe to be 40. then note as before what line cutteth 40. on the Index, as 32. and take that for your horizontall line C D. which added to the former 18. maketh 50. for the whole line A C. which is to be protracted and layde downe for the two lines A B. and B C.

And if at any time it hapneth (as often it may) that the meaſured diſtance of the hipothenuſall line exceedeth the greateſt number on the Index: In ſuch caſe take halfe, or a third part of the meaſured diſtance, and finding that number on the Index, note what line from the left ſide of the quadrant interſecteth therewith on the edge of the Index, and the double or triple of the number of that line, is your horizontall line ſought for.

Chap. XLII.

To reduce hipothenuſall to horizontall lines by the Circumferentor, or by the Plaine Table, with vſe of thoſe meanes expreſſed in the deſcription thereof.

PLant your Inſtrument as before, at the foote of the hill, and let a marke be placed in the toppe thereof, in manner as is directed in the laſt, then directing your ſight to that marke, moue the vane vp and downe on the longer ſight, till through the ſmall hole thereof, and by the pinnes head in the ſhorter ſight, you eſpie the marke, then note among the hipothenuſall diuiſions, what is then cut by the edge of the Vane, which ſuppoſe to be 7. ſignifying (as is expreſſed in the deſcription, Chap. 3) 107. Then meaſuring the hipothenuſall line, which ſuppoſe to be 40. by the rule of proportion, reaſon thus. If 107. the hipothenuſall in the Inſtrument, yeeld 100. the ſide of the ſquare thereby proiected, what 40. the hipothenuſall meaſured and by increaſing 100. by 40. and parting the Product by 107. your anſwere will be 37. and very neere [illegible]. the length of your horizontall line ſought for. And the

the ſame courſe in all reſpects which you haue here holde in this Angle of aſcention, the like is to bee obſerued in all works whatſoeuer for Angles of deſcention.

Or otherwiſe it may be performed thus.

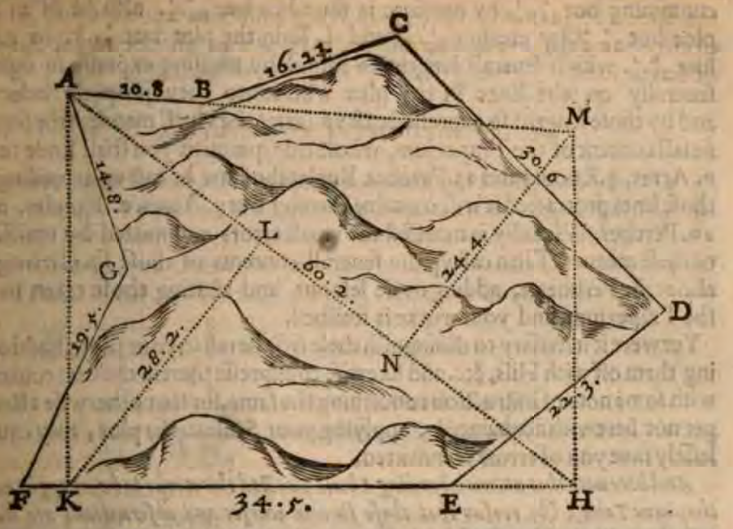
BY any Inſtrument take the quantitie of the Angle, eyther aſcending or diſcending as before taught, and then by the 11. or 12. Chapter protract the ſame Angle, and on the one ſide, from the point thereof, lay downe the meaſured length of your hipothenuſall line, and from the point where thoſe meaſures end, by PROB. 5. 2. let fall a perpendicular on the other ſide of the Angle; and the Segment of that other ſide, betweene the interſection of the perpendicular, and the point of the Angle ſhall bee your horizontall line required.

And thus hauing ſhewed the meanes for the reducing of theſe lines; let vs now conſider of the application and vſe thereof; which for our preſent purpoſe is to finde and expreſſe the true content of irregular and vneuen grounds, and withall notwithſtanding their irregularitie, in protraction to plot and lay them downe in ſuch ſort, as neyther in themſelues they exceede the bounds of their owne Perimeter (but may truly incloſe though expreſſed in Plano) *nor diſplace or thruſt out of order the grounds adiacent. And ſeeing it is impoſſible, and againſt the rules of art and nature, preciſely to expreſſe and limit a ſolid, or bodie within the bounds or termes of one viſuall ſuperficies, which is compriſed and compoſed of many: It is therefore not to be expected, wee ſhould truely expreſſe the irregular capacitie of mountainous and vneuen grounds in a plaine ſheete of paper: for if the plot bee exact and anſwerable to the reſt, the ſuperficiall content muſt needes be wanting, or if the true content of lines and angles bee expreſſed, the plot of neceſſitie muſt bee erronious: yet notwithſtanding we are now to reſolue of ſome direct and immediate courſe, aſwell for the obtaining of the true ſuperficiall content, as for the orderly expreſſing and laying downe of ſuch diſordered Figures, which ſhall be amply and plainely taught and deliuered in the next following Chapter.*

CHAP. XLIII.

The beſt and exacteſt means for the dimenſion & protraction of mountainous and vneuen grounds, and the obtaining of their true Contents by the Plaine Table.

SVppoſe ABCDEFG. bee a mountainous and vnleuelled ground to bee meaſured and plotted: Firſt, plant your Inſtrument at A. and directing your ſight to B. and meaſuring the line A B. draw the ſame by the edge of your Ruler, and after the vſuall manner finding the line Horizontall, place thereon your meaſured length found, from A. to B. $10^{\circ}\frac{1}{8}$. then place your Inſtrument at B. where finding an aſcent to C. direct your ſight to a marke there placed as is taught in Chapter 40. and hauing drawne your line at length towards



wards C. as if it were leuell ground, meaſure the Hypothenuſal diſtance frõ B. to C. $16^{\circ}.\frac{1}{2}.\frac{1}{2}$. but withal finde out the horizontall diſtance as before is taught $15^{\circ}.\frac{1}{6}$. of which length lay down your line B C. but expreſſe theron in figures your meaſured Hypothenuſall length $16^{\circ}.\frac{1}{22}$. ſo haue you the horizontall truely as it is laid down & your hypothenuſal length, for the obtaining of the true content expreſſed thereon; then plant your Inſtrument at C. and finding from thence a deſcent to the next angle D. direct your ſight thither to a marke there placed as before, and drawing your line at length, meaſure the Hypothenuſall diſtance, which found to be $30^{\circ}.\frac{1}{6}$. expreſſe it on the line drawne; but ſearching out the horizontal diſtance $21^{\circ}.\frac{1}{4}$. make your line C D. of that length, and in like ſort ſhould you proceede if there were diuers other aſcending and deſcending lines: but ſeeing all the reſt in this figure are horizontall and leuell lines, proceede with your worke in all reſpects as is taught in Chap. 38. So ſhall you exactly incloſe with your other grounds this irregular figure.

But yet are we further to cõſider, that notwithſtanding we haue obſerued the difference betweene the Hypothenuſall & horizontall lines happening in the Perimeter of this figure, wherby we are able to place the ſame in his due ſcituation, yẽt are there within the compaſſe of this Perimeter many hils & dales wherof we haue hitherto taken no notice, ſauing only in cõpaſſing thẽ about: And if we ſhould, with theſe lines alreadie had, caſt vp the ſuperficial content after the vſual maner, we ſhould come far ſhort of the true quantitie thereof; which to redreſſe, worke thus. Before you take your work from the table, reduce the ſame into the largeſt *Trapezium* you may, by drawing the lines A M. M H. H K. & K A. as in the former Diagram, then croſſe the *Trapezium* with the diagonall line A H. and theron let fall the Perpendiculars M N. and K L. then by direction of your Inſtrument or otherwiſe let thoſe lines be exactly meaſured with the chaine ouer Hils & Dales in a right extention; which by reaſon of the vneuenneſſe of the ground you ſhal find to cõtaine much more in length then your lines alreadie laide downe; as the line A H. in the plot con-

containing but $_{51}^{1}\cdot\frac{1}{4}$. by measure is found to bee $_{60}^{6}\cdot\frac{1}{2}$. also M N in the plot but $_{22}^{2}\cdot\frac{1}{3}$. by measure $_{24}^{2}\cdot\frac{1}{4}$. and L K in the plot but $_{24}^{2}\cdot\frac{1}{8}$. by measure $_{28}^{2}\cdot\frac{1}{2}$. which seuerall lengths so found by measure expresse in figures seuerally on the lines in the plot whereunto they properly belong; and by those lengths so expressed cast vp (after the vsuall manner) the superficiall content of the Trapezium, whose true quantitie you shall finde to be 9. Acres, 3. Roodes and 23. Perches. But let the same be cast vp according to those lines protracted it will containe thereby but 7. Acres, 2. Roodes, and 10. Perches. Whereby is manifest the vsuall errors committed by omission of these meanes. Then cast vp the seuerall contents of those small triangles about the Perimeter, adding those left out, and abating those taken in by the Trapezium, and your worke is finished.

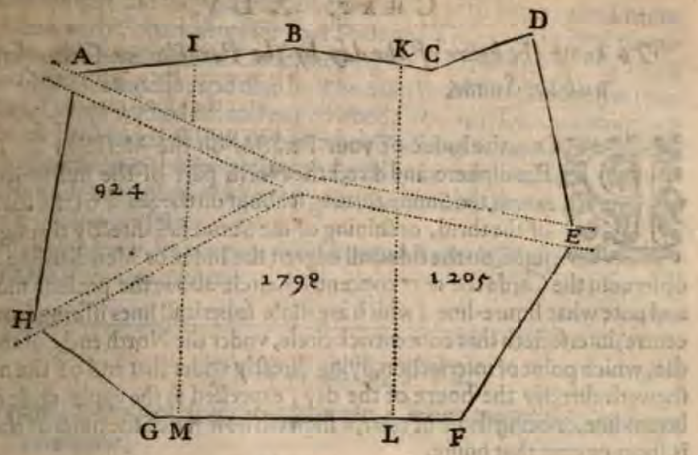
Yet were it necessary to distinguish these frō the rest in your plot, shaddowing them off with Hils, &c. and likewise to expresse therein the true content, with some note of instruction concerning the same, for that otherwise a stranger not herewith acquainted, applying your Scale to the plot, may causelessely taxe you of errors committed.

And here note that notwithstanding I haue directed this worke to be wrought with the plaine Table; (by reason that these former courses and obseruations are more vsually omitted in the vse of that Instrument then any other) yet I doubt not but hee who can performe the same by that, (with due obseruation of what hath beene formerly deliuered) will be able to effect the same by any other Instrument. For your obseruations being had and taken in the field, and then laide downe accordingly; you shal thereby afterwards measure your Diagonall and perpendicular lines in the field; as before is directed.

CHAP. XLIIII.

To diuide a Common of pasture, or a common field into any parts required.

SVppose ABCDEFGH bee a stinted pasture, or a common field in the vse and occupation of three men, as A. B and C. and let it be required to diuide the same betweene them proportionally, either according to their seuerall stints (beeing a stinted pasture) or according to their seuerall quantities, being an arrable field in common: First measure and plot the whole quantitie, and as is taught in the second part of the second Booke, finde the superficiall content thereof which suppose to bee 4268. Perches, or by reduction 26. acres 2. roodes 28. perches, then seeke the content of the high wayes A E and H E passing through the same, which let be 341. perches to be deducted out of the whole quantitie: and there resteth 3927. Perches, which to diuide according to their seuerall portions, reason thus with the rule of proportion. If all the whole number of beast-gates of A. B and C. together yeeld the whole quantitie 3927. what the number of those belonging to A. and the answere will be his part: & working thus seuerally for their three seuerall parts suppose them thus, to A. 924. Perches, to B. 1798. and to C. 1205. Then as is



is taught in the ten last Problemes of the second Booke, diuide your plot accordingly, by the lines I M. and K L. laying euery mans part in such place as they shall mutually agree: which beeing performed on your plot, you are then to effect the like on the ground, wherein you are onely to lay out the lines I M. and K L. in their due places, which is thus to be performed. Finde out by your Scale the distance on the plot betweene the next angle, and the beginning of your first line as G M $\frac{2}{3}\cdot\frac{5}{6}$. then find also the angle G. in the field, and with your chaine measure out that length from G. on the line G F. to end in M. where place your instrument, and finding by your Protractor on what degree the line M I. passeth on the plot, on the same degree of your Instrument place the Index: and looking through your sights, cause dooles and markes to be made and placed in a rig t line from M. to I. and for the more exactnesse, and your better satisfactio, note in your plot also what angle is next vnto the ende I. of the line M I. as A. from whence take your distance by the Scale on your plot to I $_{18}^{2}\cdot\frac{1}{8}$. and finding the Angle A. in the field, from thence measure by your chaine that length $_{18}^{2}\cdot\frac{1}{8}$. on the line A B. which if you finde to ende in I. is an infailable assurance you haue truely wrought; if not, reforme it by reducing the ende I. of your line M I. to that place. And by the like meanes, you are to lay out the line K L. and more, if more required. And after this sort shall you lay out and diuide any common or waste whatsoeuer; into what parts soeuer the same is required, to bee deuided, and layde out.

CHAP.

Chap. XLV.

To know the houre of the day by the Peractor or Circumferentor with the Sunne.

PLace the Index of your Peractor on the Meridian line of the Planisphere, and direct the North part of the Instrument towards the Sunne, turning it about on the Staffe til the shaddow of the thrid, or shining of the Sunne fall directly through the sight, on the fiduciall edge of the Index or Meridian line: then obserue in the Carde the next concentrick circle aboue the present moneth, and note what houre-line (which are those sphericall lines issuing from the centre) intersecteth that concentrick circle, vnder the North ende of the needle; which point of intersection, lying directly vnder that end of the needle, sheweth directly the houre of the day, expressed at the vpper ende of that houre-line, or being short or ouer, it sheweth how much the time of the day is short or ouer that houre.

And the like is performed by the Circumferentor with turning the North ende of the Instrument towards the Sunne, till through the sight, the Sunne shineth on the Meridian line; and making your obseruations as before.

Chap. XLVI.

The ordering of a plot after the protraction thereof.

THe order and course of protraction and laying downe of plots according to the diuersitie of obseruations taken, is alreadie in this Booke sufficiently declared; and likewise the meanes of obtaining the true superficiall content of all sorts of Figures by the Second part of the Second booke; (the conclusion of which part, I would aduise you to make vse of for your further ease therein.) Now it resteth (the plot being thus protracted and cast vp) next to consider whether it were fitting, to draw it fayre of the same Scale and scantling wherein it is, or first to haue it reduced into a lesser forme. If the businesse be not so large, but that with conueniencie it may bee drawne in the first Scale wherewith it was plotted and cast vp, then prouide you a piece of ordinarie new linnen cloth of a reasonable fineneſſe, and thereon paste you cleane paper, according to the order of Maps (but those for the most part are too course) of the largeneſſe of your plot; which beeing well washed with Allome water, and dryed, fasten your rough plot, slenderly thereon with mouth glue at each corner thereof; and with a bodkin or pin of brasse (which I hold the best for these purposes) trace out all your lines with a reasonable hand; for a light hand with discretion wil make sufficient impression on your new plot, whereby you may well discerne to draw your lines either with Pen or pensill as you please; and then expresse your houses, buildings, woods, riuers, waters, wayes, and all other remarkeable things in their due proportion perspectiuely; not placing your houses and trees euery way, whereby here

here the tops and there the bottomes shall seeme standing vpwards, as is vsually accustomed; and then garnish your plot about with some neate border, and within with Copartments for your Scale and Title; and in some conuenient place thereof describe a Carde, shewing the scituation according to the points of the Compasse; and then let it be neately coloured about the seuerall lines, lightly washed off, and not dawbed all ouer, as some painting Surueyors vse. But aboue the rest, forbeare much writing in your plots either of names or quantities (beeing absurd and grosse) but onely numbers of reference to your ingrossed booke concerning the same, if you make any; if not, then it may serue, as Chalke on a trencher.

But if it bee required to haue your first plot reduced into a lesser or greater forme; vse the helpe of the next Chapter.

Chap. XLVII.

To reduce any plot from a greater to a lesser quantitie, and the contrarie.

IN the third part of my Second booke I haue at large declared the manner and meanes as well of reducing and translating of all superficiall Figures from one forme into another, retaining the same quantitie; as one quantitie into another, retaining the same forme. But those being of particular figures, are not so meet or necessarie for the Reduction or translation of a plot consisting of many (being often in vse.) Wherefore I will here deliuer you a very speedie and exact meanes for the performance thereof. According to the proportion whereunto you would reduce your first plot, lay papers together with mouth-glue; as if you would reduce it into a fourth part, make your new plot to be in quantitie a fourth part thereof. Then place your new made plot on your rough plot in such sort, and with such discretion, as the middle of the one may be about the middle of the other, whereby all the worke of the one may be reduced the better into the other, and there fasten the one to the other slenderly at the corners with mouth-glue, in such sort, as when occasion serueth, any one of those glued places may be easily taken asunder, and the paper folded in; then take your reducing ruler mentioned in Chap. 9. and fasten the same with a needle or blue pin striken into the table about the middle of the plots through the centre hole of the same rule, in such maner as both the plots together may bee turned about at pleasure vpon the table; wherein you must take great care of renting or tearing out your centre point in the plots; which to preuent, would require to bee strengthened with a small piece of a Carde or past-boord, to bee glued thereon, vnderneath the first plot. And being thus prepared, you shall finde good part of the worke in your first plot, to lye without the vtter edges of your cleane paper, which let be first reduced; wherein (hauing resolued into what proportion you will make your Reduction, as into ½. of the first) worke thus; bring the edge of your Ruler to any Angle in your first plot, and note what number of diuision on the edge of your Ruler is there cut, which admit 40. then take halfe

therof which is 20. and againſt that diuiſion by the edge of your Ruler make a pricke on your cleane paper, then remoue your Ruler to the next Angle in your firſt plot, and note the diuiſion there cut, whereof take likewiſe the halfe, and againſt that halfe by the edge of the Ruler make another prick; and betweene theſe two prickes draw a line, which ſhall repreſent the line betweene thoſe two Angles of your firſt plot; and ſo proceede from Angle to Angle, and from Cloſe to Cloſe, till you haue reduced all the worke on your olde plot, lying without the edges of the new, or ſo much as lies without the ſame towards any one ſide or corner thereof; and then vngluing one of your corners or ſides, fold in backwards towards your olde plot, that part of your new plot as is wrought; ſo ſhall you come to worke that which formerly lay vnder the ſame; and thus by folding in, and working one ſide after another to the centre; whilſt the other ſides are faſtned together with the olde plot, you ſhall ſpeedily reduce the whole plot into your deſired proportion: For in taking the halfe of euery line in your firſt plot your new by THEOR. 49. 1. ſhall be $\frac{1}{4}$ of the olde.

