Quarterly No. 101, October 2000

FoMRHI Quarterly

BULLETIN 101
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Bulletin Supplement

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FELLOWSHIP OF MAKERS AND RESEARCHERS OF HISTORICAL INSTRUMENTS
Honorary Secretary:
Lewis Jones, London Guildhall University, 41-71 Commercial Road, London, E1 1LA, U.K.
New Hon. Secretary and Hon. Editor: David Armitage and I have been getting into the swing of our new roles, and the bulk of FoMRHI paraphernalia has been moved from Oxford to London. I must apologise immediately for the late appearance of this Quarterly. The task of getting to grips with the several layers of FoMRHI administration has, frankly, taken longer than I had envisaged, and there have been problems of family illness, but things are now reasonably well organised. The delays have been transitional in nature, and so should not recur. We would like to thank our predecessors, for whom our admiration grows apace, for all their help in handing over.

Renewal of Subscriptions: Please renew NOW, using the enclosed slip. You may use the back of the slip for any amendments to the list of members (see especially my note below about e-mail addresses). Please send your renewals (cheques made out to FoMRHI) addressed to Barbara Stanley, Honorary Treasurer FoMRHI, 79 Stanley Avenue, St. Albans, AL2 3AQ, Herts, UK; 01727 832174; b.stanley@net.nll.com. The subscription rate remains unchanged: £10-50, including surface postage world-wide, plus £1-50 for airmail to Europe, or plus £3-00 if you want airmail to anywhere else. My bank tells me that Eurocheques really are coming to an end on 31 December, so any payments from abroad by that means would have to be sent before the end of the year. (It is apparently the date on the cheque that counts, not the date it is received, but please renew now in any case). Otherwise Eurocheques will attract the ‘normal’ bank charge of £10. Regrettably, if you pay by any other kind of foreign cheque, you must add this £10 to the subscription, otherwise FoMRHI will receive only 50 pence, which will make much extra work for Barbara, and lead to delays in posting. If several of you can arrange to send a single foreign-currency cheque, the bank charge will be shared, but please ensure that you list clearly the names of all those renewing. In recognition of the likelihood that the delay in posting this Quarterly will result in some surface-mail subscribers, at least, receiving this too late to renew by the end of the year, we will relax by one issue the usual rule (normally applying to the January issue) that Quarterlies are not sent to those who have not renewed. So if your subscription is not with Barbara by the start of April, the January Quarterly will be the last you receive, but please in any case renew as soon as possible.

List of Members: e-mail addresses: It is clear that FoMRHI’s record of the e-mail addresses of members is not up to date. I communicate by e-mail with several members whose addresses are not in the latest List of Members, and I suspect there must be many others. If you now have an e-mail address and would like it included, please let me know. You can of course e-mail it to ljones@lgu.ac.uk.

London International Exhibition of Early Music: Jeremy, David and I represented FoMRHI at the October exhibition at the Royal College of Music, and it was good to meet many friends and other members who have previously only been names to me. Several new members joined, and some lapsed members rejoined.

Future Directions for FoMRHI
The reaction to my Brief Thoughts about the Future of FoMRHI (Comm. 1721) has been muted. It may be that the Comm. was not noticed as having a bearing on our future, but it’s difficult to gauge opinion if there is no response. Eph and Jeremy have both written to endorse the suggestions I made, and Eph’s detailed response to one point is included later, as Comm. 1735. Other oral comments have been in the nature of general encouragement rather than specific endorsement, amendment, criticism or further suggestion. I will review progress on some of the possibilities here.

FoMRHI Finances: Eph has suggested that I should include a summary of our finances in the Bulletin each year. I would be happy to do this, subject to agreement with the officers and fellows as to an appropriate form for their presentation. FoMRHI is not rich, but we do now have a healthy reserve, beyond the working capital needed annually for the production and distribution of the quarterly, and we need to maintain one to insulate us from unpredictable circumstances. At least two British-based instrument societies have come close to the brink of the financial abyss within recent memory, and we should be able to survive, for example, an unexpected
increase in postal or printing costs, or an appreciable thickening of the Quarterly during one year as a result of the sheer productivity of members! How large a reserve we need depends on what else we aim to do – whether we intend to invest it in other projects, which might themselves eventually generate income, or to offer new opportunities to members. Comm. 1721 should have demonstrated that I would like to see FoMRHI working in other ways than just publishing the Quarterly. Eph too is keen that that 'we should try to be imaginative about what we could do with the money. The publication of our indexes was along these lines. They made a dent in our surplus, but not much.' He writes 'I would like it to be invested in publication projects which are sellable in book shops but are either free or at cost to members. One idea is that we can co-operatively produce an historical glossary of what European art instruments and their parts and accessories have been called in different places and times. Another is that we publish Steve Heavens's translation of Praetorius's *Syntagma Musicum* Vol. III. Another is that we co-operate with LGU (if they are willing) on the 15th century instruments conference mentioned by Lewis in Comm. 1721 and in publishing the proceedings.' I share Eph's view that these are amongst the kinds of things we could be doing, and would welcome your thoughts about these proposals, and any other suggestions you may have.

**FoMRHI Quarterly**

**CD-ROMs of Past Quarterlies:** We have been considering the suggestion (made in Jeremy's Bulletin 100) of reissuing all of the past Quarterlies on CD-ROM. In favour of this proposal, Ian Knowles has noted that 'access is not easy for most of us and it is concerning that bound sets are rather vulnerable, cf. the collection at your [LGU] Commercial Road Library. Maybe they could be scanned into Acrobat files, like the old NASA reports. Those of us who wished could get a CD-ROM for Xmas or download from a web site.' This is essentially what we have been looking into. It may be possible to have the work of scanning done at LGU, perhaps by a student, who would be paid. It is too soon to be able to predict what the costs might be, but it would be helpful to have an indication of the level of interest among existing members, assuming that the CD was reasonable in price, to members especially.

**Restoration and Repair:** In Comm. 1721 I noted that 'restoration' was explicitly replaced in the Fellowship's title by 'research' in the nineteen-eighties, and that repair also was perhaps implicitly demoted at the same time. I am keen to encourage the publication in FoMRHI of reports and all sorts of discussion of the ways in which we affect historical instruments by our actions. To set the ball rolling, I offer here a report of work done at LGU on an instrument from FoMRHI's former secretarial home, the Bate Collection in Oxford. Since the restoration was done a decade ago, it is possible that not everything would now be done in exactly the same way, but I present it in the same spirit in which the late John Bames published some piano restoration reports in the Quarterly in the nineteen eighties. I hope it will prompt discussion and encourage others to follow with their own reports, proposals and topics for debate.

**Nuts and Bolts Comms:** I noted that these seemed to be drying up. The flow seems to be resuming in this issue, and I hope it will continue. I hope that we can maintain a good mix of the historical and the practical, reflecting both aspects of FoMRHI's name. I was struck at the recent exhibition by the range of reasons people found for not writing for FoMRHI. Some, whom I know to have done original work which would be of interest to others, claim to have nothing of value to say, while others, amongst them established makers of standing, volunteered that they would have loved to have written things up over the years, but had not done so for fear of being shot down in a blaze of destructive criticism, which might have affected their professional standing. FoMRHI is fundamentally a friendly organisation, with constructive aims, and I hope we will be able to demonstrate to those I spoke to that their self-doubt and fears are unfounded.

**Book Reviews:** This Quarterly partly clears a modest backlog of materials submitted for review. I hope that the remainder will largely be reviewed in the next issue. Nobody responded to my invitation to members to put themselves forward as reviewers of publications in a particular field, so I will rely on my knowledge of members' expertise and interests in approaching potential reviewers. Incidentally, would anyone be interested in reviewing a facsimile of a multi-volume nineteenth-century Spanish work on organbuilding?

**Record Reviews:** We have received a number of CDs for review, mostly of instrumental and mixed vocal and instrumental ensemble music from the late fifteenth to eighteenth centuries, all from one record company, and predominantly recorded by one group. In comm. 1721 I repeated the suggestion I made several years ago that FoMRHI might concentrate on reviewing recordings primarily from the viewpoint of their value as documents
of the sounds of important historic instruments, or of important reconstructions. There may in any case not be a consensus that this is what we should be doing, but none of the discs to hand really serves that objective. The instruments are mostly modern copies and, with the exception of parts of two discs (of music by Josquin et al, and of music of the court of Maximilian I), are largely combined in mixed groupings that make assessment of the qualities of individual instruments relatively difficult. They raise a host of wider questions about historical instrumentation and performance practice which, if considered thoroughly from an instrument-historical point of view, would result in lengthy reviews. Such recordings are fairly widely reviewed elsewhere, often expertly, and not infrequently (as for example in *Early Music Review*) with instrument-specific knowledge. Record reviews have never been one of FoMRHI’s mainstream activities, and if we are to include them, I think we should do so distinctively, and in a manner appropriate to our objects. One possibility is that we could include a few reviews of greater length than most of the other periodicals can afford, exploring in depth fundamental issues that are rarely addressed, or are at best superficially alluded to. I would still be interested to have members’ views about this. If you are interested in seeing what might be done with one of the discs we hold, I could write a specimen review myself, or ask someone else to do so.

Plan Reviews: I have included here what I hope will be the first of several reviews of published instrument plans, one from a new series announced by the Renaissance Workshop Company. I hope that they will continue to submit them, and that other publishers of drawings also will make them available for review.

Reviews and English Summaries of Foreign Periodicals: Charles Stroom’s summaries of the *Bouwerskontact Bouwbrieft* resume in this issue. I had intended to mention here the reduced-price offer of the Haags Gemeentemuseum oboe volume, but since he gives the details in his second paragraph, I won’t repeat them. We have received the first three issues of the *Bollettino della Società Italiana del Flauto Traverso Storico*, of which I have written a short review (which doesn’t fit here but will appear in January). This recently formed society has proposed that we might establish reciprocal membership, and I would welcome this. Is there anyone who would like regularly to summarise the contents in English?

Other Activities and Projects

Seminars and Conferences: I mentioned in Comm. 1721 that I expected to be able to announce further details of the conference on 15th-century Instruments and Instrumental Music I have been planning, but there remain uncertainties of institutional collaboration and finance, so this will have to wait until the next Bulletin. Amongst other suggestions I have made is that we should mount a Joint meeting with the Lute Society of Great Britain. FoMRHI enjoys reciprocal membership with the Lute Society, and the idea has arisen of a meeting probably to be held in London in mid-2001. The programme would concentrate on matters likely to be of interest to members of both societies: instruments of the lute and related families, their history, construction and use. There was a feeling, when I discussed this possibility with Chris Goodwin recently, that the Lute Society had given fair attention to lute stringing recently, and that we should concentrate on other aspects of the instrument. It might also be possible to follow up in various ways the forum at the Society’s November meeting on ‘What makes a good lute?’ If FoMRHI members have suggestions for the meeting, or might be interested in speaking, please let me know by late January so that plans can be made.

Internet Discussion: In Comm. 1721 I proposed that FoMRHI might maintain an internet discussion list to allow more immediate dissemination of new ideas and news, and to permit free discussion of current ideas. This would cost internet-connected members barely more than the time taken to delete any unwanted messages. Only Eph has voiced enthusiasm for the idea so far. Since he and I could correspond privately if we were the only participants in a dialogue, I will put the idea to one side for the time being if I hear nothing more in favour of it by the deadline for the April issue. The same, I think, applies to the proposal I made for a Register of Historical Instrument Research which we might maintain (please refer back to Comm. 1721 for details). I believe this could be valuable, but it’s not something I would wish to inflict on FoMRHI if it’s not wanted.

On the Viola d’amore: Eph. has sent the following brief note. ‘In his very useful Comm. 1719, Marco Tiella does not choose between O’Bryan’s report on the length of the ‘oncia bolognese’ and his own in Comm 1720. The viola d’amore’s string stop appears to be the nut-to-tail distance minus the tail-to-bridge distance, or 13 once bolognesi. It would appear to be 69.3 cm with his value and 40.1 cm with O’Bryan’s value. If we assume that the pitch standard was a’=430 Hz, the c’ highest string would have a frequency of 511.4 Hz. I have determined from Praetorius’s information that the highest working pitch for a gut string times the string stop (in metres) is
210. So the maximum string stop for this pitch calculates to be 40.1 cm. This strongly favours O'Bryan's value. We would expect this highest string to be tuned as high as it could safely go.'

Fifth International Clavichord Symposium, Magnano, 5-8 September 2001: A call for papers has been issued, with a preference for topics on Scandinavia: historical clavichords and musical repertoire; Matching instruments to repertoire; and The clavichord as an educational tool. There will be a forum for builders addressing 'Complex systems of structures and acoustics and the musical consequences considering structure, sound bridge acoustics, string scaling and striking point'. Proposals are wanted by 15 January 2001, and should be sent to Bernard and Susan Brauchli at Via Roma 43, I-13887 MAGNANO (BI), Italy; tel. & fax: +39 015 67 92 60; email: brbrauchli@world.com.ch. There are also Magnano courses in playing all the early keyboard instruments, between 16-26 August 2001 (details from the same address).

A Workshop Recreated: Andrew Atkinson, who has a deep interest in the history of tools, and has built up a remarkable collection of them, has embarked on a project to recreate a musical instrument maker's workshop of the sixteenth or early seventeenth century over the next two years. He is likely to concentrate on tools appropriate to stringed and perhaps stringed keyboard instrument making. I hope there will be a comm. about this shortly, but in the meantime, anyone interested in the project is invited to contact him.

Renaissance Recorder Database: Adrian Brown (note his new address) has recently started a web site database with details of all extant renaissance recorders known to him. The address is currently: www.brown.demon.nl/database, but a very impressive improved version is being tested, so I hope to be able to publicise a new address shortly.

Deadline for the next Q: We hope to adhere now into a pattern of assembling the Quarterly around the seventh of the month of publication, giving me a week to assemble the Bulletin, incorporating any news and materials received by the first of the month, with the objective of posting before the end of the month. Given the lateness of this issue, we'll set those deadlines back by one week for Quarterly 102, so I'll accept material for the Bulletin up to January 7, and it should be possible to accommodate Comms. received up to Jan 14. Remember that David Armitage and I are both to be contacted at London Guildhall University, 41-71 Commercial Road, London E1 1LA, UK; Lewis: 020-7320 1841; ljones@lgu.ac.uk; David: 020-7320 2844; armitage@lgu.ac.uk; fx (both of us) 020-7320 1830. If comms are sent to me with material for the Bulletin, I'll pass them on to David immediately.

Lewis Jones
Honorary Secretary

1999 FoMRHI List of Members — 6th Supplement as at 28 October 2000
# in left hand margin = change of address or other change

# Carey Beebe, cb@hpenschd.nu
Julian Boby, Holborne, Dodsley Grove, Eastbourne, Midhurst, West Sussex GU29 9BE, UK; 01730 816 388; baby@altglobal.net (vln, viol, bows; M.).
# Adrian Brown, Kramatweg 55/2, NL-1095 JW Amsterdam, Netherlands; t/fx (0) 20 668 7283; abybee@brown.demon.nl (recrdr; M,L,W).
# Hans von Busch, Auedeich 33, D-21129, Hamburg, Germany.
Richard Coleman, 19 Valentine's Road, Ilford, Essex IG1 4RZ, UK; 0208 554 7925; rcolemanraccoon@aol.com (plucked insts; M, R).
# Clive Catterall (traverso; M; historical manufacturing methods); clive@flutes.fsbusiness.co.uk
Andrew Garrett, Early Keyboard Instruments, Lymininge, Folkestone, Kent CT18 8EE, UK; 01303 862 132; andrew.garrett@btclick.com (keyboards).
Jeff Giddings, Briar Bank, High Easter, Essex CM1 4QJ, UK; 01245 231 423; 
geff@giddings.treeserve.co.uk (vln, gtr, mandolin; M, R, P).

Ian Graham, 6 Cross Street, Gillingham, Kent ME7 1JU, UK (whistles, fl, Uillean bagpipes; M).

