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The Hidden Signature : Scale Keys in Italian Renaissance Architectural Drawings

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THE HIDDEN SIGNATURE :
SCALE KEYS IN ITALIAN RENAISSANCE ARCHITECTURAL
DRAWINGS

PAUL DAVIES

Measured architectural drawings are often difficult for architectural historians to attribute with any certainty, and the reason why is fairly obvious to anyone that has attempted it. The use of drawing instruments such as the straightedge and compass produce uniform lines that undermine a drawing's individuality; and this relative lack of individuality makes the normal connoisseurial techniques of establishing authorship by identifying personal mannerisms far more difficult, and sometimes impossible. When presented with these difficulties architectural historians generally rely on other methods to determine authorship, such as identifying idiosyncratic drawing conventions, or the handwriting style of any annotations, or – in the case of project drawings – the architectural style of the building drawn. Techniques such as these have proved themselves to be very useful, especially when used together, and have collectively become the standard method for attribution. Yet there is another technique which, despite being considered by scholars such as by Heinrich Thelen¹, Gordon Higgott², and Richard Hewlings³ in their studies of seventeenth- and eighteenth-century drawings has not yet been fully exploited by students of sixteenth-century Italian architecture. It is what might be called scale-key analysis, a method that compares and contrasts scale-key design as a means of helping to determine a drawing's authorship.

What makes this technique possible is the fact that there is a huge variety of scale keys used in Italian Renaissance architectural drawings, and – more importantly for the present argument – that multiple examples of the same recognisable scale key can be identified on various different sheets. That the same scale key tends to get used time and again suggests that, in the case of each individual architect, it evolved into a distinctive formula through habitual use. Alternatively, it is equally conceivable – and this is a possibility that should not be ignored – that scale keys were consciously personalised. Having said this, not every architectural draughtsman has a scale key that is distinctive enough to be analysed, but many do as will be shown. It is the purpose of this essay to suggest that a sufficiently distinctive scale key can be used in conjunction with

*1a Giovanni Battista da
Sangallo: Arch of Janus,
London, Royal Institute of
British Architects, Codex
Stosch, fol. 2r*

the other techniques mentioned above to attribute drawings to a particular architect or draughtsman.

Indeed, the scale key might well be an especially useful tool for attribution for the simple reason that in almost every case the scale key would have been drawn in preparation for making the drawing.⁴ And, at this early stage in the professionalisation of architecture before the establishment of large workshops with teams of draughtsmen, it is probable that in most cases the scale key would have been laid out by the draughtsman who went on to produce the drawing. In this way, especially at this date, the drawing and the scale key are intrinsically linked. In fact, the scale key and associated drawing are more closely linked than are the drawing and its accompanying annotations. Annotations, by their very nature are added after the drawing has been produced and, significantly, not always by the draughtsman, a factor that can easily lead to misattribution.

1b Detail of fig. 1a

Therefore the accurate identification of the hand of a scale key could – at least as far as the sixteenth century is concerned – be a more reliable indicator of authorship than securely identifying the ›hand‹ of the annotations. Yet, in order for scale-key analysis to work well, it needs to be shown that at least some architects were reasonably consistent in laying out their scale keys. So it is this question of consistency that I shall address first.

GIOVANNI BATTISTA DA SANGALLO'S SCALE-KEY SYSTEM

In trying to answer this question of consistency I have taken the drawn oeuvre of Giovanni Battista da Sangallo (1496–1548), the brother of Antonio da Sangallo the Younger (1484–1546), as a starting point, using the recently rediscovered Codex Stosch to test the hypothesis.⁵ This codex is an ideal case study, as it contains a collection of drawings all produced by the same draughtsman, and it has a good range of scale keys to compare.⁶ The first to appear in the codex is the one on fol. 2r, a drawing of the Arch of Janus (figs 1a–b). It has a horizontal core line that is merely underscored and thus largely invisible, along which the units of measurement have been marked, but without numbering of any kind. It is divided into sections of 10 feet, which are indicated with six-pointed stars, falling at 0, 10 and 20 feet respectively, stars that are constructed from a vertical down stroke, intersected with an x-shaped cross. Between these major intervals is a 5-foot subdivision that falls at 5 feet, 15 feet, and 25 feet, which has been given a completely different form. This mark consists of a single vertical down stroke, extending as much above the core line as it does below it, with short horizontal bars at top and bottom. Then, the scale key is further broken down into smaller units still. At the extreme right, the last 5-foot subdivision is divided into individual feet, using simple dots.

2 *Giovanni Battista da Sangallo: Temple of Antoninus and Faustina, London, Royal Institute of British Architects, Codex Stosch, fol. 9v, detail*

3 *Giovanni Battista da Sangallo: Temple at Cori, London, Royal Institute of British Architects, Codex Stosch, fol. 3r, detail*

The other scale keys in the codex are all essentially the same, that is to say they all use stars, bar-topped vertical lines, and dots in the same hierarchical arrangement. The one on fol. 2v, an elevation of the Arch of Janus that follows on from the plan on the recto, is reproduced in exactly the same way. Yet there are some minor variations in the Codex that need to be considered, in order to establish how consistent Giovanni Battista da Sangallo was in his use of scale keys. On fol. 9v – a drawing of the Temple of Antoninus and Faustina – the scale key has fewer vertical lines marking the 5-foot divisions (fig. 2). The same variation appears in the drawing of the Doric Temple in the Forum Holitorium on fol. 14v, and a similar one is used in the drawing of the Hadrianaeum on fol. 6r. In these cases the difference in the design of the scale key is not so much a lack of consistency as an adaptation of the scale-key system to the size of the building drawn. In these last cases the reduction in the number of 5-foot subdivisions can be explained by the fact that the drawings represent larger buildings than the Arch of Janus and they are as a consequence drawn on a smaller scale to fit on the sheet. A different variation appears on fol. 3r in a drawing of the portal of the Temple at Cori (fig. 3). While its scale key is treated in much the same way as the ones we have seen, it differs in one respect. One of the individual feet at the right of the scale key has been divided into quarters. Giovanni Battista did this for the simple reason that the drawing is of a detail rather than the whole structure, and so he decided it would be useful to provide a smaller

unit of measurement. The same approach can be found in the drawing of the detail of the entablature of the Temple of Vespasian (fol. 17r). In this case the distance between the stars is one foot and the interval between the star and the vertical stroke is half a foot, and that between the dots is an ›oncia‹ or inch (with 16 ›once‹ making up the Roman foot).

