MARTIN EDMUNDS

Venetian Viols of the Sixteenth-century

RESEARCH into the origins of the viol has become increasingly concerned with discovering how the earlier instruments sounded and were constructed. To do this we must look at surviving examples with eyes unclouded by the later traditions of violin-making. Ian Harwood published an article, 'An Introduction to Renaissance Viols' in *Early Music* (Vol. 2, No. 4, October 1974). The following year I was enabled by the Galpin Society Research Award to spend a fortnight in Vienna examining the very fine series of early Italian viols in the Kunsthistorisches Museum. With the friendly co-operation of Dr Wegerer, the Curator, I was able to examine them in detail. The present article will concentrate on descriptions of seven four-cornered Venetian viols including five from Vienna. Table 1 has already appeared in Early Music (Vol. 6, No. 4, October 1978, pp. 519–25) and lists the known instruments of this type which are accessible in collections. Table 2 gives detailed measurements and comments on the instruments which have been examined.

TABLE 1

Surviving 16th-century Venetian Viols

Maker	*Type*	*Location*	*Cat. No.*
Francesco Linarol	Tenor	Vienna	C71
Hainrich Ebert	Tenor	Brussels	M1402
Antonio Ciciliano	Tenor	Bologna	1761
	Tenor	Vienna	C75
	Bass	Brussels	M1424
	Bass	Vienna	C76
	—	Yale	—
	Large Bass	Vienna	C77
Batista Ciciliano	Bass	Brussels	M1425
son of Antonio	Bass	Brussels	M1426
Ventura Linarol	Bass	Witten collection, date on label 1582	
son of Francisco	Violone	Vienna	C78, date on label 1585

TABLE 2

Main points and dimensions of some 16th-century Venetian Viols

Maker	*Type*	*Cat. No.*	*String-length cm.*	*Down-bearing Ratio*	*Body-length cm.*	*Width of Bouts cm. Upper*	*Width of Bouts cm. Lower*	*Rib Depth cm.*	*o/a Length cm.*	*Front*	*Back*
Francesco Linarol	Tenor	C71	53–56	0.18	48.5	28.5	25.5	12.8–10.5	88	Flat plate bent, two transverse bars, small bass-bar.	Two bars, possibly later
Hainrich Ebert	Tenor	M1402	?52–55 originally	0.22	42.5	25.5	21.5	10.2–9.0	?87 original	Originally two transverse bars.	Two bars on edge, free edges chamfered.
Antonio Ciciliano	Tenor	C75	49–53	0.33	48.0	26.5	23.0	8.4	85.8	Carved, bass-bar modern?.	Fold bar only. Damaged by soundpost.
	Bass	C76	72?	0.3?	57	32.0	29.5		115		
	Large Bass	C77	80–84	0.29	70	40.0	36.5	14.8–13.5	131	Carved and bent, bass-bar ?modern.	Plate and bar below fold modern?, Colletti 1912
Batista Ciciliano	Bass	M1426	63–67	0.36	59.5	35.5	33.0	12.5	106.5	Carved, no bar or thickening.	No bar of any kind.
Ventura Linarol	Violone	C78	106–110	0.36	100.0	58.0	49.5	20.0	174	Carved, bass-bar modern?	Fold bar. Bar for soundpost may be later.

LINAROL, Francesco

The earliest instrument is a tenor catalogued by Schlosser[1] as C71. The label reads *Franciscus Linarolus Bergomensis Venetiis faciebat.* Schlosser suggests a date of 1540. Witten[2] infers that Francesco Linarol was born between 1511 and 1515, and had probably died by 1577 when his son Ventura started signing instruments. Venetian documents give Ventura's age as over sixty in 1601 and two instruments by him are signed 'son of Francesco' and dated 1581 and 1585. Unfortunately a printer's error in Schlosser's catalogue has confused several later scholars. The captions and numbers for the illustrations of C71 and C72 have been interchanged. Schlosser's description identifies C72 as having a pierced 'durchbrochene' scroll. This clearly refers to the guitar-shaped instrument on the right of his Plate XVI. The Linarol label quoted above is firmly fixed in the instrument with four corners, illustrated on the right of Schlosser's Plate XVII.

The Linarol tenor (Fig. 1) is the earliest survivor of a series of similar viols made by a group of Venetian makers. I assume that they were a common type of instrument which was developed early in the 16th century and which by the middle of the century was being made in some quantity. The Linarol has several features in common with this series of Venetian viols. The instrument has four corners, an arched front, a flat back, bent just above the upper corners, and a well-arched fingerboard set at a rather low angle. The scroll has flat sides decorated with spiral grooves, and three flutes running round the front and down the back of the scroll. The neck is thick and parabolic in section. It is joined to the body by a butt joint reinforced with one or more large nails. The neck joint slopes; it is not perpendicular to the plane of the front. As a result, where the back starts to swell out below the neck joint it is noticeably wider than the front. This makes the top ribs slope inwards as they rise towards the front. Around the top ribs, the back of the Linarol tenor is up to 5 cm. wider than the front.

