From Elizabethan to Restoration: Changes in design and sound of English virginals

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In Martin Souter's liner notes for his recording of music by William Byrd on the Leversidge virginal of 1670 in the Ashmolean Museum, Oxford, he acknowledges that the music 'was all composed around a century before the instrument was made' but concludes that 'the instrument has an archaic feel – it was old-fashioned when it was made – and it suits the music perfectly'.[1] Souter is well known for his engaging performances on original instruments rather than modern copies, yet in some ways this is an strange statement, akin to advocating the use of a late nineteenth-century piano for historically informed performance of piano music by Mozart. There is no reason to suppose that the sound of keyboard music played on instruments built a century apart shared the same aesthetic but, in the absence of fully functioning historical instruments surviving from the sixteenth century, Martin Souter's choice of the Leversidge instrument was one of the few available to him in 2003, when the recording was made. The organological research undertaken by the present author on the two unplayable virginals that have survived from before 1600, which involved reconstruction as part of the investigation, casts light on the differences in construction and sound between the virginals of the so-called virginalists, active from the late sixteenth century until *c.*1625, and those made later in the seventeenth century. This article is an attempt to articulate how keyboard instruments made at different points during more than a century of instrument-making changed in terms of their design, and how this reflected different aesthetic concerns in terms of their sound. The author's copy of the 'AH' virginal, the original of which dates from around 1570, facilitates the comparison of the Elizabethan sound world with that of post-Restoration England. The sound of the 'AH' copy may be heard in this recording of a short fantasy by Thomas Tallis 🔊, which is markedly different from that of an instrument by Robert Hatley of 1664, which may be heard in this recording of a Corant by John Roberts from *Melothesia*, performed by Terence Charston 🔊.[2] Whether or not the Leversidge virginal sounds old fashioned may be judged from

[1] Souter 2003.

[2] Taylor 2005, track 15; Charlston 2003, track 11: I am grateful to Terence Charlston for permission to use this extract.

an extract of this performance of Byrd's *Ut Re Mi Fa Sol La* by Martin Souter 🔊.[3] The sound world of the Elizabethan and early Jacobean virginal certainly seems unlike the instruments heard on many recordings of early English keyboard music.

Given the large corpus of keyboard music composed in England from the mid-sixteenth to the late-seventeenth century, it is perhaps surprising that there are only 22 extant rectangular virginals, ranging in date from *c*.1570 to 1684. There are, of course, various reasons to explain the loss of many instruments, such as the English Civil War and the Great Fire of London.[4] It should also be emphasised that not all instruments were British made.[5] The relative peace and prosperity in Britain from the beginning of the eighteenth century may well have been, perhaps surprisingly, one of the main reasons for the loss of many instruments, as families were in a position to purchase more-fashionable spinets – and later harpsichords – to replace older instruments.

The marked increase in popularity of the spinet in England from around 1680, no doubt encouraged as much by instrument makers as by their customers, saw a change in fashion to a style of decoration based on natural woods without the expanse of gold and paint that characterised the virginal. The style was evidently adopted for harpsichords as well,[6] and later, when fashion again changed – this time to the Georgian instruments as best represented in the

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[3] Souter 2003, track 4. I am grateful to Classical Communications Limited for permission to use this extract.

[4] Samuel Pepys, in his diary entry for 2 September 1666, writes '… and only, I observed that hardly one lighter or boat in three that had the goods of a house in, but there was a pair of virginalls in it …'. Many of those that were 'saved' in such a way were probably water or humidity damaged. The damage to buildings and their fabric caused by the Civil War varied according to region, but it was responsible directly or indirectly for the loss of instruments.

[5] There are two well-known examples. The first is 'Queen Elizabeth's Virginal', an instrument made by Giovanni Antonio Baffo in Venice, 1594. The subsequent alterations show that, regardless of whether we accept the attribution of ownership to Queen Elizabeth, it was in England from the second half of the seventeenth century at the latest. The other example is the Ruckers harpsichord procured for Sir Francis Windebank by Balthasar Gerbier. This instrument is probably the 1639 Ioannes Ruckers harpsichord now in the V&A Museum, London. See Woods 2001. Import of virginals was subject to customs tariffs, suggesting it occurred often enough to justify collecting the income. The term 'British' is used in its post-1707 Union-of-Parliaments sense to mean 'England, Scotland or Wales'. However, all surviving virginals were almost certainly made in England rather than Scotland or Wales.

[6] The surviving harpsichords by makers who normally built spinets (such as Haward, Barton, and Slade) follow the same decorative designs as the spinets. See Martin 2009.

examples of Kirckman and Shudi – it was still natural wood (albeit in veneered form) that was the dominant decorative feature.

An English virginal, on the other hand, has a natural wood exterior, almost always oak,[7] but the lid opens to reveal an almost overwhelming sense of colour on the inside: gold embossed papers adorning the inner case parts such as faceboards, keywell, jackrail and soundwell, separated by crisply-cut mouldings (either in a pale wood or painted), a soundboard with painted decoration of flowers and birds, and inserted gilded roses, and full landscapes on the interior of both the lid and fallboard. The lack of variety in the overall effect, to judge from the surviving seventeenth-century examples, implies that a standard decorative scheme was invariably followed, with only small variations found in a few examples.

In contrast to the decoration found on the instruments, there is both variation and development in what may be described as the elements of the instrument that affect its sound. In that regard, it appears that makers were building to commission according to the requests and requirements of the customer rather than speculatively producing virginals on a production line. Such an operation is, to a great extent, not what we would see today as efficient workshop practice. The arrival of the spinet, with the opportunity for makers to build both speculatively and in batches, was no doubt seized upon as a great opportunity to reconfigure the customer-maker relationship in the maker's favour.

