BEDWELL. MESOLABIUM. ARCHITECTONICUM. 1631.

MESOLABIVM ARCHITECTONICVM

THAT IS,

A most rare, and singular Instrument, for the easie, speedy, and most certaine measuring of Plaines and Solids by the foote:

Necessary to be knowne of all men whatsoeuer, who would not in this case be notably defrauded:

Inuented long since by *Mr. Thomas Bedwell* Esquire:

And now published, and the Vse thereof declared by *Wilhelm Bedwell*, his nephew, *Vicar of Tottenham.*

LONDON,
Printed by *I. N.* for *VVilliam Garet*
1631.

TO THE ILLVSTRIOVS,

Right-honourable, Right-worſhipfull, and dearely beloued, the Nobility, Gentry, and Commons of *Great Britaine*, and *Ireland*.

GOd, *ſayth the wiſe man, hath ordered all things by meaſure, number, and weight. And man, the image of God, ought, as the Philoſophers teach, to order all his life according to the ſame directions. And yet who knoweth not, how little they are of all men regarded! To paſſe by the generall, and to come to that which concerneth our commerce, What ſmatterer in the Mathematicks is hee, who knoweth not, what neglect or ignorance there is, euen in thoſe artiſts, whom all men, the Rich aſwell as the Poore, do, and muſt daily truſt, in matters of meaſuring! I accuſe no man of wilfull fraude or malice. But this I ſay, There is no man whatſoeuer, that is not ſome peece of a ſcholler, that can meaſure tymber truely: And thoſe who are moſt skil-*

all in both, cannot do it either speedily, or readily. All which, Illustrious, Right honourable, Right-worshipfull, and Dearely beloued, I promise in this short treatise, by the ordinary Instrument, in this case vsed, to teach the meanest of vnderstanding, though wholy vnlearned, to do, with that speede, facillity, and certainety, that may not be bettered. This as a prodromus, begun and ended, in the middest of many and great troubles, I thought good to premise and send out, before a larger discourse of the Fabricke, and more ample Vse thereof, which, God willing, shall follow, so soone as Figures and Diagrammes may conueniently be cut, for that purpose, with all possible speed: In the meane time the Author, wholy deuoted to his Countries seruice, resteth

Your H.H.H. in all obseruancy,

Wilhelm Bedwell.

MESOLABIVM ARCHI-TECTONICVM.

CHAP. 1.

Of the Mesolabe : And of the vse of it in generall.

1 To measure by this Rule, is by two knowne lines, to finde out the third vnknowne.

THe Instrument whose vse at this time wee intend to declare, is no other, in respect of matter and forme, in generall, but the Carpentars rule, by them vsed in the measuring of Tymber, and Bourd by the Foot square: For it is a flat Ruler, or oblong parallelogram, of two foote, or a foot & halfe long: Two inches and an halfe, or there abouts, broad: And of such convenient thickneſſe as shall at euery mans discresion be thought most fit.

Againe, as theirs, so this on the one side, contayneth a Scale of equall diuisions, First of Ynches, Halfe-ynches, Quarters, Halfe quarters, and so forth: Then againe, on the same side, you haue an Ynche diuided into Seauen, Eleuen, Thirteene, Seauenteene, Nineteene, and Three and twenty, and such other equall parts, as euery man for his owne vse shall think most fitte, and the workmans hand shall be able to performe.

Moreouer, on the other side, as on theirs also, you haue a Scale of vnequall diuisions, seruing for the measuring of Bourd and Tymber: But after a farre different manner: For their diuisions are only markes or small strokes, in one of the limbs of that side, determinyng from the Fore-end of the Rular in ynches, and partes of ynches, the Square measure of solids or Tymber. Wheras this of ours consisteth of two sortes of straight lines, the one Beuelling or Slanting, drawne askue from side to side: The other Parallell that is equidistant one from another running along the Rular, from the one end toward the other: And therefore cutting those former, and diuiding them into vnequall portions, whereby not onely their sayd Quadrate or square measure is performed: But also all other whatsoeuer, and that with great facillity, speede, and certainety.

Lastly here, as also there, you must make a distinction betweene end, and end; For that end we call the For-end of the Rular, from whence the diuisions of it into ynches, on both sides are begun to be reckoned: And that the Backer-end where they doe end and determine: Or, contrarywise, the For-end is that from whence the numbers ascribed to the Beuelling linnes are lesse and lesse. But the distances betweene them are greater and greater.

