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FoMRHI Quarterly

FELLOWSHIP OF MAKERS AND RESEARCHERS OF HISTORICAL INSTRUMENTS
Honorary Secretary: Jeremy Montagu, 171 Iffley Road, Oxford OX4 1EL, U. K.

FELLOWSHIP of MAKERS and RESEARCHERS of HISTORICAL INSTRUMENTS

Bulletin 89 **October, 1997**

It's Time to Renew your Subscriptions: For those of you who've not done it, it's time to renew again. Same rates (£10.50 for UK and everywhere by surface; plus £1.50 for air to Europe, or £3.00 for air anywhere else, and plus £5.00 – just over $8 – if you are paying in currencies other than £ sterling), no increase (your fault – Qs have been smaller than they might have been because you've not sent Comms, so printing costs have been down). There's an Invoice with this Q (headed Invoice to help those who can pay through an office). **Do please look at the back of it.** If your name is there, you're already clear for 1998 so don't pay again. As always, if you can add a bit it helps those (there are still number of them, and we're always happy to hear of more) in countries whose currency is not practicably exchangeable. Where conversion costs are a nuisance, try getting together with fellow-members; it costs us much the same to convert a cheque for one member as a single cheque for a dozen or more – just make sure that Barbara gets all the names. And please don't send things registered or recorded delivery because they don't deliver them and she has to chase down to the post office to collect them, and believe me she's busy enough making bassoons that she has no time to waste on that. Cheques etc made out to FoMRHI, please (don't try to combine them with payments to Barbara – it creates total confusion with her tax inspector), and sent to Honorary Treasurer FoMRHI, 21 Broad Street, Clifton, Beds SG17 5RJ, **by January 1st**.

The London Early Instrument Exhibition: You'll find quite a few new and restored members in the Members' List Supplement herewith. That's one of the advantages of the London Early Instrument Exhibition, which took place at the Royal College of Music in September. Another is that I get to see many of you there, and to meet for the first time some of you whom I've known by correspondence for a long while. There is currently a disadvantage, and that is that the London Exhibition is timed to clash with that at Utrecht, and a number of people feel that if they have to choose between the two, they're better at Utrecht. There aren't so many occasions in the year when we can all see each other and see what we are each producing nowadays that we can afford such clashes. I realise that there are problems with the Royal College – we can only use the place in vacation and we have to fit in with their timetable, but surely we can move one week one way or the other. Because Utrecht combines the exhibition with a major festival and concert series, they have to plan so far ahead that it may well be easier for us to shift than for them, and many of us hope that it will be possible for us to do so another year and stop this somewhat insular stupidity. The other point, of course, is do we want an exhibition every year, and the general feeling seems to be that we don't. This is another reason that some people weren't exhibiting this year. The expense is more manageable every other year than each year, and also it is more practicable to have some things to exhibit if there is a year in between to catch up with the waiting list. It can be a bit rough to ask people to wait longer than usual for their orders just so that the instruments they have ordered can be seen, and played, as samples at the RCM.

Another Apology: I've done a bit badly this year. Not only did I totally corrupt a member's name (see the last Bull.), but I have now discovered that for a number of years I have inverted a member. Enzo (first name) Guido (surname) has been the wrong way round in our Members' List ever since he joined in 1995, and I do apologise to him. The trouble is that I've known people both with Enzo as a first name and with Guido, and I guessed wrong – I'm sorry!

Obituary: We have lost two members since the last Bulletin, Caroline Jeanprêtre in Switzerland and David Rycroft here in Britain. Caroline I never knew, save as a member; David I have known for forty years or so, both as a friend and as a colleague, as a brass player and as an ethnomusicologist, and of course most recently as editor of the *Galpin Society Journal*. His successor in that post is Charles Mould, a co-option at present until the post can be formally elected at the next AGM.

A Warning: Carey Beebe warns me that all Australian phone (and of course fax) numbers are changing to eight digits. I have not received any other corrections yet, so if you need to telephone or fax any Australians in this list (or any other list of course) you'd better check their numbers first. Phone calls I imagine will be intercepted as they are here (let's hope that the electronic voice won't sound quite so condescending and patronising as ours does), but I don't know what they do about fax.

Stolen Instruments: The Cambridge University Faculty of Music had a break in and a couple of flutes were stolen. One is a 1-key flute by Christopher Gerock, the head marked: [tudor rose] / C.GEROCK / 76 / BISHOPSGATE ST / LONDON, varnished boxwood, ivory mounts, flat ivory cap, square silver key with corner nicks, largish oval embouchure 10.9 x 9.2 mm, foot ring cracked, OL 630 mm, pitch d′ at A@427 Hz, in a modern case. The other is an anonymous, conical Boehm system, probably English, cocus, with white bronze (german silver etc) mounts and keys, OL 658mm, pitch c′ + 30 cents = A@448 Hz, in its original wooden box, one of whose hinges is breaking out. If anyone sees them, could they please tell the Librarian at the Music Faculty (or me and I'll pass it on).

Recorder Fingerings: A note came from Jan Bouterse which may interest others: "I got a letter from Thomas Sherwood (Cambridge) who told me that there is an e-mail discussion on the Recorder Teacher Homepage abut recorder fingerings (English-fingering and Baroque fingering). My question was: why is b2 on baroque alto recorders often so sharp (with Ø 1 2 3 . 5). The e-mail discussion started with John Child (a recorder teacher, his email address: http://ourworld. compuserve.com/homepages/john child/) [I'm pretty certain there's a syntax error here, with a space between 'john' and 'child', but those used to http may be able to sort it out – JM]; he became answers from Bob Andrews (from Baroque Music – Live!), John and Susie Howell (Virginia Tech Department of Music) and David Bellugi (Professor of the 'Luigi Cherubini' Conservatory of Music in Italy). One of the outcomes of the discussion: for the b1 it is easy enough to close hole 7, if necessary (0 1 2 3 . 5 6 7), for b2 hole 6 must be half-covered (no problem on renaissance recorders with big holes) or shaded. Baroque instruments with 'modern' English(= Dolmetsch) fingerings, have a big fifth hole what is not so nice and has perhaps influence on the sound quality. On historical instruments the holes 4, 5 and 6 are more evenly sized. My comment (Jan B.) No old fingering chart gives the possibility of shading or half-covering hole 6 for the b2! However, my thanks to Thomas Sherwood for sending me some prints of the discussion."

Queries: A new departure here. One from Marco Perini is accompanied by a drawing, so I've done it separately as FoMRHI Query (instead of a FoMRHI Comm). Another, about Lira and Lirone, is also accompanied by drawings, so I've left that to Eph to insert separately.

Musicians & Instrument Makers Forum: This is a web site (http://www.mimf.com) which invited anyone coming under that header, though mainly addressed to makers, to be in touch, visit the site, chat on it, etc, and to take out advertisements on it (which costs of course). I told them that we didn't have a web site, and they replied that "FoMRHI still has a working FTP site with info and back issues at a Dartmouth address" – anybody know about this? I'm very happy that we have such sites where people can get information, but I don't remember hearing about this one (which may be bad memory on my part). They've offered to set up a web site for us, but it would cost "as little as $240 a year plus design fees", and I'd rather we didn't spend as much of your money as that. On the other hand, they're right and we should have a homepage and web site. Any volunteers to establish and run one for us? Meanwhile, drop in on their site and see what you think of it. If like me you've got email plus technical problems which don't allow you access to net sites, MIMF is run by Nick Von Robison (n.v.rob@deltanet.com, and nick@mimf.com) and Deb Suran (deb@mimf.com) and you can contact them that way.

A Secret Conference: Probably not the way they'd like it headed, but the Kunsthistorisches Museum in Vienna has a three-day conference on 600 Years of Harpsichord Making in Austria starting the day after tomorrow and they circulated publicity about it by email on 24 September. A pity because it sounds interesting and I would have hoped that as one of our members they would have liked us to tell the rest of our members about it. No point in telling you any more now.

Codetta: For the moment that's it.

Deadline for next Q: New Year's Day I should think, but remember that posts get gummed up at that time of year and that, in this country at least, the post office jumps at every possible excuse for not delivering any letters today, so try to get things in early.

Remember, too, your renewals. Those that reach Eph after he's prepared the envelopes for the January Q are not likely to go out until the April Q, and remember it takes a few days for renewals to get through the pipe line. So any that arrive after the first week of January may sit until April. You have been warned!

Remember, too that FoMRHI was started as a medium of exchange – exchange is one of those funny two-way words – you can't exchange one handed. If you like to receive information (and I can't imagine why you've read this far if you don't), do please remember that all our other members like to as well. **So please write something for them to read!**

Have a nice autumn and first half of winter.

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BULLETIN SUPPLEMENT

Ephraim Segerman

Comm 1528: In that Comm. when equating the tension differences in Hooke's Law with those in Mersenne's Law, I stated that I assumed constant cross-sectional area A. That is unnecessary. If A changes significantly between the two tensions, Hooke's Law becomes $T/A-T_o/A_o = E(L-L_o)/L_o$, and Mersenne's law becomes $T/A-T_o/A_o = 4\rho L_o^2(f^2-f_o^2)$. We can then still equate the two equations, with the result given in the Comm.

Were early open-wound strings tigerlines? John Phillips has told me about a paper by Pierre Jaquier in the *Proceedings if the International Viola da Gamba Symposium*, Utrecht 1991 entitled "Rediscovery of a portrait of Jean-Baptiste Forqueray: discovery of some elements of the represented 'basse de violle'" The painting is approximately life size, is unrestored and is finely detailed. It is, and always has been, owned by a direct descendant of Forqueray. On p. 81, discussing the half-covered c and g strings, Jaquier wrote: "the way the half-covering is represented suggests that the silver wire is not wound over a normal string, but rather in the hollow of a laid (twisted) string." This could be evidence that early open- or half-wound strings were wound on roped-gut cores (what we have been calling catlines) and were what we have been calling 'tigerlines'. I would like to know in detail what the painted strings look like before accepting this as reliable evidence. Has anyone else closely examined the strings in the portrait?

London Early Music Exhibition

The funeral of Princess Diana left the Exhibition very empty on Saturday, though the start was delayed till after the procession was over. Friday and Sunday were fairly normal compared to recent years. We were told that there was a record number of exhibitors this year. There certainly was very far from a record number of visitors. I've noticed a fall in visitors since the Exhibition has become yearly. We didn't want it to become yearly. We make a net loss at each exhibition, but it is worth our coming just for the chats with visitors and other exhibitors that we would not otherwise meet face-to-face. Alternative years is enough for that. When it was every other year, the organisers (The Early Music Shop) polled the exhibitors about having it every year and the majority was against it. They went ahead anyway. It is good business for them. I suspect that they are counting on our feeling that if it is on, we can't afford to miss it. We have tried yearly over the last three years, and have decided to go back to alternative years ourselves.

So next year will be the first ever Early Music Exhibition without NRI exhibiting. If there are other exhibitors who have also decided to exhibit every other year as well, it would be nice if we picked the same years. Then we would all be exhibiting in the 'bigger' years, and could feel that we haven't missed that much in the 'smaller' years. So, fellow exhibitors and regular visitors, we shall see you there again in 1999!

The burn marks on the insides of surviving English viol soundboards

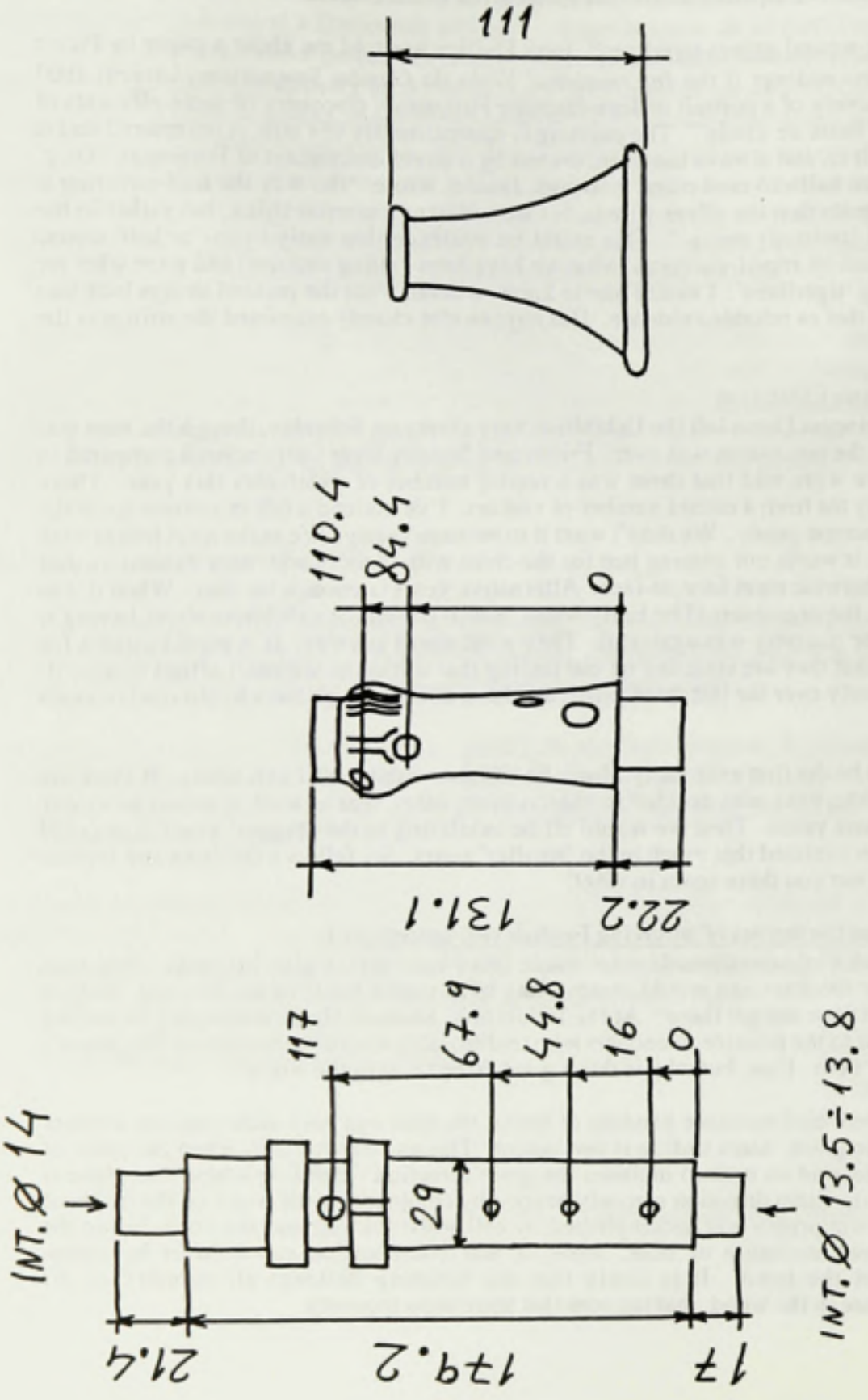
Surviving English viol soundboards were made from bent staves glued together, and then thicknessed. The thicknessing would remove any burn marks made in the bending, so how did the burn marks we see get there? At the Exhibition, Michael Heale mentioned to me that this is very similar to the practice of coopers who traditionally singed the insides of their barrels after assembling them. Fine, but why is this a good thing to do to the wood?

It seems that in heat-and-moisture bending of wood, the cells can only slide past one another by shear along the grain. Such sliding is permanent. This can happen only when the plane of the bending circle (and its centre) includes the grain direction. Bending where that plane is perpendicular to the grain direction can only happen by compressing the wood on the inside of the curve. That compression is accomplished by cell walls folding into the voids inside the cells. Given heat, moisture or time, some of that compression can recover by creep, straightening out the bend. It is likely that the singeing destroys all memory of the uncompressed state in the wood, making sure that there is no recovery.

FoMRHI Query

Clarinets by Koch

Marco Perini has most of a clarinet by Koch (see his drawings). Can anyone produce comparable measurements for the barrel and the right-hand joint.



At the Lehrkanzel "Musikalische Stilkunde und Aufführungspraxis",
Dept. Musikpädagogik, Hochschule für Musik und darstellende Kunst , Vienna
since the autumn 1996 the research project started under the title:

Lira da braccio and Lirone: Reconstruction of the Technique and Repertoire

Lira da braccio and Lirone were the most important bowed instruments of the Renaissance and the Early Baroque. They have been played by most prominent musicians and composers of that period (A. della Viola, A. Striggio sen., G. Caccini etc.) or artists (L. da Vinci, Rafaell, M. Ficino, P. della Mirandola etc.). Both instruments have been used for improvised(vocal or instrumental) music, which caused almost compleat lack of primary sources. Because of this fact it semmed to us that it would be of crucial interest to collect on one place and succesively analyse all available data (books, articles, iconography, recordings etc.) devoted to this problematic.

In the time of intensive research and reviving of Early Music it came repeatedly to very important but still isolated achievements concerning both instruments; an analysis and synthesis of all those (theoretical and practical) experiences is still lacking.

Two among best preserved instruments (one lira and one lirone) are in the posession of the Vienna collection of early musical instruments (Kunsthistorisches Museum). Due to the fact that their athenticity is doubted, another task of our project would be checking all extant(completely or partly) preserved instruments of the kind.

We want to pay special attention to the person and musical activity of Alessandro Striggio sen.. All available informations about his lira shoul be collected serving an hypothetic reconstruction of his instrument and playing technique.

The goals of our research project is founding a databank and to make as accurate as possible reconstruction of the playing technique on the lira da braccio and lirone and the hypothetic reconstruction of original lira parts. The project should end with an ample written repport.

The project is going to be realized under the guidance of the leader of the Institute for performance practice, Prof. Mag. Dr. Hartmut Krones. The research assistant is Igor Pomykalo who posseses long years of practical experience on the field of early music and the performance practice and for almost twenty years is doing his research on Lira da braccio and Lirone.

The undersigned ask /offer that all informations, ideas or questions to the theme of this project should be addressed to the folowing address:

Lehrkanzel "Musikalische Stilkunde und Aufführungspraxis"
Hochschule für Musik und darstellende Kunst in Wien
Rennweg 8, A-1030 Wien

Fax (0043-1-) 798 56 35/ 34
Tel. (0043-1-) 798 56 35/ 35
e- Mail: pomylyra @ magnet.at

o.Prof.Mag.Dr. Hartmut Krones

Mag. Igor Pomykalo

INTERVIEW FOR MUSEUMS AND COLLECTIONS OF MUSICAL INSTRUMENTS :

According to pictures we attached to this letter and the definition american musician and scientists Sterling S. Jones gave about the typical features of a Lira da braccio : "A unique feature of the lira da braccio was the indentation at the lower end of the body where the tail piece was attached. This can be observed on all extant instruments and on many of the instruments in pictures."/THE LIRA DA BRACCIO", Bloomington & Indianapolis, 1995, p.2. -

1.Do you have any extant original instrument of the kind?