At first glance, the construction seems conventional but it is noticeable that the ribs in the lower bout are arched upwards so as to be 1.5 cm. deeper at the tail-block than at the corners. This means that the front plate is arched transversely where it joins the lower rib. Examination of the inside, using a dental mirror, showed that the front plate is not carved at all but is made from a flat plate of wood, as for a guitar or lute, and then bent to shape. The arching is supported by light transverse bars, one above and one below the corners. A thin bass-bar runs between the two transverse bars. These transverse bars are about 1.5 cm. deep and 0.5 cm. thick. The edges of all the bars are chamfered to a sharp edge. Small blocks are glued to the ribs, supporting the ends

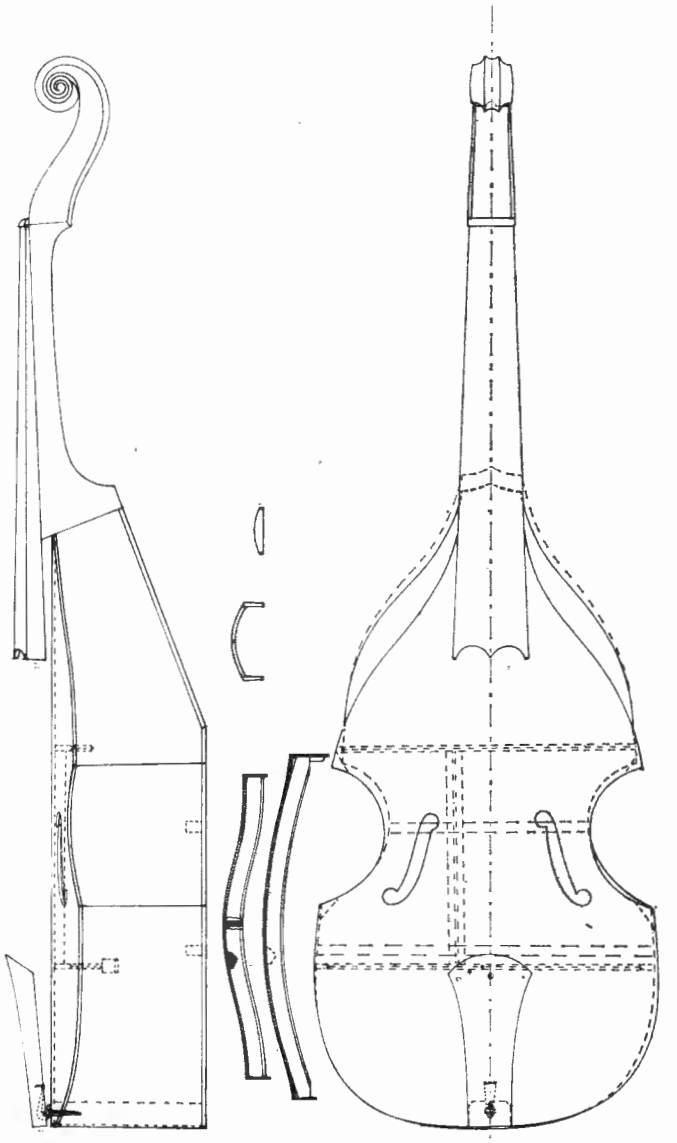


FIG. 1. *Tenor viol by Francesco Linarol, C71 Vienna.*
This drawing shows the arrangement of barring on the front and back, and the front bent from a flat plate of wood. In between the two views are sections, taken perpendicular to the length of the instrument, showing the two curved transverse bars and the cross section of the fingerboard.

of the transverse bars. They provide extra support for the bars which were probably glued in place between the ribs before the front was bent and fitted.

The back is jointed down the middle with traces of parchment reinforcement. The original parchment back linings are cut, and traces of fresh glue at the neck-block suggest that a restorer took this route and wisely refrained from disturbing the bent top. There are two bars on the back but their edges are not chamfered so it may be that they are later additions; however they are in the same positions as bars on the back of the Ebert viol. There is no sign of any plate to support a soundpost.

The neck is butted to the neck-block, with one large and three small nails reinforcing the joint as mentioned above. The back does not continue over the neck joint. There is no sign of any alteration to the neck, which preserves its original flat angle. The base of the nut is 2 cm. above the line of the front. As a result the angle made by the strings over the bridge is very small and the force exerted by the bridge perpendicular to the front is only about 0.2 times the total string tension. By contrast the thrust of the bridge feet on the top of a baroque viol would be as much as 0.4 to 0.5 times the string tension. The string-length is about 54 cm. This would allow gut strings to be tuned G–g'.

The fingerboard is carved from a thick wedge of maple similar to the neck and body of the instrument. At the end it is 6.5 cm. wide and arched 1.1 cm. The sides of the fingerboard are flat and 1.5 cm. deep below the arching at the end. To lighten the balance this very thick fingerboard is hollowed underneath right up to the nut.

The tailpiece matches the rest of the instrument in colour and varnish. It retains the original metal hook which is used instead of an end-post or tail-gut to attach the tailpiece to the body. The hook fits into a screw-eye which passes through a hole in the front plate into the tail-block as shown in Fig. 2. The screw-eye of C71 is recent. The hook is shaped somewhat like a miniature picture-rail hook (see Fig. 3). It is recessed into a tapered mortise in the back of the tailpiece with the broad end of the hook driven into the wood of the tailpiece. The stages in making a replica of this type of hook are shown in Fig. 4. An almost exact copy can be forged with minimum skill. A tailpiece with such a hook can support at least 60 Kg., or more than double the likely string tension.