Thus much of the Ruler, and the Partes therof. *Mensura, innuit Aristoteles, in quolibet mensurabili genere, est quippiam minimum*: A measure, as Aristotle seemeth to intimate, is some small portion in euery thing that is to be measured: And it is commonly termed of the Geometricians *Famosa mensura*: Aknowne, or set measure generally agreed vpon amongst all men: As in measuring by hand-breadths, feete, and passes, one hand breadth, on foot, one passe. And in deed it is an old saying of *Protagoras*, as Aristotle recordeth, *That man is the measure of all things*. And true it is, That Vitruuius, and Hero the mechanicke or inginer, do shew, That generally all measures are taken from the partes of Mans body, as a Finger, an Ynch (*Pollex*) an Hand, or Hands breadth

breadth, a Spanne, a Foot, a Cubite, a Passe, an Elne, a Fathome.

But who knoweth not, What great difference there is between man & man? And not only between men of diuerse Countreys and climats: But eu'n between those of one and the same prouince; Nay of one and the same family, children of the same parents? And, the limmes of men being proportionall to their bodys, what difference must there needs bee, betweene the measures taken from them? And in deed heerupon it came to passe, That the Measures, not only of diuerse Nations: But eu'n of one and the same, are, and alwayes haue beene much different, as doth manifestly appeare by the diligent comparisons made of them by diuerse and sundry learned men, and especially by that hopefull Willebrordus Snellius, as wee shall, Godwilling, shortly teach in Ramus's Geometry, which wee purpose to set out in English, for the benefite of such of our Countrey men, as delight in these study's, yet are ignorant of those languages where in they are written.

This difference was in this our kingdome complained of in all ages: For from hence arose many greeuous quarrells and suites in the Law, which our worthy Kings, and state in their Parlaments, in all ages haue laboured to appease, by reducing all to an vniformity: For thus wee finde in our Statutes: *It is ordeined, That 3 grains of* Barley, *dry and round, do make* an Ynche: *Twelue ynches do make* a Foot: *Three foote do make* a Yard: *Fiue yards and halfe do make* a Perch: *And* 40 *perches in length, and* 4 *in Breadth do make* an Aker. 33 of Edward the first, *De Terris mensurandis* Item, *De Compositione vlnarum et Perticarum*. Againe in a Parlament held in the 25 th of Queene Elizabeth, you haue an Act, thus intituled: An Act for the restrainte of New-buildings &c. in & nere the citys of London & Westminster *Be it enacted by the authority afor'said, That* a Mile *shall be taken & reckoned in this manner, & no otherwise: That is to say,* a Mile *to containe* 8 *Furlongs. And euery* Furlong *to containe* 40 *lugges or poales: And euery* Lugge *or Poale, to containe* 16 *foot and an halfe.*

Although this same our Rule may bee fitted for sundry other sortes of measures: Yet we haue here nothing to do, But with the Foote, and his partes, which are Ynches, Halfe-ynches, Quarters, Half-quarters, and such other sensible partes of the same.

2 Things to bee measured by this Rule, are magnitudes.

3 A magnitude is a continuall quantity.

A magnitude, or a bignesse is that which hath one, or more dimensions: Now dimensions are in number three, to weet Length, Breadth, and Thicknesse.

4 A magnitude is of one dimension, or many.

5 The measure is of the same nature with the thing to be measured.

6 A magnitude of one dimension is called a Line.

A line, is a magnitude of length onely. Or, A line is a magnitude onely long. Such are wayes, or distances betweene place and place. Such a magnitude, sayth Proclus out of Apollonius, is conceiued in the measuring of iourneys. And by the difference of a lightsome place, from a darksome. Such are Lenghts, Heighths, Depths, and Breadths. Therfore here

7 The measure vsed is a line.

Here therefore there is no further skill required in the measurer then a due application of the measure giuen: And therefore here in this case there is not any vse of this our Instrument.

CHAP. II.

Of the measuring of Plaines by the foot square.

1 A magnitude of many dimensions, is of two or three: That is called a Surface: This a Solid.

2 If a dimension giuen, be eyther greater, or lesser, then any of the numbers vpon the Rular, you must take some lesser, or greater, which

which is proportionall vnto it.