As surprising as the lack of decorative variation is, the surviving instruments of the period tell a second story. Of the 22 extant virginals, 20 were made between 1638 and 1684, while the other two (both without signature or date) were probably made around 1570 and 1580 respectively. The two other plucked keyboard instruments from before the Restoration are both from this earlier timeframe. A harpsichord (completed as a claviorgan during or soon after construction) was built by Lodowyk Theewes in 1579, and the other – now essentially just a case shell – was made by John Hasard in 1622. It is not until the last quarter of the seventeenth century that another surviving harpsichord and the earliest spinets were made.

Such a small number of surviving examples presents questions for which there are no easy answers. Do the extant instruments, in any meaningful way, represent what was made, suggesting – for example – that harpsichords were built in some numbers until *c.*1625 and then hardly at all until *c.*1680? Such a situation is unlikely, since there are references to harpsichords being made during that period,[8] and the much larger number of spinets that survive from 1680

[7] Only two instruments use a different wood. The 1641 Gabriel Townsend is made of walnut, and the 1679 Rewallin is of deal.

[8] In his diary, written during the 1660s, Samuel Pepys provides almost as many references to harpsichords as to rectangular virginals.

to around 1720 is also marked by comparatively few harpsichords. Harpsichords, being the more expensive items, were probably more regularly updated and replaced as fashions changed, and older instruments had little financial value.

It is possible to give a fairly thorough description of the seventeenth-century English virginals, given their general consistency. They have rectangular oak cases, which are varnished on the exterior.[9] There is a three-piece coffered lid and fallboard which are usually attached to the case with iron strapwork hinges and lockplates.[10] The interior is decorated in a collage of colour. Pine faceboards, keywell, soundwell, and jackrail are decorated with mouldings of pencil cedar, pine or oak, usually varnished and occasionally coloured,[11] which form the borders for gilt embossed papers. The keyboards are usually boxwood,[12] with accidental of various materials sometimes inlaid with decorative designs. The soundboard is of conifer wood,[13] decorated with one or more gilt roses and painted flower and bird designs, with the edges having border patterns to act as a frame. The interior of the lid and full-width fallboard have landscape paintings of various designs in a naive style.[14] There are various common themes – for example a general parkland scene with human and animal figures, or a scene of Orpheus taming the animals.

The keyboards are always set to the left of centre. The plucking point ratios vary from instrument to instrument, and sometimes within the extant output of the same maker. The left bridge is essentially straight, though generally having a slight inward curve towards the register. The bridge is most often on freely-

9 The 1641 Townsend virginal has a case of walnut rather than oak, and the 1679 Rewallin virginal is of deal. The 1675 Rewallin virginal is of oak, which now has a painted woodgrain effect, but as this goes over the hinges and lockplates, it is undoubtedly not original. The 1638 Thomas White virginal is made of deal but is the orphan child of a mother-and-child combination rather than a standard virginal.

10 A number of instruments have had their lids flattened at later times in their history.

11 The 1679 Rewallin has maroon-painted mouldings. Those on the 1671 Jones and 1675 Keene virginals are green.

12 The 1671 Jones, and the 1668 and 1675 Keene virginals are snakewood, and the 1664 Hatley and 1684 Bolton are ebony.

13 The term 'conifer wood' is used generically to mean spruce, fir or pine. Of those that have been analysed or otherwise identified it seems that spruce is the commonly used material, but the 1664 Player virginal uses American white pine (identified by microscopic examination carried out by John Koster). It is accepted (by the present author) that cypress is also a conifer wood but it has been specifically excluded in the above definition.

14 The 'AH' virginal fallboard is only the width of the keywell, rather than the width of the full instrument. The 1638 Thomas White virginal has no fallboard as it was originally housed inside the 'mother' instrument.

vibrating soundboard wood.[15] The right bridge has a smooth curve in the treble with a straight section in the tenor and bass, the bass end usually butting up to the raised hardwood wrestplank capping.[16] The tuning pins, drilled through this capping, are divided into two sections, the treble and alto pins going into a piece set more-or-less parallel to the straight section of the bridge, and the tenor and bass pins set in a piece parallel to (and against) the right side of the case. The tuning pins are in two rows. The hitchpins are set in the soundboard edge mouldings along the left end and spine. The few instruments with both a left and right wrestplank divide the hitchpins and bridgepins between the two sides.

The earlier surviving instruments show that many aspects of the decorative appearance which are found as standard in the seventeenth century had their origins in the sixteenth century. The three instruments from *c.*1570 to *c.*1580 have different lid and fallboard decorations, though two have the paintings set in panels surrounded by a type of scrollwork decoration. Of the two virginals, one ('Mar') has the full-width fallboard, whereas in the other ('AH'), the fallboard spans only the width of the keywell. Other than those differences, and the use of embossed leather covering the exterior of the Theewes harpsichord, the instruments are decoratively identical to the later examples.

The one exception to the general scheme as described above is the harpsichord by John Hasard, dating from 1622. Although now missing many of its parts, including the keyboard, keyframe, soundboard (except a small section in the treble), framing, and lid, it clearly came from a different decorative concept in which the oak case has a natural (rather than dark) varnish, there are no embossed papers, and the maker's name is painted on the keywell front above the keys, with a Latin motto around the soundwell. The soundboard, notably of cypress rather than the normal conifer wood, was probably unpainted although it may have had a rose.[17]

Although the decorative schemes of these early instruments are similar to those from after *c.*1625, the same cannot be said for those aspects of construction which affect the sound. There are both developments which are seen when looking at the instruments as a whole, and the occasional 'left-field' approach which is found in only a few examples before disappearing again. There are also different approaches to the plan layout – similar in distinction between the 'muselar' and 'spinett' virginals of the Ruckers family, albeit it with a much lesser range of tonal contrast. The fact that the different layouts can be found in

[15] The two virginals (1668 and 1675) by Stephen Keene and the 1671 Jones virginal have a wrestplank on the left side, on which the bridge (at least in part) sits.