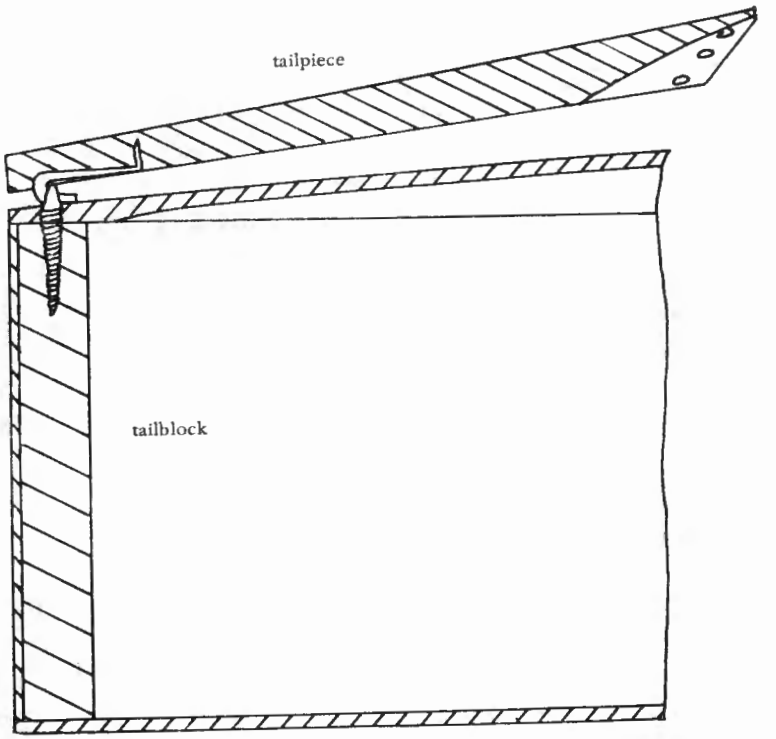
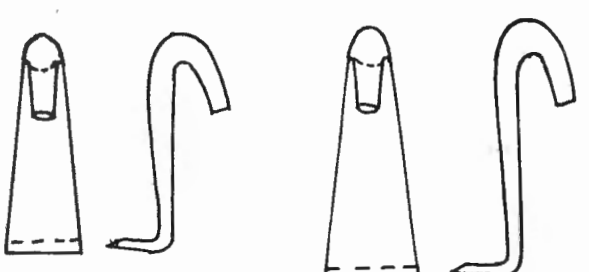


FIG. 2. *Cross section through the tailpiece and tailblock of a bass viol, showing hook and eye tailpiece fixing. Antonio Ciciliano, C77 Vienna.*
The hook fits snugly in a tapered mortise. The turned up portion is driven into the wood of the tailpiece.



Francesco Linarol
C71 Vienna

Antonio Ciciliano
C77 Vienna

FIG. 3. *Tailpiece hooks drawn full size.*

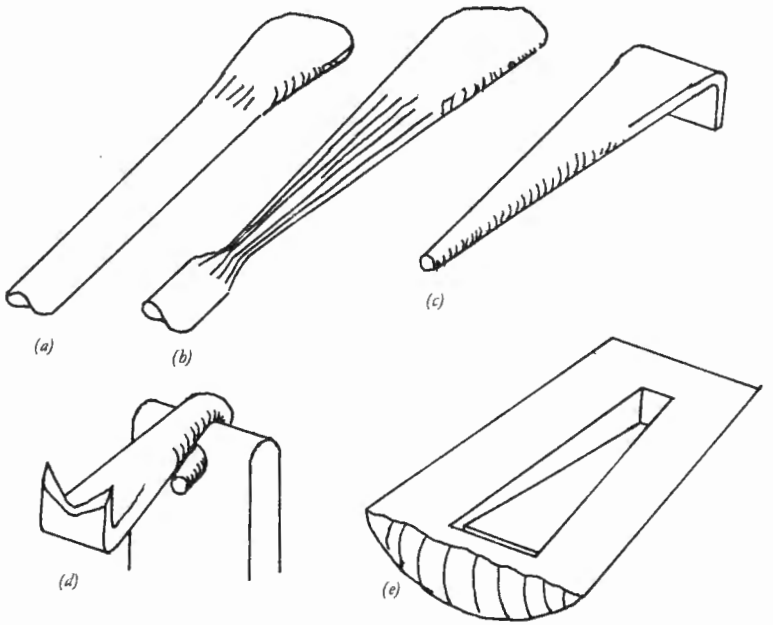


FIG. 4. *Stages in forging a hook.*

(a) broad flat forged on end of 8 mm. mild steel rod.
(b) tapered section forged on rod.
(c) cleaned up with file and flat bent down.
(d) hook bent on steel former.
spikes cut on flat to drive into tailpiece.
(e) mortise in tailpiece ready for hook.