3 A ſurface is a magnitude long and broad.

That is, a ſurface is a magnitude which hath two dimenſions, to weet Length and Breadth. Such magnitudes, ſayth Apollonius, are the ſhadowes vpon the ground, which ouerſpread the fields farre and wide, but do not enter into, or pierce the earth: Neither haue they any thicknes at all. The Greek woord *Epiphania*, is here more ſignificant. For this worde intimateth no more but, The outward appearance of any thing. For of a magnitude nothing is to be ſeene but the ſurface. Such are bourds eſteemed to be by the Carpentars: Wainſcotte, by the Joyners: Glaſſe, by the Glaſiers: Cloth, both linnen & Woollen, by the Drapers: Land, Medowe, & Wood, by the Surueighers: For in the meaſuring of theſe, there is only Breadth & Length conſidered, with out any reſpect at all had to the Thickneſſe. Therfore

2 Here the meaſure is a Surface.

Surfaces, according to their diuerſe natures, are meaſured with diuerſe and ſundry kindes of meaſures: Wood, Land, & Medowe, are meaſured by the Rod or Perch: Cloth, Painting, Pauing, & Wainſcotte, by the Yard: Bourd and Stone, by the Foote. Although this our Inſtrument may be fitted to all theſe, or any other like meaſure, Yet wee at this time intend to meddle with no other but the laſt, to weet With the Footeſquare.

4 A ſurface is either Plaine or Vneu'n.

5 A Plaine ſurface is a ſurface, which lyeth equally between his bounds.

A ſurface, the learned knowe is geometrically made of Lines: Therfore as lines are either ſtraight or Crooked: So from hence are all ſurfaces Straight or Crooked: Or, to ſpeak more properly, Eu'n or vneu'n, Plaine or Rugged: Yea & by a ſtraight line are ſurfaces tried, whether they be Eu'n, or vneu'n. For if a right line applyed to a ſurface euery way, do touch it in all places, it is Eu'n: Otherwiſe, it is vneu'n.

9 Plaines, as wee sayd, are measured by the Foote square, That is the quadrate of 12 ynches.

A foote of plaine or flatte measure is the quadrate of 12 ynches, or that which is equall vnto it. That is, it containeth 144 square Ynches: For 12 times 12, are 144. Hauing therefore a plaine giuen of 12 ynches broad, there is no question but 12 ynches of that breadth shall make a Foote. But if the breadth giuen be greater or lesse then 12, there is a question, What length, with the breadth giuen, shall make a plaine equall to the square 144. Here

7 Of the two lines giuen, the one is the breadth assigned, the other is alwayes the beuelling line 12.

Here againe it must bee remembred, *That onely those plaines are to be measured which are Rightangled parallelogramms*, Or to speake in their owne Language, which are comprehended of a, Base, and Heigh which are rationall betweene themselues: Ramus 9 e 1111. Those plains therfore which are not such, must bee reduced vnto these kinde of figures.

1 An example or two shall make all plaine. A bourd of 16 ynches broad, and 18 ynches long, (And so a stocke of 13 bourds) is to be measured. Here I finde 16, the line answering to the Bredth, to crosse the beueller 12, at 9 ynches from the fore-end of the Rular. Therefore I say euery 9 ynches of that length shall make a Foot of bourd: Or which is all one, shall be equall to 144, the square of 12 ynches. Now 9 ynches I finde to bee contained in 18 foote, the Length, 24 times: Therefore I say, The bourd assigned doth containe 24 foote of bourd. Lastly, there being in the stocke 13 such bourds, I say the whole stocke doth contayne 312 foot of bourd.

11 A Table of 36 ynches broad, and 28 foote long, is to be measured. Here 36 is greater then any of the parallels found vpon the Rular: Therefore by the 2 e of this, I take

take 18 the halfe of it, which I finde to meete with 12, the bending line, at 8 ynches from the for'end of the Rular: Therefore enery 8 ynches of length, of the bredth 18, shall contayne a foote of bourd: But the breadth giuen is 36 ynches: That is twice 18: Therefore euery 8 ynches in length, of that Table shall be 2 foote of bourd. Now againe I finde 8 ynches, in 28 foote 42 times: Therefore the Table containeth twice so many foot: That is 84 foote of bourd.

III A pane of Glasse, 7 ynches broad, is to bee measured. Here 7 is lesser then any of the parallels: Therefore by the 2 e of this, I take 14, the double thereof: Which I obserue to meete with 12, at 10 ynches and 2 seauenth parts of an ynch from the fore-end: Therefore euery 10 ynches and 2 seauenth partes of an ynch, of 14 ynches breadth, shall bee a foote of Glasse: But the breadth giuen is but 7 ynches: Therefore euery 10 ynches, and 2 seauenth partes of an ynch shall be but halfe a foote of glasse.

Of the measuring of Triangles, and all other Rightlined plaines.