Ross Grover, 4 Rossmoyne Road, Scotforth, Lancaster LA1 4SN, UK; 01524 67584 (pno, P; arpeggione, R).

Paul Jefferies, 18 Wren House, 2 Gernon Road, Bow, London E3 5DJ, UK: 020 8980 5838 (perc, vln; M, R).

Ian Knowles, The Vicarage, Mount Skippett, Ramsden, Oxon. OX7 3AP, UK; t/fx 01993 868534; 
iannknowles@cwcom.net

Peter B. Koval, C/O Mrs. Ruth Koval, 10 Gowran Park, Oldham, Lancs. OL4 3BE.

Review of: **Ottavino Spinet: Plan** (by A. J. Calvert) and **Construction Manual**. The Renaissance Workshop Company Ltd., 38 Maningham Lane, Bradford, BD1 3EA. £89-50, excluding VAT.

This is the first to be published of an extensive series of plans of instruments, ranging from the late Middle Ages to the mid eighteenth century, recently announced by the Renaissance Workshop Company, a manufacturing offshoot of the Early Music Shop. These are essentially the plans that accompany their kit instruments, sold with a copy of the appropriate Construction Manual, but without the kit. An accompanying List of Parts suggests that selected parts are available individually to makers who want them, as are sets of strings and finishing materials. This example is based fairly closely on the triangular Italian octave spinet in the Victoria and Albert Museum. Some changes have been made, for example to free the ends of the mitred soundboard bridge which oversail the spine liner and register, and the curious sliding under-board of the original is omitted without comment. Decorative features such as the mouldings seem to be reproduced fairly accurately.

The plan itself is excellent, presented on a single sheet of robust white paper (1280x610mm), and drawn by computer, rather than by hand. The lines are fine and clear. The curves are actually stepped, being composed of multiple straight lines, but one has to look very closely to realise this. A general plan view, drawn as though the soundboard and wrest plank were transparent, is accompanied by sections through the case, both parallel and perpendicular to the front of the keyboard. Two smaller sections show the action, drawn through both a natural and a sharp key. Curiously these include the only dimensions specified on the drawing itself: the height of the wrest pins above the wrest plank, and the depth of their holes in the plank. Details include the key levers themselves (weighted, as in the original, necessitated by their brevity), the jacks (drilled for a bristle spring, rather than the leaf springs of the original), the bridge (a suggested undercutting at the ends), the nameboard (with a proposed decorative scheme deriving from rather than precisely reproducing that of the original), the jack rail, and a simplified rose (to be made of two layers of parchment). Since it is now available separately, I will consider the plan's value primarily to a maker working from scratch, independently of the kit parts. The **Construction Manual** is a nicely produced A5 booklet of twenty-four pages, the central opening of which presents twenty-seven good colour photographs of successive stages of the assembly of the kit form of the instrument. This is unashamedly the book of the kit rather than a set of instructions for building the instrument from raw materials, independently of the ready-made parts. Beginners will not find all they need to know here, but a competent woodworker, able to prepare the parts from the plan alone, will find much valuable information about the assembly of the instrument and setting it up to play. They would be helped if a list of other sources of

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1 This was apparently intended to distance the instrument from the front of the player's body. Was the instrument perhaps played standing at some time in its history, suspended about the player's neck, with the sliding board resting against the front of the body?
information, such as the Victoria and Albert catalogue, and of materials could be included. Someone with no experience of making early keyboard instruments would do well to adapt to this design the techniques described by John Barnes in *Making a Spinet by Traditional Methods* (Welwyn, 1985). The plan does not specify materials, and the information about them in the manual relates to those provided with the RWC’s kit of the instrument, in which mahogany, for example, is used for the case sides, and other such substitutions are made for most of the materials of the original. The original instrument has a decorated outer case of coniferous wood, which is not included in the plan. So delicate an instrument would benefit from one, and it would be helpful if a small-scale drawing could be provided. The series is greatly to be welcomed, but this example does seem rather expensive in comparison with other plans of comparable size and complexity.

FoMRHI Comm. 1727

Lewis Jones


This beautifully produced volume celebrates and records the continuing success of the biennial Magnano International Clavichord Symposium, organised by the International Centre for Clavichord Studies, co-chaired by Bernard Brauchli and Christopher Hogwood. It presents most of the formal papers read at the third of the symposia which, as Brauchli says in his introduction, have already become a tradition, and this collection is no less successful than its predecessors in filling lacunae in writings on the subject. Clavichord touch (three papers) and Haydn and the clavichord (four papers) were amongst the main themes of the gathering, but the scope of the volume ranges from the early sixteenth century, with Daryl Martin’s study of the clavichord painted by van Hemesen, and some of Bernard Brauchli’s addenda to his ‘A Comprehensive list of Iconographical Documents on the Clavichord’ (*De Clavicordio [I]*) , to Jean-Jacque Dunki’s contemporary experience of ‘Composing ‘with’ the Clavichord’. The geographical range also is wide, form Brauchli’s important study of ‘The Clavichord on the Iberian Peninsula’ to Pekka Vapaavuori’s survey of ‘Historical Clavichords in Finland’.

I will concentrate here on the papers principally concerning the instruments themselves. Daryl Martin’s study examines closely the clavichord portrayed in remarkable detail by van Hemesen (c. 1529) and, noting the shallowness of the space under the keyboard, offers drawings of alternative reconstructions, both with and without a baseboard. Peter Bavington’s ‘Keylever, Tangent and String: a Preliminary Analysis of Clavichord Touch’ attempts an integrated view of the elements of the clavichord action which contribute to touch, and goes far beyond previous work in this area. The geometry of the sounding string is considered in relation to key leverage ratios, and the resulting hardness of touch of clavichords of different designs, and with differing string tensions is compared. He assesses the behaviour of the clavichord in relation to five qualities: hardness of touch, pitch stability, controllability and, relating to sound output but depending appreciably on the action, response and sustain. His study represents a fundamental step forward in our understanding of the instrument. It is essential reading for all clavichord makers, and it should help players to play more effectively. Richard Maunder draws together information from surviving Viennese instruments and documents to show that the clavichord was ‘alive and well’ in Vienna throughout the eighteenth century, that for much of that time a distinctive ‘Viennese’ short bass octave would have been normal (and was apparently exploited by Haydn), and that unfretted instruments were known there only from the 1780s. His survey is complemented by John Barnes’s detailed study of the Bohak clavichord in the Royal College of Music, London, which belonged to Haydn. Koen Vermeij presents a good case for the five-octave fretted clavichord being one of the most versatile types of clavichord for modern use, and Joel Speerstra’s study of the pedal clavichord is remarkable as a record of research integrating historical investigation, instrument reconstruction and playing.

In the absence of information about the original materials, I offer the following list, based only on; ocular inspection: baseboard, sliding underboard and, as far as can be seen, internal structural parts, fir or spruce; case walls and soundboard, cypress; bridges, maple or sycamore; wrest plank and register, service or pearwood; keylevers, beech (quartered); natural covers, ivory; sharp keyheads, ebony-veneered hardwood; nameboard, jack rail, upper case mouldings and soundboard well veneer, ebony; jacks perhaps pear; jack springs are now wire, but were formerly of quill; rose, parchment. I am grateful to James Yorke who kindly allowed me to examine the instrument closely in 1990.

That it is possible to reconstruct the instrument with a baseboard under the soundboard is shown by an example made in 1984 by Stephen Morris, following drawings I made the previous year.
As Jeremy pointed out in FoMRHI #100 (congratulations!), I have not been providing any summaries of the Bouwbrief for some time now. Of course I could say that “heavy commitments obliged me to do other things”, and it would be a true statement. Fact is that I did some major overhaul of two chambers in my house, for which I took a 6 week holidays, but they are still not finished after 3 months, but at least more or less habitable again. So, back to the Bouwbrieven.

But, before I do so, I would like to draw your attention for the catalogue of the Haags Gemeentemuseum collection of Dutch double reed instruments which was published in 1997 by Laaber Verlag. This catalogue is quite similar to the Catalogue on Dutch recorders (for a review, see C-1058), but with even more pages (264 vs 155) and it was correspondingly more expensive. I believe the price was about Dfl 450,- (~205 euros). Recently, the Gemeentemuseum has acquired a stock and were offering the book at the reduced price of Dfl 250,- (~113 euro), still not cheap, but very attractive for the wealth of information provided (data and photographs). I don't know whether the offer is still valid (Haags Gemeentemuseum is in the address list), but I thought you might be interested.

BB 96 starts of with a detailed description about the methods used by Piepenbroek (an article edited by Gerrit Menkveld) to build square recorders in a small series, based upon earlier articles of Alec Loretto in BB's 83, 84 and 89. It contains very detailed drawings of the templates made and used, however the text is not very easy to follow, even not for a native reader. Nevertheless, an interesting article, even though I got scared at the photograph which showed using a circular saw to make the labium, with fingers very close to the unguarded saw blade (but maybe I am somewhat over-cautious since I hit my own unguarded running circular saw blade with my thumb two years ago: very, very quick indeed). However, an old saying says: "if it looks dangerous, it probably is".

Another interesting article, this one by John Boersma, describes simple tools for the metal organ pipe makers. In detail, he describes, again with drawings, a "kopse snijder" (end-cutter, to reduce the length of the pipe), which costs about 360 euros in the shop. In addition, he describes a way to cast the material for the toe of the pipe, which needs to be of a different thickness as the walls (which he normally buys). An extra advantage is the re-use of all scrap material as well.

There is a rectification to tables in the article by Peter Hoogerheide in BB-95. So, if you use a copy of that article, you should get a copy of the corrections as well.

Similarly, there is a correction to one of the drawings of the article on the clavecitherium by Jan Burema (not Jan Burens, as I wrote erroneously in my last review). You should really use the two drawings together as the rectification is only half-size.

Gerrit Menkveld announced the availability of drawings of a study keyboard for carillon players. He has made several of these "klokkenspellen" and he suggests that others with similar interests would join in an evening meeting later in the year.

Jan Burema was surprised to see a left-handed clavichord in the 'Theatrum instrumentorum' by Praetorius, plate XV, instrument 3. He believes that this is unlikely to be a misprint because it is one of 4 instruments on the same page and a gravure cannot be imprinted in mirror image. The instrument is
called "gemein clavichord", and the word "gemein" could be related to the old-germanic word 'maina' which means 'verwechselt', or 'falsch'. This would indeed imply that left-handed instruments have been build or at least considered.

Gerrit Menkveld continues his series of articles on tools. He is still at a rather basic level.

Several other journals are reviewed (das Musikinstrument, Instrumentenbau, FoMRHI), but to give reviews on reviews, seems somewhat odd, so I will skip these from now on. Bouwbrief 96 concludes with some summary reports of the "Open Zolderdag voor Orgelbouwers", where the "Zolder" refers to the attic in an old factory, which is the Bouwerskontakt's permanent workshop in Arnhem. Furthermore, the guitar builders and the woodwind made some small reports.

Bouwerskontakt Bouwbrief 97, My Summary

BB-97 starts of with a long, more than 9 pages, and detailed article by Hans van Loben Sels on the constructional aspects of the guitar. Van Loben, a professional builder with technical background, describes the effects of ribbing on the bending of the guitar and gives various elementary formulas to illustrate his views. The article is an adaptation of an earlier aural presentation, made in 1996.

Ed van Weerd has collected "a bag of fire wood" from some acquaintances, which appears to be the remains of a small cello, early 18th century. He does not know how to continue, because of the poor state and the low musical expectations he has.

For the amateur organ builders, Jan van der Vegt's article goes into the details of making a simple wind chest (wind lade). (I am using a German-English terminology list from the web on http://www.islandnet.com/~arton/orgdict.html.) It has a couple of useful tricks for people with a minimum of electrical tools and he still wants to try to build a small organ.

Jan Bouterse reports on a few recorder inventions he has seen in recorders by other makers. One invention, from some years ago, was a recorder with a Böhm system but he does not remember who made that. Another invention (by Adriana Breuking) tries to eliminate (again) the lack of dynamics in the recorder by using a tiny hole very near to the labium. Opening such hole would increase the pitch and, to compensate, the player has to decrease pressure, so it lowers the sound volume, and, voila, a recorder with a dynamic range has been made. The tiny hole opening is controlled with the chin, which is operated by a lever. (CSt: was something similar not done by Dolmetsch long time ago?)

Jan Bouterse himself is experimenting with a recorder head on a traverso body. He is still working on that and he lists some of the problems in intonation and tuning.

There is a correction and addendum to the article of square recorders in the last Bouwbrief (BB-96).

Yet another "tools" article from Gerrit Menkveld, followed by a small article of Arie Koorneef, who has mounted a wheel under the case of his wife's gamba case to facilitate carrying the beast around.

The book reviews included a series of booklets, called "Tipboek" (a "tip" here means gadget, or trick). The complete series will consist of 28 volumes, covering all kind of musical instruments, and cost about 6 euro each. So far, the following volumes have been issued: keyboard, electric guitar, drums,
saxophone, trumpet, and some more. (CSt: sounds interesting but I have never seen one myself and they seem to be in Dutch; the editor is "The Tipboek Company, Haarlem, NL, http://www.tipbook.com/, yes, the English book spelling although all books seem to be in Dutch only.)

The Bouwbrief concludes with the reporting from 4 different working groups: the string, the keyboard, the organ and the guitar builders.

Bouwerskontakt Bouwbrief 98, My Summary

Quite a few interesting articles this time. The first is a comprehensive overview article on varnishing string instruments by Ed van Weerd. He has collected information from previous BB articles, combined this with results of the various discussions in the Werkgroep on Strings and his own experience and this resulted in this nice article, with many details. His approach is very pragmatic and he concludes with some literature references (e.g. Geigenlacke, ed. Bochinsky), tool and material addresses and varnish suppliers.

John Boersma describes a method to make a keyboard without the usual help of a band or scroll saw. Essentially his method is to start with straight pieces of wood (you will need a circular saw) and to glue the front pieces to the sides. Something like the following picture:

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glue
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He describes some templates to facilitate this procedure and to achieve necessary accuracy. More little tips are included.

Cees de Zeeuw gives a method to make a conical mandrel for making conical organ pipes, not using a lathe (easy, but not everybody has one), but on a circular saw. Detailed drawings illuminate the workings of his set-up. It does not seem to be a very fast method but it will work.

Gerrit Menkveld report the existence of a "voetbas" (literally a foot bass), difficult to describe, but the photograph and drawings explain a lot. The instrument is made by Luuk Salomons for folk music performances. It consists of a single bellow put on the floor and with 6 different large buttons. Pushing one of them with your foot, compresses the bellow and produces a sustained bas drone, originated from a metal tongue, as in a harmonium. Releasing the foot, a spring will push the bellow up and the player can continue. Claimed to be probably unique in the Netherlands, it was also used by the Flemish group "'t Kliekse".

There were some reactions to Ed van Weerd’s article in BB-97 (the bag of fire wood). One reader believed it was probably 20th century from Czech, because of some of the characteristics.

The BB-98 includes 2 translated articles from the Woodwind Quarterly, both by David Smith. I will not summarise translated articles (I will leave this to one of the FoMRHI members, who is also subscribed to the WWQ and could summarise the original).

The series on tools by Gerrit Menkveld has started its 2nd part (it looks as the first part, spread over 3 articles, was treating the measuring devices). This 2nd part starts off with saws and their characteristics (rake, gullet, clearance angles, etc.).
The book reviews include "Meubels restaureren" (restoring furniture), an originally Spanish book, which gets good critics from Gerrit Menkveld. The other books reviewed are some of the specific "Tipboeken" (see previous BB). These are the Saxophone, Trumpet/Trombone acoustic, guitar and the violin.

The Bouwbrieft concludes with the various reports of the Werkgroepen. The organ group has made an excursion to the organ maker Hans van Rossum. The woodwind group (which I unfortunately had to miss, I usually go) has been discussing many things, but in particular the efforts to make a computer program, to replace the old, not any longer maintained, "Resonans" program. Progress is ongoing, with the basics working. More to come.

And that is it.