2.Any part of an original instruments of the kind?

3.Any (modern) falsificate or copy?

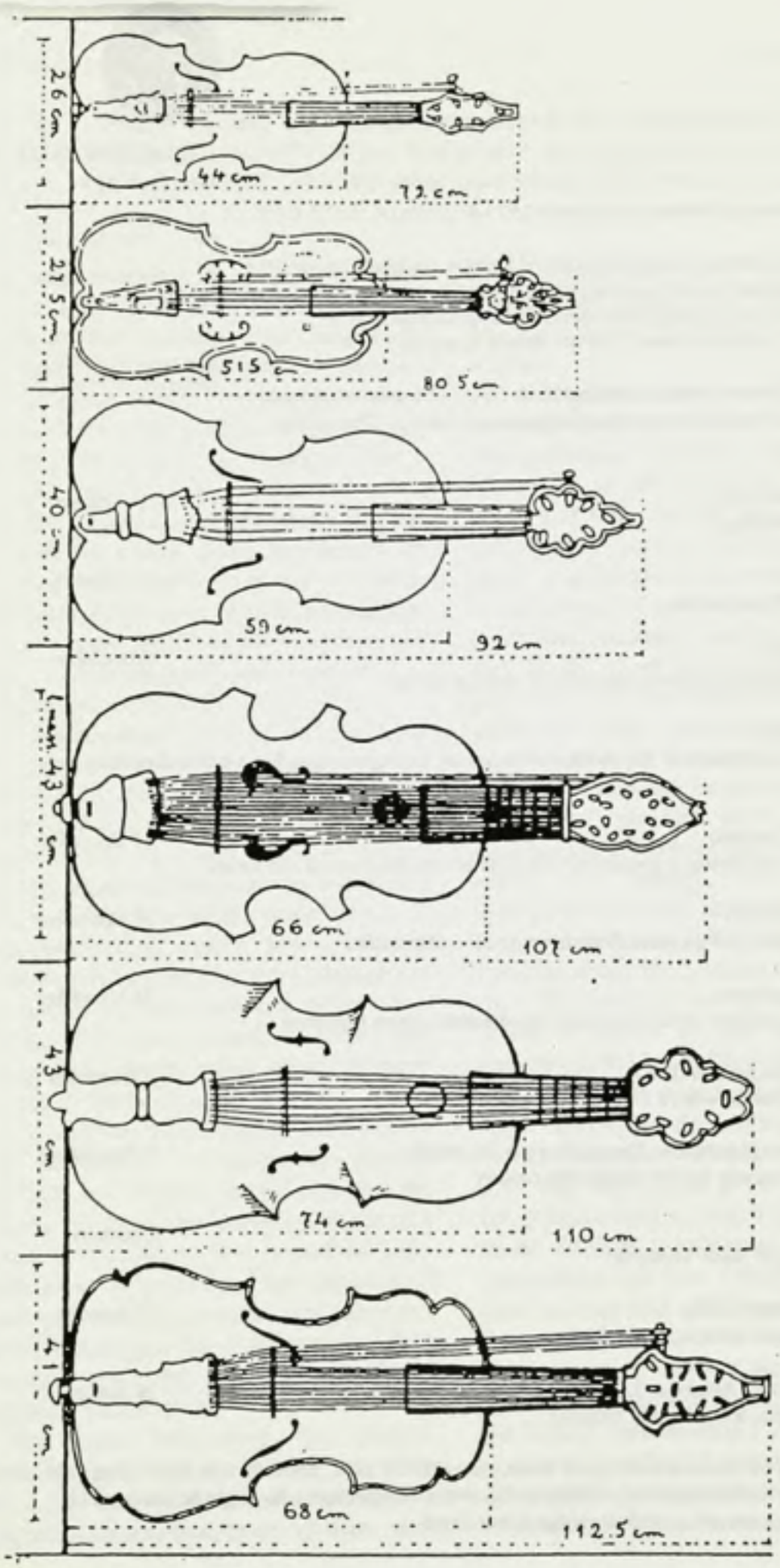
4.A (ex-) LIRONE or LIRA DA GAMBA could be "hidden" in a (restored) cello or viol.

5.If yes, please, send us a photo, a detailed description with measurements and the present condition of the instrument.

6.For our project (and Databank) ALL kind of informations are important: for instance those about the instrument(s) still existent before the World war II and destroyed /damaged or desappeared during the war. Also if somebody (a musician, musicologist or instrument maker) had tried the instrument or made any kind of research, reparation, took measurements, copied and wrote a repport or an article about.

7.What do you think about our project and would you like to cooperate with us?

8.Your advices, comments or suggestions?


26 cm
44 cm
72 cm
27.5 cm
51.5 cm
80.5 cm
40 cm
59 cm
92 cm
43 cm
66 cm
107 cm
43 cm
74 cm
110 cm
41 cm
68 cm
112.5 cm

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Music and Technology Research Seminar; 1997-8

The Music and Technology Research Group of London Guildhall University is pleased to announce its second series of weekly public seminars devoted to current research into musical instruments and applications of new technology in the service of music. All are invited to attend.

All meetings will be at 4.45pm in Room 100 or 100A, 41 Commercial Road, London E1 1LA (close to Aldgate East Underground Station). Discussion will end by 6pm.

Kendall Wrightson (LGU) — 14 October
What is acoustic ecology?

Brian Lee (London) — 21 October
A new approach to just tuning

Allan Seago (LGU) — 28 October
Towards an appropriate computer interface for musical sounds

Terry Pamplin (LGU) — 4 November
Lyra viol, bandora and baryton: the problems of reviving lost repertory and instrumental performance technique

Peter Bavington (London) — 11 November
Keylever, tangent and string: a preliminary analysis of clavichord touch and action

Edward Pillinger (LGU) — 18 November
Clarinet mouthpieces: design, manufacture, materials and acoustics

Andrew Lamb (London) — 25 November
Materials analysis and the conservation of a seventeenth-century trombone

Jose Antonio Martin Salinas (LGU) — 2 December
Julian Carillo and the *Sonido 13* (Thirteenth Sound)

Patrick Ozzard-Low (Alternative Tuning Projects, Norwich) — 9 December
A new chamber orchestra for the twenty-first century

Sam Verik (LGU) — 6 January
Towards a new MIDI 'flute' controller

James Edward Barrett (LGU) — 13 January
Primary school music: lessons from Africa

Lewis Jones and David Armitage (LGU) — 20 January
A nineteen-note equal temperament recorder

Further details may be obtained from Lewis Jones; tel +171 320 1841, fax +171 320 1830. Details of the spring semester series should be available in December. Researchers who might be interesed in contributing to the series are invited to contact Lewis Jones.

Review of: Phillip T Young, *Woodwind Instruments in the Oberösterreichisches Landesmuseum*, Linz, 1997, 259pp, illus of each instr, indexes etc; hard cover, ISBN 3-85474-013-1. ÖS 380 (plus p&p) from OÖ Landesmuseum, Museumstraße 14, A-4010 Linz, Austria.

This is a small collection, only 91 instruments, but with 7 cornetts, 6 curtals, and a number of other instruments of comparable importance, one that would be the envy of many a much larger and better known museum. Such envy could be all the stronger with this, one of the best catalogues that I have ever seen.

Phillip Young has struck exactly into the centre of the happy mean between those catalogues which leave you wishing for more information about most of their instruments and those which, for all but the most expert of us, leave us hunting for a view of the wood among the plethora of the trees.

Each instrument is covered on two facing pages. The first two columns are the detailed description in German; the next two, one on the left-hand page and one on the right, the same in English. The rest of the right-hand page is photographs, monochrome but printed in brown so that it looks like wood colour, of the instrument in its separate joints so that all tenons etc can be seen. For many, though not all, there is a detail, either a photo or a drawing, of the maker's mark. There are also eight (plus the cover) colour photos of some of the most outstanding instruments.

The book has a colour photo on the cover of the wonderful !! !! !! curtal (when there is a perfectly good English name I don't see the necessity for using the mongrel Dulcian as a translation of Dulzian). It is printed on high-quality paper (so good that I kept thinking I'd turned over two pages when it was only one), with the usual apparatus of indexes of maker, cross-references to different catalogue numbering, and so forth.

The earliest instruments, the cornetts, crumhorns, renaissance recorder, the Denners, the 3- and 4-key bassoons, and so on, came from monasteries, many of them from Kremsmünster in the early nineteenth century, and others from Wilhering after it was shut down by the Nazis after the Anschlüss.

Young divides his descriptions into eleven sections, plus a header. The header gives the catalogue number, says what the instrument is, whom it is by, where it was made and when (where any of these details are known). Section I is the details of the mark. II is the pitch, where discoverable. III is the material of the body and its mounts. IV is number, material, how fixed, shape, what they do, etc, etc of the keys, with dimensions, and giving, as I also believe one should, both upper and lower register names for clarinet keys to avoid any confusion, and, which I've not seen before that I remember, giving both actual and nominal pitch for keys for instruments of 'other' sizes, instead of just saying, for example, e♭ key. V gives dimensions of the instrument, giving the length of each joint with, before the figure, + however much for a tenon at the upper end (or – for a socket), and the same after it for tenon or socket at the lower end. For example: (+25) 186 (-19) to mean that a joint is 186 mm long plus a 25 mm tenon at the upper end (always the end nearer the player's mouth, rather than that physically upper) and a 19 mm deep socket at the lower end. This has infuriated me because I thought I had just about finished a catalogue of all my reed instruments and now I think that this is so good an idea and adds so much clarity that I'm going to have to measure all the European ones all over again. Also in this table are external and internal bore diameters, the internal measured (as I've also done) only at exposed ends. VI covers condition and quality. VII is approximate hole diameters, vertical and across, to the nearest tenth of a

millimetre. VIII is provenance. IX is details of the maker, with any biographical material (some of this is new, incidentally, and not yet in the *New Langwill Index*). X is the location of any other instruments known by the same maker, more detailed, sensibly, for the rare ones than for the better known; several instruments here are the only, or almost the only, ones known by the makers. And XI is Bibliography. There is usually, too, a line drawing of the key, and one of the indexes is of the shapes of the keyhead (Young calls these flaps, a term I dislike since it suggests that they flap around loose), analogous to those in his wonderful *4900 Historical Woodwind Instruments*.

To my mind, this is pretty well all the information that one needs from a catalogue unless one is going to make a copy of the instrument, and if one is, as Young suggests in his introduction, even the most detailed catalogues we have are inadequate for that without a proper measured drawing.

The book is highly recommended to all who are involved in early woodwind and, I suppose (I'm grateful for the extra information at the same time that I am dubious as a systematic organologist), to all who are involved in early brass, for we have here, subsumed under woodwind, two mute cornetts, three cornettini, two cornetts, and two basshorns, perhaps just because they have fingerholes, though why then the absence of the three early and important key trumpets (one of them a bass, which are pretty rare), which have, like the basshorns, key-covered holes? There are other brass instruments in the Museum according to the old Othmar Wessely catalogue, not enough nor important enough on the whole, to justify a catalogue of their own, which makes it a pity that it wasn't possible to include them all here. Still, there are also a few keyboards and strings, as well as some ethno, so perhaps one day it will be possible to produce a volume covering 'the rest'.

For the information of anyone wondering, Wessely lists four anonymous fretted clavichords, two squares, grands by Walter, Erard (given to Beethoven) and anon, a variety of early 18th and late 17th century gambas, barytons, and fiddles, a lute, a theorbo, and a couple of chitarrones, hook harps and pedal harps, horns, trumpets, and trombones, and various other odds and ends, so that there is enough of 'the rest' to merit further consideration by the Museum one day.

Certainly and without any doubt, however, this volume covers all the most important things in the museum, and I am very grateful to Phil Young for asking the museum to send me a copy on his behalf, and I am also grateful to the museum for permitting me to review it here – it was sent as a gift, not as a review copy, but it's so good that I thought it worth telling you about it and therefore asked for permission.

FoMRHI Comm. 1535 **Jeremy Montagu**

Review of: ***Swedish Clavichords – Mikko Korhonen plays instant music*****, CD SVCD 8, SMS Musikmuseet, Box 16326, S-103 26 Stockholm.**

The Musikmuseet sent me a copy of this CD, saying "We hope that you will enjoy this CD and recommend it to friends of the clavichord and others. It can be purchased from well-equipped music-chops or ordered from the Musikmuseet's shop." I checked with them, and they still do not take Eurocheques so if you order from them it has to be international money orders etc.

I debated long and hard whether I should review this CD or just ignore it. My problem is that it is without exception the worst clavichord recording that I've ever heard, and the debate was whether one should be kind and ignore it altogether, or whether one should publish a warning. In the end, I decided that they had asked me to recommend it and that they had said, yes, I should review it (at that stage I hadn't played it; if I had I'd probably just have binned it), and that therefore I should warn you against buying it..

The playing is unbelievably heavy-handed. It's not just that notes clunk and are often driven sharp by the force of attack but that one can hear the underside of the keys banging on the base of the instrument, and at least once one can hear what sounds like the tangent slamming its way between the strings.

There is a good deal of important Swedish repertoire for these instruments, as well of course of an immense international repertoire. Despite this, and despite the opportunity to display some of this repertoire to the rest of the world, they decided that everything should be improvised by the player. It is improvised in styles appropriate to the instruments and, I suppose since I don't know their keyboard music, it is not for me to say whether Mr Korhonen's improvisations are better than the music of Roman or any other Swedish composer, they sound convincing enough. However, with so much unknown repertoire available, it seems a curious decision to have made.

The recording is close and clear, using the same microphone and placing for each of the four instruments, a triple-fretted Woytzig, a pairwise fretted anonymous, an unfretted Specken, and a very big Kraft (2 metres wide and six-octave range – they say, but the keyboard is 5½, FF-c''''').

Certainly each instrument sounds very different from the others, but I'm not convinced, between the bangs, clicks, thumps, twangs, and crashes, that this how they ought to sound. Listening is not a pleasure, both for those reasons and because so much is out of tune so much of the time because of the extra pressure put on the strings. A pity – we need good recordings of such instruments and, as you'll know from my work at the Bate and the number of CDS we published there, or to be more accurate allowed others to publish for us, I believe very strongly in making the sound of original instruments available under proper conditions.

These are not proper conditions and I cannot possibly recommend this recording.

FoMRHI Comm. 1536 Rod Jenkins

Hardening and Tempering Tool Steel

As a result of reading a recent Comm. it occurred to me that fellow instrument makers may find the following information on tool steels useful. The main thrust of this Comm. is to describe how to harden and temper tool steels but a little background information may help the reader to understand what is going on.

When pure iron is heated the crystal structure of the material changes from one pattern to another. Each of these structures is known in metallurgy as a phase and the physical properties of the iron depend on which phase the material is in. Most woodworking tools are made from tool (carbon) steel, which is a mixture of iron and about 1% carbon and, sometimes, other elements such as chromium, molybdenum, tungsten and vanadium..

A phase change occurs in iron at temperatures above 723°C. In this high temperature phase the iron, although still a solid, can dissolve a weight of carbon in its structure equivalent to 2% of the iron. In the phase that exists at temperatures below 723°C only 0.02% of carbon will dissolve in the steel. Iron that contains 1% at high temperature will, on cooling, only have small amount dissolved in the structure. The rest of the carbon forms iron carbides with some of the iron. These carbides are hard and have the effect of making the steel less soft than pure iron. However, if steel is rapidly cooled (quenched) from the high temperature phase then the surplus carbon does not have time to form carbides and the presence of extra carbon in the low temperature phase causes the crystal structure to be grossly distorted, which makes the steel very hard and brittle. If the steel is now heated to a temperatures of between about 150°C and 400°C some of the carbon is able to form carbides and the structure becomes less distorted and therefore less hard, but also less brittle, when the steel returns to room temperature. The actual amount of modification caused by this re heating, which is called tempering, depends on the temperature to which the iron is heated, with the result that its properties can be changed from hard and brittle through to soft and malleable. The other alloying metals that were mentioned, such as tungsten, form carbides that are even harder than iron carbide and also modify the rate at which the steel has to be quenched together with a raising of the tempering temperature.

Tools are manufactured by first forming them to shape when the steel is in the soft, annealed, condition. They are then hardened and tempered to achieve the optimum properties for the intended use. These can vary, even among chisels. A tool that is meant to be hit with a mallet will need to be tougher than one meant for delicately carving limewood. The former chisel will therefore be likely to have been tempered to a higher temperature, increasing the toughness but decreasing the hardness, with the result that it will not keep its edge for as long as the carving chisel but will not be so likely to break or to have chips come out of the edge. As an aside, many woodturning tools are now made of High-Speed steel. This material can be heated until red hot without losing its hardness and can therefore be sharpened on the grinding wheel with no danger of over tempering. However it is not as hard as tool steel which has been hardened and tempered for metal machining and it is not possible to get as fine a finish on the tool. High-Speed steel is not a carbon steel and the heat treatment of it requires conditions not available in the small workshop.

Two types of annealed tool steel are readily available; silver steel and gauge plate – also known as oil hardening ground flat stock. Silver steel, known as drill rod in the USA, is only available in rounds, which are always sold in precision ground diameters. Silver steel is also available in a free cutting version which just means that it is easier to machine in the annealed state. Gauge plate is, as the name suggests, designed for making gauges and jigs which will be

hardened to avoid wear in a production environment. It is specially formulated so that there is a minimum of distortion when it is hardened and is available in various rectangular and flat sections. Both of these materials are useful for making small edge tools. They are machined or filed to the required shape, hardened, tempered and then honed to give the final cutting edge.

Hardening silver steel or gauge plate is actually very easy provided you are dealing with sections small enough to be heated with a gas blowtorch. Both silver steel and gauge plate can be quenched in water but, industrially, gauge plate is normally quenched in oil to minimise the distortion. This is only really necessary when accurate jigs or gauges are being made. Prepare a container for the quenching medium, clean water or oil. Proper quenching oils are available but clean unused engine oil will do. Used engine oil should not be used as it will contain petrol and other contaminants which may well catch fire. There should not be any problem with new oil but take sensible precautions and have something available to smother any resulting conflagration. Enough oil or water should be used so that after plunging in the red hot steel the liquid is barely warm. After filing to shape the tool should be heated up until it glows bright red. Cherry red is the colour usually quoted but I think that the colour of cooked carrots is a better description. When this colour has been reached the tool should be plunged or dropped into the water or oil. On retrieval the metal should now be glass hard and this can be tested for with a file. If the tool is not hard then this means that it did not get hot enough in the first place or it cooled too much on its way to the quenching bath; heat it up and quench again.