EBERT

The next instrument, also tenor-sized, belongs to the Brussels Conservatoire, catalogue No. M1402. The printed label reads HAINRICH EBERT. Witten states that Ebert is mentioned in Venetian documents of the 1560s. This tenor has many features in common with the Francesco Linarol C71, especially the high nut, and the two are probably contemporary. Charles Beare has pointed out that the front plate, which is carved with a small central bar integral with the wood of the plate, is probably later than the rest of the instrument. It was possible to re-examine the interior with the instrument open, after seeing the front barring on C71. On each of the ribs close to the

corners are marks of a block which has been removed, in exactly the position where it would have supported an original transverse bar. The lower rib and the waist are arched up and it seems almost certain that the original front plate was bent and barred transversely as in the Linarol. However there is an important difference between the two. The ribs of the Ebert are only slightly arched. It is unlikely that the restorer who replaced the top around 1600 would have cut the arching down from 1.5 cm. to its present 1.1 cm. If he had cut the ribs down he would have made the front edge lie in a plane to simplify fitting a new top. Two explanations occur to me. If the original top had been made from a very slightly arched flat plate we would have had an instrument very close in its construction to a lute or guitar. It may be that the flat arching led to the failure of the top; this could explain why it had to be replaced. The second hypothesis is that the original top was both carved to give more arching and transversely barred. The Ebert has a purfled decoration on the fingerboard whilst the Linarol is not purfled at all. It is a wild speculation, but possibly carved fronts were used on more decorated instruments whilst flat fronts served for the 'student' model.

In its other characteristics the Ebert is very similar to the Linarol. The shoulders slope forward. The scroll is of the same design but embellished with a delightful little flower at the centre. The fingerboard is purfled with a simple geometrical knot. Lines of purfling run along the edges of the fingerboard. If this purfling were originally parallel with the edges then the fingerboard must have been around 6 cm. longer. There is a neat splice just below the pegbox where the neck has been shortened by about this amount. Originally, then, the string length would have been 54–56 cm., allowing gut strings to be tuned *G–g'*.

The front plate has a hole for a screw-eye, and this hole continues in the tail-block. There is no trace of any end-pin or tail-post. Unfortunately the original screw eye is missing and the tailpiece is a 19th-century replacement. That restorer has fitted his own design of hook nailed in place with carpet tacks. The back has two transverse bars above and below the corners at the same positions as the marks for the presumed front bars. The back bars appear to be original and have the same sharply chamfered edge as the front bars on the Linarol. In its original state the Ebert tenor would have appeared very elongated to our eyes, for the body is only 42 cm. long or about 80 per cent of the string-length. This suggests that the maker wanted the body of the instrument to work best on the higher notes.

CICILIANO, Antonio

The next two instruments are by Antonio Ciciliano. Witten states that Antonio Ciciliano is recorded in Venetian documents in 1566, 1569 and 1581. Vienna has three viols by this maker. Unfortunately I was only able to examine two, the tenor, Schlosser C75, and the large bass, C77. The tenor differs from the other instruments in having the ribs turned slightly outwards at the corners (Fig. 6*a*). Apart from this it conforms closely to the general Venetian pattern. The ribs are shallower than on the Linarol tenor and have the same depth all round. The top is carved from a single piece of quartered pine oriented with the coarser rings from the heart of the tree on the bass side. These makers preferred close-grown timber for the front. Here there are 14 rings to the centimetre in the treble, 8 in the middle, and 3.6 in the bass.

The back has a single very small bar across the fold. There is no plate, and the soundpost which is fitted at present has caused serious distortion to the back. There is a bass-bar but this, like the soundpost, is probably a recent addition.

The neck-block has nail holes but no nails. Traces of glue and filler suggest that the neck has been removed but it has probably been refitted at the original angle. The base of the nut is level with the top of the ribs. The fingerboard is well arched with deep sides and is carved away underneath, almost to the nut, for lightness. The geometric design on the fingerboard is similar to the Ebert but a later hand has gnawed away the deep sides of the fingerboard to make it appear lighter where it projects over the front.

The tailpiece is later than the rest of the instrument and is now attached with an end-pin and tail-gut. Under the tailpiece, the hole in the front plate for the original screw-eye is clearly visible. Looking inside, a split in the tail-block shows why this change was made.

The large bass by Antonio Ciciliano, C77, is made from splendid burr maple. The figure is so pronounced that in parts of the ribs a torch can be seen to shine through, between the burrs. Wood so delicate could not span the back unsupported, so Ciciliano has laminated the back with an inner lining of hardwood, probably pear or walnut. The back averages 0.40 cm. thick of which the inner lining contributes 0.25 cm. The V-cut on the inside at the fold goes right through the lining and part-way through the outer burr. The back was probably laminated first and then cut and folded like a solid one.

The rib around the lower bout is arched about 1.5 cm., similarly to the Linarol tenor; however the top is carved. On looking inside, it is

apparent that the top was bent to increase its arching after it had been carved from a block of which the side adjacent to the ribs was initially plane. A triangular area (about 20 by 20 cm.) under the tailpiece shows considerable scorching which indicates that heat was used to set the extra arching in the lower part of the front plate. This seems to be a construction technique midway between the bent front of the Linarol and a fully carved top. The effect is to give an increased arching whilst at the same time economising on labour and more particularly on material. The technique is not so frightening as one might suppose. A large heated iron is required with a double curvature which suits the front. The front plate is heated and drawn into the required curve in much the same way as one bends ribs.