[16] With the exception of the 1641 Townsend virginal, this is always of oak, and is about 4 mm high. The Townsend virginal uses walnut, to match the case material.

[17] The wrestplank shows no evidence of paintings as found on other instruments. There is a compass-drawn rose on the baseboard which probably represents the existence of an actual rose in the soundboard.

instruments by the same builder shows that the general tonal characteristic (at least as can be defined by the plan layout) was a variable over which the customer had some choice.[18]

It is often considered that the English virginal (more correctly, the surviving English virginals of which the earliest dated example is 1638) had the instruments by the Ruckers family as their point of departure.[19] Whereas it is probable that Ruckers virginals were occasionally known in England, and that there were those who were familiar with them from time spent in the continent,[20] it would be unwise to assume that there was a deliberate attempt to copy their instruments. It should also be pointed out that earlier modern writers were either unaware of, or uncertain about, the dating of the 'AH' and 'Mar' instruments which, even after they became known to the wider organological community, were generally considered to come from the early- or mid-seventeenth century.[21] It has subsequently been argued that these instruments date from around 1570 to 1580, a time in which any direct Ruckers influence is highly unlikely, if not impossible.[22]

Although both instruments show signs of subsequent alteration, an examination of them suggests they are from the same workshop tradition, though not by the same maker. However, a detailed examination comparing the 'AH' virginal with the Theewes harpsichord leads to the attribution of the 'AH' virginal to Theewes himself.[23] The Theewes harpsichord is dated 1579, but the virginal is undoubtedly earlier, and has been dated (by the present author) to *c*.1570. Theewes was an émigré from Antwerp who arrived in London in 1567,[24] which provides the earliest possible date for the instrument.

Although Theewes would clearly have brought his instrument-making skills and knowledge with him from Antwerp, this does not mean to say that the instrument was designed in a style fundamentally different from other English instruments of the time. Indeed, features which can be thought of as particularly

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[18] In practice, altering the plucking point ratio presents few, if any, practical difficulties for the maker.

[19] See, for example, O'Brien 1990, p. 206.

[20] As can be demonstrated by the full correspondence between Windebank and Gerbier. See Woods 2001.

[21] For example, Raymond Russell and Frank Hubbard give the date range of surviving virginals as 1641 to 1679, being unfamiliar with the 'AH' and 'Mar', as well as the 1638 Thomas White and 1684 Thomas Bolton instruments. See Russell 1959, p. 69 and Hubbard 1965, p. 151. The first published reference to the 'AH' and 'Mar' was in Napier 1986, pp. 24 and 27.

[22] See Martin 2000 and Martin 2003, vol 2, pp. 9–48.

[23] See Martin 2003, vol 2, pp. 9–48. This updates the conclusions drawn in Martin 2000.

[24] See Boalch 1995, pp. 191. Theewes was a member of the Protestant Dutch Church in London, which is a possible reason for his move from Antwerp. See Rose 2004, pp. 577–93.

English are clearly evident. The use of oak for the casework, the three-panelled coffered lid, the use of embossed decorative papers, the decorative accidental touchplates and the chromatic-bass compass are all absent from earlier Flemish instruments.[25] However, they are standard features on other English-made instruments, showing that the instrument is representative of the early English virginal-making school. It is, of course, possible that aspects of the instrument's construction derive from an earlier, pre-Ruckers, Flemish tradition, either directly from Theewes, or from earlier cross-cultural fertilisation.[26]

Although 'AH' was badly damaged at some point before being repaired for public display, it is comparatively easy to give a description of it as originally built. The baseboard is of deal, as possibly was the spine.[27] The case ends, left and right faceboards, keywell sides, lid and fallboard are of oak. The fallboard is the width of the keywell, fitting in between the two faceboards. The keywell liner and the frames are of deal, as are the liners. A 'nameboard' slides down in slots in the keywell sides, just in front of the keywell liner. The wrestplanks, one along the right end for the bass pins, and another almost parallel to the bridge for the treble pins, are of hardwood. A lower guide, made of conifer wood, covers the full area behind the keywell, slightly overhanging each of the frames, and having the belly rail glued to it at the front edge. There are slots for the jacks to pass through: the wood has been cut a little oversize for each pair of jacks, and a leather guide has been glued to the underside, cut for the individual jacks to pass through. The soundboard has similar slots and a leather register glued to the top side. To the front of the register is a piece of deal, approximately 7 mm wide, cut out in the centre to reduce weight, which is glued to both the lower guide and the soundboard, acting to stiffen up both boards. This is the only 'soundboard barring' in the instrument. The left bridge is behind the register, and the right bridge – in typical 'hockey-stick' shape – is to the right of the keyboard in front of the angled wrestplank. There is a single rose in the soundboard. The jackrail is positioned over the register, the bass end attached to a support batten parallel, and

[25] Strictly speaking Antwerp, where these instruments were made, is not part of Flanders, but part of the Brabant Region. However, the term 'Flemish' has been used in a broader sense from the earliest days of keyboard organology.

[26] It is likely that earlier instruments would have come from the Low Countries to England from the earliest decades of the sixteenth century on. It can be seen that the clavichords and virginals shown in paintings from the Low Countries between 1510 and 1565, and the virginals by Ioes Karest of Antwerp (1548 and 1550), are built in the same style as the clavichords and virginals made in Naples during the same period. Although geographically separated, both were part of the realm of Charles V of Ghent. The same type of case construction (albeit using oak rather than maple) is found on the 'AH' virginal.