The tool now needs to be tempered. When a piece of bright steel is heated gently in air an oxide coating forms on the surface. This oxide coating forms interference colours on the surface of the steel, like the rainbow colours on an oily puddle, and the colour is an accurate indication of the temperature that the steel has reached. Carbon steel tools that are meant for cutting metals are usually tempered to a pale straw colour whilst woodworking tools are tempered to a darker straw or pale brown, depending on their intended use. We can see the tempering temperature by the colour that the tool goes, so the next step is to clean it up with abrasive paper or an abrasive pad so that it is bright silver all over. Two methods are convenient for tempering small tools. The better is to prepare a bed of dry sand in a shallow metal tray, a jam jar lid will do for small items. The tool is immersed so that its top is level with the sand. Use a gas torch to play a gentle flame on the underside of the tray. Do not be too hasty, it will take some time for the heat to travel to the tool and we do not want to over-temper. Stop heating when the steel has turned to a dark straw colour and remove it from the sand. The alternative method is to heat the tool gently from the non business end. The colours will travel towards the edge and heating should stop when the correct colour has reached the sharp end. Again be very gentle with the flame, wafting it gently across the tool and allowing the temperature to equalise before applying more heat. If you should over temper then go back, reheat and quench. The cutting edge of the tool should only need touching up with a slip stone before it is ready for use.

These somewhat crude methods do not provide the ideal conditions to get the best properties from the steel but they are entirely satisfactory for woodworking purposes. I have made long drills, reamers, purfling knives and plane blades in this way and I have even made my own small rasps by making a pointed chisel and using this to hammer the raised teeth into a length of gauge plate previously filed to a half round section.

Even in the annealed state silver steel is tougher and a bit harder than mild steel. Because mild steel has only 0.1-0.2% carbon content it cannot be hardened. However the carbon content of the surface of mild steel can be modified and this process is called case hardening. The mild steel is heated to red heat and is dipped in some carbon rich compound – blacksmiths traditionally used hoof parings. Some of the carbon dissolves in the surface of the steel and locally increases the carbon content to the 1% or so required to enable hardening. A commercial material called Kasenit is available. The tool to be case hardened is simply heated to red heat, dipped

in the Kasenit and then heated a little longer for the carbon to dissolve. It is then quenched. There is no need to temper a case hardening since the underlying material is still relatively soft and therefore tough. The hard coat is only one or two thousandths of an inch thick so very little sharpening is possible beyond a touch with a slip stone.

Two sources of supply with which I have had satisfactory dealings with are:

Great Northern Distributors Ltd, Great Northern Works, Hartham Lane, Hertford, Herts SG14 1QN, Tel. 0992 552962

A J Reeves &Co (Birmingham) Ltd, Holly Lane, Marston Green, Birmingham B37 7AW, Tel. 021-779-6831

Both are suppliers to the model engineering hobby, issue a catalogue, accept credit cards and are used to dealing with orders from outside the U.K.

FoMRHI Comm. 1537 Jeremy Montagu

The Pipe and Tabor is Alive and Well and Living in Euskadi.

I have just returned from the Basque country where I had been invited to speak at a conference of Txuntxuneroak, the Basque for taborers, in Pamplona. I think that this invitation was chiefly because of my recent tabor pipe article in *GSJ* 50, and therefore what I said was based on that material. While I and Jean Baudoin from Gascony were the only people from other countries, there were other 'foreigners' on the programme, Marcus Frengani Martins, who is a Basque but who is now working in Bamberg, who had much interesting iconographic and historical material, three or four Catalans who were speaking on the flabiol (they were very pleased with my idea that the flabiol may have been the earliest form of the tabor pipe – I assume that any of you interested enough to be reading this have read my *GSJ* paper and therefore that I do not need to rehash it here), and several from Extremadura, Salamanca and Zamora who were talking about their gaita, one of them, Alberto Jambrina Leal, also with much interesting iconographic and historical material. Jean Baudoin was speaking about his flabuta or flauta and the tamborin or string drum, of which he had several different types with different tunings and I think different string materials – certainly the sound was quite different, and both his flabuta and his tamborin were also somewhat different from the chiflo and salterio from Aragón which Alvaro de la Torre spoke about and played. One of the fascinating things about the whole conference was the differences, sometimes subtle and sometimes very considerable, between the different tabor pipes and different tabors which we saw and heard.

The main participants were all Basques, from the different provinces of Euskadi, with their txistu, which is the world's only fully chromatic tabor pipe (achieved by covering the distal end more or less with the little finger to flatten the pitch). Since all the papers were in Castillian, except for Jean Baudoin's, who spoke in French, and mine which was in English, I was lost a good deal of the time, save where there was musical or iconographic illustration. It was very clear, though, from what I could follow, that the txistu, flauta, gaita, etc, are the subject of serious and comprehensive study, historical, ethnomusicological, and scientific and acoustic (one paper was illustrated with sonographs), as well as being very strongly in use, right across the Basque country and northern Spain as far south as the Baleares, across into Portugal and up into southern France, just as I knew the flabiol to be throughout Catalunya.

While I was the guest of the txistulari as a whole, my participation was, I think, at the instigation of Sabin Bikandi Belandia, the town piper of Bilbao, who recently completed an MA at Goldsmith's College and is now about to start a PhD there. He had invited me to stay on for a few days with him in Galdakao, a small town which today is more or less absorbed as a suburb of Bilbao and is now fully industrialised and with large blocks of flats. Nevertheless, much of it is only a stone's throw from open countryside, one of the great advantages of so mountainous (and beautiful) a landscape, for there is less inducement to build on a one-in-five slope than on flatter ground.

Sabin's duties are not as onerous as those of the city waits or the *Stadtpfeifer* of earlier times. He does not have to play from the town hall balcony every hour, for example, nor to walk the streets at night, keeping the citizens awake to show that he and the watchmen are also awake and on guard, but he is on call, with three colleagues (one of whom was ill in hospital when I was there so that I only heard and was able to record the three of them instead of all four) for all civic ceremonies and occasions. On average he plays two or three times a week, and of course he wears a traditional costume when he does so. Nor is he alone in this; there are many pipers throughout the Basque provinces playing for all sorts of

occasions, formal and informal, civic and personal (weddings and so on), dancing, and processions, both as amateurs and, like Sabin, as professionals, though many of the latter are part-time, rather than full-time like Sabin.

The society of txistulari, or pipers, (they publish an excellent journal called *Txistulari*) was formed seventy years ago, and on our way back to Galdakao from Pamplona, Sabin took me to the anniversary meeting of the txistulari, which was held where they had founded the society, on the top of a mountain, in what is now a conservation area and nature reserve called Arrate. This was a very impressive occasion with a hundred or so pipers, plus dancers and a few side drummers. They are, incidentally, nowadays usually called pipers (txistulari), though this is a fairly recent practice – in the old days, as in the English tradition, where Thomas Slye was referred to as Will Kemp's taborer when he morrised from London to Norwich, they were always called tamborileros (Castillian) or txuntxuneroak (Basque), and it was noteworthy that the conference in Pamplona was called under the old title of Txuntxuneroak. When playing in large groups, as they were at Arrate, they often play only the pipe, leaving the rhythm to the side drummers. They play in three parts, txistu 1, txistu 2 and silbote. The last (the one who was missing from the Bilbao town group when I heard them) is a longer pipe, a bit longer than a tenor recorder, but still with three holes. Because of its length, the player cannot reach the end with his (or often today, her) little finger, and therefore both hands are used, one on the three fingerholes and the other to close the open end for chromatics etc. The silbote player, therefore, never plays a tabor as well. I mentioned 'or her' just now. Traditionally, of course, taboring was an exclusively male thing, but nowadays women are accepted, especially among the larger amateur groups, though not I think for such posts as Sabin's.

After the long church service, during which I was able to gossip with a number of players, some of whom had been at the conference in Pamplona, and also with one of the side drummers who is also a percussionist in the local symphony orchestra, and after the outdoor concert, processions, and dancing, there was an even longer, and pretty bibulous, lunch at which, through the kindness of that side drummer who lent me his drum and sticks, I was permitted to join in the playing (the fact that the 'professor from Oxford' was taking a part in the proceedings was well-received, and several people whom we later met had already heard of me as the drumming professor!).

Sabin took me to meet various txistu and tamboril makers and also a shawm maker. There is a good deal of important and innovative work going on with these instruments, using new techniques, new designs, and new materials, as well as the long-standing traditional methods. One maker, Gancedo at Amurrio, who makes instruments in African blackwood and coca-bola, is also working in new plastics, for the sake of increased stability, making his own plastic in order to maintain full control of the uniformity and the quality of the material. He has introduced devices to control the precise angle of the airstream through the mouthpiece and where it meets the labium, with grub-screws and allen key. While he also makes some alboka (the double hornpipe) and cowhorns, and even serpent and french horn mouthpieces in the same plastic, his main work is with the txistu in all sizes, from a piccolo, the same size as the txirula, the smaller Basque tabor pipe, through the tenor silbote to an experimental metal bass, about the same length as a bass recorder and with a dogleg in the tube similar to that of the bass by one of the modern industrial makers (Adler, is it?) with a key that pivots a plate across to close the open end.

The shawm maker, Jose Manuel Agirre of Tolosa, is also using a resin plastic, producing the local dulzaina, an excellent instrument akin to the Navarrese gaita, but using, as the Navarrese do also (Navarre is over the border in the French Basque country), a reed closer to that of the bassoon than the original; both are made from *Arundo donax*, but the scrape of the modern reed is very different from that of the older pattern. I have encountered simi-

lar changes on the Valencian dulçaina (in Valèncía spelled with a c-cedilla, here in Tolosa with a zed, but neither in any respect dulcet in sound), where one that I bought from Michael Morrow more than thirty years ago has reeds with a fairly unformed scrape, whereas one that I got a couple of years back in Valèncía also has a rather bassoon-like scrape.

This maker is also using innovative techniques in the production of drum shells of all sorts, which he produces to a greater extent than he does shawms. Normally goat skin is used for the heads. His tambourines (pandero), like those throughout the area, have jingles which are stamped out as crinkled discs. The tabor for the txistu has a single gut snare, the side drum has four strands, of gut for the txistulari but occasionally using guitar wire-covered E strings for the dulzaina, when brass shells are sometimes used, and the tabor used with the dulzaina with two strands. He makes all his tabors and drums to sizes that are standard in the pop world today, though still close enough to the traditional, so that he can use plastic heads when required – useful for outdoor work when the weather can be bad.

Tabor technique is impressive indeed, far more elaborate than anything that Arbeau ever suggested. For one thing, the drum hangs from the crook of the left arm so that the batter head is the lower, facing obliquely downwards (the snare today, incidentally, presumably following side-drum practice, is never on the batter head, but always on the other. It looks, from an old instrument in the Bilbao Museo Vasco, as though this change came at least a hundred years ago and perhaps longer). Players use flams, drags, and other multiple beating techniques, using their fingers or very relaxed wrists for the multiple strokes where a side drummer depends on the bounce on an upward-facing head to help him reiterate. I have to say, though, that this may vary more than I first thought, for while all the players I heard used these elaborate beatings, one CD which Sabin gave me, of players from Gipuzkoa, sounds as though it could come straight from *Orchésographie*, and the photo on the cover of the booklet shows a snare on the batter head, as well as a pipe quite different from the normal txistu. I have not yet worked out the text of the booklet, but it is possible that this is a deliberate archaizing.

Many makers are interested in the older traditions, so that my slide of Frances Palmer's illustration from *Early Music* of the Mary Rose pipe attracted much interest, as did the Bate Collection drawings of the two nineteenth-century tabor pipes there (unfortunately, a slide of Bill Waterhouse's early pipe did not arrive in time to be included), as well of course as the iconographic material in my and other papers. The main interest, though, is in the modern use, the modern design, its acoustics, how it can be further improved, and so on. While we in FoMRHI and in other countries are mainly producing somewhat hypothetical Praetorius, Mersenne, Arbeau, and Will Kemp pipes, as well as wholly imaginary plastic and metal instruments, they are producing txistu, gaita, txirula, and all the other pipes, and judging from the range they achieve (two and a half to three octaves) and the quality of the sounds that they produce, I think that we have a good deal to learn from them.

Certainly they have here a living tradition that however much it may have changed from the sixteenth century is still in direct descent and in direct contact with mediæval practice, and there is, I think, a good deal to be said for our pipe makers to establish firm contact with them. The txistulari are hoping to establish an international pipe and tabor society, and I hope that when they do our makers and players will join them. I hope, too, that we may be able to arrange a FoMRHI pipe and tabor day when Sabin is next in this country.

Meanwhile, the pipe and tabor, in all its varieties and ramifications, is alive and well and living in Euskadi.

The Van Bolhuis Auction (1764)

Jan Bouterse

Some years ago I got the information that there were some historical woodwind instruments (a recorder and a traverso by Van Heerde) found in the coll ection of Mr. Jonxis, an old professor who lived in Groningen, the most northern province of the Netherlands, with a capital city with the same name. I was directly interested, because in this province I was born and I knew about the cultural aspects of the area. In churches in the province of Groningen we find one of the most rich concentrations of historical organs in the world. These organs were often granted to the churches by wealthy families. More or less there was a competition between the villages and cities to have the most beautiful instrument made by the best organ makers (Schnittger, Hinsch, and others). But we become aware now that there were in Groningen in the early 18th century more cultural and musical activities than making and playing church-organs.

One of these activities was found in the family Van Bolhuis, magistrates in the city council of Groningen. And we are now happy that one of the members of the family spent his time not only to make money, but also to make some music. Michiel van Bolhuis bought a large quantity of musical scores and musical instruments. After his death, in 1764, this collection (together with other objects of art) was sold at an auction in Groningen. We are so lucky that a catalogue of this auction was published, and that one catalogue is found where all prices of the sold items were registered. Albert R. Rice wrote in 1992 about this catalogue and the musical instruments of this collection in the Journal of the American Musical Instrument Society (Vol. XVIII, p. 5-21).

He based his article on a copy of the auction catalogue, but I had the opportunity to visit Mr. Jonxis himself who proved to be one of the descendants of Michiel van Bolhuis, and I saw not only the original catalogue, but some more interesting things, such as the two woodwinds of which I had heard about.

About the woodwinds in the Van Bolhuis auction, the following items are listed (in Dutch language, I give the translation in *italics*):

No. 25 Een basson, of Fagot, van Winker. *A bassoon by Winker (2-0).*

No. 26 Een Bas-Fluit. *A bass recorder (1-2).*

No. 27 Een Fluit Travers van J. W. Oberlender, met drie middelstukken. *A traverso by J.W. Oberlender, with three centre joints (3-10).*

No. 28 Een dito van dezelve, met een Mondstuk, als van een Fluit Doux. *A dito by the same, with a mouthpiece, as on a recorder (4-5).*

No. 29 Een Fluit Travers d' Amour van dezelve, met vier middelstukken. *A flûte d'amour by the same, with four centre joints (6-0).*

No. 30 Een Fluit Travers van Scherer, met Yvoor, en een onderstuk, om een Fluit d' Amour te maken. *A traverso by Scherer, with (in) ivory, with a lower piece to make a flûte d'amour (8-0).*

No. 31 Een dubbele Ters (terts) stemmende Fluit a bec, van M. Parent. *A double recorder by M. Parent (2-0).*

No. 32 Een Sext-Fluit van Van Heerde. *A sixt flute by Van Heerde (1-10).*

No. 33 Een kleine Fluit à bec. *A small recorder (0-11).*

No. 34 Een Alt-Hautbois van T. Boekhout. *An alto oboe by T. Boekhout (3-0).*

No. 35 Een Hautbois d' Amour van Winker. *An oboe d'amour by Winker (0-12).*

No. 36	Een Hautbois van Ebbenhout, met Yvoor en Zilvere Klappen, van T. Boekhout.	*An oboe in ebony, with ivory and silver keys, by T. Boekhout (4-10).*
No. 37	Een Clarinet van Van Heerde.	*A clarinet by Van Heerde (1-0).*
No. 38	Een dito by Strehly.	*A dito by Strehly (0-13).*
No. 39	Een dito van dezelve.	*A dito by the same maker (0-9).*
No. 40	Een Schalmey	*A shawm (0-13)*
No. 41	Een Cinq, of Cornet	*A cornett (0-7).*
No. 42	Een dito, half van Yvoor	*A dito, half made of ivory (0-14).*
No. 43	Een Chalameau van J. Steenbergen	*A chalameau by J. Steenbergen (0-13).*
No. 44	Een dito.	*A dito (0-12).*

The prices of the instruments are given in guilders (florins) and stuivers (20 stuivers in one guilder): 3-10 means: 3 guilders and 10 stuivers.
In comparison: an anonymous harpsichord was sold for 29 guilders, a violoncello by Goffriler for 21 guilders, a 'staafspel' (xylofoon or carillon) for 34 guilders, but some violins were rather cheap: 3 or 4 guilders. The printed music was sold for very low prices: the 6 concerti armonici by Ricciotti (in fact by Van Wassenaer!) was sold together with 14 sonatas for violins and oboes by Rosiers for only 6 stuivers. Three concerti by G.F. Handel (for flauto traverso, 1st and 2nd violin and basso continuo) were sold together with one sonata for two violins and basso continuo for 12 stuivers, and so on.