Even in the 16th century first-rate wood was scarce. The front of C77 is made from very close-grained pine. At the centre joint there are 18 growth rings in one cm. At present there is a bass-bar but this does not appear to be original. It is quite possible that the instrument was built originally without a bass-bar. The top plate thickness is unsymmetrical with a thickening on the bass side. Viols based on this instrument work well without a bass-bar. A label on the back indicates that Alfred Colletti carried out repairs in 1912. The present corner-blocks, bass-bar, a bar on the back below the fold and a very thick soundpost plate probably all date from Colletti's restoration.

C77 has its original tailpiece and hook which is very similar to that on the Linarol tenor, but here the original screw-eye is present. The screw-eye is made from wrought iron or steel with a neatly rounded eye just large enough to receive the hook. The tapered thread has been cut with a small round file. (Like the hook, this is not a difficult piece to work from a short length of 6 mm. steel bar: the eye is formed and pierced with a punch; the shank is worked to a taper, after which it is cleaned up with a file and given a thread (see Fig. 5). Alternatively, an eye can be forged on the parallel shank of a No. 14 wood-screw from which the head has been removed. I prefer to cut a tapered thread, which holds better in the end grain of the tail block.)

The neck and fingerboard are certainly original. The glue at the neck joint has weakened but the two large nails originally fixing the neck to the neck-block are still holding securely. The nut is level with the line of the top of the ribs. The string-length is about 82 cm. Since the original strings would have been gut, the tuning must have been lower than *D–d'*. Tuning in *C–c'* is possible, as mentioned in Ganassi. However, at this string-length the frets are separated by about 4 cm., which is about the limit to allow an average hand to use one finger on each fret. It may therefore be justified to tune a viol of this size down,

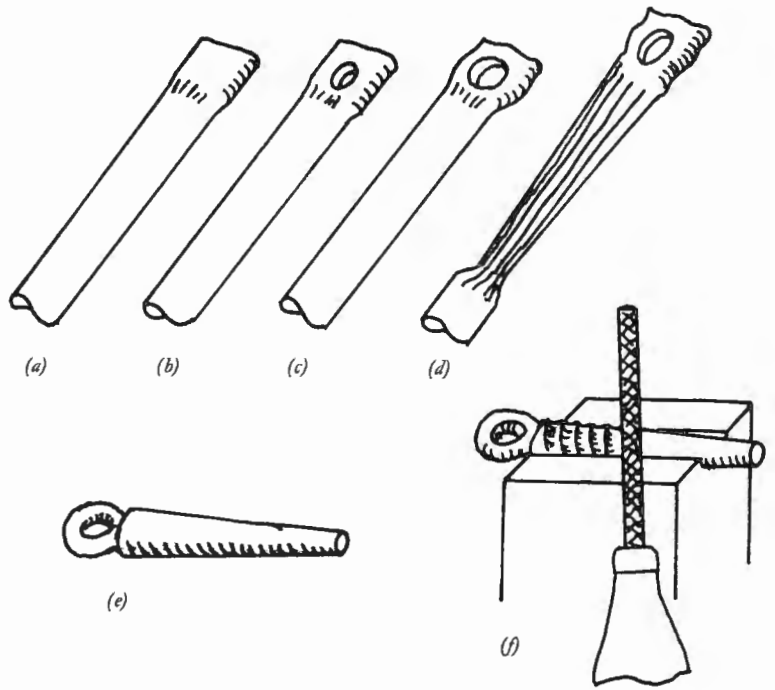


FIG. 5. *Forging a screw eye from mild steel rod.*
(a) 8 mm. rod forged flat at one end.
(b) small hole drilled or punched.
(c) hole enlarged with tapered drift.
(d) tapered shank forged.
(e) eye and shank cleaned up with file.
(f) thread cut with 3 mm. round file.

slightly below the breaking pitch for the top string. Ganassi reminds us to fit thicker strings if this is done. Instruments based on C77 work well tuned to modern *A–a'*. This allows a consort to be made up with the bass in A, the middle voices in D and the top voice in G, i.e. a fourth apart. Alternatively, if the high instrument has a string length of 48 cm. it can be tuned *a–a''*, an octave above the bass. Tunings like this may explain the rarity of treble viols from the 16th century.