[27] The present spine is a modern replacement following what must have been extensive damage to the original.

attached to, the bass keywell side, and the treble to a smaller block glued to the spine. The space between the left case end and the bass jackrail support is taken up by a small box for storing tools. Although the bottom of the box is part of the soundboard, it does not vibrate in any meaningful sense.

Built perhaps ten years later, the 'Mar' virginal is closer to the virginals surviving from the seventeenth century.[28] The fallboard was full width and the faceboards decorated with mouldings separated by papers.[29] Although the decoration of the lid and fallboard is different from the later examples,[30] it matches the concept and style of the Theewes harpsichord. As in the 'AH', the lower guide of the 'Mar' covers the complete area above the keyboard and has leather-covered slots cut for the register. There is also a 7 mm wide bar glued between the soundboard and lower guide board with slots cut out to reduce weight. There are further bars behind the register (slightly in front, on the left bridge) and a short bar parallel to the left bridge in between it and the spine. There is a further bar in the keywell area near the treble end running from the back of the keywell liner to the full-depth register bar. As this soundbar is essentially perpendicular to the soundboard grain, it acts to flatten and stiffen the soundboard in that area. The area to the right of this bar has no further support, meaning that the right bridge was more-or-less centrally placed in the large area behind the right faceboard.

The main other point of interest concerning the construction of the 'Mar' virginal is the soundboard register. In all other examples of English virginals, the register (like the lower guide in this example) has leather over slots cut into the soundboard wood. In the 'Mar' virginal, a large rectangular slot has been cut, into which a walnut piece, with individual jack slots cut out, has been placed. The reasons for this type of construction are not immediately apparent. It is clear that the instrument's maker was familiar with the normal type of construction, as he used it on the lower guide, and the method employed is both more time consuming and difficult than using leather on the soundboard wood. It is possible that there was some type of error or accident which required the inlaying of the full piece. In any case, the use of wood – rather than leather – for the register might result in a little extra noise, but otherwise has no other tonal effect.

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[28] The name comes from the reputed ownership of the instrument by Marie Stewart, the Countess of Mar (d.1644) who, with her husband, acted as custodian to the children of James VI and I when he moved to London following the death of Queen Elizabeth in 1603.

[29] The fallboard has subsequently been cut and the end pieces nailed over the faceboards, giving it an appearance very similar to the 'AH' virginal. The remaining part of the fallboard probably acted as a slide-in cover for the keyboard. The original fallboard and faceboard decoration can be seen on X-rays taken from the front of the instrument.

[30] The lid has three oval panels with images, and the fallboard has diamonds at each end of a panel containing a Latin motto. The later instruments have full-width paintings.

An examination of the string lengths and plucking points of the 'AH' and 'Mar' virginals allows them to be easily compared. Also included in Table 1 is the rear (longer scaled) register of the Theewes harpsichord. Although there is an element of uncertainty over precise measurements as a result of replaced or removed bridges on the 'AH' virginal and Theewes harpsichord, there is no question that the figures are more than adequate for the present purpose.[31] The Theewes has been included because it is contemporary with the virginals, and because its layout (at least in terms of the nut, register and bridge positions) is fairly typical of a harpsichord from Northern Europe.[32]

There are three columns for each instrument in Table 1. In the first is the string length, measured from the left to right bridge pins (in the virginals) or from the nut to the bridge pins (Theewes harpsichord). The second column gives the plucking point from the left bridge (sometimes referred to as the nut) to the position where the plectrum touches the string. The third column (in bold) is the distance along the string at which it is plucked as a percentage.[33]

The string lengths appear to bear little relation to each other. However, it has been shown that English virginals (and the harpsichords of the period) were designed using c^3 as the scaling note, determining the design pitch level of the instrument.[34] Using inches, the 'AH' is 6″ (152.3 mm), the 'Mar' is 7″ (177.6 mm) and the Theewes is 6¾″ (171.3 mm). This suggests three different pitch levels.[35] Mathematically, a string should double in length for an octave drop in pitch (known as

[31] In fact, the inaccuracy of any reconstructed figure would amount to no more than 5 mm in absolute distance. Even in the treble of the instruments, such a distance has very little bearing on anything to do with the design of the instrument.

[32] It could be argued that the instrument's design, with the faceboards either side of the keywell, is a result of its being designed in relationship with the organ it sits upon. However, even if this were true (and the instrument used fairly standard endblocks), the bridges, registers, and nuts would still be essentially the same.

[33] For example, a figure of 50 percent means the string is plucked at the halfway point, and a figure of 33 percent has a string plucked at one-third of its length. It should be mentioned that a string plucked closer to its end (further away from 50 percent) is more nasal in tone quality, all other things being equal. Therefore, 67 percent plucks one-third from the right bridge and 33 percent plucks one-third from the left bridge, but both are plucking the string at the same proportion of the total fixed string length.

[34] See Martin 2003, pp. 47–54.