From this analysis it may be inferred that Giovanni Battista da Sangallo used not exactly the same scale key but rather the same scale-key system, and that he used it consistently throughout the codex. In short, he never uses a visible horizontal core line and never uses numbers. In this he is consistent. He is also consistent in using a hierarchy of symbols for the subdivisions: 6-pointed stars for large units, bar-ended vertical lines for middle-sized units, and dots for the smaller ones. While this hierarchy is used in every instance, each symbol is not fixed to a particular unit of measure. So the distance between 2 stars could represent 10 feet in one drawing and 1 foot in another. Moreover, Giovanni Battista da Sangallo uses a scale key that is in general uniform, but with variations that depend on the scale of the drawing, that is to say whether the drawing is of a whole building, part of a building or a small detail. Crucially, these variations are not so great as to render the scale key unrecognisable. His preferences remain clear.

That Giovanni Battista da Sangallo was consistent in his use of this scale key can be demonstrated by looking at other drawings produced by him. Among his drawings of antiquities in the Uffizi – ones that also bear his handwriting – are several that bear this scale-key system, or one that is very close to it. For example, the drawing of the Theatre of Marcellus (GDSU 1122 A) (fig. 4) bears a scale key that is almost identical to the one of the Temple of Antoninus and Faustina in the Codex Stosch (fol. 9v); and another drawing of the plan of the same building (GDSU 1270 A) also uses Giovanni Battista's readily recognisable system.

Giovanni Battista da Sangallo was not alone in using a largely consistent scale-key system as can be shown if we consider the graphic oeuvre of Baldassare Peruzzi (1481–1536).⁷ Peruzzi also has a set of preferences that are readily identifiable, and when these preferences appear together they would provide evidence for confidently attributing a drawing to him. Like Giovanni Battista da Sangallo, he does not use a horizontal core line to unify the scale key; instead he relies on a scored or faint chalk line as a guide to indicate where he should mark the intervals. Again like Sangallo, he never uses numbers, relying on the diagrammatic nature of the scale key to make the units self-explanatory. But, unlike Sangallo, he does more regularly specify close to the scale key what the unit of measurement is, whether ›piede‹, ›palmo‹ or ›braccio‹.⁸ One of the various characteristics of his scale keys that make them immediately recognisable is their length. They are in general extremely long. This can be illustrated by a project for a villa (GDSU 616 Ar), probably for a Sienese location given the scale key's subdivision into ›braccia‹ and ›canne‹ (fig. 5). In this case the scale key runs right across the drawing.⁹ Exceptions to this preference are actually quite rare in his known oeuvre and they are generally easily explicable. They appear either in his earliest drawings, perhaps before he had settled on a consistent system as can be seen in GDSU 459 A, or in cases when the use of a long scale key would disfigure the drawn image as in the case of GDSU 357 A, a project for Palazzo Ricci in Montepulciano. In this latter case, it became clear to him that the project, which is at an angle to the edges of the sheet, would take up the whole of the area available for drawing, and so he seems to have taken the decision to limit the extent of the scale so that it would not awkwardly cut across the building.

When using his preferred long scale key, he tends to subdivide it using one of two hierarchical systems. Sometimes he uses a set of hierarchical marks that is consistent and unchanged along the length of the scale key, as can be seen in the drawing of a Sienese villa (GDSU 616 A, fig. 5). Here the scale is at least 42 ›braccia‹ long with short vertical lines indicating the ›canne‹ and dots marking the individual ›braccia‹. Among the many other drawings with this system is one associated with the Palazzo Farnese in Caprarola (GDSU 506 A). This sheet bears a scale of 200 units (unspecified), with long vertical lines for the 50-unit markers, short vertical lines for the 10-unit markers, and dots for the 5-unit markers.

5 *Baldassare Peruzzi: Project for a villa, Florence, Uffizi, GDSU 616 A*

More commonly, he uses a system that changes as it moves along the length of the scale key. In this system he uses a simple set of hierarchical marks several times in the same scale key. Precisely what I mean by this can be seen if we consider a few of his drawings in detail. In a scheme for S. Domenico in Siena (GDSU 340 Ar) the scale key runs through the centre of the church along the axis of symmetry (fig. 6).¹⁰ At the west end (right) of the church the scale key is

6 *Baldassare Peruzzi: Project for S. Domenico in Siena, Florence, Uffizi, GDSU 340 A*

divided into units of 5 >canne< by short vertical lines, and these intervals are then subdivided into individual >canne< indicated with dots. This system continues from right to left until the more detailed section of the scale at the east end of the church where the same system is transferred to smaller units. The short vertical lines, previously the 5->canna< markers become the individual >canne<, while the dots, formerly the individual >canna< markers, become individual >braccia<. The system as used here might be described as having a two-level hierarchy. Elsewhere he uses hierarchies that have three or even four levels. In a scheme for a house (GDSU 597 Ar) he used a three-level hierarchy (fig. 7). At the far right, intervals of 10 feet are represented by simple dots. Then moving 50 feet to the left, the dots are replaced by short vertical strokes with dots now used to indicate 5-foot intervals. Then at the far left, the dots used to indicate 5-foot intervals are also transformed into short vertical strokes, with dots now being used to indicate individual feet.¹¹

In another house project (GDSU 598 A), a four-level hierarchy can be identified. Reading from the right there are first of all intervals of 10 >palmi< represented by dots. After 50 >palmi< the dots become short vertical lines; after 100 the space between the vertical lines is subdivided by dots representing intervals of 5 >palmi<. And in the last 10 >palmi< section, the 5->palmo< marker becomes a short vertical line and the individual >palmi< become dots. The dot therefore can represent 1, 5 and 10 >palmi< in the same scale.¹²

From this analysis, it would appear that these two architects were reasonably consistent in their use of scale keys. The variations that do occur can often be explained by the particular needs of the drawing, whether small or large scale and by the placement of the drawing on the sheet. So while the scale keys might not be completely identical, the design principles that underpin them are. Therefore it is proposed here that once these principles are established for a range of known architects, they might be used as an additional, supplementary tool for identifying the hand of a particular drawing.