Some remarks

- The woodwind instruments were made by Dutch and German makers. *Strehly* could be I. G. Strehli (see Waterhouse in The New Langwill Index, London 1993, p. 389). *Winker* could have been one of the members of the Winckler-family in Leipzig, but actually, we don't know. The prices of the instruments by Winker and Strehly at the auction were rather low.
- Scherer and Oberlender were well known German families of woodwind makers. A traverso with a *mouthpiece as on a recorder* (No. 28) is a bit enigmatic. I remember vaguely that long ago I have seen a traverso (in the Haags Gemeentemuseum?) with a device to project the air stream of the player to the corner of the mouth hole. But later, I have never seen such accessory again (or have I dreamed this history?). Of course, we know about the recorders of Stanesby-Junior, with a traverso-profile, but that is an other story.
- About No. 30, the Scherer-traverso. We know that the Scherers made many instruments of ivory (in fact: almost all his traverso's), but interesting is the (longer) lower joint (or joints?) to transfer the instrument in a Flûte d'amour. In Young's 4900 Historical Woodwind Instruments (London, 1993) I could not discover other instruments with this possibility, not by Scherer, and also not by Denner. But I remember that I have somewhere seen information about a Denner-traverso with a very long upper (not lower!) centre joint to make a Flûte d'amour. Who knows more about that instrument?
- About the Dutch instruments in the collection: Boekhout, Van Heerde and Steenbergen were well known makers of Amsterdam. But no sixt flutes by Van Heerde survived (I have seen such instruments by W. Beukers and Steenbergen). An *Alt-Hautbois* was apparantly an oboe in f, a fifth lower than the normal oboe in c1. Nowadays we speak about tenor-oboes, to avoid confusion with the oboe d'amore (in a, a thirth lower). I know about at

least four Dutch tenor oboes in f (two by Haka, one by H. Richters, one by R. Wijne), but I have not discovered Dutch oboes d'amore. There is one bell joint of an oboe, shaped as a bell joint of an oboe d'amore (but I think: much shorter) by Van de Knikker (Bate Collection, Oxford), that is all. No Dutch chalumeax (or chalameaux) survived, and in fact No. 43 (and maybe No. 44) are the only traces that these instruments were made and used.
- There were two instruments still in the Van Bolhuis-Jonxis family, both by Van Heerde, a boxwood alto recorder and a dito traverso (boxwood without ivory rings, and with a brass key). These instruments were in the family since the 18th century, but were apparently not in the inventory of the auction. Both instruments are interesting, having almost identical stamps with a *lion rampant* above the name. The tails of both lions however are slightly different. The instruments were rather good playable; after Michiel van Bolhuis nobody plaayed the instruments for almost two centuries! The pitches were a bit different, the traverso being a bit sharper (almost a- 415 Hz) than the recorder (a- 410 Hz). But I have made copies of both instruments, and then it appeared that the pitches of the copies were almost identical (about a- 410 Hz).
In the family a handwritten diary of Michiel van Bolhuis existswhere he describes a journey from Groningen to Amsterdam and The Hague. It is not very easy to read, but I hope that I can find some time to do that, maybe there is some information in it about a visit to a woodwindmaker in Amsterdam!

- I mentioned about the six *concerti armonici* by Van Wassenaer (and published, not composed by Ricciotti). I became curious to see these concerti in the list, and looked further. To my surprise I found some works by *Wassenaar: 3 Concerti a 4, 5 & 7 stromenti* and a *Sonate a violine prim., secund. e basso*, sold for only 10 stuivers (Nos. 208 and 209 of the list). The music is lost, but the fact that Van Wassenaer is mentioned in the auction list proves that he was indeed a composer. Of course I gave this information directly to Professor Albert Dunning in Cremona, who has made the discovery about the relation between Van Wassenaer and the *Concerti armonici*.

- In fact, nearly all printed and handwritten music in the auction list, some by well known, some by obscure composers, is lost. However: 3 of the 25 music books with handwritten menuets, airs (etc.) survived. Two of these books were already in the music labrary of the Haags Gemeentemuseum, one was still in the family (a copy of it is in the museum as well).
But now I have a problem: which music did those families play in Groningen: Vivaldi, Telemann, Van Wassenaer, Corelli and those famous names? Or did the play only the simple dance tunes as we find in the three music books that survived?

I was glad to made aquaintance with Mr. Jonxis, descendant of an old family in Groningen. In World War II, Jonxis was children's doctor, and he advised then the authorities in the hungry city Rotterdam to give extra vitamine-D to pregnant mothers. So he saved many children from rachitis, and so my wife, who was born in 1944 in Rotterdam. After the war Jonxis became professor in human nutrition, but he was also active in the world of arts, being in the board of directors of the Groninger Museum. Many belongings of the family are given to musea in the Netherlands. The recorder and the traverso by Van Heerde are given to his grand-daughter, who is active in music and who is well aware of the importance of the instruments. Mr. Jonxis died two years ago, over 80 years old, a week later followed by his wife.

The Selhof Auction (1759)

Jan Bouterse

Nicolas Selhof (1680-1758) was born in The Hague (Netherlands) and played an important role in the music life in that city in the first half of the 17th century. In 1713 Selfhof started a business as a music bookseller, in 1725 he formed a *Collegium musicum perpetuum* which played every Monday. He had connections with important Dutch musicians and composers of his time, such as the organ player Veldcamp and also with Graaf Unico Wilhelm van Wassenaer, the composer of the well known six *Concerti armonici*.
After his death, the music library, instruments and other property was sold at an auction in The Hague, in 1759. The catalogue (mostly in French language) of this auction was republished in 1973 by Frits Knuf in Amsterdam, with in introduction by A. Hyatt King.
Some of the woodwind instruments and their makers were reported by Langwill and later again by Waterhouse (New Langwill Index), but it is interesting enough to pay some new attention to the catalogue, because we find some interesting names of makers in it.

About the string instruments: we find here makers' names* as Jacques (Jakobus) Stainer (from Absam), Nicolas and Hieronimus Amatus (Amati, from Cremona), Mattheo Albano (from Solfano), Mattheus Hofmann (Antwerpen, Belgium), Joan. Bapt. van den Slaghmeulen (Antwerpen, Belgium), Johan Hasert (Eisenach). Richard Mearens (London), Frane. Antonio Luppo (Milan, Italy), Matthias Palmerion (Padoua), Jacobus Goldt (Hamburg), Joh. Dursell, J. Bapt. Frebine, Gottfried Tielke (Konigsberg), H.J. Stofs (Tirol), Goftiler (Venezia), Ambroise decomble (Tournai, Belgium), Fl. Guidantes (Bononiae), Maria Peuscher (Cremona), Joh. Brown (London), Theodore Tresselt (Bachbreit), Fleischer (Hamburg), Ulrich Dieffenprugkher (Venezia), Nicolas Bertrant (Paris), John Rose (Brattwell), Henri Geaye (Soutwark), Joachim Tiele (Hamburg), Jorks Duelling (Northampshire), Gillis York (Northampshire), Ricard Blunff (London), Parkel Dwelling (Northampshire), Jacob Weiss (Saltbourg). H. Gay (Southwark, London).
From the following Dutch makers instruments were sold: Hendrik Jacobz, Cornelis (also Corneille) Kleinmann, Gysbert Verbeek, Pierre Rombout, Jean Bouwmeester (all of Amsterdam), J.B. Walther (la Haye - The Hague), G. Stevens (from Leyden)

* The names of the makers and the places are spelled as in the original auction list.

About the harpsichords: instruments are listed by P.E. Johannis Couchet, Andreas Ruckers and Thomas Hancoek.

About the woodwinds, the following items are listed:

No. 126 Un basson ou Fagotte de Villars, avec les garnitures & Embouchures d'Argent, Instrument très bon & parfaitement conservé & travaillé.
A bassoon by Villars, with silver mounts and embouchure, very nice and perfectly made and preserved.

No. 127 Un dito de E. Terton. *A dito by E. Terton.*

No. 128 Un dito de Scheer. *A dito by Scheer (Scherer?).*

No. 129 Un dito de J.B. Willemsz. *A dito by J.B. Willemsz.*

No. 130 Un dito de T. Boekhout. *A dito by T. Boekhout.*

No. 131 Une Flute douce longue de Basse de R.T. Bressan.
A long bass recorder by R.T. (?) Bressan.

No. 132 Une dito de de Bie. *A dito by de Bie.*

No. 133 Une Flute traversiere de de Bie, avec 2 pieces.
A traverso flute by de Bie, with two joints.

No. 134 Une dito de de Bie avec 2 piéces du bois d'Ebeine avec les garnitures d'Argent.
A dito by de Bie, with two joints, in ebony with silver mounts (and keys).

No. 135 Une dito de Naust avec 2 piéces du Buois, les garnitures d'ivoire et d'Argent.
A dito by Naust, with two joints in boxwood, with ivory and silver mounts (and keys).

No. 136 Une dito de Peltier, avec trois piéces. *A dito by Peltier, with three joints.*

No. 136* Une dito de C. Palanca, avec 2 piéces. *A dito by C. Palanca, with two joints.*

No. 137 Une dito de de Heerde. *A dito by Van Heerde.*

No. 138 Une dito de Rottenburgh. *A dito by Rottenburgh.*

No. 139 Une dito de Serspiers, avec un Embouchure dessus.
A dito by Serspiers, with a mouthhole above (?)

No. 140 Vier Pypers Fluyten van Borkens. *Four pipers flutes by Borkens.*

No. 141 Deux Flutes Octaves de Borkens. *Two octave flutes by Borkens.*

No. 142 Quatre Flageolets de Borkens. *Four flageolets by Borkens.*

No. 143 Un dito de Terton, dans un Etui, très bon. *A dito by Terton, in a very nice case.*

No. 144 Une premiere & seconde Flute a Bec, de Borkens.
A first and second recorder by Borkens.

No. 145 Deux flutes a bec de Brasam. *Two recorders by Brasam (Bressan?).*

No. 146 Deux dito de Terton. *Two dito by Terton.*

No. 147 Une dito de Terton avec l'embouchure d'Ivoire.
One dito by Terton, with ivory mouthpiece.

No. 148 Deux dito de Rosen. *Two dito by Rosen.*

No. 149 Deux dito de de Jager. *Two dito by de Jager.*

No. 150 Une dito de de Heerde. *One dito by Van Heerde.*

No. 151 Une dito de Ardenberg. *One dito by (van) A(a)rdenberg.*

No. 152 Une dito sans Auteur. *One dito without makers' mark.*

No. 153 Une Flute de quart de Beukern. *A quart recorder by Beukern (Beukers).*

No. 154 Une Flute Octave. *An octave recorder.*

No. 155 Deux Flutes Bec d'Alto, de Terton. *Two alto recorders by Terton.*

No. 156 Deux dito de Boekhout. *Two dito by Boekhout.*

No. 157 Une dito Rottenburgh. *One dito (by) Rottenburgh.*

No. 158 Une dito sans Auteur. *One dito without makers' mark.*

No. 159 Deux Hautbois de Richters, du bois d'Ebeine. *Two oboes by Richters, in ebony.*

No. 160 Un dito de de Heerde, du bois d'Ebeine, avec les garnitures d'Argent.
One dito by Van Heerde, with silver mounts (or keys).

No. 161 Un dito de Desner, de Buois, garnie d'Ivoire & d'Argent.
One dito by Desner (Denner?), with ivory and silver mounts.

No. 162 Un dito de Buckern. *One dito by Buckern.*

No. 163 Un dito d'Amour de Desner, du Buois, garni d'Ivoire.
One dito by Desner, with ivory mounts.

No. 164 Un dito d'Amour de Norck. *One dito by Norck.*

No. 165 Un dito de Muller. *One dito by Muller.*

No. 166 Deux clarinettes de Borkens. *Two clarinets by Borkens.*

No. 167 Cinq Chalummaux, dont 1 de Borkens & 1 de de Bye.
Five chalumaux, of which one by Borkens and one by de Bye.

No. 168 Trois Cannes a Flute a Bec. *Two walking stick alto recorders.*
The Nos. 169 to 210 in the catalogue are most accessories for musical instruments, all items printed in Dutch language, just as No. 140.

Some remarks

- The list is very international: string instruments of Italian, Dutch and Flemisch, German and Austrian Makers. Woodwind instruments mainly by Dutch makers, but also some instruments by Italian (Palanca), English (Bressan), Flamisch (Rottenburgh, Willems) and French (Villars and Naust). The same international character however we find in the list of musical scores: all kinds of music was sold (and played), from Italy, France, Germany, England and also from the Netherlands.

- The most well known Dutch woodwind makers are Van Heerde (in the list spelled in the French way as 'de Heerde'), E. Terton, P. Borkens, T. Boekhout, A. van Aardenberg, H. (or F.) Richters. These makers all worked in the first half of the 18th century. In fact, I presume that most of the woodwind instruments were rather new. The Flamish maker Willems started in 1758 making and selling instruments. On the contrary, most harpsichords and the Amati-violins were rather old. The fame of the Ruckers-instruments was very great, up to far in the 18th century.

- Some makers' names are interesting. One of them is De Bie (or De Bye). We know about some instruments by him, for instance the very beautiful boxwood alto recorder in the Haags Gemeentemuseum. But we do not know where he lived. De Bye or De Bie is a Flamish name, but many Flemisch people moved to Holland in the 17th century. Especially in Delft and Haarlem we find this name (spelled in various ways), and maybe he could have lived there. The other interesting name is Rosen. There is one bass recorder, by I. Roosen, also in the Haags Gemeentemuseum. Roosen could be a Dutch name, and I know some people (nearby, in Leiden) with this name. But Roosen can also be a Flamish, or even a German name.

- Not all names are spelled correctly. Aardenberg must be (van) Aardenberg. I can't explain the initials R.T. in R.T. Bressan; the name Brasam could be Bressan as well, Desner could be Denner and Scheer Scherer. Also some name of violin makers are spelled in various ways. That means that the names of these makers were not commonly known.

- In the list of instruments we find traverso's, recorders and oboes in about the same quantities, and thus, they might have been equally important. It is a pity that we have no prices of the sold items at the auction.

- No. 144 deals with '*Une premiere & seconde Flute a Bec* (by Borkens)'. Thus: a pair of recorders, with a first and a second instrument. Maybe this means the same as 'Premier Flauden' and 'Second-Flauden', such as J. Denner made in 1720 for the monastery in Göttweig (see E. Nickel: Der Holzblasinstrumentenbau, Munich 1973, p. 273). The first recorder could have had a somewhat different sound than the second, what was more interesting for the ears of the listeners if the instruments were played together. The sound of a recorder can be a bit boring for the listeners, and two recorders with the same sound can

even be boring for the players. However, some other items (Nos. 145, 146, 148 etc.) are not mentioned as a pair, but only as two recorders, or twoas before (deux dito).

- On some instruments *garnitures* are found of ivory and silver (No. 161), sometimes only of silver (No. 134). I suppose that those garnitures are not (or not only) mounts (rings), but that it also means the keys of the instruments.

- I do not understand No. 139: a traverso with an *embouchure dessus*, what means: with a mouthhole above. What does that mean? The maker's name (Serspier) is also obscure. Strange is that some traverso's have only two *pieces*, what I think means two **extra** joints (No. 133, 134 etc.). Today we should say: the instruments had **three** corps de réchange.

- About the *Hautbois d'Amour*: three items are listed (Nos. 163, 164, 165), all by unknown or obscure makers. Who was Norck? Maybe Christian Noack (1682-1724) from Leipzig? I suppose so; an Oboe d'Amore by Noack is found in Praha (see: Waterhouse, New Langwill Index, 1993).
Muller (No. 165) is a very common German name, Waterhouse has found more than 30 woodwindmakers with this name. A Johann or Johann Christian Müller lived in Dresden, making (and or playing) Waldhorns and Jagdhautbois. Desner (No. 163) could be Denner; there is no Desner in the New Langwill Index.

- About the recorders. *Flutes a bec* are recorders, and it is interesting that in the catalogue these instruments are not called simply Flutes (Dutch: *fluyten* or *fluiten*), what was the Dutch habit. Most of the Flutes a bec will were alto recorders in f1; the *Flute Octave* (No. 154) was a sopranino in f2, but I am not sure about the *Deux Flutes Octaves* by Borkens (No. 141). The place in the list suggests that these instruments could have been piccolo-traverso's in d2. The *Flute de quart* (No. 153) however was probably a (soprano) fourth flute (recorder) in $b^{b}1$.
I suppose that the *Vier Pypers Fluyten* (4 pipers flutes) by Borkens (No. 140) were short traverso's, without key, such as used in military bands (Schweizer Pfeiffen).

Conclusion: historical inventories are nearly almost interesting, but also a bit problematical. Names were not spelled correctly, and there can be some doubt about the description of the instruments as well. One of my theories: in the Netherlands music was sold from all important European countries, and played on instruments which originated from as many countries as well. In terms of making music on authentical instruments: it was (and is) not forbidden to play French music on English instruments (and vice versa), German music on Italian instruments, and so on, and son on.

1997 FoMRHI List of Members — 2nd Supplement as at 6 October 1997

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One new one above: *mob.* = mobile

Those who use email will know that there must be no gaps and that therefore line breaks in the middle of the address are purely for convenience and must be ignored

FoMRHI Communication Number - 1540 **Alec V Loretto**

Recorder Voicing

1] Recorder Voicing - noun - can loosely be defined as those parts of the recorder which have a strong and direct influence on - a] how the instrument articulates b] the pitch and tone colour that is produced with a variety of breath pressures c] the physical feel of how the instrument blows d] how the instrument deals with the inevitable problem of moisture and condensation.

2] Recorder Voicing - verb - is working on those parts of the recorder that influence 1] above.

3] Recorder Voicing - noun - is usually taken to mean those parts of the instrument extending from the Windway Entrance [**FIGURE B**] to the south end of the labium [**FIGURE C**] or underlabium [**FIGURE E**], whichever is longer. The block [**FIGURE B**] is part of the Recorder Voicing.

4] Recorder Voicing - verb - is generally taken to mean working on those parts of the recorder under 3] above

5] Re-voicing - verb - the act of carrying out adjustments to the original Voicing. For example, if the instrument is constantly clogging with moisture, a player is justified in asking that the recorder be Re-voiced.

From the above definitions, it is clear that Voicing has taken on some very specific meanings as far as the recorder is concerned. But other matters not generally included under the term Voicing can also, seriously affect items listed under 1] above. For example, take a baroque alto recorder whose top F [Ø14.5] speaks clearly and quickly. Take a piece of chewing gum and place it somewhere in the bore of the foot. The top F might now become difficult, proving that the bore of the foot has a considerable effect upon how the top F articulates. But the bore of the foot is not generally included in the noun Voicing, which leads to an important understanding viz: a good recorder is good not because one or two of its elements are good. It is a good instrument because all of the things that make a recorder are well related with a good balance. These include the speaking length; the bore profile; the finger hole sizes, positions and undercutting; the wall thicknesses; the windway geometry; the chamfers etc etc etc. It is a very long list and makers strive to get everything right. Their search for a perfectly balanced instrument is never ending. It is misleading therefore, to isolate elements of recorder design and believe that by concentrating on one or two of them in isolation, a superb instrument will result. Nevertheless, it can serve useful purposes if one experiments with one element [the bore say] to learn what things can happen if, in different places, the bore is made larger in diameter; or smaller; more tapered; or less tapered; longer; or shorter - and so on. The following article details the Voicing parts of the recorder that influence how the instrument responds under 1] above.

