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FOMRHI Quarterly

FELLOWSHIP of MAKERS and RESTORERS of HISTORICAL INSTRUMENTS

Bulletin no.18 January, 1980

A happy new year to well under 50% of the membership; the rest will receive their new year greetings rather late, when they get round to renewing their subscriptions! I hope that it is not the rise in the subscription rates that has caused a drop-out, rather than inertia causing a delay. We do try to hold the rates down but inflation defeats us as it does everyone else. There have been suggestions that we should put the subscription way up so that those of us who do the work could be paid for it, but I don't see any point in it myself; we wouldn't do the job any better if we were paid for it and that isn't the way a Fellowship like this should be run, to my mind. Anyway, if we did put the rates up to that level, I wouldn't be able to afford to be a member myself!

Members' List Supplement: I've had a couple of suggestions about this. One that it should be separate from FoMRHIQ so that it could be filed with the main list, the other that it should be in the middle of the issue so that it could be pulled out and filed with the main list, and also so you would always know whereit was in any issue if you didn't pull it out. Two problems with the first suggestion are that it would waste pages (and thus postal weight, which we have to watch carefully) unless it happened to be divisible by 4 pages, which we can never guarantee, and that it would probably cost extra because it would be a separate folding and stapling job. Putting it in the middle might be practicable, though pulling it out would again be a matter of the 4 page unit. I'll pass this on to Djilda and see what she thinks; certainly the more useful it is to you, the better, provided that it doesn't waste your money either in production or postage.

Lost Members: Thank you to several for Karl Baumann's address; nothing has come back yet, so presumably it arrived safely.* Malcolm Prior turned up, and the same applies. Nothing has come in for Philip Lord, though; doesn't anyone know of him or his whereabouts?

NEWS OF MEMBERS: Maish Weisman asks me to say that he and Michael Sprake have set up together in California in a joint lute and fretted instrument making activity. New address in Supplement herewith.

Peter Kempster (address in last Supplement) is an importer and seller of harp strings in South Australia.

Martin Jones is involved in running the Studium Musicae, an umbrella organisation for early music in Belgium, which sounds rather like our Early Music Network and us and BouwersKontakt combined. They are organising an Early Music Exhibition on the lines of the Horticultural Hall one next April 26th and 27th. Eph Segerman is co-ordinating the UK contributions, and Martin's address is in the last Supplement if you want to get in touch with him.

QUERIES: Don Barney asks how many people get answers when they write asking for information? He finds it a bit like listening to one side of an extremely interesting telephone conversation without ever getting the other side. It might be worth bearing in mind that while one member has asked the question, there are probably several who would find the answer useful, and sending me a copy of the reply. If it's more than three or four lines, please type it single spaced if you can, and send me the top copy and the enquirer the carbon. I had quite an interesting answer the other day, but it was double spaced and the carbon, so unless Djilda can get it typed, you won't see it; I haven't the time to retype it at the moment. Also, please don't just send the answer to me; if you do I have to send it on, and it takes less time for you to do

* I didn't send his FoMRHI because other stuff got returned. DS

your answer than it takes me to do the three or four mr that arrive here. But do please answer questions if you can; Don's fear, and mine too sometimes, is that I bung in the queries and nobody ever answers them.

One answer here, from Henk van Dijk:

Concerning the fear, George Bowden spoke about (15, p 8 -that all that water, comming from Comm. 173's-methode, might give a "raised grain" problem) to lessen, probably the best answere is: use timber with fibers parallel to the surface - no raised grain problem then.
What about when it's not, or you're not sure? Again there's a good answere: if you don't know a thing: have a try-out of your chosen methode on scrap and see with your own eyes (maybe not only with a good pair of glasses, but also with the help of a light, very low angled across the surface). But before looking, first a methode to invite a raising-grain is needed...
The following methode also is a start of a remedy. After sanding (flintpaper tends to loose its grit particles, who are able to make -not such musical-flutes, anyway.) moisten the surface with a wet rag and leave it a while. Then dry it with a hairdryer, close to the surface, so that the steam can reinforce the process of raising grain. The last step to take, is to take a ball of fine steel wool and whisking it against the protuding fibers (never across!), so that the loops of the steel wool can do their work...

COMMENTS on COMMS.: Geoff Mather suggests some comments in the past have been a bit rough and could "lower the tone of a publication and breed uneasiness instead of a general friendship and goodwill. This is a FELLOWSHIP we are engaged in and the established makers should help us beginners rather than knock us back." Worth bearing in mind, I think, though there is always the problem, when something is definitely wrong, of leaving it uncorrected to mislead others. However, when it's a matter of opinion, rather than fact (and more often than not, it is), a personal letter or a reasoned reply may be the answer. I must confess to being thankful that someof the comments I got in my last Comm were personal rather than public!

Incidentally, he tells me that the sketches with his Comm. herewith grossly exaggerate the deflection of the transverse bars so as to make it obvious.

FURTHER TO: Bull.17, p.3, Early Music Exhibition: Donald Garrod commented on the Catalogue, from which he was omitted, and this made me wonder how many of you besides myself were plagued with repeated phone calls trying to persuade us to take advertising space? I got fairly fed up with it; it wasn't just once, but again and again.

Bull.17, p.4, Ivory: Robert Gemmell Smith asks why "the very best players" should have the exclusive right to decadence? And asks what improvement if any does an ivory back give to a lute? He suggests holly as the traditional alternative, and perfectly adequate for stringings, and bone for nuts and such things, whre most of the plastic and resin substitutes are too chippy. He adds: "The only obstacle I can see against the elimination of ivory in musical instrument making is persuading our customers that it is really not necessary to use the stuff at all and that it si not clever to flash their money around at the expense of the elephant." See below for another recommendd substitute material.

Bull.17, p.4: Oils: Ture Bergstrom reminds me that the maker who recommended peanut oil at the Nürnberg Restorers Conference (I'm not naming him till he publishes himself on this), recommended boiled linseed oil for the outer surface and peanut oil for the inside. I'd forgotten this, and it could make a difference.

Bull.17, p.4, Book Prices: Don Barney says the Charles Ford book is available in America as a paperback already, and he paid $7.95 for his copy, just over half the hardback price and less than a quarter of the English hardback price. Neil Buckland, in Australia, paid $8.50 in Australian dollars (about £4.25) for my Med & Ren, whereas the price for my Bar & Class is about $25. Both were printed, bound, etc here and the Australian publisher paid £1.40 a copy for Med & Ren and £2.38 a copy for Bar & Class. Allowing for transport, wholesale and retail profits and so on, £4.25 seems reasonable as a profit on £1.40, if a bit on the high side, but £12.50 seems a hell of a jump on £2.38. And if the book only cost £1.40 (I don't see my publisher here giving away a loss), why did they have to charge £7.50 here? We are being ripped off by the book trade aren't we?

Bull.17, p.4, Tap-Tuning: Arthur Marshall suggests: "The old makers must have worked largely by instinct and a 'feel' for the materials they used since they had no knowledge of the precision measuring instruments and X-rays etc which we now use to evaluate their work. In which case each instrument they produced would differ slightly from its predecessors although the overall production would have some characteristics directly related to the individual craftsman. This is certainly true of the dozen or so viols I have made to date. Without templates, I find the bellies generally approximate to the same curvatures etc and using nothing more sophisticated than finger and thumb (plus eye) for thickness I find they give a similar pattern and intensity of transmitted light when held against the workshop window against direct sunlight. The finishing stages must inevitably remove variable amounts after final assembly which can make a nonsense of precision measurement and tuning before assembly but the end product is what the player has to use to make music and a belly which is 'lively' to feel before assembly will inevitably give rise to a responsive instrument when it is strung. I too have wondered whether our 'Museum Pieces' were the ones that didn't get played in case the fine decoration got damaged and in my limited experience of viols produced in the last decade I have seen a number displaying craftsmanship in decoration which I can admire and envy but which I would not like to have to play since they make far bigger demands on the player's technique than many less pretentious products."

Bull.17, p.5, Tuners: Ture Bergstrøm (sorry, I forgot the / at the foot of the previous page) wrote to recommend the Widener tuner which I mentioned on that page. Anyone from Europe, particularly Scandinavia, who is interested is welcome to get in touch with him. Address in the July Supplement.

Bull.17, p.7, Clavichord cum Harpsichord: Bengt von Matern says that he has made such an instrument, rather as a toy, with a single string and one jack which is shared by all the keys. The tangent touches the string, so defining its length, which is immediately plucked by the jack and one can then, with the bebung, have a harpsichord with vibrato. I told him that while I was in Stockholm, Cary Karp showed me a Swedish square piano with tangents as well as hammers, presumably for the same effect. If anyone else is looking for a harpsichord with vibrato, they may like to try this idea of Bengt's or my other suggestion to him, which is a downward bearing pressure bar behind the bridge, operated with a pedal, by which one could vibrato like the Japanese do on the koto after plucking the string.

Bull.17, p.8, Index to FoMEHIQ: Geoff Matter stresses the point that this would only be worth while if it were a proper index, with all subjects indexed, not just a list of titles such as I send out to new and prospective members. This I entirely agree with. He and others feel that an index would be useful. If Malcolm produced one would you pay

a couple of pounds for it? I don't see it could be much less and it would have to be an extra; we couldn't afford to do it on the annual subscription.

Bull.17, p.9, Postage of Plans: Elizabeth Wells points out that she told Kenneth Williams that plans had been damaged in cardboard tubes when sent by surface mail. In seven years, they've had no trouble or damage when sending by air mail. She says, too, that rolling them round a dowel would add a lot to the weight and increase the postage costs very considerably [the increase is 4½p or 5p, depending on destination, for every 10 grams, jm]. Also it would not be possible for the dowel to project two inches beyond the plan because the keyboard plans are only just within the maximum length (1050mm) that the Post Office will accept.

GLUES: Robin Almond says: "Glue seems to feature in FoMRHIQ. Does there exist a comprehensive survey of it? If not, would it be worth while to pool our collective experience to produce one?" Well worth while I think, and the beginning of one follows; please carry on. We all stick bits of instruments together and we must all have experience and advice to offer.

Christopher Allworth says: "I have noticed a tendency for fish glue to release joints under hot and damp weather. Could we have more facts comparing fish with hide glue? I need convincing that fish is stronger and more 'weather-proof' than hide". He adds that the glue sold in his area (Nova Scotia) as Lepage Liquid Strenghth is in fact fish glue with a preservative added.

Robert Gemmell Smith has three separate points on glues: "On carpenters wood glue I should comment that I have had no trouble with this stuff at all since I do not let my workshop get too cold, most glues are going to give trouble at low temperatures. I believe that some, cascamite in partiuclar, can be damaged in some way by frost."

"On comm.228, I believe it is the duty of an instrument maker to make repairs on his work as simple as possible, to this end I use hot glue wherever the instrument may need repair and 'titebond' elsewhere. I assume the glue that Mark Butler proposes to use is the same as cascamite in which case adjustments and repairs will be very much more difficult."

"On glueing parchment roses I have found'Bostik clear' adhesive to be very effective, joints can be opened with acetone."

I have been sent, by the Franklin Glue Company, Columbus, Ohio 43207, four large booklets in a packet entitled Glueing Guide Kit. These are: Wood Glueing, some basic principles and techniques; Adhesive Trouble Shooting; Calculations for Wood Glueing; Glueing and Furniture Design. The Calculations seems addressed mainly to the workshop with a lot of machinery, huge presses and so on, but the others all look useful whether you use Franklin's titebond or not. They'll be here is anyone wants to look at them, and they might send you copies if yous ask nicely.

Finally, for the moment, there's a detailed Comm on the subject further on here. Lets have more.

MATERIALS: Robin Almond replies to a request in the last issue: "Bristles come from Bristles Ltd, 6 Broadway Market, London E.8. 18 months ago they were about £1 per oz of approx 1000 bristles."

Paul Gretton says: "The sticks of artifical ivory I've had from the Early Music Shop are convincing and inexpensive. I've used them for mouthpieces [for cornetts], but they shatter if one doesn't go easy when turning. There is also a visually convincing artifical ivory consisting of vari-coloured layers of celluloid which Moeck used to use for the heads

of Rottenburgh recorders, but I'm told that this has various technical disadvantages. The manufacturer is Westdeutsche Celluloidwerke GmbH, Postfach 5046, D-4005 Meerbusch, West Germany, but they only make the stuff to order andin large quantities. A kilo of 5.5mm sheet costs DM 27.40. It looks good." JM adds that one of the technical disadvantages may be that celluloid is highly flammable - be careful.

Malcolm Rose (address in last issue) and a metallurgist colleague have been engaged on a study of wire for the last three years, with access to sophisticated equipment which will give figures on all aspects of performance of wires and undertake chemical analysis and hardness testing. Comprehensive figures are available on the performance of most modern wires, and copies can be supplied on request. See also his appeal for help under REQUESTS below, to carry on the work.

TOOLS: Geoff Mather has sent me a copy of his list of tools. Some of you will have seen some of the beautiful planes he makes at the Early Musical Instrument Exhibition, very small tools with a handle rather like that of a chisel. There is a considerable range of carving planes, carving tools, planes, mice, spokeshave, purfling tool, edge-cutting tool, and so on. Since they are hand-made in his spare time, don't send any rush orders, but he might send you a list if you ask. He is not interested in trade orders or working through dealers (see the later portion of a Comm from me herewith, if Djilda has room for it) but a craftsman happy to help other craftsmen.

MUSEUMS: Peter Spohr tells me that a new museum of instruments is being established in Frankfurt. I have asked him to keep an eye on it for us and let us know what they have and what information, documents and so on they publish.

Early on, we had a number of members who reported on publications and plans etc available from their local museums. Can we revive this, please? I have some material for this issue, but there are a number of other museums which seem likely to have produced more material since we last heard and from which we have heard nothing for quite a while. Some museums are themselves members, and some of them keep us up to date, and some don't. We would be very grateful if they could all do so. If we could print their lists of plans and so on, it would help them, both by getting them widely known, and so sold, and also save them dealing with quite so many individual requests for the lists.

The Paris Conservatoire Museum reopened last June after reconstruction work. As well as the permanent exhibitions they will have temporary ones, at the moment one of instruments by the Erard brothers (catalogue available at 20 F). They have some 3,000 instruments, a photo library (1800 negatives), library etc. They are open 2-6 pm on Wednesday, Thursday, Friday, Saturday (except holidays) and ask for a minimum of 15 days notice if you want access to anything except an ordinary museum look-round; like all museums, appointments have to be made if you want to get into the stores or take instruments out of cases. They have postcards, recordings and plans available (a list of the plans is printed elsewhere in this issue).

Martin Jones (address in last issue) offers to act as a contact with the Brussels Conservatoire Museum. We also have a member of the museum staff as one of our Fellows (Nicolas Meeùs - address in July issue), so you have two lines of approach there. We would be very glad to hear of publications from them. I have heard that the Mahillon Catalogue has been reprinted, but I've not seen a copy; I have had three issues of their excellent Bulletin (1, 2 and 4) but I don't know if any more have appeared - it would be a pity if that had been dropped as it contained a lot of very valuable information, but the last issue I've seen was 1974

and I don't know whether 1973 or any later issues have ever appeared. I remember from a visit there years ago that they have an excellent series of postcards. I hope that Martin will keep us up to date with further information.

PLANS: Philip Lourie has sent us a Comm. on the Victoria & Albert Museum plans of the Choc Liuto Attiorbato, which appears elsewhere in this issue. He sent them a copy of the Comm. and had a nice letter back, saying that they are very pleased"to get some informed (and polite [I hope that they haven't had impolite reactions from any of our members - see further comments of mine below; jg]) feed-back as so often we do all this work and hear nothing from our customers, the only gauge of our success being the number of drawings we sell..... One ofthe reasons for producing the drawings at all has been to protect the instruments so that they do not have to be withdrawn from the showcase more than very rarely but also to protect our very small staff who have more than enough to do apart from this, so we naturally want the package to meet all the foreseeable requirements of those who buy the drawings.....There is no great body of experience on which to base our judgement of what we should be doing in this field so collaboration between the makers and ourselves is greatly to be welcomed."

So over to you; it is clear that polite and constructive feed-back is welcomed at the V&A, and almost certainly is elsewhre as well. Don't ask for the impssible - no plan can show everything, and remember that the more is shown, the more the plan costs to produce and the longer it takes to prepare. Most museums have to pay someone to measure up the instrument and prepare and draw the plans, pay for X-rays and so on, so that the more detail there is, the more the plan will cost. You can't complain on the one hand that one small detail is missing and on the other for the cost, when it may take an extra so many hours at a cost of so much an hour to include that detail. The museum does have to decide on how much detail is important. On the other hand, if you can convince them that a certain detail is important and is needed by all or by the majority of their customers, then the plans will be improved.

Phil tells me also that he believes that they will shortly have available plans of a similar instrument by Sellas and of an 11 course ivory Italian lute by an anonymous maker; further information from the Furniture & Musical Instrument Dept at the V&A (or here if they send it to us).

One piece of immediate feed-back, Robert Gemmell Smith suggests that all plans, especially the NRI loan ones, would stand up to use better if they were printed on plastic. As he says, they would be far more expensive but cheaper in the long run. What do others think?

On the Hardangerfele, for which there was a request for plans in the last issue, see Book News, herewith, last item.

Donald Garrod says that he published plans and constructional details for a virginal, for which there was also a request in the last issue, in the Woodworker Magazine, in the October, November and December numbers. The articles were written for wood-workers with some skills in that area who had not yet made a musical instrument.

Elizabeth Wells has promised to send me a copy of the complete list of plans available from the Royal College of Music as soon as its ready, but meanwhile the three new ones now available are the I.Denner recorder, the tortoiseshell guitar attributed to Jean Voboam, Paris, c.1680, formerly known as the Rizzio, and the German regal of 1629.

David Hill has sent me the following note about the plans of instruments in the Hill Collection at the Ashmolean Museum, Oxford. They are available either from stock from Hill's (address in the Supplement herewith

as he has joined FoMRHI) or to order from the Ashmolean. The price is the same either way.

When my Grandfather in 1948 donated the remaining instruments to the Ashmolean Museum, few makers were interested in reproducing early instruments. With the revival in the Sixties of baroque instrument making, we noticed that certain exhibits were beginning to deteriorate due to inexpert handling during measuring. One individual was most upset when he was refused permission to place Sellotape over the sound holes of the Messie in order to trace them!

In 1978 we commissioned John Pringle and Stephen Barber to produce working drawings of the majority of instruments in the Collection. So far we have completed:-

Catalogue No. 2 Bass Viol by Gaspar da Salo.
4 Bass viol attributed John Rose.
5 Lyra viol by John Rose.
10 Violin (Charles IX) Andrea Amati.
11 Viola (Charles IX) Andrea Amati.
15 Violin (Alard) Nicola Amati.
41 Guitar by Antonio Stradivari.

which are priced at £25.00 except for the three Amati instruments which are £15.00.

These drawings are complete in every respect even including peg dimensions.

We hope with the publication of these drawings, that future generations of music lovers will be able to admire these instruments because they will have survived the ravages of time and inexperienced makers.

As I have mentioned above under MUSEUMS, there is a list of the Paris Conservatoire Museum plans elsewhere in this issue.

There is also a note about postage problems with plans on p.5.

REQUESTS: Cajsa Lund asks if members could let her know about any archaeological finds which could be sound-producing devices or musical instruments. Do remember that to the ethnomusicologist and the archaeo-organologist, if it is deliberately made to produce a sound it is important, whether it's what would be called a proper musical instrument or not.

Peter Storm (address in the last issue) would like literature on guitar sound, its "mechanism" and "quality". Has any one done any plate-tuning research on guitars? Incidentally, he does not say anything about date or type.

Duncan Preston would like to know of any articles orother references in English and available in England on the Chinese cheng.