A brief comment on C76 by Antonio Ciciliano can be made based on photographs although I have not been able to examine it at first hand. The wood and general style appear very similar to C77 except

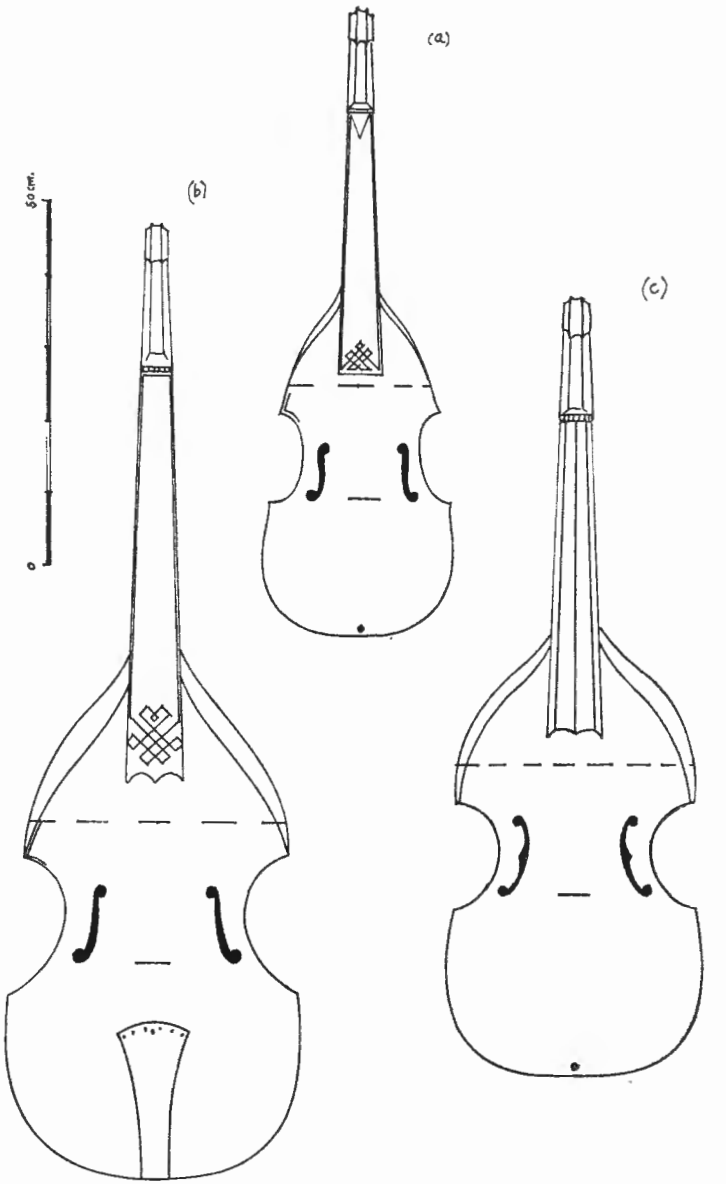


FIG. 6. *Viols by the Cicilianos*
(a) Tenor by Antonio, Vienna C75. (b) Large Bass by Antonio, Vienna C77.
(c) Small Bass by his son Batista, Brussels M1426.

that the body is smaller in proportion to the string-length of about 72cm. Seen end-on from the tail there is no arching in the lower rib. The front is carved but the joint between the front and the ribs lies in a flat plane. As the two instruments appear to be a closely related pair, it would seem likely that the use of bending for the front of C77 was dictated by the size of the instrument and the availability of a very fine wedge for the front, which was slightly too thin for carving alone to give sufficient arching.

CICILIANO, Batista

For the last two instruments we move on to the next generation of makers. Brussels owns two very similar instruments by Batista Ciciliano, catalogue nos. M1425 and M1426. The present description will refer to M1426. This is a small bass signed 'Batista son of Ant° Ciciliano in V[a]' and continues the characteristic Venetian features. The shoulders slope forward and the scroll is similar to the others but omits the flower at the boss and truncates the fluting on the back. Batista also uses a chubbier outline and C-holes, instead of the un-nicked f-holes used by his father.

It was possible to see the interior of this instrument whilst it was open. Except for the possible addition of thin lining strips, the interior does not appear to have been touched by restorers. There is a small rectangular tail block. The back centre joint is reinforced with parchment. There are no bars or plate on the back and there is no trace of them ever having been present. No corner-blocks are used. The corner joints are mitred and lined with parchment. The neck is joined to the neck-block with a nail. The fingerboard is similar to that of the other viols but the inlay consists only of three longitudinal strips.

The front plate is made from two pieces of pine, jointed down the centre line and very evenly thicknessed. No bass-bar has ever been present, nor is there any longitudinal thickening of the front. Although there are pressure marks on the front where a soundpost has been fitted at some time, it seems unlikely that this was originally intended since there has never been any reinforcing plate on the back.

Again the front has a hole for a hook-and-eye tailpiece-fixing which continues down into the tail-block. The tailpiece is recent, made by the same hand as that now on the Ebert, but the screw-eye is original (see Fig. 7). A neat round eyelet is forged on the end of a short tapered rod on which a shallow thread is cut with a round file. It is so exactly similar to the one on C77 that I am convinced that these two screw-eyes, now in Brussels and Vienna, came from the same source. Batista

was probably using the same box of fittings as his father and re-ordering from the same supplier when stocks ran low.