BULLETIN SUPPLEMENT

David Armitage

I would like to take this opportunity to say that I am looking forward very much to working with Lewis on the future production of FoMRHI Quarterlies.

As an organ for the dissemination of information regarding the historical and practical aspects of musical instrument manufacture I think that the Q has no peers, and stands as a monument of which Jeremy and Eph can be proud. It is slightly frightening to be treading in these footsteps.

Apologies are due for the late arrival of this issue. Apart from the problems associated with the transition, there have been nasty bouts of flu getting in the way. I am sure that members will bear with us.

My guess is that the January edition will be a bit late, and that by April we will be back on track.

Regarding the format of submissions, I would remind members that there is a comprehensive set of notes on the back cover of the July 2000 List of Members.

I should draw your attention particularly to the requirement for a 25 mm margin around the text as it sits on the sheet of A4. The printer, Mark Ellis, informs me that the top and bottom margins are not as important as those on the side. I should like to express my thanks to Mark and Anna here for being so helpful during the production of this edition of FoMRHI.

Submissions for publication in the Q can be sent to me at London Guildhall University, 41-71 Commercial Road, London, E1 1LA, U.K. They can also be sent by e-mail to armitage@lgu.ac.uk
Museums Report

Following my most enjoyable Winston Churchill Memorial Trust travelling fellowship trips to Germany, Austria & Czech Republic between April 99 & April 2000, I have been meaning to write a quick report on activities in the museums & collections that I visited. I travelled variously in the delightful and informative company of William Waterhouse & Will Ring and Graham Lyndon-Jones, had a wonderful time and measured many bassoons.

Lübeck; St Annen Museum:
Has been having a "Bach & Buxtehude" exhibition since June, now finished sorry. In which they were showing some of their instruments e.g. 2 cornetti, 2 trumpets, a clavichord with "echo" stop, their quart-bass pommer & quart-bass bassoon by Eichentopf, the latter at least has never been on public display before.

I have just received a letter from Dr Althöfer saying that they now have a special exhibition of all of their instruments, running only until the middle of October. The instrument collection there is not large but one of the interesting aspects is that all of the instruments have some direct connection with the town, for example the museum has the original order from the MarienKirche for the pommer – in Buxtehude’s hand!

When Graham & I were there they were preparing a very interesting and well illustrated catalogue for the B&B exhibition, I do not know if copies will still be available nor whether there is a cat. for the instrument exhibition.

Schloss Sondershausen:
Are putting on display all of their instruments (80+) from October onwards, it was not clear whether this was to be permanent, I think it was for at least a year.

Very few of their instruments have been on display up to now, I only know about the dulcians & bassoons, which include some very important and unique examples, e.g. the only bassoon by Haka.

Leipzig; Museum der Universität:
While we were visiting Dr Fontana got the news that funds have been allocated for a complete renovation of the Grassi Museum complex and that this would start early next year. This is badly needed but means that the collection will have to go into storage for about 2 years!

While we were there they were setting up a new "Bach Year" exhibition which will include the plums of the baroque woodwinds and others such as the pedal clavichord.

They also have an excellent new display of their keyboard insts as part of the combined museum (Leipzig, Nürnberg & Berlin) piano exhibitions and a new rennaisance gallery.

Halle; Händel-Haus Museum:
Has got another part of the adjoining building, almost completely derelict but with remains of 17th cent cellars, which is to be rebuilt to house their instruments currently held in an annex a few hundred metres from the Händel-Haus itself.

These were the time-limited exhibitions I wanted to let people know about, I will write more about the other collections we visited later if that is of interest, no time now as I am off to hospital for a wee operation!
An Improved Wooden Bodied Bore Reamer

Twenty years ago Bob Marvin wrote comm 180 outlining his method of making wooden bodied reamers for "flute type" instruments.

I have made a modification to the design outlined in comm 180 to allow the use of wooden bodied reamers to be reliably used in smaller instruments such as treble recorders or traversos. However the modification reduces the chip clearance and so reaming is slower. I have outlined the basic approach below, and I apologise for any duplication with comm 180.

The main problems with wooden reamers are that there is a high level of friction between the wooden body of the reamer and the bore of the instrument, and that the wooden body of the reamer is not very stiff or strong to resist the friction torque. Obviously the approach to solving this problem is to make the reamer as stiff as possible within the limits of the material, and to reduce the friction and cutting loads as far as possible.

Examining a failed recorder centre joint reamer (made to Bob's design) I noticed that a crack had started at one of the holes drilled in the reamer to accept a fastening screw. This suggests that the holes in the reamer are acting as stress concentrators.

The reamer had also twisted along its length, and had felt very "spongy" during use.

The Improved Design

I tried a number of different arrangements and then found that by bonding a metal blade into a substantially circular cross section reamer body you could get close to the strength and stiffness of a plain wooden rod, and as a secondary benefit you had no holes to act as stress concentrators.

Because most of the bore is now filled with the reamer body you need to pare away a little area ahead of the blade to allow the chips to collect.

Generally I have found (as was reported by Bob) that the body diameter needs to be around 0.2mm smaller than the blade dimension.
Making the reamer
First cut a length of material allowing a transition section on the front to take the bore from the pilot hole size to the lower size of the reamer, and allowing a 75mm long handle with the bore profile length in between.

![Diagram of Reamer](image)

If your blank is nice and square in section then you can mount it in a four jaw chuck. The ones with engineering type jaws give a very good support to the blank. If the blank is not very square then use a prong drive, but you will need to be much more careful to avoid the blank whipping, particularly for long centre joint reamers.

Turn the blank 0.2mm under the bore profile at each measurement point. Turn the very end of the transition section to a diameter slightly less than 0.2mm under your pilot hole diameter. I usually do the final sizing with coarse sandpaper, as it is easy to ease the diameter to size and ensure that the profile is not wobbly in between the measurement points. Be careful if using this method as some woods have a marked difference in their radial and tangential hardnesses, and can sand noticeably oval. If this is the case then take the larger dimension and ensure that when you come to slit the reamer you cut along the long axis (or the reamer may bind in the bore).

![Diagram of Orientation of Blade with Oval Reamer](image)

Remove from the lathe and cut a longitudinal slit with a handsaw. The slit should run for the whole length of the reamer and extend down to the centreline (i.e. you are cutting down halfway)

Pare a small flat along one side of the slit to provide a small chip clearance area ahead of the cutting edge (see diagram above).

Try fit a blade into the slit and grind it away until there is only a small amount to be removed to bring the reamer to size. It is a good idea to rough grind the blade before bonding it into place, as you can cool the
blade with water. Once the blade is in place you need to be very careful not to overheat the blade as it can destroy the bond between the blade and the adhesive.

Clean the blade with alcohol and bond it into place. Use plenty of adhesive, allowing it to squeeze out as the blade is inserted. The idea is to completely fill the slot up with metal blade and adhesive to replace the material removed during the slitting operation and return the strength of the reamer to a complete circular cross section. The blade should run for the whole length of the reamer, so that when it is bonded into place all of the reamer is stiffened up by closing the slot. Excess epoxy can be wiped off and remaining residue cleaned off with alcohol.

Allow the adhesive to cure completely. For standard araldite this takes at least 24 hours (48 hours is better). For the “5 minute” epoxies allow at least 1.5 hours!

The blade can be filed or ground to the correct bore profile according to your design. Be careful to grind or file the blade so that the back corner does not rub against the bore (making the ground edge of the blade tangential to the reamer body will do this). Also be careful not to remove too much material or you will have a section of the reamer that will not cut.

Materials and tools
I use oak for my reamers. As hard and close grained as you can get. This is just because oak is a cheap and readily available wood with a hard surface and high strength. It is not the nicest of woods to turn, but is adequate if you do the final sizing with abrasive rather than try to get it to size with a turning tool.

Oak is not the easiest of woods to dry, so inspect the surface for checks to make sure your supplier hasn’t dried it too fast. Assume that any surface checks travel a substantial distance into the wood and discard that piece and buy a different one. Even if the checks are shallow they can catch the tool and pull a chunk out of the surface rendering the reamer useless. If the wood has any defects at all you can expect the reamer to collapse in use, and all of your hard work will be wasted.

For long reamers 12” hacksaw blades are too short and I use bits of worn out bandsaw blade. However for shorter reamers (e.g. for a four joint flute) then Sandvik “All Hard” HSS hacksaw blades are excellent, producing a long lasting edge.

For slitting down the length of the reamer body I start the cut using a 550mm tensioned mitre saw. Once a kerf is established I use use a normal 22” handsaw with nice coarse teeth (7 tpi or so), so the sawdust will collect in the gullets. Just be careful of your fingers when establishing a kerf!

I use epoxy adhesive to hold the blade in place. Either “5 minute” Devcon, or standard Araldite.

Lubrication
To lubricate the reamer I have found that the best thing to use is talcum powder liberally rubbed in to the back of the reamer on the opposite side to the blade.

You can get cheap talcum powder from supermarkets without any scent, but all of my reamers smell of lavender, as I am using up one of Cath’s unwanted Christmas presents!

I have been unsuccessful using either non-drying or drying oils, both when the reamer is soaked in oil and when the excess is wiped away. It works for a bit and then locks solid. However this may be due to the wood I am using for the reamer (Bob and others have recommended oil as a lubricant for wooden reamers).

Using the reamer
I ream by hand gripping the blank in a vice and using and gripping the back of the reamer with an adjustable spanner. (I turn the reamer from 1” square section blanks and the handle section is left square).
It is important not to turn the reamer backwards when retracting it or the chips will lock up between the body and the bore.

Keep the reamer sharp! You don’t need to raise a burr on the edge to get the reamer cutting but do keep an eye on it and sharpen it if necessary. Discard the reamer when sharpening has made it cut undersize.

With a reamer with such a shall chip clearance area it can save a lot of time to step-drill the bore after the first pilot hole has been drilled through. Always leave the step-drilling a little short of the point where the drill diameter meets the final bore diameter to allow for slight eccentricity of the step-drilling and wander during reaming. Step-drilling also helps to reduce reamer wander as the reamer starts cutting at more than one place along its body, helping to align the reamer with the pilot hole.

It is important to retract the reamer every couple of turns and brush off the chips using a toothbrush or slip of wood. If you don’t then the chips will bind as mentioned above. If you rub the planed surface of the chip clearance area with a soft pencil then it helps to stop the chips sticking.

Clive Catterall
Pythagorean concepts have clearly been a major influence in musical theory but to try to relate this to Arnaut's clavisimbalum doesn't make sense to me. The instrument is drawn according to geometrical methods. No one can deny that. The strings do not follow Pythagorean proportions.

To argue that this aspect of Pythagorean Theory was known, and therefore followed universally, from the time of Pythagoras doesn't seem at all convincing. For one thing how many stringed instruments before, say the fifteenth century, could this apply to? Families such as the lute, rebecs and fiddles have open strings all of the same length that cover whatever octave range is required. Certainly to achieve other notes they are, theoretically, stopped according to Pythagoras' proportions. But they have no choice. You could say this is a necessary coincidence. Since we are talking about unstopped string lengths here the only instruments, at this time, that had one open string per note were things such as psalteries, dulcimers and harps. Looking at contemporary images of these it is not difficult to find, for example, dulcimers drawn with strings all of the same length or instruments with two straight bridges. These cannot be influenced by Pythagoras. Even as late as 1496 Francino Gaffori, in his Theorica Musice, published in Milan, shows an illustration, labelled 'Pitagoras', of a monochord with six strings of identical length but with weights to give different tensions. The range covered is two full octaves plus the starting note again. This is not the interpretation of Pythagoras as applied to harpsichords. The notion of doubling string lengths per octave drop was not, then, a universal law.

I would suggest that Pythagorean proportions were only introduced to stringed instruments when two (related) things happened. Firstly, when the compass of such instruments was enlarged beyond around three octaves. And secondly, when small instruments that were hand held and had an ergonomic reason for keeping them to a manageable size became too large to handle.

The bass strings of the clavisimbalum do work. However if its range was extended downwards by a few more notes they would soon become useless if you continued the diminishing proportions. In other words the instrument has reached the limits of its design with regard to its compass. This is irrespective of the size the clavisimbalum is built as it must relate to the length of the top string. In the second instance once the idea of placing them on a table to play was established the longer bass strings that Pythagoras gives become a practical possibility especially if you want to increase the compass. This, surely, is a key factor in the transition between a mechanismed psaltery and a developed harpsichord.

But why did Arnaut set out the clavisimbalum using geometry anyway? This is where Euclid comes in. Like the Pythagoreans and their belief that the whole universe related to numbers, geometry also was seen to govern everything. In their book 'The Mathematical Experience' Cavis and Hersh put it this way: For the Greeks, mathematics meant geometry, and the philosophy of mathematics in Plato and Aristotle is the philosophy of geometry. And: "Geometry had served, from the time of Plato, as the supreme exemplar of the possibility of certainty in human knowledge."

In the Middle Ages geometry, was still an underlying science particularly in architecture. (See 'The Master Builders, Architecture in the Middle Ages' by John Harvey, Thames and Hudson) In discussing the origins of Gothic we shall see that a main factor was the introduction of Euclid's Elements of Geometry to the west about 1120-25 by means of a translation from the Arabic version by the Englishman Adelard of Bath. It is also interesting to note that the English version published in 1570 included an image and label of Musica on its title page. It had a 'very fruitful preface' by John Dee who was the astrologer who had (very successfully?) indicated a suitable day for the coronation of Queen Elizabeth I. Arnaut, too, was an astrologer. In 14th and 15th century European courts astrologers held significant positions it was a serious business. Arnaut would be highly skilled and knowledgeable about geometry. This was his science,
and it is quite possible that to plan something geometrically gave it special (mystical?) significance for him.

"We, who are heirs to three centuries of science," writes Sir Kenneth Clark in 'Landscapes into Art'. "can hardly imagine a state of mind in which all material objects were regarded as symbols of spiritual truths or episodes in Sacred History. Yet, unless we make this effort of imagination, mediæval art is largely incomprehensible." Davis and Hersh repeat this remark under the heading 'Number Mysticism' but rewrite it thus: ".We who are heirs to three recent centuries of scientific development can hardly imagine a state of mind in which many mathematical objects were regarded as symbols of spiritual truths or episodes in sacred history. Yet, unless we make this effort of imagination, a fraction of the history of mathematics is incomprehensible." Either version seem quite relevant.

The point is that Arnaut's method works (within the confines of this instrument) so for him his science is valid. The clavisimbalum is a viable, workable instrument. It is definitely not a harpsichord; the sound and effect is quite distinct and it has musical possibilities unique to itself. To try to impose Pythagoras on it is simply to use a different and inappropriate science even if we may believe Pythagorean science is more 'scientific' and would have lead to what we might think of as a 'better' instrument. This was not the thinking in the Middle Ages. Once this step is taken, though, we are on the road to the developed harpsichord. It seems no coincidence that this was happening as the Renaissance, with its new approach, was getting under way.
The Clavisimbalum of Henri Arnaut de Zwolle

The famous manuscript drawing shows a plan view of an early form of harpsichord - or does it?

I have recently finished a reconstruction of the *Clavisimbalum* using the second action. My aim has been to interpret the information as closely as possible to the information given without trying to impose any preconceived ideas which would inevitably come from later knowledge of the developed harpsichord. I believe the end result is quite distinct from its later descendant and is much more an immediate development of the psaltery family of instruments than a primitive form of harpsichord. This interpretation can help solve some of the apparent difficulties to be encountered in the manuscript.

CASE and LAYOUT

Stewart Pollens, in his book *The Early Pianoforte*, assumes that the diagram is only schematic and that neither the outer casework nor the keyboard end blocks are included. In the clavisimbalum we find that the top and lowest keys have a small significant detail, which should not be overlooked. The back half of the visible part is tapered inwards, presumably to line up with the far end of the lever but also perhaps to clear the sides of the case, which lie within the outline shown.

If, instead of assuming the layout found in harpsichords, one take the notion that this is simply a psaltery fitted with a keyboard and action (i.e. a Clavisimbalum!) then some confusion in the text starts to make sense. I see no reason to assume the drawing is so incomplete. The only part not shown is the area that covers the action and this will be different for each of the actions specified, which is why it is omitted from the drawing but details are given in the text.