Jacob Misset (new address in this issue) would like to be in touch with other chitarrone makers and players and asks especially if anyone can put him touch with Douglas Smith? We have so many lute makers in our list that I've fought shy of indicating with 'a' or 't' or 'c' anyone who makes archlutes, theorboes and chitarrones, especially as I suspect that most lute makers have on will or may produced one or more. Do you want me to indicate this? And if so, please say which you make or play. The next main list will be sent the next issue, so now is the time to tell me.

Don Barney would be very grateful for any information on orpharion plans,

drawings, measurements, constructional details. He is especially interested in variations of body shapes and methods of sound board decoration, saying that he can't tell from the pictures he's seen whether they were painted or inlaid. I don't know anything apart from Bob Hadaway's article in GSJ 28 on the Tollemache John Rose and Donald Gill's general article in GSJ 13; does anyone else? It was Don who asked whether such queries ever got answered - please prove to him that they do!

Henk van Dijk (address in July issue) asks for suggestions, literature, articles, designs, etc, about keyboard decoration and painting. He does not say for which style (Flemish, Italian, German, etc) or date.

Malcolm Rose (see p.6 towards the top) says that a picture has emerged of the development of iron and copper-alloy wires from about 1790-1850, but further work is hampered by the difficulty in obtaining reliable specimens from earlier in the 18th and if posqible in the late 17th centuries. Any help with the location of good specimens would be much appreciated; an exact record of the instrument, note name and speaking length is essential, as the study includes the implications which the wire has on pitch.

Bryan Poynton (address in last issue) asks for a recommendation to any publication that will give the theory of relationship between finger holes and bores, cylindrical or tapered, in layman's terms preferably. Specifically for recorders, but I imagine the information for any instrument would be useful. Does such information exist in layman's language? And if not, would any of properly educated members be willing to write it out as a Comm? I don't suppose that he and I are the only ones that can't cope with the calculus such information is usually written in. As I've said elsewhere, I've got French-English, German-English, etc dictionaries, but I don't know of a Calculus-English one.

TECHNIQUES: Phil Lourie asks for information or advice on making flattened lute backs, as on the Choc lute referred to above on p.7.

Bryan Poynton asks whether there is any device used by recorder makers to take the awkward hand chiselling away from producing accurate windways such as a plunging or reaming tool?

Paul Gretton asks whether anyone can suggest accurate methods of measuring the backbore conicity of cornett mouthpieces. So far he has been using drill-bits (I asuume and hope the blunt ends) as feelers. It occurs to me as I write that perhaps there is a dental material that could be used as a mould to take an accurate caste of the inside and measure that, but is there any sure way of getting it all out again (with memories of trying to scrape the pink stuff off my beard and moustache last time I had one done). Is there anything that would give an accurate caste without shrinkage and that would slip out easily from wood or ivory?

Julian Drake asks for information on the construction of folk cornetts. All I know is that you split them, hollow them out and stick them back together, often with a bark covering to prevent leaks.

He is also interested in old techniques of panel painting as he has become interested in painting landscapes on harpsichord lids (I've already suggested that Henk van Dijk gets in touch with him).

INVITATION: Peter Spohr writes:

I also own a small "collection" of musical instruments almost exclusively transverse flutes, piccolos etc. Instruments and parts of instruments before about 1870 are by C. Kruspe, E. Challier (mark), Th. Cahusac sen., Freyer& Martin, J.S. Stengel, V. Metzler, Th. Lot, Ch. Delusse and F. Lehner. Later instruments are by L. Lot, Wm.S. Haynes, J. Hammig, A.R. Hammig, W. Wetzel, A. Cooper, F. Mehnert and A.I. Eppler. Furthermore there are some

copies of old instruments by F. v. Huene, Gr. L. Jones, R. Tutz and G. Kowalewsky. Anyone who would like to see and play (most of them are in playing order) these instruments should contact me at my address or telephone (Frankfurt 622860 and 655976). I will be pleased to show them.

OFFERS: Malcolm Rose (address in last issue) has workshop space and possibly accomodation available in East Sussex, including use of machinery and other equipment; it would best suit a lute or viol maker. Anyone interested is welcome to write to him for further details.

MY MOVEMENTS: I shall be in Israel, lecturing and on last year's summer holiday, from the middle of February to early March, so don't be surprised if you don't get quick answers to letters, and also don't be surprised if you are one of those who has not yet renewed at a delay between responding to the reminder and receiving this. I'm not likely to get the stock of this issue before I leave and it may take a week or two to work through the mountain of mail that is likely to build up inside the front door while we're away.

NOTE TO CONTRIBUTORS: A lot of you have sent in Comms while you were renewing your subscriptions, and we're very grateful for them. At the same time, we must keep postage weight down to 100 grams, so please forgive us if we have to hold anything over till next time. The April issue always goes over the 100 because of the main List of Members that goes with it, and therefore the issue can also be bigger because once we're over the 100 we can go up to 250 within the next step for surface mail (though we'd hesitate to go that far because air mail outside Europe goes up in 10 gram steps; European air mail goes like surface for some silly reason). So, although it's Djilda not me who decides such things, I think I can promise that anything that does get held over will be in the next one with whatever you send us for that.

DEADLINE FOR NEXT ISSUE: April 2nd, please. This is also the deadline for any corrections to List of Members, which comes with it.

Have a good year.

Jeremy Montagu

BULLETIN SUPPLEMENT Djilda Segerman

We (and just about everybody else we know) have received an ad. from Frank Bormann who is making lute backs. Address: Vidkaersvej 9, Nr. Vissing, 8660 Skanderborg, Denmark. Can any member give us a report on the backs?

Maggie Urquhart, NRI's in-house bowmaker is not in-house any more, since she's just acquired a house with plenty of workshop space. The bench she had is now available. Enquiries to me. We would prefer a bowed-instrument maker.

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SOCIETE DES AMIS DU MUSEE INSTRUMENTAL
du Conservatoire National Supérieur de Musique
14, rue de Madrid - 75008 PARIS

Tél: 292 15 20 CCP: La Source 33.693.69

DIFFUSION DE PLANS D'INSTRUMENTS DU MUSEE INSTRUMENTAL

n° 1	LUTH à onze choeurs, Anonyme, France (?), XVIIe siècle, E.540 C.156, diapason 680mm, Pierre Abondance, 1976	40,00 F
n° 2	GUITARE à cinq choeurs, Anonyme, France (?), XVIIe siècle, E.30 C.263, diapason 725 mm, Pierre Abondance, 1975	60,00 F
n° 3	MANDORE à dix cordes, Anonyme, Italie (?), XVIIIe siècle, diapason 355 mm, Pierre Abondance, 1976	50,00 F
n° 4	VIOLE DE GAMBE (basse), six cordes, Henry Jaye, Londres, 1624, E.23 C.171, diapason 670 mm, Pierre Jaquier, 1976	100,00 F
n° 5	VIOLE DE GAMBE (pardessus), six cordes, Nicolas Bertrand, Paris, 1714, E.1005 C.138, diapason 180 mm, Pierre Jaquier, 1976	60,00 F
n° 6	VIOLON, Nicolas Lupot, Orléans, 1772, E.899 C.19, diapason 193 mm, Pierre Jaquier, 1979	60,00 F
n° 7	ARCHETS (2 de violon, 1 de basse), Anonymes, France et Louis Tourte, Paris, milieu XVIIIe siècle, E.0165, E.0199, E.406 C.65, Pierre Jaquier, 1979	60,00 F
n° 8	PIANOFORTE (carré), Anton Walter, Vienne, fin XVIIIe siècle, E.976.3.1, 4 octaves + 1 note (mi-fa), Michel Robin, 1978	100,00 F
n° 9	PIANOFORTE (carré), Anonyme, Allemagne, ca.1800, E.954 C.336, 4 octaves + 3 notes (mi-sol), Michel Robin, 1978	100,00 F
n°10	EPINETTES DES VOSGES (4), France, XVIIIe et XIXe siècles, BUCHE DES FLANDRES, Flandres, XVIIIe siècle, CITHARE, Allemagne, XVIIe siècle, Pierre Abondance, Pierre Jaquier, Michel Robin, 1978	80,00 F

A paraître:

GUITARE, Jean Voboam, Paris, 1690 (E.2087)
VIELLE A ROUE, Louvet le jeune, Paris, XVIIIe siècle (E.1412 C.1049)
EPINETTE "Irena", Rome, 1564 (E.704)
EPINETTE, Jean-Claude Goujon, Paris,,1753 (E.971.5.1)
CLAVECIN, Jean-Claude Goujon, Paris, 1749 (E.233 C.326)
CLAVICORDE, Anonyme, Vienne, XVIIIe siècle (E.976.5.1)

ADHESIVE BONDING IN MUSICAL INSTRUMENT CONSTRUCTION

FoMRHI Comm. 247

Lawrence D. Brown

Ultimately, the quality of a musical instrument depends not only on the sweetness of its tone, but also on its continued service and durability in a variety of climates. Deterioration of an instrument may come from internal or external forces, and usually involves joint failure rather than impact or chemical spillage. External forces are those that come from hard use, or from normal string tension. Internal forces are the result of the natural tendency of all woods to shrink, warp, and shift position in response to changes in moisture content. Poorly shaped parts that have been forced together by clamping pressure are also capable of generating internal forces by the steady pull on the joint caused by the misalignment. The structural integrity of any instrument, its ability to stay together and retain an attractive appearance over a number of years, depends on the choice of carefully sawn woods with a uniform moisture content, on the type and design of the joints used, on the expertise and experience of the builder, and on the adhesive used. This paper will be concerned primarily with the latter, although some discussion of joint design and humidity is inevitable.

Adhesive technology expanded enormously with the introduction of synthetic adhesives during the last forty years. The adhesive industry today recognizes four basic types of adhesives: Adhesives that obtain strength by drying (poly-vinyl acetate glues, aliphatic resin glues, and animal glues), by cooling (hot-melt adhesives), by chemical reaction (epoxies, urea resins, melamine resins, phenolics, resorcinol glues), or by a combination of these methods (casein, soybean, and blood glues). Glues that obtain strength by drying have gained the widest acceptance among woodworkers, primarily due to ease of application and speed of set. In addition, these water based adhesives will set and cure at room temperature, and, with the exception of animal glue, do not require preparatory mixing. Only this category, comprising the traditional and most widely used glues, will be considered at this time.

The instrument maker must be concerned with yet another classification: reversibility. If an instrument is of any value at all, and if any part of it may someday have to be dissasembled for repair, then an adhesive <u>must</u> be used that makes the assembly of that part reversible. On thin, delicate joints that are easily cracked or ruined by forceful wedging, a glue that can be removed by the application of a mild solvent (such as water) or heat is preferable to one that must be removed by mechanical means, such as cutting or scraping.

While all of this may seem rather obvious to the experienced luthier, I wish to emphasize the point for the following reason--Far too many of the lutes and viols that pass through my shop

have been made extremely difficult to repair by the use of irreversible or inappropriate adhesives. Most of these instruments are of recent manufacture, and may originate from either side of the ocean. Discussions with other makers and repairmen reveal that this is a common complaint. It is hoped that this article will help in some measure to improve the situation by dealing with the practical considerations of adhesive bonding in the building of musical instruments.

The successful application of an adhesive usually requires a carefully controlled gluing operation. The glue (usually a polymer dispersed in an aqueous solution) is spread on two pieces of wood which are then pressed together. The glue and the water penetrate the pores of the wood for about a thousandth of an inch. As the water continues to penetrate the wood, the polymer is retained in the open cells and fiber walls near the surface. Complete dispersion of the water from the glue line results in setting and drying.

The condition of the bead of glue which squeezes out of the joint is not a reliable indicater of the condition of the glue in the joint. Moisture from the squeeze-out, which is a much thicker film than the glue in the clamped joint, will evaporate slowly into the air, while moisture from the thin film of glue in the joint disperses much more quickly into the wood. The squeeze-out will therefore nearly always dry much more slowly than the glue in the joint.

Animal glue is considered a drying glue, although the initial set results from cooling, because it obtains its ultimate strength by diffusion or evaporation of the water content. The highest grade of animal glue is made from hides rather than bones and tendons, and is often referred to as <u>hide glue</u>.

Polyvinyl acetate glues (or PVA's) are commonly known as <u>white glue</u>. They are usually made by emulsion polymerization of vinyl acetate in water. Other monomers besides vinyl acetate may be used, but the formulas are usually closely guarded by the manufacturer. They are all referred to as PVA's for convenience, and share several physical properties in common. The glues set by diffusion of the water into the wood, and the coagulation of the emulsified polyvinyl resins. They remain elastic after drying, and are weakened by high temperatures and high humidity. They also demonstrate poor resistance to certain solvents. The most serious drawback, however, is their tendency to "creep" under tension. This lack of resistance to continuous tension at normal room temperature is also called "cold flow."

Recent reformulations of PVA's in an attempt to overcome these limitations have resulted in the production of the aliphatic resin emulsions. Commonly called "yellow glue", the Franklin Glue Company's <u>Titebond</u> is the most well-known. This adhesive will adequately resist solvents that will swell PVA's, such as acetone and methyl ethyl ketone. It dries harder than white glue, and is not subject to creep or cold-flow under tension. It is a thermoplastic adhesive that can be dissolved by high temperatures in order to separate a glued joint.

The first of these three glues, the PVA or white glue, is totally inappropriate for any type of instrument construction. Although it is thermoplastic and can easily be melted in order to separate a glued joint, it leaves a sticky, gummy residue that often requires scraping or sanding to remove, resulting in alteration or thinning of wooden surfaces. Worse, because of its tendency to creep, a lute top or bridge glued on with white glue will slowly slide in the direction of the load, quickly resulting in total failure of the joint.

An aliphatic resin glue such as Titebond is more appropriate for some phases of instrument assembly. Titebond is used by some makers to glue a lute top onto a body, since it does not creep. However, removal of the soundboard is complicated by the fact that the amount of heat ormoisture required to dissolve the bond may also cause the soundboard joint to separate slightly at each end of the instrument. If the braces have been glued onto the soundboard with Titebond, they may also come loose at the ends. Thus, although top removal is not difficult, it is often necessary to reglue the ends of the braces and sometimes the soundboard joint at each end of the soundboard.

Hide glue is still the most efficient and useful adhesive for bonding lute and viol soundboards to the sides of an instrument. Since it has a lower melting point than other glues, a soundboard may be removed with bracing and soundboard joint intact (providing they have not been glued with hide glue as well). All traces of hide glue may be removed with a hot, damp rag.

Preparation and use of hide glue is not difficult, but some precautions must be observed in order to preserve the integrity of the glue and prevent bond failure. The glue must be mixed with clean, cold water, and heated (in a double boiler) to a temperature no higher than 150° F (65° C). High temperatures and continued heating "cooks" the glue and reduces its working strength. These precautions are more necessary in lute making, because a lute top requires a considerably stronger bond than a violin top. In addition, glue for a lute top must be mixed with less water than is common in the violin trade. Violin tops are removed by simple mechanical wedging, at room temperature, and without the addition of moisture. The glue must of necessity be rather thin to facilitate this removal technique. Normally, in the violin shop, one part of glue is mixed with two parts (by volume) of water, yielding a solution of approximately 33% solids. The glue is usually thinned again during use. Violin makers normally rely on a visual check of the glue's viscosity. Specific measures of glue and water are not used since water must be continually added to make up for evaporation during a long day of repairing. A higher percentage of solids to water will produce a stronger joint. Mixing one part water to one part of glue is recommended for gluing on a lute top, making a solution of about 50% solids. A lute top glued on with the lower viscosity solution used for violin and viol tops may be pulled off in a warm, humid environment. Violin tops rarely come loose because the string tension on a violin is a downward load, which tends to push the top against the body. The string tension on a lute tends to pull the top across and off of the instrument. It is therefore necessary to use less water for lute construction than is commonly used in gluing violins.

Since an extremely viscous solution of hot hide glue will set faster than the top can be clamped into position, it is necessary to remelt the glue in situ, using an infra-red lamp or a hot iron and damp rag. After spreading the glue, the top must be clamped loosely into position, by whatever clamping method you choose. The glue is then re-melted in small areas, working around the perimeter of the soundboard, by applying heat and pulling each section tight. If no squeeze-out of melted glue occurs when the joint is pulled tight, more heat must be applied, or more hot glue added to the joint. As long as squeeze-out occurs, maximum assembly time has not been exceeded, and the joint will be sound. It helps to work in a warm room, rather than in an air-conditioned workshop. Violin makers often preheat the wooden surfaces over a fire or electric hot plate to help increase working time. By now everyone has heard the stories about the scorch marks inside of old harpsichords. The makers would set a fire in the inside of the instrument before gluing in the soundboard. Some modern makers still do this!

The necks of viols and violins are often fitted to the body block with a tapered dovetail joint. For maximum strength, the joint is carefully cut until the dovetail fits firmly and tightly into the mortice. If an ordinary adhesive is used the neck will not fit into the joint unless the joint is made sloppily in order to accomodate the thick glue. The use of hot hide glue allows a tight, perfect fit, since the hot glue can be made quite thin and the neck squeezed into place. Sizing the end grain beforehand with hot glue prevents a "starved joint." Because of the enormous leverage exerted on the joint, and because of the relative weakness of end-grain adhesion, no glue will hold it permanently. A neck comes loose sooner or later, and must be reset. If hide glue was used by the original maker, the neck can be reset perfectly, and with little difficulty.

Unless a viol is constructed of well-dried wood, and in an environment that approximates the lower range of humidity that the instrument will encounter in use, the top and back plates will shrink and pull away from the ribs. In some areas of the U.S. the relative humidity frequently drops to 10%! A viol will certainly pull apart unless it was constructed at a humidity nearly this low. Shrinkage of the top and back plates will cause the rib outline to be larger than the top and back of the instrument. If a thin mixture of hide glue was used in construction, the repair is now a simple one. The body is made smaller by separating the ribs from the lower block and trimming off a small amount from each rib, shortening its length. The body is then made smaller by pulling the ribs together and re-gluing to the bottom block. This can be done so that the top and back fit precisely into place. Trimming of the periphery of the top and back plates and subsequent damage to the varnish is thus kept to a minimum or avoided altogether. This repair is common enough that it should be anticipated by every viol maker when an instrument is built. Hot hide glue should always be the primary adhesive used in viol construction. In spite of this fact, the number of viols glued entirely with white glue that have found their way into my shop is surprising and dismaying.

Bottled liquid hide glue should never be substituted for hot hide glue. Liquid hide glue is extremely sensitive to high humidity. If a joint is under stress from string tension or from shrinkage of wooden plates, the use of liquid hide glue will guarantee failure of the joint when the humidity rises for any length of time. Furthermore, because of additives used as preservatives, liquid hide glue remains soft in the bond line and does not attain the ultimate strength of hot hide glues.

I attended the lute seminar mentioned by Mr. Butler in Comm. 228. The normally high East Coast humidity was responsible for the separation of five lute tops, one bridge, and the explosion of a harp. Mr. Butler states that "both Titebond and hide glue failed under these conditions." It was my understanding from speaking to several makers of the unfortunate lutes that the glues in question were Titebond and liquid hide glue. One lute soundboard glued on with liquid hide glue failed in spite of the fact that the maker used a wide, internal guitar-type liner to increase the gluing surface.

I have found only one legitimate use for liquid hide glue. It is ideal for gluing a fingerboard onto a lute. The glue allows a long assembly time, making it possible to position the fingerboard exactly. The lack of tension on a fingerboard and the relatively large surface area being glued prevents bond failure. Most importantly, liquid hide glue makes a fingerboard extremely easy to remove. This part of a lute is removed most often, usually to adjust the action or repair a separated pegbox. After ten minutes under a heat lamp, the fingerboard can be lifted neatly off.

It has been noted in this quarterly and elsewhere that Titebond is sensitive to conditions of high humidity. It is my experience that Titebond is a reliable adhesive. However, there are a number of factors that may adversely effect joint strength. These are as follows:

First, the Franklin glue company (manufacturers of Titebond) recommends six months at 70° F. as the maximum shelf life for Titebond. They recommend purchasing no more glue than can be used within six months.