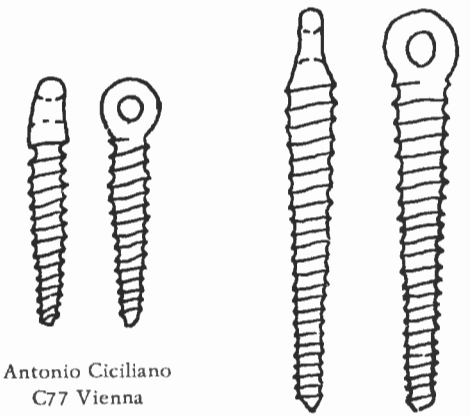


FIG. 7 *Screw eyes drawn full size.*

LINAROL, Ventura

Finally we come to the violone, now in Vienna, by Ventura Linarol, Schlosser C78. He signs his instruments as 'son of Francesco' and dates the violone 1585. The craftsmanship is superb and the instrument seems hardly to have been used since it left the maker's hands. In most particulars it appears very close to the rest of this family of instruments. Variations are firstly the shoulders, where the ribs are perpendicular to the front plate, so that the back and front have the same width. Secondly, the tailpiece is flat and fixed with gut or wire to a button fitted into the tail-block through the middle of the lower rib. The instrument is large, with a string length of 108 cm. which is similar to a modern double bass. It was built to be played resting on the floor as there is a rubbing strip fixed over the joint between the lower rib and the back to take this wear.

The fingerboard and tailpiece are veneered in ebony, with triple purfling around the edges. The front, back and scroll are also purfled. The neck and fingerboard are set at the usual angle, with the nut level with the top of the ribs. Four large square nails go through the block into the heel of the neck. Inside, the instrument is very clean and seems

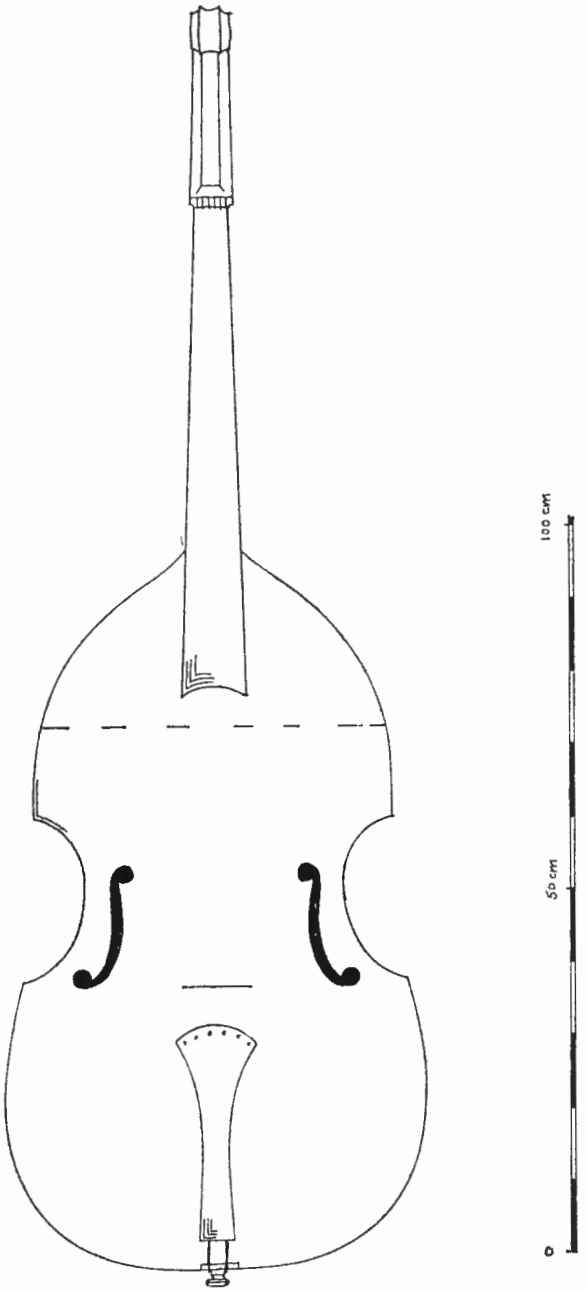


FIG. 8. *Violone by Ventura Linarol, son of Francesco, Vienna C78.*

hardly to have been altered. There are very small corner-blocks and separate lining blocks are spaced at intervals around the joint between back and ribs. A shallow bar is glued to both parts of the back across the fold. Short lining blocks, about 3.5 cm. wide by 1 cm. deep span the centre back joint at even intervals. There is a bar across the back on which the soundpost now stands. The bar may have been added: it is cut away at its ends to avoid the corner-blocks and two of the short lining blocks at the waist. There is an irregularity in the even progression of blocks spanning the centre join where it is crossed by the bar. The blocks immediately above and below the soundpost bar are quite close. If the bar, which is about 4 cm. wide, were not present, there would just be room for one more block in the regular sequence down the centre join. Smears of glue occur around the bar but nowhere else in the interior. For these reasons I suspect that the soundpost bar may have been added later, which could imply in turn that the soundpost too is later.

The front is joined to the ribs with no linings. At present there is quite a large bass-bar, but this too looks to be a later addition. If these conjectures are correct then the original internal construction would have been similar to M1426 by Batista Ciciliano.

CONCLUSIONS

By the second half of the 16th century three makers were producing viols with individual differences but a close family resemblance. Two of these makers passed the trade on to their sons, who were active in the last two decades of the century and still making very similar instruments. I believe that the general style was established early in the century and that closely similar instruments were being built in substantial numbers throughout the century.