SCALE KEYS IN THE WORKSHOP OF ANTONIO DA SANGALLO THE YOUNGER

In order to assess how useful this technique might be in practice I have considered a range of drawings associated with the workshop of Antonio da Sangallo the Younger with a view to establishing the particular scale keys used by some members of the team.¹³ Having already established that Giovanni Battista da Sangallo has a distinctive and readily identifiable scale key, it is necessary now to determine whether some of the other workshop members had their own.

Bastiano da Sangallo (1481–1551), better known as Aristotile, also used a recognisable scale key and one that is significantly different from the ones used by Giovanni Battista and other members of the workshop. It appears on drawings that are part of a group first assigned to him by Pasquale Ferri in the nineteenth century.¹⁴ Although the attribution to Aristotile has been contested, it is clear that many of the drawings are by the same hand as they bear identical handwriting, and it is also evident that this handwriting compares well with annotations by Aristotile on GDSU 1043 A which are generally considered to be autograph.¹⁵ Aristotile's preferred scale key appears, for example, in the right hand margin of GDSU 1742 Ar – a drawing of two antique cornices and a base (fig. 8).¹⁶ This scale key has no visible horizontal core line, but it has a series of clearly differentiated marks running in a line. Its major interval markers are set 8 units apart. These consist of a longish stroke that begins at the invisible horizontal core and moves away from it towards the edge of the sheet. Then the paper has been turned around and another line is produced again beginning at the same point but moving in the opposite direction, creating what appears at first glance to be a single line running through the invisible core. The scale is further subdivided with intermediate markers set at 4 units apart. These consist of lines, which are like the major markers but only applied to one side of the scale (in this case on the side closest to the edge of the sheet).

8 *Aristotile da Sangallo: Two ancient cornices and a base, Florence, Uffizi, GDSU 1742 A, detail*

9 *Aristotile da Sangallo: Mouldings of the Santa Casa in Loreto, Florence, Uffizi, GDSU 1744 A, detail*

Then the markers for individual units of measure are simple dots. These major, intermediate and minor markers are probably half feet, quarter feet and >once< (inches) respectively, given that the scale key is subdivided into groups of 4 units and the Roman foot was made up of 16 >once<. Very similar scales appear on GDSU 1742 A, 1743 Av, 1746 A and 1748 Av, 1749 Av.¹⁷ In some cases, though, there are only two rather than three levels in the scale key's hierarchy, and these tend to combine dots with the less elaborate type of stroke that is applied to just one side of the core line as is the case with GDSU 1744 Ar (fig. 9) and 1746 Av. Most of these scale keys appear on drawings after ancient buildings, but at least one is associated with a project. It is a site survey made in preparation for Antonio's redevelopment of Palazzo Pucci in Orvieto of c. 1528 (GDSU 1070 A).¹⁸ This last example demonstrates that even if this group of drawings turns out not to be by Aristotile, they were nevertheless produced by a member of the Sangallo workshop.

Antonio da Sangallo the Younger's scale-key preferences are also easily identifiable and very distinctive. His preferred scale key appears on many of his project drawings that are clearly autograph. By way of example it can be found on a sheet with drawings associated with St Peter's (GDSU 57 Ar, fig. 10).¹⁹ With no visible horizontal core line, it has a series of interval markers that are made up of very short down strokes all of the same size. These markers are set 5 units apart and each 5-unit interval is numbered from 5 to 35. The number is placed in the centre of each interval and to make it clear which point on the scale the number refers to Antonio adds a loop, which leads the eye to the appropriate marker. This system is found on innumerable drawings by him

10 *Antonio da Sangallo the Younger: Project for St Peter's in Rome, Florence, Uffizi, GDSU 57 A, detail*

11 *Antonio da Sangallo the Younger: Project for S. Maria di Monte d'Oro in Montefiascone, Florence, Uffizi, GDSU 1275 A, detail*

such as a project for S. Maria di Monte d'Oro in Montefiascone (GDSU 1275 Ar, fig. 11) and another for the Cappella Paolina (GDSU 1125 A).²⁰ The idea of using loops in this way seems to come from his practice of surveying ancient buildings in which he indicates measurements along the walls of buildings by means of looping lines cradling dimensions as can be seen in his drawing of SS. Cosma e Damiano (GDSU 716 A).²¹

Antonio also uses another system, which also makes use of loops but has a slightly different purpose. In this case the loops are not used as part of a running sequence of measurements but rather as indicators of significant units of measure – a system that is modular in character. So, for example, in GDSU 796 A – a project for the refortification of Genoa – the loops above the horizontal core line all cradle the number 50 indicating that all these major intervals are of that particular size.²² In fact in this scale key he uses both systems of measure – the running and modular – one above the other, the bottom one designed to provide a running total and the top one to indicate the dimensions of the principal intervals. In such cases the loops of the individual 50 foot markers are more carefully drawn, insofar as they run more precisely from point to point, unlike the running sequence, where the loops emerge from about halfway along the previous loop in the run.