And this kinde of Reduction hold I the ſpeedieſt and exacteſt of all other: Which by ſmall practice, you ſhall much better finde and vnderſtand, then with many words of Relation.

And after this manner may you make your Reduction, into any other proportion, or reduce your plot from a leſſer to a greater forme in any proportion required; by increaſing your ſecond number proportionally, as in this worke you decreaſed the ſame.

CHAP. XLVIII.

To reduce any number of Perches giuen into Acres, and the contrarie.

SVppoſe 5496. Perches were giuen to bee reduced into Acres. Firſt after the vſuall manner (conſidering that a Statute Acre containeth 160. ſquare Perches) diuide the giuen number by 160. the quotus will be 34. and the remainder 56. which remainder diuided by 40. (the number of Perches in a Roode) quoteth 1. and the remainder 16. So is the whole Reduction 34. Acres, 1. Roode, 16. Perches.

Or more briefely thus.

THis rule is much briefer in operation, though not in demonſtration then the former; which is thus. Frō your giuen number cut off with a ſtroke, the firſt Figure towards the right hand thus, 549|6. then diuide the other three Figures by 4. and your worke will ſtand thus. the 137. being ſo many Roodes, and 16. Perches remaining, then diuide likewiſe that 137. by 4. and your worke is finiſhed and will ſtand thus. Where note that your firſt remainder with the Figure cut off, are alwaies the odde Perches; and the laſt remainder (if any be) are Roodes.

```
   1
5 4 9 | 6
1 3 7
     1
5 4 9 | 6
1 3 7
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  3 4 -- 1 -- 16.
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And

And if you would reduce theſe Acres, Roodes, and Perches, into their leaſt Denomination, as into Perches. Firſt multiply your number of Acres 34. by 160. the product is 5440. then multiply the number of Roodes 1. by 40. produceth 40. which together with the number of Perches 16. added to 5440. makes 5496. the firſt number. And the like of all others.

Here might I now much inlarge this worke by ſhewing many other neceſſarie concluſions fit for a Surueyor to know, as the menſuration of Timber, Boorde, Glaſſe, Pauements, and the like; alſo the ſeuerall waies and meanes of plotting of countries and large continents; of carrying of mynes and trenches vnder ground; of Waterworkes, and the conueying of the water from any Fountaine to appointed places of whatſoeuer poſſible diſtance; of the taking and making of the formes and models of Plot-formes, Forts, Caſtles, Houſes, and the like. But ſeeing that not onely theſe, but infinite other Concluſions Geometricall, may be eaſily performed and wrought by the former rules and inſtructions well vnderſtood and practiſed; and for that they are without the ſcope and limits of Surucy, whereunto I chiefly bend the ſubiect of this Booke; I will leaue them to your owne indeuours, and diligent practice.

And hauing thus performed at large the Mathematicall part of Surucy in generall; we will next conſider of the Legall; and in the meane ſpace here conclude this Third Booke.

The end of the third Booke.

THE LEGALL PART OF SVRVEY.

The fourth Booke.

THE ARGVMENT THEREOF.

I Would not bee mistaken, or haue it vnderstood; that I here vndertake (as a Lawyer) to instruct or teach the rules or Institutions of the Law (being out of mine element) but as a Surueyor, briefely and truely to expresse and deliuer herein what I hold fit and meete for a Surueyor to know and vnderstand. As first what a Mannor is, and the seuerall parts and members thereof, with the appendants therevnto: Next, the perquisites, casualties and profits of Court, and their seuerall natures: Then the diuersitie of estates, whereby any Lands or Tenements may bee holden, occupied or enioyed; and the seuerall tenures depending on those estates; with the Rents and seruices incident and belonging to those tenures: Also what reprises, paiments, and deductions may bee issuing out of a Mannor, and the con-

considerations thereof to bee had: Likewise what courses are to bee obserued and taken, before the beginning of a Suruey: The order and manner of keeping those Courts: The entrie of the Tenants euidence and estates; and the orderly manner of ingrossing the same: with other briefe and necessarie Rules, and Obseruations tending to those purposes.

CHAP. I.

Of a Mannor with his seuerall parts, and of the name and nature thereof: how made and maintained, and how discontinued and destroyed.

AS in my workes concerning the Mathematicall part of Suruey, comprised in the three former Bookes, I premise the definitions, principles and grounds thereof: so in this *Legal part* I hold it answerable to order, and a good decorum, (before we abruptly enter on the Suruey of a Mannor) first to consider what a Mannor is, and the seuerall parts thereof (lest being questioned of our present imployment, wee discouer our owne weakenesse in vndertaking we know not what) and then to informe our selues of the seuerall natures, qualities and conditions, of the estates, tenures, and seruices of land; and of the seuerall profits, rents, and commodities thereunto incident and appertaining; with such other meete and necessarie obseruations, as are most fitting for a Surueyor to know and vnderstand, before he assume and take vpon him the name, or at least the office or function to a Surueyor belonging. Of all which in order; and first of a Mannor what it is, and of the parts thereunto belonging.

Mannor whence deriued.

Concerning the Deriuation or Etymologie of the word, I will not stand, whether it be of *Maneo manere* to remaine in a settled place; or of *Mano manare* to proceede or spread abroad out of the bountie of those Princes liberalitie who in the beginning bestowed them; or of *Manuarius* gotten by labor of the hand; which I hold the best; because there is more skil in getting then keeping; and with *Manerium* I will not meddle, seeing (as I take it) Mannors were created before the word was made: But from whencesoeuer deriued, A Mannor is now that which hath therunto belõging, messuages, Lands, Tenements, Rents, Seruices & Hereditaments; wherof part are Demeanes, being those which anciently and time out of minde, the Lord himselfe euer vsed, occupied and manured with the Mannor house; the residue are Free-holds, Farmes,

What a Mannor is.

Parts of a Mannor.

Farmes, and customarie or coppihold tenements; and these haue commonly diuers seruices besides their rents properly belonging thereunto, whereof I will hereafter speake.

Parts of a Mannor.

There is moreouer belonging to a Mannor a Court Baron, and to diuers a Court Leete; which is of more worth and efficacie, and is alwaies granted from the King, or held by prescription. To these Courts, and consequently to the Mannor is there vsually belonging; Fines, issues, amerciaments, heriots, waiues, straies, excheates, reliefes and other perquisites and profits of Court; whereof likewise I will further speake.

Appendants to a Mannor.

Besides, those there are often appendant and belonging to a Mannor (which are not of necessitie to be taken as the proper parts thereof) Wards, Marriages, aduowsons, patronages, free-gifts or presentations of parsonages, Vicarages, Chappels, Prebends, &c. also Commons of Pasture, Moores, Marishes, free Warrens, Customes, Liberties, Franchises, and Priuiledges; likewise yeerely Rents, suites of Court, tenths and seruices issuing and repriséd out of other Mannors. And of these, a Mannor is neither made by them; nor destroyed or marred for want of them; wherefore they are termed rather appendants then parts of a Mannor.

No present meanes to make a Mannor.

Neither doe those parts formerly named, properly of themselues make a Mannor: For should any man at this day alott and appoint out any competent quantitie of Land, and diuide the same into demeanes and tenement Lands; in feoffing Tenants in Fee of some part, and granting others by copie of Court-Roll, and perfecting the rest which before is said to belong vnto a Mannor; yet all this will not make a Mannor; for that it is the office of time by long continuance to make and create the same.

Continuance of time may perfect a Mannor.

How a Mannor may be destroyed and dismembred

But a Mannor at this day may bee dismembred, and vtterly destroyed both in name and nature, by escheating the Free-holds, and Copie-holds; for if of Free-holds or Copie-holds there are not two at the least, then are there no Sutors, and if no Sutors, no Court, and consequently no Mannor, and then may it bee termed a Seigniorie, which can keepe no Court Baron at all.

How one Mannor may be diuided, and made diuers Mannors.

Also it is to be vnderstood, that one Mannor may bee diuided into diuers Mannors; whereof wee haue diuers examples at this day; as where a Mannor descendeth to co-heires, and they make diuision and partition thereof; allotting to euery of them demeanes and seruices; whereby euery of them hath a seuerall Mannor, and may keepe seuerall Courts Baron thereon, as if anciently entire.

How diuers Mannors may be reduced into one Mannor.

And in like manner two distinct and seuerall Mannors may bee conioyned and made one entire Mannor, if formerly the one held of the other; and that Mannor so holding of the other doe escheate; but otherwise not. And thus much concerning the name, nature, and parts of a Mannor.

CHAP. II.

Of Perquisites Casualties and profits of Court, and their seuerall natures.

IN the former Chapter I declare, that (among other things) there is belonging to a Mannor a Court Baron at the least, and to some a Leete or Law-day, commonly called the *view* of *Franke pledge*: Now herein will I shew what perquisites, casualties, and profits are incident and belonging to those Courts; wherein I would haue it vnderstood, that it is not of necessitie, that all these hereafter mentioned, must be in euery Mannor, but that they may be in any. And first of Fines.

Fines of Land.

Fines of post mortem.

FInes of lands are of diuers kindes; As first, if a man holding to him and his heyres, or otherwise certaine Lands and Tenements, by Copie of Court Roll, according to the custome of the Mannor dye, his heyre vpon his admittance by the Lord, shall pay a Fine for such his admittance: And these Fines are of two sorts, either certaine, or arbitrable; if certaine, as one or two yeeres rent, or the like; there is then no other question to bee made, but the Lord by his Steward is to admit him, and hee to pay such certaine Fine accordingly; if vncertaine or arbitrable, then is the Tenant to vndergoe what Fine the Lord shall in reason impose or require; and these are called *Fines of post mortem.*

Fines of alienation.

Also a Tenant by Copie of Court Roll, hath not power to Alien or sell his estate or interest vnto any other man, without he surrender the same into the Lords hands to the vse of him vnto whom he shall so sell the same; for which Alienation the Lord is also to receiue a Fine, which in some Mannors are likewise certaine, and in others arbitrable, but being arbitrable, they are vsually rated at a lower and more reasonable value then those after death, and these are commonly called *Fines of Alienation.*

Likewise if a customarie Tenant let or set his lands vnto another for any terme of yeeres, not warranted by the custome, hee is first to obtaine licence of his Lord in this behalfe; and is to pay a Fine in respect thereof.

And moreouer if the Lord of a Mannor grant a Lease of any lands vnto a Tenant for any number of yeeres or for life or liues; and besides his annuall Rent, make composition for a Fine to be in hand paide; this is also a *Fine of Lands.*

Also in some places, the Custome is, that if a customarie Tenant alien and make surrender of his whole estate hee shall pay and yeeld vnto the Lord the best beast hee hath, or a certaine piece of money, in name of a *Farewell.* And in some places as well Free-holders, as customary Tenants on euery alienation shall pay a certaine summe of money for a Fine in name of *Offare*, and *onfare*, and all these and the like are *Fines of Land.*

A farewell paid.

Offare & onfare

Amerciaments.

Amerciaments.

AMerciaments are also perquisites of Court, whereof there are diuers sorts; which in generall are such Fines, penalties, and amerciaments as by the homage or afferers of the Court Leete, or otherwise are imposed on such Tenants as are found offenders within the Mannor; As if the Free sutors, Copie-holders, or other Tenants, make default or bee absent from the Lords Court, they are therefore amerced. Wherein is to be noted, that many Free-sutors make composition, and are at their Fine certaine in respect of their seruice of suite of Court; and these are called common Fines.

Common Fines quid.

Heriots.

AN Heriot is properly the best beast which any heriotable Tenant is possessed of at the time of his death, whether it be Horse, Oxe, Cow or the like; for which in many places a summe of money is paide by ancient composition, and in some places for default of liue Cattell (or the best beast not being to the Lords minde) it is in his choise to take the best of any other goods, implement, or commoditie the Tenant hath at the time of his decease.

Of these Heriots there are two sorts, *Seruice* and *Custome*: Heriot seruice is commonly mentioned and expressed in the Tenants grant: and therefore the Land answerable for satisfaction thereof; and Heriot custome is that which time out of minde hath beene euer paide vpon and after the death of any Tenant dying seised of any such heriotable Lands: And these Heriots of either kinde, are by the homage of euery Court to bee presented as they fall due; and seised by the Lords Bayliffe accordingly.

Heriot Seruice.

Heriot Custome.

And it is to bee vnderstood, that if a Tenant dieth seised of diuers tenements or lands, which haue beene anciently charged with diuers Heriots; the Lord at the time of the death of such Tenant shall receiue so many seuerall Heriots, as those lands at any time then-to-fore were anciently charged or chargeable to yeeld.

One Tenant may be chargeable with diuers Heriots.

And moreouer, if any heriotable Tenement shal be seuered & diuided into diuers parts, amongst seuerall Tenants; the Lord shal haue of euery such Tenant particularly a seuerall Heriot, for and in respect of those seuerall heriotable parcels; which the Lord may seise and take, whereseoeuer hee shall finde the best for his best aduantage.

Heriotable lands diuided, are severally chargeable.

Lib. Ass. 27. 24.

Reliefes.

RElieses are likewise accompted amongst perquisites of Court: but seeing it is a speciall seruice tyde to the tenure of Lands; I will here omit to speake thereof; referring you for your satisfaction therein to the Title of *Warde, Marriage* and *Relieſe*, in the 4. Chap. following.

Escheates.

Eſcheates.

Eſcheates what they are.

THeſe are likewiſe perquiſites of Court; and are ſuch as if a Free-holder or Copie-holder of inheritance, commit any manner of Felonie, and be thereof attainted; his Lands are eſcheated and forfeited to the Lord of the Mannor of whom they are holden; but the Lord ſhall not immediately enter thereinto; for the King is firſt to haue *annum diem & vaſtum*; after which time expired, it then remaineth to the Lord and his heyres for euer.

Alſo if any ſuch Tenant dye without heyre generall or ſpeciall, all his Lands and Tenements ſhall fall vnto the Lord by eſcheate, to remaine vnto him and to his heyres for euer.

Forfeitures.

Forfeitures of diuers kindes.

FOrfeitures are of diuers kindes; As if a Copie-holder or cuſtomarie Tenant deny, or will fully refuſe the paiment, doing or performance of his Rents, Seruices and Cuſtomes; or if hee fell or cut Timber on his Copie-hold Lands contrarie to the cuſtome; or doe or commit waſte in the houſes or otherwiſe; or if he grant or ſell his Copie-hold eſtate by deede; or alien or let the ſame without licence of the Lord, beyond limitation of the Cuſtome; In all or any of theſe, the cuſtomarie Tenant ſhall forfeite his Copie-hold eſtate into the Lords hands: Which offences are to bee found and preſented by the homage at the next Court; and thereupon ſeiſure made accordingly.

Alſo Tenant for terme of yeeres, life, or liues, may forfeit his eſtate for making a larger eſtate of Free-hold then he hath, or for not performance of ſuch prouiſoes and conditions, as are expreſſed in his Leaſe or Deede, if any be.

Waiues.

IF any man felonioufly ſteale or take any goods or chattels of what nature or kinde ſo euer; and by earneſt proſecution he is inforced in flying to leaue the ſame behinde him; theſe goods are called *Waines* or waiued goods; and in what place ſoeuer they are ſo left and waiued, they ſhall be taken and ſeiſed for the vſe of the Lord of that Mannor, if by his grant, charter or preſcription, they belong vnto him (or otherwiſe they are the Kings) and being ſo ſeiſed by the Bailiffe or other Officer, they are to bee preſented and found at the next Court by the Homage there. But if the right owner make freſh ſuite after the thiefe, and attaint him at his ſuite for ſtealing thereof, hee ſhall haue his goods againe, although they be waiued. And the like in all reſpects is if any goods be taken by an officer, from any whom hee ſuſpecteth to haue ſtolne the ſame, though there be no purſuite made or proſecuted.

Freſh ſuite. Waiued goods reſtored.

Eſtraies.

Eſtraies.

ESTraies are when a Horſe, an Oxe, Sheepe, or any other Cattell of what kinde ſo euer come into a Lordſhip or Mannor, no man knowing from whence, nor the owner thereof; ſuch are to bee ſeiſed to the Kings vſe, or to the vſe of the Lord of the Mannor who hath the ſame by grant or preſcription; and if the owner come and make claime within a yeere and a day, then hee ſhall haue the ſame againe, paying for the charge thereof; or elſe after ſuch time expired, the propertie thereof ſhall be to the King; or the Lord of the Mannor hauing the ſame by graunt or preſcription; So that Proclamation bee thereof made in the next markets and the Pariſh Church, according to the Lawes in that behalfe.

Pleas and Proces of Court.