[35] There were four different pitch levels commonly found in England during the period from *c*.1550 to *c*.1700, each a semitone apart. Most of the surviving virginals were designed with a 6″ string length for c^3, which was the highest pitch level. The Queen Elizabeth Yard, in use in England at this time, gives an inch which was very close to the modern inch – a surviving official yardstick measures 35,972 modern Imperial inches to the yard, so that one inch is 25.378 mm. The 6″ string length for c^3 equates to 'quire' pitch, approximately a^1 at 473 Hz. See Haynes 2002, pp. 88–92. The other three string lengths and pitch levels are 6¼″ (a^1 at 448 Hz), 6¾″ (a^1 at 423 Hz), and 7″ (a^1 at 403 Hz). Obviously,

Table 1 String lengths (str len) and plucking points (pl pt) of 'AH' and 'Mar' virginals, and Theewes harpsichord

	AH[36]			**Mar**			**Theewes**[37]		
	str len	pl pt	**pp/sl %**[38]	str len	pl pt	**pp/sl %**	str len	pl pt	**pp/sl %**
c^3	151.5	102	**67**	176.5	57.5	**33**	171.5	132	**77**
f^2	231.5	107	**46**	238	48	**20**	265	139	**52**
c^2	305	110	**36**	324.5	57.5	**18**	349	143.5	**41**
f^1	441	112	**25**	466.5	58	**12**	497	150	**30**
c^1	603	125	**21**	633.5	65.5	**10**	637	155	**24**
f	799	127.5	**16**	836.5	64	**7.7**	890	161.5	**18**
c	962	140	**15**	1028	75.5	**9.0**	1124	166.5	**15**
F	1141	144.5	**13**	1253	79	**6.3**	1434.5	174	**10**
C	1314	156	**12**	1434	88	**6.1**	1661	178	**11**

Pythagorean scaling), so that, for example, a 6″ (152.3 mm) c^3-designed instrument should have a c^2 string length of 12″ (304.5 mm) and a c^1 (middle *c*) string length of 24″ (609.1 mm). Theoretically, this should continue all of the way to the lowest note but, in practice, the bass strings would be impractically long. Therefore, makers need to reduce the string length, usually (in the case of English-made instruments) from c^1 at the lowest, a practice known as 'foreshortening'.

there is no reason why an owner could not tune their instrument to a slightly lower pitch that the one for which the instrument was designed (perhaps by a semitone or tone), and this might explain why the majority were built for the highest pitch level.

[36] Neither bridge is original, but the present bridges have been accurately placed over the original positions. The string lengths have been reconstructed by basing the string positions on the lower guide register slots and using the string angles found on other instruments for a computer reconstruction.

[37] The bass part of the bridge is missing, but its original position can be easily determined. The string lengths in this section have been reconstructed by assuming that the strings are parallel throughout the compass.

[38] This figure is calculated by dividing the position of the plucking point (measured from the left bridge) by the total string length and multiplying by 100 to give the percentage of its position along the string. It has been given to two significant figures.

Examining the string lengths of the 'AH' virginal, it can be seen that the string lengths between c^3 and c^1 are Pythagorean. The Theewes harpsichord follows the same practice in the top octave, and then starts to foreshorten gradually from c^2. The 'Mar' appears at first to use a different system in which there is an immediate foreshortening below the top note. However, this can be explained as a result of the instrument-making process. The builder would use a template,[39] giving the 'hockey-stick' shape of the right bridge, which would have been designed before constructing the instrument. In the case of the 'AH' virginal, it appears the template was designed to give Pythagorean scaling with c^3 of 6″. The maker of the 'Mar' virginal also appears to have designed and used a template for a 6″, c^3 instrument but, requiring a longer string length, simply moved the finished bridge one inch to the right to make a 7″ (rather than 6″) string length for c^3.[40] The right faceboard, and total case length, were also made a corresponding inch longer.

The use of a different template giving an immediate foreshortening, as found in the 'Mar' virginal, has a tonal effect. This can be best imagined by tuning the string of a violin or guitar down in pitch. It can be heard that the sound quality changes as the pitch gets lower, until the actual pitch level is almost no longer determinable. In practice, the effective drop in pitch caused by the foreshortening of the 'Mar' virginal is audible, but few would generally find it 'unacceptable' in any way.[41] It is also difficult to determine how much of the effect on the tone in a particular area of the compass is due to string foreshortening, rather than being put down to other factors. It can be said only that the tone would be different had the maker used a template to give Pythagorean scaling for the desired pitch level.

The plucking point position has a much greater effect on timbre than string length. This is most immediately discernible on instruments by makers such as Kirckman and Shudi which have close-plucking lute stops as well as a 'normal' register on the same set of strings. Table 2 gives measurements for a 1787

[39] This is a piece of wood which has been cut out to the correct bridge shape. The maker places it on the wood from which he wishes to make the bridge, marks around it, and then cuts to those marks. This saves remeasuring the bridge shape for every instrument.

[40] This can be demonstrated by taking 24.2 mm off each of the quoted string lengths in the table to give a figure of 6″ for c^3. Doing so gives 152.3 mm (6.00″) for c^3; 300.2 mm (11.83″) for c^2; and 609.3 mm (24.01″) for c^1. The slightly short figure at c^2 is within the bounds of handmade construction variation.

[41] There are physical reasons why a string sounds best when close to its breaking point. By examining both surviving instruments, and writings from the period, it can clearly be shown that makers designed instruments with different string lengths for different pitch levels.

Kirckman harpsichord to illustrate the difference between a normal plucking point and the lute stop.[42]

Table 2 String length and plucking points (pl pt) for normal register and lute stop for a 1787 Kirckman harpsichord

	string length	**'normal' pl pt**	**pp / sl %**	**lute pl pt**	**pp / sl %**
f^3	137	50	**36**	13	**9.4**
c^3	177	60	**34**	16	**9,0**
f^2	255	72	**28**	19	**7.5**
c^2	350	82	**23**	22	**6.2**
f^1	525	94	**18**	26	**5.,0**
c^1	695	104	**15**	29	**4.2**
f	987	121	**12**	36	**3.6**
c	1197	133	**11**	45	**3.8**
F	1465	152	**10**	53	**3.6**
C	1642	165	**10**	60	**3.7**
F_1	1790	205	**11**	70	**3.9**

The tonal effect is obvious when hearing an instrument of this type being played and, as both registers are plucking the same set of strings, the difference is fully attributable to the point at which the string is plucked.