At first these viols may generally have had fronts made from a flat piece of wood bent over transverse curved bars. This would fit in with the theory that the viol developed from the guitar (vihuela). Later, carved fronts were preferred but the earlier tradition allowed makers to continue combining carving with transverse bending, particularly on large instruments where a substantial economy in materials could thus be made. Internally the back of the instruments was either unbarred or had one or two bars set on edge above and below the corners. All the bars which I have seen that were definitely contemporary have chamfered top edges which could not have supported a soundpost. Instruments survive with no soundpost plate but none survives with an original plate. This, combined with Ganassi's advice

on moving the bridge to adjust the pitch of a viol, suggests that he did not expect a soundpost to be used.

On viols with a bent front, the fingerboard lay nearly parallel to the line of the front, with the nut raised above the line of the front. Later, with a carved top, the neck was moved slightly backwards, taking the nut level with the top of the ribs. Always the fingerboard was substantially curved and very thick, with deep edges. The balance was improved by hollowing underneath the fingerboard.

The tailpiece was rounded similarly to the fingerboard. This implies a bridge that was comfortably curved to allow easy access to each string. The tailpiece was fixed to the body by a hook-and-eye arrangement. Traces of a hole in the appropriate place can be seen in several other early viols, including some of the guitar-shaped ones in Vienna. Since the news of a hook-and-eye has prompted restorers (and may prompt modern makers) to devise their own versions, detailed drawings are included of the original Italian design. This works perfectly well and, as we have seen, is very easy to copy.

Viols with transversely-barred bent fronts had a very thin longitudinal bar on the bass side. At least one carved front survives which never had any form of bass-bar. Several other early viols have fronts with an integral bass-bar left on the inside when the rest of the plate was carved. The violin tradition among later repairers will often have led to a bar being fitted, although there is a violin made by Ventura Linarol in 1581 (Schlosser C96) which has never had a bass-bar. The tool-marks on the inside of this violin's front plate are so deep that it would be impossible to fit a bar. My conslusion is that the Venetian viols usually had no bar.

Fronts may have been carved from a wedge with a plane under surface. The maker was then free to increase the arching, if necessary, by deepening the lower rib at the tail-block and bending the front to fit. Alternatively, the two halves of the wedge may have been jointed at an angle as can be seen in the two early basses in the Hill collection (Boyden 2 and 3). This trick was especially useful on large instruments, where it could make significant savings of wood.

NOTES

1 Julius von Schlosser, 'Die Sammlung Altermusikinstrumente, Vol. III'. Vienna 1920.

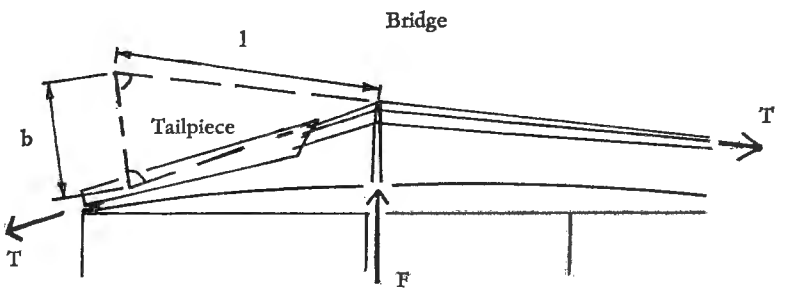
2 Laurence C. Witten II, 'Appollo Orpheus and David'. *Journal of the American Musical Instruments Society*, Vol. 1, '75, pp. 5–55.

APPENDIX

Downbearing: the ratio between bridge pressure and string tension. When a viol is built the maker must decide on the geometry of neck, strings and bridge. In Table II the Downbearing Ratio is given. This ratio summarises the result of the makers choice of geometry. I would suggest that the ratio should be included whenever the dimensions of a viol are specified, since it distinguishes between instruments which require a very rigid front and those where the lower thrust on the front allows less rigidity. String tension can be measured by removing a string from its peg and tying it to a spring balance. The spring balance will read the tension directly when it is pulled so as to bring the string up to pitch. The tension in each string should be approximately the same if they are to feel even under the bow. On each side of the bridge the string tension will be equal and directed downwards pressing the bridge onto the front.

The Downbearing Ratio is measured as follows. Viewing the viol from the side, construct an isosceles triangle with one equal side the continuation of the line from nut to bridge, whilst the other equal side is the line of the strings from bridge to tail-fixing. The ratio of the short base of this triangle to one of the equal sides will be the same as the ratio between the string tension and the downbearing on the bridge. This ratio is the Downbearing Ratio.

The early viols described in Table II start with the ratio as low as 0.18 with a flat bent front; and rising to 0.36 for the 1585 violone. If one moves forward to the 1720 Nicholas Bertrand in Paris, the ratio has increased to 0.46. It is also interesting to look at some modern designs with very high bridges and the necks raked back. It would seem that these instruments are designed and intended to function in a totally different way from the early viols.



$$\text{Downbearing } \frac{F}{T} = \frac{\text{force on bridge}}{\text{total string tension}} = \frac{b}{l}$$

FIG. 9. *Side view of viol.*