THeſe are where the Lord of a Mannor in the Court Leete, or Court Baron, holdeth plea of his Tenants for actions of debt, of treſpaſſe or other cauſes, not exceeding the value of xl*s*. debt and damage.

And vnder this title of perquiſites is compriſed all other caſualties whatſoeuer, which may happen to grow or ariſe within any Mannor; as profits ariſing by mines of Copper, Tynne, Leade, Cole, and quarries of Stone; alſo by ſale of Woods, Turbarie, and Pannage; likewiſe profits of Fayres and Markets, Fiſhing, Fowling and the like. All or any of which may become certaine; by beeing letten and diſpoſed of for yeerely rents.

Caſualties may become certaine.

CHAP. III.

Of the diuerſitie of eſtates, and their ſeuerall natures.

HAuing alreadie ſhewed in the two former Chapters what a Mannor is, with the ſeuerall parts thereof, and the appendants thereunto: I hold it fitting here now to conſider of *Eſtates*; as how and by what meanes a man may bee eſtated either in a Mannor or any other Lands or Tenements: wherein it is to bee vnderſtood that all eſtates in generall conſiſt of two principall kindes as *Free-holds* and *Chattels*: which more particularly are ſub-diuided into diuers other parts or branches; as firſt *Feeſimple* and *Feetaile*, which are termed Free-holds of inheritance: alſo eſtates *After poſsibilitie of iſſue extinct*; *By Curteſie*; *In dower*; and *for terme of life*: Which foure laſt mentioned, are called Free-holds, but not of Inheritance: Likewiſe eſtates by *Copie of Court Roll*, being claimed & held by cuſtome, and are diuided into the like parts, as Free-holds at the common Law: and laſtly eſtates *For terme of yeeres*, and *at will*, which two laſt are Chattels. Of all which briefely in order as followeth.

1. *Fee*

1. *Fee-simple.*

Defined. Fee simple of all other estates is the most large, ample, and absolute that wee haue in this Kingdome, or that can by our Lawes bee inuested or made; and is that which is granted to any man and his heyres for euer, without any further or other limitation of vse or vses; and therefore if such Tenant hath issue of his bodie, the land descendeth to him, if not, to the next of kinne within the degrees of limitation hereafter specified.

But if a man purchase in Fee-simple to him and his assignes for euer, omitting this word heyres; here hath he but an estate for terme of life; for heires is the word which carrieth the inheritance.

Yet it is otherwise if lands be so deuised by Will; for the Law intendeth that learned counsell cannot alwaies be present in such cases; and therefore is such deuise construed for the best, according to the Testators meaning and intention, and not to the strict letter of the Will.

Also if Lands be granted to any man with a woman in Franke-marriage, this word implyeth an estate of inheritance without mention or addition of the word Heyres; Or to a man and to his bloud the like.

And here is to bee considered, who are those which are said to bee within the degrees of limitation before spoken of; that is, who are vnderstood to be a mans heires by the common Law. Suppose A. B. dieth seised of a state of inheritance without issue of his bodie: Neither his brother, or sister of the halfe bloud, nor their issue shall be his heyre; nor his bastard; nor his father, mother, grandfather, or grandmother; for inheritance may lineally or collaterally descend, but by no meanes lineally ascend by our Lawes; but the brother or sister of the father of A. B. (which is called a collateral descent) shal be his heyre; and then they dying seised without issue, the father of A. B. shall haue the land as heyre to his vncle or aunt, but not as heyre vnto him.

The halfe bloud. *A bastard no heire.* *Lineall and collaterall descent.*

Likewise it is to be vnderstood, that by the lawes of this Realme the eldest sonne is wholly to inherite; and he dying without issue, the second son, and so of the rest; and if no sonnes but daughters, they shall ioyntly inherite as coparceners; but if no issue neither sonne nor daughter, then shall the eldest brother be heyre, for want of such all the sisters; and in default of them, the vncle by the fathers side, if the Land came by the father, or bee of the purchase of him so deceased: But if there be no heyre of the fathers side, the purchased lands goe to those of the mothers side; But if none such, then all those lands shall Escheate to the Lord of whom they are holden.

Coparceners.

Escheate.

2. *Fee Tayle.*

Fee taile of two kindes. *Generall tayle.* This estate of Fee-taile is diuided into two kindes or sorts *Generall* and *speciall.* The first, being Fee-tayle generall, is when Lands or Tenements are granted vnto any man, and the heyres of his body begotten without limitation, or expresse mention made by what woman; wherefore if such Tenant marrieth diuers wiues, and hath issue by them seuerally; they shall all be capable of the Inheritance of those Lands. But if it be mentioned and expressed in the graunt by what woman, his Heyres shal proceed or

be begotten, as if the gift be made to A. B, and to the heyres of his body lawfully begotten on C. his wife, this is an especial In-taile, for any of his issue begotten by another woman, shall not inherite by force or meanes of this graunt or tayle. And the like in all respects if Lands bee granted to a woman in the like kinde. *Speciall taile.*

Also if Lands be granted vnto A B. and C. his wife, and to the heyres of their two bodies lawfully begotten; here are the man and his wife Ioynt-purchasers, and this is also a speciall tayle both in him and her.

Likewise if any man grant Lands or Tenements to another man with his Daughter in Franke-marriage, this is also a speciall tayle; and both the man and woman shall be here Tenants in the speciall tayle, for the word Franke-marriage implyeth as much. *Franke mariage.*

Also if Lands be granted to a man and the heyres Males of his bodie; this is an estate tayle, and here the Female shall not inherite. *Descent by heires males.*

3. *After possibilitie of issue extinct.*

Free-holds. If Lands or Tenements be granted to a man and to his wife, and to the Heyres of their two bodies lawfully begotten, and either of them dye without such issue betweene them; then is he or she suruiuing Tenant in tayle of those Lands, but are without all hope and past possibilitie of hauing such Heyre to inherite those Lands as was limitted in the graunt; & therefore is he or she so suruiuing and ouer-liuing the other, called Tenant in tayle after possibilitie of issue extinct: and from and after the death of him or her so suruiuing; the estate taile so made and granted vnto them, shal be vtterly voide, extinct and dead, as if the same were neuer granted; and the estate of inheritance of and to those lands, shal reuert and turne vnto the first Donor thereof and his heires.

4. *By courtesie.*

If a man marrie a wife, being an Inheritrix, and hath issue by her, and she die; by our lawes he shall hold, occupie, and enioy such lands as his wife died seised of either in Fee-simple, or Fee taile, during his naturall life; and he is called Tenant by courtesie of England, because no other Nation admitteth the like estate. Wherin the Law requireth that such issue be vital, & brought forth into the world aliue, although it immediately die, and also it is requisite that the husband bee in actuall and reall possession of those lands, and seised of them in the right of his wife, at the time of her death, or otherwise he shall not be admitted Tenant by courtesie thereunto.

But if any such Tenant by courtesie commit or suffer any stripe or waste, he is punishable in that behalfe, by action of waste.

Also it is to be vnderstood, that no man can bee Tenant by courtesie of a reuersion: for if a woman solye seised in Fee, granteth a Lease to A. B. for terme of his life, and afterwards marry and hath issue, and then dye; the Tenant or Leasee for life suruiuing; her husband in this case shall not be Tenant by courtesie.

5. *In Dower.*

BY the common Law of this Kingdome, if a man marry a wife, and at any time during the time of couerture he be directly and lawfully seised, either by purchase or descent of any lands or tenements, either in fee-simple or fee-tayle, and being so seised die, his wife shall be indowed of a full third part of all those lands and tenements, during her life; and being thus indowed, she is called *Tenant in Dower*, and this is by the common Law.

Dower at the common Law.

Dower by custome.

Besides this, there is Dower by custome, for in some places the woman shall haue a moytie, and in some places more, and in others lesse during her life, of all the lands her husband was seised of at any time during the couerture, according to the custome of the place.

But if the wife be not aboue the age of nine yeeres, at the time of her husbands death; the common Law will not permit her indowment.

A woman shall haue no dower.

And for diuers causes a woman may be defeated of her dower; as if shee or her husband, commit treason, murder, or felony, and be thereof attaynted (yea, though they haue their pardon:) also if she forsake her husband and liue incontinently; and be not againe reconciled without constraint of law; or if shee detayne and with-hold the deedes and euidences from the heire, of those lands, whereof shee claymeth dower, and the like.

And some things there are, whereof a woman is not capable of indowment; as of Commons, Annuities, Estouers sans number, Homages, Seruices, and the like.

There are besides these other kindes of dowers, as one called dowment, *Ex assensu patris*: another termed dowment *ad ostium Ecclesiæ*: and a third, *de la plus bel part*: As appeareth at large by our common Lawes; whereunto I referre you.

6. *For terme of Life.*

A Tenant for terme of life, is he, who holdeth lands or tenements, either for terme of his owne life, or for terme of another mans life; but for distinctions sake, he who holdeth for his owne life, is termed barely *Tenant for life*, and hee that holdeth for anothers life, is called tenant for terme *d'auter vie*, that is. of anothers life.

Waste.

And if either of these kinde of tenants commit or suffer waste, the leasor or he in reuersion, shall bring and maintayne against him an action of waste, and thereby recouer treble damages.

7. *By Copie of Court roll.*

THese tenants are such, as in diuers Mannors hold lands and tenements to them and to their heires, some in the nature of fee-simple, others in fee-tayle, or for terme of life or liues, at the will of the Lord, according to the custome of the Mannor; and in some Mannors they hold by copie for terme of yeeres: And all these haue no other euidence to shew concerning the tenure of their lands, saue only the copies of the rolls of their Lords Court; and therefore are they called tenants by *Copie of Court roll.*

Alienation of estate.

And if any of these tenants alien or sell his lands or estate by deede, he shal absolutely forfeit the same into the Lords hands: wherefore if he will alien his

his copy-hold estate, he must come into the Lords Court and there surrender the same into the Lords hands, to the vse of him vnto whom he alienateth the same.

Surrender out of Court.

But in diuers Mannors the surrender may be made out of Court, vnto any copy-hold tenant, in presence of two of the homage (to the vse as aforesaid) who are to present the same vnto the Steward at the next Court, and admittance made accordingly.

And these tenants can neither sue or be sued, in any of the Kings Courts, by writ or otherwise, for these lands so holden. But they must implead and sue for the same, by way of plaint, in the Lords Court.

Tenants at will.

And some are of opinion that these tenants are but in the nature of tenants at will of the Lord; who at his pleasure may displace them, and they without remedie, but by the Lords fauour. Yet others are of a contrarie minde, who maintayne, that if any such customarie tenant (but those for yeeres, their terme being expired; paying and doing their seruices) shall without iust cause be ejected and displaced by the Lord; he may bring and maintayne his action of trespasse against him, at the common Law.

Remedie for copy-holder put off.

Waste.

And if any of these cut timber, growing on his lands, without licence of the Lord (but only for repaire of his tenement) it is a waste, and an absolute forfeiture.

Forfeiture.

And in most Mannors if any such tenant shall farme or let out his land, for any longer time then a yeere, without the Lords licence, it is likewise a forfeiture vnto the Lord. But of these and many other the like, we are to be guided according to the custome of the Mannor, where such tenants are.

Base tenure.

And generally these tenants, for that they haue no free-hold at the common Law, but by custome, are termed tenants of base tenure.

And thus much concerning free-holds and estates of inheritance; and next of Chattels.

8. *Terme of yeeres.*

A Tenant for terme of yeeres, is he, vnto whom an estate is granted of lands, for any number of yeeres agreed vpon, betweene the Lord and Tenant; which terme is alwayes expressed in the lease so granted.

Rent reserued.

On which lease there is vsually reserued some annuall rent, payable either halfe yeerely or quarterly, according to their contract. For the recouerie and obtayning of which rent, if it happen to be ariere and vn-paid, the leasor is at his choyce; whether he will enter and distrayne, or bring his action at the common Law for the same.

Distresse or action of debt.

No liuery of seisin.

And in these leases for terme of yeeres, whether by writing or otherwise, there neede no liuery of seison, but the tenant may immediately enter by vertue of his lease without further ceremonie. But in leases for terme of life or liues, it is otherwise.

Waste.

Also if this tenant commit or suffer waste; the leasor may bring his action of waste against him; wherein he shall recouer *locum vastatum*, and his treble damages.

And if this tenant shall grant vnto any other man a greater or larger estate

in those lands he holdeth, then he hath therein himselfe; whereby hee conueyeth the fee-simple to himselfe, hee shall forfeit his lease and the state, and terme of yeeres therein granted.

9. Tenant at will.

Displaced at pleasure.

A Tenant at will, is he, vnto whom lands or tenements are granted, to hold at the will of the Lord or leasor, by whom they are granted. And this tenant may bee displaced or put out at any time, without further notice, at the Lords pleasure; yea, although he hath tilled and sowne his grounds. Yet in this case the law alloweth him free libertie of ingresse, egresse, and regresse, aswell to take, cut, and carry away his corne when it is ripe; as to take and carry away his goods, and house-hold-stuffe, within conuenient time; without punishment of committing trespasse, or otherwise; for that he knew not his Lords intention or time of entrance. But with tenant for terme of yeeres it is otherwise.

Libertie to take his corne and goods.

Like remedie for rent.

And the Lord or leasor here hath the like remedie against this his tenant at will, for his rent, if it be behinde and vn-paid, as he hath against the tenant for terme of yeeres, last before mentioned.

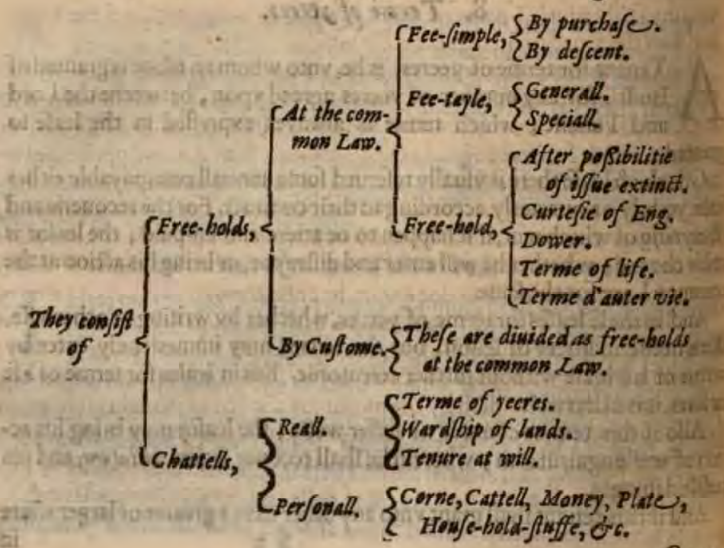
No action of Waste.

And it is to be noted, that this tenant at will is not by the law charged or chargeable with reparations, as is the tenant for yeeres; and therefore no action of waste lyeth against him; vnlesse he wilfully committeth waste, by pulling downe the buildings, or felling of timber, &c. In which case it is held, that the leasor may bring his action of trespasse, and recouer his losse sustayned.

Trespasse.

And thus much briefly concerning estates in land; whereof the two later kindes are termed Chattells reall; *and all moueable goods are called* Chattels personall; *as appeareth by this breuiate following.*

An Analysis or briefe resolution of all estates in generall.



Chap.

Chap. IIII.

Of the diuersitie of Tenures, and their seuerall natures, with the seruices belonging.

HAuing informed our selues, as before, of the diuersitie of estates (for all lands whatsoeuer, consist of some of those, formerly mentioned) let vs here, next, consider of the seuerall tenures and seruices thereunto particularly belonging; which are maine and principall obseruations to be had and vsed in suruey of a Mannor, and most meet and necessarie for a Surueyor to know and vnderstand. Whereof in order as followeth.

1. *Knights seruice.*

THis tenure of Knights seruice includeth Homage and Fealtie, and commonly Escuage; and whoso holdeth any lands or tenements by this seruice, is bound by the Lawes of this our Realme, to doe vnto his Lord Homage and Fealtie; being a seruice of the greatest humilitie and respect, that can be performed by a tenant vnto his Lord: and for the most part, he is to pay Escuage, called *Scutagium*, that is, seruice of shield; which is to be assessed by authoritie of Parliament, as shall be hereafter declared.

Homage.

When the tenant shall doe homage to his Lord, the Lord shall sit, and the tenant kneeling downe before him, on both his knees, and holding both his hands betweene his Lords hands, shall say thus: I become your man, from henceforth, of life and member, and of earthly honor, and to you will be faithfull and true, and faith to you shall beare for the lands I hold of you (sauing my faith which I owe and beare vnto our Soueraigne Lord the King) and then the Lord so sitting, shall kisse him.

How the tenant shall doe homage

Fealtie is as much to say, as *Fidelitas*, or fidelitie. In doing whereof, the tenant shall lay his right hand on a booke, and say thus: I will be vnto you my Lord, faithfull and true, and faith to you shall beare, for the lands and tenements which I claime to hold of you, and duly shall doe and performe vnto you the customes and seruices which I ought to doe, at the termes assigned, as helpe me God; *and then he shall kisse the booke.* And it is to be noted, that *Homage* must be done vnto the Lord himselfe personally; but *Fealtie* may be made to the Steward of the Court, or to the Baylife thereof. Also, tenant for terme of life shall doe *Fealtie*, but not *Homage.*

How fealtie is to be done.