Comparing the plucking-point percentages of the 'AH' and 'Mar' virginals with the two registers of the Kirckman serves to highlight the different approaches used in the two instruments. For ease of comparison, these figures have been combined in Table 3.

Table 3 Comparison of the plucking points of 'AH' and 'Mar' virginals with two registers of 1787 Kirckman

	AH	**Kirckman 'normal' register**	**Kirckman lute register**	**Mar**
f^3		36	9.4	
c^3	67	34	9.0	33
f^2	46	28	7.5	20
c^2	36	23	6.2	18
f^1	25	18	5.0	12
c^1	21	15	4.2	10
f	16	12	3.6	7.7

[42] Harpsichord by Jacobus and Abraham Kirckman, London, 1787, now in the Staatliches Institut für Musikforschung Preussisher Kulturbesitz, Berlin, no. 5254. For full details of the instrument, see van der Meer 1991, pp. 150–54. All measurements have been taken from the catalogue.

c	15	11	3.8	9.0
F	13	10	3.6	6.3
C	12	10	3.7	6.1
F_1		11	3.9	

For reasons of instrument-design geometry,[43] the plucking points in the treble (down to around c^1) must be comparatively long, and (for the same reason) the plucking-point figures cannot form a smooth curve. Even taking this into account, it can be seen that the 'AH' virginal is comparable to the normal register of the Kirckman harpsichord, whereas the 'Mar' virginal has plucking points typically about halfway between that of the Kirckman's normal and lute registers (and, perhaps as a more significant comparator, generally half of the 'AH' virginal).

The maker of the 'Mar' virginal could have achieved the longer (7″) scale length without needing to have such a close-plucking register.[44] It would have been possible to use the 6″ right-bridge template and glue the bridge in the same position as for a 6″-designed instrument, and then position the left bridge further from the register, thus increasing the plucking point of all notes throughout the compass. Alternatively, with the right bridge in its present position, he could have angled the left bridge further away from the register in the bass. This would have enabled the string lengths to be closer to Pythagoren in the alto region, increasing the plucking point to give a 'rounder' sound.

Given the ease by which either of the two above-mentioned possibilities could be enacted by the builder, it is evident that his main priority was to achieve

[43] The English virginals have the jacks (which hold the plectra that pluck the strings) in lines of two, and they are positioned between the strings. In this way, for example, the jacks that pluck the *c* strings might have plectra facing towards the player, whilst jacks for the *c*♯ strings pluck away from the player. Looking at the strings from above, one sees a pair of strings close to one other, then a gap in which two jacks are placed, then the next pair of closely spaced strings, and so on. The space required for the two jacks is greater than if each jack had its string on the same side.

[44] The term 'scale' needs to be defined in relation to 'string length'. An instrument will have as many string lengths as it has strings, but only one scale. The scale is usual defined as the string length of a particular note. In much modern keyboard organology, the string length of c^2 (the *c* above middle *c*) is used. However, English virginal makers used c^3 (or f^3 in instruments that went that high), so this figure is used here. See Martin 2003, pp. 47–54. Other string lengths can be related to the design scale note so that, on a Pythagorean-scaled instrument, all strings (at least in the correctly scaled part) will have the same scale. On an instrument such as the 'Mar', in which there is foreshortening, the scale of the lower strings changes so that, for example, the c^2 string of the 'Mar' (324 mm string length) has a 'scale' of 162 mm (approximately 6⅜″), calculated by dividing the string length by two to compare directly with the c^3 string length. The scale of the instrument – as a whole – is still (in this instance) 7″.

a particular timbre rather than ensuring the string lengths were close to Pythagorean scale. The two instruments show such different approaches in terms of their scaling that the general desired timbre – at least, in so far as it can be controlled by the positioning of the bridges and register (plucking point) – must have been defined early in the initial design process.[45]

The Theewes harpsichord has been commented on above, and it is clear that the desired timbre was similar to that of the 'AH' virginal. Although it has what may be considered an elaborate disposition of three registers (2 x 8′ 1 x 4′), the plucking-point ratios of the two 8′ registers are similar to each other. However, this instrument includes what are probably 'bray' pins, screwed into the bridge, which may have acted against the strings on one register to give a buzzing sound, similar to an arpichordum stop on Flemish muselar virginals. It should, therefore, be thought of as having two different 8′ timbres rather than two 'standard' sets of strings.

The harpsichord by John Hasard is now just a shell of a case resting on a stand. Clearly an important instrument when new,[46] and decorated in a style somewhat different from other surviving English plucked keyboard instruments, there is enough remaining to determine that it was also built with tonal contrast as a major design feature. The wrestplank shows three sets of wrestpins and marks of three bridges, two of which come together in the treble. The position of the wrestpins makes it clear that one register was an octave below the other two, which is confirmed the presence of a single set of hitchpin holes in the bentside liner. There are three registers, spaced parallel to each other.

Although the compass cannot be determined,[47] it has been possible to speculate on the bridge positions with some degree of confidence.[48] Even allowing for a fairly wide range of error in measuring string length, it is evident that the two registers at the same pitch were designed to sound tonally quite different from each other. This is shown in Table 4.[49]

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[45] In Martin 2003, vol 2, pp. 24–45, there is an analysis of the design and layout of the 'Mar' virginal. Here it is argued that the maker placed the register, and then positioned the left bridge. He would then have positioned his right bridge to get the correct scaling. This is entirely consistent with the various other possible approaches as described above. The present author built an instrument based on the 'Mar' virginal following the described method with results that duplicated the original.

[46] It is believed to have been made for Lady Anne Clifford, wife of Richard Sackville, 3rd Earl of Dorset. This explains why the instrument is at Knole Park, Sevenoaks.

[47] The present author has argued for G_1, A_1–c^3 compass in Martin 2003, vol. 2, pp. 340–53.