Second, the addition of materials to extend the working time of Titebond could cause gellation and/or loss of adhesive quality.

Third, in any emulsion adhesive, discrete particles of adhesive are in suspension in an aqueous solution. The dispersion of water into wooden surfaces pulls these particles together to form a continuous film. If the drying temperature is too low, discrete (unjoined) particles are left in the dried film, resulting in a weak joint. The temperature of the wood, glue, and air should be monitored in the winter. A thermometer can be used to discover cold spots in a shop. Floor areas or corners where glue or wood is stored may be much colder than other areas.

Fourth, assembly time may be reduced by rapid air circulation, higher temperatures, or thinness of glue spread. If squeeze-out occurs when clamping, maximum assembly time has not been exceeded.

Fifth, excessive clamping pressure may cause a very weak joint. The wooden cam-type clamps used by most instrument makers are capable of exerting tremendous pressure on narrow surfaces such as soundboard braces. When gluing a brace onto a soundboard, the uniformity of pressure is more important than the amount of pressure. If it were possible to fit two surfaces together so perfectly that an even, thin glue line were produced, no clamping would ever be necessary. Since this is obviously impossible, clamps are used to distribute the glue as evenly as possible in a joint. A certain amount of pressure must be used to spread the glue evenly. However, excessive pressure results in a "starved joint" —too much glue is squeezed out and too little left in the glue line. Using too little glue (spreading a small amount on one side of the joint only) will also result in a starved joint.

Sixth, if two pieces being joined are not of uniform moisture content, the higher moisture content board will shrink more than the lower moisture content board, causing bond failure. A sling psychrometer should be used to check the humidity in the various work and storage areas of the shop. This device allows for a quick conversion to relative humidity and then to equilibrium moisture content of the wood. Thus the effects of unequal moisture content on the dimensional stability of a finished joint may be anticiapted, and glue line failure prevented.

Seventh, glue never penetrates into wood more than several thousandths of an inch. If the surface is poorly machined, the glue line may eventually rupture. Dull cutting tools or clogged sandpaper may tear and loosen wood fibers without removing them. Since the glue does not penetrate very far, it adheres to a surface with no integrity. A dull planer blade will beat the fibers down, compacting the surface and causing inadequate glue penetration.

Eighth, surfaces to be joined should be freshly cut or sanded. Surface preparation should be done the same day as the gluing. This prevents contamination of the surface by dust, resins, and moisture changes.

Ninth, the moisture content of the pieces being glued should approximate the lower range of conditions where the instrument will be used. As noted above, the relative humidity in some areas of the U.S. regularly drops to 10%. An instrument that is being built for a customer in one of these areas should be constructed at a relative humidity no higher than 30%. Instrument failure is nearly always the result of unequal shrinkage. The expansion of joint members which would occur in a very humid climate is unlikely to cause joint failure, except when the glue is softened by the high humidity.

Tenth, insufficient or non-uniform joint pressure and the resultant thick glue line reduces joint strength. Joining soundboard braces to a lute soundboard with weights, as recommended in some lute construction texts, will almost certainly result in a thick or uneven glue line. Some sort of clamping arrangement should always be used to distribute the gluing pressure as evenly as possible.

Contrary to some popular opinion, the more time that is taken to assemble and clamp a joint, the longer the glue will take to set. Reducing the assembly time hastens the speed of set. Long assembly times produce a thick, weak glue line.

The problem of humidity may be the most critical of all. Far too many luthiers are insensitive to the extremes of humidity that ravage the East Coast and Midwest. This is especially true of craftsmen who live in climates where the range of humidity is quite narrow, i.e., Great Britain, large areas of Europe, and the West Coast of the U.S. The problem arises when an instrument is built in a moderate climate and sent to an area with a wider range of temperature and humidity. The relative humidity in a centrally-heated home in the colder areas of the U.S. normally drops to about 30% in the winter. Outdoor areas of some Western states reach 10%. During the summer, the relative humdity in the Eastern, Southern, and Midwestern states may hover in the upper 90's for days or weeks. These changes are not gradual but abrupt. A relative humidity of 100% is not uncommon in most areas. (It is this last condition that we confront summer after summer at the American Lute Society summer seminars in Barrington, Rhode Island.)

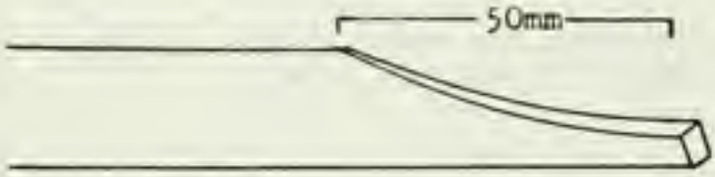
The joint design used in lute construction does little to minimize the problems caused by these extremes of humidity. It is well known that the relative dimensional change between longitudinal and tangential directions in wood is the most extreme. In other words, the amount of stress in a joint is maximized by gluing two pieces of wood with the longitudinal grain of one piece at right angles to the longitudinal grain of the other. Since this is the way in which lute braces are glued to the soundboard, it is necessary to take steps to minimize the disruptive forces that would normally be sufficient to break the bond. Experience has shown that if an instrument is constructed in a high humidity and sent to a much lower humidity, it is somewhat more likely to fail than if the reverse is true. It would seem that the disruptive forces of shrinkage are much more damaging than those accompanying expansion. In practise, an instrument should be constructed at a humidity no higher than 45%, and no lower than 20% (depending largely on where it will be sent). Humidity in a workshop may be controlled with an air-conditioner, humidifier, dehumidifier, and an electric heater. It should be monitored with a certified hygrometer or sling psychrometer. In the humid summer months, an air conditioner is usually sufficient to keep the humidity below 45%. An air-conditioner alone tends to work against itself since cooler air is capable of holding more moisture than warmer air. Alternating an air-conditioner with a large capacity de-humidifier will help keep the temperature in the shop from getting too cold. On unusually humid days, the use of an electric heater and an air-conditioner at the same time will very quickly pull the humidity down to the desired level.

Weatherstripping, insulation and storm windows can be used to seal off the work area and keep the electric bill as low as possible.

It is important to note that most of the dial-type hygrometers offered for sale are complete frauds. An examination of a display of hygrometers hanging in your local hardware or department store will reveal that the instruments give readings that vary from each other by 50% or more. These "instruments" are sold for cosmetic rather than practical applications. Using the zero-adjust to set one of these devices to the correct humidity will not help since the internal mechanism is faulty. An accurate hygrometer will be accompanied by a certificate of accuracy stating that the instrument has been tested and should be accurate to within 3%. A suggestion for testing the instrument and a guarantee to repair or adjust it will also be included. Without this certificate of accuracy, the instrument should be considered worthless. The German-made Lufft hygrometers are certified accurate and sell for about $70.00. A certified hygrometer is also available from Airguide Industries of Chicago for considerably less (about $25.00). It should be noted that Airguide also produces a line of less expensive, non-certified hygrometers. The most accurate method of obtaining the relative humidity is still the wet/dry bulb measurement taken with a swing psychrometer. Although it takes a few minutes to calculate the relative humidity, a swing psychrometer should always be used to test the accuracy of dial hygrometers. These instruments sell for about 6 to 35 dollars.

Assumptions about the inherent qualities of different glues or different types of joints should not be based on casual observations of specific instances of joint failure. A glue-joint testing program, using destructive testing of joints, should be designed to fit the particular gluing operation in question. Where moisture resistance is suspect, a vapor box may be constructed to provide a controlled level of humidity for the samples.

In nearly all of the old lutes that I have examined, the evidence indicates that the braces were glued firmly to the sides of the lute body. The ends of the braces were scalloped down to 5 to 7mm high at the terminal points. Failure to glue the braces to the ribs will accelerate brace/soundboard separation. A destructive glue-joint testing program which I devised and conducted to determine how brace stiffness effects the durability of soundboard brace joints indicated that scalloping the ends of the braces increases the ability of the joint to resist the destructive forces of normal string tension. The braces most resistant to separation from the soundboard in my tests were the ones with the greatest flexibility, i.e., with the longest scalloped sections. Again, examinations of some early instruments reveals deep scalloping (up to 50mm) of nearly all braces. Occasionally the two braces immediately in front of the bridge were the least scalloped, although it is not clear why.



Musical instrument makers are in a position unique among the professions that work with wood. The design of a musical instrument must not only allow for maximum strength and durability of the finished product, but for a particular quality of tone as well. In many cases this means that less desirable grain relationships must be used in certain joints, as in lute construction where the soundboard braces are glued with their grain at right angles to the soundboard. Other woodworking professions compensate for the destructive forces inherent in product construction and use by over-designing the product. Over-design may also compensate for poor workmanship. In the case of historical musical instruments, not only is the design usually fixed, but any attempt at over-design to gain greater structural integrity would have a marked effect on the final tone of the instrument. The instrument maker must therefore attain an extremely high level of craftsmanship if he is to be successful. A thorough understanding of the nature of the adhesive materials used in the construction of musical instruments is thus a necessity. Some information may be obtained by writing to the manufacturer of the adhesive in question. Forest service bulletins, government publications, adhesive industry journals and the like may provide much information about the physical characteristics and gluing properties of certain adhesives. Since all of these publications are oriented toward commercial timber and furniture production, i.e., toward industries that over-design their products, it is necessary for the instrument craftsman to do much of his own testing. It is difficult to interest the trouble-shooting service of an adhesive company in the gluing problems of an industry that does not purchase the adhesives in the usual fifty-gallon drums. By sharing the observations and insights into gluing problems encountered in construction and repair, this inequity may be at least partially overcome. Accordingly, I invite the usual rejoinders and replies to the above article. Given the relatively recent development of most adhesives and the absence of an unbroken tradition of lute construction, it is both appropriate and helpful that there be differences of opinion concerning the use of adhesives in historical instrument construction. Destructive glue-joint tests are relatively simple to devise. Airing your own findings and opinions in these pages can only result in a highly productive dialogue for all concerned.

FoMRHI Comm. 248 William Cumpiano

RESPONSE TO MARK BUTLER'S COMM. 228 "MORE ON TITEBOND" (Bulletin 17)

I have been using Titebond now in my shop for several years and have not found any reason whatsoever for discontinuing its use. Being aware of its precise formulated characteristics, I use it for a number of specific glueing procedures and use other glues where Titebond is not appropriate.

Mark Butler's warnings against its use obviously attracted my attention. From reading his Comm. 228 very closely, checking his sources, then checking my sources, I have come to the conclusion that Mr Butler's warnings are not only unwarranted but come as a result of hastily drawn conclusions.

Mr Butler must surely be aware that glue joints fail for many reasons, such as glue line contamination, improperly prepared surfaces, insufficient clamping pressure, excessive clamping pressure, starved joints, and so on. Another cause, significant to instrument makers, may be the improper design of the joint itself in relation to the actual stresses imposed on it. In the effort to build lightly, lute makers may be commonly requiring an insufficient glue line area to carry the load.

In view of all this, that he lay the cause for all that mayhem at a L.S.A. seminar on the doorstep of adhesive failure on a warm, muggy day is indeed remarkable. Given the rigid specifications under which glues are manufactured, it seems highly improbable that an adhesive that is used so widely in not only the furniture industry but by several of the top instrument making factories in America be failure prone at 90 degrees on a humid day.

Further on, Mr Butler rests his case by quoting a cabinetmaking textbook which 'flatly' states that aliphatic resin glue 'lacks moisture resistance' as proof of its unsuitability for musical instruments. A closer look at the same textbook reveals that 'moisture resistance' does not in this instance refer to air humidity but actual exposure to water, or immersion. It states, on page 535, - 'The major weakness of this glue (a.r. glue) is that it lacks moisture resistance and therefore is satisfactory only for interior work.' Further on, it describes butdoor work' as patio furniture and boatbuilding. I would include lutemaking in the category of 'interior work'.

The woodworking industry, in conjunction with several university testing laboratories and experts in glue chemistry, have compiled the results of exhaustive tests on every conceivable brand and type of glue. This information is to be had for the asking from technical libraries and from glue manufacturers. I would suggest that instrument makers go directly to the source rather than accept half baked information passed on with such emphatic determination as that which appears in Comm. 228.

The Titebond that is commonly purchased in stores (as distinct from industrial formulations of Titebond) has a high release temperature. As the textbook mentions, however, it will release when the seam is thoroughly wetted (it is not formulated to be waterproof). My experience is that it is not a glue to be used in a joint that may require future disassembly. Similarly it is certainly **not** the appropriate glue to use in restoration work, where reversibility is so important. It is well suited for glueing up neck blanks and attaching guitar bridges.

The original reason for the development of a.r. glue was in the effort to improve the heat resistance of the early polyvinyl acetate emulsions ('white' glues). The Franklin Glue Company, makers of numerous glues, only one of which is the Titebond found in stores, apparently pioneered this effort and lays claim to first coining the term 'aliphatic resin' itself.

Originally the release temperatures of polyvinyl glues were in the neighborhood of 130°F, too low for curing finishes in ovens or shipping finished products cross country in metal-clad freight trucks. Aliphatic resin glue is designed to hold fast in the 140°F - 200°F range.

It may appear ironic in this controversy that the principal property of choice for aliphatic resin glue is its heat resistance, in view of Mr Butler's testimonial of 90°F adhesive failure.

The Titebond that is bought in retail stores is actually a blend of aliphatic and polyvinyl resins, the mixture formulated to achieve the high release temperature characteristics (and superior strength) of the first and the quicksetting properties of the second. Actually it is categorized as a 'modified polyvinyl' in tests compiled by the University of Michigan.

Reports that some glue lines have failed in the past on coincidentally humid days or that a textbook warns against wetting is insufficient cause for putting this extremely useful adhesive aside.

FoMRHI Comm. 249

ADHESIVES FOR THE CORNETTO MAKER. Information and request for information, from Julian Drake.

I use Aerolite 306 synthetic resin powder with GBP.X hardener, both produced by Ciba-Geigy(U.K.), for joining the two halves of my maple/sycamore cornetti, and I find it strong and unaffected by the teak oil applied to the bore at least a fortnight after glueing up. I was less satisfied with epoxy resin. In two instances the oil - I can't remember whether raw linseed or teak - eroded the glue layer which burgeoned forth into a miniature jungle of a rich orange hue, abandoning all its strength in this artistic exercise.

I have not dared to use animal glue for joining the halves, even though it must have been used with success in the past. Museum cornetti seem to have held together. If the joints had ever failed, could a repair have been effected without the removal of the bindings and the leather covering? I know all too little about the properties of the different types of animal glues. Perhaps they were better than they are generally thought to be today? I'd love to know. The WOODWORKER Magazine of November 1963 carries an interesting but insufficiently informative article by E.G.Purdie (Croid Limited) on animal glues. He wrote: "With so many new synthetic glues available it is interesting to speculate why the demand for animal glue is greater than ever. No doubt every user would have his own answer - strength, reliability, proven over the years, kind to timber, eminently suitable for all internal conditions, and so on. All these factors count. There is no doubt that wood and gelatine marry well together and react in unison to changes of temperature and humidity, and this is probably the secret of their great durability. However much animal glues may be decried in certain quarters, modern research and testing

has proved that, used in the right contexts, animal glues are not merely very strong but retain their strength better over an extended period of years than other well publicised types of adhesive." Another tantalizing quotation: "...a hardener may be added to the glue so that it becomes heat reactive, or thermo-setting. This change of structure is irreversible and the mixture has a limited pot life, can be set off quickly by heat and, once set, cannot be re-melted or dissolved." No explanation about whether this is a hot or cold-setting glue, no trade name. Can anyone help?

Just to dispel rosy optimism about animal glue, one can read in David Munrow's Instruments of the Middle Ages and Renaissance, O.U.P. 1976, page 70: "In one of the more spectacular performances of the Monteverdi Vespers (1610) in recent times, one cornett did literally come unstuck. (...) In fairness it must be said that the taxing solo parts ... are enough to make any cornett want to fall apart." Munrow referred to top d". One could always adopt Andrew Parrott's downward transposition.

For sticking the leather onto my cornetti I've been using contact adhesive. It's not ideal. Mistakes are easy and messy, and it is discouragingly difficult to make a neat join at the end. I've only just begun to experiment with animal glue for this purpose, and a pretty thick concentration has worked well on samples. The nicest thing is the way the dampness gets the leather to mould itself onto the wood and into hollows. Has any other cornetto maker reading this got any useful advice or information, please, about this? I'd like to know about degree of resistance to moisture, oil, warmth, and fungal attack. The facts seem strangely hard to come by, and I'm tired of hearing "Oh no, squire, scotch glue went out years ago", and "Glue pot, boss? Yer tellin' me they still make 'em?" and "You say you've actually got some scotch glue? In them little pellets? Good God, that takes me back a good while!"

I might as well be talking about dinosaur glue.

FoMRHI Comm. 250

STRINGING KEYBOARD INSTRUMENTS - (a Nuts & Bolts Comm.)

John Rawson

This is a short note about the technical problems of putting strings on a keyboard instrument. It does not go into deciding what strings to put on - just how to do it. It is based on the use of Brass wire, which is the weakest and most brittle material, normally run very close to breaking stress, and therefore most likely to break. Steel wire is much easier to use but is harder on the hands.

Strings usually give their best tone if they are close to their breaking stress. This introduces a problem, in that to fit an actual string one has to damage it somewhat in bending it around pins, and so the more careful of one is the less likely it is to break. Some layouts are worse from the structural point of view than others, so it is a field that deserves thought.

1. The Wrestpin. These should be small to facilitate tuning, but large enough for strength. 4mm diam does for most things. Only Fortepianos need anything the size of a Zitherpin. 4mm pins can be easily made from 100mm nails which are of cold-forging grade steel and ready pointed. The traditional taper is of real use, but no commercial pins have one (some have a lead-in taper, which is little good). Putting a hole through a pin makes it much easier to fit the string but is not authentic. The large size of the pin relative to the string means that the string is not severely kinked and probably does not break at this point.

2. Bridgepins. To keep kinking to a minimum they should not be made smaller than necessary. However the size is often fixed by other factors, such as size of bridge, distance between strings, etc. It is most important that the pins should be firm in the bridge and that side and down-bearing should be correct or the vibrations will not be transferred properly.

3. Hitchpins. There are three main layouts.
(a) Eye. An eye can be made on a string by looping around a hook and twisting. The twist must be long enough to not slip.
(b) Knot. One can a take a turn around the hitchpin and then 3 turns around the wire with the intention of it pulling up tight.
(c) loop. Here the wire runs from a wrestpin around the hitchpin and back to another wrestpin.

Method (c) is a piano design that avoids the knot or eye altogether and is good structurally. But it is difficult to fit and one has to remember to make the hitchpins twice as strong as for other methods or they may bend over.

Method (b) is used by many makers but I have not had good results with it. For me it either slips irregularly, upsetting the tuning, or else comes undone altogether. In any case it is difficult to get the remains of a broken string off the pin. However it is easy to wind without tools.

Method (a) is the one I prefer as I use an electric winder and so can make a long twist quickly and easily. It needs to be at least 20mm long to be sure of not slipping and to finish straight across to transfer the load smoothly to the standing part of the string.

The hitchpin takes the full load of the string in bending. For 3 or 4 kg on a clavichord 1mm brass pins will do. For heavier loads one needs thicker pins up to 2mm steel on fortepianos (made from nails). The pins need to be fitted to hard wood for best support. If you have to put them into soft wood, such as harpsichord 4' strings, It is best to use long steel pins which are less likely to bend. They should lean backwards a little, particularly if there is downbearing to them or else the strings will come off when one is fitting them. If one cannot drill for them at an angle one can drill straight down and bend the pin a little before insertion.

Small sizes of wire (up to 0.5mm) can easily be snapped in the fingers by making a loop and pulling it tight, but it is wise to start on a thin wire or it can be hard on the fingers. It is so easy in fact that one sees why it is necessary to reject any piece of wire that is at all kinked. The thicker steel wires used on early pianos are much harder to deal with and one may have to wear gloves, also one needs to handle them carefully as their sharp ends can make painful cuts.