Having established the preferred scale keys of Giovanni Battista, Aristotile and Antonio the Younger, it now becomes possible to review the authorship of certain drawings and at the very least ask questions about the authorship of

12a Giovanni Battista da Sangallo: Project for S. Maria di Monte d'Oro in Montefiascone, Florence, Uffizi, GDSU 304 A

others. By analysing their scale keys it becomes evident that quite a number of drawings usually ascribed to Antonio the Younger are probably not by him at all, but are instead by his brother Giovanni Battista. For instance, the project drawing for S. Maria di Monte d'Oro just outside Montefiascone (GDSU 304 Ar, figs 12a–b) bears a scale key that has stars at the major subdivisions and vertical lines at the intermediate ones, a system very close to that used by Giovanni Battista, and quite different from the drawing discussed above for the same church by Antonio himself (GDSU 1275 A).²³ Again, a drawing usually associated with Antonio da Sangallo the Younger and thought to be

12b Detail of fig. 12a

*13a Giovanni Battista da
Sangallo: Project for S. Egi-
dio in Cellere, Florence,
Uffizi, GDSU 1050 A*

a project for S. Egidio in Cellere (GDSU 1050 Ar) is probably by Giovanni Battista (figs 13a–b).²⁴ This drawing does not bear Antonio's normal scale key, but rather the stars and capped bars, which we have already seen as being characteristic of Giovanni Battista's approach. These examples are just two of what could become a very long list, a list that would include project drawings for Montecassino and S. Maria sopra Minerva, all of which will probably need to be re-assigned to Giovanni Battista.²⁵

It is not really very surprising that these measured drawings are by Giovanni Battista rather than Antonio himself, even if they at first sight appear to

13b Detail of fig. 13a

*14a Sangallo workshop and
Antonio da Sangallo: Project
for S. Giacomo degli Incurabili
in Rome, Florence, Uffizi,
GDSU 873 A*

be project drawings. Antonio's work load must have been enormous and the preparation of a measured drawing of this sort would have been hugely time-consuming. As a consequence he would have relied on many draughtsmen, including his brother, to prepare measured drawings of his proposed projects, which he might then go on to modify and annotate.²⁶ That he used his brother in precisely this way is suggested by Vasari's testimony, which tells us that »Antonio left a brother, Battista Gobbo, an ingenious man, who devoted all his time to his brother's buildings«. ²⁷ He goes on to say, that he made use of Battista when he was very busy: »Antonio at that time had five important works on his hands, all of which he supplied – even though they were in different places far from each other – and he did it in such a way, that he did not let anyone down, because if he could not go himself there soon enough he used his brother, Battista«. ²⁸ Although Vasari does not clarify what Giovanni Battista's role was it is probable that he spent much of his time preparing measured drawings. Yet,

it is worth considering whether Giovanni Battista's role in the workshop was merely that of mechanically reproducing designs prepared by his elder brother. Some of these project drawings – now re-assigned to Giovanni Battista – bear evidence that design changes were made during the course of the drawing's production. It is possible, therefore, that Giovanni Battista effected some minor design-changes himself, and if so, it might indicate a greater role than previously thought for him in the design of buildings produced by the Sangallo workshop. Whether or not it was Giovanni Battista who was responsible for the overlaid modifications, scale-key analysis has nevertheless been able to clarify Giovanni Battista's œuvre as a draughtsman.

Besides Giovanni Battista, Antonio seems to have employed a very wide range of draughtsmen to judge by the range of scale keys to be found among his project drawings. Take, for example, a project for S. Giacomo degli Incurabili (GDSU 873 Ar, figs 14a–b). This drawing is often attributed to Antonio da Sangallo on the basis that the drawing resembles other project drawings by him for the hospital church and because it bears his handwriting.²⁹ Yet this drawing carries a scale key that is quite unlike the one Antonio usually uses. In this case the scale key's numbering is located directly under each of the marks, rather than between them, and there are no loops. As the authorship of the scale key and drawing are almost always linked at this date, only two possible conclusions can be drawn. One is that Antonio did on occasion vary his scale-key preferences and the other – and in my view more likely explanation – is that the drawing is by an assistant and that it was later annotated and emended by Antonio. As has been noted in the literature the drawing was also annotated by another hand, possibly the ›maestro di strada‹ Bartolomeo Baronino.³⁰ Yet the drawing is unlikely to be by him either, as it would almost certainly have been submitted to his office for comment and approval. As a consequence of these observations, the author of this drawing remains for the moment an unknown member of the Sangallo team. In this instance, analysis of the scale key illustrates a methodological pitfall for students of architectural drawings, namely that annotations are not necessarily a reliable indicator of a drawing's authorship.

15a Sangallo workshop (Gradoli assistant): Farnese Palace in Gradoli, Florence, Uffizi, GDSU 189 Av

Another project – one associated with the Farnese Palace in Gradoli (GDSU 189 Av) – is also usually ascribed to Antonio the Younger on the grounds that the handwriting of the annotations is his.³¹ But the drawing itself, as with the previous example, is almost certainly by an assistant, who may for the moment be referred to as the >Gradoli assistant<. The scale key is unlike Antonio's, but it is distinctive (figs 15a–b). The main 10-unit interval markers have a vertical down-stroke flanked by curving diagonal strokes, different from any of the other scale keys discussed so far.