ACTION

I have used the second action that is shown, partly because it is more obviously different to the first or third and is also because it is so distinct from the harpsichord jack. A plectrum labelled 'cornu' is shown,
carefully drawn with a rounded top surface and a straight, sloping under surface. There is nothing to suggest an escapement, as we might know it. At the end is drawn a shape that, I believe, is a separate guide and adjustment device. When the main lever is made there is bound to be some side-to-side movement. The flag-shaped guide is fitted into a rail and can turn about a rounded stem very much like the blade of a hurdy gurdy. This fulfils two vital roles and it does them perfectly. It guides the motion of the action with precision and can be used for regulating the projection of the plectra beyond the string. Indeed it is the only method of voicing/adjusting once the action is fitted. Two other factors make this possible. Keeping the alignment of the strings, as shown in the drawing, along the centre line of each key lever the linkage is slightly offset and pulls the action lever onto this guide. If anymore twisting motion is required the brass spring can be angled to achieve a positive pull onto the guide.

The proportions shown in the diagram of the second action seem accurate and work very well. The script describes a 'rigid piece of brass.' Rigidus, according to a Latin dictionary, translates as: stiff, unbending, rigid, hard. 'Lato... rigidam.' I have taken it to mean hard brass, in other words brass hardened to make a spring as opposed to a soft brass, which is far from springy. Later on, following a description of the fourth mechanism, Arnaut says:

'Note that... in the second type of mechanism the spring is above and in the shape of a thin strip.' He has shown this spring in plan view instead of the side elevation used for the rest of the drawing. It was not uncommon to combine views to give the maximum information. To make the springs I used brass inlay strip 1.6 x 3.2mm and beat it till it was about half its original thickness. This 'work-hardening' produced strips that have an uneven outline. Arnaut has used a ruler for the drawing of the lever and supporting bracket but the strip is drawn with an uneven outline and slightly flared ends. This is just the appearance of the beaten brass. When installed as a complete action it is possible to disconnect the chain from the spring, which can then be swung to one side to allow removal of an individual lever unit. This is an important point if we are to consider that this was a 'real' instrument as the only alternative to enable repairs would be to dismantle everything and remove the whole set of springs before gaining access to the levers. (Probably a days work - not very practical!)
The text for the second action has the instruction: "the keys are long and extend almost to A and in this case it is also necessary that the keys be thoroughly bitumened, as in portatives, on account of their length." Various explanations are possible. The word bitumen, apparently, was used quite commonly in Latin to mean any natural hydrocarbon. It could be used in connection with mortar (referred to as 'slime' in some translations of the bible.) In the eighteenth and nineteenth century bitumen was used as a pigment to make a rich brown paint, which unfortunately never dries completely and has caused problems to many paintings. (I can't find if it was used in this way in the fifteenth century though). Lamp-black is also a hydrocarbon and might even be referred to as bitumen, though the Latin word *fuligo* means lamp-black. For action 'number two' the back end of the keys do extend beyond the chest and are visible beneath the instrument. I have taken it to mean that because of their length they therefore need painting.

The only alteration to the mechanism I made was to alter the position of the pivot. As drawn the lever reduces the motion of the plectrum end from the dip of the key. Experiments suggested that for a double strung version the keydip would have to be at least 12mm, which seemed too much for such tiny keys. On the other hand the position shown would be quite appropriate for a single strung version. I have kept the same ratio but swapped to the other end. The action, I believe, is drawn very carefully and completely. There is no need to add parts not shown or to change the shape of the plectra.

Chains, springs, rivets and links would, you might think, give a very noisy action. However the result is surprising and there is virtually no action noise at all. It is certainly quieter than jacks running in a slot, as the use of the guide takes away any side shake in the main lever and the spring keeps the whole thing in tension. There is nothing to rattle.

**The Clavisimbalum**

As a musical instrument it is quite different in sound and capability to any harpsichord and should not be thought of as such. Not as powerful as a small harpsichord its sound is ringing and resonant. The 'pluck' is much more of a 'strum' so the sound does not have the dry pop of a harpsichord. This is especially true with the double strung version as you get four strikes per note. The sympathetic resonance then swells the sound so that the pluck is not a crisp and dominant part of the overall effect. It has the acoustic of a cathedral all of its own. The bass is very effective as a drone and is relatively light and the treble very clear. The name *Clavisimbalum* describes the sound better than I can for that is exactly what it is.

For more details find it on my web page [www.barlowharps.demon.co.uk](http://www.barlowharps.demon.co.uk) or contact Philip Pickett for it musical usage.
Hornworking nuts and bolts:
Selecting raw material

Horn as a raw material seems to have had very little written about it. As such, anyone starting to work with horn needs to learn by trial and error about what constitutes 'good' or appropriate material. The following thoughts are offered as points of consideration when selecting horn.

Horn is available in various forms as a starting point for work:
- pre-turned cylinders of solid horn (often used for bagpipe mouthpieces)
- solid slabs of horn, similar in dimension to small bars of chocolate (usually used by gunsmiths, knifemakers, and reconstructors of historical weapons)
- thin pressed sheets (traditionally used for lanterns)
- raw horn (this is the horn in its natural state taken straight from the animal. BSE laws in the UK prevent 'wet' or fresh horn being obtained directly from abattoirs – in other countries this may be the more common way of obtaining horns. Dried horns from commercial suppliers often come from India or Pakistan.)
- polished horns (these are entire dried horns, with a clean-cut wide end, a clean interior and with the outer surface brought to a smooth fine polish).

The following considerations, for the most part, will relate to horn in its raw dried state. They will also relate more to cow or ox horn, rather than to ramshorn. The factors contributing to the material's suitability of the job in hand are varied. It is advisable to examine these factors, and to realise the features and properties required by the finished item. A good horn supplier will be able to discuss these requirements, and will be able to advise on the most suitable horn.

The length of solid tip in proportion to length of horn:
This varies according to the breed of the animal, oxhorn having a longer proportion of solid tip than cowhorn.

Presence of delamination:
Delamination is the separation of radial layers within the horn's structure. The tendency of a horn to delaminate varies according to breed, and the climate/lack of water supply in the animal's environment. Some breeds will tend to delaminate at the tip, others at the base. It is important to be aware of this, in order that the potential area of delamination is at the opposite end of the horn to the end that will be used. Some batches of horn, however, may show multiple fine delaminations, or one marked separation of layers along the length of the horn. UK cattle, e.g. Highland cattle, produce a horn which is reliably free of delamination, but BSE laws prohibit its availability.

Damage caused to or by the animal:
Damage occurs in a mild form when an animal knocks its horn against something, whether it be another animal's horn or a solid object. Due to the curvature of the horn's surface, this knock results in a kind of a 'bruise' – a white circular mark within the surface layers. When working the horn, these may be left in for effect or may be removed, by removing horn to a level deeper than that of the 'bruising'.
More serious damage occurs when the horn is knocked with enough force to cause a break or crack, which occurs longitudinally for a short distance along the horn. In time, subsequent complete layers of horn will grow over this crack. If the crack is near the surface, then again, horn can be removed to a deeper level than that of the damage. If the crack opens out onto the inner surface, then the usefulness of the horn should be assessed. The crack may be sealed with glue (e.g. epoxy resin), though visible sign of damage may be undesirable.
Shape of the horn:
Horns have a characteristic slight spiral, either to the left or to the right. If the workpiece requires a horn to be centrally aligned, or to have a specifically shaped opening at the wide end, then the horn can be softened in hot water for 10-30 minutes, then left to dry on an appropriately shaped former.

Colour of horn and related hardness:
Dark horn is softer than light horn, and is therefore, at times, easier to work. When both colours are present, this difference is more noticeable. Horn in general has a translucent quality, with longitudinal 'flares' of other colours – ranging from brown to grey to green. These colour areas can be observed, and certain flares of colour can be brought to the surface by removal of more material. There is often a layer of lighter horn with a more opaque chalky quality, on the outer surface of the base end. This can be left, for effect, or removed to reveal the more translucent light horn beneath.
The colour of the horn can be taken into account in relation to the other component parts of the instrument being made. For example, it may be chosen to match or provide a contrast with the wood.

Condition of the inner surface:
The inner surface may be smooth, or it may have a ridge running longitudinally along its length. If this is an undesired feature, it may be removed with a file or rasp. The surface should be free of any residual traces of dried membrane. These are more difficult to remove once dried. If they are present, they can be removed with wire wool, but they are of a different substance, and have an unpleasant smell when worked.
If horn is obtained from an abbatoir, it will usually come with the soft pulp still inside. The most efficient way to remove this (according to a Basque alboka maker) is to boil the horn for an hour, then tip the pan out onto the ground. If you then stamp on the horn, the inner core will fly out cleanly, leaving no residue. The boiling must be done in a well-ventilated area due to the pungent smell.

Condition of the outer surface:
Cracks, splits and breakages can be observed and assessed. They may be easily removed, or may conceal flaws within the horn. The work required to remove enough horn to attain a workable piece should be considered.
If the horns are from India, the horns may be covered with painted patterns, due to the animal's religious significance whilst alive.

The above thoughts and comments are offered, with hopes that further comments, insights, and knowledge may subsequently be added by others.
I would like to heartily endorse every one of the points made in Comm. 1721, except for the one on the 'confrontational' aspect of my reviews, which will be discussed below. I am particularly concerned with the restoration and repair of original instruments which, whether we like it or not, is a fact of life today. Every competent practitioner makes useful observations and develops special methods that could be useful to others. If not published soon after the work, this information tends eventually to get lost. I would like to see reports of these in every Q. We need to develop a culture that encourages such reporting, without criticism of why it has to be done. We also have to learn to accept that any such work can never be fully adequate because of limited time and resources, and be grateful for whatever information is offered.

In my reviews of influential papers (one is offered for this Q), I have usually concentrated on the evidence and how the presented theory explained it, and compared these explanations with an alternative theory. If my claim that the author's theory is inadequate and the alternative theory is better is being 'confrontational', then it can't be avoided if one accepts, as I do, that scholarship is about choosing between theories on the basis of fidelity to all of the evidence. Arguing that a theory is inadequate does not in any way diminish general respect for its originator as a person or as a professional. The best scholars pursue inadequate theories at times.

There is a social aspect of scholarship that is important. For career advancement, one needs to be liked and respected by the recognised leaders in the field. Their opinions are also crucial in the reputations of work published. If they had been properly trained in the discipline of scholarship, they will judge the quality of work primarily on its demonstration of the theory's superior fidelity to all of the evidence. In our field, such leaders are rare. The early-music movement has raised public awareness, and since it has swelled our ranks, it has considerable influence. It feels insecure and wants stability. Thus the respected leaders have been writers that collect and organise knowledge, not those that generate it. These usually judge new theories as laymen do, on how well the results fit in with what they already 'know', and how attractively and convincingly it is presented. They encourage speculation, but not controversy.

A typical leader is skeptical about all theories that have not 'stood the test of time'. Convincing him to consider a new approach to an old problem is very difficult. He can't take part in the ancient tradition of scholarly debate because his rules of interaction are different - following the old professional ethos (derived from the aristocracy and military), of always preserving the appearance of being united. Though open criticism of inferiors may be necessary for training, such criticism of fellow professionals is strongly avoided. It appears confrontational and undermines authority. With such pressure for conservative conformity, the few who feel that they can afford to argue in print (and I include Catch here) are particularly valuable. Controversy is necessary for free growth.

We should not take alarmist advice about libel law from anyone other than a law professional. A lawyer tells me that the legal position is no different for a requested review than for any other publication. The party who feels that an injury has been done to his reputation must convince the court that what was written is untrue as well as that the injury was substantial. This should be very difficult when a scholarly debate is properly conducted. Scholarly criticism should be backed up by evidence and preferably be constructive (showing how deficiencies can be improved), be limited to the works discussed, and not denigrate the author in any general personal way.

It is appropriate to be restrained in criticism of new authors, to not discourage them. But my critical reviews have been of papers either by field leaders or aspirers for such leadership, so such restraints do not apply. Showing how the interpretations were inadequate can be disturbing and even hurtful to the author and to those that have uncritically accepted what was written, so I can be accused of being ungentlemanly. I very much regret any hurt that I give to anyone else, but is this not a price worth paying for bringing objectivity standards in our scholarship up to levels that are common in other fields? We have a particular responsibility to instruct new practitioners in what those standards should be, and being mealy-mouthed in the name of dignity preservation will only provide excuses for bad practice. High standards are as important in historical scholarship as in any other profession.
A late 16th century French picture with instruments

A few years ago, when I realised I knew of no evidence on the sizes of 16th century French citterns, I asked Peter Forrester if he knew of any relevant pictures. He sent me copies of three photographs of an anonymous gouache painting given to him by Patrick Deleval.

Centred in the painting is a painted picture frame, within which is a typical village landscape. Flying above the village is an ornate kite on which is written: 'LE VILLAGE DE ROCQ', beneath which is '1596'. Peter wrote that the village is now called Recquignies, near Avesnes-sur-Helpe, in northern France. Between the painted frame and the real frame is a painted border strewn with musical instruments. These include a portative organ, a virginals, a harp, a lyre, two little mandoras, two citterns, four lutes, three fiddles (violons), two trumpets, assorted woodwind and percussion instruments and music books. The painting style seems realistic. There is evidence here on the relative sizes of the instruments, to be questioned only if it conflicts with other evidence. I measured the string stops of the fingerboard instruments.

Only the backs of two of the lutes and one of the citterns are seen. The distance from the nut to the tail could be measured, and the string stops were estimated from the proportion of this measure to the string stop on examples where both could be measured. The two smaller fiddles had missing bridges, and the string stops were estimated from the measured distance between the bridge end of the tailpiece and the nut by assuming the same proportion as in the basse where both can be measured.

If we scale the picture so that the string stops of the fiddles fit into the range calculated for that time in Comm. 1658, the dessus is as large as it could be, with a string stop of 37 cm, and the basse as small as it can be, at 80 cm. The middle size is in the middle of its range at 48 cm. Two of the lutes had a string stop of 47 cm, one of 55 cm and one of 59 cm. The string stops of the citterns were 46 and 50 cm, and that of the one mandora that could be measured (the nut of the other is obscured) was 24 cm.

The sound holes of the dessus violon can't be seen. Those of the middle member are outward-facing C holes, and those of the basse are S holes, with the bridge-ends of the S's pointing at one-another, and with a pointed widening in the middle of each. It seems that French fiddles, till well into the 17th century, had sound holes with a variety of designs that did not include Italianate f holes. All of the pictures I have seen show the bridges well below the sound holes towards the tailpiece. For realisation of my suggestion that four strings on a treble fiddle implies the use of a soundpost (as a bass enhancer) on all members of a set, the soundpost could not have been inserted and adjusted near the bridge in the modern way. Either it was not close to the bridge or it was fixed in place when the instrument was opened up.

The lutes were probably tuned with the highest string to c, a' and g'. Two of the four, being of the smallest size, seem to demonstrate the popularity of very small lutes in late Renaissance France. This supports to my theory (Comm. 1592) that the important baroque tunings were developed on very small French lutes. The mandora highest string could tune up to c''. The cittern sizes are like that of common Italian and Flemish citterns, and not small like Praetorius's English cittern. The one with the neck narrower than the fingerboard, a feature deriving from the overhanging fret blocks of the 15th century cetra, and standard on Italian citterns. Previously known evidence on French practice is ambiguous. Peter has interpreted it as favouring narrower necks than fingerboards, and I had interpreted it as favouring full-width necks. With the one piece of clear evidence here, we can conclude that, as far as scholarship can tell, Peter was right. I don't say 'probably right' because that is implied in any conclusion of scholarship, which can only interpret the currently available evidence.