There are no problems in putting the string on. One puts the loop over the hitchpin, cut the string to length and wind on to the wrestpin, keeping the hands low so that it does not come off the hitchpin. When the wrestpin nears its hole one puts it in and hammers it down all the time keeping the string taught with the left hand. Then one takes up any slack with the tuning hammer and slips the string onto the bridge pins. Pull it approximately up to pitch at once.

Some Thoughts on Manufacture and Production

The Early Music Centre in Holland Park arranged a day's Seminar just before Christmas on various aspects of instrument making. Most of the speakers were FoMRHI members and so I will leave it to them to write up whatever parts of their material they would like to discuss with the membership as a whole, and concentrate on my own subject and some further thoughts that arise from it.

I was asked to talk about folk instrument making techniques and how they could be of use to us, and I must admit that I drew pretty heavily on Holtzapfel's Turning and Mechanical Manipulation (Holtzapfel & Co, 1878, 5 volumes - 6 were announced but the last never appeared), which includes a mass of information on simple hand techniques as well as on very elaborate mechanical methods; it is by no means confined to lathe work. Also on Laurence Picken's Folk Musical Instruments of Turkey (Oxford Univ.Press, 1975), which is the best book ever to have been written on musical instruments of any sort and includes detailed descriptions of the manufacture of many of the instruments. Also on my memory of a paper which Ian Morrison gave to the UK branch of the IFMC in Edinburgh in 1978 and which he has promised to expand for us one day; he is an archaeologist who has worked in the Middle East and has taken the opportunity of watching 'ud and other instrument makers at work.

The point is that "early instruments" are still in normal use in a good part of the world, and if the instruments are not exactly the same, their constructional techniques are. A Turkish kaval is by no means the same as a mediæval recorder, but both are cylindrically bored duct flutes, and if you can make one on a hand-operated bow lathe, so you can the other. Equally, a saz and a kemençesi (Black Sea fiddle) are not the same as a rebec, but if you can hollow one out to a wall thickness of 2 or 3mm with an adze, using a gouge for the final cleaning, so you can the other. Examing the instruments made in these ways makes it quite clear that we do not need expensive mechanical equipment to set up shop; if we are content to use traditional methods, then we need little or no capital expenditure. What we do need is skill, and this can either be acquired laboriously through experience, through training if we can find anybody skilled in the old methods to teach us, or by planning our holidays to include visits to countries where these techniques are still in use.

There are also practical advantages in the older techniques; Paul Hailperin found (FoMRHIQ 13 p.9) that hand-hammered bells produced a different sound from spun bells on oboi da caccia. I have the feeling that the constant vibration from machine tools can upset materials; they will settle down again but in the meanwhile their responses can be misleading. Francis Baines always said that a coach journey shook all the low notes out of his double bass, and as a timpanist I would agree with this; we both found it took most of the three hours of rehearsal or even longer for the instruments to settle down again. I advanced the theory, which the audience did not think much of, that a reciprocating lathe such as a bow lathe allows the work and the tool to rest on the back-stroke, thus reducing any effects of pressure and any risk of over-heating.

The 'ud making techniques of the Middle East could be of particular relevance to us. Many makers churn them out in considerable quantities and while one would hesitate to say that they slap them together, certainly they are no more carefully made than a good many old lutes in European collections. One of the other speakers said that his customers expected their instruments to be made to a high level of craftsmanship. Looking round our museums, one can see that this was also true for some

customers and some instruments in the old days, but by no means true for all of either. I am convinced that there is a market today, also, for the ordinary instrument, not slapped together any old how, but a good competent job put together without any trimmings, the equivalent of the 8/6 (about $1.25) violin of the catalogues of the early years of this century. If I may take an anaology from another trade, there used to be bespoke boot-makers in St.James's (a very high class part of London), shoe-makers in towns up and down the country, and cobblers in most villages. They all made perfectly good shoes, but standards of finish and of price differed; they were, of course, all hand-makers and they would all make to order and to your size and shape of foot. There was little point in going to St.James's unless you or your manservant had hours to spend, polishing and boning the shoes to the sort of gloss that the sergeant-major used to expect on the square. Equally, you wouldn't go to the village cobbler for something to wear in the ball-room at Buckingham Palace. Now I am certain that far more people are buying St.James's instruments than need them, and I am also certain that a lot of people are paying St.James's prices for ordinary town instruments, and that many people who would be happy enough playing at home and in small groups with cobblers' instruments can't get them.

If any of you agree with me, what about going back to folk techniques, to those cobblers who are still making excellent shoes or instruments for ordinary people to wear or use?

One of the problems is price, and here we come onto a phenomenon that did not exist in older times; how do we stand regarding the instrument trade and the dealer? We live in a market economy, in which the population as a whole is accustomed to going to supermarket, or at least to the retail shops, for its needs. No longer does the butcher have a slaughter-house in the back yard, and not all early musicians want to, or can, go from maker to maker to find the instrument they like (this is the great value of the biennial Early Music Exhibition; the customers can go from stand to stand and try the products of different makers and then order what they prefer, but its scope is still pretty limited both in the customers who can get to it and the makers who can show at it).

So let us take an imaginary maker who has made an instrument. It has taken him so many hours, and he reckons his time is worth so much an hour. He adds on a proportion of his rent and other costs and a share of the capital expenditure in setting up the workshop, plus whatever it cost in materials with whatever interest that money would have accumulated while the materials were seasoning (and probably a few other things I've forgotten) and finally whatever profit he thinks will keep him happy and interested in instrument making. For convenience let us say he arrives at a figure of £100. Now anybody coming to his workshop can buy that instrument for £100 (plus VAT of course or whatever sales tax the local form of governmnet imposes). Suppose now a dealer comes. If the maker is looking for high turnover and small profit, he may be willing to give the dealer a discount; if, on the other hand, he says that £100 is the right price, then that's what the dealer has to pay.

However, the dealer also has to live; he has to cover the costs of his shop, his advertising, his sales staff and allow for the fact that the instrument may sit in the shop, losing interest on his purchase cost, for six months or more. So he adds a mark-up, let us say 50%, so that the instrument now costs £150. And here is where the trouble starts. The customer can either go to the dealer and pay £150 or to the maker and pay £100. And if the customer is canny, he can go to the dealer and try a dozen different makers' instruments and then go to the maker of his choice, so the dealer is acting as a shop window but isn't selling

any instruments, and that way he will go bankrupt before long. So the dealer goes to the maker and says "Look mate, I know you say £100 is the right price for your instrument, but if you will sell them to me for that price and to everyone else for £150, we can both make a living. And if you won't, I can't afford to stock your instruments, and then you won't sell so many". Now some makers are quite happy to go along with this and get an extra fifty quid for nothing from their private customers. Others are less happy about it and feel, as I do, that this is why people are paying St.James's prices for ordinary town instruments (and the mark-up suggested hasn't always been as low as 50% by any means).

Several members have been talking to me about this situation. Some have gone along with the suggestions and some haven't, but all are worried about it. I thought therefore that it was time to bring it into the open and encourage some discussion of it. I must admit that I don't know what the answer is. The dealers do have to live as well as the makers, and I think that we should bear in mind that some of the dealers have done a tremendous job in making instruments available and in making the public aware both of the instruments and of early music itself. Had it not been for Richard Wood's enterprise in setting up the Early Music Shop and in initiating the Early Musical Instrument Exhibition, there wouldn't be a lot of the interest there is today, and there wouldn't be EMIMA or FoMRHI, both of which started at Exhibitions. Other dealers I am sure have also benefited us, so don't let's just start dealer-bashing.

We would welcome discussion on either of the main aspects of this Comm. both on cobblers' instruments and on how to deal with pricing, and from both sides, for we have several dealers among our members. Any of you who are interested in folk techniques and who have practical experience of using them are asked to write them up for us.

One final point, and a return to the beginning: the Early Music Centre is thinking of holding another similar Seminar in a year or so. If you didn't hear about this one and would like to have, drop them a line and ask them to let you know. The address is in the Members List.

FOMRHI Comm. 252

MORE ON COMPUTER CATALOGUES

In October's FOMRHI Quaterly Tim Hobrough asked if I could give more details of my computer-based catalogue, certainly! It arose from a card listing I had produced to keep my data in order. To do this I kept simple numerical listings and assigned new finds the next number on the list - thus creating a random file. I then set out to devise a standard format which catered for all conditions that need recording for all instruments and this I fed into the computer. However, at this point, two problems arose:- i) as all new entries of the catalogue were at the end, the first 100 pages or so (then), 300 pages or so (now) were simple repetitions of the previous listing and therefore pointless; ii) As all finds were different, about 80% of the file was made up of zero-value data e.g. mouthpiece type:- No data, Instrument tonality:- No data, etc. etc. Thus, each fresh outputting of the file simply consumed trees!

A further sophistication built into my original system was provision for graphics. Data was stored as co-ordinates and a graphics routine utilised to draw these. However, once again two major problems arose:- i) In order to get adequate definition of the graphic image a large number of individual points are required and these take a) some time to encode and b) a lot of space on tape/disc/w.h.y. ii) If the graphic image is to be outputted with any definition, it must be done on a plotter thus necessitating a second operation, following the outputting of the textual data. For my part I now use a graphics package (PICASO - excuse the spelling: only six letters allowed!!) when I wish to examine a particular instrument in detail but not as part of the catalogue.

Following my initial efforts I had to produce a neat listing of my index and transferred the card-index information into a reasonably standardised format on A4 paper. I then realised that 99% of this data would remain unchanged during a given year and therefore hardly needed a computer to re-organise it! What was needed, however, was a quick way of getting into the data at the appropriate point. This is now accomplished by assigning key words to all my ertries - very liberally - and giving this to the computer to sort out. Some references have a dozen or more ertries - greatly facilitating retrieval of data. Every time I use a particular reference I tend to add further cross-referencing - thus making the data more accessible next time. One tends to know one's own data anyway and a listing like mine helps to lubricate the system! It's also very handy to have a listing which you can amend at will knowing that the computer can up-date it for you! All my program really does, therefore is to produce an index - or rather two, one alphabetic and one numerical. This it formats into an easily usable form and integrates whatever new data has been added. In this way it supplements an existing filing system making buried data more accessible.

As for Ed. Bowles' comments - I agree entirely but I shudder to think of the work involved. At times I have wondered whether I was in the catalogue/index business or researching instruments! My own efforts have absorbed literally hundreds of hours of effort. The net result is what I feel to be a pragmatic answer to the problem. It is for most people a delicate balance between time absorbed in compiling the index and time saved by having it available. I was about to go on to say that the scales tipped against me on this score but can think of several inter-relationships that have come to light as a result of my index. What the computer really does is to allow one to start small with a listing of a few entries and to add to this at will.

In conclusion then my system consists of a standard card-index system (duplicated on A4) plus a very extensive computer-based cross-referencing index based on keywords. This index is about 30 pages (3000 entries) long compared with 300 pages for the catalogue. To use my program as it stands, all that is required is a keyword listing with numerical references preceeded by "DR" documentary reference; "IC" iconographic reference; "SD" specimen detail; "SR" specimen represertation. (See details in comm. 225, p. 48, July 79).

That's it really, nothing clever - but it works. If you wish to know more, drop me a line or give me a ring.

Peter Holmes

FELLOWSHIP of MAKERS and RESTORERS of HISTORICAL INSTRUMENTS

1979 LIST OF MEMBERS - 3rd Supplement, as at 3rd January 1980

* in left-hand margin denotes a change of address from the main List or one of the previous Supplements.

Lars H.Andersson, Vaisalavägen 8, 02130 Esbo 13, Finland; tel:90-464440 (viol; M,P).
Donald Barney, add: (strings, woodwind; M,P).
Neville A.Bland, 108 St.John's Road, Ipswich, Suffolk, IP4 5DG; tel: 713596 (string instrs; M,R).
* Cristobal Boettcher, 6900 Heidelberg, Postfach 101364, West Germany.
Werkgroep Bouwers-Kontakt, insert: 3511 GP Utrecht.
Robert Bramley, Cedar Cottage Nursery, Crown Lane, Farnham Royal, Bucks; tel: Farnham Common 5627 (lute, viol. woodwind; M,R).
* Maurice Briggs, 1A Locke Street, Warwick, Queensland, Australia 4370.
Neil Brook, add: PR2 4QE.
David Butler, change phone no. to: 704, and add (...guitar).
Rod Cameron, add: tel: (415) 282-8653.
Robert Clair, 2021 Francisco St., Berkeley, CA 94709, USA; tel:(415) 841-9431 (recorder, lute, double reeds; C,P; physicist).
Sand Dalton, change phone no. to: 2930 and add: (...flute, recorder, bassoon, P).
Henk van Dijk, change instrs to: (keybds, esp.clavichord,M,P; lute,M, tpt).
* John Downing, 1 Balcomie Crescent, Troon, Ayrshire KA10 7AR; tel: Troon 316536.
Doug Eaton, change instrs to: (flutes, viol bows, M,R; timber, res).
Basil C.A.Foraud, 9 Cuckmere Path, Uckfield, Sussex TN22 1LY; tel: Uckfield 2812 (harp, harpsichord; M).
Ian Gould, add: B77 5EZ.
R.A.Greensitt, 48 Colne Way, Watford WD2 4NA; tel: Watford 39247 (harp, woodwind; M,P).
Philip Gruar, 17A Marden Road, London N17; tel:01-808 7172 (flute;M,P).
Dominic Gwynn, add: (..., regal).
Leonard W.Hanna, 94 Courcelette Rd, Scarborough, Ontario, Canada M1N 2T2 (bar.tpt, cornett, shawm, recorder; P).
G.J.van der Heide, Withagersteeg 4, Putten (Gld), Netherlands.
B.N.Heighton, 55 Winchester Road, Countesthorpe, Leicester LE8 3PH.
W.V.Helmond, Achthoeven 25, 5071 AP Udenhout, Netherlands; tel: 04241-2214 (keybds, organ, hurdy-g, ww; M,R,C).
David Hill, Havenfields, Great Missenden, Buckinghamshire HP16 9LS; tel: Great Missenden 3655 (violin, viola, cello; M,R).
* Tim Hobrough, c/o Gorehill House, Gorehill, near Petworth, West Sussex; tel:0798-43112.
Jon Hunnisett, 146 Albert Road, Southsea, Hampshire PO4 0JS; tel: 0705-730561 (all strings; R).
Edgar Hunt, change to: Rose Cottage, 8 Bois Lane, etc.
Akira Ishii, correct to: Mizutami
Mark Andrew Jackson, 6 Maltings Mews, West Street, Hertford, Hertfordshire SG13 8ES; tel: Hertford 58908 (fretted strings; M).
Peter Kempster, add: (small harp,M; any harp,R, harp strings, D).
Tim Kendall, Mount Pleasant Coanwood, Haltwhistle, Northumberland (recorder; P).
Mary Kirkpatrick, add: OX5 3RY.
* Eugene Lambe, "Wavecrest", 119 Upper Salthill, Galway, Eire, and add: (.... flageolets, M).
Graham Little, 35 St.Hilda's Street, Sherburn, Malton, North Yorkshire YO17 8PG; tel: Sherburn 501.
Robert Longstaff, add: (....rebec, psaltery, dulcimer).

Bengt Lönnqvist, change code to: S-59156.
* J.C.Macpherson, 64 High Street, Fochabers, Moray IV32 7DM.
William Margolis, Bena, Virginia 23018, USA (recorder, lute, computer models, programming, etc).
Geoff Mather, add: WN4 ORF.
* C.R.F.Maunder, 54 High Street, Sawston, Cambridge CB2 4BG; tel: Cambridge 832112 (keybds,MRCP; ww, MRC; bass viol, bar.fag.,P).
David Miller, delete 13 from beginning of address.
* Stephen J.Minett, 15 Woodside, Wrenthorpe, Wakefield, West Yorkshire.
* Jacob G.Misset, 'T Bijltje 8, Middelburg, Netherlands; tel: 01180-37852 (lute, archlute, theorbo, vihuela; M,P).
Anthony Moonen, insert: 6216 TE Maastricht.
Thomas Munck, add: Margaret Munck.
Christopher Page, revise instrs to: (string instrs pre-1450, perf.practice).
Samuel Palmer, 152 Romford Street, Whitechapel, London E1; tel:01-385 8054 (string instrs, esp. hurdy-g; M,P,R,L,T).
Susann Palmer, 56 Brookville Road, Fulham, London SW6; tel:01-385 8054 (all instrs,esp. hurdy-g; C,P,L,W).
P.D.Pearson, Yeomans, 3 Hollies Rd, St.Stephens, Launceston, Cornwall; tel: 2369 & 2371 (recorders, narrow-bore wind caps; M,P).
Michael Plant, add: tel: 0742-306744.
Duncan Preston, change instrs to: (clavchd, zithers, plucked strs, M,C,P).
John Pringle, add: baroque.
* Malcolm Prior, 471 Battersea Park Road, Latchmere, London, SW11.
Paul Rans, 62 Palewell Park, London SW14 8JH; tel: 01-878 7362 (lute;M,P).
Thomas Rein, 2076 Ash Grove Pike, Nicholasville, KY 40356, USA; tel: (606) 273-3168 (guitar; M).
* William Samson, 10 Manse Crescent, Stirling, Scotland FK7 9AJ; tel:61391.
G.D.Saunders, 205 Whiteladies Road, Blackboy Hill, Bristol 8; tel: 0272-35149 (recorders, D).
A.J.Schoolderman, P.Saenredamstr. 16, 7312 RE Apeldoorn, Netherlands; tel: 055-251746 (guitar, lute; M,P).
A.W.Simpson, add: BN7 1XN.
Roger Spalding, correct code to: BD18 4DY.
* Peter Spencer, 43 Lode Way, Haddenham, Ely, Cambridgeshire; tel: Cambridge 63125 ext.214.
Helge Michael Stiegler, Kopernikusgasse 10/6, Wien 1060, Austria (recorder; M,P,L).
* Heinrich Thein, 2800 Bremen 1, Stavenstr.7, West Germany; tel:0421-325693.
M.J.Turner, c/o St.Barnabas Vicarage, Oak Hill Road, Beckenham, Kent (lute, rebc, hurdy-g, psltry, viol; M).
Ian Watchorn, add: tel:062-542101 (...... bows).
Hirotaka Watanabe, 22-4, 5 Chome, Kamimeguro, Meguroku, Tokyo 153, Japan (lute, guitar; M,P).
* Maish Weisman, 442 Monterey Dr., Laguna Beach, CA 92651, USA; tel:(714) 494-2872.
Henk de Wit, insert: 1011 AX Amsterdam.
Jack Woodahl, change instrs to: (bar. flute, oboe, bassoon; M).
Nicholas Woodward, 87 Cumberland Road, Bristol BS1 6UG; tel: 0272-28489 (violin & viol family; M).
Russell Wootton, add: DY11 7TE.
* Nigel Wyatt, 31 Boyden Close, Wickhambrook, Suffolk.
Arthur F.Young, D-5030 Hürth-Mitte, Villering 26, West Germany; tel: 02233/72278 (bowed & plucked strings; M,P).