As concerning Escuage: hee that holdeth his lands by a whole fee of Knights seruice; when the King goes in person to the warres, he is bound to be with him by the space of fortie dayes, sufficiently appointed for the warres: and he that holdeth by the moitie of the fee of Knights seruice, is bound by his tenure to be with the King in such sort as before, by the space of twentie daies; and so proportionally, according to the quantitie and rate of his tenure.

What dutie belongeth to Escuage.

Parliament. And it is to be vnderſtood, that after the Kings returne from the warres, a Parliament is vſually called; by authoritie whereof, it is aſſeſſed, what and how much, in money, euerie man that holdeth by a whole fee of Knights ſeruice (who was neyther perſonally, nor any man for him, with the King) ſhall pay vnto the Lord of whome he holdeth his land, by Eſcuage: and according to ſuch aſſeſſement, euerie tenant ſhall pay to his immediate Lord, after the rate and proportion of his tenure: and this money thus aſſeſſed, is called *Scutage*, or *Eſcuage*; for which, the Lord vnto whom the ſame is due, may diſtraine for non-payment thereof.

What Eſcuage to be paid.

Cuſtome. Yet ſome tenants by cuſtome, are not otherwiſe bound, but to pay a moitie or third part of what ſhall be aſſeſſed, as aforeſaid.

Eſcuage certaine And in ſome places the cuſtome is, that whatſoeuer be aſſeſſed by Parliament, yet their Eſcuage is certaine, and they pay neither more nor leſſe, but ſuch a ſumme of money, as fiue ſhillings, or the like; and this is called *Eſcuage certaine*: and this tenure is Socage tenure, and not Knights ſeruice; the *Eſcuage* whereof is alwayes vncertaine, and ſo called. And this *Eſcuage vncertaine* (belonging alwayes to Knights ſeruice) draweth vnto it Ward, Marriage, and Reliefe, as hereafter appeareth.

2. *Ward, Marriage, and Reliefe.*

AS formerly appeareth, Knights ſeruice (the tenure laſt before mentioned) draweth vnto it *Ward*, *Marriage*, and *Reliefe*; and therefore I hold it fitting here next to treat thereof. Wherefore, firſt it is to be vnderſtood, that if a man hold any lands or tenements by this tenure, and dieth, his heire male being within the age of one and twentie yeares;

Ward. the Lord of whome thoſe lands are holden, ſhall haue the *Ward*, that is, the cuſtodie and keeping of thoſe lands ſo holden of him, to his owne vſe and behoofe, without account, vntill the heire come to the full age of one and twentie yeares: for it is intended by the Law, that vntill he attaine to that age, he is not fit or able to performe ſuch ſeruice, as by this tenure is required.

Marriage. And if at the time of the death of ſuch tenant the heire be vnmarried, the Lord ſhall not onely haue the wardſhip of his bodie and lands, but the beſtowing of him in marriage.

Heire female. And if a tenant by Knights ſeruice die, and leaue an heire female, being of the age of foureteene yeares, or vpwards; then the Lord ſhall not haue

The full age of a woman. the ward of ſuch heire, neyther of her bodie nor lands; becauſe a woman of that age may haue a husband able to performe the ſeruices required by this tenure.

But if ſuch an heire be vnder that age of foureteene yeares, and vnmarried at the time of her anceſtors death, then ſhall the Lord haue the wardſhip of her lands ſo holden of him, till ſhe attaine to the age of ſixteene yeares; by force of an act of Parliament, in the Statute of *Weſtminſter* 1. *Cap.* 12.

And note here the great difference betweene the ages of Males and Females:

males: for the Female hath theſe ſeuerall ages appointed vnto her by the Law. Firſt, at ſeuen yeeres of age the Lord her father may diſtrayne his tenants for aide to marry her. Secondly, at nine yeeres of age ſhee is dowable. Thirdly, at twelue yeeres of age ſhee is held able to aſſent to matrimonie: Fourthly, at foureteene ſhe is able to haue her land, and ſhall be out of ward, (if ſhee be of this age at the death of her anceſtor.) Fiftly, at ſixteene ſhee ſhall be out of Ward, though ſhee were vnder foureteene yeeres of age at the death of her anceſtor: and ſixtly, at one and twentie yeeres ſhee is able to make alienations of her lands or tenements. But the Law limiteth to the Male, only two ages, that is, at fourteene yeeres to haue his lands holden in Socage: and at one and twentie to make alienations.

Diuerſitie of the ages of women.

Mens ages.

Reliefe. As concerning *Reliefe*, if a man hold his lands by Knights ſeruice and dyeth, his heire male being of the age of one and twentie yeeres, or his heire female of the age of fourteene yeeres, the Lord of whom ſuch lands are holden, ſhall haue *reliefe* of the heire.

What reliefes are to be paid, and how. Alſo it is to be noted, that all Earles, Barons, or other the Kings tenants (holding of him in chiefe by Knights ſeruice) if they dye, their heire being of full age, as aforeſaid, they ought to pay the old reliefe for their inheritance, that is, the heire of an Earle for a whole Earledom an hundred pounds; the heire of a Baron for a whole Baronie a hundred markes; the heire of a Knight fiue pounds, and he that hath leſſe ſhall giue leſſe, according to the old cuſtome of Fees. And the like is to be vnderſtood and obſerued of all others, that hold ſuch lands immediately of any other Lord.

And alſo a man may hold lands of a Lord by two Knights fees, and then the heire being of full age at the death of his anceſtor, ſhall pay to his Lord for reliefe ten pounds.

3. *Caſtle garde.*

Defined. IT is alſo to be vnderſtood, that a man may hold lands by Knights ſeruice, and not by eſcuage, nor pay eſcuage for the ſame: But hee may hold by *Caſtle garde*, which is to keepe a tower or ſome other place of his Lords Caſtle, on a reaſonable warning, when the Lord heareth of the approch of his Enemies.

This is likewiſe Knights ſeruice, and draweth thereunto ward, marriage and reliefe, in all reſpects as the common Knights ſeruice doth, before mentioned.

4. *Grand Sergeantie.*

Defined. ALſo there is another kinde of tenure in Knights ſeruice, which is called *Grand Sergiantie*, and this is where a man hold any lands and tenements of the King, by ſome ſuch certayne ſeruices, as he ought to performe in proper perſon, as to beare the Kings Banner, or his Speare, or to conduct his Hoſt, or to be Sewer, Caruer, &c. and ſuch ſeruice is called *Grand Sergeantie*, that is, a high or great ſeruice, becauſe it is the moſt honorable and worthy ſeruice that is: for whoſo holdeth by eſcuage, is not tyed by

by his tenure to performe any other more speciall seruice, then another holding by escuage, but he that holdeth by *grand Sergeantie*, is tyed to performe some speciall seruice to the King.

And if a man hold land of the King by *grand Sergeantie*, and dye; his heire being of full age, then shall his heire pay vnto the King, not only fiue pounds, as he that holdeth by escuage, but also the cleere yeerely value of such lands, as he shall hold by *grand Sergeantie*.

Cornage. And also in the borders of *Scotland*, diuers hold their lands of the King by cornage, which is to blow a horne, to giue notice to the Countrey of the Enemies approch, which seruice is also a kinde of *grand Sergeantie*.

No tenure in grand sergeantie, but of the King. And it is to be vnderstood that none can hold by this tenure of *grand Sergeantie*, of any other Lord saue only of the King.

5. *Petie Sergeantie.*

Defined. PEtie Sergeantie is, where a man holdeth lands or tenements immediately of the King, and for his seruice in respect thereof, is bound to pay vnto the King yeerely, a Bow, a Speare, a Dagger, or some such other small thing belonging to the warre. And this seruice is in effect no other then *Socage*, because the tenant is not tyed to performe any personall seruice, but to pay somewhat yeerely, as a rent is paid. Wherefore this seruice of *petie Sergeantie*, *No Knights seruice.* is no Knights seruice. Yet can it not be held of any other Lord saue the King only, aswell as *grand Sergeantie*.

6. *Homage Ancestrell.*

IF a man and his Ancestors, whose heire he is, haue holden lands or tenements of another, and his ancestors time out of minde, by homage, and haue done vnto him homage, this tenant thus holding, is called *tenant by homage ancestrell*, by reason of the long continuance which hath beene by title of prescription, aswell concerning the tenancie in the bloud of the tenant, as concerning the Signiorie in the Lord.

This tenure extinct. And it is to be noted, that if this tenant by *homage ancestrell*, shall at any time alien those lands vnto another, although he immediately, or at any time after, purchase them againe, he shall no longer hold by this tenure, because he hath discontinued, but shall from thenceforth hold it by the accustomed homage.

7. *Socage tenure.*

Defined. TEnure in Socage is, where a man holdeth lands or tenements of a Lord by certayne seruice, for all manner of seruices; so as the seruice be not Knights seruice: As where a man holdeth of his Lord by fealtie and certayne rent, for all manner of seruices; or else, where a man holdeth by homage, fealtie and certayne rent, for all manner of seruices; for homage by it selfe maketh not Knights seruice. Also a man may hold his lands by fealtie only, which is likewise *tenure in socage*. For euery tenure that is not tenure in Chiualrie, is *tenure in Socage*.

These

These tenants were tyed in ancient time euery of them with their ploughs by certayne dayes in the yeere, to plow and sow their Lords demeanes, for which cause this tenure was called *Socagium*, or *seruicia socæ*, which is the same with *Caruca*, one Soke or one plow land. But now that seruice is by mutuall consent, betweene the Lord and Tenant, in most places, conuerted to an annuall rent, yet the name of *Socage* still remayneth. *Why so called.* *Conuerted to rent.*

Also if a man holdeth by escuage certayne, as is before spoken, he holdeth in effect but by socage. *Escuage certayne.*

And further, it is to be vnderstood, that when *a tenant in socage* dyeth, the heire is to pay vnto the Lord, of whom those lands are holden, a reliefe, that is to say, the value of one yeeres rent, besides the yeerely rent, for the payment of which reliefe, the Lord may at his pleasure immediately distraine. *Reliefe.*

8. *Franke Almoigne.*

THis tenant in *Franke Almoigne*, or free almes, is where an Ecclesiasticall person holdeth lands of his Lord, in pure and perpetuall Almes, which tenure beganne in ancient time, thus: If a man being seised of certayne lands and tenements in his demesne, as of Fee, should thereof infeoffe an Abbot and his Couent, or a Prior and his Couent, or any other Ecclesiasticall person, as a Deane of a Colledge, or Master of an Hospitall, or the like, to haue and to hold the same lands to them and their successors for euer, in pure and perpetuall almes, or in franke almes, in these cases the tenements should be holden in *franke Almoigne*. By force of which tenure, those tenants which hold lands thereby, were bound to make Orisons and Prayers, and to doe other diuine seruices, for the soules of their Grantors and Feoffors, &c. and therefore discharged by the Law, to doe or performe any other profane or corporall seruice, as fealtie, or the like. *Defined.* *Seruice to be done.*

But it is now otherwise, since the Statute called *Quia emptores terrarum*, *An.* 18. Ed. 1. So as now no man can hold in *franke Almoigne*, but by force of such grants as were made before that Statute. *Otherwise since the Statute.*

9. *Burgage tenure.*

A Tenure in Burgage is, where an ancient Borough is, whereof the King is Lord, and they which haue tenements within the same Borough, hold of the King, by paying a certayne yeerely rent, which tenure in effect is but socage tenure. And the like is, where any other Lord spirituall or temporall is Lord of such Borough. *Defined.*

And it is to be noted, that for the most part such ancient Boroughs and Townes, haue diuers and sundrie customes and vsages, which other Townes haue not. For some Boroughs haue a custome that the yongest sonne shall inherit before the eldest, which custome is commonly called *Borough English*. And in some places the woman by the custome of the Borough there, shall haue all such lands and tenements in Dower, as her husband at any time during the couerture stood seised of. *Diuers customes.*

There are diuers other customes in *England*, which are contrarie to the course of the common law, which being probable and standing with reason, are *Diuers customes contrary to the course of common Law.*

are good and effectuall, notwithstanding they are against the common law.

No custome without prescription. But no customes are allowable, but those, as haue beene vsed by prescription, or time out of minde.

10. *Ancient Demesne.*

Defined. THere is likewise another tenure, called *ancient demesne*, and the tenants who hold by this seruice, are Free-holders by Charter, and not by copie of Court roll, or by the verge after the custome of the Mannor, at the will of the Lord.

And these are such tenants as hold of those Mannors, which were Saint Edwards the King, or which were in the hands of King William the Conqueror, which Mannors are called *the ancient Demesnes of the King, or the ancient demesnes of the Crowne of England.*

Quit of toll. And to such tenants as hold of those Mannors, the Law granteth many large priuileges and liberties, as to be quit of toll and passage, and such like impositions, vsually demanded and paid of and by other men, for their goods and cattell, bought and sold in Fayres and Markets by them; also to

Free of taxe. be quit and free of taxe and tallage granted by Parliament, except it please the King to taxe ancient demeanes, when he thinketh fit, for great and vrgent occasions. And diuers other priuileges are belonging to this tenure, wherein I refer you to our Lawes.

And if such tenant be at any time distrayned, to doe and performe vnto their Lord any such other seruice or dutie, which they or their ancestors haue

A writ of Monstrauerunt. not beene accustomed to doe, they shall sue out a Writ, called a *Monstrauerunt*, directed to the Lord, commanding him that he distrayne them not to doe other seruices or customes, then they haue beene accustomed to doe.

Doomes-day booke. And it is further to be vnderstood, that in the Exchequer there is a booke remayning, called *Doomes-day-booke*, which booke was made in the time of S. Edward *the King*, and all those lands which were in the seisin and in the hands of the said S. Edw. at the time of the making of the said booke, are ancient demesnes.

And thus much concerning the diuersitie of tenures and seruices. Now next let vs consider of the rents thereon vsually reserued, and the seuerall kindes thereof.

Chap. V.

Of Rents, and their seuerall natures.

COnsidering that on euery tenure there is vsually some rent or other reserued: I hold it not vnfitting to say somewhat here concerning the same. And first, it is to be vnderstood, that as there are diuersitie of tenures, so likewise of rents; as one sort

Diuersitie of Rents. which is called a *Rent seruice*, another *Rent charge*, and a third *Rent seck*, or *Redditus siccus*, a drie rent.

Rent seruice. As concerning *rent seruice*, it fitly hath the name, for that it is vsually tyed

tyed and knit to the tenure; and is, as it were, a seruice, whereby a man holdeth his lands or tenements, or at least, when the rents are vnseparably coupled and knit with the seruice. As for example; where the tenant holdeth his land of the Lord by fealtie and certaine rent, or by homage, fealtie, and by certaine rent, or by any other kind of seruice and certaine rent, this rent is called *rent seruice.*

Distresse of common right. And here is to be noted, that if at any time this *rent seruice* be behind and vnpaid, the Lord of whome the lands or tenements are holden, whether in fee simple, fee tayle, for terme of life, for yeares, or at will, may of common right enter and distraine for the rent, though there be no mention at all, nor clause of Distresse put in the Deed or Lease.

The nature of this *rent seruice* I say is to be coupled and knit to the tenure; and therefore, where no tenure is, there can be no *rent seruice*: wherefore, if at this day I be seised of lands or tenements in fee simple, and make a Deed of Feoffement thereof vnto another in fee simple, and reserue by the same Deed a rent, this can be called no *rent seruice*; for that there can be now no tenure betweene the Feoffor and Feoffee. But it is otherwise of Feoffements made before the Statute of *Quia emptores terrarum*, formerly mentioned. For before the making of that Statute, if any man had made a Feoffement in fee simple, and had reserued thereon vnto himselfe a certaine rent, although it had beene without Deed, here had beene created a new tenure betweene the Feoffor and Feoffee, and the Feoffee must haue holden of the Feoffor, who by meanes thereof, might of common right haue distrained for such rent: but since the time of that Statute, there can be no such holding or tenure created or begun; and consequently, no *rent seruice* can at this day be reserued vpon any gift in fee simple; except in the Kings case; who being chiefe Lord of all, may, and euer might, giue lands to be holden of him.

Anno 18. Ed. 1.

No rent seruice can be now reserued on gift in fee.

Thus it is apparant, that at this day no subiect can reserue any *rent seruice* vnto himselfe, vnlesse the reuersion of those lands, so by him graunted, be still in himselfe: as where hee graunteth them in fee tayle, or maketh but a lease for terme of life, or for yeares, or else at will; for in all these cases, the reuersion of the fee simple remaineth still in him: wherefore, if any rent be here reserued, it is to be called *a rent seruice*; and of common right is distrainable, although there be no clause of Distresse compriſed in the Deed or Lease.