In conclusion, string-stop measurements on the fingerboard instruments in this picture do not present any problems in interpretation, and they give us useful information about French instruments of the period. Measuring the historical sizes of instruments from pictures is a topic that has been very little pursued. Much more could and should be done. I would be glad to try to interpret photos of other pictures of fingerboard stringed instruments that are sent to me.
Knowledge, belief, catlins and a response to Comm. 1723

What is historical knowledge? It is different for different people. To a non-scholar, it is what the historians write in history books, dictionaries and encyclopaedias. To a post-modernist scholar, it is simply what he or she believes was true, and though a study may collect a mass of evidence to establish credentials, the objective is to convince others of this ‘obvious’ truth. To a consensus scholar (who can otherwise be called a facts-and-speculations dichotemist), knowledge is ‘facts’, defined as what the recognised specialist experts have accepted was most probably true, and new ‘facts’ that are so overwhelmingly supported by the evidence that they are sure to be accepted. To someone trained in the principles of scholarship, it is what most reasonably explains all of the relevant evidence.

Non-scholars generally believe what the historians write. Belief is at the core of the approach to historical knowledge by post-modernist scholars. Consensus scholars are torn between skepticism and belief; their ‘facts’ are what they can let themselves believe because it is (or would be) accepted by their respected colleagues (preferably for some time), and their ‘speculations’ are what they can’t (yet) properly believe. Properly trained scholars believe that fidelity to the evidence is the only basis for objective knowledge, and though belief in that knowledge itself (and in one’s hunches that one hopes one’s work will lead to knowledge) is usual, it must be conditional, always with some doubt (and something like a sense of humour), free to be readily abandoned when better explanations appear, often (but not necessarily) as a result of new evidence.

The non-scholars will follow whatever uncertainty qualifications are made by the historians they read. The post-modernists would not apply uncertainty qualifications when expressing their knowledge. The consensus scholars will follow the uncertainty qualifications of the leading specialist experts, and of course they use these qualifications for their ‘speculations’, which are candidates for eventual ‘most-probably-true’ consensus status. People trained in the principles of scholarship only need to use them if there is more than one candidate for knowledge (i.e. theory) that reasonably explains all of the relevant evidence, and the one leading (in reasonableness of evidence explaining) is not so far ahead of all of the others. All knowledge is based on evidence and theories currently available, and has a degree of uncertainty based on what the future may offer. That is generally understood, though predictions about likely changes in the future may induce some to use uncertainty qualifications in some circumstances.

Catch argues against my making a ‘positive categorical statement’...‘which is neither generally accepted knowledge nor supported by evidence’, and which the ‘editor or referee of a reputable scientific journal’ would ‘return the paper to the author for reconsideration’. The issue is my two theories about the thicker gut string type called ‘catline’ or ‘catlin’. One was that it had rope construction, and the other was that the name derived from a nautical rope.

The first theory was not generally accepted because most early musicians (used to the sound of bass strings wound with wire) considered that all-gut strings with rope construction did not sound bright enough. The theory was supported by the evidence that gut strings were sold by rope makers in Mersenne’s Paris, that the only material mentioned in the sources was gut, and that rope construction is the only one suggested that would give an all-gut string the elasticity needed for musical usefulness. Few other than Catch were interested in the second theory, which was supported by the suggestive evidence that the nautical ‘cat rope’ needed to be more elastic than other ropes, and that musical strings were too thin to be called ‘ropes’, but were of the size that could be called ‘lines’. Catch’s criticisms were helpful in its clarification.

There were no other theories offered at the time for either the construction of catlines or for the origin of the name. Since my theories was the only ones that appeared to explain all of the evidence, they were the knowledge of the time, and did not need to be expressed with uncertainty qualifications to properly trained scholars. The editors and referees of reputable scientific journals are much more likely to be properly trained scholars than the editors or referees of arts history journals, so they would have been much less likely to ‘return the paper to the author for reconsideration’

Since then, the rope-construction theory has been challenged by the loaded-gut theory, which fails in
validity because there apparently is no appropriate loading material that can produce the optical clarity of catlins mentioned in the sources. Also, new direct evidence of obvious roped-gut construction of thick gut musical strings has appeared, showing that rope technology was in common use for thick gut musical strings. So the rope-construction theory remains the current knowledge of properly trained scholars.

The second theory, of a nautical origin of the name, has since been rejected because it was noticed that all of the identified origins of other names of string types were places that the strings were exported from. It was replaced by the theory that the origin was 'Catalan' (the region in Spain). This theory is supported by the evidence that there was a thriving string-making industry in Barcelona at the time the name became established, and a reasonable story of how the making of these strings got there. Such particularly elastic strings had previously been made in Munich. South German merchants ran the Spanish economy, which was awash with New World gold. It makes sense to transfer production from Munich to Barcelona, where the market could support much higher prices. In that theory, nautical and feline associations with the name contributed to its popularity.

Catch's has been arguing against my theories without offering any alternatives. His approach seems to be a kind of inverse of the post-modernists, disbelieving and denigrating any scholarship on string types that is not to his liking. This approach is shared by many other facts-and-speculations dichotomists whose motivation is to maximise the historical support for what the early-music musicians do and use. So whenever a scholarly study concludes, from an analysis of the evidence, that what is historically correct (to a high probability) is other than what the musicians do or use, these people are quick to point out that the conclusion was not proven beyond the shadow of a doubt.

This argument has the great advantage of allowing the musician to claim that the position of historical scholarship on the matter is still uncertain, and that what they do or use is an historical possibility, thus providing a rationalisation that can satisfy the audience's expectation of authenticity. That helps the early-music industry and its promoters, including many musicologists and amateurs. It has the great disadvantage of limiting any research that can lead to such a conclusion to the thick-skinned few who can afford (psychologically and career-wise) to do scholarship which is likely to be denigrated. This stifling of research is bad for scholars and for the advancement of historical knowledge.

Finally, Catch argues against my interpretation of Talbot's statement on wound strings, as given in Comm. 1710. My reading of Talbot is:

"Lyons only[?] [below] are[?] [above] in lowest Basses twisted [new line] with Copper or Silver Wire [new line] in lowest str. of Bass Violin [new line] or Viol."

The words 'Lyons' and 'are' appear to be on the same line, and 'only' is on the next line, the same as 'in lowest Basses twisted'. The statement seems then to read as 'Lyons are only in lowest Basses twisted with Copper or Silver Wire' followed by 'in lowest str.of Bass Violin or Viol'.

The historical meaning of 'Basses' needs to be considered. According to Playford in *Skill of Musick*, only the lowest string of the violin and of the bass, tenor and treble viol was called the 'Bass'. As with the viols, the names of strings on the bass violin should be the same as on the treble violin. So the plural 'Basses' here would mean only the lowest strings of relevant instruments. The 'only in lowest' before 'Basses' here would then be redundancy to reinforce this meaning. In the rest of the quote, the relevant instruments are specified. The redundancy would be to eliminate the meaning of 'Basses' that Mace used for his lute, where it refers to a number of strings on the same instrument that don't have individual names.

Nevertheless, Talbot can possibly be interpreted in another way that does not categorically rule out multiple wound strings. Thus Catch can use a wound 5th string on his bass viol for repertoire played in the 1690's and can successfully claim that is is not absolutely forbidden historically. This kind of spin on historical knowledge can convince those who feel that commitment and loyalty is more important than objectivity, but it has nothing to do with historical scholarship, which is about what is objectively most likely to have been true.
Review: ‘Monteverdi’s Violini piccoli alla Francese and Viole da braccio’
by David D. Boyden

The early chapters of David Boyden’s classic book *The History of Violin Playing from its Origins to 1761* (1965) dealt with the history of the violin before the baroque, and provide the ‘knowledge’ on which early-music ‘Renaissance violins’ are based. He used the unfortunate term ‘violin family’ to refer to all sets of 16th century fiddles described in the sources, and assumed that the singular term ‘violin’ always was the treble member. He also assumed that this ‘family’ was fully formed by about 1550 (with the report by Jambe de Fer), and continued without essential alteration into the baroque. In this simple Renaissance-baroque-continuity theory, the members had three tunings, the highest of the violin, the middle that of the viola, and the lowest a tone lower than the cello. With French fiddles, where all members had four strings (from around 1550), the evidence supports this theory. Boyden gets the evidence of Italian fiddles with 3-string highest and middle members to conform to the theory by assuming that they were missing the highest string, which was added around 1600.

In the evidence provided by Zacconi (1592), there were also three tunings for the *viole da braccio*. The middle members though, had four strings. They were tuned a fifth above the lowest member, not a ninth above it which the theory requires. To explain this discrepancy, Boyden assumed that there were four tunings in a set which combined Zacconi’s *viole da braccio* with his *violini*. Zacconi consistently discussed the *violini* as separate instruments from the *viole da braccio*. He discussed the ordinary *violino* with standard violin tuning (which Boyden deduced was the same as the highest *viola da braccio*), and he implied that there also was a lower *violino* (that Boyden assumed was tuned like the viola). Boyden’s explanations of Zacconi’s evidence were offered superficially in the book. The paper being reviewed here was referred to for the detailed analysis. Thus this paper was crucial in forming the current popular understanding of 16th century Italian fiddles.

The first section of the paper deals with the nature of the instrument intended when Monteverdi specified *Violini piccoli alla Francese* in *Orfeo*. The second section deals with all of the tunings of early fiddles given by theorists, and then focuses on the writings of Zacconi.

**The Violini piccoli alla Francese**

Early in the paper, Boyden states that, ‘in my opinion, the discant *viole da braccio* was the usual violin, although in exceptional circumstances it could also be the viola; and the *Violini piccoli alla Francese* in *Orfeo* were pochettes, small boat-shaped violins tuned an octave above [the lower three strings of] the ordinary violin, and treated as transposing instruments’. He argues against the speculation of Sachs (1940) that the *violino ordinarij da braccio* (also called for in *Orfeo*) were violas, and the *violino piccolo* was a violin in the modern sense. His main point is that the range of the *violini ordinarij* parts lead to anachronistic high-position playing if they were violas, and stays comfortably in first position on violins. Sachs probably assumed transposition, but Boyden does not discuss this possibility.

As for the *violini piccoli*. Ruhlmann’s (1882) opinion that the were *pochettes*, is considered ‘undoubtedly correct’, as opposed to the opinions of Westrup (1940), Moser (1919) and Bessaraboff (1941) that it was a small violin tuned a fourth above the normal violin. Boyden concludes, as Moser and Bessaraboff did before, that the music was played an octave higher than written. Thus the range of the music does not distinguish between these two possibilities. He claims that ‘the only instruments that fit all the conditions of context, notation, and playing conditions are the French pochettes.’

The supporting evidence on ‘context’ is that the two *ritornelli* that use the *violini piccoli* bracket the shepherd’s *arioso*, and preceding these is *Orfeo*’s air *Ecco pur...*, described by Boyden as ‘faintly reminiscent of the French *airs mesurés* or *airs de cour*. This gives a possible French connection, but the instrument name is a much stronger connection. He then quotes Praetorius speaking of ‘the very small Geiglien strung with three strings and called *Pochetto* by the French’, perhaps assuming (but not saying) that *pochettes* were the only French fiddles of that size. That would be the only way that being French could distinguish between the pochette and small violin theories. This tuning and
implied size is not included in Jambe de Fer’s set of fiddles, and if they were the only sizes of normal shape used in France, his point is established. Small fiddles of this size that were not rebec shaped were used in England since one is depicted on the Eglantine Table.

The supporting evidence on ‘notation’ offered is that a normally shaped fiddle would be a violino piccolo (not French), which ‘is not a transposing instrument’. I am sure that the evidence this statement is based on is from much later than Orfeo, and that there is no reason to believe that this reading tradition started and continued from so much earlier. As for supporting evidence on ‘playing conditions’, I couldn’t find any in the paper that could begin to distinguish between the two theories.

Consequently, his case for the pochette theory over the small-violin theory is supported not by arguments he presents, but by evidence of sizes of French fiddles that he does not mention.

The viole da braccio

Boyden lists the tunings of sets of fiddles given by:

1. Ganassi’s (1542) imitation of fiddles on viols with three strings: Cant: g,d’,a’ (adding ‘early violins,’ 3 strings), Tenor: c, g, d’ and Bass: F, c, g.
2. Agricola (1545): Discant: g,d’,a’, Alto-tenor c,g,d’ and Bass: (F),G,d,a.
3. Jambe de Fer (1556): Dessus: g,d’,a’,e” (adding ‘true four-stringed violins’), Taille-haute contre: c,g,d’,a’ and Bass: Bbb,F,c,g.
4. Zacconi (1592): Violini: g,d’,a’,e” and c,g,d’,a’ (adding ‘Zacconi gives both tunings for violini’). Viole da braccio: Soprano: g,d’,a’,e” and Bass: Bbb,F,c,g.
5. Cerone (1613) only relative pitches given: Tiple: g,d’,a’,e”, Tenor: c,g,d’,a’ and Bass: Bbb,F,c,g.
6. Praetorius (1619): Gar klein Geig: a’,e”,b” or g’,d”,a”, Klein discant Geig: c’,g’,d”,a”, Violino. Rechte discant Geig: g,d’,a’,e”, Tenor Geig: c,g,d’,a’, Bass viol de braccio: F,c,g,d’e or C,g,d,a and Gross Quint-Bass (5 strings): FF,C,G,d,a, and
7. Mersenne (1638): Dessus: g,d’,a’,e”. The “three parts of the middle”: c,g,d’,a’ and Basse: Bbb,F,c,g.

Earlier sources missing from this list (see Comm. 1658) are:

8. Agricola (1528): Discant: g,d’,a’, Alto-tenor: c,g,d’ and Bass: F,c,g.
9. Gerle (1532) only relative pitches given: Discant: g,d’,a’, Alto-tenor: c,g,d’ and Bass: C,G,d,a, and
10. Lanfranco (1533) only relative pitches given: Soprano: g,d’,a’, Contralto-tenor: c,g,d’ and Bass: Bbb,F,c,g.

There are problems with the number of strings and their pitches in Boyden’s reports of Cerone’s (5.) Tiple and Tenor and Zacconi’s (4.) Soprano viole da braccio tunings. (The problem with Zacconi’s second violino tuning will be discussed later). Cerone gave a relative tuning diagram with only three strings for the Tiple and Tenor, identical to the relative tunings given by Lanfranco (10.). But he gave a playing range for the Tenor that was the same as given by Zacconi, implying that a 4-string version also existed and the added string was an F at the bottom. Boyden erroneously adds an a’ at the top (I presume that this was an honest mistake that was not picked up because it fitted expectation). There was no ambiguity in the number of strings (three) on the Tiple, and Boyden arbitrarily adds a fourth on top at e” . He also assumes that Zacconi’s Soprano had four strings, so the top string was tuned to e”.

That makes each string of the Soprano a ninth higher than the corresponding string of the Tenor. This is inconsistent with all of the other tunings above with three tunings in the set (i.e. all except Praetorius (6.), where each string of the high member of the set is tuned a fifth above the corresponding string of the middle member. Boyden didn’t notice this. In vocal music, the tessitura difference of a ninth between the soprano and middle voices would be highly unusual, and instruments in sets tended strongly to follow normal vocal ranges. The inconsistency would be resolved by Zacconi’s Soprano having three strings, which will result in the highest string being a fifth above the highest string of the 4-string Tenor. The music played on the soprano is mostly on its higher strings, so for the musician, the highest string is much more important than the lowest string.

The evidence behind Boyden’s assumption of four strings is Zacconi’s statement contrasting viole da
gamba and viola da braccio, with the former having six strings and the latter having four. This statement must have been statistical in nature since we know that many viola da gamba, like those of Vincentino (c. 1600) and most according to Ganassi (1542), had five strings. Most of Zacconi’s viola da braccio still would have four strings if the Soprano had three.

There are indications in Zacconi that the number of strings on the Soprano varied. The main indication of variability is in Zacconi’s qualification in parenthesis ‘(parlando delle violae ordinario)’ referring to the ‘usual’ Soprano (when stating that its lowest string was what the Basso highest was tuned to). Another indication of this variability is the omission of the range of pitches playable on the Soprano, when that range was given for the other members of the set. Thus the inconsistency is resolved with Zacconi’s ‘usual’ Soprano having three strings, with Boyden’s top e” eliminated.