By gathering these distinctive scale keys, it is theoretically possible to identify a corpus of drawings associated with a particular workshop member; and by grouping them it would become possible to assess his contribution to the workshop. I have begun to do this for one workshop member.³² This draughtsman has

15b Detail of fig. 15a

a highly idiosyncratic scale key, which appears on GDSU 258 Ar, a drawing associated with Antonio's project for the lantern of St Peter's of about c. 1540 (figs 16a–b).³³ This scale key does not resemble Antonio's system at all, and even though it more closely resembles that of Giovanni Battista da Sangallo, it is not close enough to his set of preferences to allow an attribution. It has major markers that are in the form of a dot surrounded by six tiny circles, which together make a sort of six-pointed star. Its intermediate markers are simpler in being a dot with two tiny circles, one located immediately above and the other immediately below it. Its minor markers, indicating individual units, are simple dots, and these are located right at the centre of the scale key linking two of the intermediate markers. In the middle of the scale key is a major marker that differs from the other major ones insofar as it is rotated through 30° with respect to the other star-like markers. This very distinctive scale key reappears in identical fashion on a drawing of a small villa or casino usually attributed to Antonio da Sangallo (GDSU 1266 A), which would suggest that this measured drawing was prepared for Antonio by this same assistant.³⁴ While these two scale keys are in essence identical there are versions of it on other sheets, which would appear to be by the same draughtsman.

16a Sangallo workshop: Lantern of St Peter's, Florence, Uffizi, GDSU 258 A

One variant appears twice on a sheet in the Uffizi (GDSU 829 A bis) that carries a pair of laid-down drawings, both usually attributed to Antonio the

16b Detail of fig. 16a

17 Sangallo workshop: *Two scale keys, Florence, Uffizi, GDSU 829 A bis, detail*

18 Sangallo workshop: *Lantern of St Peter's in Rome, Florence, Uffizi, GDSU 89 A, detail*

Younger or a member of his circle (fig. 17).³⁵ In this variant, the major intervals are represented by six-pointed stars with the distinctive feature of a tiny circle at the end of each of the star's radii. The intermediate intervals, however, are unlike those in the drawings of the lantern and casino, consisting of a vertical line with a single additional line intersecting it running from top right to bottom left. It has smaller vertical lines indicating ›once‹, and smaller ones still to lay out the ›minuti‹ – the subdivisions of the ›oncia‹.³⁶ Also different is the presence of loops linking the stars, which indicate the unit of measure

19 *Sangallo workshop: Ancient cornice, Florence, Uffizi, GDSU 1321 A, detail*

– »palmo«. Despite the differences, the highly idiosyncratic way in which the stars are treated suggests that the drawings are by the same draughtsman that executed the lantern and casino drawings. A link between these two sets of scale keys is provided by another of the drawings associated with the lantern of St Peter's (GDSU 89 Ar, fig. 18).³⁷ Like GDSU 258 A and 1266 A, the scale key has the star with rings, which is combined with intermediate vertical markers that finish in rings, but like GDSU 829 A the markers are linked by loops. Another scale key that bridges the two variants appears on a drawing of an antique cornice (GDSU 1321 Ar), which has precisely the same characteristics.³⁸ This last example is particularly interesting in the context of this study as the original annotation by the draughtsman under the scale key is supplemented by a comment written by Antonio himself above it (fig. 19). Yet another drawing with a related scale key, although damaged in part, is a scheme perhaps for the façade of the Palazzo Comunale in Castro of c. 1537 (GDSU 1684 A).³⁹ Who this member of the workshop is remains to be determined.⁴⁰ On the basis of the group that shares the same scale key, all that can be said with certainty at the moment is that this assistant seems to have been an active member of the Sangallo workshop in the years around 1535–45 when the Castro projects were being prepared and when the lantern drawings for St Peter's were being made.⁴¹

CONCLUSIONS AND CAVEATS

These observations suggest that scale-key analysis is a promising additional technique for helping to attribute measured architectural drawings. It is, in general, a useful aid in identifying groups of drawings that were produced by the same draughtsman. It is particularly helpful for identifying authorship in cases where there are no annotations, and in confirming or revising the authorship of those drawings that had previously been attributed to individual architects on the basis of annotations alone.

Despite these advantages there are some limitations. Not all architects had scale keys that are susceptible to this form of analysis. Palladio, for example, rarely used a visible scale key and preferred a series of barely visible pinpricks.⁴² Moreover, some architects might have been rather less consistent than others, and as a consequence identifying hands using this method becomes all but impossible. What is more, scale keys are sometimes modified during the drawing process making them less susceptible to analysis; and some are left incomplete which might easily result in them being misconstrued as different scale-key types. Another possibility – and one that should not be ignored – is that architects in modifying a drawing prepared by one draughtsman might also have adjusted the scale key to suit their own preferences, with the result that the scale key becomes a composite design, and thus difficult to analyse.⁴³

Furthermore, when used alone without other corroborating evidence, scale keys might lead to incorrect conclusions. Take, for example, GDSU 177 Ar (figs 20a–b), a project drawing for the Chapel of the Corpus Domini in Foligno Cathedral produced by the Sangallo workshop. On the basis of scale-key analysis this drawing would be given to Antonio da Sangallo the Younger as it bears his scale key. But the drawing is, in general, attributed to Giovanni Battista da Sangallo on the basis of handwriting.⁴⁴ So is this drawing by Antonio or by Giovanni Battista, or perhaps even both? It is improbable that Giovanni Battista used Antonio's scale key. It is perhaps possible that Antonio prepared the drawing and that it was annotated by Giovanni Battista. But a third possibility – and to my mind the most convincing – is that both of them drew on the sheet. First came the site plan showing the pre-existing buildings which was prepared and annotated by Giovanni Battista and second came the new project drawn over the top of it by Antonio, who added his own scale key. This reading parallels Antonio's approach on other projects such as drawings associated with Palazzo Pucci in Orvieto, where a project drawing is drawn on top of a site plan

(GDSU 969 A) perhaps prepared by another member of the workshop.⁴⁵ In the case of the Foligno project, the drawing was prepared in two stages by two different draughtsmen and the scale key relates to one of those two stages, in this case the later one. From this it is clear that not all drawings can be attributed solely on the basis of scale key evidence. Nevertheless, the identification of the authorship of the scale key has provided a fuller understanding of its authorship and how drawings were made.