And if a man shall absolutely and wholly graunt away in fee simple anie lands or tenements by him so holden, leauing no reuersion thereof in himselfe; and yet shall reserue vnto himselfe in his Graunt an annuall rent; with a clause of Distresse in his Deed indented, That it shall be lawfull for him to distraine for the same, if need require; this rent (in regard, that the land is therewith charged) is called *a rent charge*: But hee cannot distraine for this rent of common right, as before for the other, but onely by force and vertue of his Deed indented.

Rent charge.

And if there be no such clause of Distresse contained in the Deed, then is this rent so reserued called *a rent seck.*

Rent seck.

Also, if a man standing seised of lands and tenements in fee simple, will graunt either by Indenture, or poll Deed, an yearely rent vnto another, issuing

ing out of the same lands, whether it be in fee simple, fee tayle, for terme of life, for yeares, or at will, with clause of Distresse; then this rent is called a *Rent-charge*, and he vnto whome this rent is graunted, may for default of payment enter and distraine.

And it is further to be vnderstood, that if a man make a lease vnto another for terme of life, and reserue thereon vnto himselfe an yearely rent, and afterwards graunteth that rent vnto A.B. reseruing the reuersion of the lands vnto himselfe; this rent is but a *Rent seck*: for that A. B. who hath the rent, hath nothing in reuersion of the land.

Rent seck.

And if a man giueth lands and tenements in tayle, and reserue to him and his heires a certaine rent; or else make a lease for terme of life, reseruing certaine rent; if he graunt the reuersion to another, and the tenant attorne accordingly, the whole rent and seruice shall passe by this word reuersion, because the rent and seruice in such case be incident to the reuersion, and passe by the graunt of the reuersion; and here is the rent a *Rent-charge*. But if hee had graunted the rent onely, it had beene then a *Rent seck*.

Rent charge.

Chap. VI.

Of Reprises and Deductions.

AS we haue formerly vnderstood, what seuerall rents, profits, and commodities may yearely arise or grow out of any Mannor to the Lord thereof; so is it as fitting to consider, what Reprises, Deductions, Payments, Charges, and Duties, may be yearely issuing or going out of any Mannor from the Lord thereof: For otherwise, in the conclusion of our Survey, or in making a perfect Constat, or Particular, (such duties not being repriſed) the true value of the Mannor may oftentimes seeme greater then in truth it is; which would tend much to our shame and discredit.

These *Reprises* and *Deductions* are neuer certaine, or in all Mannors alike; but in this more, and in that lesse: yet in one and the same Mannor they are commonly the same, and vsually such as these here following.

Reprises are any manner of Rents, either in Money, Capons, Hennes, Pepper, Cummin seed, or the like, issuing and payd out of one Mannor to another: also Suits of Court, or annuall fines for the same; and the like may be issuing and payable to a Sherifes Turne or Hundred; also Pensions or Portions to Ecclesiasticall liuings: likewise a rent may be issuing for way-leaue, or some particular Passage; also for Water-courses, or placing of Pipes for conueyance of Water: likewise yearely Fees to Officers, as Stewards, Receiuers, Baylifes, Collectors, Keepers, &c. and also stypends, salaries, or annuities to Chaplins, or the like: All which are euer to be deducted and repriſed out of the totall value of a Mannor.

And hauing thus furnished and informed our selues, first of the Mathematicall *part of Survey, by the three former Bookes; and thus farre of the* Legall, *as to know*

know what a Mannor is, and the seuerall parts thereof; and likewise of all estates in generall; and what Tenures, Seruices, and Rents are thereunto incident, appertaining, and belonging; let vs proceed in an orderly and formall course; supposing we are now to vndertake the survey of a Mannor, which is to be performed as followeth.

Chap. VII.

Obseruations and courses to be held and taken, before the beginning of a Survey.

IT is first to be considered, for whome the businesse we vndertake, is to be performed: if for the King, then are we to obtaine Commission from his Maiestie out of such Court or Courts as is requisite, according to the tenure of the lands to be surueyed, as the Exchequer, Duchie, &c. In declaring the forme of which Commissions, I need not spend time, for that they are vsuall, and of ordinarie course (in such cases) graunted out of those Courts. Yet seeing, that for the most part, those Commissions giue power to the Surueyor, by reference to certaine articles annexed; and according to the efficacie and force thereof, the power and authoritie of the Surueyor is limitted; it behoueth to haue those articles as ample, full, & forcible, as you may deuise; not knowing with what people you are to deale (who often proue obstinate) nor the nature, estate, or condition of Tenancie (for the most part variable.) Which articles let be these here following, or the like in effect.

Articles to be inquired of, and courses to be obserued and held by A. R. in this present Commission named, for the better effecting and execution of his Maiesties seruice, in surueying of his Highnesse Honors, Lordships, or Mannors of A. and B. in the Countie of C. and of all Castles, Houses, Parkes, Messuages, Lands, Tenements, and Hereditaments thereunto belonging and appertaining.

1. FIrst, the said A.R. is to enter into the said Honors, Lordships, and Mannors, and all and singular other the premisses, and euery of them, and into euery part and parcell of them, and euery of them, and to make a suruey of the quantitie, qualitie, and yearely value thereof, and of euery part, parcell, and member thereof respectiuely.

2. Also the said A.R. is to call before him all such as now are or formerly haue bin Stewards, Baylifes, Reeues, or Collectors of all or any his Maiesties issues, rents, reuenewes, and profits within the premisses, and their deputies, and euery or any of

them, and to charge them on their oaths to deliuer in vnto him true and perfect Rentalls of all and euery their ſeuerall collections: and likewiſe to call before him all and euery ſuch perſon and perſons, as haue or are ſuſpected to haue any Euidences, Court Rolls, Rentalls, Bookes of Suruey, Couchars, Terrars, Eſcripts, Writings, or Mynuments whatſoeuer, touching or concerning the ſaid Mannors, Meſſuages, Lands, Tenements, and Hereditaments, and euery or any of them; and all and euery ſuch perſon and perſons to examine vpon their oathes concerning the ſame writings, and euery of them: and alſo to demand, require, and receiue of them, all and euery ſuch Bookes, Rentalls, and other Writings, as he ſhall ſo find to be in their hands or cuſtodie: And if any ſhall make refuſall of the deliuerie thereof, to certifie his or their name and names, and the reaſon of ſuch his or their refuſall, to the Lord Treaſurer of England, and Chancellor of the Exchequer, that ſpeedie and due courſes may be therein held and taken accordingly. But this is to be vnderſtood of Bookes and Writings not being in the hands of the preſent Steward or Stewards of any of the premiſſes, nor in the cuſtodie of any of his Maieſties Officers of his Highneſſe Courts of Record at Weſtminſter; whereof he is only to take and extract notes, for his better inſtruction and information concerning the premiſſes.

3. Likewiſe he is to inquire, what are the ſeuerall limits, butts, and bounds of all and ſinguler the premiſſes, and to expreſſe the ſame accordingly; and what Lord or Lords are conioyning or boundering thereon; & whether they or any of them haue or do intrude or incroach vpon or within the limits or bounds aforeſaid, or the liberties or priuiledges compriſed within the ſame.

4. Alſo, whether the premiſſes, or any part thereof, doth lye or extend into any other Mannor; and whether any other Mannors, Meſſuages, Lands, or Tenements do lye within the limits or bounds of the premiſſes; whoſe, and what they are; and to make perfect diſtinctions thereof particularly.

5. What Caſtles, and other Mannor or Manſion houſes his Maieſtie hath within the ſame; in what eſtate of reparations the ſame now are and be; and if decayed or waſted, by whome the ſame hath bin committed, & to what value; what demeſne lands now are, or heretofore haue bin, belonging or appertaining to the ſaid Houſes, and in whoſe tenure and occupation the ſame now

now are; by what right or title they clayme or challenge to hold; what ſeuerall rents they pay in reſpect thereof; and what is the true quantitie, qualitie, and yearely value of the premiſſes.

6. What Forreſts, Parks, and Chaſes his Maieſtie hath within the premiſſes; what number and ſtore of Game are in them; what Officers are thereunto belonging; what Fees they receiue in reſpect thereof; in what eſtate of reparations, the Houſes, Lodges, Walls, Pales, and Fences are; what is the quantitie, qualitie, and yearely value thereof by the acre; what Iuiſtments, or what Cattell, as Oxen, Kyne, Horſes, or the like, are vſually depaſtured within the ſame; who hath the diſpoſall thereof; and what is the value of a Beaſt-gate there.

7. Alſo, what Moores, Marſhes, Heaths, Waſts, or Sheepe-walkes, his Maieſtie hath of, in, vpon, or belonging to the premiſſes; what are the ſeuerall quantities thereof; how many Sheepe may be kept on thoſe walks; and what is a Sheepe-gate worth.

8. He is alſo to inquire, what Free-holders there are within and belonging to the premiſſes; what Mannors, Meſſuages, Lands, or Tenements they hold thereof, and what are their ſeuerall quantities; and likewiſe, by what ſeuerall tenures, rents, and ſeruices they hold the ſame.

9. Alſo, what other eſtates there are; as tenants for terme of life, or liues, yeares, or at will; what cuſtomarie or copy-hold tenants, or what other tenants there are within the premiſſes; what lands they do ſeuerally hold, and the true quantitie, qualitie, and yearely value thereof ſeuerally, and what yearely rents they pay for the ſame.

10. Alſo, what are the ſeuerall cuſtomes concerning the cuſtomarie tenants; whether their fines vpon death or alienation be certaine, or incertaine, and arbitrable; and if certaine, what Fines they vſually pay on euery death or alienation of Lord or Tenant; and how, and in what manner, doe thoſe cuſtomarie lands deſcend after the death of an anceſtor.

11. What Reliefes, Heriots, Fines, or other duties are payd, or anſwerable, vpon or after the death or alienation of any Free-holder, Copy-holder, or other tenant within the premiſſes; how and by whom are they vſually collected and diſpoſed of; and what may be the value thereof in *Communibus annis*.

12. Whether any cuſtomarie tenants (whoſe lands are hariotable) haue ſeuered, aliened, diuided, or diſmembred the ſame, who hath the vſe and occupation thereof, and what are the ſeuerall quantities, qualities, and yeerely values of the ſame.

13. Alſo, what are all and euery the cuſtomes in generall of, within, or belonging to the premiſſes, and how, by what meanes or for what cauſe, may a copy-holder or cuſtomarie tenant, forfeit or loſe his cuſtomarie eſtate.

14. What Commons there are, of, within, or belonging to the premiſſes, whether ſtinted or vnſtinted; if ſtinted, then how, by what meanes, and according to what rate and proportion, how many beaſt-gates they contayne, the value of each beaſt-gate, and the quantitie, qualitie, and value of the whole.

15. What arable fields and meddowes there are, which lie in common, what are their ſeuerall names, and of the ſeuerall furlongs and wents therein contayned; alſo how and in what manner they are kept and vſed; whether is it lawfull for any tenant at his pleaſure to incloſe any part thereof, without leaue of the Lord; how are they imploied when the corne and graſſe is taken away, how ſtinted, and what is the eatage therof worth by the beaſt-gate, or ſheepe-gate, after the corne and graſſe is ſo taken off, as aforeſaid.

16. What woods or wood-grounds his Maieſtie hath within the premiſſes, what grounds haue beene heretofore wood, and now conuerted to other vſes, how long ſince & by whom, what waſtes and ſpoiles haue beene had or made of his Maieſties woods, how long ſince, by whom, and of what value; whether may any profit by pannage be made or rayſed, by, or within the ſame woods, and what the profit or value thereof may yeerely be.

17. Alſo what tenants there are within the premiſſes, who demiſe or let any part or parcell of their lands or tenements vnto vnder-tenants, either for their whole terme or any part thereof, and what fines and rents haue or doe they receiue for the ſame.

18. Likewiſe, what lands, tenements, rents, ſeruices, or other profits, are concealed or detayned from his Maieſtie, how long ſince, by whom, and what the yeerely value thereof is.

19. What lands, tenements, leaſes, or other eſtates of, or in the

the premiſſes, haue beene or are eſcheated, or forfeited to his Maieſty, by whom, when, for what cauſe, and in whoſe occupation the ſame now are, and what is the value thereof.

20. What fines, iſſues, amerciaments, perquiſites of Court, heriots, waifs, ſtrayes, felons goods, and other caſualties doe yeerly accrue and grow vnto his Maieſtie out of the premiſſes, by whom the ſame is, or hath beene collected, gathered, and receiued, and what is and hath beene the value thereof yeerely in *communibus annis*.

21. Alſo what incloſures and Incrochments haue beene heretofore made of, in, or vpon any of his Maieſties commons, waſtes, or other grounds, how long ſince, by whom, what rents are paid for the ſame, and what the yeerely value thereof is.

22. What Corne-mills, Fulling-mills, or other mills, his Maieſtie hath within the premiſſes, who hold the ſame, what rents they pay, what is the yeerly value thereof, what cuſtomes are thereunto belonging, and in what eſtate of reparations are all and euery thoſe Mills.

23. What Markets and Fayres are there within the premiſſes, on what dayes kept, what tolls are belonging to the ſame, by whom the ſame is collected and receiued, and what yeerely profit ariſeth thereby vnto his Maieſtie.

24. Alſo what Warrens, Fiſhings, Fowlings, Hawking, Hunting, or other Royalties his Maieſtie hath within the premiſſes, by whom the ſame is occupied or enioyed, what rents are yeerely paid for the ſame, and what is the yeerely value thereof.

25. What quarries of ſtone, mines of Tinne, Lead, Cole, or other mines his Maieſtie hath within the premiſſes, who hath the vſe and occupation thereof, what rents they pay for the ſame, and what the yeerely value is.

26. What Moſſes of peate or turffe, what Broome, Heath, Furze or Flagge, are within the premiſſes, belonging to his Maieſtie, what are the rents and yeerely values thereof.

27. What Aduowſons, Patronages, Free-gifts or preſentations of Parſonages, Vicarages, Chappells or Prebends, or what Impropriations, are appendant or belonging to the premiſſes, who is or are the preſent Incumbent or Incumbents, who hath the vſe of ſuch Impropriation, what rent is paid for the ſame, and what is the yeerely value thereof.

28. Whether any Tenant or other perſon or perſons whatſoeuer haue plowed vp, caſt downe, remoued or taken away any meere-ſtone, baulke, hedge-row, or land-ſhare, betweene the demeanes of the premiſſes, and any other meſſuages, lands, or tenements, or between any the freeholds, and the tenement or cuſtomary lands, or betweene any of the premiſſes, and the lands of other Lords, by whom ſuch offence was committed, and where, and in what place and places thoſe altered bounders ought to ſtand and remaine.

29. Alſo what Officers his Maieſtie hath within the premiſſes, what fees doe they yeerely receiue in reſpect thereof, what rents, deductions, repriſes, or other payments or ſummes of money, are yeerly paid, repriſed, or iſſuing out of his Maieſties reuennues of the premiſſes, and to whom, for what cauſe, and to what end and purpoſe are the ſame ſo paid.

30. And laſtly, the ſaid A. R. is to make all and euery other ſuch further and other inquirie and inquiſition of, for, and concerning all and euery ſuch matters and things whatſoeuer, as in his diſcretion ſhall be held fit and requiſite, for the better effecting and execution of his Maieſties ſeruice, in ſurueying of the premiſſes.

Theſe Articles or the like, being drawne and faire written in Parchment by the Surueyor (the commiſſion being to be taken out of the Exchequer) a briefe warrant is to be directed to one of the Remembrancers, and written vnder the Articles to this effect.

M. I. O. Theſe are to will and require you immediately to cauſe a Commiſsion to bee made, and directed to A. R. for the ſuruey of his Maieſties Honors, Lordſhips, and Mannors of A. and B. in the Countie of C. and of all Caſtles, Houſes, Parkes, Meſſuages, Lands, Tenements, and Hereditaments, thereunto belonging or appertayning; wherunto is to be annexed the abouementioned Articles. Whereof fayle you not: and theſe ſhall be your warrant in this behalfe. From the Court, &c.

Which

Which Warrant is to be ſigned by the Lord Treaſurer, or Chancellor of the Exchequer, and deliuered to the Remembrancer accordingly.

But if the buſineſſe vnder-taken, be not for the King, but for a priuate man, then in regard that a Surueyor hath no power by any authoritie of Surueyorſhip, to be granted vnto him by any ſuch priuate man, to miniſter an oath, or performe ſuch other duties as are requiſite, it is fitting either that the Steward of the Mannor, which is to be ſurueyed, ioyne with him, in calling a Court Baron, and Court of Suruey, to be there held (wherein the Steward is to giue the charge and to deliuer Articles, and miniſter oathes, aſwell concerning the Court Baron as Court of Suruey.) Or otherwiſe, the Surueyor is to haue a commiſſion, grant, or deputation from the Lord of the Mannor vnder his hand and ſeale, of the office of Steward and Surueyor of his Mannors, Lands, and Tenements, for a certayne terme, or during pleaſure: And then may the Surueyor, of himſelfe execute all thoſe offices and duties fit and requiſite for a Steward and Surueyor, to doe and performe. Which commiſſion, grant, or deputation, let be thus, or to the like effect.