FIGURE B shows numerous factors all of which can, individually and in combination influence very important responses.

The Under Labium shape is determined by how much material is removed from the bore, and from where. **FIGURE E** shows the two main features - the Under Labium Length and the size of the Under Lip. On original instruments where the wood was almost certainly removed using hand held tools the Under Labium Length [**FIGURE E**] was often less than the Window Width [**FIGURE C**]. The Under Lip [**FIGURE E**] was often very small and sometimes non-existent with the curve being tangential to the Labium Edge.

An overly thick Labium Edge [**FIGURE B**] causes the instrument to speak slowly. An overly thin Labium Edge [**FIGURE B**] introduces a hissing noise into the sound.

The North/South length of the Labium [**FIGURE C**] has to be carefully controlled. A long Labium [**FIGURE C**] combined with a long Under Labium [**FIGURE E**] can make for a thin Labium that might easily warp, all the more so if the Labium Edge [**FIGURE B**] is thin.

The North Wall [**FIGURES B** and **C**] and the South End of the Block [**FIGURE B**] are generally in line as shown. Having them slightly out of alignment can often help strengthen notes and/or improve their articulation.

The Windway Roof [**FIGURE B**] is built into the instrument by removing wood, and is therefore easy to get wrong by removing too little material. If that is the case more wood can be very carefully removed. Much worse is to remove too much wood. Saving such a instrument by replacing wood is a time consuming and very skilled operation. Many badly damaged original recorders have been treated thus, restoring them to better playing condition.

Although often shown straight as in **FIGURE B**, the Windway Roof is sometimes concave as shown by the dotted line, many makers having their own theories as to the actual shape and amount of the concavity. The Windway Roof may be flat or arched - see **FIGURE D**.

The Windway Floor [**FIGURE B**] is built into the Block, and again can be straight as shown or concave as shown by the dotted line with makers again having their own theories. The Windway Floor can be flat or arched - see **FIGURE D**.

The distance between the Windway Floor [**FIGURE B**] and the Windway Roof [**FIGURE B**] is critical. If the distance is too small the instrument feels tight and stuffy. If the distance is too large the instrument can lack resistance with the tone breathy and expressionless.

The Top Chamfer [**FIGURE B**] is built into the instrument, and needs to be cut with great care. Removing too much wood often means throwing away the entire head.

The Bottom Chamfer, often referred to as Block Chamfer [**FIGURE B**] is built into the Block.

The Chamfers tend to strengthen the sound; give the instrument a blowing stability; influence greatly the articulation of individual notes; and influence the balance between the different registers. The size of the Chamfers, their angles, their uniformity and their finish have an enormous effect upon how the instrument sounds and how it articulates.

The Step - **FIGURE G** can be defined as the difference in height between the Under Labium at its Edge [**FIGURE B**], and the Windway Roof [**FIGURE B**]. It is built into the instrument and during making can be readily adjusted. Adjusting the Step of a finished instrument is a delicate operation. If the Step is made too large the tone becomes coarse,

inflexible, and lacks focus. If the Step is made too small the tone becomes thin, albeit sometimes very sweet, and it can deprive the player of an expressive instrument. The size of the Step is one of the most influential aspects as to how the Recorder plays and sounds.

Windways are sometimes parallel and sometimes tapered - see **FIGURE D**. Parallel Windways are the same width North and South. Tapered Windways are wider at their North end - see **FIGURE D**. Many players prefer a Recorder in which the windway tapers North to South both in Width [**FIGURE D**] and in the distance from Windway floor to roof [**FIGURE B**], believing that such a contraction offers some resistance to the breath and acts as a support to the whole blowing process.

The size of the window is very important. If the Window Width - see **FIGURE C** - is too small the instrument can lack power and projection. If the Window Width is too large the instrument can sound overly strong and even coarse.

The Window Height or Cut Up - see **FIGURE C** - is critical. As a general rule the smaller the Height or Cut Up [within reasonable limites] the more the higher notes are favoured. Conversely the larger the Height or Cut Up the more the lower notes are favoured.

The height of the West and East Walls [**FIGURE C**] and the height of the North Wall [**FIGURES B** and **C**] - influence the pitch, stability and projection of the recorder. The height of the Walls is influenced by the position of the Labium in relation to the Centre Line of the Recorder. The nearer the outside of the instrument the Labium is carved, the lower the Walls will be. The height of the Walls [**FIGURES B** and **C**] is much influenced by the outside diameter of the Recorder at the Blockline [**FIGURE C**].

FIGURE C shows the Walls pretty well parallel from North to South. Flaring the walls [having them diverge from North to South] influences the pitch, focus and projection of the Recorder.

FIGURE A shows another of the important factors that a maker builds into the instrument – the angle of the windway in relation to the centre line of the bore. Once the recorder is made, it is a delicate operation to modify this angle. There is no universal agreement among makers what the effects are of having windways that blow down, up or parallel. But there is agreement that if one opts for a windway blowing down or up, the amount of angle must be very slight indeed. Too much angle introduces into the sound breathiness and lack of focus.

The Position of the Labium in the Airstream - see **FIGURE F** - is of considerable importance. The Labiums on a good surviving Recorders and their modern copies, sit low in the Airstreams - see Airstream X. With a small floor-to-roof Windway this Labium position lends itself to a flexible and focussed instrument. The penalty is that the articulation of the instrument is much affected if the Block swells and/or the Windway Roof changes shape and, on drying, the wood fails to return to its starting position. The Windway geometry is now misaligned making for an instrument with a weak lower register that easily breaks and/or an upper register that 'coughs' before it speaks.

To overcome this problem cheaper Recorders are made with larger floor-to-roof Windways with the Labium sitting higher in the Airstream - see Airstream Y. The penalty is that the sound becomes rather breathy and often lacks a clear focus. The advantage of the Labium's central position is that the Windway Floor and/or Roof, have a considerable margin of latitude. They can distort more than a little yet the instrument continues to produce its original sound.

Labiums sitting very high in the Airstream - see Airstream Z - produce an extremely breathy, open sound which often consist more of unrelated noise than musical sound.

The Voicings of different types of Recorders vary for two main reasons - first, musical reasons and second, commercial reasons.

Musical Reasons: different types of recorders have different musical demands made upon them. As an example, Renaissance Recorders are instruments with a range [more or less] of an octave and a fifth. Makers can concentrate on building into the instrument a round, rich vocal sound, full and strong in the lower register yet clear and focussed in the upper register. The Window's Height and Width [**FIGURE C**] can be slightly larger than a Baroque Recorder of equivalent pitch. The slightly greater Height helps strengthen considerably the lower register which provides a better balance between it and the usually stronger upper register. The slightly greater Width allows the instrument to produce a little more sound without the high notes/low notes balance being jeopardised.
However, a Baroque Recorder with a range in excess of two octaves, requires a Window Height and Width which provides a full low register and a focussed upper register. The Window dimensions are fractionally smaller than those of an equivalent pitched Renaissance Recorder but even so the Baroque Recorder's upper register is always more powerful than its lower, a characteristic exacerbated by blowing the instrument from its wider end.
Each different type of recorder requires therefore a Window size appropriate to its function.
To leave Voicing for a moment, another example concerns the bore. A larger diameter bore is less successful in producing high notes than a smaller diameter bore of the same length. A larger bore encourages fuller low notes. Because of this one finds Renaissance Recorders have a larger bore than equivalent pitched Baroque Recorders.
Each different type of Recorder requires all features - bore, chamfers, step, windway size and profile, hole sizes etc etc. to be appropriate to the instrument's function. And as mentioned earlier, if the instrument is to be a good one, all these variables have to be related to each other and be in good balance.
Makers are constantly trying to control and get into perfect balance the variables in a Recorder's Voicing. These elements of Voicing must of course be related to the rest of the instrument - the bore, wall thicknesses, finger holes etc etc. Very often the difference between a good Recorder and a superb one is known to be in the various parts which make up the Voicing. But the differences are extremely subtle and are so incredibly minute they cannot seemingly be measured. If they could be totally understood and unfailingly replicated, makers would no longer continue to produce very good recorders. They would all be quite superb!

Commercial Reason: to produce a high quality Recorder and to get everything in balance is a time consuming task. Some of the work can be done with accuracy using machines. But much has to be done by hand including such things as the Chamfers; finishing the Labium; adjusting the thickness of the Labium Edge and adjusting the Block. There are many other tasks outside the Voicing, such as undercutting finger holes and adjusting the bore. These hand operations

consume much time, and in Recorder making as in much else, time means money. To lessen the costs, extremely sophisticated machines have been developed to minimise the handwork. These machines work to astonishingly fine tolerances turning out instruments that vary hardly at all in their critical dimensions and in their overall appearance. This abilty to produce uniformity is the machine's strength. It is also a limiting factor. If the materials used to make Recorders were uniformly homogeneous, a best-model-for-that-material could be produced. But wood is not homogeneous within itself, nor from piece to piece. So a machine produces rosewood, plumwood, maple and ebony instruments all pretty well identical in appearance and dimensions. By the law of averages there will be some machine produced instruments in every batch that are superior to the rest, simply because the particular design suits well this or that piece of wood which has its own individual characteristics. And alas, there will be some below average simply because that same design ill suits the individual characteristics of a piece of wood which might look very similar to the other pieces but which varies enormously in age, grain, weight, density, structure and resonance. The makers of hand made Recorders apply their skills to obtain from every individual piece of wood the best possible qualities. With experience and understanding they change chamfer angles; chamfer sizes; window dimensions and other elements of Voicing in their search for the Holy Grail, but like machine made Recorders, those produced by hand can vary considerably. It is fortunate for both factories and individual makers that Recorder players, like those who play other instruments, cannot reach total agreement on what constitutes the perfect instrument. This ensures a ready market for good quality Recorders with different yet special characteristics.
Makers and players know that a well designed accurately made mass produced wooden or plastic Recorder is often better than an inferior hand produced wooden instrument. The factories and those making hand made Recorders have influenced each other in raising to new heights the qualities found in the Recorders made today, as have the players who increasingly insist on instruments that meet fully the demands made upon them.

Lastly, one often hears the words Voicing and Tuning mentioned together. They are different, yet related operations. Suffice to say that before one embarks on tuning or retuning a recorder the instrument's Voicing must be in optimal condition. It is a waste of time to tune a recorder which is not playing well with perhaps its labium distorted; its windway dirty; and with joints that are leaking - to mention a few problem areas. Once these conditions are put right the instrument responds in quite a different manner, and the previously acceptable tuning can be seriously disturbed.

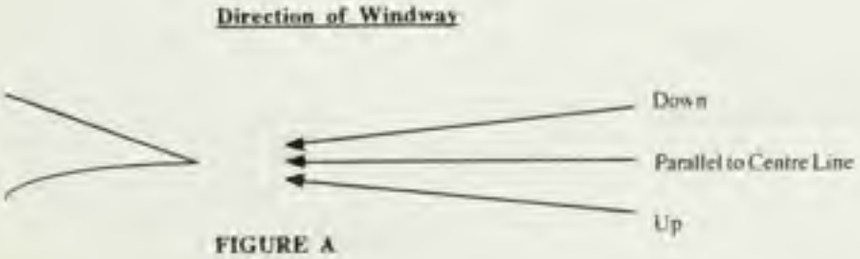


FIGURE A

Walls, Window and Labium

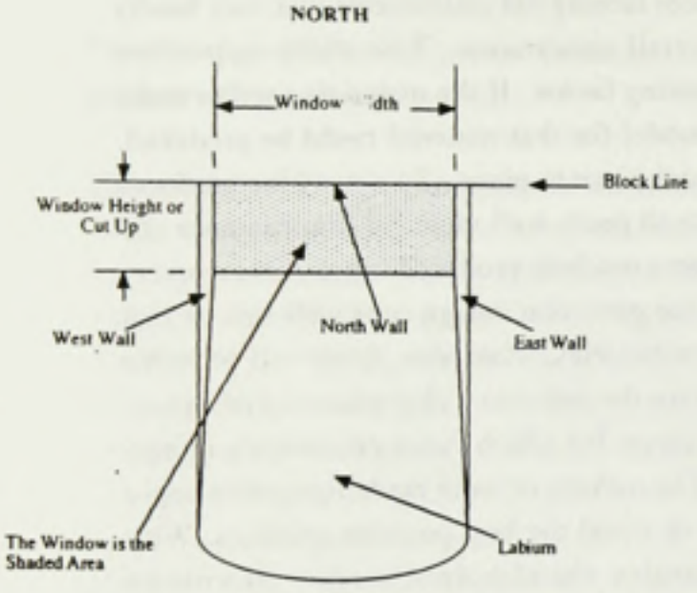


FIGURE C

Arched and Flat Windways

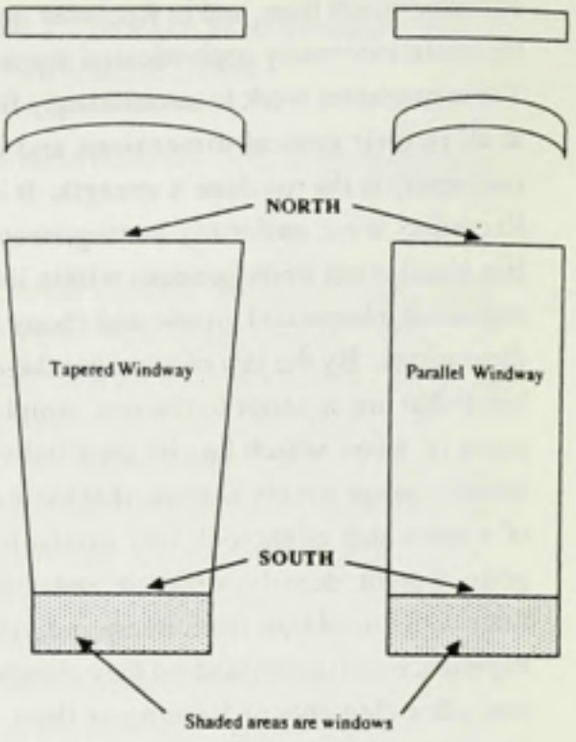
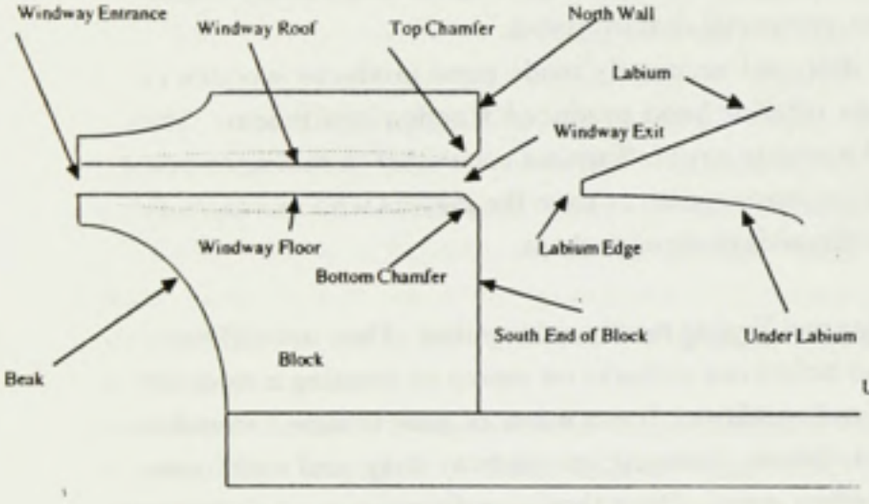


FIGURE D



Cross Section of Windway and Labium

FIGURE B

The Under Labium Shape

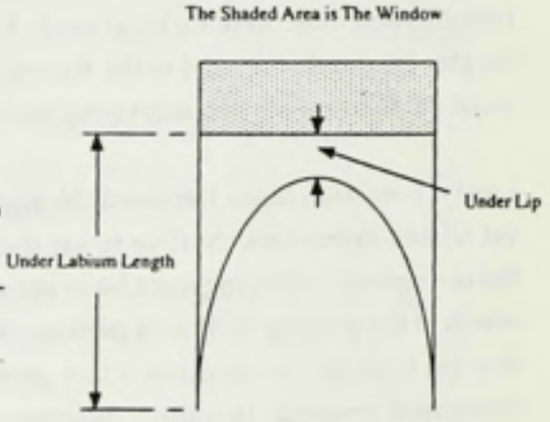
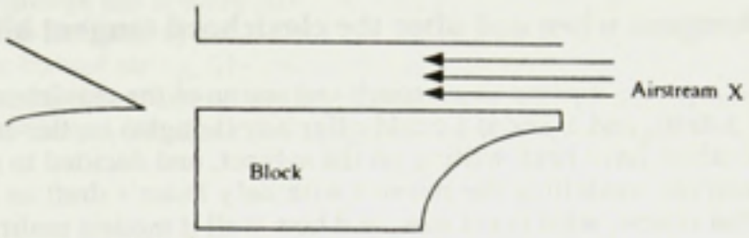
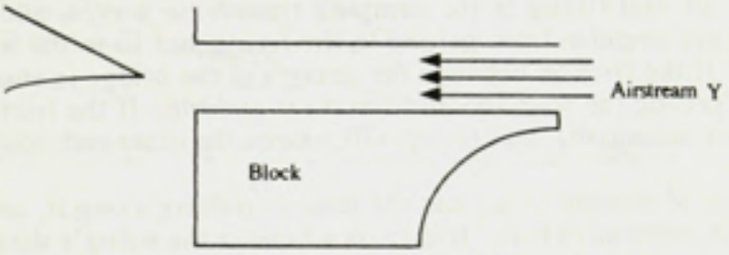


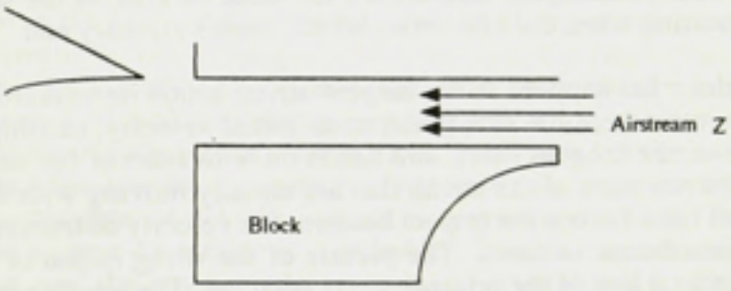
FIGURE E



Labium positioned low in airstream



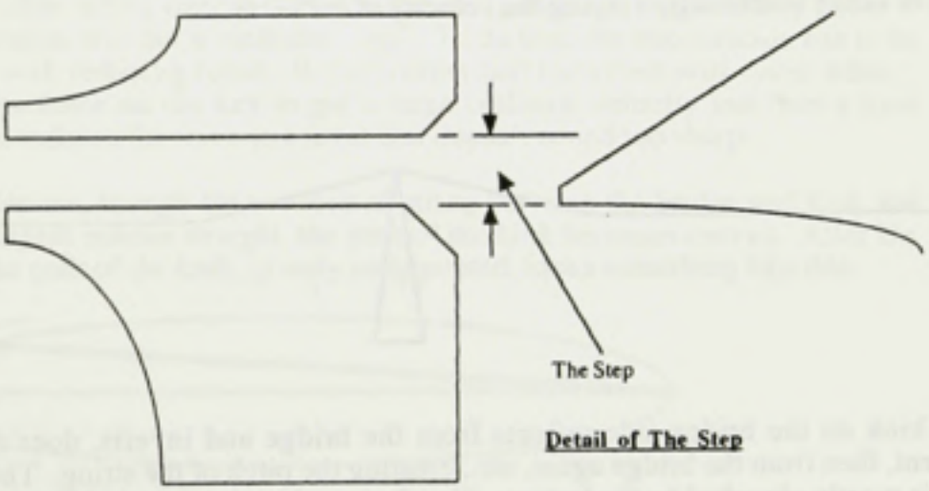
Labium positioned in middle of airstream



Labium positioned high in airstream

Position of Labium in Airstream

FIGURE F



Detail of The Step

FIGURE G

FoMRHI Comm. 1541

Ephraim Segerman

What happens when and after the clavichord tangent hits the string?