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<u>Computers</u>: William Margolis
<u>Iconography</u>: William Margolis
<u>Performance Practice</u>: Chris Page
<u>Photography</u>: Marcel Glover
<u>Recording</u>: Marcel Glover
<u>Woods</u>: Doug Eaton

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Organological Index

All instruments: AE Hirschfeld, Susann Palmer

String instrs. general: Donald Barney, Neville Bland, Jon Hunnisett, Mark Jackson, Christopher Page, Samuel Palmer

Strings: Peter Kempster Dulcimers: Robert Longstaff

Psalteries: Robert Longstaff, M.J.Turner

Misc.Zithers: Duncan Preston (ch'in, cheng)

Keyboards general: W.V.Helmond, Margaret Munck

Harpsichord etc: Basil Foraud,h Michael Stevens,hvs

Clavichord: Henk van Dijk, Duncan Preston

Plucked strings general: Arthur Young

Lute: Robert Bramley, Robert Clair, Henk van Dijk, William Margolis, Jacob Misset, Paul Rans, A.J.Schoolderman, MJ Turner, Hirotaka Watanabe

P'i-p'a: Duncan Preston

Guitar: Neil Brook, David Butler, Thomas Rein, A.J.Schoolderman, Peter Storm, Hirotaka Watanabe

Vihuela: Lawrence Brown, Jacob Misset

Cittern etc: Lawrence Brown, cob

Bowed strings general: Arthur Young

Bows: Doug Eaton, Ian Watchorn Rebec: Robert Longstaff, M.J.Turner

Violin family: David Hill, Nicholas Woodward

Viols: Lars Andersson, Robert Bramley, A.E.Hirschfeld, Margaret Munck, M.J.Turner, Nicholas Woodward

Hurdy-gurdy: W.V.Helmond, Samuel Palmer, Susann Palmer, M.J.Turner

Harp: Basil Foraud, R.A.Greensitt, Peter Kempster

Woodwind general: Donald Barney, Robert Bramley, R.A.Greensitt, W.V.Helmond, Brian Vale

Transverse Flute: Sand Dalton, Doug Eaton, Philip Gruar, Jack Woodahl

Recorder: Robert Clair, Sand Dalton, Leonard Hanna, A.E.Hirschfeld, Tim Kendall, William Margolis, P.D.Pearson, G.D.Saunders, Helge Stiegler

Flageolet: Eugene Lambe Kortholt: Marcel Glover

Organ: W.V.Helmond Regals: Dominic Gwynn

Reed instrs. general: Robert Clair, A.E.Hirschfeld, P.D.Pearson

Bassoon: Sand Dalton, Jack Woodahl Oboe: Jack Woodahl

Shawm: Leonard Hanna Trumpet: Leonard Hanna Cornett: Leonard Hanna,c

Geographical Index

Austria: Helge Stiegler, Wien Belgium: Martin Jones, Lasne

Canada: Leonard Hanna, Ont Finland: Lars Andersson, Esbo

West Germany: Arthur Young, Hürth Japan: Hirotaka Watanabe, Tokyo

Netherlands: A.J.Schoolderman, Apeldoorn G.F.van der Heide, Putten
W.V.Helmond, Udenhout

United Kingdom, England by counties:

G.D.Saunders, Avon	Peter Spencer, Cambs	R.A.Greensitt, Herts
Nicholas Woodward, --	Steve Heavens, Chesh	Mark Jackson, -----
Robert Bramley, Bucks	P.D.Pearson, Cornwl	M.J.Turner, Kent
David Hill, -----	Jon Hunnisett, Hants	B.N.Heighton, Leics
London:	Samuel Palmer, E1	Susann Palmer, SW6
	Philip Gruar, N17	Paul Rans, SW14
Tim Kendall, Northumb	Basil Foraud, Sussx	Graham Little, N.Yorks
Neville Bland, Sufflk	Tim Hobrough, W.-----	

Scotland: John Downing, Ayrshire Margaret Munck, Glasgow

U.S.A.: Robert Clair, CA Thomas Rein, KY William Margolis, VA

FoMRHI Book News Jeremy Montagu

Malou Haine's book Adolphe Sax, sa Vie, son Oeuvre, ses Instruments de Musique, has just arrived and I don't think I'm going to have time to read it before this issue ought to go off to Djilda. It will be reviewed in the next issue, but you ought to know about it now. It is published by Editions de l'Université de Bruxelles, Parc Léopold, Rue Belliard 137a, 1040 Bruxelles and costs 480 Belgian francs. At a quick glance it looks a useful study, with full lists of patents of all the family (father, brothers, etc).

Bouwerskontakt: The rest of Bouwbrief XIV has come. What was missing from my copy noted in the last issue was some reviews (they seem to agree with us on Charles Ford's Making Musical Instruments) and notes on courses, with a couple of pages on last year's Schloss Breiteneich instrument makers' course, one page of which is quite a detailed plan of a cylindrical 'sopraanblockfluit' (290mm speaking length) designed by Alec Loretto. Further to what I said last time about Toon Moonen's articles on crumhorns, he tells me that he has got more information now and wants to revise the whole thing. He will remember that we are interested too, and when he is ready to rewrite it will either provide us with a translation or with the Dutch text which we can get translated.

No.XV has also arrived. There is a 3 page article on measuring and drawing instruments by Flip Baart; a brief note on filling the pores of pallisander by Hans den Brok, 2 pages (which includes the previous note) by Jan Bouterse on flute making; 5 pages by Toon Moonen ,'Kromhoorns, verder onderzoek, rektifikatie en konklusies', the final details on the crumhorn referred to in the previous paragraph; I hope that he will now put it together for us in whatever form he wants. There are several short notes on flutes, guitar-barring and recorders (1 page each or less) and two pages by Jan Hendriks on the labium of the recorder. As always, the copy is with Djilda at NRI if you want to see it or have copies of any of it.

Tom Savage tells me that E.P.Dutton in New York have published a book by Irving Sloane, Making Musical Instruments, which includes a chapter on the Hardangerfele, with plans, constructional details, etc. "The book also covers the construction of Banjos, Drums, Dulcimer (Appalachian) and Dolmetsch Recorder", he ----

FoMRHI Comm. 253

A THEORY OF VIOL DESIGN I

Ephraim Segerman

GEOMETRY OF THE INSTRUMENT-STRINGS RELATIONSHIP

Introduction

Mathematical expression of the geometry of the relationships between strings and an instrument allows the deduction of the sizes of some variables when others are known or easily estimated. Viol makers, when they have to, usually perform these operations either on a drawing board or experimentally with wood and strings. Such procedures often involve some trial and error. If the maker is comfortable with mathematical techniques the methods outlined here can get a new model into a working instrument more quickly.

When typical parameters for each size in each tradition of viol making are documented, these design operations will not be needed. The variables defined here could then provide a convenient means for communicating this information.

Meanwhile viol makers often avoid such design exercises by copying either modern viols which are deemed by players to be successful or surviving instruments which almost always are set up according to 18th century practice. If one either attempts to make an instrument set up in a 17th century way or if one is scaling a model to a different size with various parts involving different scale factors, a design exercise is required, and the methods here may be of some use.

We intend to write future Comms. in this series on the theory of scaling to different sizes and on an exploration of the sizes of parameters on some original viols.

Curvature of fingerboard, undersides of strings and bridge

We need first to define the variables used. Visualization might be helped by referring to Figure 1. Let the symbol 'q' represent the radius of curvature of the fingerboard surface or the projection of the fingerboard, the symbol 'r' represent the radius of curvature of the underside of the strings and the symbol 's' represent the radius of curvature of the top surfaces of the strings. Let the subscript 'n' associated with the above symbols represent the nut position, '7' represent the seventh fret position, 'e' represent the position at the end of the fingerboard away from the nut, 'o' represent the position in the bowing plane and 'b' represent the position at the bridge. The subscripts will also apply to the symbol 'l' which represents the distance from the nut to the specific position, to the symbol 'a' which represents the height of the bottoms of the strings above the fingerboard, to the symbol 'f' which represents the straight-line distance between the bottoms of the two end strings, and g represents the distance between lines connecting the total width of the fingerboard at the nut and the total width of the top of the bridge (without necessarily also being the width of the fingerboard in other places). To a close enough approximation the variables q, r, s, a, f and g are linear with respect to l. Let us call any one of those six variables u, and assign x, y and z to any three of the subscript position variables n, 7, e, o and b. Knowing the l's and the u's at y and z, we can calculate the u at x. This linearity can then be expressed as:

$$\frac{u_x - u_y}{l_x - l_y} = \frac{u_x - u_z}{l_x - l_z} \qquad (1)$$

and the solution for u_x is:

$$u_x = u_z \left(\frac{l_x - l_y}{l_z - l_y} \right) + u_y \left(\frac{l_z - l_x}{l_z - l_y} \right) \quad . \qquad (2)$$

As an example, if we know the u variable at bridge and nut and want to know it in the bowing plane,

$$u_o = u_b \left(\frac{l_o - l_n}{l_b - l_n} \right) + u_n \left(\frac{l_b - l_o}{l_b - l_n} \right) \quad .$$

But since $l_n = o$ we can write this formula as

$$u_o = u_b \frac{l_o}{l_b} + u_n \left(1 - \frac{l_o}{l_b} \right) \quad . \qquad (3)$$

Some other relations between our variables are

$$3\, l_7 = l_b \qquad \text{and} \qquad (4)$$

$$q_x + a_x = r_x \quad . \qquad (5)$$

Thus, using equations (2), (4) and (5) we get

$$r_b = 3\, a_7 - 2\, a_n + q_b \quad . \qquad (6)$$

The variable a_n is the height over the fingerboard of the bottoms of the notches in the nut, i.e. the height of the zero'th fret (which need be hardly any higher than the first fret than the first fret is than the second fret). We use a_7 as the measure of the height of the action; i.e. the height of the 7th fret plus the clearance over that fret of the bottoms of the strings. This equation (6) gives the radius of curvature of the bottoms of the strings r_b, in a plane at the bridge position which is parallel to the planes that the other radii are measured in. This equation involves a_n and a_7 plus q_b, the projection of the fingerboard onto that plane (i.e. the curve generated at the bridge position when one runs a straightedge over the fingerboard's curve). To translate such curvatures in their plane to curvatures in the actual plane of the bridge, one needs to take into consideration the angle between the two planes, which we shall call 'δ'. We assume that the fingerboard surface and the bottoms of the strings lie on coaxial cones (the strings and edges of the fingerboard do not, in general, lie along elements of these cones; the angles between these lines and cone elements have been considered to be negligibly small). The radii of curvature q and r as well as the distances a and f are measured in planes perpendicular to the axis of these cones, which runs through the centres of curvature. The angle between the perpendicular to this axis and the bridge can be seen on an elevation drawing of the instrument.

When a circular arc is projected onto a plane that is at an angle to the original plane of the arc, an ellipse is generated. As is common in drawing-board practice, an ellipse can be approximated by two symmetric pairs of circular arcs, one pair with larger radius and the other with smaller radius than the original circle. The larger one is relevant here, and call the radius of this arc in the bridge plane (which goes through the bottoms of the string notches) 'r_b''. The relationship between r_b'

and r_b turns out to be:

$$r_b' = r_b \left[\delta - (\delta - 1) \cos \gamma \right] , \qquad (7)$$

where $$\delta = \frac{1}{1 - \dfrac{r_b - f_b}{\sqrt{r_b^2 - f_b^2}}} . \qquad (8)$$

The value of δ is normally about $2\frac{1}{2}$ and r_b' can be larger than r_b by about 10%. The error introduced by approximating the ellipse by a circle is less than $\frac{1}{2}$%.

Curvature of string bowing surfaces

In the last section we have related the radius of curvature of the under surfaces of the strings in the bowing plane to fingerboard and bridge parameters. To link this with bow clearances on the instrument, we need to relate the curvature of the under surfaces of the strings to the curvature of the upper or bowing surfaces.

The radius of curvature of the under surfaces is r_o and call the radius of curvature of the upper surfaces s_o. We can perhaps assume that one wants the same angle of clearance of the bow around each string and that the distances between adjacent string centers are all the same. Then the bowing surfaces need to be along a circular arc. Alternatively such a circular arc for the bowing surfaces would also serve well if one wanted to space the strings slightly further apart in the bass to give more bowing clearance to strings there.

We define the angle of bow clearance about a particular string as the angle between the bow hair when it touches both that string and its neighbour on one side and the hair when it touches both that string and its neighbour on the other side. If the clearance angle is the same about one of the neighbour strings as well, the angle subtended by the two strings at the centre of curvature is the same as the clearance angle. Let us call this angle α.

We can calculate the radius of curvature of the upper surface s_o if we assume all-gut stringing with equal tension so that string diameter is doubled for each octave down. We assume a 2-octave open-string range. The method chosen is to fit a circle to the extreme strings (the sixth four times the diameter of the first) and to a fictitious string in the centre with a diameter twice the first.

Using difference methods, we get

$$s_o = r_o + \frac{d_m}{4} \left(\frac{3 \cos^2 \theta - 2 \cos \theta + 1}{1 - \cos \theta} \right) , \qquad (9)$$

where d_m is the diameter of the thickest string, θ is half the angle subtended by the extreme strings at the centre of curvature of r_o. The length $f_o = 2 r_o \sin \theta$. (10)
On a typical viol s_o is greater than r_o by about $2\frac{1}{2}$ times the diameter of the thickest string. The centre of curvature of s_o is shifted to the bass side from the centre of r_o by an amount

$$\frac{3 d_m}{8 \sin \theta} . \qquad (11)$$

One plots the appropriate point for the variables shown on the bottom and on the left and uses linear interpolation to find the value of $\theta + \frac{\alpha}{2}$ accurately. In the case of f_o, $\frac{\theta}{\alpha}$ appears in the formula as well as $\theta + \frac{\alpha}{2}$, so a relationship between θ and α has to be assumed to make the lines on the graph. If m = the number of strings, we assume equal spacing, so $\theta = \left(\frac{m-1}{2}\right)\alpha$. We let m = 6 on the Graph.

In linear interpolation

$$\theta + \frac{\alpha}{2} = \left|\theta + \frac{\alpha}{2}\right|_L + 5^o \frac{\left(\frac{h}{c} - \left|\frac{h}{c}\right|_L\right)}{\left(\left|\frac{h}{c}\right|_R - \left|\frac{h}{c}\right|_L\right)}$$

where $\theta + \frac{\alpha}{2}$ is the accurate value of $\theta + \frac{\alpha}{2}$ for the plotted point, $\left|\theta + \frac{\alpha}{2}\right|_L$ is the $\theta + \frac{\alpha}{2}$ of the up and down line on the left, $\frac{h}{c}$ is that for the plotted point, $\left|\frac{h}{c}\right|_L$ is the $\frac{h}{c}$ for the intersection between the up and down line on the left and a horizontal line through the plotted point, and $\left|\frac{h}{c}\right|_R$ is the $\frac{h}{c}$ for the similar intersection on the right.

How the value of c related to the outside shape of historical viols is a subject for research. From a practical point of view, one can determine the end of c where the bow hair intersects the soundboard-edge plane by the following procedure:
Hold the bow so that the hair touches both the end string and its neighbour and notice how much distance there is between the bow hair and the third string in. Then angle the bow so that the hair has the same distance from the second string in. Then notice where the hair crosses the plane of the soundboard edges.

We have found it difficult to bow the end strings of viols when the end of c is just at the minimum width of the waist. These were all instruments with overhanging bellies and backs made by a famous maker around 1970. Most of the viols that we have played which afford comfortable bowing of the end strings have the end of c at about $\frac{1}{3}$ of the way in to the waist cutout. A good measure of this optimum on viols with waists is $c = \frac{1}{6}(W_u + W_m + W_l)$, (15)
where W_u and W_l are the maximum widths at the upper and lower bouts respectively and W_m is the minimum width at the middle bouts.

Application to designing a Viol

When designing a viol, usually one already has decided on body shape, bridge position, string stop, fingerboard length, fret heights, height of the strings over the fingerboard, neck geometry, arching height of the belly and bridge height. This allows most of an elevation drawing of the viol (with the bottom of a hyphothetical central string) to be made. One can't yet put in the edges of the fingerboard or of the bridge top. On the plan drawing we usually have these edges. We are most interested in finding the curvature of the fingerboard at the bridge-end once we have assumed a curvature at the nut end. The curvature at the bridge is also useful for drawing out its design.

In the elevation drawing one estimates the probable position and angle of the bowing plane and measures off h from the top edge of the soundboard at the edges to the string (string thickness can be ignored here). From the body shape one calculates c from formula (15). We now have $\frac{h}{c}$ for the Graph. We now need either f_o or g_o. For f_o, we need to put the end strings into the plan drawing and measure the distance between them in the bowing plane. Alternatively, we can assume f_b and f_n and get f_o from equation(3). For g_o, one accepts the approximate relation between end strings and edges at the bridge and nut. One then draws lines in the plan drawing between the edges of the bridge top and of the fingerboard a the nut, and one measures the distance between them at the bowing plane. Alternatively we assume g_b and g_n and get g_o from equation(3). We now have $\frac{h}{c}$ and either $\frac{f_o}{c}$ or $\frac{g_o}{c}$ for the Graph, which we use and get $\theta + \frac{\alpha}{2}$.

The magnitude of this shift is typically about the diameter of the thickest string. Such a shift can often be neglected. When bowing a string in the middle of its total clearance angle the bow hair is tangent to a radius of the s_o circle. When the bow is touching two strings simultaneously the hair is tangent to a slightly smaller circle with radius $t_o = s_o \cos \frac{\alpha}{2}$ (12)

The magnitude of t_o is about $\frac{1}{2}\%$ less than s_o and so the difference can often be ignored.

Geometric relation between strings and body in the bowing plane

At this point we relate the curvature of the strings in the bowing plane to the clearance the bow has with the edges of the soundboard. Figure 2 might help visualize the variables here. Let us assume that the edges of the soundboard (where the bow hair could come close to it) lie in a plane, and call the distance from the highest point of the arc (with radius t_o) of the tops of the strings to that soundboard-edge plane 'h'. This is close to the height of the arching plus the height of the bridge. We want to consider where the soundboard-edge plane is intersected by the hair of the bow when the end string has the same clearance angle as the other strings. This point on the t_o arc is at an angle $\theta + \frac{\alpha}{2}$ from the vertical line between the centre of curvature of the arc and the highest point of the t_o arc. Let us call the distance between this vertical line and the point of intersection between the bow hair and the soundboard-edge plane 'c'. We then find that

$$\frac{h}{c} = \tan\left(\theta + \frac{\alpha}{2}\right) - \frac{t_o}{c}\left(\frac{1}{\cos\left(\theta + \frac{\alpha}{2}\right)} - \frac{1}{\cos\frac{\alpha}{2}}\right) \qquad (13)$$

where we can let $t_o = \dfrac{g_o}{2 \sin(\theta + \alpha/2)}$ (13a)

The uncertainty in the value of c with which we are dealing here makes it quite justifiable to approximate $\dfrac{1}{\cos \alpha/2}$ by 1 and thus we can deal with only one angle variable $\theta + \frac{\alpha}{2}$, thus maintaining genera lity in how it may be split up by the strings. This says that we can also ignore the difference between t_o and s_o. We can also ignore the difference between these variables and r_o. So we can let $s_o = \dfrac{f_o}{2 \sin \theta}$ and derive the relationship :

$$\frac{h}{c} = \tan\left(\theta + \frac{\alpha}{2}\right)\left(1 - \frac{f_o}{2c}\right) + \frac{f_o}{2c}\tan\frac{\theta}{2} \qquad (14)$$

In each version of this formula there are five variables, θ, α, h, c and one of the variables t_o, f_o, or g_o. If we know θ, α and two of the three other variables there is no problem in using the formula to calculate the remaining one. But if one wants to find $\theta + \frac{\alpha}{2}$, which is often the case, these formulas are of little use. We therefore have a Graph relating the variables as a way to readily provide the solution. It is three graphs in one. They are used one at a time during which one makes believe the other two aren't there.

On the Graph we have $\frac{h}{c}$ varying left to right with its value on the bottom, $\frac{t_o}{c}$ varying up and down with its value shown on the left. As alternatives $\frac{f_o}{c}$ or $\frac{g_o}{c}$ also vary up and down and use the same scale as $\frac{t_o}{c}$. On this graph we have values for $\theta + \frac{\alpha}{2}$ plotted as up and down lines in steps of 5°, a set of lines for each equation.

ERRATUM FoMRHI No. 18, pages 36 and 37 are reversed.