OMnibus ad quos hoc præſens ſcriptum peruenerit *A. B. de C. Comit. E. Armig. ſalutem. Sciatis me præfat. A. B. tam pro ſincero amore & benenolentia qua iamdudum affectus ſum, erga A. R. de cuius prouida circumſpectione, pia ſedulitate, ac ſingulari in hac parte prudentia merito plurimum confido, quam pro diuerſis alijs cauſis & conſiderationibus, ex mera & ſponta-nea voluntate mea dediſſe & per præſentes conceſsiſſe eidem A. R. Officium Seneſchall. ſiue Seneſchalciam omnium & ſingulorum Domin. Maner. & hæreditament. meorum quorumcunq; in Comit. F. & cuſtod. ſiue officium tenendi omnes & omnimodas Cur. Baron. Letar. Viſ. franc. pleg. Dominior. & Maner. prædict. & eorum cuiuſlibet, ac gubernationem & ſuperuiſionem eorundem. Ac ipſum A. R. generalem ac capital. Seneſchall. ac Superuiſorem meum omnium Curiarum, Dominorum, Manerorum, & hæreditament. meorum prædict. facio, conſtituo, & ordino per præſentes. Habend. tenend. gaudend. exercend. & occupand. Officia prædict. cum pertinentijs, à dat. præſentium durante bene placito meo. Mando inſuper vniuerſis & ſingulis Balliuis, Præpoſit. Firmarijs, tenentibus & occupatoribus meis præmiſſor. & eorum cuilibet, quod præfat. A. R. de tempore in tempus, aſsiſtentes ſint, obedientes, & auxiliantes in omnibus prout decet durant. termin. præd. In cuius rei teſtimonium huic præſenti ſcripto meo ſigillum meum appoſui. Dat. &c.*

Or to the ſame purpoſe in Engliſh.

And being thus authoriſed, we may now proceede.

CHAP.

CHAP. VIII.

What courſes are firſt to be held in the beginning of a Suruey.

CONſidering how precious time is, and withall, how chargeable theſe imployments are to thoſe whome it concerne; it behoueth a Surueyor (reſpecting his credit and reputation) ſo to appoint and diſpoſe of his buſineſſe in an orderly courſe, as no time be idly loſt, or vainely ſpent therein. Wherefore, firſt let the Baylife of the Mannor be called, and a Warrant or Precept directed and deliuered vnto him, to ſummon as well a Court Baron (if need require) as a Court of Suruey; to this, or the like effect.

Branton. *A.R. Seneſchall. & Superuiſ. Manerij præd. Baliuo eiuſdem, ſalutem: Tibi præcipio pariter & mando, quod diligenter præmonere facias omnes tenentes infra Maner. prædictum, tam reſidentes quam non reſidentes, atq; omnes tenentes cuſtumarios Manerij prædicti, quod ſint coram me in hac parte ſufficienter deputato apud Branton prædictam, die Lunæ ſecundo die Septembr. proximè futuro poſt datum huius, Non ſolum ad faciend. ſectam ſuam ad Curiam Baron. & Superuiſ. ſed etiam ad producend. & oſtendend. omnes Literas, Chartas, Inſtrumenta, Indentur. copias Cur. Rotul. ac al. euidenc. vnde tenere vendicant ſeperal. terr. & tenement. ſuas de Manerio prædicto; & omnia alia quæ eis incumbent, & pertinebunt; & hæc nullatenus omittas, & habeas ibi hoc præceptum: Datum ſub ſigillo meo viceſimo quarto die Auguſti, Anno Regni &c.*

Or to the like effect in Engliſh.

Wherein let a conuenient time be limited, as fiue or ſixe daies at the leaſt after notice giuen for the tenants apparance, that they may the better prepare themſelues, and be the more inexcuſable, if they happen to make default.

Then are you to receiue from the Baylife all ſuch Rentalls as he hath concerning his whole collection, as well ſuch as are ancient, and of former times, as thoſe of his laſt collection; which you are diligently to compare together, noting the difference: and if the later be leſſer, then what decayes of rent there are, and how occaſioned; if greater, then what increment of rent, and whereon rayſed; which you are carefully to note and expreſſe, when you come to ingroſſe your Rentall.

Next

Next would I haue you to reduce your Rentall to an Alphabeticall forme: wherein, vſe all the moderne Tenants names; not omitting the ancient; which will be a great helpe for the ſpeedie diſpatch of your entries; and the readie finding of any Tenants name, or rent, as you are to vſe them: which would be written thus, or in the like manner.

Atkinſon Thomas, late *Brownes*,——xx$^{s.}$
Armſtrong William, late *Tomlinſons*,——v$^{s.}$
Bennet Iohn, late *Brights*,————xv$^{s.}$
Branthwait Edward, late *Finches*.—xxij$^{s.}$

And in this ſort proceed Alphabetically with all the whole Rentall; which is much auaileable, where manie Tenants are.

And hauing thus prepared your Rentall in a readineſſe, againſt you haue occaſion to vſe it; you are to ſpend the reſidue of the time, vntill the day appointed for your Court, in conferring with the Steward concerning the preſent eſtate of the Mannor; and in diligent view and ſearch of the Lords Euidences and Court Rolls; taking them orderly before you, and from yeare to yeare briefely to expreſſe in a Booke, for that purpoſe prouided, the ſeuerall Cuſtomes, Eſtates, Tenures, Rents, and Seruices, and all other remarkable things. So ſhall you be able fully to informe your ſelfe of the nature, qualitie, eſtate, and condition thereof; and to vnderſtand, what articles are now moſt fit and apt to be preſented vnto your Homage, or Iurie, to be inquired of, when you haue giuen them their charge; which you haue now alſo fit opportunitie to write in a readineſſe for them againſt that time. And theſe articles would I haue to be ſuch as are expreſſed in the laſt Chapter, or ſo manie thereof as you hold fitting and neceſſarie for the purpoſe; and (if need require) to adde and inſert ſuch others thereunto, as you ſhall find meet and requiſite; for as much as by the laſt article annexed to your Commiſſion, you haue power and authoritie to make ſuch further and other inquiſition, as in your diſcretion ſhall ſeeme fitting.

Alſo, now haue you conuenient time, either to ride or walke abroad, and to take a reſpectiue view of the ſituation and extent of the Mannor; whereby you ſhall be able to informe your ſelfe, where, how, and in what ſort you may with moſt conueniencie begin, continue, diſpoſe of, and performe your Inſtrumentall menſuration, either by your ſelfe or ſeruants, whome you imploy therein: wherein, for manie reſpects, I would haue nothing done or performed, before the firſt day of your Court be paſt; when as you haue read and made knowne your Commiſſion, and ſettled an orderly courſe with the tenants, for their attendance, aide, and aſſiſtance in that behalfe.

And thus, and in this like manner, may you ſpend the time to good purpoſe, till your Court day come.

CHAP.

Chap. IX.

The order of keeping a Court of Suruey.

IF a Court Baron be kept with your Court of Suruey, as is euer moſt fitting, then are you firſt to enter the ſtile of the Court in this manner.

Branton. *Curia Baronis & Superuiſ. A. B. Armiger, ibidem tent. die Lunæ, videlicet ſecundo die Septem. Anno Regni* Iacobi, *Dei gratia Angliæ, Franciæ, & Hyberniæ Regis fidei defenſ. &c.* xiiij. *& Scotiæ* 50. *tent. per A.R. Seneſchallum & Superuiſ.*

After the ſtile of the Court thus entred, you ſhall cauſe the Bayliffe, who ſerueth the Court, to make Proclamation by crying once *Oyes*, and then ſhall you will him to ſay, thus; All manner of perſons, who were ſummoned to appeare here this day, to ſerue the Lord of the Mannor, for his Court now holden, draw neere and giue your attendance, and euery one anſwere to his name, as he ſhall be called, vpon the payne and perill that may fall thereon.

Then by your Rentall, call them all ſeuerally by their names, marking thoſe which are abſent to be amerced. Which done, cauſe the Bayliffe to make another *Oyes*, and willing them to draw neere, and keepe ſilence whilſt the Commiſſion be read; let the ſame be read vnto them, and likewiſe the Articles thereunto annexed, if it be for the King.

Then out of thoſe tenants which are preſent, make choiſe of the moſt ſufficient for your Iurie, wherein your beſt courſe is, formerly to informe your ſelfe, and to take ſpeciall notice, who are moſt fitting for your purpoſe, and to haue their names readie written in a paper by themſelues, which you may now thereby call accordingly. But being for the King, you haue alwayes a writ of aſſiſtance directed to the Sheriffe of the ſhire, requiring him to returne you a ſufficient Iurie: yet may you without him by vertue of your Commiſſion, impannell any Iurie at your owne pleaſure. Then direct the Fore-man of the Iurie, to lay his hand on the Booke, and ſweare him as followeth, or to the like purpoſe.

YOu ſhall diligently inquire and make true preſentment of all ſuch matters, as on the Lords behalfe of this Manner, ſhall be giuen you in charge, you ſhall neither for fauour, feare, affection, or other parciall reſpect whatſoeuer, forbeare to preſent what you ought to finde, or finde what you ought not to preſent, you ſhall herein keepe the Lords counſell, your owne, and your fellowes, and in all things according to a ſincere and vpright conſcience, you ſhall preſent the truth, the whole truth, and nothing

thing but the truth, as by euidence and your owne knowledge you ſhall be induced, to the beſt of your power, ſo helpe you God, and by the contents of the Booke, which he is to kiſſe.

And after the Fore-man is thus ſworne by himſelfe, then cauſe three or foure of the reſt of the Iurie, to lay their right hands together on the Booke, and giue them their oath, as followeth.

THe ſame oath which A. B. your Fore-man before you, for his part, hath made and taken, you and euery of you, for your parts ſhall truly keepe and performe to the vttermoſt of your powers, ſo helpe you God. And cauſe them ſeuerally to kiſſe the Booke.

And in like manner ſweare all the reſt. And all being ſworne, cauſe the Bayliffe to number them, as you reade their names. Then cauſe him alſo to make the third Proclamation, and ſay thus: All you that be here ſworne, draw neere and heare your charge, and all the reſt keepe ſilence.

Then make your exhortation, and deliuer the charge of a Court Baron, after the vſuall manner. Which being finiſhed, you are to addreſſe your ſpeech vnto them, concerning the preſent buſineſſe of Suruey, as occaſion ſhall be offered, whereof to preſcribe you any forme or preſident, were to little purpoſe, ſeeing it is to be framed and directed to ſuch ends and purpoſes, as the preſent cauſe requires, which you ſhall alwayes finde different and variable, and therefore I refer the ſame to your owne diſcretion, deeming you now able and fitting ſufficiently to performe the ſame in any kinde.

And then deliuer vnto them the Articles which you haue readie drawne, according to the directions of the laſt Chapter, which is their charge concerning the buſineſſe of Suruey, relating vnto them, that as they receiue theſe Articles (whereof they are to inquire) in writing, ſo are they to anſwere the ſame in writing vnder their hands and ſeales particularly by a day, now to be limitted and appointed, which for many reaſons is moſt fitting to be, about the time of your concluding the buſineſſe. Which day is to be expreſſed vnder their Articles, and your name ſubſcribed thereunto.

And now are you to take order, and giue ſpeciall directions vnto all the tenants for their attendance, aide, and aſſiſtance, in your inſtrumentall menſuration, appointing them by turnes, how, when, and where you are to vſe their helpe and aſſiſtance, wherein you are to deale with ſuch diſcretion, as you neither faile of their helpe, when occaſion ſerueth, nor oppreſſe them with grieuance by their ouer-much attendance.

And hauing thus farre proceeded, the reſt of this day may be ſpent in entering their ſeuerall deedes, euidences, and eſtates, in manner as ſhall be hereafter declared.

But before you diſcharge the tenants, you are to conſider (according to the number of them) in what time or how many dayes, you ſhall be able to enter their eſtates, and if they conſiſt of diuers Townes, as large and ſpacious Lordſhips vſually doe; then your beſt courſe is to appoint them ſeuerall

rall dayes for their attendance, and bringing in of their euidence by ſeuerall Townesships, for it would be no leſſe troubleſome to your ſelfe, then diſtaſtefull to the tenants, to require their generall and daily attendance vntill the buſineſſe were wholly finiſhed.

And now may you aiourne the Court vnto the next day, (or ſuch other time as you thinke fitting) by cauſing the Bayliffe to make proclamation to that purpoſe, and the like from time to time, till you haue ended your buſineſſe.

The next day you may beginne your menſuration in the fields, either by your ſelfe or thoſe whom you imploy to that purpoſe, according to the inſtructions of the third Booke. But it were fitting for your owne part to be imployed in entering of the tenants eſtates, vntill you haue finiſhed, or you may ſpend ſuch time therein, as when the weather is not fitting to ſtirre abroad, or in the mornings and euenings, as you ſhall finde meeteſt for your purpoſe.

CHAP. X.

The order and manner of entering the Tenants euidence, and their ſeuerall eſtates.

FIrſt, it is to be conſidered, that moſt Mannors (as is formerly ſpoken) conſiſt of diuers Townesships or particular parts, and the tenancie of thoſe Townesships of diuers eſtates, as Free-holds, Copy-holds, &c. Wherefore, I hold it fitting and an orderly courſe, that not only euery of thoſe Townesships, but the ſeuerall eſtates therein, be entered and taken ſeuerally and particularly by themſelues, that is, all of one and the ſame Townesship and eſtate vnder one and the ſame title, for auoyding of confuſion. As, ſuppoſe you are to ſuruey the Mannor of *Branton*, which conſiſteth of theſe ſeuerall Townesships or parts, *Branton*, *Bodley*, and *Sutton*, and within thoſe Townesships, are diuers tenants, holding their lands by ſeuerall eſtates, as Free-hold, Copy-hold, &c. Then would I haue you make your ſeuerall entries vnder thoſe ſeuerall titles whereunto they properly belong, as vnder the title of *Branton townesship Free-hold*, enter all thoſe which are of that Townesship, and of that nature: and vnder the title of *Branton townesship Copy-hold*, enter all the Copy-holds of that townesship, and the like of all the reſt.

And theſe entries I would haue made in looſe ſheets of paper at large, keeping them alwayes ſorted, according to the ſeuerall Townesships and eſtates, till you haue finiſhed all your entries, and then to file them together orderly in a Booke, each Townesship following other.

In which ſeuerall entries obſerue this courſe: hauing written your title as before, in the head or top of the ſheet, then enter the tenants name, and the very words of grant, as they are in his Deede, Copy, or Leaſe, which is to be written from the margent the whole bredth of the ſheet, leauing only towards the right hand a ſpace, wherein is to be expreſſed the rents, and ſeruices, and in the margent alwayes expreſſe the tenure.

And

And conſidering, that in few or no Deedes, Euidences, Copies, or Leaſes, the lands are particularly expreſſed by particular names, cloſes, and quantities, as the tenant now holdeth the ſame, and as you ſhall find them in your inſtrumentall menſuration; hauing entred the effect of the Deed, Copie, or Leaſe, according to the purport thereof: it is fitting to queſtion with the tenant, what ſeuerall parcels he holdeth; for and vnder the ſeruices and rents contained in euerie Deed, Copie, or Leaſe particularly; as, what Meadow, what Arable, what Paſture, and their ſeuerall names and quantities, as he eſteemeth them; and if he know not what acres they containe (as moſt tenants will ſeeme ignorant thereof) let him expreſſe of his Meadow how many daies mowing, of his Arable how many daies plowing, and of his Paſture how many Beaſt-gates, and the like: for although it be not greatly materiall for theſe their giuen quantities, in reſpect you meaſure euery particular; yet this kind of entrie will ſerue you to good purpoſe, as ſhall hereafter appeare. Alſo, you are to queſtion him concerning his Paſtures, as well thoſe in ſeuerall, as the Paſtures in common, what euery Beaſt-gate is worth by the yeare in euery of them ſeuerally; whereof you may otherwiſe alſo informe your ſelfe, leſt you be deceiued. The forme of which entries let be in this manner.

BRANTON Towne-ſhip Free-hold.

Socage. ANTHONIE BORNE *holdeth freely to him and his heires for euer, by deed indented, bearing date* 14. die Ianuarij, Anno Reg. Reginæ Elizabeth. &c. 30. *made and graunted by and from* WILLIAM BATEMAN, *of &c. All that Meſuage or Tenement* (expreſſing the verie words of Graunt) *On which Graunt is there a deed of Feoffement of the ſame date, with liuerie of ſeiſin thereon paſt accordingly; by the yearely rents and ſeruices of* — Fealtie, & iij.ſ.

Particular.

	r.	a.	
THe manſion-houſe, out-houſes, and ſcite, conſiſting of two Orchards, three Gardens, and two Yards or Garths, containing together	3.		
A Cloſe of Meadow, called Broad Meade, containing		2.	10.
Another called White-thorne cloſe, containing		2.	8.
Meadow in the common Meadow, called Long meade, three parcels containing		d.	12.
A Cloſe of Arable, called Bennets, containing		2.	7.
Another of Arable, called the High Cloſe,		2.	15.
Arable in the South field, in ſix parcels, which containe all together	2.	1.	4. 3.

Arable

	a. r.
Arable in the North field, fiue parcels containing	6. 2.
One Close of Pasture, called the Oxe Pasture, containing 30. *beast-gates, at* 13.s. 4.d. le gate,	gates. 30.
Another called the Calfe Close, containing 12. *beast-gates, at* 8.s. le gate,	gates. 12.
In the great common Moore, at 2.s. 8.d. le gate,	gates. 20.
In the common Cow-pasture, at 6.s. 8.d. le gate,	gates. 10.
On the Downes depasturing, for 150. *sheepe, at* 3.d. le gate,	gates. 150.
Common sans stint on the Moores.	

And in this order, and vnder this Title, enter all the Free-holds within the Towne-ship of BRANTON: But withall, obserue this course in all your entries; that these particulars, in the entring of them thus in your rough Booke, exceed not, nor extend past halfe the breadth of euerie sheet or leafe, or little further, because directly after the seuerall contents, before specified, there is particularly to be expressed afterwards, the true quantities of euery parcell found by measure; and after that, the seuerall and particular yearely values thereof, as shall be hereafter shewne.

In like manner, let your tenants for life or liues, in euerie Towne-ship, be entred vnder their due and seuerall titles thus.

BODLEY Towne-ship for liues.