Peter Bavington is giving a paper about touch and action of the clavichord at a conference. He kindly sent me a draft, and asked if I could offer any thoughts on this topic. I have not been following what others have been writing on the subject, and decided to approach the problem from basic principles, modelling the physics with only Peter's draft as background. We can later sort out what is new, what is not new, and how well it models reality.

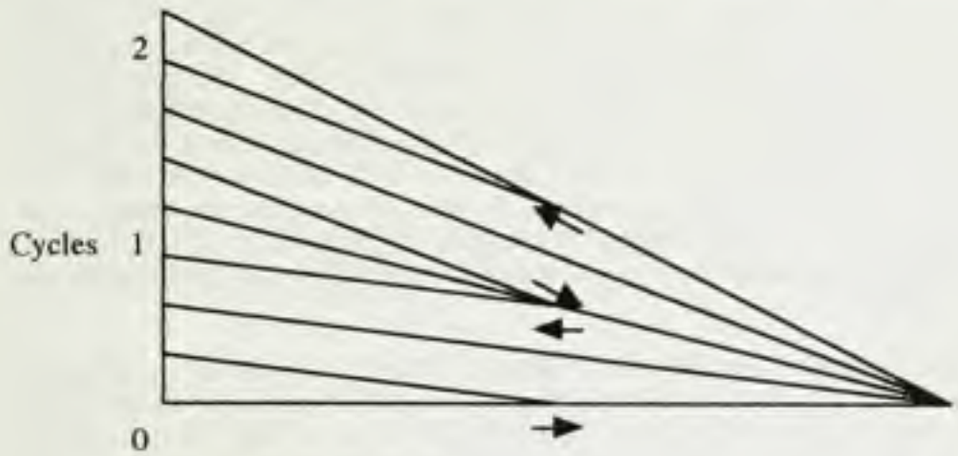
When the tangent hits the string, there is a compressional impulse that radiates in all directions from the point of impact. Some of it is transmitted compressionally through the tangent to the key which it bends slightly, and thus it can move air so we can hear it as a click. Some moves across the diameter of the string, which does not move enough air for us to hear it. The rest moves compressionally along the string in both directions. The lasting on the string between the tangent and the end-fixing is for damping transverse waves, and so will not stop the compressional wave impulse from getting to the fixing and so to the woodwork, which will make it audible. If the friction between the string and the bridge is enough, the impulse will rock the bridge, getting the soundboard to make it audible. If the friction is not enough for this, the woodwork around that end-fixing will, like on the other end, contribute to audibility.

A stationary piece of straight string has the tension pulling along it, and there are no forces tending to make it move anywhere. If there is a bend in the string's shape, there is a resultant force from the tension on both sides to make the string tend to straighten out. In the process of trying to straighten out, it tends to shift the bend along the string. That shift is at the velocity of transverse sound. If the bend is initially stationary (the plucked string situation), half of the bend amplitude moves away in each of the two directions. The slip-stick action of the hair on the bowed string is asymmetrical, and allows the bend or kink in the string to move in one direction only, inverting when the kink reflects from each stationary end.

Let us now consider what happens in the tangent-string action immediately after contact. The tangent advances into where the string was at an initial velocity, causing bends in the string. There is a bend over the tangent itself, and bends on both sides of the tangent. Each of these latter bends is between parts of the string that are already moving with the tangent, and parts that are unchanged from before the impact because the velocity of transverse sound hasn't yet transmitted the disturbance to them. The picture of the string is that of an isosceles triangle sitting on the horizontal line of the original string position. The top corner of the triangle is the tangent, and it is moving up at the tangent's velocity. The bottom two corners are moving away from the tangent at the velocity of transverse sound propagation. The base angle of the triangle has a tangent (geometrical) which is the ratio of the two velocities. The sharpness of that angle, with the tension, determines the energy carried along the string to the bridge, so the player varies loudness by varying the velocity of collision.

The kink on the bridge side reflects from the bridge and inverts, does the same from the tangent, then from the bridge again, etc., creating the pitch of the string. The kink on the other side is mostly absorbed by the lasting. The change of angle of the string at the bridge when the

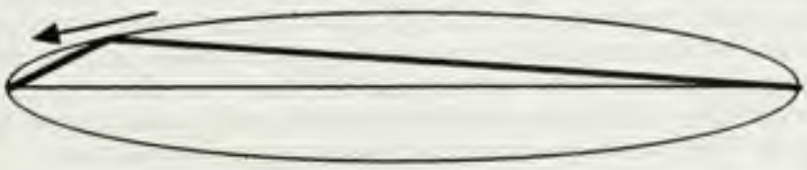
kink is reflected there changes the component of the tension force normal to the soundboard, and that is the force that moves the soundboard. At this stage, that force is an upward step function with time, one step for each cycle. When the tangent eventually stops, that function shape would be that of the bowed string, like the teeth on a rip saw. Following is a diagram, enormously exaggerated in the movement of the tangent, which shows the string shape for every quarter cycle over the first two cycles if the tangent is moving at constant velocity:



From this diagram we can see that at constant tangent speed, the tangent and the kink just meet for the tangent's reflection of the kink. If the tangent suddenly stops, new kinks radiate away from the tangent in both directions with a straight bit of string over the tangent which, carrying the momentum the tangent previously gave it, leaves contact with the tangent. When the original kink crosses the new kink and then the tangent position, it goes over the tangent and the energy it carries is absorbed in the lasting. Then there is the sound of the string colliding again with the tangent when the upward momentum of the string is overcome by the force of the string tension trying to straighten it out. This collision creates a new kink. A sudden stop like this is unrealistic, but a large deceleration is possible. This deceleration will probably continue over a short time, and the noise would be repeated several times. This effect was called a 'tzip' because of its sound by Arthur Banade in the very short section on the clavichord in his classic book *Fundamentals of Musical Acoustics* (1976).

If there was a constant force actuating the key, there would be a deceleration of the tangent due to the force from the tension acting over the bend in the string over the tangent. My guess is that this level of deceleration will not actuate the 'tzip'. To do that, the deceleration has to be more drastic than this, with reducing force. It thus seems that the effect will occur when a player starts with a large force on the key to get a large collision velocity and thus a loud sound, and then too soon reduces the force to a level that doesn't sound too sharp.

When the tangent decelerates, though the sections of string between the bridge and kink and between the kink and tangent remain straight, the path of the kink becomes curved. After the tangent stops moving, the path of the kink, grossly exaggerated, looks something like this:



with the kink moving along the shallow curve shown. The force on the bridge that moves the soundboard is the vertical component of the tension force acting along the straight line between the bridge and the kink.

If one gives the key of a clavichord an impulse without following through, the tangent bounces off the string. The string under tension does act like a spring. If one releases a weight on a key to simulate a constant-force finger action, and if there were no energy losses in the system, the tangent would bounce off the string and return to its original position (like on a trampoline). There are losses in the system, and if they are great enough, the tangent will not bounce off the string, and will just undergo damped oscillation while in continuous contact. The frequency of that oscillation is $(1/2\pi)\sqrt{[T(a+L)/(aLM)]}$, where T is the string tension, M is the effective mass giving the tangent its inertia, and a and L are the lengths of string on each side of the tangent. Banade wrote that the period (time per cycle) of this frequency on the clavichord is tenths of a second. There must be an intermediate damping level at which the oscillating tangent just barely manages to lose contact with the string at the end of the first cycle. Then the kink carrying the string's note gets lost in the lasting, and a new lower-energy kink forms when the string and tangent meet again.

Therefore, I would guess that the conditions for making a good clean note on a clavichord would include having enough distance between the resting tangent position and the string for the finger to accelerate the tangent (with not too much finger force) so that the velocity on contact is high enough to give a decent volume of sound. Then during the tenth of a second or so when the tangent moves onto the string, the finger force should not decrease, because that creates the 'tzip'. In the next tenth of a second or so after that, slightly more finger force is required to prevent the string from bouncing the tangent from it. This would usually happen without thinking because the muscles are instructed to keep the finger still. Then, if the note is too sharp, one can release some of the finger force to tune it. Starting loud notes sharp could well have been a normal original component of performance practice.

This advice is theoretical, purely out of the imagination, and has no validity unless it agrees with practical experience. If it doesn't, then the theory must be faulty, and there are important factors that I have not taken properly into consideration. Could we please have some discussion about this?

FoMRHI Comm. 1542 — Ephraim Segerman

The purpose of the cotton between the hurdy-gurdy wheel and string

At the Edinburgh Galpin Society conference in August, one speaker discussed hurdy gurdy wheel-string geometry, and mentioned that the instrument wouldn't work without the cotton, but he had no idea about what the function the cotton was. There was no time for discussion at that time, so I will compensate for my frustration then by stating here what I think I understand about it.

The rosin on the wheel only serves to lock the rotation of the cotton with that of the wheel, as if they were geared together. The actual slip-stick bowing action is by the rosin rubbing on the string, supported by the cotton (replacing the hair of conventional bows), supported by the wheel. Without the cotton, the area of contact between the rosined wheel and the string is too small to get a proper grip. It is a very thin contact line between two relatively hard convex surfaces. But the cotton presents a softer concave surface to the string (this is what hair does), with lots more area to grip. The wheel does not 'bow' the string, the cotton does.

FoMRHI Comm. 1543 Ephraim Segerman

Origins of the 'guitarra portuguesa'

It is very gratifying when a speculation deduced from tenuous circumstantial evidence turns out to be right when the real evidence shows up. I tracked down an article called 'The Portuguese Guitarra: A Modern Cittern' by Ronald Louis Fernández in the 1991 Fall (autumn) issue of the Journal of the Guild of American Luthiers. He wrote: 'in 1795, António da Silva Liete of Oporto wrote a method for learning the *guitarra portuguesa* [*Estudio de Guitarra*, copy in the Library of Congress] in which he states that the beloved national instrument had been imported from Great Britain, and that many fine examples were created by Mr. Simpson of London. Furthermore, he tells us that in his own city, instruments of similar quality to Mr. Simpson's were being made by Luís Cardoso Soares Sevilhano.'

Antonio da Silva Liete also mentioned that the tuning was the same as the English guitar (from bottom up, major 3rd, minor 3rd, 4th, major 3rd and minor 3rd). An 1806 method by Domingos Varela mentioned an alternative second tuning with the 4th and 6th courses raised a tone and the 5th course raised a semitone. Varela wrote that it was also possible to have a 7th course, which was tuned a tone lower than the original 6th course. This is the earliest evidence that could imply more than 10 strings. An early 20th century method gave the original tuning, which was called 'natural', plus two alternatives. The 'mouraria' tuning differed from the 'natural' one by having the 5th course raised a semitone. The 'fado corrido' tuning differed by having both the 2nd and 5th courses raised a semitone, and the 6th course lowered a tone. This last one seems to be the tuning mainly used today, with the 6th course being an octave pair. The fan-shaped setting of the tuning screws seems to date from around 1900 since a book on fados by Mascarenhas Barreto published around 1970 claimed that it was 70 years old. Modern playing technique involves finger picks tied to the thumb and index finger by thread, positioned as extensions of the natural finger nails.

FoMRHI Comm. 1544 John R. Catch

Comm. 1203; An Amendment

In Comm. 1203 (1993) I wrote that "the etymological difficulty [about the word catlin or catling] is fairly obvious and it may well have been raised and answered elsewhere". I learned only very recently that Stephen Bonta had in fact raised it in 1988 (J. American Mus. Instr. Soc., XIV, p.38). He does not seem to have recognised that the spelling catline has no historical basis (I know of no example before 1976) but otherwise materially anticipated Comm. 1203.

The disappointing thing about this is that during four years no reader of FoMRHI Quarterly - indeed, nobody at all - has publicly (so far as I know) or privately made the amendment which I now gladly make.

14th August 1997

FoMRHI Comm. 1545 Ephraim Segerman

On Praetorius and the sizes of Renaissance bowed instruments

The evidence on sizes includes contemporary pictorial representations, surviving instruments and contemporary writings.

Sizes in pictures and statues are rarely life-sized, so they usually need to be scaled. To do this I usually scale from the face of the player, either from the distance between the eyes or the distance from the mouth to the centre between the eyes, whichever suffers the least perspective contraction. I assume that distance to be between 6.0 and 6.5 cm. full scale. It is possible that the purpose of the representation was to display unusual instruments, but when this is not clear, it is very much more probable that the purpose was to show the players and what they were doing, with instrument being secondary and thus fairly typical to not be distracting.

Surviving instruments usually have, for hundreds of years, been available for people to modify for playing music that they were interested in. Only a small fraction have survived unaltered, and it is almost impossible to demonstrate that any one of them has remained so. Instruments that have no function to serve tend to be discarded, and the size statistics of surviving instruments usually reflects the size statistics at the latest time that they have been found useful, and not the size statistics when they were new. Since we are interested in matching instrument sizes with the repertoire the instruments were made to play, the sizes of surviving instruments cannot be assumed to be typical without corroboration from different types of evidence.

Contemporary writings could mention actual measurements, or they could mention tunings. Tunings can be a basis for size estimation if we had a way of estimating the pitch standard used. Then, from knowing the longest string stop a gut string at a certain pitch can have without the string breaking too often, and knowing the largest pitch range with parallel bridge and nut in that period, we can estimate the possible range of string stops for any particular tuning range that fits the properties of the gut.

Highest pitches, lowest pitches and string stops

Each string stop (vibrating string length) has a highest pitch that a gut string can be safely tuned to. Many people reason that since thin strings are associated with higher pitches than thicker strings, a thinner string can be tuned higher than a thicker string. This is only true if the thicker string has more twist in it than the thinner string. The tensile strengths of high-twist and rope-construction (catline) gut strings are less than that of low-twist gut strings. The thinnest (highest-pitched) strings of stringed instruments are almost always made of low-twist gut because it provides maximum tensile strength, and the advantage of better tone by increasing the twist are least needed.

The 1sts and 2nds of violins (and most other instruments) are of low-twist gut, and so they have the same tensile strengths. That means that the tension that breaks the string divided by the cross-sectional area is the same for both strings. By the Mersenne-Taylor string formula, the tension divided by cross-sectional area defines a pitch if the string stop is given. Thus the violin 1st and 2nd will break at approximately the same pitch (around g" or g#" if one keeps turning the peg until it snaps). The second is thicker and so needs more tension to break it, but the breaking tension divided by the cross-sectional area (and the breaking pitch) are the same.

The highest pitch one will tune a string to is a matter of judgment. The higher it is, the sooner it will break, as all gut strings eventually do. Lute players have been known to tune the highest string to several semitones higher than recommended for a recording session, and it has lasted for the required time. My recommendation is to follow the judgments of the original early musicians, as can be deduced from Praetorius's information.

If a gut string is tuned to a pitch appropriately near to breaking, and one fingers that string to

make it shorter (resulting in its sounding at a higher pitch), it still has the same nearness to breaking as it had before. The same relationship exists between the highest pitch for an unstopped string and the string stop, i.e. each semitone of decreased length leads to the rise of a semitone in highest pitch. For strings of the same tensile strength, the frequency of the highest pitch multiplied by the string stop is a constant.

When a thicker gut string is chosen to sound at a lower pitch, it is less stretchy than a thinner gut string. This makes the thicker string increase in pitch faster than a thinner string for the same change in length. Pressing a string against a fingerboard increases its length slightly, and if the string too unstretchy, the string will sound too sharp when fingered in the same position as thinner strings. Another effect of reduced stretchiness is inharmonicity in the string's sound. Inharmonicity reduces the number of higher harmonics in the string's sound. This reduces the brightness and focus in the sound. Both of these effects put limits on the lowest acceptable pitch a gut string can be tuned to.

The stretchiness of a gut string can be effected by the twist in it. A high-twist string is stretchier than a low-twist string, and a roped gut (catline) string is stretchier than a high-twist string. Thus, to keep up the trueness in fingering and brightness in sound, as one goes for thicker and thicker strings, one switches from low-twist to high-twist gut, and then to roped gut. A metal wound gut string is stretchier than an all-gut string of the same weight because its stretchiness is that of its core alone.

If one has a thick string which is borderline in acceptability in trueness of fingering or brightness of sound, and then fingers it to different pitches, there is no clear change in acceptability with the different combinations of pitch and vibrating length thus produced. We can thus deduce that the lowest acceptable pitch relates to the string stop in the same way as the highest pitch, i.e. the frequency of the lowest acceptable pitch multiplied by the string stop is a constant. Thus the pitch range between the highest and the lowest pitches is the same for all string stops when the same string twists are involved.

Of course, acceptability of the sound of a string is a matter of judgment. Since we are here concerned with instrument history, only the judgments of the original players is relevant. Their judgments of acceptability are reflected in the tuning ranges of the instruments they used.