[48] See Koster 1980, pp. 54–64. His arguments form the foundation for the subsequent analysis presented by the present author.

[49] The given note names are based on the arguments presented in Martin 2003, vol 2, pp. 340–53. Even if a different view is taken (for example, John Koster argues for a C–e^3 compass), it has no bearing on the argument presented here regarding the deliberate desire for different timbres. The string lengths have been measured from a computer

Table 4 String lengths and plucking points (pl pt) for the John Hasard harpsichord of 1622

	Long string length	**pl pt to middle register**	**pp / sl %**	**Short string length**	**pl pt to middle register**	**pp / sl %**
c^3	101.5	34.5	49 / **34** / 23	97.5	34	49 / **35** / 24
c^2	203	48	**24**	185	38	**21**
c^1	406	61.5	20 / **15** / 10	367.5	38	16 / **10** / 4.6
c	738.5	75.5	**10**	681	37.5	**5.5**
C	1129	89.5	9.8 / **7.9** / 6.1	1055.5	37.5	5.5 / **3.6** / 1.6
G_1	1301	94	**7.2**	1214	37.5	**3.1**

Needless to say, it is impossible that both sets of strings were plucked by the same register. Rather than systematically show all possibilities – something which readers have all the required information to do themselves – the above table shows the range of possible variation as found in the two higher-octave registers for the notes c^3, c^1 and *C* (presented to show rear / middle / front registers in that order).[50] Only by using the most extreme combination (the long 8′ plucked by the front register and the short 8′ by the rear register) would there be anything approaching a tonal similarity, which could be achieved more easily by using a single nut for the two higher-octave registers.

The earliest of the standard 'typically-decorated' English virginals dates from 1638, and is as unusual as the Hasard. Built by Thomas White, and at the same pitch level as the high-octave registers of the Hasard, the instrument is the orphan child of a mother-and-child virginal combination, which has been separated from its mother at a comparatively early stage. This instrument is clearly influenced by the mother-and-child virginals from the Ruckers family of Antwerp, probably to the extent that Thomas White was personally familiar with an example used as his model. Although the slot for the mother's jacks to connect to the child's keys is now closed, small blocks remain underneath the child's keys, and by drawing the positions of the string relationship it can be shown that the

reconstruction of the instrument based on speculations about the bridge position by John Koster and the present author. It is not possible to determine which register of jacks was intended for a particular set of strings. Therefore, both nut positions have been measured to the middle jack register. The registers are 21 mm apart, and so it is possible to try any combinations of plucking positions. The lower register has not been included here as it has minimal direct bearing on the different timbres available to the two registers of the same pitch.

[50] Only the middle register is shown in bold, for the sake of clarity.

mother instrument had its keyboard to the left, as in other surviving English virginals.

There are nineteen surviving virginals dating from 1638 to 1684, representing the work of fourteen different makers. Only Thomas White has left more than two surviving examples – four instruments in addition to the child virginal mentioned above. James White, Adam Leversidge, Stephen Keene and Charles Rewallin have each left two examples. One maker – Philip Jones – was clearly signing an instrument under his own name while working in Stephen Keene's workshop, and it is reasonable to include him together with Keene.[51] Various features of the 1684 Thomas Bolton virginal suggest that he most likely was also an apprentice or journeyman of Keene.

Three of the instruments by Thomas White, dated 1642, 1651 and 1653 respectively, are essentially the same 'model' with similar string lengths (although the 1651 has a G_1/B_1–d^3 compass rather than a C–c^3 range).[52] The plucking point of the 1653 instrument is about 5–6 percent of string length in the bass (even more nasal than the 'Mar' virginal), whereas the other two instruments are around 10.7 percent in the bass.

The other Thomas White virginal is particularly interesting as it has double stringing in the bass from G_1/B_1 to A.[53] Although the use of a second string and jack for C is common, particularly in earlier instruments, and the instruments by Charles Rewallin have up to four double strung bass notes,[54] in these instances the doubled strings are possibly to fortify the low notes when drone effects are required, or to provide extra character in rhythmic dance pieces. The use of the double stringing for over an octave clearly suggests that it was heard in all music played on the instrument, regardless of style. It is possible that these extra strings were tuned an octave lower, similar to 'Bassys' as found in contemporary organs, though in that case it would be most likely that the jacks for those strings would be removed in the effect was not desired.[55] There is the occasional spinet

[51] Not only does the Jones virginal share a number is distinct characteristics with the instruments of Keene, but it can also be shown that one of the moldings is identical (including a flaw) to that found on the 1675 Keene, proving that Jones was using Keene's tools. This is consistent with Keene's later workshop practices, where he jointly signed instruments with Edward Blunt and Charles Brackley.

[52] Inasmuch as makers ever used particular 'models'. More correctly, they are the same pitch and have the same basic case layout.

[53] The nameplate reads 1684, but that can be clearly seen to be an overpainting where the third digit was previously a 6. However, Thomas White had died by 1664. On the basis on the decoration – both by work of the maker and the soundboard and lid painters – a date of 1644 is more likely.

[54] The 1675 instrument has double stringing for G_1/B_1 and C, and the 1679 instrument has it for G_1/B_1, C, $C\sharp$ (probably with the note tuned to A_1) and D.

[55] This instrument and its stringing will be discussed in greater detail in a forthcoming publication by the author

or virginal from England and Europe with two full registers, but those instruments would not have the obvious 'break' in the register where it changes from one to two strings.[56]

There are two design aspects which, although not obvious to the general player, have a significant effect on the timbre of an instrument. The first is the use of separated wrestplanks, as found in instruments by Stephen Keene and Philip Jones. In the three instruments by these makers, the wrestplank for the treble strings is in its usual position at an angle between spine and the right end of the case, whereas the bass wrestplank (normally parallel, and attached to, the right case end) is moved to the left side, mimicking the general angle of the right hitchpin rail, but longer to act also as a hitchpin rail for the treble strings. The left bridge is very near – or over – the wrestplank itself. This effectively stops the left bridge from vibrating, meaning that only the area in front and to the right of the register is moving and creating sound.