THOMAS HOCKLEY *holdeth by Indenture, bearing date* 23. die Nouembr. Anno Reg. Reginæ Elizabeth. 32. *made and graunted by and from A. B. All that Messuage or Tenement* (vsing the words of Graunt) *for the terme of the naturall liues of the said* THOMAS HOCKLEY *now aged* 50. *yeares; of* IANE *his wife now aged* 42. *yeares, and* IOHN *their sonne now aged* 30. *yeares, successiuely each after other: and payeth rent* per annum — xx.s.

Particular.

AND here write the particulars in forme as before.

Then vnder the foot of those particulars make a briefe *Memorandum* of such necessarie obseruations as are to be noted, thus.

There is due vnto the Lord on the death of euery of them dying tenant in possession, the best Beast *Nomine Heriot.* The tenant is to pay his rent quarterly, or within one and twentie dayes, on paine of xx.s. *Nomine pœnæ*; or within fortie dayes, on paine of forfeiture by prouiso. To doe all manner of reparations (except great tymber.) Not to let the whole, or any part, without the

the Lords licence. The Lord warranteth the premisses against him and his heires.

And the like notes may be expressed vnder all your other entries.

Where note, that speciall care is to be alwayes had in the entrance of these grants for liues, whether they are all ioynt purchasers, as all named in the words of grant, or whether only granted to one, during all their liues; wherein there is great difference; which is to bee noted, and the verie words of grant to be euer precisely expressed in your entries as before.

As concerning your Copihold Tenants let them be entred thus.

SVTTON Town-ship Copi-holds.

W. B. *holdeth the Copie of Court roll bearing date* viij. die Iunij Anno Regni Regis IACOBI Angliæ iij. *of the surrender of* C. D. *One messuage or tenement* (according to the words of the Copie) *late* E. F. *and before that* G. H. *To him and his heires at the will of the Lord according to the custome of the Manner. For which he payd fine* XL.s. *And payeth rent* per annum. — xxx.s.

Particular.

Then write your particular as before: and after that such briefe Memorandums as you shall finde fitting, according to the former directions in that behalfe.

And the like course are you to holde with Tenants for terme of yeeres, and at will; and all the rest: vntill you haue fully finished all your entries. Then place all your leaues in order; and if you bee assured that all are entered (which will easily appeare by your Rentall, if you alwayes crosse the same, as you enter them seuerally) then write a new Rentall according to this your rough Booke, and ioyne the same to the beginning of your Booke, and file all together; But let your Rentall bee alphabeticall; or else if your booke be verie large, make an alphabeticall Index or Table of all the Tenants names, to be placed in the beginning of the Booke, before the Rental, with numbers of reference to the number of leaues; whereby instantly you may turne to any Tenants name therein as you shall haue occasion to vse the same.

And thus haue you finished with the Tenants concerning their seuerall entries; but haue not yet fully perfected your rough Booke; whereby you may be able to ingrosse the same. Wherefore proceed therein as is taught in the next.

CHAP. XI.

The meanes and order of perfecting the Booke of entries laſt mentioned, and the due placing therein of the ſeuerall contents of euerie particular found by meaſure through the whole Mannor, with the valuation thereof.

WE are now to ſuppoſe before wee beginne this worke, that not onely all the Inſtrumental menſuration throughout the whole Mannor is finiſhed; but alſo the firſt plot drawne; and the ſeuerall contents thereof caſt vp, and expreſſed therein; with the proper and particular numbers, ſeuerally belonging thereunto, according to the inſtructions of the Third Booke.

Which being effected, we are firſt to make an Index or alphabetical Table of al the Tenants names; wherunto is to be added the Lords and the Parſons, the one for Demeſnes, the other for gleabe; which Index is thus to bee compoſed. If one ſheet of paper will not ſerue, you are to take two, three or more, and with mouth-glue faſten them end to end, making thereof a long ſcrole or ſchedule of the bredth of the whole ſheet. And with a ſmall margent towards the left hand, let it from thence be ruled with blacke or red Inke ouerthwart the whole paper, of the diſtance of lines in ordinarie writing; betweene which lines downe by the ſame left margent write all the Tenants names each vnder other alphabetically, leauing all the reſt of the ruled Paper to be thus imployed.

Firſt, take your Field-booke, and beginning where you firſt beganne your worke in the fields, take all the numbers before you expreſſed in the margent thereof, as appeareth in *Chap.* 10.3. and noting to what Tenants name they belong in your Field-booke, againſt the ſame name place them in your Index betweene the ruled lines; whereby you ſhall ſpeedily expreſſe and reduce the ſeuerall numbers repreſenting the ſeuerall fields and cloſes throughout the whole Mannor againſt euery mans name in the Index to whom they properly belong.

Then take your common Field-booke (mentioned in *Chap.* 40.3. and with it performe the like; but make a ſtroke or other marke for diſtinction betweene theſe and the former numbers; ſo haue you alſo euerie mans particular parcels lying in the common fields expreſſed againſt his name. And thus is your Index perfect and fit to be imployed as followeth.

Take now your rough Booke of entries, and turne to the firſt Tenants particular therein entred; and looke in your Index what numbers are belonging to that Tenant; alſo take your Field-booke, and comparing thoſe numbers in your Index with the ſame in the margent of your Field-booke, you ſhall find therein the ſeuerall names of the fields and cloſes belonging to that Tenant; and the like names ſhall you find in your Booke of entries, in that Tenants particular: wherefore expreſſe thoſe ſeuerall numbers againſt euerie particular parcell in the margent of your entries, whereunto they properly belong: and the like performe in all reſpects with your common field-booke, for thoſe parcels lying in the common fields. Then lay your rough plot before you, and finding thoſe ſeuerall numbers in your plot, note the ſeuerall content and quantitie of euery ſeuerall parcell of ground, expreſſed in the plot repreſented by thoſe numbers; and thoſe quantities expreſſe and write downe in figures particularly in your booke of entries, to euery parcell wherennto they belong next after the quantities deliuered by the tenant. As for the particular quantities in the common fields, you ſhall not find them in the plot, but in your common field-booke, according to the direction thereof in *Chap.* 40. 3. before recited; which let thereby be expreſſed accordingly.

And the like courſe in all reſpects is to be holden with all other the entries throughout your whole booke.

But it is to be conſidered, that one tenant may within this Mannor hold lands of ſeuerall eſtates, and by ſeuerall rents and ſeruices, as Free-hold, Copy-hold, Tenement Lands, &c. yet are they all compriſed and repreſented within and by thoſe numbers expreſſed in the Index. In ſuch caſe you are to compare theſe numbers with the particular names expreſſed in your field-booke, and thoſe with the entries; and you ſhall moſt eaſily diſtinguiſh the one from the other, and expreſſe and aſſigne to euery of them their due and proper number and quantitie, as before.

Alſo, it is here to be conſidered, that we haue not yet ſpoken of any means to expreſſe each mans particular quantitie in the common ſtinted paſtures, or ſheepe-walkes, whereof onely the generall quantitie is taken by meaſure, and expreſſed in the plot. Which to performe, worke thus.

Suppoſe there is in the Mannor a ſtinted Cow-paſture, wherein euery tenant hath a certaine number of Beaſt-gates, ſome more, and ſome leſſe, which are vſually rated and ſtinted, either according to their rents, or after their quantities of knowne grounds, or their parts in the common arable fields: and imagine this paſture is found to containe by meaſure 212. Acres, 3. Roods, 20. Perches; firſt, collect out of your entries all the number of gates in the ſame paſture; which added together, let containe in the whole 116. Then reduce your meaſured quantitie into the loweſt denomination, as Perches (according to the directions of *Chap.* 48.3.) whereby you ſhall find the ſame to be 34060. Perches: and ſuppoſing the tenant, whoſe quantitie you ſeeke, hath in the ſame paſture 10. beaſt-gates, by the rule of proportion reaſon thus. If 116. the whole number of beaſt-gates, giue 34060. Perches, the whole quantitie, what giues 10. gates; and by increaſing 34060. by 10. and parting the product by 116. your anſwer will be 2936. Perches, and a ſmall quantitie more, the proportionall quantitie belonging to 10. gates; which reduced into acres (by *Chap.* 48.3. before recited) is 18. Acres, 1. Rood, 16. Perches. And in like manner worke with all the reſt. And here is to be noted, that hauing thus gotten the proportionall quantitie belonging to a beaſt-gate, and truely vnderſtanding the value of a beaſt-gate, you ſhall be able at pleaſure, and moſt certainely, to expreſſe by the acre the true yearely value thereof.

And thus haue you perfected your entries, for the true and certaine quantities, according to measure; and now resteth the valuation.

The best, speediest, and most certaine meanes for your valuation, in mine opinion, is thus: Let it first be considered, that all grounds generally consist in qualitie of these three kinds, Meadow, Arable, and Pasture; and supposing euery of these kinds likewise to consist of three sorts in value and goodnesse; as the first and best sort; the second and meane; and the third and worst sort: In your instrumentall mensuration, when you write in your field-booke the title of euery field or close, consider with your selfe, which of those three sorts the same field or close consisteth of; if of the best sort, expresse in some place of your title the figure 1. if of the second sort, the figure 2. and if of the third and worst sort, the figure 3. and hauing informed your selfe by the best meanes you can (which I hold not fitting here to relate) of the generall value, what the best sort of Meadow, Arable, and Pasture, is worth by the acre, and the like of the other sorts, throughout the whole Mannor; then, according to those rates, passe ouer your whole booke of entries, and value euery particular parcell by it selfe; which, by finding in each title of your field-booke of what sort they are, is most speedily and exactly performed. And thus are your entries thus farre perfected.

But yet, before we proceed to the ingrossing hereof, or rather before wee finish with the tenants concerning their entries, it is to be enquired and considered, what other profits and commodities, besides these lands and tenements, are demised and granted by the Lord to any tenant within the Mannor for yearely rent, or otherwise; which likewise are to be entred and expressed in your rough booke, with the rents and yearely values thereof: as Mynes of Tynne, Lead, Copper, Coale, &c. Quarries of Stone, Fishing, Fowling, Hawking, and Hunting, Iuistments, Herbage, and Pannage, free Warrens, Customarie workes, or Seruices, profits of Fayres and Markets, and mosses of Peat or Turfe; all or any of which, and the like, may be within a Mannor, and disposed and letten for yearely rents, which by no meanes are to be omitted. All which premisses, and the seuerall quantities, rents, and values thereof, are here to be summed vp, and their seuerall totals expressed.

Then are you to expresse the seuerall reprises issuing out of this Mannor, being such as are mentioned in the sixt Chapter of this Booke. All which being likewise summed vp, the totall thereof is to be deducted from the former value, and the cleare remainder expressed.

Next are you to consider, if any of those profits and commodities, last before named, or the like, are within this Mannor, and not letten by lease, or otherwise, for any certaine yearely rent; and if any such be, then are they to be here mentioned and expressed as casualties, and the yearely value thereof estimated, what they may or are likely to proue worth by the yeare.

Also, the names and quantities of the common Fields, common Meadowes, stinted Pastures, and all other vnstinted Commons, are here to be expressed; and of those vnstinted Commons, how they are accustomed, held, and occupied; whether peculiar to the Lord and tenants of this Mannor; or whether any other Lord or Lords, and their tenants, haue rake, escape, eatage,

eatage, or other interest therein; and the butts, bounds, and limits thereof seuerally.

Also, what woods and vnderwoods are within the Mannor, and their seuerall values.

Then would there be entred an abstract, in nature of a Custome-roll, shewing briefely all the ancient customes of and belonging to the Mannor. And also a Suit-roll of all the free suitors, &c.

And lastly, a true and perfect description of all the out-bounds and limits of the whole Mannor.

And hauing thus perfected your rough Booke, you may now call your Iurie, and receiue their verdict, as in the next.

CHAP. XII.

The manner and order of receiuing the Iuries verdict, and the courses therein to be obserued.

WHen you are drawing towards a conclusion of perfecting your Booke, according to the directions of the last Chapter; it were not amisse, that you hasten the Iurie, in perfecting their verdict, lest you be forced to spend time idly in attendance for the same: Which when they haue effected, considering, that for the most part they are vnacquainted with matter of forme, though in effect and substance they may answer your desire and expectation, according to the articles deliuered vnto them; you are to call them before you, and reading, examining, and comparing the articles, with their seuerall and particular answeres thereunto, reduce the same into an orderly forme of an Inquisition, obseruing still the substance of what they haue found and presented: and then hauing read the same vnto them, with their approbation and allowance thereof, cause your Clarke to ingrosse the same accordingly in parchment, and then let them againe consider thereof; and hauing set their hands and seales thereunto, demaund of them, if they are mutually agreed on this their verdict; which when they haue acknowledged, receiue the same from the Fore-man, and dismisse your Court.

And here haue you finished what here need to be performed: and now may you leaue the Mannor of BRANTON; *and repairing homewards, may there perfect your plot, as you are formerly directed by the third Booke; and ingrosse your Survey, as is hereafter declared in the next.*

CHAP.

CHAP. XIII.

The forme and order of ingroſsing a Surney.

TO preſcribe and direct one certaine and ſetled forme and courſe herein for all in generall, were impoſſible, in reſpect of the varietie of occaſions offered, according to the nature of the buſineſſe, and the diſpoſition of thoſe for whome the ſame is performed: wherefore, the performance hereof muſt mainely depend vpon the iudgement, skill, and diſcretion of the Surueyor. For mine owne part, I neuer yet for any two Lordſhips or Mannors limitted my ſelfe to one and the ſame forme; but euer framed my courſe as the cauſe required: as in one Mannor, where I find a commixture of other lands and tenements within the ſame, being holden of other Lords; here of neceſſitie muſt I abutt and bound euery ſeuerall particular thereof: but in another, which I find entire, I hold it needleſſe. Againe, I find in one Mannor diuers and ſeuerall Towne-ſhips and parts, and thoſe to conſiſt of ſeuerall eſtates and tenures; in ſuch caſe, theſe are to be ſeuerally diſtinguiſhed and diuided, according to their ſeuerall parts. Another ſhall you find ſole and entire, which is to be ordered accordingly: and many other ſuch like differences ſhal you find, which will miniſter occaſion to alter any ſetled forme.

Beſides, the will and diſpoſition of him by whom you are imployed, ſhall often cauſe you to alter your courſe: one perhaps approuing of the forme you vſe; another will haue it in the nature of your ancient Terrars; a third, in order of a Particular, or Conſtat; and a fourth, it may be, in a fourth forme; for *Quot homines, tot ſententiæ*. And againe, one, for his owne vnderſtanding, will haue it in Engliſh; and another, of better vnderſtanding, will require it in Latine. And certainely it were very requiſite, although your rough booke be drawne in Engliſh, that alwaies your ingroſſed booke be written in Latine; vnleſſe the contrarie be ſpecially required. Yet in theſe mine examples and directions following, I hold it moſt fitting to deliuer the ſame in Engliſh, for the better vnderſtanding of thoſe who haue moſt need; conſidering, that a reaſonable Surueyor may be lame of that legge.

But notwithſtanding ſuch varieties often happen; yet will we for a generalitie propoſe theſe rules and directions following; which I hold moſt meet and fitting to be obſerued and held in a formall and well ordered Surney.

To which purpoſe, let vs now ſuppoſe wee are to ingroſſe a Surney of the Mannor of BRANTON; according to the rough booke thereof, ſpecified in the tenth Chapter of this Booke; wherein firſt begin with the title, which let be thus, or to the like effect.

An

An exact and perfect Surney and view of the Mannor of BRANTON, in the Countie of D. being parcell of the poſſeſſions of A. B. who holdeth the ſame of our Soueraigne Lord the King, as of his Mannor of G. in free and common Socage, and by the yearely rent of xiij.ˢ. iiij.ᵈ. Had, made, and taken there, as well by Inquiſition, and the oathes of a ſufficient Iurie in that behalfe, as by the view and particular menſuration of all and euery the Meſſuages, Lands, and Tenements, of, within, and belonging to the ſame. *Anno Domini* 1616. *Annoque Regni Regis* IACOBI, *Angliæ, &c.* 14.

By *A. R.* Superuiſ.