Praetorius (1619/20)- general

In *Syntagma Musicum* II, Praetorius provides us with instrument lengths (from scaled drawings), the pitch standard (from the dimensions of a set of pitch pipes) and tunings. Investigating his evidence allows us to develop tools that will help in situations not so richly endowed with evidence.

If one surveys the bowed instruments discussed by Praetorius one finds that the largest open-string range used is an octave and a 4th, on the viola bastarda. We assume that in this case the highest string was at the limit of acceptable rate of string breakage, and the lowest string was at the limit of acceptable sharpening on fingering or dullness of tone. From the string stop, the extreme nominal pitches of this instrument and the pitch standard, we can calculate the constant that is the frequency multiplied by the string stop for the highest and lowest pitches for any bowed instrument. It is assumed here that the highest string is made of low-twist gut and the lowest string is made of roped gut, and for simplicity, all semitones are equal tempered. The result is shown in Table 1 for both Praetorius's pitch standard at a' = 430 Hz, and the standard he actually preferred, a tone lower, at a' = 383 Hz.

Actually, the pitch standard is not involved in any calculations from Praetorius's information, such as Table 1. It is only necessary in comparison with other information which is at another pitch standard that is not simply an integral number of semitones away from his standard. Then the frequency in Hz multiplied by the string stop in metres is 209.3 for the highest pitch with a low twist gut string, and 39.2 for the lowest pitch with a roped gut string. As an

example, consider a late 19th century violinist playing a gut e" string .33 metres long at 659.3 Hz (i.e. at a'= 440 Hz). The product of these two numbers is 217.6, which is 2/3 semitone higher than 209.3. An earlier 19th century violinist playing at a' = 455 Hz would be at more than a semitone higher. Either 19th century gut was stronger than 17th century gut or, more likely, 19th century violinists had to tolerate a higher rate of string breakage because of having to compromise more with the wind instruments about pitch standards in orchestras.

The tone-lower pitch standard Praetorius preferred was predominant in southern Europe, where the main centres of instrument making were. It was called 'Chor thon' in southern German-speaking areas (different from the Chorthon in his own area), 'Ton de Chappelle' in France, 'Corista' in Italy, and was the pitch of mean lutes, viols and domestic voices (singing madrigals) in England. When Praetorius depicted an instrument that was made for that standard, he usually prefaced the name with 'Chor-'. He wrote that it was the pitch of their ancestors, which was subsequently raised to current higher levels in places such as his own northern German area.

Also included in Table 1 is the lowest pitches when the lowest string was made of high-twist gut, the lowest acceptable pitch of which was two octaves below the highest acceptable pitch. The frequency multiplied by the string stop (in metres) for this lowest pitch was 52.3.

Roped gut bass strings became generally available in the third quarter of the 16th century. They were available from Munich for a short time around 1500, after which the monopoly apparently moved to Barcelona (the English name 'catlin' apparently derived from 'Catalan'). The prices were then so high that only the very rich outside of Spain could afford them for their lutes. Then, the open-string ranges of bowed instruments did not exceed two octaves, an appropriate range for high-twist gut basses. The bankruptcy of the Spanish monarchy in the middle of the century bankrupted the south-German (including Munich) merchants who were running the Spanish economy (these were then replaced by merchants from Genoa). Roped-gut strings then became completely unavailable, and the vihuela, the only instrument which relied on them, declined rapidly. After a while, string makers in Bologna learned how to make them, and sold them at affordable prices. Then 7-course lutes with a range appropriate for roped-gut basses started to appear (Barbetta's 1582 book of lute tablatures was named *Novae Tabulae Musicae Testudinariae Hexachordae et Heptachordae*). An analysis similar to that given here of Praetorius's plucked stringed instruments indicates that the highest pitch was the same as when it was bowed, but the lowest pitch was a tone lower than when it was bowed.

Table 2 gives a list of all of the bowed instruments for which Praetorius gave both the tuning and a scaled drawing from which we can measure the string stop. The maximum and minimum string stops for each tuning is taken from Table 1. It also shows the number of semitones worth of string stop (fret lengths if there were frets) shorter the depicted instrument's string stop was than the longest allowed by the tuning, and the number longer than the shortest allowed by the tuning.

Praetorius's Geigen

We can see in the first 5 rows of the Table that the violino and smaller instruments had string stops much closer to the maximum for their tunings than to the minimum for their tunings. Yet they were shorter than the maximum by rather more than a semitone of length, apparently to make their highest strings last longer.

An unexpected comment associated with the two Poschen (rebec-shaped fiddles) in the Plate is 'an octave higher'. Their tunings were not an octave higher than any other fiddles, so it most likely means that they play the music an octave higher than written. Then the Tenor Viola de Braccio could have played the bass line in octave-higher ensembles, all members of which would be held on the arm, as implied by the name. The Klein Discant Geig was associated with the comment 'ein Quart hoher'. It was tuned a fourth higher than the Violino, but it also

could make a similar all-arm-held ensemble with the Violino and Tenor, which could have played the music either transposed up a fourth or an octave. Such ensembles were probably very common in the 16th and 17th centuries. The Eglantine Table in Hardwick Hall shows fiddles with string stops of 15, 28 (with the same indented shape as Praetorius's Klein Discant Geig) and 36 cm string stop, apparently such an ensemble.

The Violino shown by Praetorius was particularly small, and the bridge had been shifted lower than between the nicks in the f-holes to increase the string stop. If it were between the nicks, the string stop would be about 2 cm or over a semitone's worth shorter than that shown. If the string stop was just another semitone shorter, it could have comfortably played at the fourth higher tuning at a place where the pitch standard was a tone lower than that of Praetorius.. In those days violin sizes were much less standardised than they are now.

The Tenor-Geig string stop was somewhat closer to its minimum for the tuning than its maximum, presumably for ease in handling as it was held on the arm. The Bas-Geig shown had 5 strings, almost filling the range. Four-string basses tuned F to d' could have been smaller, and those tuned from C to a could have been either larger or smaller (this is the earliest evidence for this modern 'cello tuning). Since the Gross Quint-Bass had 5 strings almost filling the range, we can deduce that its string stop was about 95 cm.

Praetorius's Viole de Gamba and remaining bowed instruments

Omitted here are the historical tunings numbered 3, 4, and 5 in the Table given for the three smaller sizes, which are copied from Agricola (1528). He copied a drawing of one of Agricola's viols on Plate XXXIV. They are unrelated to his viol drawings on scaled plates.

The string stops of all of the viols shown by Praetorius are much closer to the shortest they can be for the tuning than the longest. He wrote about English viols that usually had nominal tunings a 4th or 5th higher than the actual pitches of the German viols, which they sometimes tuned down to when playing without other instruments. Since a viol has an open-string range of 2 octaves and the total possible range with gut is a 4th more, it can only tune up or down over a range of a 4th. Praetorius's Cant (treble) was almost a tone longer than the shortest it could be for its tuning, so a treble his size could only tune up 3 semitones at his pitch standard. Assuming that the sizes of his and English viols were the same, if the English normal nominal pitch was a 5th higher (as he guessed), these viols would be at a pitch standard 4 semitones lower than his, and if the normal nominal pitch was a 4th higher (as we know), the pitch standard would be a tone lower than his. If English viols were smaller than his, it could only be by a one semitone fret length because his tenor is that much bigger than the smallest it can be for that tuning, and English tenor viols could play with that tuning. If English viols were bigger than his, the pitch standard followed would be lower than that deduced above, and that is most unlikely.

Thus the English viols Praetorius knew were essentially the same sizes as his viols. If they were significantly different, we would have expected him to have mentioned it. More confirmation of this equality is that there is no evidence of English viols changing size in the 17th century, and Talbot's c.1693 measurement of 24 inches (61 cm) for the tenor viol string stop was within a fret length of being the same as that of Praetorius's tenor viol. Talbot's consort bass viol had a string stop of 32 inches (81 cm), appropriate for being tuned a 5th below the tenor viol rather than the 4th of Praetorius's depicted bass viol.

It seems that there was some standardisation in sizes for viols that played in sets in the 17th century. Trebles had string stops of about 40 cm (16 inches), tenors about 60 cm (24 inches), and basses about 80 cm (32 inches). Approaches to tuning differed. In England, viols were tuned to the highest pitches for their sizes (or the longest string stop for the tuning), while in Praetorius's area, viols were tuned near to the lowest pitches for their sizes (or near to the shortest string stop for their tuning). The English had 1st strings for their treble, tenor and bass viols tuned to d", g' and d' respectively at a pitch standard a tone lower than Praetorius's

Cammerthon, while Praetorius's first strings were tuned to a', d', and g (or a) at his pitch standard.

There was a larger viol with string stop of about 100 cm (40 inches) that sometimes played in sets in England and Germany, and an even larger one with string stop about 125 cm (50 inches) that Praetorius used in sets as well.

Soloistic viols were also used. They had sizes in-between the tenors and basses of sets They were sometimes called types of 'bass viols' in England, but usually just 'viola da gamba'. Praetorius's Viola Bastarda was one. In England, that instrument was called 'lyra viol'. Praetorius described it as having metal sympathetic strings tuned in unison with the bowed gut strings. The sympathetic strings had been recently introduced in England. The instrument shown has no sign of sympathetic strings, and only single purfling. That makes it unlikely to have been English. His other viols had double purfling, making them more likely to be English. If that were the case, the bass viol that be depicted, being somewhat smaller than English bass viols for sets, could well have originally been an English soloistic viol.

The Lyra de bracio shown is the only bowed instrument with the string stop outside the range deduced assuming that the viola bastarda represented how far players then were willing to go in highness and lowness of string pitch for the length. It is half a semitone's length longer than the limit for the tuning pitch. The instrument was obviously made for playing at a lower pitch level. Praetorius lowered its highest string from the usual nominal pitch of e" to d" to make it playable at his pitch standard, but the string would still break more often than usual then. Being usually a solo instrument for accompanying the voice, it would not need to conform to any pitch standard. It's original pitch level was probably a bit lower than Corista.

Praetorius had all of the strings of the Lyra de bracio going over the nut. Originally the instrument was made (or designed for) when the total acceptable range for gut strings was only two octaves. The tuning range was a tone more than that, so the lowest string (and its octave partner) were made longer by going off the fingerboard to a knob into the side of the peg plate, higher up it, before going to their tuning pegs. Praetorius showed the knob plugged into the side at the nut, unused. He did the same with a similar knob on the Lyra de Gamba. That instrument never had the problem of needing to lengthen the lowest course to fit the acceptable pitch range, but it had that design feature probably just to show its relationship with the Lyra de bracio.

Banchieri's (1609) bowed instruments

A decade earlier than Praetorius, Banchieri published a book in Bologna on playing the organ. It included a chapter on tuning stringed instruments to the organ or harpsichord. He called each octave starting on some F by a different name, so EE and lower was sotto gravissimo, FF to E was gravissimo, F to e grave, f to e' acuto, f' to e" sopracuto, and higher pitches were acutissimo. Keyboard tuning was from f, called 'F acuto'. He wrote that corista was the natural pitch standard for instruments and voices. We know from other evidence that corista was a pitch standard about a tone lower than Praetorius's standard. Whenever that pitch appeared in the tuning of stringed instrument, Banchieri wrote 'F acuto corista'.

The nominal tunings of bowed instruments given by Banchieri are shown on Table 3. Because we know both the pitch standard and the nominal tunings, we can deduce the ranges of possible string stops from Table 1, and these are also shown on Table 3.

There is no problem in associating the Ultimo Violino with the violin as we and Praetorius knew it. Banchieri wrote that the Secondo Violino was for tenor and alto parts, so it was probably similar to Praetorius's Tenor Geig and our viola, held on the arm. The d pitch for the 4th string violates the usual tuning in 5ths of the family, so it is either a misprint or the low c note did not sound up to expectations since this instrument was shorter in its range of string stops for its tuning than the other members of the family.

The Primo Violino per il Basso, tuned an octave below the Ultimo Violino, could possibly have been as big as Praetorius's 5-string Bas-Geig, but it is more likely to have been the normal Italian bass violin. It was the bass violin used in 17th century England, and Talbot measured its string stop to be 24$^1/_2$ inches (62 cm).

In the previous chapter on ensembles, Banchieri mentioned both Violini da braccio and four Viole da braccio in Soprani. It was not in the same context, so it is not clear whether the same instruments were implied. He didn't use the term 'soprano' for any violino, so there is reason to expect that there was a difference.

There is no question about Banchieri's viols being big. The Violone in Contrabasso could only be of the 125 cm (50 inch) size. He mentioned that it would be best to avoid sounding the low DD, probably because the string stop was particularly small for its tuning. The Violone da Gamba could only be of the 100 cm (40 inch) size. He cannot have skipped one of the standard sizes since, as seen in Table 3, his Quarta Viola in Soprano cannot be small enough to be the 40 cm (16 inch) size. So his Viola Mezzana da Gamba was of the 80 cm (32 inch) size (like the English bass viol), and the Quarta Viola in Soprano was of the 60 cm (24 inch) size (like the English tenor viol). The set of viols was shifted one size larger than the English or German sets. The string stops of the two highest-pitched members had the longest string stops that the tunings would allow, as was the case with the English usage of viols with those sizes.

Praetorius discussed the use of size shifts like this. Three adjacent sizes were all that was usually needed to play the music. A shift to one size bigger (like Banchieri's set) was fine, but a shift of two sizes (with the 125 cm viol as bass) didn't really work, with too much throbbing and beating. He preferred using the largest size for playing the bass an octave down, with ordinary viols playing the upper two lines. In Banchieri's set, that largest size could well have been used similarly, playing with the two smallest sizes, substituting for the third size down, playing an octave lower whenever appropriate.

A viol with a g' or a' highest string (as Praetorius and Banchieri tuned the smallest viol) is appropriate for playing treble parts in the C1 clef mostly on the highest three strings. The English would use the same tuning for tenor parts in the C3 clef mostly playing on the 2nd, 3rd and 4th strings. An English treble viol with a d" highest string is appropriate for playing treble parts in the G2 (treble) clef on the highest four strings. An English bass viol with a d' highest string is appropriate to play bass parts in the F4 (bass) clef mostly playing on the 3rd, 4th and 5th strings. The same tuning for Praetorius and Banchieri serves for a tenor part in the C4 clef mostly playing on the highest three strings. A viol with a g or a highest string can serve by playing bass parts in the F4 (bass) clef mostly on the highest four strings.

We thus see that sets which have the d' viol in the middle mostly would play from lower clefs and stay on their highest strings on all parts, while viol sets which have the d' viol on the bottom mostly would play from higher clefs and play on lower strings on bigger viols. It is most likely that the tunings chosen in each area were associated with the clef combination most commonly used there. When unusual clef situations were encountered, there were simple transpositions to resort to.

We must ask what was played on the lower strings when the music read was only on the upper strings. One possibility is that the set occasionally played an octave lower for variety. Another is that individual viols often replaced notes by the division of original note - octave lower - original note. Another is that the viols often played the appropriate chords beneath the written notes. Another is that such chords were arpeggiated, acting as a division. Speculative exercises like this are necessary for trying to understand possible styles of playing.

Other sources on fiddles

Of particular interest on the history of the violin is what Zacconi (Venice, 1592) wrote. I

have not seen the original, and am using and reinterpreting the information given by G. R. Hayes (1930). Hayes had doubts about a low pitch standard mentioned. I presume that it was corista.

Zacconi treated violini and viole da braccio as separate types of instruments. He wrote that the violino had a range of 17 notes. This is appropriate for a 4-string instrument tuned in fifths played in first position. He then gave the notes for the range as c to a", which is 20 notes, combining the ranges of the treble and tenor. Either some early violins had 5 strings, a distinct possibility, or he including the range of both instruments. He gave a diagram only giving the tuning of the 4-string treble violin. This apparently is an example of the commonly occurring inconsistency between the comprehensive and the usual. What is very interesting about this evidence is that by 1592 in Italy, the violini, in whatever ways that they differed from the viole da braccio, had not yet developed into a family. There was no bass, and the tenor had not yet developed a separate identity from the treble.

This is supported by the scoring of G. Gabrielli's *Sonata pian e forte* (1597), which could well have been for a 5-stringed violino. Monteverdi, in his score for *Orpheo* (1607) specified the violino ordinario da braccio separately from the set of soprano, tenore and basso viole da braccio. By 1609, Banchieri had a full set of violini da braccio. It must have been after this that that the two families merged, probably by removing the essential difference between them.

My suggestion is that the violino became a distinct instrument by acquiring a soundpost at about the same time that roped gut strings became generally available late in the 16th century. Both of these cooperated to give it the glory of a big fat bass sound never before heard from a portable instrument. The Linarol violin in Vienna from this period has a soundpost on a parchment stand and never had a bass bar. The viole da braccio were all small portable instruments, and some players added a 4th string to exploit the more resonant bass sound of roped-gut strings. The addition of a bass bar around 1600 gave the violino a big glorious treble sound as well. After that, the viole da braccio players had soundposts and bass bars installed and then became indistinguishable from violins in the kinds of sounds they produced. Soprano, tenor and bass viole da braccio became violini piccolo, treble and tenor violins (i.e. our violins and violas) respectively. Besides acquiring the new internal fitments, the set underwent a shift of one size in the bass direction. Monteverdi in 1607 could well have specified a violino piccolo alla francese because the Italian violino piccolo had not yet appeared.

The (Italian) viole da braccio were tuned in fifths throughout, with highest strings apparently at a', d' and g. The two smallest members of the set usually had 3 strings each. Previous writers have assumed that they were the same size or larger than our violin and viola, and were tuned like these instruments with the highest strings missing. The largest member of the family usually had 4 strings, and was supposed to be about the size of our 'cello tuned a tone lower. These relative tunings in the set are attested to by Lanfranco (1533) and Cerone (1613), and the actual pitches by Ganassi (1543) and Zacconi (1592). The actual pitches given were always ambiguous as to octave, and could just as well have been an octave higher. This appears actually to have been the case, as is shown by there being Italian pictures of fiddles smaller than our violins and no Italian pictures of fiddles with string stops more than about 60 cm. If the lower octave were the case, the reverse would be what we see in the Italian pictures.

There is evidence that at the beginning of the 16th century, French fiddles were the same small sizes as the Italian ones. Some time before 1556, when Jambe-de-Fer reported tunings, the number of strings in France became 4 for all sizes. The dessus (treble) and taille (tenor) dropped a 4th in pitch and appropriately got bigger (by about a size shift). The taille became too big to be held outwards from the shoulder and was suspended vertically against the chest from a hook in the back of the instrument. The original dessus was retained as a specialist instrument. This was the first time that the member with e" as the highest string became the treble (and a' the tenor) of the family. The bass size dropped an octave to become floor-standing. As seen in Table 3, the string stop was a metre or more. When roped-gut strings became available, its string stop dropped to a more manageable 80 cm. The two sizes can be

seen in the two famous pictures showing almost the same couple dancing the Volta, accompanied by a fiddle band. There are also German pictures of very large floor-standing fiddles in the second half of the century. The Germans used every size of fiddle available.