8 A triangle is nothing else but the halfe of a quadrangle, or parallelogramme: And if it haue one right angle, it is the halfe of a rightangled parallelgramme. *Therefore*

9 It is to bee measured as the Rightangled-parallelogramme, onely conceiue that the number found, shall bee the double of that which is sought.

Here therefore it must bee conceiued, That of the two sides encluding the Rightangle, the one is to be vnderstood to be the Breadth, the other the Length.

I Suppose a Rightangled-triangle, whose sides including the Right-angle, are 18, and 24, are to bee measured. Here I take 18 for the Heighth, or Breadth of the parallelogramme

gramme. which also I finde to meete with the beuelling line 12, precisly at 6 ynches from the fore end of the Ruler: Againe 6, the sayd line found, I finde iust 4 times in 24 the Lenghth giuen: Therfore I auerre the Triangle giuen to conteine the halfe of 4 foote, that is 2 foote of bourd.

20 If the triangle giuen bee not right-angled, then is it by a perpendicular, let fall within the triangle, from one of the corners vnto the base, to bee reduced vnto two rightangled triangles.

How this is to be done, *Euclide* teacheth at the 11 & 12 propositions of his I, booke; And P. Ramus, at the 9 & 10 elements of his V. booke of Geometry. It is also to bee done by the squire. Or by a triangled leuell, and otherwise.

11 An Obtusangled triangle, whose three sides are 26 40, and 42, is to bee measured. Heere by one of those aboue named wayes, I finde the perpendicular or plumbline, falling from the greater corner, vnto the opposite line, to be 24. And 24 I finde vpon the Ruler to meete with the line of 12, at 6 ynches from the fore-end of the same: Againe 6 I find in 42 seauen times: Therefore the Triangle giuen doth conteine halfe so many foote, That is 3 foote and an halfe of bourd.

11 From hence it is manifest how any Rhombus, Rhomboides, Trapezium, or irregular rightlined multangles are to bee measured.

To weet, that they are to be measured by parts, or by the particular triangles, which euery such figure doth contayne. Examples you may haue in the xiiii booke of Ramus's Geometry, or in any others, which haue written of Geometry.

Of the measuring of any ordinate multangle figured.

12 Ordinate multangled plaines are measured by

by their halfe Perimeter, and the plumbline from the center, vnto the middeſt of any one ſide.

Theſe ſortes of plaines may bee meaſured, as the former were, by diuiding them into their ſeuerall Triangles. But this laſt is farre ſhorter: And therefore to bee embraced & rather to be vſed in practiſe. Here the halfe of the perimeter, or bout-line, anſwereth to the Length in a parallelogramme: And the plumbline here, is in ſtead of the Height or Breadth there.

I An ordinate Pentangle, whoſe ſides are 24 ynches a piece; And the Plumbline from the center, to the middeſt of any one of the ſides 16, is to be meaſured. Here 16 the Plumbline or Height, doth, vpon the Rular, meet with the ſlanting line 12, at 9 ynches from the oft named end: And 9 is contayned in 60, the halfe of the perimeter, 6 times and two thirds: Therefore the Pentangle giuen conteineth 6 foot, and two third partes of a foot of Bourd.

II A Sexangled ordinate figure, whoſe ſides are 12 ynches broad a piece, is to bee meaſured. Here the Plumbline from the center to the middeſt of any one ſide, is 10 ynches, and 8 one and twentyths of an ynch: The double of 10 (that is 20.) and 6 one & twenty parts of one ynche, I obſerue to meete with the beueller 12, about 7 ynches, & one quarter of an ynch, from the fore end of the Rular. Which 7 and a quarter, is contained in 44 ſix time, and two twenty ninth partes. Therfore I ſay the Sexangled figure giuen doth containe 6 foote of bourd, and ſome ſmall quantity more. The Circle, or Circular forme is in like manner meaſured: For

13 The Circle is meaſured by the Ray, and the halfe of the perimeter.

For, ſayth the Geometrician; *Planum è radio & peripheria dimidia eſt area circuli.* The plaine of the ray, and halfe of the circumference is the content of the circle. A Round table, whoſe diameter is 4 foote, and 8 ynches, (or 56 ynches) is to

be measured. The halfe of 59 is 28: And the halfe of the circumference is 88. Now 28 being geater then any of the paralells, I take 14 the half therof: Which I find to meet with the beuelling line 12, at 10 ynches, and a quarter, from the for'end of the Rular: Therfore I say euery 10 ynches, and a quarter of an ynche of that Table shall be 2 foot of bourd. And because 88 doth containe 10 and 1 quarter, 8 times, and 20 fourty ones; Therefore I say, the whole doth containe 16 foot of of bourd, and 144 ynches.