In preparing this paper it has become clear to me that there are several questions that have yet to be addressed and that will need to be considered for the technique to become really useful. First of all, there is the question of the

extent to which an individual architect's scale key develops throughout the course of his career. Secondly, there is the question of what happens to the scale key when architects copy drawings. Do they copy the one found on the original, or do they replace it with their own preferred system? Thirdly, did Italian Renaissance architects ever have scale keys prepared by assistants, a practice which would make the use of the scale key as a means of identifying the hand of the drawing's author problematic? Lastly, there is the issue of whether architects changed the scale key according to the status and function of the drawing. Did they tend to use a more basic form for a drawing that was intended just for workshop use and a more refined one for a presentation drawing? These are questions that will all need to be addressed as scale-key analysis is developed.

20a Giovanni Battista and Antonio da Sangallo the Younger: Project for the Cappella Corpus Domini in Foligno Cathedral, Florence, Uffizi, GDSU 177 A

20b Detail of fig. 20a

NOTES

- The paper on which this essay is based was presented both at the conference staged by the *Census* in Berlin in 2013 and then at a conference to commemorate the tercentenary of Worcester College Oxford in 2014. At those events a number of scholars made a series of important remarks that I have incorporated here, and in particular I would like to thank Richard Hewlings, Gordon Higgott, Andreas Huth, Fritz Eugen Keller and Timo Strauch.
- 1 Heinrich Thelen: Francesco Borromini. *Die Handzeichnungen*, 2 vols, Graz 1967. In this study Thelen pioneered the identification of scale keys, attempting to associate them with individual draughtsmen. However, he does not provide an analysis of the merits and demerits of the approach. His standard practice can be found exemplified in Textband cats 38 and 40.
 - 2 Gordon Higgott analyses scale keys extensively in his on-line catalogue of the drawings associated with St Paul's Cathedral in London: <http://www.stpauls.co.uk/Cathedral-History/The-Collections/Architectural-Archive/Wren-Office-Drawings>. Detailed analysis of individual scale keys is provided in the section of Wren and his draughtsmen: <http://www.stpauls.co.uk/Cathedral-History/The-Collections/Architectural-Archive/Wren-and-his-draughtsmen>. Here Higgott highlights one potential problem in using scale keys as an attributional tool. He points out that among the drawings of Edward Pearce are two drawings (WRE/2/4/5 and WRE/2/4/5) that bear the scale key of another of the hands ›an unidentified draughtsman‹ who was a member of the Wren office. This suggests that the sheet was prepared by the unidentified draughtsman in preparation for Pearce to make the drawing. See also Gordon Higgott: The Revised Design for St Paul's Cathedral, 1685–90: Wren, Hawksmoor and Les Invalides, in: *The Burlington Magazine* 146 (2004), pp. 534–547.
 - 3 See, for example, Richard Hewlings: Sir George Savile's Architectural Drawings, in: *English Heritage Historical Review* 6 (2011), pp. 80–109; Richard Hewlings: The Architect of Weston Park, Staffordshire, in: *The Georgian Group Journal* 20 (2012), pp. 22–32, where the author attributes a drawing to James Paine on the basis of scale-key evidence.
 - 4 Gordon Higgott pointed out to me that there is evidence that is clear from the workshop of St Paul's Cathedral in London that the scale key was occasionally prepared by an assistant before the designer or draughtsman took over (see note 2). While there is as yet little evidence that this practice was employed in sixteenth-century Italy, it must remain a possibility. If such a practice took place in the first half of the sixteenth century in Italy, it is likely to have been more prevalent in larger workshops or in large-scale projects where very many drawings were produced, and in the light of this it would be worth considering whether such an approach was employed in project drawings for St. Peter's.
 - 5 For the Codex Stosch, see Ian Campbell: *The Codex Stosch*, Lyon and Turnbull, sale catalogue, Edinburgh 12 July 2005; and Ian Campbell, Arnold Nesselrath: *The Codex Stosch: Surveys of Ancient Buildings by Giovanni Battista da Sangallo*, in: *Pegasus. Berliner Beiträge zum Nachleben der Antike* 8 (2006), pp. 9–90.
 - 6 For the attribution of the Codex Stosch to Giovanni Battista da Sangallo, see *ibid.*, pp. 18–23.
 - 7 Much of the graphic oeuvre of Baldassare Peruzzi was published in Heinrich Wurm: *Baldassare Peruzzi. Architekturzeichnungen*, Tübingen 1984, but the intended catalogue raisonné to accompany the volume of illustrations never appeared. For the most recent analysis of his architectural drawings, see Ann Huppert: *The Archaeology of Baldassare Peruzzi's Architectural Drawings*, PhD thesis, University of Virginia 2001.