The fact the member of the fiddle family that acquired the special characteristics to give it a new Italian name was the one with an e" highest string points to a likely French origin of those special characteristics. The Polish connection that Praetorius wondered about could possibly have resulted from speculation about Agricola's (1545) extraordinary Polnische Geigen, or since there was some intense royal interaction between France and Poland at about the right time, the soundpost could have come to France from Poland.

The relationships between ranges of possible string stops of 16th century fiddles and reported pitches is given in Table 3. A pitch standard of a' = 383 Hz is assumed because there is some historical evidence for this kind of pitch level at the relevant times and places, and no evidence for any other. Fiddlers usually played by ear and were primarily tune smiths and harmonisers, adding decoration and pseudo-polyphony, so reports of tunings are more likely to be of pitches in relation to other instruments rather than, as with viols, varying pitch assumptions made by players to facilitate reading the available music.

Conclusions on fiddles

The following history of sizes of Renaissance fiddles in sets is consistent with all sources: In the first half of the 16th century, the soprano had an a" top string and a string stop of up to about 25 cm long, the alto and tenor had a d" top string and a string stop of about 35 cm, and the bass had a g' top string and a string stop of about 55 cm, usually suspended against the chest from a hook. Sometimes the family avoided that bass size by shifting to one size smaller, with a particularly tiny soprano. Around the middle of the century, the French shifted one size bigger for the two higher members of the family and two sizes bigger for the bass, having e", a' and g top strings on string stops of about 35, 50 and 105 cm respectively. The bass stood on the floor. When roped-gut strings became available in the final quarter of the century, these string stops dropped to about 30, 40 and 80 cm. This shrinking made the middle size playable on the shoulder like the smallest size, and improved fingering mobility on the largest size.

The Italians did not follow the French size changes for their fiddles (the viole da braccio), but when the French fiddles acquired the soundpost, the Italians adopted the dessus as a specialist instrument they called 'violino'. Around 1600, the violino acquired a bass bar as well. Within a few years, a family of violini developed, with a French-like tenor and a new bass tuned an octave below the treble with a string stop of about 60 cm. Soon the viole da braccio acquired soundposts and bass bars and merged with the violini.

Other sources on viols

Tuning reports of Italian viols indicate that in the late (roped gut) period, all had 6-strings and the tunings were all in 4ths with a 3rd in the middle, so only the pitch of the highest string will be mentioned. The set of Marinati (Rome, 1587) was d", a' and d, that of Zacconi (Venice, 1597) was a', d' and g, that of Cerreto (Naples, 1601) was d", a' and d', and that of Cerone (Naples, 1613) was g', d', and g.

An a' viol cannot comfortably be tuned at the corista pitch standard while using three different adjacent sizes and still have all viols of the postulated standard sizes. Either viols with a string stop of at most about 55 cm were available, or corista was not being followed. In this period, we would expect viols to be more involved in entertainments involving other instruments than previously, and so following the prevailing pitch standard would have been more important. Then, being able to project to an audience would also be important, and so sizes would tend to be near the largest for their tunings. Thus Zacconi's and Cerone's (as well as Banchieri's) viol sets would had been shifted one size larger than Marinati's and Cerreto's sets.

In the earlier period, around the middle of the 16th century (before roped-gut strings), the

In the earlier period, around the middle of the 16th century (before roped-gut strings), the tuning situation was very different. Viols came in a much wider range of designs, and a somewhat wider range of sizes. Viols with 6 strings could only change their pitch levels by moving their bridges. Ganassi (1543) wrote that they could also do this by changing string diameters. That was probably as untrue then as it is now, so he probably wrote it because it seemed so very reasonable (as it does today), without his really testing it.

When assembling a set, they apparently collected 4 different sizes of viols (the middle two tuned to the same pitches), and adjusted the pitch level of the set and the bridge position of each member for the best accommodation between them, preferably with a 5th between the first two and a 4th between the lowest two. If there was a problem with getting the middle two to fit, they tried having the 4th above and the 5th below. If there was a problem with getting the smallest or largest to fit , they tried 4ths both above and below, or both 5ths.

Once the set was optimally tuned together, the open strings (and the fingerboard positions at the frets) were assigned pitch names, with that of the highest string of the smallest instrument called either d" or a', depending on where the music they wanted to play lay. They often learned the fingering patterns for both pitch assumptions, for playing from a wider variety of music sources. When the key of the music had (sometimes) one or (more usually) two flats, they often learned the fingering positions for pitch assumptions a tone lower, effectively transposing the music a tone higher than otherwise. This made the fingering positions of chords and scales more familiar. This gave them more freedom in applying improvised embellishment (gracing and diminution).

With this procedure, each set of viols had its own primary pitch level (not a pitch standard, which is a pitch level recognised and followed widely), plus probably some other levels for alternative pitch assumptions. Whatever regularity there was in the absolute pitch levels used depended on the ranges of viol sizes available, and not on reported tunings. Only the pictures can give us this information. My rough conclusions from an unsystematic survey of the iconography is that the string stops of the original 15th century vihuelas were about half a metre, sizes double that appeared around 1500, and sizes intermediate between these appeared soon after.

If conforming to pitches of other instruments was required, the set could not tune higher, but it could tune lower, sacrificing the effective use of the lowest string on each instrument. Whenever such pitch-level flexibility was wanted, 5-string viols were used. A set of 6-string viols with string stops of 50, 75 and 100 cm would be playing at a pitch level about a tone higher than corista with highest-string assumptions of a', d' and a. This explains Ganassi's statement that most players play their viols with these highest-string pitch assumptions, and he gave the pitches for only 5 strings on each viol in the set. It seems that most players were interested in playing in the corista pitch standard. Alfonso della Viola's assumption of e' for the bass is a way of keeping 6 strings for a 75 cm stop instrument and still play it in corista.

Early in the 16th century, we see pictures of quite small viols with about 30 cm string stop. They are shown either playing the bass to higher instruments of other types, or with no other instruments. They don't fit into the above understanding of the sizes of viols in sets, and probably were never intended for playing with other viols in sets. This size of specialist viol was revived briefly late in the century, called sopranino viol in the 1589 Intermedii, and violetta picciola by Zacconi. Praetorius, not being aware of its existence, misunderstood Zacconi and thought that this was another name Zacconi gave for the treble viol. An example by Giovanni Maria survives in the Hill collection at the Ashmolean Museum in Oxford.

Large viols were also played with other types of instruments or alone in the 16th century. Ganassi described using a bow with slack hair to imitate the lira da braccio. The lirone was a specialist viol that developed this practice. Alfonso della Viola established a reputation as a virtuoso, probably on a standard type of viol. We don't know whether special sizes were made for soloists. In the later period (using roped-gut bass strings), soloistic viols were made in all sizes between 60 and 80 cm string stop.

Conclusions about viols

The history of sizes of Renaissance viols in sets then seems to be as follows: In the first 3 quarters of the 16th century, sets of viols had string stops scattered about the size of 50 cm for the treble, 75 cm for the alto and tenor, and 100 cm for the bass. Adjacent members were tuned a 4th or 5th apart. Once a set was assembled and tuned, actual string pitches remained unaltered. The highest string of the treble was called either d" or a' according to the notational range of the music, or a tone lower if the music was in flat keys. With these sizes, the popular a' assumption led to actual pitches that were usually somewhat higher than corista with 6-string viols, but 5-string viols could play comfortably in that pitch standard.

In the 3rd quarter of the century when roped-gut strings became generally available, 6-string viols became standard, with favoured viol sizes for sets changed to about 40, 60, 80 and 100 cm, tuned with highest strings to d", g', d, and g, all in corista. The original 50 cm treble served as an a' viol when that was wanted. Then there was a small set with d" treble, a' or g' alto and tenor and d bass viols, and a large set with a' or g' treble, d alto and tenor and g bass. The original 75 cm size continued to be used for soloistic purposes. The 100 cm size was used as a contrabass for the small set, and a new 125 cm size in d was made to be a contrabass for the large set. The small set was adopted in England, and later in France (according to Rousseau, 1687).

This was all done for the benefit of players that wanted to conform to the corista standard. The stringed-instrument making centres of Europe were in south Germany and Italy, where this standard was observed. Unfortunately, Praetorius was in an area where the pitch standard was a tone higher. The only way Germans there could use the viol sizes available was to use the sizes of the small set but to tune them to nominal pitches which were essentially those of the large set. Thus the actual pitches of Praetorius's German viols were unusually low for their sizes. He was used to them tuned that way and grew up to like the kind of sound from them. The English viol players apparently liked that sound too, but only for occassional variety, tuning down then for playing introverted polyphony. Italian viol players generally tuned their viols to the more extrovert pitches near to the highest the viol sizes could go, and the English usually did the same. South German areas did this too, and there is mid-17th century evidence that they used the large set of viols.

Summary

From Praetorius's evidence on how string stops relate to pitches, rough estimates of the atring stops of Renaissance fiddles and viols can be made. They are shown in Table 4.

TABLE 4: Typical String Stops and Nominal pitches

	Treble		Tenor-alto		Bass	
Instrument	String stop cm	Nominal pitch	String stop cm	Nominal pitch	String stop cm	Nominal pitch
Italian fiddles						
16th century (viole da braccio)	25	a"	35	d"	55	g'
17th century (violini)	30	e"	40	a'	60	e'
French fiddles						
First half 16th century	25	a"	35	d"	55	g'
3rd quarter 16th century	35	e"	50	a'	105	g
4th quarter 16th century and after	30	e"	40	a'	80	g
Viols						
First 3/4 16th century	50	ad lib	75	ad lib	100	ad lib
After that, large set (It & Germ)	50 or 60	a' or g'	80	d'	100	g
After that, small set (It, Eng & Fr)	40	d"	50 or 60	a' or g'	80	d'

TABLE 1 STRING STOPS AND PITCH RANGES OF GUT STRINGS

STRING STOP (cm)	At a'=430 Hz Pitch Standard			STRING STOP (cm)	At a'=383 Hz (Corista) Pitch Standard		
	Low-twist gut Highest pitch	High-twist gut Lowest pitch	Roped gut Lowest pitch		Low-twist gut Highest pitch	High-twist gut Lowest pitch	Roped gut Lowest pitch
18.2	d'''	d'	a	18	e'''	e'	b
19.3				19			bb
20.5	c'''	c'	g	20	d'''	d'	a
21.7	b''	b		22			
23.0	bb''	bb	f	23	c'''	c'	g
24.3	a''	a	e	24	b''	b	
25.8				26	bb''	bb	f
27.3	g''	g	d	27	a''	a	e
28.9				29			
30.7	f''	f	c	31	g''	g	d
32.5	e''	e	B	32			
34.4			Bb	34	f''	f	c
36.5	d''	d	A	36	e''	e	B
38.6				39			Bb
40.9	c''	c	G	41	d''	d	A
43.4	b'	B		43			
45.9	bb'	Bb	F	46	c''	c	G
48.7	a'	A	E	49	b'	B	
51.6				52	bb'	Bb	F
54.6	g'	G	D	55	a'	A	E
57.9				58			
61.3	f'	F	C	61	g'	G	D
65.0	e'	E	BB	65			
68.8			BBb	69	f'	F	C
72.9	d'	D	AA	73	e'	E	BB
77.3				77			BBb
81.9	c'	C	GG	82	d'	D	AA
86.7	b	BB		87			
91.9	bb	BBb	FF	92	c'	C	GG
97.3	a	AA	EE	97	b	BB	
103.1				103	bb	BBb	FF
109.3	g	GG	DD	109	a	AA	EE
115.8				116			
122.6	f	FF	CC	123	g	GG	DD

TABLE 2 PRAETORIUS'S BOWED INSTRUMENTS

Name in Table	Tuning in Table	Maximum string stop (cm)	Minimum string stop (cm)	Plate and Number	Measured string stop (cm)	Number of strings shown	Name in Plate	Semitones shorter than longest	Semitones longer than shortest
Viole de Braccio. Geigen									
Exilent: gar klein Geig	a', e", b"	21.7	9.1	XVI-8	17.9	3	Klein Geig Posche genant	3.3	11.7
mit drey Saitten	g', d", a"	24.3	10.2	XXI-1	22.5	3	Kleine Poschen/ Geigen,	1.3	13.7
not in table	g, d', a', e"	32.5	20.5	XXI-2	26.8	4	ein Octav hoher (1 and 2)	3.3	4.7
Klein Discant Geig.	c', g', d", a"	24.3	15.3	XXI-3	22.5	4	Discant-Geig ein Quart hoher	1.3	6.7
Discant Viol. Violino	g, d', a', e"	32.5	20.5	XXI-4	29.8	4	Rechte Discant-Geig	1.5	6.5
Tenor Viol.	c, g, d', a'	48.7	30.7	XXI-5	35.4	4	Tenor-Geig	5.5	2.5
Bass Viol. de Braccio	F, c, g, d'	72.9	45.9						
not in table	BBb, F, c, g, d'	72.9	68.8	XXI-6	72.2	5	Bas-Geig de bracio	0.2	0.8
Bass Viol. de Braccio	C, G, d, a	97.3	61.3						
Gross Quint-Bass	FF, C, G, d, a	97.3	91.9						
Viole de Gamba. Violen.									
Cant Viol de Gamba	A, d, g, b, e', a'	48.7	36.5	XX-1	40.2	6	Violn de Gamba 1	3.3	1.7
Tenor=Alt=Viol de Gamba	D, G, c, e, a, d'	72.9	54.6	XX-2	58.1	6	Violn de Gamba 2	3.9	1.1
Klein Bass-Viol de Gamba 1	GG, C, F, A, d, g	109.3	81.9						
Klein Bass-Viol de Gamba 1	GG, C, E, A, d, g	109.3	81.9						
Klein Bass-Viol de Gamba 1	AA, D, G, B, e, a	97.3	72.9	XX-3	75.0	6	Violn de Gamba 3	4.5	0.5
Klein Bass-Viol de Gamba 2	FF#, BB, E, A, d, g	109.3	86.7						
Gross-Bass Viol de Gamba 1	EE, AA, D, G, c	163.7	97.3						
Gross-Bass Viol de Gamba 2	DD, GG, C, E, A, d	145.9	109.3						
Gross-Bass Viol de Gamba 3	EE, AA, D, G, c, f	122.6	97.3	VI-4	102.3	6	Violone, Gross Viol. de Gamba Bass	3.1	0.9
Gar gross Bass-Viol	DD, EE, AA, D, G	218.5	109.3	V-1	128.7	5	Gross Contra-Bas-Geig.	9.2	2.8
Viol Bastarda 1	D, G, c, e, a, d'	72.9	61.3						
Viol Bastarda 2	C, G, c, e, a, d'	72.9	54.6						
Viol Bastarda 3	AA, E, A, e, a, d'	72.9	72.9	XX-4	72.9	6	Viola Bastarda	0.0	0.0
Viol Bastarda 4	AA, D, A, d, a, d'	72.9	72.9						
Viol Bastarda 5	AA, D, G, d, g, d'	72.9	72.9						
Lyra									
Lira de Bracio	d, d', g, g', d', a', d"	36.5	27.3	XX-5	37.5	7	Italianische Lyra de bracio	-0.5	5.5
Lirone perfetta Arce violira, Grosse Italianische Lira	Gb, db, Ab, eb, bb, f, c, g, d, a, e, b, f#, c#' g, d', a', e"	77.3	43.4	XVII-4	67.7	12	Italianische Lyra de Gamba	2.3	7.7

TABLE 3 FIDDLES AND VIOLS AT CORISTA

Name	Tuning @ a' = 383 Hz	Maximum string stop (cm)	Minimum string stop (cm)	Suggested typical stop (cm)
BANCHIERI				
Violini da braccio				
Ultimo violino per il cant	g, d', a', e"	36	23	30
Secondo violino accord	d, g, d', a'	55	31	40
Primo violino per il bass	G, d, a, e'	73	46	60
Viole da gamba				
Quarta viola in soprano	G, c, f, a, d', g'	61	46	60
Viola mezano da gamb	D, G, c, e, a, d'	82	61	80
Violone da gamba	GG, C, F, A, d, g	123	92	100
Violone in contrabasso	DD, GG, C, E, A, d	164	123	125

OTHERS	Tunings reported a'=383 Hz assumed	Maximum string stop	Minimum with high-twist	Suggested stop	Minimum with roped gut	Suggested stop
Viole da braccio						
Soprano 3-string	g', d", a"	27	15	25	11	25
Soprano 4-string	c', g', d", a"	27	23	25	17	25
Alto-tenor 3-string	c', g', d"	41	23	35	17	35
Alto-tenor 4-string	f, c', g', d"	41	34	35	26	35
Bass 4-string	Bb, f, c', g'	61	52	55	39	55
Violons						
Dessus	g, d', a', e"	36	31	35	23	30
Taille	c, g, d', a'	55	46	50	34	40
Bas	BBb, F, c, g	123	103	105	77	80
Viole da gamba	d, g, c', e', a', d"	41	41		31	d" treble g'
	c, f, bb, d', g', c"	46	46	treble	34	40 60
	Bb, eb, ab, c', f', bb'	52	52	50	39	
	A, d, g, b, e', a'	55	55		41	a' treble
	G, c, f, a, d', g'	61	61	tenor	46	50
	F, Bb, eb, g, c', f'	69	69	75	52	
	E, A, d, f#, b, e'	73	73		55	g' tenor d'
	D, G, c, e, a, d'	82	82	bass	61	60 80
	C, F, Bb, d, g, c'	92	92	100	69	
	AA, D, G, B, e, a	109	109		82	d' bass g
	GG, C, F, A, d, g	123	123		92	80 100
	f#, b, e', a', d"	41	32			
	e, a, d', g', c"	46	36			
	d, g, b, e', a'	55	41	50		
	B, e, a, d', g'	61	49			
	G, c, e, a, d'	82	61	75		
	E, A, d, g, c'	92	73			
	D, G, B, e, a	109	82	100		
Specialist viols						
Violetta picciola (high)	g, c', f', a', d", g"	31	31	30	23	30
Bass (low)	D, G, c, e, a, d'	82	82	80	61	60 to 80
	E, A, d, f#, b, e'	73	73	75		