After listing his tunings, Boyden states ‘The one real constant in all this is that the “proper discant” viola da braccio uses the g-tuning of the violin today.’ He here assumes that a fiddle with the three-string tuning g,d’,a’ should be considered to be the same instrument as one with the 4-string tuning g,d’,a’,e”. This may look reasonable on paper, but is not to a practical musician or a stringed-instrument technologist. As stated before, a musician plays much more on the highest string of a treble instrument than the lowest, and so would keep the same highest pitch when adding a string to his instrument. The uncertainty that Zacconi expressed about his Soprano involved its lowest string, so when it did have four, the lowest string would be different, i.e. a fifth lower, at c.

A stringed-instrument technologist knows that with gut strings not wound with metal, the longer the string stop is with a given tuning, the brighter all strings sound (i.e. there are more harmonics above the fundamental). The limit in how long it can get is when the top string breaks too often. The projection of brightness is particularly needed for a dance-band treble instrument. Strain in supporting an instrument, or in finger-stretch for stopping, can lead musicians to reduce the string stops of larger instruments (at a cost in brightness), but the treble instrument does not not have either of these problems, and so it tends to be as long as it can get for a tolerable breaking rate of the highest string. Thus a treble with an a’ top string would tend to be much larger than a treble with an e” top string (about half-again as big for the same top-string breaking rate). Boyden’s assumption that they are the same instrument cannot be accepted.

Next, Boyden quotes from the ‘violin family’ article by Hayes in Grove’s Dictionary (1954). Hayes wrote the following: ‘The tunings of the viole da braccio, first for three and later for four strings, were: soprano: c,g,d’,a’, tenor: F,c,g,d’ and bass: BBb, F,c,g, (with three stringed versions omitting the lowest string). Not until the late 16th century does the violino, tuned to g,d’,a’,e”, appear as a separate instrument that was later added to the ‘family’. Monteverdi’s violino piccolo alla Francese was tuned to e’,g”,d”,a”. The family began with an instrument of alto pitch.

The response of Boyden is ‘This passage could hardly be more incorrect. The discant is not the e-tuning but the g-tuning, if we may believe the theorists cited above’. Hayes believed them, and correctly summarised the nominal Italian tunings reported. Boyden’s attempt to force all tunings into the same mould doesn’t work. Then, ‘Hayes’s comment regarding the violino piccolo can hardly bear close examination in light of what has already been said’. What has already been said by Boyden on the subject ‘can hardly bear close examination’, but his conclusion could well be right, in which case Hayes’s only error was to assume that there was a fourth string. Hayes is next properly criticised for claiming that the alto member of the set of viole da braccio was the first to develop, since there is no evidence for other than the whole set appearing together.

Following is the claim that ‘it is clear from the theorists that the normal soprano (discant) of the viole da braccio used the g-tuning and was therefore the violin. This conclusion is corroborated time and again from other sources including the music itself. The evidence of Praetorius, taken as a whole, is overwhelming’. The supporting evidence is that Praetorius includes the violino in the category of viole da braccio (unsurprising since it is a viola, and it is played da braccio) and it is called the ‘proper discant fiddle’. This is consistent with the baroque evidence, and Boyden forces it to be consistent with the non-French 16th century evidence by insisting that the same lowest string (and not the same highest string) characterised 3-string and 4-string versions of the same treble instrument.

Boyden’s theory is faulty, and we need to explain how the fiddles evolved from the 16th century, as
well as the clear distinction between the violino and any member of the sets of viole da braccio made by all of the evidence, especially that of Zacconi, Vincentino, Monteverdi (in Orfeo) and Cerone.

Praetorius’s fiddles include two boat-shaped 3-string little ones which were not normal members of sets, and two discant ones, a small one and the ‘proper’ one, apparently the discants of sets. The proper one (violino) had the same tuning as the dessus of the earlier French sets, and the small one has the same tuning as the soprano of the earlier Italian sets, but an octave higher. If one takes seriously both the apparent sizes of instruments in pictures and the relationships between sizes and string pitches as illustrated by Praetorius, the 16th century Italian fiddles did sound an octave higher than their nominal (reading) pitches, just like Monteverdi’s violini piccoli. The tunings of the 16th century viole da braccio would then have been: Soprano: \((c')g'd''e''\), Contralto and Tenor: \((f)c'g'd''\) and Bass: \(Bbfc'g'\).

In the 16th century, the plural term violini was sometimes used, and it is clear from the context that the term referred then to the whole set of viole da braccio (this usage, as an alternative general term distinguishing between the small and the large viole, is occasionally also found in the baroque). All the evidence of the singular il violino in the 16th century related to a soloistic instrument that played in various ensembles that did not include any other da braccio instruments. From its tuning, it apparently derived from the French dessus de violon. Hayes was right about the violino’s independence from the sets of viole da braccio when it appeared late in the 16th century.

In this paper, Boyden also attempts to show that his ‘conclusion is inevitable in musical usage’. He first cites Rossi’s Sinfonie e gagliarde (1607) for two viole and continuo. Of the violo parts, he says ‘the music requires the register of the highest (e) string of the violin’. Alternatives that would fit the range (and normal terminology of the time) that he did not consider are treble viole da gamba with \(d''\) top strings and contralto viole da braccio with \(d''\) top strings playing at pitch. The ambiguity of the term viole was probably deliberate, to denote any type, including the violino.

The second is Monteverdi’s Orfeo (1607), which he claims ‘is prima facie evidence’. ‘The heading of the score lists 10 viole da braccio but no violins. In the course of the opera, however, Monteverdi specifically calls for the violino, ... and the parts are in the first-position violin register, including passages on the highest string. This can only mean that the violins proper are included among the 10 viole da braccio, and they are the discant members, since none go higher except the Violini piccoli alla Francese, which are listed separately’.

What Boyden misses here is the strong probability that violini were played by violino players and viole da braccio were played by viola da braccio players. Thus if one acquired two players of the violino piccolo alla Francese (which were violini and in the score list heading), you automatically acquired two violino players. After the piccoli was used, the change in instrument for each player was signalled by the specification violini ordinarji da braccio, after which only violini were specified. The top viola da braccio part, having a similar range as the violino part, would have been played on a contralto with a \(d''\) top string.

This set of viole da braccio provides us with the transitional stage in the development of the viole da braccio needed to historically connect the 16th century set with the baroque fiddle band. Orfeo seems to be the first time that the viole da braccio were accepted for playing ‘serious’ music supported by the Italian nobility. They played at pitch (not an octave higher) and stopped using the original soprano member. The ranges of the parts suggests that they dropped the pitch of the original tenor by a fourth, and dropped the pitch of the original bass by a minor third. The set would then have been treble (originally contralto): \(f,c',g',d''\), tenor: \(c,g,d',a'\) and bass: \(G,d,a,e\), with each member tuned a fourth away from the next. In the next transition, to become the Italian baroque string band, the former contralto again became the contralto by dropping in pitch to be the same as the tenor, making way for the violino to play treble as it joined up with the viole da braccio family.

Zacconi on the violino and the viole da braccio

Boyden reproduces the relevant passage on the tunings of the viole da braccio in Zacconi’s book, with a translation. That translation is:

But the viole da braccio, because they are tuned in the order of the violin, and the violin is tuned
by fifths, conform to this order, first to tune the lowest string of the soprano in unison with the soprano string of the Bass, and the soprano string of the Basso has to be in [unison with] the second string of the Tenor amongst the highest strings: in such a way that the Tenor with all the other violas of the middle will form the range a' - F beyond the beginning of the [Guidonian] hand, and the Bass because it is tuned to the lowest note that can be played by the soprano (speaking of the ordinary viole) will have the range from BBb - d'.

It is clear that the ranges are what can be fingered in first position, and give the tunings of the tenor and bass as F, e, g, d' and BBb, F, e, g respectively. This is consistent with the first string g of the bass tuned to the second of the tenor. That string is also tuned to the lowest string of the ordinary soprano. That tuning would apparently be different with the extra-ordinary soprano, and coupled with the range of the soprano not being given, this strongly suggests that the soprano could have either 3 strings, like other reports of the soprano viola da braccio, or 4 strings, as was becoming fashionable with the tenor. The possibility of the ordinary soprano having 4 strings is the only one considered by Boyden, but for reasons given before, this is very unlikely, leaving three as the most probable choice.

From his assumption that the soprano had 4 strings, Boyden deduces that its tuning is the same as the violino. From this, and equating the Zacconi's ordinary viola here with the ordinary violino in Monteverdi's Orfeo, he states that 'there can be no doubt that in Zacconi the usual soprano viola da braccio...is the violin; and he makes this doubly certain by giving the written notes g - b'', for the range of the violini'. Boyden's reasoning here is remarkably illogical. He doesn't address the important question of: if what he says is true, what kept Zacconi from saying so when he had every reason and opportunity to say it?

In his discussion of the violino, Zacconi wrote that it had a range of 17 diatonic notes, and the range extended from c to a''. This is inconsistent because the notes given cover a range of 20 notes. Most assume that the range upwards from c represents another and much less usual type of violino. Zacconi followed this with a diagram showing a range of 17 notes from g to b''. This is clearly the range covered by the normal violin tuning g, d', a', e'' in first position. There is octave ambiguity in the pitches of high notes expressed in hexachord names (as Zacconi did), so Boyden can justify assuming the range of the other violino to be from c to a', or 13 notes. But then he makes the astonishing assumption that this represents the open-string range, leading to a tuning of c, g, d', a', and claims that this tuning 'is explicit in Zacconi's text'!

This cannot be right because Zacconi always discussed fingered range, and never open-string range. Boyden's complaints of Zacconi's 'inconsistency and confusion' has more to do with the fit of his hypotheses with Zacconi's evidence that with that evidence itself. To fill a 13 note fingered range (implying tuning from c to d') that other violino would have had three strings tuned in fifths. If it had a 20 note fingered range (implying tuning from c to d''), it could either have had four strings with sixths between strings (with all notes but no redundancy when fingering in first position), or five strings with 3 fifths and a fourth between strings.

In any case, it would have been the size of a contralto or tenor viole da braccio. Some kind of violino of that size is required to explain the range of the violino part in Giovanni Gabrielli's Sonata Pian e Forte (1597), that goes below g. Banchieri (1609) gave the only other report of a violino of this size, and the tuning he gave was, interestingly, in 2 fifths and a fourth (d, g, d', a'). After the violino and the viole da braccio joined forces, there were no more incursions of the violino into viole da braccio territory.

Conclusion

The simplicity of Boyden's conclusions and his language of commitment are very convincing to those who judge scholarly papers by how comfortably the conclusions add to what they think they already know, and don't critically examine how reasonably and comprehensively these conclusions explain the evidence. This unfortunately includes the vast majority of readers. The few who will take the time to do that critical examination will see that his conclusions are no more than speculations that do not even deserve the status of a valid historical theory, since there is apparently contrary evidence that is not explained. It is very much worth exploring other theories, like the alternatives given above.
The Hieronymus Albrecht Hass Clavichord in the Bate Collection of Historical Instruments, Faculty of Music, University of Oxford: Restoration Report

The Bate Collection Hass clavichord is inscribed on the soundboard: *Hieronym Albr: Hass / In Hambg. Anno. 1743.* It is probably the example shown by J. B. Cramer & Co. at the International Inventions Exhibition, London, in 1885. By 1904 it was in Oxford, in the Taphouse Collection, and shortly afterwards it was referred to in the *Musical Times.* It is not known precisely when it was deposited on permanent loan to the Faculty of Music, but the instrument was restored around 1948 or 1949 by Arnold Dolmetsch Ltd., and this may have been in immediate anticipation, or as a consequence, of the change of location. It is understood that chiefly C. Leslie C. Ward, Arnold Dolmetsch's son-in-law, did the work of restoration. The instrument was certainly at the Music Faculty when the late Frederick Sternfeld arrived at the University in 1956. In 1992 it was bought by the Bate Collection with the assistance of the National Art Collections Fund, the National Heritage Memorial Fund, the Friends of the Bate Collection and several individuals.

The instrument is typical of the five-octave clavichords made by the Hass family in the middle years of the eighteenth-century. The compass is FF to f', unfretted except for d#"e", with 22 octave strings in the bass (FF to d). The 14 lowest notes are double-pinned at the bridge. The case is of pine, now painted black, with red lacquer on the visible inner surfaces and upper edges of the walls, on the belly rail and toolbox walls. The mouldings cut into the upper edge of the case walls, and about the soundboard edge, are gilded. This internal decoration is apparently original. An unusual feature is the substantial pine brace that crosses the keywell diagonally, behind the balance rail, stiffening the baseboard. The underside of the lid has a painting of Apollo and the Muses. The exterior of the case has evidently been repainted, apparently before the twentieth century. I am grateful to Ann and Peter Mactaggart for allowing me to quote here the findings of a preliminary investigation of the existing paintwork (see Appendix), which suggest that the original exterior decoration may have been more ornate. The keys are of lime, with wave-carved sharp levers, and guide-slips of horn. The natural keys are covered with ivory, decorated with two pairs of parallel grooves filled with red pigment, and have ebony arcades. The sharps are of a close-grained, black-stained hardwood, perhaps pear, and are capped with ivory and ebony in a chevron pattern. The keywell is veneered in olivewood, and the toolbox lid, to the left of the keyboard, is veneered in tortoiseshell, olive and ivory.

The principal accretions are an elegant music rack, apparently late nineteenth- or early twentieth-century work, attached to the rear of the nameboard, and a rotating prop to support the divided lid, screwed centrally to the rear of the case.

Until about 1984 the clavichord was kept tuned at about a' = 409 Hz, and was occasionally played by the students of the University and others. The strings were then slackened off, reflecting concern about distortion of the case and deterioration of the soundboard. Some of the earlier soundboard repairs had failed, and cracks were thought to be opening. The keyboard movement was sloppy, and consequently noisy, and the stringing and other musically significant aspects of the setting up of the instrument were at variance with 18th century practice.

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2 I am grateful to Jeremy Montagu for this information.
3 *The Musical Times* No. 45, 1906.
4 Andrew Douglas, who then worked for Dolmetsch, provided the information regarding the date of the restoration. According to Boalch 3, p. 369, the work was done 'pre-[Second World]-war', but on what authority is not stated.
5 It is noteworthy that the lid hinges and lock are now secured by domed brass screws, rather than the nails we would expect. It seems likely that they were removed when the case was repainted and replaced afterwards.
6 The slips are not of iron, as stated in Boalch 3, p. 369.
The restoration described here was undertaken under my supervision between April and July 1989 at the London College of Furniture. The students involved in the work were Peter Bell, Julia Morley and Dominic Parker. The objectives of the restoration, arrived at in discussion with the Curator, were to return the instrument to playing condition, reproducing the presumed 18th-century playing characteristics as faithfully as was consistent with the retention of its original fabric; and the removal, where judged to be appropriate, of anachronistic accretions. Musically inessential missing parts were not reconstructed.

In the following account, the instrument is described as it was in 1989. Where this state evidently differed from the original, this is noted. Features of the instrument not pertinent to the 1989 restoration are not noted here. Access to the interior of the instrument during the restoration permitted internal details to be noted. A separate photographic record of the interior of the instrument was made, and a copy is lodged at the Bate Collection. Right and left are noted here as seen by the player.