- 8 See, for example, Florence, Uffizi, GDSU 353 A, 358 A, 453 A, 456 A, 459 A, 475 A, 492 A, 505 A, 510 A, 579 A.
- 9 Other examples of scale keys that are very long or extend across the drawing sheet are GDSU 505 A, 453 A, 597 A, 353 A, 359 A, 335 A, 339 A, 632 A, 576 A.
- 10 This was a common practice for Peruzzi, who usually laid out the scale key on the longitudinal axis of symmetry; see for example GDSU 107 A, 109 A, 123 A, 339 Ar and v, 340 A, 341 A, 342 Ar and v, 380 A, 495 A (here on transverse axis), 498 A; Vienna, Nationalbibliothek, Codex 10935, 136a recto. Sometimes he would place it in front of the façade in a ground plan as in GDSU 507 Av. In such cases it can run right across the page as in GDSU 616 A, or else begin at the building's axis of symmetry as in GDSU 624 A.
- 11 Wurm 1984 (note 7), p. 321.
- 12 Ibid., p. 322. Other examples of this system appear in GDSU 321 A, 337 A, 593 A, 614 A. Sometimes he combines both systems as in a scheme for the Villa at Belcaro (GDSU 346 A).
- 13 Given the scope of this preliminary study I have not as yet had the opportunity to survey all the drawings produced by the Sangallo workshop with a view to identifying the scale keys of all the individual members. This would be an enormous undertaking, and it is beyond the scope of this essay which seeks to establish the principles of scale-key analysis.
- 14 See Pasquale Nerino Ferri: *Indice geografico-analitico dei disegni di architettura civile e militare esistenti nella R. Galleria degli Uffizi in Firenze*, Rome 1885, p. xl.
- 15 For the history of this debate, see Adriano Ghisetti Giavarina: *Aristotile da Sangallo e i disegni degli Uffizi*, Rome 1990, pp. 54–57. Ghisetti Giavarina attempts to reattribute much of the corpus to Tommaso Boscoli, though this argument has not been generally accepted.
- 16 For a discussion of this drawing, see Ghisetti Giavarina 1990 (note 15), pp. 71–72.
- 17 See Alfonso Bartoli: *I monumenti antichi di Roma nei disegni degli Uffizi di Firenze*, 6 vols, Florence 1914–22, vol. IV, figs 576, 578, 579, 580, 581.
- 18 For this drawing, see Ghisetti Giavarina 1990 (note 15), p. 67, who attributes it to Tommaso Boscoli.
- 19 Arnaldo Bruschi: U 57A, in: *The Architectural Drawings of Antonio da Sangallo the Younger and his Circle*, ed. by Christoph L. Frommel, Nicholas Adams, vol. 2: Churches, Villas, the Pantheon, Tombs and Ancient Inscriptions, New York/Cambridge, Mass./London 2000, pp. 82–83, with earlier bibliography.
- 20 For GDSU 1275 A, see Gustavo Giovannoni: *Antonio da Sangallo il Giovane*, 2 vols, Rome 1959, vol. 1, pp. 223–226; Fabiano T. Fagliari Zeni Buchicchio: *Dal Duomo di Montefiascone a S. Giovanni di Val di Lago: architetti rinascimentali e chiese a pianta centrale intorno al Lago di Bolsena*, in: *Bollettino di studi e ricerche a cura della Biblioteca Comunale di Bolsena* 4 (1989), pp. 81–97, here pp. 84 and 91, note 27; Christoph Jobst: U 1274A, in: Frommel, Adams 2000 (note 19), p. 227. For GDSU 1125 A, see Christoph L. Frommel: *Antonio da Sangallo's Cappella Paolina*, in: *Zeitschrift für Kunstgeschichte* 27 (1964), pp. 1–42 and id.: *La cappella Paolina di Antonio da Sangallo: un contributo alla storia edilizia del palazzo Vaticano*, in: id.: *Architettura alla corte papale nel Rinascimento*, Milan 2003, pp. 359–391. Other Uffizi drawings that bear this scale key, or close variants of it, include (all Uffizi): GDSU 57 A, 177 A, 189 A, 299 A, 315 A, 551 A, 744 A, 745 A, 747 A, 749 A, 756 A, 757 A, 786 A, 792 A, 796 A, 866 A, 871 A, 904 A, 931 A, 953 A, 1519 A. Some scale keys such as that on GDSU 738 A – a project for S. Francesco in Castro – combine the loops of Antonio the Younger's system with the stars to be found more commonly in Giovanni Battista's scale keys. This could suggest that on certain occasions Antonio used stars. Alter-

- natively, it could mean that the scale key was laid out by Giovanni Battista and then modified by Antonio. For the literature on this last drawing, see Hubertus Günther: U 738A, in: *The Architectural Drawings of Antonio da Sangallo the Younger and his Circle*, ed. by Christoph L. Frommel, Nicholas Adams, vol. 1: *Fortifications, Machines, and Festival Architecture*, New York/Cambridge, Mass./London 1994, pp. 116–117.
- 21 For this drawing, see Ferri 1885 (note 14), pp. 137 and 157, and Bartoli 1914–22 (note 17), vol. VI, p. 72.
 - 22 For this drawing, see Nicholas Adams and Simon Pepper: U 796A, in: Frommel, Adams 1994 (note 20), p. 135 and p. 313, with earlier bibliography listed.
 - 23 For the traditional attribution of GDSU 304 A to Antonio da Sangallo, see Christoph Jobst: U 304A, in: Frommel, Adams 2000 (note 19), pp. 133–134, with earlier bibliography.
 - 24 See Manfredo Tafuri: U 1050A, in: Frommel, Adams 2000 (note 19), pp. 196–197, with earlier bibliography.
 - 25 Two drawings associated with the redevelopment of the monastery at Montecassino bear a scale key close to Giovanni Battista's (GDSU 181 A and 1276 A); see Simonetta Valtieri: U 181A, in: Frommel, Adams 2000 (note 19), pp. 116–117, with earlier bibliography. Two drawings for S. Maria sopra Minerva (GDSU 1310 A and 1313 A), both normally attributed to Antonio the Younger bear a scale key that is far closer to Giovanni Battista's preferred system; for the attribution to Antonio of these two drawings, see Ursula Kleefisch-Jobst: U 1310A and U 1313A, in: *ibid.*, pp. 231–232 and 232–233, with earlier bibliography. Giovanni Battista was certainly involved in the project for S. Maria sopra Minerva as is suggested by GDSU 1661 A, which Ursula Kleefisch-Jobst has argued was a collaborative effort between the two men; see Ursula Kleefisch-Jobst: U 1661A, in: *ibid.*, pp. 255–256.
 - 26 For an analysis of the drawing practices of the Sangallo workshop, see Christoph L. Frommel: Introduction. *The Drawings of Antonio da Sangallo the Younger: History, Evolution, Method, Function*, in: Frommel, Adams 1994 (note 20), pp. 1–60.
 - 27 Giorgio Vasari: *Le vite de' più eccellenti pittori scultori ed architettori*, ed. by Gaetano Milanesi, 9 vols, Florence 1878–85, vol. 5, Florence 1880, p. 471: »Rimase, dopo la morte d'Antonio, Batista Gobbo suo fratello, persona ingegnosa, che spese tutto il tempo nelle fabbriche d'Antonio, che non si portò molto bene verso lui.«
 - 28 *Ibid.*, p. 463: »[...] Antonio in un medesimo tempo allora avesse alle mani cinque opera d'importanza: alle quali tutte, benchè fossero in diversi luoghi e lontane l'una dall'altra, di maniera suppliva, che non mancò mai da fare a niuna; perchè, dove egli alcuna volta non poteva così tosto essere, serviva l'aiuto di Batista suo fratello.«
 - 29 For this drawing, see Christoph Jobst: U 873A, in: Frommel, Adams 2000 (note 19), pp. 170–171.
 - 30 Marianne Heinz: *Das Hospital S. Giacomo in Augusta in Rom: Peruzzi und Antonio da Sangallo i. G. Zum Hospitalbau der Hochrenaissance*, in: *Storia dell'Arte* 41 (1981), pp. 31–49, especially p. 46.
 - 31 See Fritz-Eugen Keller: U 189A verso, in: Frommel, Adams 2000 (note 19), pp. 119–120.
 - 32 This workshop member already has a corpus of drawings associated with him, by Cara Rachele (<http://www.polomuseale.firenze.it/gdsu/euploos/#/disegni:@00053979>), which can be listed again for convenience here: GDSU 829 A bis; 1151 A, 1154 A, 1305 A, 1306 A, 1321 A, 1612 A–1622 A, 1624 A, 1626 A, 1634 A, 1635 A, 2036 A, 2051 A–2053 A, 2104 A–2107A. Wolfgang Lotz also identified GDSU 1671 A as being by the same hand as well as a drawing from the Casa Buonarrotti (Casa Buonarrotti, inv. 128 A bis) and two from the Albertina (Vienna, Albertina, Graphische Sammlung, inv. Rom no. 1073 and no. 1088); see