The use of split wrestplanks is found on virginals with two distinctive soundboard barring layouts and, although the sample is small, two of the three are in playing condition. There appears to be an obvious tonal effect: the sound of the two playable instruments is notably less 'full', and, perhaps, more harpsichord-like. There is a clarity of tone – perhaps due to only a single vibrating bridge – as opposed to a 'richness' of timbre.

Another aspect of design, which appears to follow a general trend though all of the English virginals, is that the soundboard barring gets heavier (in the sense of there being more bars) the later they were made. As already mentioned, the earliest instruments – the 'AH' and 'Mar' virginals – have minimal barring, in which large areas of the soundboard are free to move. The earlier of the dated instruments – those of the 1640s and 1650s by makers such as Townsend, the White family and Loosemore – generally have a 'cut-off bar' in front (and often also behind) the register slots to support that area, two or three bars behind the keywell to the cut-off bar, sometimes with a further bar to the left of the keywell, and between one and three bars set under the straight part of the right bridge, almost perpendicular to it. Often these bars have cut-out sections where they cross under the bridge itself. In the instruments from the 1660s onwards, the number of bars increases, with usually four or five bars behind the keywell, often also passing under the left bridge as well. There are normally three or four (occasionally five) bars set under and almost perpendicular to the right bridge. Several makers used a markedly different approach in the area of the right bridge, having bars more-or-less parallel to the straight part of the bridge, about 3″ (75

[56] Some clavichords, in particular those from Hamburg and Scandinavia, have 4′ strings in the bass which also stop partway up the compass. Again, there is a 'break' in the sound where this change occurs.

mm) away from it. This is found on the earlier Stephen Keene virginal (1668),[57] and instruments by Leversidge (1666 and 1670) and Rewallin (1675 and 1679).

There are probably two contrasting approaches to the different barring designs. The more normal method, with perpendicular bars passing under the bridges, seems to be structural in concept. By using bars in this manner, the soundboard can remain comparatively flat, and not be subject to much bridge roll.[58] Although the decision to use such barring is essentially structural, cutting recesses under the bridge itself is an attempt to obtain a consistent timbre rather than a noticeable and sudden change of tone where the bars cross the bridge. The use of an increasing numbers of soundbars as time went on probably relates more to timbre than structure, suggesting that there was a conscious attempt to restrict the vibration of the board as a whole. This is in direct contrast to instruments which have the soundbars parallel to the right bridge, allowing the soundboard to act as a single entity over a much larger area.

It is difficult, when hearing the limited number of playing instruments, to determine the extent to which soundbars affected the sound. There are many variables in an early keyboard instrument which have an effect, and opinion of timbre is subjective. It is clear, however, that makers never strived for a single 'sound'. The increasing use of soundbars shows that there was an overall change in tonal characteristics over the 100 or so years during which these instruments were made, and modern reproductions of virginals demonstrate that the resulting timbre tended to become 'drier' and 'less complex' through the period. The early bentside spinets – dating from the 1680s – also tend towards the very controlled soundboards achieved by using soundbars, even though the actual overall soundboard area is considerably smaller. Similarly, the 1683 Charles Haward harpsichord – built essentially in the style of the bentside spinet – exhibits very heavy soundboard barring, including part of the soundboard blocked off by heavy planks and not able to vibrate at all. A comparison between the Theewes and Haward harpsichords – made at the start and end of the English virginal period – does much to illustrate the differing approach to soundboard barring over a century. The Haward harpsichord, with its original two sets of strings, but three

[57] But not on his later 1675 instrument, nor on a similar virginal by Philip Jones.

[58] 'Bridge roll' occurs when the soundboard rises on one side and dips on the other. The soundboard is therefore no longer flat and the top of the bridge moves in the direction of the dip. This is particularly problematic with the left bridge as it is at an acute angle to the direction of the soundboard grain. The roll is caused by the tension of the strings and also by the amount of side-draft, which tries to pull the top of the left bridge towards the spine. Normally, the effect occurs quickly (within hours or days) rather than being the result of tension over a prolonged period of time.

registers (two 'lute' and one 'normal' stop), is designed to provide tonal variation between each of the registers.[59]

Such a change in timbre and design over a period of more than a century is of little surprise, and these differences are less than may be found when comparing, for example, the Haward harpsichord with a Kirckman of the 1780s, or a seventeenth-century French harpsichord with a late instrument by Pascal Taskin. Just as the Taskin is not the ideal instrument for the music of the seventeenth-century French harpsichord school, it can be argued that later English virginals by makers such as Stephen Keene do not represent the tonal ideal of sixteenth-century composers. On the other hand, there is clearly a case that can be made for using models from the 1640s and 1650s for music from the first quarter of the seventeenth century, and no doubt this was done at the time. The tone of surviving instruments is, of course, an unreliable guide to their original sound. But, by hearing those instruments, along with various reproductions made in modern times, it is possible to determine certain characteristics. Although purely subjective, the sound does change as the instruments develop through the seventeenth century. The tone of all playable examples is closely related to each other. And even though bentside spinets are a notably different shape, much of the English virginal timbre can also be detected in the earlier surviving examples.

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[59] For full details about the Haward harpsichord, see Martin 2009, pp. 27–49. Although this instrument predates the last extant English virginal, its style is clearly related to the bentside spinets that Haward was making by that time.

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