CHAP. III.

Of the measuring of Bodies or Solids by the Foot.

1 A Body is a magnitude of three dimensions. A Body or Solid is a magnitude which hath Length, Breadth, and Thicknes.

2 Here the measure is also a body, to weet the Cube of 12 that is 1728.

This is our opinion: Yet if any shall thinke it a paradox, or shall gaine say it, or mainetaine the contrary, wee will not contend.

And

3 Of the three dimensions, two are giuen, the third is sought.

4 Bodies are of diverse sorts: But we will at this time meddle only with such as are comprehended of parallelogrammes, or with Cylinders.

True it is, that this our instrument may bee fitted, and applyed to the measuring of many other sorts of Solid bodies: But because we see no great vse of it in the measuring of any other, then of these two sorts: Therefore wee will declare the vse of it, in the measuring of these two onely. Of these the first is the Parallelepipedum, which is a plaine Solid, whose opposite sides are parallelogramme.

I A rightangled parallelepipedum (or a squared tymber logge) of 12 Ynches thicke, 18 broad, and 16 foote long, is to be measured. Here the Thickneſſe and Breadth are giuen: The Length is sought. These I finde vpon the Rular to meet at 8 ynches from the oft named fore-end: Therfore I Say, Euery 8 ynches of that Logge in length shall make a solid foote of tymber. And becauſe I finde 8 Ynches, in 16 foote, 24 times: Therfore I say in the Tymberſticke giuen, there is 24 foote of solid measure.

II A squared stone of 14 Ynches thicke, fiue foote (or 60 ynches) broad, and 10 foote long, is to be measured. Here 60 is greater then any of the parallels vpon the Rular: Therfore I take 12 the 5th part of it: And I obſerue 12 and 14, to meete at 10 ynches, and 2 seaunth partes of an ynche, from the Fore-end of the Rular. Therfore I say, That euery 10 ynches, and 2 seaunth partes of an ynch in length of that stone shall be 5 foote of solid measure. And becauſe that 10 foote conteineth 10 ynches, and 2 seaunth parts of an ynche, 11 times and 5 seau'nty twoos: Therfore I say the whole stone conteineth 58 foote, and one third parte of a Foote of solid measure.

III A rightangled Priſma, both whoſe sids, Parallelogramm's I meane, conteyning the rightangle, are 18 ynches broad; the whole being in length 16 foot, is to be measured. Here vnderstand that, as before was shewed, as a Triangle was but the halfe of a quadrangle: So a Priſma is nought but the halfe of a Parallelepipedum, sawne longways from corner to corner though the midd'st: And hence in Greek it hath the name: This knowne I enter with the numbers giu'n, and I finde 18 to meet with 18, at 5 ynches and one third parte of an ynche from the oft named end of the Rular: Therefore I say, That euery 5 ynches, and 1 third parte of an ynche in length of that sticke shall be but halfe a foote of solid measure. Nowe becauſe 5 ynches and 1 third of an ynche is conteined in 16 foote, 67 tymes and 14 sixteen partes, that is almoſt 68 times: Therfore I say, The Priſma

giu'n doth conteine almost 68 halfe foot's, or 34 foote of solid measure.

IIII A fispaned solid, all whole sides are 6 ynches broad a peece and 16 foote long, is to bee measured. Here the two lines giuen are, as aboue was taught, the Plumbline from the center, vnto the middest of any one of the sides: And the halfe of the compasse; That, as before was taught, is 5 ynches, and 2 eleuenth partes of an ynche: This is, as you see 18. Now 5 and 2 eleu'nths doth meet with 18, at 19 ynches and 1 fifth parte of an inche from the fore-end: Therfore I say, That euery 19 ynches, and one fifth parte of an ynch, shall be a foote of solid measure. Lastly, because 16 ynches, and 1 fifth parte is conteined in 16 foot, 10 times, and 2 fifteene pates, I say that the tymber sticke giu'n doth containe 10 foot of solid measure, and some small quantity more.

Lastly a Round columne, or Cylinder, of 44 ynches about, & 12 foote long, is to be measured. Here according to that aboue taught, the two lines giu'n are, The half diameter, & the halfe circumference: This is 22: That 7. Now these two do meete vpon the Rular at 11 ynches, and 17 seauenty two partes, of an ynch, from the fore-end there of; Therefore the sticke containeth about 13 foot of tymber or solid measure.

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