If we used f_o, we assumed equal spacing and m = 6 strings. Then $\Theta = \left(\Theta + \frac{\alpha}{2}\right) - \frac{\alpha}{2}$ where the final $\frac{\alpha}{2} = \frac{\left(\Theta + \frac{\alpha}{2}\right)}{m}$, so $\Theta = \frac{5}{6}\left(\Theta + \frac{\alpha}{2}\right)$. Then equation (10) can be used to get r_o, i.e. $r_o = \frac{f_o}{2 \sin \Theta}$. If we used g_o, we can use its version of equation (10) which is $t_o = \frac{g_o}{2 \sin (\Theta + \frac{\alpha}{2})}$, and approximate t_o by r_o

Once r_o is known, with r_n assumed, we use equation (2) to find the parameters r_7 and r_b. Using equations (7) and (8) we then get the radius of curvature of the bridge r_b'. Given the action parameter a_7 we get q_7 from equation (5) and from q_n and q_7 we then use equation (2) to calculate the radius of curvature at the [illegible] of the fingerboard [illegible]

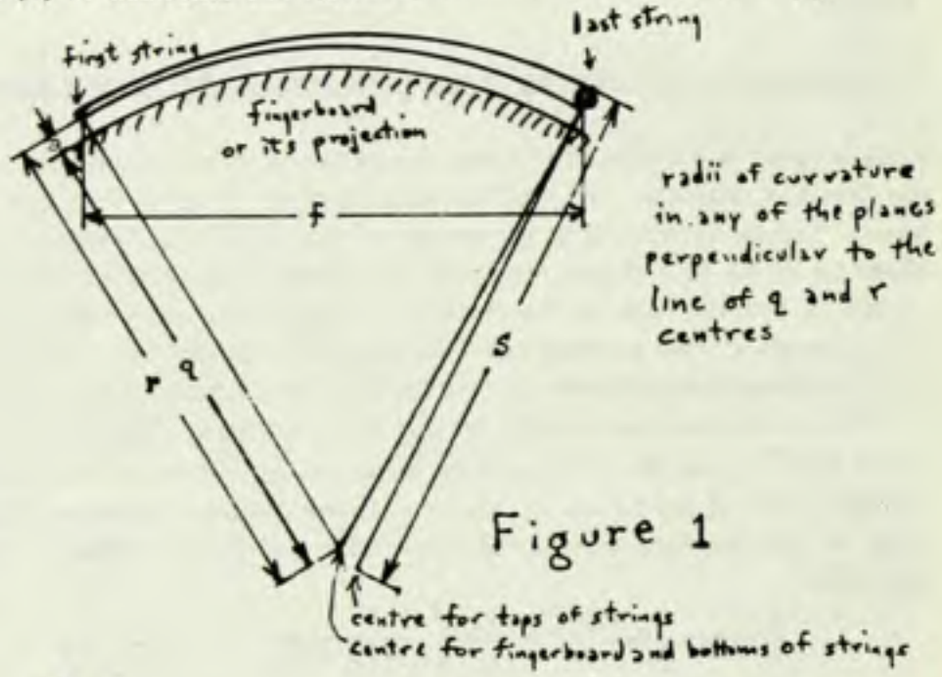


Figure 1

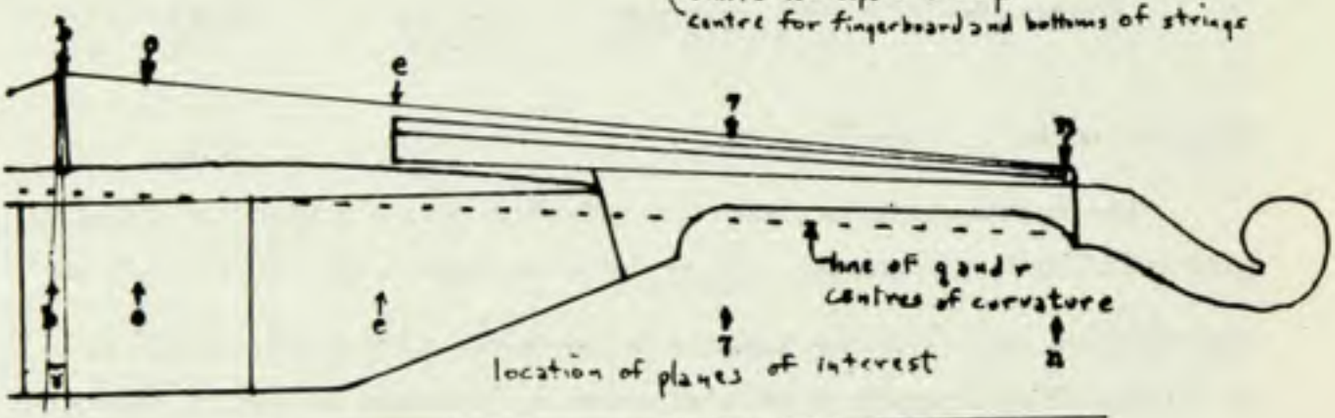
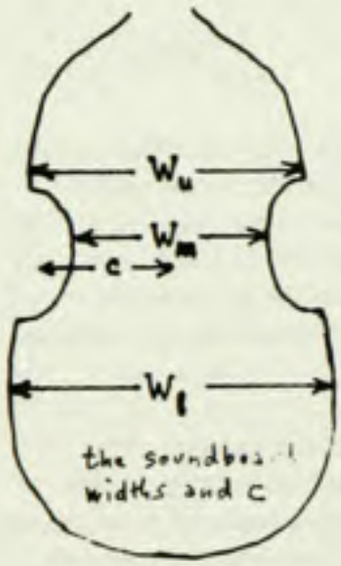


Figure 2



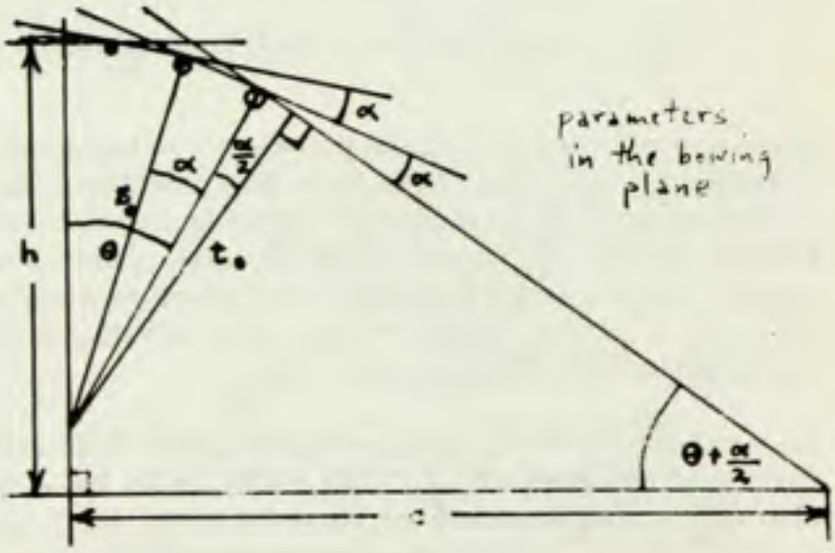
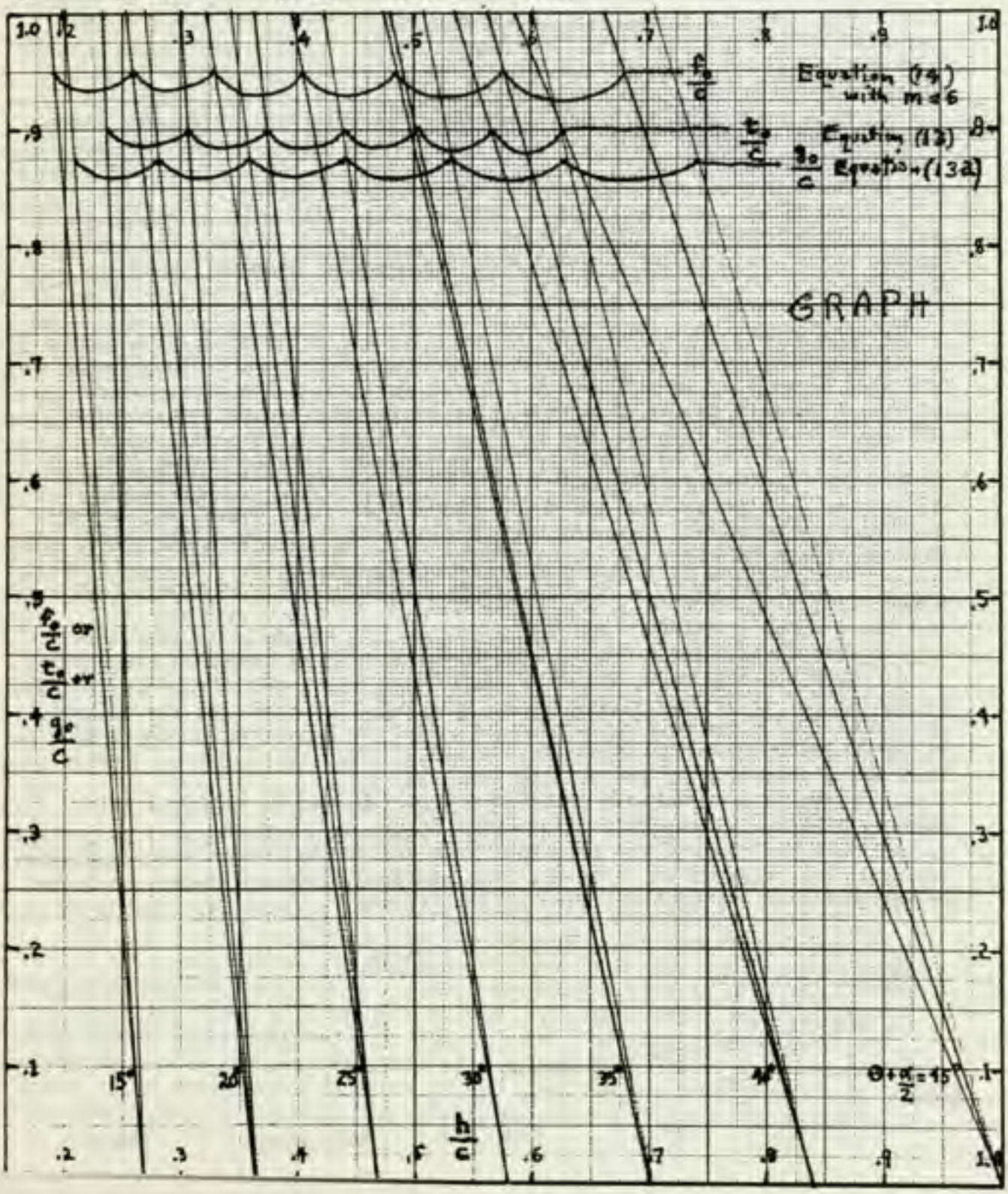


Table of $\frac{h}{c}$'s for Constructing Graph

$\theta + \frac{\alpha}{2}$	$\frac{t_o}{c} = \frac{g_o}{c} = \frac{f_o}{c} = 0$	$\frac{t_o}{c} = 1$	$\frac{g_o}{c} = 1$	$\frac{f_o}{c} = 1$
15°	.2679	.2327	.1998	.1887
20°	.3640	.2998	.2701	.2552
25°	.4663	.3629	.3440	.3251
30°	.5774	.4226	.4226	.3995
35°	.7002	.4794	.5078	.4802
40°	.8391	.5337	.6015	.5692
45°	1.0000	.5858	.7071	.6697



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MAKING WOODWIND KEYS

Robert Bigio

Beautiful and efficient keys are all too rare on reproduction woodwind instruments, and yet they are very easy to make.

I presume the reader to have some knowledge of metalworking; beginners are recommended to read the books listed at the end of this article.

1. Material. Brass and silver are the most common. The key must be hard enough to resist bending and general wear and tear. Silver sheet is usually sold "annealled", too soft to be used for keys without hardening. Brass can sometimes be purchased "hard". Both metals work-harden; that is to say, bending and forging operations will harden them. Annealled metal can be hardened by hitting it with a flat hammer on to a flat steel surface. Too much hammering will cause the metal to crack. Metal can also be hardened by burnishing, about which more later.

Flat keys, such as those found on eighteenth-century flutes, are usually made of metal about one millimetre thick. The material for such keys should be 1.2 mm thick, to allow for hammering, filing, and polishing.

The pin should be made of the same metal as the key.

The rivet (see fig. 1) on a silver key is best made of silver as well; a brass rivet can show through on the front of the key. The strain on the rivet will not be so great that the material used will make any difference.

2. Marking out. It will be easier to make the key symmetrical if a centre line is scribed on to the metal, using an engineer's square. The square can also be used to ensure that the shank (see fig. 2) is straight and square. A pattern can be made from scrap metal. The centre lines of the pattern and of the material can be aligned and the outline scribed on.

The shank should be left slightly oversize to allow later fitting to the slot in the instrument.

3. Cutting and filing. Cut out the key with a piercing saw (USA=jeweller's saw) using 2/0 blades. Do not attempt to use a pair of tinsnips - you will only have to spend more time filing.

It is very likely that the shapes of files have been standard for a very long time, and it is always possible to find a file that will cut the precise curve that you are trying to copy. Jeweller's suppliers have dozens of different files, many of which will be just what you need.

Save the half-moon shaped offcuts (fig. 2) to make the hinge.

4. Soldering. In Britain use only "hallmarking grade" solders for silver. For brass find a brazing alloy that is a good colour match. There is a silver-based brass-coloured solder available from Johnson Matthey Metals that has a conveniently low melting temperature.

There is no advantage in using a high temperature solder - the easiest solder will do. Soft (plumber's) solder will not do.

Make the hinge (fig. 1) either from the two half-moon shaped offcuts or from one piece of solid metal. Some eighteenth-century makers used one method and some the other. I find it less fiddly to use a solid piece of

Fig. 1

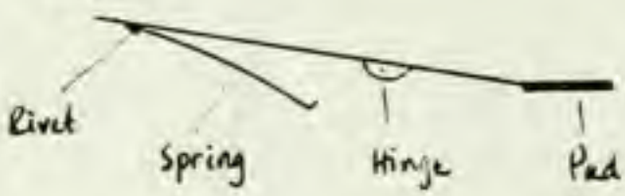
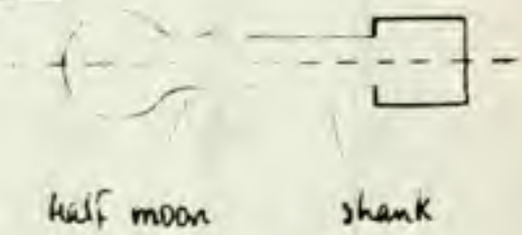


Fig. 2



metal, but it makes no real difference apart from that.

Clean the metal carefully and attach the hinge with soft iron wire. At the same time clean the space for the rivet, which can be soldered on in the same operation. Put flux on both places, along with small pieces of solder. In a pair of tongs hold a piece of 2.0 mm wire (about 40 or 50 mm long) in the rivet place, on your centre line. Heat the entire key. Remove the heat as soon as the solder runs. Silver, if overheated, can develop an ugly purplish stain - "firestain" - that can often only be removed by filing, and that sometimes can only be seen after the final polishing of the key.

When the work has cooled cut off the excess wire, leaving a rivet 3 or 4 mm long. Do not quench silver after soldering or it will become as soft as it was before you hammered it. It will soften much less if it is allowed to cool slowly before being placed in the acid.

It is possible to buy ready-made flux powder - Johnson Matthey make quite a few - but I prefer to use plain borax. Jeweller's suppliers will have a borax cone and dish, which is very cheap and effective. Borax has been used as a flux for thousands of years.

The acid should be sulphuric, mixed ten to one by volume with distilled water. Your local pharmacist should be able to help.

5. The spring. After filing the key to its final shape, drilling the pin hole, and filing away all the excess metal from the hinge, cut a small piece of 0.8 mm brass sheet to make the spring. Hammer the spring vigorously all over to temper it. At one end of the spring drill a hole 0.2 mm bigger than the rivet (if it is too tight the spring may split when the rivet expands on hammering). File the spring to a shape that will not show behind the key. File away the hammer marks and polish the spring. Using a burnisher rub the spring hard on to the horn of a small anvil until the spring curls. Attach the spring to the key, file away the excess from the rivet, and hammer the rivet, with the key on a smooth steel surface.

Bend the spring to the shape shown in fig. 1. Polish the end of the spring to minimize friction against the wood. Make certain that the wood is perfectly smooth or, better still, put a polished brass slip at the bottom of the slot. (Do not be concerned about the authenticity of a brass slip - there are plenty of original examples.)

There can be nothing worse than having to play an instrument with a stiff key. Make certain that the spring is not too thick and is properly tempered, and minimize the friction. A drop of oil will help.

6. Polishing the key. Go over the key with a very fine (no. 6 cut) file, to remove all rough marks. Remove the marks of the fine file with Water of Ayr stone (available from jeweller's suppliers in sticks, sizes ⅛" to 1"). Water of Ayr can be filed to any shape to fit curves, etc. It must be used with water. Follow the Water of Ayr with grade 0 emery paper, then 2/0, and finally crocus paper. Wrap the papers around a flat stick to avoid rounding over all the edges.

The key will not have a good surface unless care is taken with every stage of abrasive. Remove all the marks before continuing.

The key can be held firmly by the hinge in a toolmaker's clamp.

At this stage there are two alternatives to completing the polishing: motor polishing and burnishing. I find burnishing better in every way.

Motor polishing will require a 3000 RPM motor with a tapered spindle to hold various polishing mops (a slower motor, for some reason, will not produce as good a finish). You will need a hard felt "bob" with a diameter of about 75 mm and a width of about 25 mm, a calico mop 100-150 mm by 25 mm, a "swansdown" mop of the same dimensions, some tripoli, some rouge, and a

room outside your workshop in which you do not mind making a mess. You will also need to be prepared to be covered in fine red powder.

The key should first be applied to the hard felt bob which has been charged with tripoli. This will cut the surface of the metal and provide the basis for a good finish. A new bob can tear the metal, so try it out on a piece of scrap first. After the bob, use the calico mop, again with tripoli. Tripoli is a surprisingly violent abrasive that can easily wipe out the detail and the clean edges of your work, and must be used very carefully. At this stage wash and thoroughly dry the key to remove all traces of the grease that accompanies the tripoli. Buff the key with the swansdown mop charged with rouge. A gleaming finish can be obtained if a small amount of paraffin (USA=kerosene) is put on the work or on the revolving swansdown mop.

Burnishing requires one tool costing a few pounds and a bit of lubricant, such as the liquid soap you would use to wash dishes. The process is very simple - the metal is rubbed with the burnisher until the surface is perfectly smooth. As burnishing is not an abrasive process there is no danger of washing out detail or rounding edges that should not be round.

Burnishers are made of high-quality, hardened steel that has been given a mirror finish. They can be purchased ready-made or they can be made from silver steel, hardened and tempered to light straw. Ready-made burnishers often need considerable polishing before they are ready for use. The best burnishers are made of agate or other hard stone. Agate burnishers are available ready-made but are very expensive for what they are - a miniscule piece of stone on the end of a poorly made handle. A lapidary shop will be able to polish a suitably sized piece of agate for you for a pound or two.

Before burnishing make certain that every bit of abrasive has been removed. Hold the key in a toolmaker's clamp, lubricate it with some soap (or oil or even saliva), and rub the surface with the (previously polished) burnisher. This will produce an astonishingly good surface. As you will be squeezing the metal against the clamp, you will be hardening it enough to compensate for the annealling effect of the soldering. You will harden the surface to an extent that the finish will last for a very long time and will need a minimum of cleaning to restore to its original shine.

If you are not satisfied with the finish the first time, rub the key over with crocus paper and start again. Do not use the burnisher twice on the same area without first rubbing it with crocus paper. It becomes more and more difficult to produce a good finish the harder the surface becomes, so try to get it right first time, and learn to leave well enough alone.

Ready-made burnishers often have nasty sharp points. Should you slip when using such a burnisher, the point can scratch the work, jab your finger, or skewer your hand. The point serves no function that I can think of, so grind it away and avoid the damage.