NExt after this, or the like Title, in the following leaſe, are you to write and expreſſe an Index or Alphabeticall Table of all the Tenants names (as hath beene formerly taught) with numbers of reference againſt each name, in what leaſe or leaues of the Booke each Tenants particular is to be found: But notwithſtanding, this Index is to be placed in your Booke firſt and next after the Title; yet is it moſt conuenient and fitting, to collect and write the ſame (and alſo the Rentall next hereafter following) after the whole Booke be ingroſſed; before which time, you ſhall not know how to place your numbers of reference therein, according to the number of the leaues.

Then after this let next be placed a generall rentall of the whole Mannor, but to be diuided into ſuch townеſhips and parts, as your Booke is diuided into; wherein firſt expreſſe your rents of ſuch demeſnes, as are letten in leaſe, then the rents and ſeruices of your free-holds of inheritance. Thirdly, of your cuſtomarie or copy-hold tenants. Fourthly, of the tenants for life or liues. Fiftly, of thoſe for terme of yeeres: and ſixtly and laſtly, your tenants at will, wherein let euery of theſe beare their ſeuerall titles, and vnder the foot of each kinde, let the totall thereof be collected and expreſſed, and in the end or foot of the whole rentall, expreſſe firſt the totall of euery kinde, and after that the generall and totall ſumme of all together. And if any rents or other repriſes be iſſuing out of this Mannor, you may here expreſſe them particularly vnder the title of repriſes, which let be deducted out of the former totall, and expreſſe the cleere remainder.

And thus is your Rentall finiſhed; but to be collected and written (as I formerly noted) after the bodie and ſubſtance of the Booke be ingroſſed.

And

And your rentall being thus finiſhed, you may next place (if you pleaſe) the out-bounder of the whole Mannor; and if any of the townſhips or parts thereof lye diſperſed and remote (as in many places you ſhall finde them perhaps twentie miles diſtant, from the chiefe and principall part of the Mannor; and ſometimes in another Countie) it were very fitting and neceſſarie, to expreſſe ſeuerally the ſeuerall out-bounders of thoſe townſhips and parts. And it is to be noted, that in the expreſſing of theſe bounders, a maine and principall care is to be had, that you vſe, obſerue, and keepe the olde and ancient names of ſuch meeres, markes, and bounds, as haue beene anciently vſed and accuſtomed; for that innouation in this kinde is very dangerous for many cauſes; yet if you finde the ancient meeres, markes, and bounds, to be very few and ſlender; or any of them decayed and worne out of knowledge, you may adde as many moe as in diſcretion you ſhal finde cauſe; but by any meanes omit not, or leaue out any of thoſe which are ancient and noted bounds. If you thinke good, theſe bounders may be placed after, or in the ende of the booke; which being no matter of neceſſitie whether (ſo it bee had at all) I leaue to your diſcretion.

And now are you to begin with the body and ſubſtance of the booke; and firſt of all with the Mannor or manſion houſe, and the ſcite thereof; wherein you are to conſider, whether the ſame be in the Lords owne hands and occupation; or whether letten by Leaſe, or otherwiſe vnto any Tenant or Tenants, and to enter the ſame accordingly, as followeth vnder this Title.

BRANTON DEMESNES.

A. B. Eſquire is Lord of this Manner, and hath at this preſent in his owne hands and occupation, the Mannor or manſion houſe with the ſcite thereof; and ſo much of the demeſnes thereunto belonging as are hereafter particularly expreſſed. Which Mannor with all and ſinguler the appurtenances, he holdeth of our Soueraigne Lord the King, as of his Mannor of G. in free and common Socage, and by the yeerely rent of xiij^{s} iiij^{d}

Particulars.

THe Mannor or manſion houſe called Branton Hall, being faire-ly built with free ſtone, and all offices thereunto belonging, with two Stables, one Oxe-houſe, and a Doue-houſe; alſo the ſcite conſiſting of three faire gardens, two orchards, two courts, and three out-yards, lying all together betweene the high ſtreete of Branton ſouth, and the Oxe-paſture hereafter mentioned North; abutting Eaſt, on Long meddow, and Weſt on the ſcite of the Parſonage. And containeth together fiue Acres, two Roodes, and twenty Perches. a. r. p. 5-2-20.

Valet per annum —— xx^{li}.

Then next vnto the houſe and ſcite, expreſſe the Parkes (if any be) with the number of Deere therein; what number of Aunteller, and what of raſcall Deere; alſo what number of beaſts may bee therein luiſted without preiudice to the game; and alſo what pannage; and theſe may you particularly abutt and bound as before if neede require; which is moſt eaſily and ſpeedily done, hauing before you the rough plot of the whole Mannor, and in the concluſion hereof expreſſe the quantitie and yeerely value as before.

Then after theſe Parkes, enter particularly all ſuch ſeuerall fields and cloſes of the demeanes, as the Lord hath in his owne vſe at the time of this Suruey; which you may particularly abutt and bound as before, and expreſſe the ſeuerall quantities, and values thereof: But herein for orders ſake it were fitting firſt to enter all the meddow grounds particularly each after other, then the incloſed arable grounds, and next the paſtures; and if any of the demeſnes are lying in the common fields, then to expreſſe them particularly with their quantities and values; alſo you are to expreſſe what woods the Lord hath; and what right or cuſtome the Tenants haue or claime therein, either for depaſturing or otherwiſe: and laſtly, what waſtes the Lord hath within the Mannor. And at the foote of this particular, expreſſe the totall quantitie and value thereof.

But it is to be noted, that all theſe particulars are to be collected (by help of the numbers in your Index) out of your field-booke for the names, and out of the rough plot for the ſeuerall quantities, for that it is needleſſe to enter theſe lands which are in the Lords hands into your rough booke of entries; and the like courſe alſo is to be holden for your Glebe lands.

And if any of the Demeſne Lands are in Leaſe, let them alſo bee entered vnder the former Title, in this manner.

C. D. holdeth by Indenture of Leaſe, bearing date the twentith day of Ianuary An. R. Regis Iacobi &c. ſecundo, made & granted by and from A. B. vnto the ſaid C. D. All thoſe lands, &c. (vſing the very words of graunt) *for the terme of one and twentie yeeres, commencing from and after the Feaſt of the Birth of our Lord God laſt paſt, before the date of the ſame Leaſe, for and by the paiment of the yeerely rent of* —— xxx^{li}.

Particular.

THen here enter the ſeuerall and particular Cloſes, which you may abutt and bound, as before, expreſſing the particular quantitie and value of euery ſeuerall Cloſe, and at the foot of the particular expreſſe the totall quantitie and value, and if the yeerely value exceede the rent reſerued, deduct the rent from the totall value, and expreſſe the cleere remainder, thus.

Valet ad demittend. —— x^{li}.

And

And vnder this particular expreſſe a briefe memorandum of the ſeuerall couenants, clauſes, conditions, and prouiſoes in the leaſe contayned, after this manner.

The Tenant is to pay his rent quarterly, or within one and twentie dayes after euery Feaſt, on payne of forfeiture, by prouiſo to that purpoſe. He is to doe all manner of reparations (except great timber) not to let or ſet without licence of the Lord. The Lord maketh ſpeciall warranties againſt his father, himſelfe and his heires, &c.

And the like courſe is to be held for all other Leaſes, after the particulars expreſſed.

And here alſo vnder this title of Demeſnes, are you to enter all ſuch Mills, Mines of Tinne, Leade, Copper, Cole, &c. alſo quarries of Stone, Slate, and the like; alſo Fiſhing, Fowling, Hawking and Hunting; likewiſe Iuiſtments, Herbage, Pannage, free Warrens, cuſtomarie Workes or Seruices, profits of Fayres and Markets, and alſo moſſes of Peate or Turffe, and the like, as are letten and demiſed by the Lord, to any Tenants within the Mannor by leaſe for yeerely rent or otherwiſe: all which (being thus letten) are in the nature of Demeanes, and are to be particularly entred and expreſſed accordingly, with their ſeuerall Rents and the yeerely values thereof.

But all of thoſe laſt mentioned (excepting Mills) are to be ſeuered and diſtinguiſhed from the Demeſne lands, becauſe they are not matters of firme, ſtable, and certaine perpetuitie: For notwithſtanding, that during the termes of the ſeuerall leaſes thereof made and granted, the Tenants may be charged and bound to pay ſeuerall yeerely rents for the ſame, which for the time being are certaine; yet perhaps at the end and expiration of thoſe termes, they may be of little or no value at all; or on the other ſide of farre greater worth and value then now they are, as often happeneth by thoſe mines of Tinne, Leade, Copper, Coles, and the like. Wherefore notwithſtanding they are entered vnder this generall title of Demeſnes; yet for deſtinctions ſake, let them paſſe more particularly vnder this title of *Caſualties made certayne.*

And after all theſe demeſnes are thus entred and ingroſſed, make a briefe concluſion thereof vnder-neath the ſame, in this or the like manner.

Con-

Concluſion of the Demeſnes.

The Demeſnes of this Mannor, conſiſteth of

- Lands, Tenements, & Mills in the vſe of
  - The Lord
    - Quantitie — a. 1320 — r. 0 — p. 0.
    - Value — li. 660 — s. 0 — d. 0.
  - The Tenants
    - No. of Tenants — 5.
    - Quantitie — a. 163 — r. 0 — p. 0.
    - Rent — li. 54 — s. 6 — d. 8.
    - Value — 81 — 10 — 0.
    - Ad demitt. — 27 — 3 — 4.
- Caſualties made certayne.
  - No. of Tenants — 6.
  - Rent — li. 25 — s. 8 — d. 6.
  - Value — 94 — 18 — 0.
  - Ad demitt. — 69 — 9 — 6.

And after the Demeſnes are thus entred and ingroſſed, then next vnto it place the Rectorie or Parſonage, and then the Vicarage (if any be) vnder the proper title thereunto belonging, after this manner.

The Rectorie of BRANTON.

A. B. *Clarke, being Parſon there, holdeth the Rectorie of the gift of the Lord of this Mannor* (if it be ſo, and if otherwiſe, expreſſe it accordingly) *who hath the gift, nomination and preſentation thereof, as in the right of this Mannor, as often as the ſame ſhall happen to be void, which is valued in the Kings bookes* per annum. — Lvi li.

Particular.

THe Parſonage or Manſion-houſe with the out-houſes belonging thereunto, as a Barne, Stable, Oxe-houſe, and a Doue-coate, with the ſcite thereof, conſiſting of two Gardens, an Orchard, and three out-Yards, which lye together betweene the high ſtreet of Branton *South, and a field called the Oxe-paſture North, abutting towards the Eaſt on the ſcite of this Mannor, and Weſt on a Lane there leading out of the high ſtreet into the Oxe-paſture aforeſaid, and containeth together, one Acre and three Roodes.* — a. 1 — r. 3 — p. 0.

Valet per annum — iij li.

And in this sort let euerie particular parcell of glebe-Land bee expressed with the buttes and bounds thereof, which by helpe of the plot and field-Booke lying before you (being directed thereunto by the numbers in your Index) is instantly and exactly performed: For these glebe-Lands; and the Demesnes which are in the Lords hands, are neuer entred in your rough Booke of entries. Wherein is alwaies to be obserued; that you expresse the true quantitie and yeerely value of euerie particular parcell; and in the foot of the particular, the totall quantitie and value as before. Yet is it not vsuall neither of these nor the Freeholds of Inheritance to expresse any value at all; which I will referre to your owne discretion, and the will and disposition of those by whom you are imployed. And in like maner are you to expresse the Vicarage if any such bee.

And hauing thus finished your Parsonage, Vicarage and glebe-Lands, proceede next vnto the Free-holds within this Towne-shippe; which are to bee entered and ingrossed after this order, and vnder this title following.

BRANTON Free-holds.

Socage. { A.B. *holdeth freely to him and his heires for euer by deed indented bearing date* xxviij die Marcij Anno Regni Regis IACOBI Angliæ, &c. Sexto *made and granted by and from* C.D. *All that messuage or tenement* (expressing the verie words of grant) *By the yeerely rents and seruices of* ——— } Fealtie & v.s.

Particular.

THe Mansion house, out-houses and the scite thereof consisting of one Garden, two Orchards and three out yards, lying together betweene the high street of Branton *North, and the common field called the South-field South; abutting East on the Church-yard, and West on a lane leading into the South field. And containeth three roodes and thirtie perches.* } a. r. p. 0-3-30.

And thus proceed with euerie parcell belonging to this free-holder; which being finished, at the foot of this particular expresse the quantitie and value thereof: But as concerning the valuation of Free-holds, vnlesse it be specially required, by reason of some purchase thereof to be made; or a possibilitie of escheat, or the like, you need not trouble your selfe therewith.

And hauing perfected your particular, expresse vnderneath the same, a briefe *Memorandum* of such necessarie obseruations as you shall find fitting, aswell concerning the Tenants euidence, as what Heriots, Reliefes and other Duties and Seruices the Tenant ought to yeld, doe and performe vnto the Lord on euery death or alienation.

And

And in like manner vnder the same Title enter all other the free-holders within this townesship; after which, collect and expresse together their seuerall quantities in one totall summe, and likewise their values (if it bee required as before:) But in these and all others, as I haue formerly noted, I would alwaies haue an orderly course holden in placing the particular lands of one and the same nature and qualitie together, as first (after the house and scite) all the meddow grounds, &c.

And thus hauing entered and ingrossed your free-holds of this townesship, let next be entered your copyholds or customarie Tenants, after this manner, and vnder this Title.

BRANTON Copy-holds.

A.B. *holdeth by copie of Court roll, bearing date* 26 Februarij Anno Regni Regis Iacobi Angliæ &c. 4^to. *of the surrender of* C.D. *All that messuage or tenement &c.* (vsing the very words of the Copie) *to him and his heyres at the will of the Lord, according to the custome of the Manor. For which he paid Fine on his admittance* vli. *And payeth rent for the same* per annum, ——— } xls.

Particular.

LEt your particulars here be entred in all respects as before with the seuerall buts and bounds thereof, expressing the quantitie and value of euery seuerall parcell: and in the foote of the whole particular expresse the totals as before; then out of the totall value (which admit to bee xli.) deduct the Rent, and expresse the remainder thus.

Valet in toto per annum xli.

Viz. ad dimittend viij li.

Then vnder this particular thus perfected, make (as before) a briefe Memorandum of such necessarie obseruations as are fitting, as what herio^t (if any be due on the death of the Tenant) what fines on death or alienation; and what other seruices the Tenant oweth, &c. And after this order and vnder this title enter all the rest of the copy-holds within this townesship.

And the like course in all respects is to bee holden in entrie of the Tenants for life, or liues; for terme of yeeres; and those at the Will of the Lord; whereof to make seuerall demonstrations, and to deliuer seuerall examples, were but great labour to smal purpose, seeing they tend all to one and the same end.

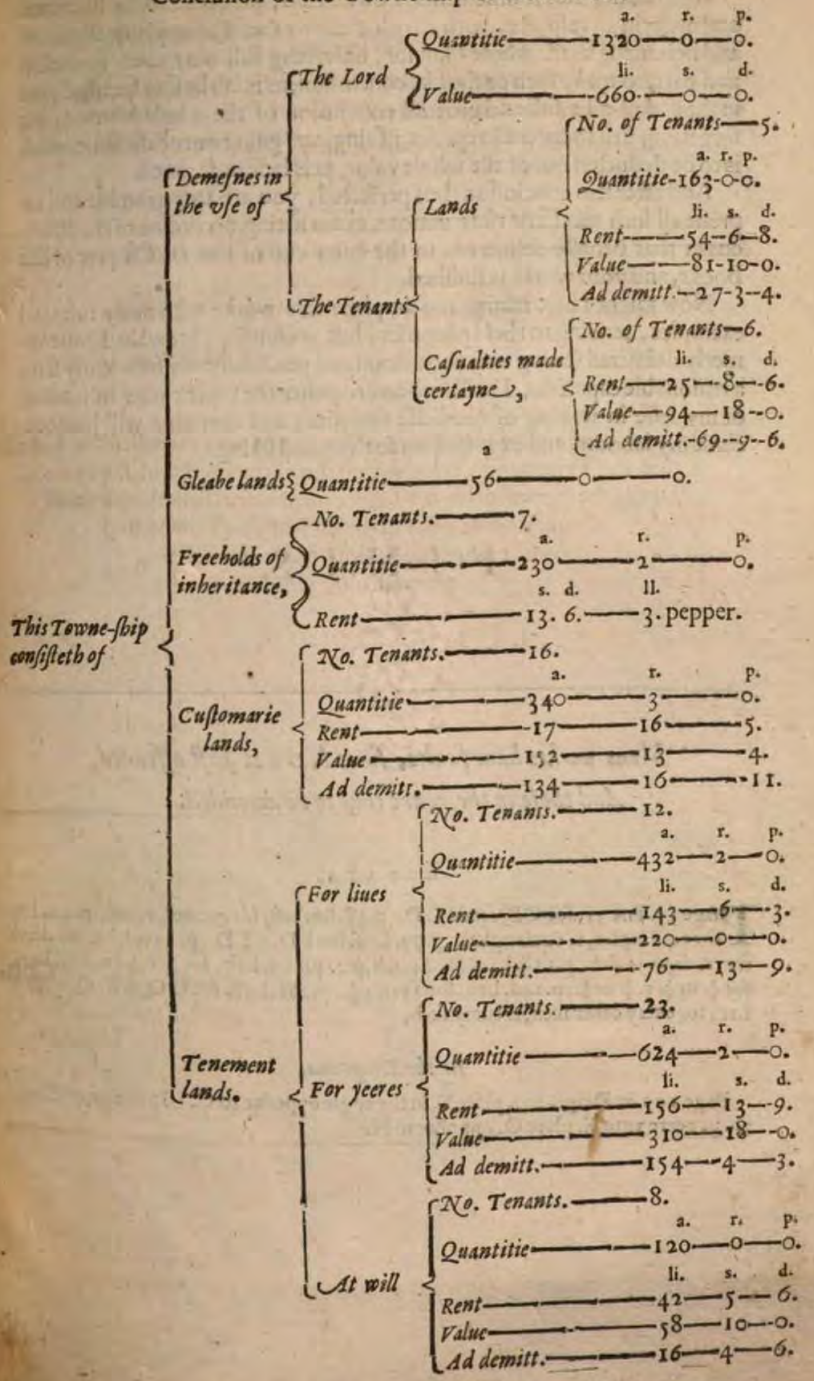
Wherefore take this for a briefe and generall rule, that all lands whatsoeuer, and the tenancy thereof, consist of one of these seuen kindes, which in euery Mannor where they are, are to be vsed as your seuerall titles, and ought to be placed in the ingrossing of your Booke, each after other, as here they are expressed, viz.

1. Demesnes.
2. Gleabe-lands.
3. Free-holds.
4. Customarie.
5. For liues.
6. For yeeres.
7. At will.

And hauing after this forme and order entred and ingrossed the seuerall Lands and Tenements, lying within this Towne-ship of BRANTON, vnder the seuerall titles last before mentioned, collect your totall of euery kinde, and in the end of this Towne-ship make your conclusion to this or the like purpose following.

Con-

Conclusion of the Towne-ship of BRANTON.



And hauing thus finiſhed this Towne-ſhip, proceede in the like forme and order in all reſpects, with all other the townеſhips and ſeuerall parts of and belonging to the whole Mannor, obſeruing ſtill after euery townеſhip and part, to make ſuch or the like concluſion, as is laſt before ſpecified; and in the end of all a full and generall concluſion of the whole Mannor; not forgetting firſt to enter all repriſes, iſſuing, and going out of the ſame, which is to be deducted out of the whole value, as is before declared.

And after this concluſion thus perfected, you are to remember and expreſſe all ſuch neceſſarie obſeruations, as are fitting, according to the directions in that behalfe deliuered, in the latter end of the 11. Chapter of this Booke, and your worke is finiſhed.

Now might I here inlarge and amplifie this worke with many rules and examples, tending to theſe purpoſes, but preſuming that what I haue formerly deliuered (being well vnderſtood and practiſed) may ſufficiently ſerue a reaſonable capacitie; I will forbeare to peſter the practicioner in reading, or my ſelfe in writing of needleſſe varieties; and therefore will here conclude my labours, and expoſe them to thy good liking.

FINIS.

Mens workes haue faults, ſince Adam *firſt offended,*
And thoſe in theſe, are thus to be amended.

Errata.

Page 35 line 31. for CB. reade CD. p.38. lin. laſt, for cut out, r. cut. p.42. l.9. for equiangles, r. equiangled. p.77. l.19. for FD. r. ED p. 110. l. 39. for draw the, r. draw to the. p.118. l.11. for 24. r. 240. p.127. l.17. for $\frac{3}{4}$ r. $\frac{1}{4}$. p.133. l.10. for $\frac{1}{8}$. or $\frac{1}{4}$. r. $\frac{1}{4}$. or $\frac{1}{4}$. p.146. l.13. for 15. r. $9\frac{1}{2}$. p.162. l.38. for O Q r. X. Q. p.204 l.16. for euery other ſuch, r. euery ſuch.

In the Diagrams.

Page 109. in Diagr. 109. place K. in the angle oppoſite to C. In Diagr. of Chap. 29. 3. neere vnto K. place O. oppoſite to N.