**Structural repairs**

The baseboard is of two substantial boards of pine, now slightly cupped, each with a central chain of minor splits. Repairs made by Dolmetsch involved cutting a large rectangular hole in the baseboard in order to gain access to the underside of the soundboard. This measured approximately 355mm long by 283mm wide at the right-hand end (278mm at the left), the latter representing about 53% of the total width of the baseboard, which must greatly have reduced its stiffness. The hole was covered with a protruding slab of thick plywood, secured by screws from beneath. Two cracks extended from the right-hand end of the instrument to the hole (141mm and 339mm from the rear edge), separating from the rest of the baseboard the intermediate part, to which the wrest plank support block was originally glued. Since it was intended after restoration to subject the instrument to approximately its original playing tension, it was decided that as much strength as possible should be restored to the baseboard. The egregious plywood slab was inadequate in this respect, and it was decided to replace it with an inserted plug of pine, of the original thickness. Different ways of fitting the new piece were considered. A glued butt joint, endgrain to endgrain, would have been hopelessly weak, and the alternatives involved either the sacrifice of more original wood or the use of a protruding flange. After photographing the underside of the baseboard, slight irregularities in the edges of the rectangular hole were evened up, and a lap joint was formed all round it, by routing away the wood of the baseboard to half its thickness, extending approximately 57mm lengthways (left to right), and 23mm from front to back. This was judged to be a reasonable compromise, allowing good continuity of strength to be established along the length of the instrument, while avoiding needless destruction of much more of the already seriously violated baseboard.

The isolated, central-right portion of the baseboard (to which one end of the new plug was to be fixed) was secured, regluing it to the wrest plank support block and case side above (it was otherwise held only by the dowels passing through the baseboard and into the case wall), and linking it to the surrounding wood of the baseboard by pine shims penetrating the full thickness of the board. The shrinkage cracks in the rest of the baseboard, adequately stabilised by the superstructure, were left untouched.

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7 The London College of Furniture subsequently became part of the City of London Polytechnic, now London Guildhall University.
8 We are indebted to Jeremy Montagu, then the Curator of the Bate Collection, for his encouragement, advice and co-operation throughout the restoration.
9 It is my intention to publish these details separately.
10 The baseboard is 534mm wide at the right end, reducing to 532mm at the left end of the Dolmetsch hole, where shrinkage is not constrained by the opposed grain direction of the end wall of the case, or by the belly rail.
In order to achieve a reasonably close match of timber type, and to minimise problems of shrinkage, the new plug was made of old wood (from a disassembled mid-19th-century organ\textsuperscript{11}), two pieces being selected and jointed to give an acceptable match of grain. The plug was planed to a precise fit, very slightly tapering at the upper edge to ease its insertion. Once the internal work of repairing the soundboard and measuring and photographing the interior was complete, the endgrain surfaces were sized with thin hide glue, the wood of the plug was warmed (sufficiently to shrink it very slightly across the grain, to avoid damage during insertion), glue was applied, and the plug gently tapped into place. Initially protruding by about 0.5mm, the plug was cross-planed and scraped almost flush with the surrounding surface of the baseboard, taking care to stop short of marking the original wood.\textsuperscript{12} It is recommended that, should there ever be a need to remove it, the plug should carefully be sawn out, a little within the outline of the original hole, and that the remaining wood be carefully pared away from inside, the glue having been softened.\textsuperscript{13}

The bass hitchpin rail / 4-foot wrest plank has parted slightly from the adjacent case wall, particularly in the middle. However, it is well supported at the ends, and it was decided not to force the rail and wall together for fear of stressing the wood and straining secure joints elsewhere.

The lid of the instrument, of pine, with substantial battens at the ends to keep it flat, is divided for its full length, immediately behind the keyboard. The underside of the lid bears a painting, apparently original, of Apollo and the Muses. Several factors indicate that the separation of the lid into two is not original, and that it was skilfully done at a later date to allow the instrument to be played with the main part closed. The original staple for the lid cord is on the main part, just below the division into two, and since there would have been no way of displaying the lid as a whole (other than by resting the flap against a wall, stressing the hinges), the painting is meaninglessly truncated if the front flap of the lid hangs back. The present, swivelling lid-prop, screwed to the rear of the instrument, is plainly modern, and may date from the Dolmetsch restoration. The small butt hinges which link the two parts of the lid are of a modern kind, fastened with machine-made screws rather than the brass nails used elsewhere, and the dull red paint on these edges of the lid, revealed when the flap is turned back, differs from that elsewhere on the instrument. It is clear from other instruments that Hass normally made lids of one piece.

The lid flap was removed, and several splits about the small butt hinges were glued. The lid cord received with the instrument (a length of twin-core rubber- and cotton-covered electrical flex) was removed. Although the existing lid-prop is out of keeping with the instrument, it has been retained, and it is recommended, in view of the frailty of the wood surrounding the cord staple and the butt hinges, that it is used when the lid is raised. For this reason no new cord was fitted.

Soundboard

The soundboard had been extensively shimmed, most of the repairs being reinforced by gluing broad bands of parchment to the underside. The upper surface was thickly coated with a spirit-soluble shellac varnish,\textsuperscript{14} presumably applied by Dolmetsch to even up the appearance after shimming. This extended more thinly over the bridge also. Raised rectangular fields of thicker varnish protected the maker's name and the gauge markings by the wrestpin holes. (A distinct step in the varnish surface indicated that the surrounding wood had been masked as these areas were sealed, the whole, including the bridges, being varnished over afterwards.)

\textsuperscript{11} Lest any anxiety attaches to the source of this material, I will note that the instrument from which it came, from Wimbledon, had been dismantled several years earlier, and that the wood would have been burned had we not salvaged it.

\textsuperscript{12} The plug now extends from 103 to 573mm from the right end of the baseboard. Its forward edge ranges from 95mm (right) to 100mm (left) from the front edge of the board, and its rear edge from 90mm (right) to 95 (left) from the rear of the board.

\textsuperscript{13} Photographs of the received and rebated states of the baseboard, now lodged with the instrument, serve to confirm the measurements of the Dolmetsch hole given above.

\textsuperscript{14} This resembled the 'white hard' varnish traditionally used to seal piano soundboards in Britain.
The varnish was found to be soluble in ethanol, a small trial area behind the wrest pins having been cleaned with a cotton pad. This cleaning was cautiously extended over a few of the gauge markings, whose ink remained, unscathed. It was decided eventually to clean the whole soundboard, but initially to leave the varnish as a protective layer, while the cracks were repaired.

Of the existing repairs, a wide shim running the full width of the soundboard, 263mm from the front, was found to be secure, and was left. Like most of the other Dolmetsch repairs this had been reinforced with a broad band of parchment glued to the underside of the soundboard. Some of the other shims, with wide, rectangular ends, seemed to have been inserted in such a way as to have contributed to the further extension of the cracks they filled. Where appropriate these were removed and replaced, refitting them carefully so that they could be inserted with a minimum of force. Other cracks were shimmed or, where narrow, simply glued. The practice used in the earlier restoration of reinforcing the repairs with parchment was not adopted. The heavy varnish layer served to protect the soundboard as the new shims were trimmed virtually flush with its surface, and served to indicate when to stop trimming. In discussion with the curator it was decided not to attempt further to disguise the inserted material by tinting or other treatment. The shims are thus unashamedly evident, and the old and new repairs can be distinguished. Most of the remaining varnish was removed by the repeated, cautious use of ethanol on cotton pads. One effect of this was to wash small amounts of the dissolved varnish into the upper surface of the porous new shims, thus sealing them and ameliorating slightly their whiteness. The varnish had been applied so liberally as to allow it to run down the vertical face of the belly rail. As this is painted red, and the paint would almost certainly have been affected by the ethanol, this varnish residue was left undisturbed.

The 8-ft bridge, of beech, has a slightly open crack running diagonally across it, at the most vulnerable point in the treble, where the grain is shortest. This is apparently securely glued, and the grain orientation is such that several bridge pins reinforce the link between the two parts of the bridge. This and two existing patches of beech, neatly inserted into the crown of the straight, tenor part of the bridge, were left untouched. The alto part of the bridge has become partly detached from the soundboard, apparently before the soundboard was varnished over. Though there is still a slight gap and some staining at its forward edge, the bridge is securely glued, and it was left as it was.

**Balance rail**

The balance pins (2.5-mm diameter iron), were slightly rusted, and were cleaned with fine steel wool. They are slightly pitted. In a few cases, where the surface that comes into contact with the keys was more severely corroded (causing abrasion as the keys move about them), they were lightly scraped with a steel dental tool.

The original fulcra for the keylevers consisted, as is normal in instruments of the Hamburg School, of two cords running the full width of the keyboard, in front of the balance pins, one for the naturals and one for the sharps. These had been removed and replaced, in the Dolmetsch restoration if not before, with circular felt and paper washers. The ends of the cords (about 2mm in diameter) remained buried in vertical holes in the balance rail, cut flush with the surface, and anchored by cylindrical dowels. Traces of glue on the balance rail bear the imprint of the original cords, confirming that the cords were lightly glued.

15 The new shims were inserted from above, and taper only very slightly from top to bottom. Their lower edges were left very slightly proud, so as not to avoid tool contact with the original wood of the soundboard.

16 The possible effects of ethanol on the wood of the soundboard, and on the glue joints were – and remain – of concern to us. Little of relevance could be found in the conservation literature. Some preliminary experiments at the time, using ethanol much more liberally than on the soundboard, suggested that virtually nothing was leached from the wood by solution, and that the strength of recently glued joints in thin plates of spruce was unimpaired.

17 Any alternative repair, perhaps better able to communicate energy along the bridge, would have entailed the substitution of some new wood. From the load bearing point of view, the soundboard is, in any case, well supported here by the belly rail and the larger of the two diagonal bars that run parallel to the straight part of the bridge.
glued in place to anchor them between some of the balance pins, and that they ran immediately in front of the lines of pins.  

The felt washers were judged to be too absorbent of the energy of the string, and it was decided to reinstate something closer to the original arrangement. The ends of the original cords were partly drilled away and the remains teased out of the holes. Care was taken not to enlarge the holes (a drill smaller than the hole was used), and the original dowels were left. Slightly thinner cords (approx. 1.6 mm) were introduced into the original holes and secured, without glue, with fine wedges of soft wood.  

Except for the removal of the ends of the cords, all features of the original fixing are preserved. The new cords were glued elsewhere than in the original places, so as not to obscure the traces of the original glue.

It is noteworthy that the 1756 Gerlach clavichord in Trondheim which preserves many apparently original features lost from most extant Hamburg clavichords, has a narrow band of exceptionally fine woollen cloth passing over each of the cords. There is no positive indication that the Hass had this feature, and it was not added in the restoration.

**Keyboard**

The keyboard is of the most refined workmanship, and is well preserved. The ivory naturals (their incised lines filled with a dark red colour) and the ebony and ivory chevron-topped sharps were cleaned with a cloth slightly moistened with a very dilute detergent solution. The b² keyhead rubbed slightly against its neighbour, and was straightened by localised steaming between the nameboard line and the balance pin mortice.

Hass’s balance pin mortices are of a particularly sophisticated kind; drilled, broached (apparently using a tapered, endgrain-compressing punch), and then relieved at the sides (presumably with some sort of convex-faced chisel) so that the balance pin comes into contact with the wood only near the top and bottom of the keylevers, thereby reducing friction.

The mortices had generally worn lose about the balance-pins, giving rise to undue noise. To reduce this the surrounding wood was swelled slightly by wetting it and vaporising the water. Small wicks of rolled porous paper were put into the holes, and were moistened with water from a dropper. Once the water had had time to pass into the wood, a cylindrical metal rod, a little smaller than the holes, was heated (to above boiling point but below scorching temperature) and briefly stroked back and forth in the mortices. The effect of the sudden expansion of the water (as that in the surface layer of the wood vaporises) is to puff up the wood, tightening the key about the balance pin. Once the wood had dried, levers that were then too tight to return freely were exercised by rotating them firmly and repeatedly about a pin (thereby burningish the surface and recompressing the wood in a controlled way), or by inserting a very slightly larger pin into the upper part of the mortise.

Some keys (f, bflat and d”) had suffered more serious compression about their mortices, and these were shimmed by gluing slips of lime wood to the upper 2mm or so of either side of each mortice. The surfaces were lightly scraped clean in preparation, and the shims temporarily held in place by waxed wedges, pressed between them in the mortice. The shims were then trimmed until the key was just free

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18 These glue traces were photographed in oblique light.
19 Some of this fibrous material was preserved, now lodged with the instrument, and might be studied.
20 These wedges were left slightly proud of the balance rail, so it should be possible to extract them if this is thought to be necessary in the future.
21 Ringve Museum, Trondheim, RMT 75/15.
22 I am grateful to G. Grant O’Brien for showing this feature to me while the Gerlach instrument was in Edinburgh in 1989. I have not seen this refinement elsewhere. It might be expected to have further quietened the movement of the keys, and it would be interesting to know of any other examples of it.
23 In this instance, the key was simply flexed slightly between the two hands while being heated, and left to settle without constraint. In more serious cases of distortion, a purpose-made clamp, able to exert gentle force to the keylever (adjustable by wedges) has been found helpful in holding keys as they are straightened.
enough to return. These forms of repair were chosen in preference to the historically widespread practice of forcing small wedges into slits cut to either side of the mortice (pressing the walls of the mortice inwards), as they come closer to the ideal of reversibility.

The guide slips at the tails of the keys are beautifully made of horn. The shank that enters the key tapers in both height and thickness. They fit precisely into a neat, tapering mortice, apparently formed by driving a specially formed broaching tool into the endgrain of the key. The protruding blades, ending in a semicircular profile, have mostly worn into a hook shape, this wear affording an indication of the differing rates of use of the keys.

One slip was completely broken off, others were crude replacements and others were so frail and worn as to be unserviceable. Most of the slips are now significantly loose in the rack - looser, and consequently noisier, than one would expect of a newly set up instrument - but it was decided to replace only those which were missing or seriously impaired. They will continue to wear away if the instrument is played. It would be possible, if the instrument were to be played a great deal, to remove all the slips (they are not glued), preserving them in order, and to replace them with new, thicker ones, more precisely fitted to the mortices.

Tangents

The tangents are of brass, of almost uniform thickness (0.8 to 0.9 mm) throughout the compass. Comparison with those of other Hass instruments suggests that they are original. The condition of the tops of the tangents varies according to the frequency with which the notes have been sounded. At the extremes of the compass they are flat, but in the middle of the keyboard a central dip, caused by wear, tends to draw the two strings together as the tangent edge raises them. This can lead to the strings vibrating together in fortissimo playing - particularly the long and easily displaced ones in the tenor. The problem does not arise in the treble where the shorter strings are less readily displaced. In a modern instrument the tangent tops ideally would be levelled, but this has not been done.

Rack

The slots in the rack (beech, capped with walnut) were cleared of fluff and their walls lightly burnished with a smooth hardwood stick.

Cloth and touch

The back touch rail was covered with a single strip of green, carpet-like material, apparently synthetic. The fall of the keys was noisy. This was removed, and replaced initially with three strips of the same green woollen cloth as was used for the listing. It was found that this uniform thickness of touch cloth gave an improbably uneven depth of touch, deep in the bass and very shallow in the treble. It was decided to arrive at a satisfactory progression of touch depth, and, consequently, of keyfront height, by adjusting the cloth on the rear rail to two full thicknesses in the treble (from d' upwards), progressing tolerably evenly to three thicknesses in the alto by means of additional paper packing. Some unevenness of keyfront heights remained, owing to minor distortion of individual keylevers. This was compensated for by using a few paper washers about the balance pins, above the cord.

24 The replacements are distinguishable by their squarer outline and more robust cross-section. Those removed are labelled and lodged with the instrument.