Burnishing seems tedious but is in fact quick, easy, cheap, and "authentic". It leaves the best possible finish in the shortest possible time

The key will have to be handled after polishing. A good surface can be restored with a wadding silver polish such as Duraglit, or with powdered rouge on a rag or on a piece of leather. Do not use rouge powder on a key that is in place on an instrument - the rouge will get into the pores of the wood and may be difficult to remove.

7. Decoration. "Scalloping" (Fig. 3) can be put on before burnishing the rest of the key, although I prefer to put it on after and polish separately. The scalloping can be produced with half-round files and polished with emery papers wrapped around a round piece of wood. The burnisher will then polish the decoration without destroying the clean edges.

fig. 3

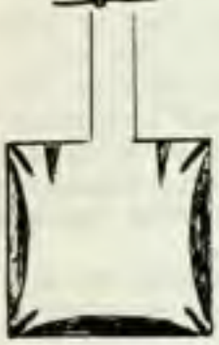
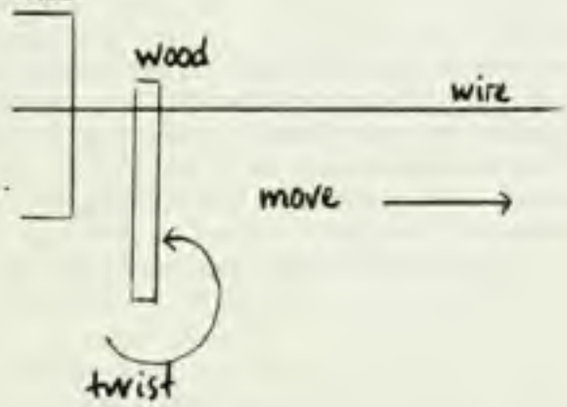


fig. 4



8. Pads. Old instruments had pads made of a leather similar to that used for kid leather gloves. Old gloves are not hard to find, and one glove should provide enough material for dozens of pads. If you cannot find an old glove, do not believe anyone who tries to tell you that kid leather is no longer available - the goat, after all, is hardly in danger of extinction. Leather merchants should be able to supply you with suitable material. One of the dozen or so leather merchants in the Leathermarket area of Bermondsey showed me some white surgical leather that is perfectly suitable, and is very cheap (a few pounds for a skin that would provide a few thousand flute pads). Chamois leather just will not do - it is too porous, and there is no historical justification for using it.

The pad can be attached to the key with shellac. Heat the key slightly and apply some melted shellac. Place the leather on the shellac and allow the shellac to harden. When the key is in place on the instrument the pad can be seated by heating the end of the key on a spirit burner and pressing it in to place. The molten shellac will squirt to wherever it is needed to level out the pad. It may be necessary to use more than one layer of leather if the leather is too thin.

It goes without saying that the pad must have a level surface to sit on. Make certain that the wood is perfectly flat.

9. The pin. Should hard-drawn rods be unavailable in a suitable diameter (1.5 mm) - and silver rarely is - soft wire can be straightened and hardened in the lathe. Drill a hole just larger than the wire into a piece of hard wood about 10 to 15 mm thick. Place the wire in the chuck of the lathe with no more than the length of a finger protruding. Put the wire through the hole in the wood and move the wood until it touches the chuck. Run the lathe slowly and move the wood to the right, twisting gently (fig. 4). The wire will straighten, and the bending involved will harden it.

10. Other methods of making keys.

(a) Casting. Of use only if many keys are to be made, casting does have severe limitations. Cast silver is very soft - softer even than annealled sheet silver. A cast key would therefore need to be very thick to resist bending. Castings need considerable hammering to harden them and to provide a reasonable surface, as their natural state is quite "grainy", and I feel the time required might just as well be spent making the key properly. However, if castings must be used, here are a few hints :

(i) Make the pattern 10% to 20% bigger than the key needs to be. This is to allow for shrinkage of the cooling metal and for hammering, filing, and polishing.

(ii) Polish the pattern properly. Good patterns give good castings.
(iii) Include the rivet in your pattern.

Castings produced by specialists to the jewellery trade are very inexpensive. A mold will cost two or three pounds, and each casting about 50 pence plus the cost of the metal.

(b) Forging. Never needed in flute making, although I have had to forge the occasional clarinet key. Silver and brass are forged cold. The metal (usually square-section wire) is annealled and hammered into roughly the required shape. Silver is annealled by heating to red heat and quenching in acid. Brass is annealled by heating to red heat, but must be allowed to cool slowly. Either metal must be annealled again as soon as it begins to show too much resistance to the hammer, or else it may crack. The firestain must be removed from silver, as it too may lead to cracking.

The rough-forged key can be filed to shape and polished as for a flat key. The pin hole can often be drilled directly into the shank of a forged key. The rivet, of course, must be soldered on.

(c) Hardenable silver alloy. This product, available from Johnson Matthey Metals, is an alloy including 99% silver. It can be hardened by exposure to extremely high temperatures (e.g. in an enamelling oven) for a few hours. JMM have published a leaflet on it. Briefly, however, it is available soft or pre-hardened. The hardened metal cannot be annealled, but can be soldered without fear of softening. Unfortunately it cannot be used in casting or it would be the answer to the prayers of every maker of Boehm-system flutes! This alloy may be useful to those who need to make long, thin keys. As it contains no copper, it cannot firestain. I am certain that this alloy is well worth experimenting with.

(d) Alternative spring materials. Some modern flutes and clarinets have springs made of phosphor bronze. The spring for a Boehm-system flute thumb key is of a suitable shape for a traditional flat key.

Some makers have used steel springs, either tempering them themselves or cutting up large clock springs. At least one recorder maker uses wound steel wire springs on the keys of bass recorders.

I prefer good old-fashioned brass springs which, if properly made, are perfectly good enough and are completely authentic. Besides, steel rusts!

11. Open-standing keys. The principles for closed-standing keys hold for open-standing keys as well, except that it is even more important that the spring be light and that friction be reduced between the spring and the body of the instrument and between the two parts of the key.

Suppliers

Brass - J. Smith & Sons (Clerkenwell) Ltd., 50 St. John's Square, London EC1.
Silver - J. Blundell & Sons Ltd., 199 Wardour Street, London W1.
- Johnson Matthey Metals Ltd., 83 Hatton Garden, London EC1.
Castings - M&S Rinberg Ltd., 26, St. Cross Street, London EC1.
Jeweller's Tools - Frank Pike, 58g Hatton Garden, London EC1.
- Charles Cooper (Hatton Garden) Ltd. 23 Hatton Wall, EC1.
Polishing Materials - T. A. Hutchinson, 16 St. John's Lane, London EC1.
Leather - A. O. Roeber & Son, 56 Bermondsey Street, London SE1.

Bibliography

Maryon, Herbert : Metalwork and Enamelling. 5th rev. ed., Dover, 1971. (My very favourite craft book - should be on everyone's shelf)

Untracht, Oppi : Metal Techniques for Craftsmen. Dale, 1968.

This Quarter's Good Cause: the FoMRHI BOOK LIST.

Tim Hobrough

It seems strange to me, but apparently no-one else in the F of MRHI has ever learned anything from a book. I APPEAL to YOU AGAIN! send to me the details of any book which you have found to be useful, and I, absolutely free of charge and with no view to personal monetary gain, will compile a LIST:

THE LIST OF BOOKS OF INTERST TO MAKERS AND RESTORERS OF HISTORICAL MUSICAL INSTRUMENTS.

What little reaction I've had so far is that "there just aren't many books on building instruments." This is true enough, but there's a lot more to building historical instruments than following someone else's directions. My own working bookshelf contains histories of music, histories of musicians, histories of instruments, a Victorian English design book which happens to contain an extremely useful section on practical cabinet-maker's geometry, four handbooks on the physical properties of timbers, cultural histories which have proven useful in deducing technological and organological history, technological histories which have shed light on organological history, a do-it-yourself toolmaking book, etc. etc. &&&. That's the sort of thing I want: books of use and interest.

Printed clearly please, on file cards, in the following form;

Author	Relevant Subjects
TITLE	"
Publisher (date)	"
(Reprint Publisher (date))	"
price at time of purchase.	
Description (& reservations) briefly please.	
Of interest to what level of competance?	

RELEVANT SUBJECTS; brief classifications, e.g. lute,timber, tools, culture, history, musicology, technology, etc. As many subjects as you think the book has relevence to, listed one under the other on the right-hand side of the card,

LEVEL OF COMPETENCE; beginner, experienced, expert, or general. Remember that an expert in one field can be a beginner in another. & please note that "amateur" and "professional" are economic terms, and do not in any way indicate level of competence, more so in instrument building than in most other trades.

N.B. this is a shopping-list, not a bibliography. The emphasis is to be on currently available material. Periodicals will get one listing. An adress should be given, especially for the more obscure publishers. Try to recall the price, so other people can decide if they think the book is worth trying to get. Don't be afraid of duplication - I have a large waste-basket, and all contributors will be listed in one alphabetical list at the back, so no-one will know.

Send everything to me at my new temporary adress:

Tim Hobrough
c/o Gorehill House
Gorehill
PETWORTH, Sussex
England

I promise to have the typing done by someone who knows what they're doing, and how to spell.

T

FoMRHI Comm. 256

FILES AND BENCHES TIM HOBROUGH

I will now discuss two subjects that, when they were explained to me, had a revolutionary effect on my work, and which I've found to be surprisingly unknown to a number of highly trained woodworkers.

FILES

For general work you need three types of file (the "cut" is stamped on the tool.)

1; RASP, with large pointed teeth, for removing a lot of wood in a hurry. (all right, a rasp isn't a file, but not one shopkeeper in fifty knows this, so I'll call it a file.)

2; BASTARD, for general work, and cleaning up the surface generated by the rasp. This is usually the finest grade of file most hardware stores carry.

3; SMOOTH, for finishing and cleaning up the surface left by the bastard. You may have to go to an engineer's supplier for this, but really good tool shops should have them.

HALF-ROUND is the most useful shape.

For each type, the teeth get finer as the length gets shorter.

It would be nice to have 6", 8", and 10" lengths of each, but for years I've mainly used a 6" bastard, 8" rasp, 10" bastard, and 10" smooth, and a few other "specialised" files, like a flat 10" mill bastard for filing guitar frets .

It's actually more complicated than this, but you'll be lucky to find a shop with a wide enough selection to cause

confusion. Woodcraft Supply Corp. carries a line of special wood-working files, which I know nothing about, but they claim they work well, and Woodcraft is usually pretty reliable.

The work should be at elbow height. If it's higher or lower you'll have trouble moving the file in a straight horizontal path, and you cannot create a flat surface with a tool which is moving in an arc. Try to have the surface being filed upermost, as it's almost impossible to file the side of something with any accuracy.

To create a convex surface, start near the file's tip, with the handle slightly raised, and bring the handle down as the file moves forward. This will generate a smooth curve, whereas the method of following the curve of the surface, starting with the handle down, is fine for "polishing" an even surface, but will make worse the irregularities of a rough surface.

You need a FILE CARD, which is a wire brush designed for cleaning clogged files, and you need to have it within easy reach, and you need to use it every few seconds.

Files are extremely hard, and brittle, so don't let them knock against each other, and never buy a file that's been unwrapped and thrown into a box with other files.

Don't force the file with too much downward pressure, or it will jam and chatter.

A quick look at the file when you clear it will show you if you're leaning to one side or the other. A few pencil lines across the surface being worked will show you if you're removing wood evenly, or filing some areas more than others.

If possible, don't use your wood-working files on metal, but if you must clean them thoroughly afterwards.

BENCH HEIGHTS

If you are not working at the correct height you are working inneficiently and, eventually, painfully. Bench heights will vary according to the height and style of the worker. YOUR BENCH IS YOUR MOST IMPORTANT TOOL, SO GET IT RIGHT. (Measurements standing erect.)

The standard cabinet-makers workbench height is about mid-way between elbow and wrist. This is high enough for comfortable planing, scraping, etc but low enough to permit working on top of largish objects sitting on the bench.

I was taught to build guitars on a bench just a smidgeon below elbow height, which is absolutely perfect for "lutherie" but a bit high for cabinet-making.

I hew harp soundboxes on a bench of wrist-height, which is perfect for working inside these soundboxes, but useless for most other jobs.

A sawing bench at knee-height is invaluable for cutting timber to length, as you can conveniently hold the wood with one knee.

This is important because if the working surface is too low you have to work bent over and your back hurts. If the work is too high, you end up standing on your toes, and your legs hurt. In either case you will be unable to achieve accuracy in filing, sawing, or planing.

FoMRHI Comm. nº 257 L.A. Esteves Pereira

OLD KEYBOARD TABLATURE USED IN MARKING ORGAN PIPES

In the XVIth century, some iberian theorists proposed the designation of musical notation based on figures, instead of letters. Juan Bermudo, in his "Declaracion de instrumentos musicales" (Ossuna, 1555) proposes a new system of notation for keyboards, starting at the C1 (with the first octave "short") and nunbering the keys from 1 to 42. This method was very cumbersome and Bermudo, himself, proposed another, numbering only the white (natural) keys, the black keys being shown as sharps, putting an X over the correspondent figure.

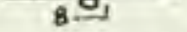
A simmilar system was used by the italian Antonio Valente, in his "Intavolatura de Cimbalo" (1576).

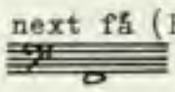
A further reduction of the above two systems was proposed by three theorists from Spain :

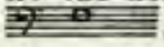
Luis Venegas de Henestrosa, in his "Libro de Cifra Nueva..." (Alcalá, 1557)
Antonio de Cabezón, in his "Obras de musica para tecla..." (Madrid, 1578)
Francisco Correa de Araujo, in his "Libro de tientos..." (Alcalá, 1626)

This last notation or tablature, consisted in figuring the musical notation, starting at the fá 0 (FF). The naturals were numbered, therefore, from 1 to 7, being the accidentals shown withan X for sharps and a b for flats. Thus, the chromatic scale was represented like this :

1	1♯	2	2♯	3	4♭	4	5	5♯	6	7♭	7
fá	fáS	sol	solS	lá	sib	si	dó	dóS	ré	mib	mi

In order to avoid any doubt about which octave the note belonged, it was proposed by Henestrosa to start the scale at the fá (FF) below the bigger organ pipe of 13 "palmos" (spans)(1), equivalent to the 8 feet CC of continental and english instruments. The first figure of the tablature was, therefore, the 1 with the addition of a point and a tail, becoming 1. This note is today written :  .

At the next fá (F), the figure 1 lost the point, becoming 1, thus  .

At the next fá (f), the figure lost the tail, becoming 1, thus  .

At the third fá (f'), the figure got a point, becoming 1' and two points at the next octave, 1'' and so on.

This method of notation or tablature was quickly replaced and droped into oblivion, except with the musicology scholars.

But the portuguese organbuilders (and I presume that also the spaniards) went on keeping a very simmilar method of marking their pipes, as late as the end of the XVIIIth century. In my country, as late as Antonio Xavier Machado e Cerveira, organbuilder (1756-1828) it was used that notation for pipes which the author of these notes is very carefull to retain in his restoration work and, traditionaly, follows using in his new constructions of organs.

The old tablature and the equivalent marking of organ pipes, may be better apreciated in the following table :

Acoustic lenght	Acoustic scale	L.V.H. Cifra Nueva	Pipe markings in port. organs	Rmks.
24 palmos 16 feet	dó 0	—		"palmos" means span
	fá 0			
12 palmos 8 feet	dó 1			
	fá 1			
6 palmos 4 feet Octave	dó 2			
	fá 2			
15th	dó 3			from here we mention the interval instead of the acoustic lenght
	fá 3			
22nd	dó 4			
	fá 4			
29th	dó 5			
	fá 5	—		
36th	dó 6	—		
	fá 6	—		
	dó 7	—		

(1) - 12 palmos in Portugal . The measure of the "palmo" was not exactly equal in the two countries.

Bibliography - Wili Apel, "The notation of Polyphonic Music, 900--1600" , Cambridge, Mass., USA, 1953.
Luis Venegas de Henestrosa, "Libro de Cifra Nueva...", Alcalá, 1557.

FoMRHI Comm 258

Roger Spalding

How authentic is the use of the little box of flutes that is so often used as a continuo instrument? The basso continuo emphasizes the harmonic stability of music and requires instruments that can play chords. It was written in such a way that the player could contribute as his own instrument permitted. Instruments used could be organ, harpsichord, harp, lute, guitar, with the bass reinforced by whatever single line instruments were available usually cello or viola da gamba. If an organ larger than the really small positive organ was available it would surely have been used. The first public concerts in England initiated by John Bannister in 1672 used an organ and those arranged by Thomas Britton the coalman, mention an organ of 5 stops of exact concert pitch. Advertisements from the period refer to organs of 8 to II stops and it is certain from pictures of the time that these instruments were used for the continuo. All surviving instruments as far as I am aware, have more than one rank of pipes, some based on a stopped 8ft., some on a stopped 4ft. The Russell collection in Edinburgh contains typical instruments and smaller 4ft. instruments

are kept in many museums including the V. and A. and Nurenburg. A typical specification would include a stopped wood, open metal, and a mixture, which gives a fair tonal range and soft to loud volume.

As far as the single rank instrument is concerned we have to refer to pictures from the I5th and I6th Centuries. Hugo van der Goes I476 shows a good positive organ with a very "modern" keyboard. Although I am not certain that this instrument has a single rank. The Van Eyck organ I425 probably had two ranks as the pipes appear to descend in semi tone steps. The best and most easily available illustrations are of the organ in the Triumph of the Church, I6th Century Flemish tapestry, and the organ in the intarsia from the Gubbio Study, Metro Museum of Art, New York. The interesting fact that has emerged from a study of these early pictures is that in no case (so far studied) has an organ been found with a single rank of stopped 8ft. or 4ft. wooden pipes. In all cases these organs have an open rank of what appears to be metal pipes of the diapason or principal type. The scales, particularly in the base, are smaller than used today, probably I½"-2" for a 3ft. P. Open metal pipes with a small scale in the base give a distinctive sound that is usually not heard in early music concerts. Although still working towards an authentic instrument I have found that an instrument based on early scalings is a very satisfying one particularly when used for contemporary music, such as the Codex Faenza and Buxheimer Organbook.

There can be little doubt that the Regal was a most important continuo instrument and judged by surviving examples was popular from the I6th to early I8th Century. Praetorius preferred the regal to the harpsichord, stating, "They can be used for concerted music- for the sound not only continues, as in the organ, as long as the key is depressed - a necessity in a consort, but it can be made very loud or soft by opening and shutting the grille. In vocal and instrumental music, the sound can be made very loud, so that it can be heard better than a positive organ, and not only is this so in noblemen's rooms in front of the long table and at banquets, but also in small and large churches.

The use of a regal in the E.B.U. Florentine Intermedi concert certainly supports this statement where it was used as a continuo for voices, strings and wind with equal success.

The request for a definitive source of information on the construction of small single rank organs has prompted me to offer the information I have obtained from my limited research and with help from fellow members.

As far as I am aware there is no book available that covers the subject in any detail although many of the standard works on organ building give some help. I have found "Organ Building for Amateurs" by Mark Wicks republished by the Organ Literature Foundation Baintree Mass. to be of fairly limited use. It has some information on pipe making but many of the techniques used for a single rank organ are not covered. I suspect that the mechanical parts of small positive organs had more in common with the regal than the larger organ and most of the techniques that I am now using result from a study of the regal. The article by Hugh Mountney in the Galpin Society Journal is excellent and offers considerable information, although it does not cover the manufacture of keys and action. However there are a number of regals available in museums and it is here that valuable information can be obtained. The Royal College of Music has two regals and I understand that drawings may be available in the future.The Russell Collection at Edinburgh has the regal that was formerly at Fenton House. John Barnes had some photographs taken of this instrument and they will give any prospective builder most of the information he

requires. The Germanisches Nationalmuseum, Nurenberg also have some excellent drawings of their Klotz regal which cost about £15 last year. There is also a very comprehensive book on regals by Reinhardt Menger, in German, published about 1975 and although I have not been able to obtain a copy I have been told it is very useful.