- Wolfgang Lotz: Sull'unità di misura nei disegni di architettura del Cinquecento, in: *Bollettino del Centro Internazionale di Studi di Architettura Andrea Palladio* 21 (1979), pp. 223–232. The attribution of all these drawings to the same Sangallo assistant needs to be revisited in the light of scale-key analysis. At least two of the drawings bear scale-keys that are quite different from the one generally used by this draughtsman: GDSU 1671 A and Albertina inv. Rom no. 1073. However, scale-key analysis would suggest that other drawings be added to his oeuvre: GDSU 89 A, 258 A, 1266 A, and 1684 A (for discussion see below).
- 33 This drawing has been ascribed to Antonio da Sangallo and assistant by Christoph Thoenes: U 258A, in: Frommel, Adams 2000 (note 19), pp. 126–127.
 - 34 See Fritz Eugen Keller: U 1266A, in: Frommel, Adams 2000 (note 19), p. 225, where the project is dated to between 1527 and 1540.
 - 35 For the attribution to Antonio, see Ferri 1885 (note 21), p. 40. See also Gustina Scaglia: Drawings of »Roma antica« in a Vitruvius edition of the Metropolitan Museum of Art: part III, in: *Römisches Jahrbuch der Bibliotheca Hertziana* 30 (1995), pp. 259, 271; and Cara Rachele in: <http://www.polomuseale.firenze.it/gdsu/euploos/#/disegni:@00053979>.
 - 36 For the subdivisions of the Roman »palmo«, see Angelo Martini: *Manuale di metrologia, ossia misure, pesi e monete in uso attualmente e anticamente presso tutti i popoli*, Turin 1883, p. 596.
 - 37 This drawing (GDSU 89 A) has been ascribed to Antonio da Sangallo and assistant by Christoph Thoenes: U 89A, in: Frommel, Adams 2000 (note 19), pp. 103–104.
 - 38 Noted by Cara Rachele in: <http://www.polomuseale.firenze.it/gdsu/euploos/#/disegni:@00053979>.
 - 39 See Hubertus Gunther: U 1684A, in: Frommel, Adams 1994 (note 20), pp. 263–264. Rings also appear in a more limited fashion in GDSU 1359 A and 1360 A, schemes for the Porta Santo Spirito in Rome, both of which might also be associated with this draughtsman; for these drawings see Francesco Paolo Fiore: U 1359A and U 1360A, in: *ibid.*, pp. 208–210.
 - 40 Among the names that have been tentatively proposed are Antonio da Sangallo the Elder, Antonio Labacco, and Pietro Rosselli, but more work needs to be done before any firm conclusion can be drawn. The identification of this hand with Antonio da Sangallo the Elder goes back to Luigi Scotti's 1832 catalogue (see Cara Rachele in: <http://www.polomuseale.firenze.it/gdsu/euploos/#/disegni:@00053979>). For the attribution of the St Peter's lantern drawings to Labacco, see Christoph Thoenes: U 89A, in: Frommel, Adams 2000 (note 19), pp. 103–104. For the attribution to Pietro Rosselli, see Bartoli 1914–22 (note 17), vol. I, p. 61.
 - 41 For the dating of the lantern drawings and the Castro projects, see the literature indicated in notes 33, 37 and 39.
 - 42 Oral communication Howard Burns.
 - 43 Some evidence that architects could on occasion modify the scale key prepared by an assistant is to be found on GDSU 1321 A, where the scale key drawn by the draughtsman was modified by Antonio the Younger as has been shown in Lotz 1979 (note 32), pp. 226–227.
 - 44 Christoph Jobst: U 177A, in: Frommel, Adams 2000 (note 19), p. 115.
 - 45 For this drawing, see Christoph L. Frommel: *Roma e l'opera giovanile di Sanmicheli*, in: Michele Sanmicheli. *Architettura, linguaggio e cultura artistica nel Cinquecento*, ed. by Howard Burns et al., Milan 1995, pp. 14–31.

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