25 Tangent measurements:

<table>
<thead>
<tr>
<th>Notes</th>
<th>Width at top</th>
<th>width at key</th>
<th>height above key</th>
<th>thickness at key</th>
<th>thickness at top</th>
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<tr>
<td>FF-F</td>
<td>7.5 (6.3)</td>
<td>4.3 (3.3)</td>
<td>21.3 (21.0)</td>
<td>0.9 (0.9)</td>
<td>0.65 (0.7)</td>
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<td>F#-e</td>
<td>5.9 (5.25)</td>
<td>2.8 (3.0)</td>
<td>21.0 (20.5)</td>
<td>0.9 (0.9)</td>
<td>0.6 (0.6)</td>
</tr>
<tr>
<td>g#-g2</td>
<td>5.1 (4.6)</td>
<td>2.7 (2.3)</td>
<td>21.1 (20.9)</td>
<td>0.9 (0.8)</td>
<td>0.6 (0.6)</td>
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<tr>
<td>a2-c3</td>
<td>4.5 (4.0)</td>
<td>2.1 (2.0)</td>
<td>21.9 (21.2)</td>
<td>0.8 (0.75)</td>
<td>0.6 (0.60)</td>
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</table>

26 There is no sign that the lower tangents have been shortened, either by driving them further into the keys or refashioning their tops, but it is possible that several factors have contributed to this unevenness, including the slight lowering of the balance rail fulcrum, and movement of the string band resulting from twisting of the case.
Stringing

There is a unison pair of strings for each note, the lowest 22 notes having additionally a single 4-ft string. As is normal in clavichords of the Hamburg school, the 4-ft strings are hitched to a rail running diagonally under the soundboard; they pass over their own straight 4-ft bridge (several mm below the 8-ft strings, and almost parallel with the 4-ft hitchpin rail), and thence directly to slender wrist pins placed amongst the 8-ft hitchpins, at the left end of the case.

The gauge of each pair of 8-ft strings is individually marked in ink by the wrist pins, alternately with the note names (expressed in the letterforms of German keyboard tablature). The gauge numbers, ranging from 7 for the two highest courses to 000 for the three lowest, correspond closely to those of similar Hass instruments. There is no indication as to whether red brass was or was not used in the bass. Some Hamburg clavichords may have used covered strings in the bass, but the fact that Hass's gauge numbering continues to the bottom note (suggesting the use of plain rather than covered wire), and the lack of any positive indication of overwinding, such as impressions on the crown of the bridge) led us not to use covered strings on the 1743 instrument.

The existing steel and brass strings were removed, and the instrument was restrung in Malcom Rose's yellow brass wire, according to G. Grant O'Brien's interpretation of the prevailing German gauge system. The 4-ft gauges used follow those marked on the soundboard of the broadly similarly scaled 1751 clavichord by Barthold Fritz, in the Victoria and Albert Museum. The patterns of loops and wrist-pin windings follow observed 18th-century practice, and the instructions of C.F.G. Thon (1817).

Neither the absolute diameters nor the rate of decrease in diameter of Rose's strings corresponds precisely to the eighteenth-century German scheme. The discrepancies between the old and new gauges are not large, and for the most part the German gauges were rounded in restringing to the next thinnest available modern gauge, changing gauges at the same points as the original. This results in a slight reduction in the overall load on the case, whose distortion is of concern, and was thought preferable to any alternative arrangement which moved the gauge-changes in order to give average tensions closer to the supposed original. As the modern wire increases in diameter more slowly than the original gauges, by the time German gauge 1 is reached (D# to F), the modern sequence is a whole gauge in arrears in relation to the original, so the four notes marked for gauge 2 (F# to A) were shared between two modern gauges (0.44 and 0.48mm). No audible disadvantage seems to result from this adjustment.

27 The Trondheim Gerlach continues the thicker gauge 6 to the top of the compass.
28 The Trondheim Gerlach retains the windings of old strings on its wrest pins. Those of the lowest eleven notes (half of those with 4-ft strings) are closely overwound with exceptionally fine wire, quite unlike the relatively coarse and open overwinding familiar from later square pianos. It is by no means certain that these strings are original, though they are certainly old.
29 G. G. O'Brien, 'Some principles of eighteenth-century stringing and their application' The Organ Yearbook 12, 1988, Table 2.
30 Victoria and Albert Museum, London, number 339 - 1882. Though the treble scalings are fairly close (1743 Hass c'' 289mm; 1751 Fritz 294mm) the match in 4-ft scaling is not as close as one might like. Because the Fritz ascends to a''\textsuperscript{1}, the layout of 4-ft bridge on the soundboard is all the more constrained, and the highest 4-ft strings are even longer than they are on the 1743 Hass. The 4-ft c of the Fritz, for example, is 652mm long, compared with 628 on the Hass. It is thus all the more likely that Fritz intended the higher 4-ft strings to be of iron, as suggested below for the Hass. The 8-ft unison c\textsuperscript{1} of the Fritz is only 567mm, compared with 578 in the Hass. (Though the treble strings of the Fritz are slightly longer than those of the Hass, perhaps indicating a small difference in the intended pitch standard, Hass's alto strings are the longer of the two).

# 8-ft Strings

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<th>Note</th>
<th>Sounding Length</th>
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Note: String B. Fritz Received German Diameter Length Gauge Diameter Diameter Used

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<tr>
<th>String</th>
<th>B. Fritz Gauge Number</th>
<th>Received Diameter [Dolmetsch]</th>
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<td>.471</td>
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</table>
The two highest of the 4-ft strings (c# and d), if of brass, are perilously stressed, even at a cautious pitch standard of a' = 392, and were found to be prone to breaking. At 581mm, the 4-ft d is appreciably longer than its 8-ft unison (d', of 515mm), indeed it is longer than the 8-ft c (578mm), and is much the highest-stressed string on the instrument. Iron strings of the same gauge as the 4-ft c on the Fritz were tried, and found to be satisfactory. It seems likely that the problem of making these strings short enough (the 4-ft bridge has to come very close to the belly rail in any case) led to the abandonment of the two or three highest 4-ft strings on later Hass clavichords, and to shortening of the higher of those remaining.

The received projecting heights of the wrest pins were approximately 31mm (8-ft) and 23mm (4-ft), and these were found to be convenient in restringing the instrument.

Alignment of the strings

The alignment of the 4-ft strings relative to the 8-ft, both vertically and laterally, is a delicate matter. If they don't lie within very narrow limits the sound suffers. The lateral spacing, set by the pinning of the bridges and the positioning of the 8-ft hitchpins and the 4-ft wrestpins, is largely built into the instrument, with a small margin of adjustment possible by ingenious listing. The vertical relationship of the horizontal plane of the 8-ft string band to the gently sloping plane of the 4-ft string band, which intersects it, is to a limited extent adjustable by careful winding of the 4-ft strings onto their wrest pins.

Vertical alignment of the strings: If the 4-ft strings lie much below the 8-ft at the tangent line, as they will if all the strings leave the bass hitchpin block at the same level, the tangent strikes the 4-ft strings in advance, making it impossible - even unavoidable - to sound only the 4-ft with a pianissimo attack. The level of the 4-ft strings is set principally by the height at which they leave their wrestpins. For the two planes formed by the 8-ft and 4-ft string bands to intersect at the tangent line (giving simultaneous contact with the tangent), the windings of the 4-ft strings must be a little above the hitchpin block. The lowest 4-ft strings (whose tangents are close to the wrestpins) must be wound almost down to the wood of the wrest plank, whilst the upper 4-ft strings, whose tangents and wrestpins are further apart, must leave their pins higher up. Due care was taken to wind the 4-ft strings and set their pins at the correct height. The need to keep them there must be borne in mind when tuning or replacing broken strings. The listing has a secondary effect upon the relative heights of the two string bands, and this is discussed later.

Lateral alignment of the strings: Each 4-ft string leaves its wrestpin approximately midway between the two 8-ft strings serving the same note, and there is every reason to suppose that the three strings were intended to pursue a parallel course to their bridges. On the 1743 instrument the lower 4-ft strings do lie within the 8-ft pairs, though closer to the front string, but the bridge pins of the upper 4-ft strings are appreciably forward of even the front 8-ft line, with the result that the 4-ft strings pass diagonally under the front 8-ft strings. For the highest 4-ft notes, d, c# and c (whose bridge pins are furthest to the left), the 4-ft string passes under the front 8-ft to the left of the tangent, with the result that the tangent strikes the 4-ft forward of both 8-ft strings, the entire sounding part of the 4-ft string being in front of the 8-ft pair. Below G# the 4-ft string passes under the front 8-ft to the right of the tangent, giving the normal 8-ft, 4-ft, 8-ft order of strings at the tangent. Most problematically, in the intervening

32 The difficulty of having to thread replacement strings through the listing makes broken strings more of an inconvenience on a clavichord than on a harpsichord, and it is likely that they were tolerated less.
33 The 1763 J. A. Hass in the Russell Collection, Edinburgh, for example, has only nineteen 4-ft strings. The highest of these (B) is 625mm long, compared with 649mm in the Hass.
34 The tenor end of the 4-ft bridge is too far forward on the soundboard for the upper 4-ft strings to run parallel with the 8-ft strings. The highest 4-ft bridge pin is close to the end of the bridge, but it is simply too far forward. Hass evidently took great care in setting out the position of the 8-ft bridge, and in ensuring that it was glued in the right place. The lower tips of several small locating pins (apparently of brass) extending from the bottom of the bridge, were visible, while the instrument was open, through corresponding 2mm holes in the soundboard. (These pins are quite distinct in appearance and purpose from the small black tacks Hass used to hold the bridge to the soundboard while it was glued.) The same kind of locating pins were not used for the 4-ft bridge. That other Hass instruments examined do not have this curious feature suggests that Hass failed to lay out the bridge positions carefully enough, or that the bridge slipped while being glued in place.
group of notes, A, B flat, B, the point of intersection of the 4-ft and front 8-ft strings coincides with the tangent. The rising tangent strikes first the 4-ft string, which itself imparts energy to the front 8-ft. As the tangent continues to rise it strikes the rear 8-ft independently, and then the 4-ft string is forced to one side or other of the front 8-ft which, suddenly released, hits the tangent with a stinging report. Additionally the notes F# to G# are troubled by buzzing due to proximity of the 4-ft and front 8-ft strings. Initial attempts were made to remedy the problem by weaving the listing so as to displace the offending 4-ft strings. These were less than dependably successful, and the solution adopted was to draw the 4-ft strings towards rear 8-ft by means of ligatures of cotton, hidden within the listing, passing around both the strings, and pulling the 4-ft clear of the front 8-ft.

Listing

The only listing present when the instrument was received was a single strip of felt, running more or less parallel to the line of tangents. This was not woven about the strings, but passed above them, pressed down in folds between the courses. This arrangement, in which the strings are not bound together, allows the maximum possible displacement of the strings by the tangents, with the result that pitch is dangerously unstable. In the Hass, the area between the rack and the tangents is wide: the non-speaking afterlengths of the strings, to the left of the tangents, are relatively long. The only internal evidence of listing offered by the instrument is a single anchorage pin, bent acutely to the right (away from the tangents) in the rear hitchpin rail, 55mm to the left of the highest tangent. Thus we know the distance from the tangents to the start of the listing on the highest few courses only. The available evidence indicates that later German clavichords were listed with a close-woven mesh of cloth strips, perpendicular to the strings, and extending fairly close to the tangents. C.F.G. Thon (1817), writing towards the end of the clavichord's heyday, gives by far the most detailed historical account. He specifies that the cloth strips should be a small quarter or a large eighth of an inch wide; that they be closely woven at right angles to the strings, over one course and under the next, in regular alternation; that they be neither too loose (letting them slide about, and impoverishing the damping) nor too tight (displacing the strings, pressing them together and thereby hindering the sound); and that at their closest they should be a good inch (einen guten zoll) along the string from the tangent. This description tallies closely with surviving listing found on some late Scandinavian clavichords. The only significant detail Thon fails to clarify is whether he intends the cloth to extend right back to the face of the rack, or even beyond it. A green woollen cloth was chosen, thin enough to pass easily between the courses without displacing the strings too much, and thick and soft enough to form an efficient, energy-absorbing web. It was cut with the weave, to give neat edges, with a minimum of stray fibres even after being repeatedly pulled between the strings.

Appendix: The Paintwork of the Case of the Clavichord

Ann and Peter Mactaggart undertook a preliminary examination of the paintwork of the clavichord in 1981. It was hoped at the time that a more detailed examination would be possible, but I am very grateful to Peter Mactaggart for allowing me to quote from his report (in a letter of 30 August 1989) of their findings from eight paint samples.

1. Black paint from beneath the centre lid hinge on the rear wall of the case. 'The pigment was almost entirely composed of fine black particles - almost certainly lamp black. One or two almost isotropic yellow particles - probably ochre - were also observed.'

2. Black paint from the lid surface. 'The pigment was mostly similar fine black particles, but more almost isotropic yellow particles were noticed as well as a few which were redder.'

3. Black paint from the lid flap. 'The sample was taken from a lumpy area which looked as if it might be composed of more than one layer. There was a little black, but the sample was mainly

_35_ Unless the design of a clavichord listed in this way is such that the distance from the tangents to the hitchpins is small, or the tension of the strings is very high, good intonation is virtually impossible.

_36_ Freely summarised after Brauchli's translation in _JAMIS_ 9.
composed of yellow iron oxide and included some quartz. (Quartz is frequently found in samples of yellow ochre). Two particles of gold leaf were noticed.

4. Black paint from the bottom of a dent in the main lid. 'The pigment was mainly finely divided black with a few particles of red and yellow iron oxide and one or two aggregates of Prussian blue. There were some particles of calcite, including a coccolith showing the calcite to be natural chalk or limestone.

5. Black paint from a crack in the moulding at the treble end of the case. 'Aggregates of black and a considerable quantity of yellow ochre, similar to that found in 2.'

6. Sample of the red paint which had offset from the bass edge of the case onto the lid. 'This was a mixture of vermilion and white lead. A particle of gold leaf and a little yellow ochre were also noticed. The pigment is unusual. The vermilion we have found on old painted objects has normally been either very finely divided 'wet process' vermilion, or the 'dry process' pigment composed mainly of parallel-sided particles with roughly fractured ends. These often have parallel striations and have straight extinction. The present sample includes, as well as some normal 'dry process' ones, a number of square or rectangular particles that showed symmetrical or nearly symmetrical extinction. There is nothing impossible about this as cinnabar can crystallise in prisms, rhombs or tablets, and I have found symmetrically extinguishing rectangular particles in wet process vermilion, but they are only a minute fraction of the size of those found in this sample. If similar particles were found on another part of the case, it might indicate that they were painted on the same occasion.'

7. Blue paint from the scroll work on the lid. 'The pigments were mainly Prussian blue mixed with lead white, but a few red and yellow iron oxides were also noticed along with a little calcite. There were a number of brown/black particles and a number of these could be identified as charcoal.'

8. Brown/orange paint from the scroll work on the inside of the lid. 'Mainly a mixture of charcoal, yellow ochre, orpiment, and vermilion. I noticed a few particles of a pink lake and some calcite.'

All the pigments that we found were available by 1743 and continued to be available well into, and probably until the end of, the nineteenth century.

The painting on the inside of the lid seems to be consistent, and the non-blue paint in the blue scroll work could easily have come from the background over which it was painted. The presence of apparently irrelevant pigments can be explained by the tendency for artists and craftsmen painters to include pigments from other areas merely because they use the same brush or mixing pots.

However the variations in the pigments on the black outside of the case cannot be explained in this way, and I very much doubt if the outer case decoration is original. One or two particles of yellow in a sample otherwise composed of black, might be explained by the desire to produce a rather greenish black, but in view of the locations of the samples I do not think that 'poor mixing' can be used to explain the two samples in which the proportions are almost reversed. It seems more likely that the yellow ochre came from either an earlier paint layer or, in view of the particles of gold leaf in 3 above, from an oil gold size which underlaid gold decoration in 3 and a gilded [baseboard] moulding in 5. The presence of the yellow ochre and the absence of gold leaf from the sample taken from the crack in the moulding can be explained by the fact that the gold size would have flowed into the crack, but the gold would have tended to bridge it. The variable quantities of red and yellow iron oxides (ochres) which occur in the outer black samples could also be explained if the background to the gold decoration had originally been a warm brown or brownish red and if this had been rubbed down before the case was painted black. (Natural ochres often include both red and yellow particles.) Hass's tortoiseshell and chinoiserie backgrounds come to mind, but those we have examined have been painted on a ground of vermilion and there is no indication that this was done here. However, those we have examined are from a later period and he may have changed his methods. I cannot remember just what the offset of red on the lid looked like, but that sounds more like a crude repaint than the sort of careful work we have found on other Hass cases that are clearly original. The fact that there is a similarly painted example may not mean very much as, even assuming that the decoration on the Brussels example is original, this redecoration could have been based on it.