My latest instrument is a single rank positive organ with keys hinged on parchment and a simple sticker action, all based on the regal. The pipes which are open principal 98% tin are conducted off through plastic tube (although this should really be lead) the largest tubes having an internal diameter of 10m.m. These conducting tubes are fitted to the wind chest where the regal pipes would normally be situated. The whole system, while being very simple and easy to manufacture, works remarkably well.

I hope to have drawings of this instrument available in the near future and as I have taken photographs of most of the construction I could produce a small book if there is sufficient interest.

Next October we are holding a one week residential course at the Micklethwaite Crafts Centre, Bingley, where it is hoped a small group of enthusiastic builders will be able to complete most of the mechanical parts for a regal, portative or positive organ.

I will be pleased to send members details of the drawings, photographs, or the course if they will send a S.A.E.

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NOTES ON THE DRAWINGS AND PHOTOGRAPHS OF THE LIUTO ATTIORBATO BY CHRISTOFOLO CHOC, VENICE. DRAWN BY STEPHEN BARBER. PRODUCED BY THE VICTORIA AND ALBERT MUSEUM.

PHILIP LOURIE

This is the first set in a series of three of drawings plus photographs and text of some of the lutes in the Victoria and Albert's collection. Drawings and text were done by Stephen Barber and photographs produced by the museum. I deliberately distinguish between the two sources of information because, as we will see, there is a difference in their intention and quality.

The museum states at the beginning of the typed notes that " ..... purchase of a set of drawings ..... entitles the purchaser to make reproductions of the instrument itself". So it is as a set of practical working drawings backed up by photographs and textual information that the package must be judged.

One must immediately applaud the Victoria and Albert for its enterprise in undertaking the project of supplying instrument makers with a prime source of information on this beautiful instrument and for having the good sense to get an established instrument maker to do the drawings. The concept of a whole package of information is an excellent one. The fact that the instrument is presented exactly as it is is a further recommendation as it allows the prospective maker to form his or her own judgement. Stephen Barber's observations as to earlier states of configuration in the text are shrewd but do not rule out other possibilities of interpretation.

There are two sheets of drawings, sheet one concentrates on the external aspects including full details of the lavish decoration of the instrument. Sheet two is based on X-ray data and this provides structural information. The drawings are very handsome and executed with admirable clarity. The price of £15 is very reasonable.

However, there are a few anomalies in the package as a whole. The photographic evidence presented is not up to the standard of that of the drawings. The photographs were not taken or selected by Stephen Barber and so do not have anything like the same value to the intending maker of the lute. The quality of the photographs is excellent but they lack any means of deriving exact scale. For example, the view of the belly is maddeningly just under half actual scale and has no scale rule included in the photograph. This sort of data is, in my view, essential in providing corroboration with the drawings. This is especially so because dye-line prints do have a tendency to stretch during the printing process. For example, the 1000 m.m. reference line on my copy of sheet two is actually 1005.5 m.m. So direct scaling from photographs is important.

One of the most characteristic structural and acoustical features of this instrument is its flattened back. A maker has to take crucial decisions about the degree of flattening built in originally and the amount of distortion which may have taken place since. Here both drawings and photographs are inadequate. Only two cross-sections of the back are given in the drawings. Several more are needed, in particular at the inside surface of the neckblock. I gather from Stephen Barber that he realised this was an omission but too late for the Victoria and Albert to include extra information as dye-line negatives had already been made. This is a pity but I understand that more of this type of cross-sectional information is included in the next set of drawings of the anonymous 17th Century II course Italian ivory lute to be released soon.

More photographs of the instrument are needed. There are seven altogether, three general views - front, back and treble side, two close ups, one of the rose, one of the cartouche bearing the makers' name, and two larger details, one of the neck and peg boxes, the other of the belly and part of the neck. These are all of course useful. However, the rather long-distance shot of the full back-view is the only photograph of the back - several views are necessary in my opinion. There is no bottom-end view of the instrument and the side view gives an exact profile of the peg boxes which leads to oblique angle on the rest of the side of the instrument. A view of both treble and bass sides should have been provided.

Stephen Barber has told me that he made drawings of each individual rib shape but I suppose that the museum must have felt that the further sheet this would entail would have pushed the price up too much. I need hardly stress just how useful that information would have been to an instrument maker.

I would not want to give the impression that the package is a failure in any way - it goes a long way to providing the right sort of data to a maker. But I for one would have been prepared to pay more to get the extra information needed - please V. & A. accept a slightly muted accolade for a worthwhile effort to do a tricky job! I hope these comments will be found to be constructive and I look forward to your next effort.

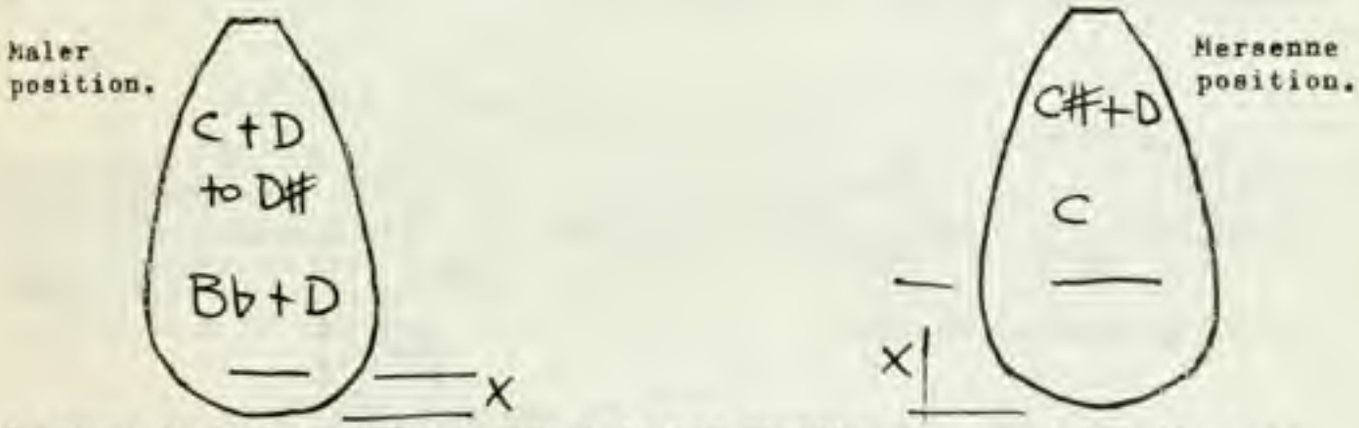
FoMRHI Comm. 260

Geoff Mather

POSITION OF BRIDGE AND BARS REGARDING TONE PRODUCTION

As members are now begining to talk about bars and tone projection in Lutes I think it right to relate one or two points concerning the ambiguity arrising from the lutes bridge and barring positioning.
I think the open strings affect the bridge equally wherever it is placed. The placement of the bridge however,affects the belly flexation differently for each position used,bringing out different fundamental and first and second overtones,relative to the dividing position of the bridge on the belly.

I constructed a resonance and tone examining idea, with views to trying different bridges,bridge positions,bars and bar positions,soundboards and thicknesses.
To start with the belly was mounted in a wooden frame to simillate the all round edge stability of the lute body,and tap toned.The fundamental resonance pitch of this shape(M154), 1.5m/m thick soundboard spoke notes of..C..
With a bridge added in the MALER position,and no strings attached,it spoke..C, and..D..to D#,when stood upright and clamped in the bench vise. When laid flat down on the bench: B♭ and D. The tones which were produced with the bridge in the position suggested by MERSENNE were C# and D when stood up, and C when flat down.



I assume the MALER position gave a deeper starting fundamental belly tone because of the greater speaking length of belly in front of the bridge. Its timbre was of short duration,quiet and clear,but deep. The higher tone coming from X was also quiet.
The tones produced from the MERSENNE position however were: longer lasting louder and mixed,and higher in pitch.They were generally louder and fuller but definitely not deeper. Also in this position, as the sound faded, very high tones were herd for a fraction of a second coming from X'.

Helmholtz,in 1863, said in his theory of consonance,that the combination tone of the first order of two simple primary tones has for its vibration number the difference between the respective vibration numbers of those primeries.(Re:Lutes,these are the fundamental belly resonance,and the Helmholtz air resonance at the lutes rose,as we know it). It is a moot point as to whether MALER in the 1540s knew about this,and used it to start a good bass response on his lutes.

Sedley Taylor,MA. in his"Sound And Music",1883,states that strings in their slowest form of vibration(ie in a single segment)produce the deepest note. They may also vibrate in forms with larger numbers of segments,at the same time,and these segments be compounded together.Each vibration form thus called into existance "sings" its own note,without heeding what is being done by its fellows. Accordingly a certain number of tones belonging to one family are simultaneously heard. If this be pertinant to the vibrations and overtones

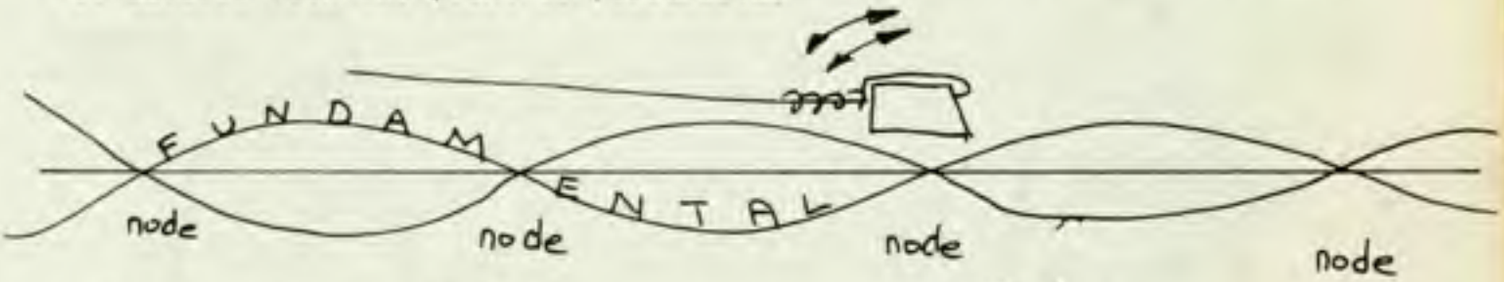
of a string,I thought may it not also be pertinant to the vibrations and tones in a lute belly?

I assume MALER placed his bridge after trial and error,where he knew it would bring out a good fundamental(in that his lutes were predominantley bass instruments),rather than middle tones,and suggest that MERSENNE'S position for a lutes bridge,in his time favoured more middle and tenor overtones.

BRIDGE POSITION CONJECTURE and RESONANCE DEFLECTION.

The bellies rate of vibration must vary as do the number of segments into which it is divided by the resonance.And the number of segments depends upon:- the flexibility of the soundboard, bars, the string plucked and the notes pitch.

If the bridge is placed upon a node in the bellies fundamental resonance(which has been found by bowing,or some modern sound pulsing technique),it cannot move in sympathy with this fundamental resonance as well as if it were placed on a ventral segment,ie ,antinode,for, a vibration form is in its most favourable position when the middle point of one of its ventral segments co-incides with the point of percussion.



SIMPLE RESONANCE DEFLECTION.

But,

The bridge works in whatever position it is placed, and its most favourable node or antinode position is therefore dependant upon ones own idea of overall tone quality.

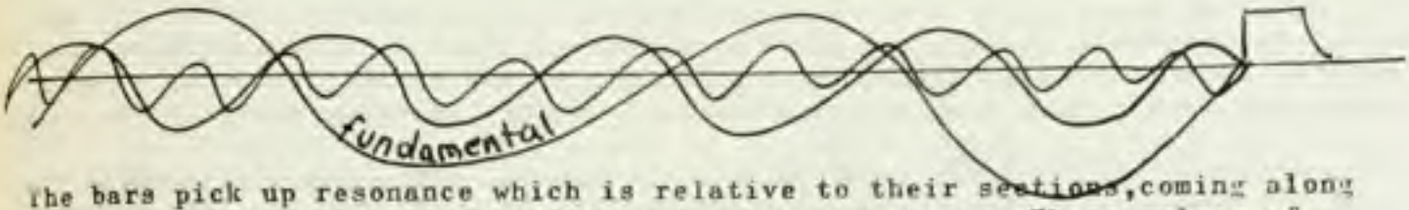
Considering now compound resonance deflection:- it follows therefore that the positions of the main strengthening bars above the bridge cannot be directly relative to the notes produced, but their SECTIONS can be.

The bulk of wood in thicker bars and sound belly is a great factor in limiting high frequency, and one should experiment with different sectioned bars,and sound belly thicknesses,in an effort to achieve the overall tone which oneself or ones customer likes.

I was unable to measure transverse resonance deflection of the bars above the bridge, however,these exaggerated sketches,show the minute movement I was able to measure in the bellys length,and at the bar ends.

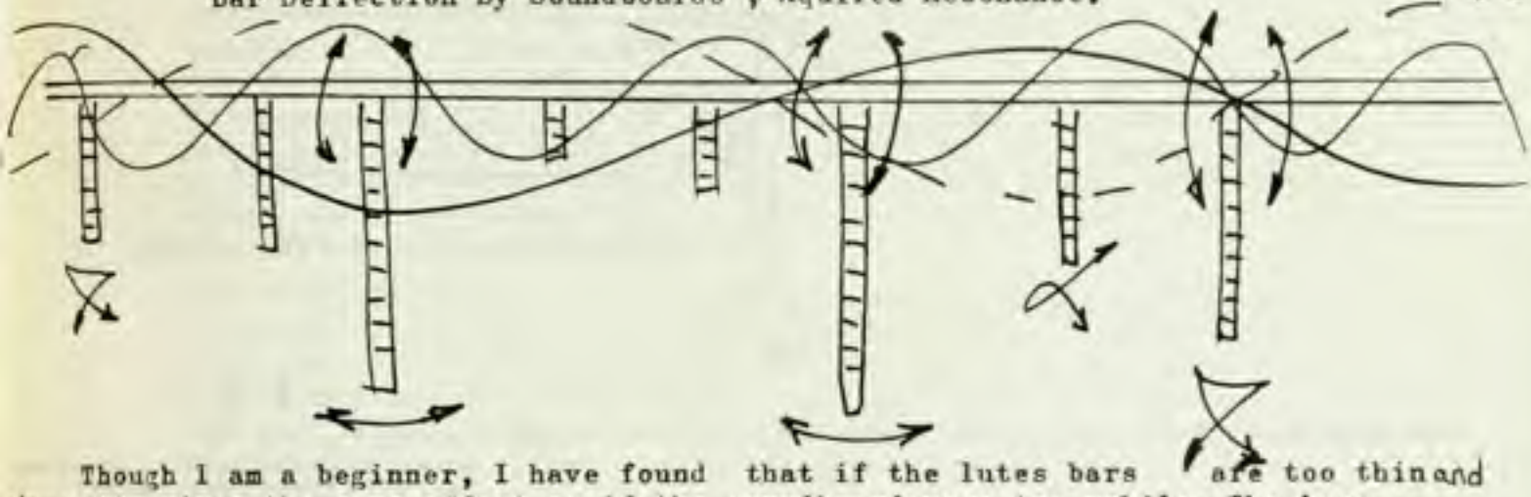
Every lute belly must surely behave differently to this yet be alike in some ways and the sketches are of [illegible] here,as a possible help,to barring systems.

Compound Resonance Deflection, Of Belly.



The bars pick up resonance which is relative to their sections,coming along and accross the soundbelly at different rates and phases. These pulses of resonance cause compression and rarefaction of the air molecules in the body cavity which in turn affects the belly again but moreover the resonance at the rose.

Bar Deflection By Soundboards , Aquired Resonance.



Though I am a beginner, I have found that if the lutes bars are too thin and deep this gives the same effect as if the soundboard were too mobile. The bass resonance is allowed to really develop(using wire overwound strings)and the lengthy duration of the strings combination tones,spoils the sound(rather like a piano with the sustain pedal kept depressed). I subdued this jarring sustained bass by shortening the depths of the deepest bars and making them thicker.

Helmholtz infers from his experiments that the character of a musical note depends upon its constitution,and that while a change of intensity in any of the componants produces a modification of character, change of phase has no influence upon it whatever.

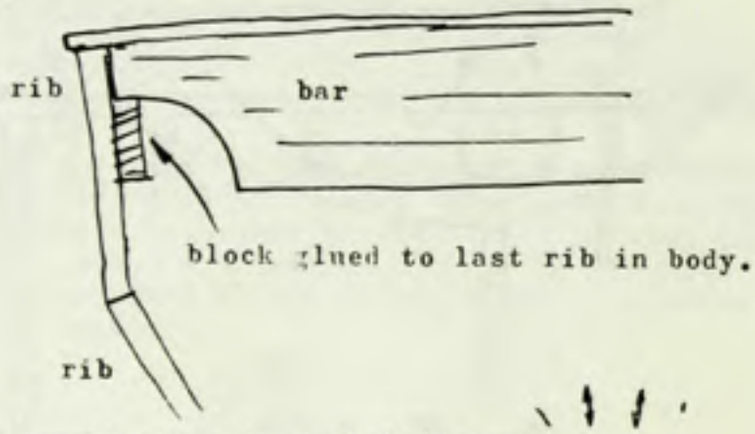
Sir .W.Thompson,however , in a paper'On Beats Of Imperfect Harmonies' adduces strong evedence to show that a change of phase has, in some cases at least, an influence on character. (4

The harmonies which are present in a note,usually find their origin in the vibrations of the musical instrument itself. In the case of stringed instruments for example,along with the vibration of the string as a whole, a number of segmental vibrations are simultaneously going on.

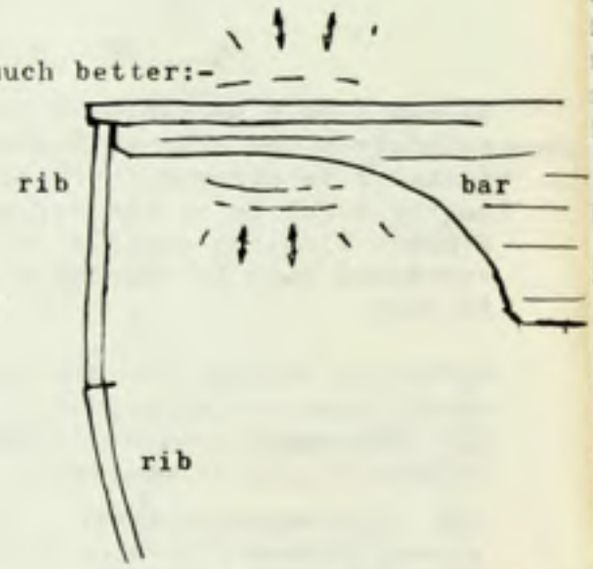
Returning to bars, a thin stiff to very stiff soundbelly will produce good high frequencies, but if the bars have too much wood in them the high frequency response is cut down or mellowed.(see Bill Samson Comm 220 bull 16), however, a point where wood can be removed to some advantage, is where the bar ends meet the ribs. I found if the bar ends are too deep ,then the lute doesnt project its tone so well as if they are thinner, ie the intensity of resonance deflection is cut down...Consider the painting of the 'Singing Lute Player' and the lute's sound belly!... The bar ends,I feel , in this instrument,must have been really flexing in play!

I dont think I'll ever fall into that catagory of men whos instruments will be played untill there is nothin left of them(see George Bowden, Bull 17 P5) but untill the internal features of the instruments which one is making, have been shifted about a little, altered and studdied,and the details recorded in some manner,one really can't know why they're designed the way they are to begin with.

The making of the lute for me,which is an intimate instrument, takes, with the physical properties of woods,a long time to get to know. But I will not copy the internal features of extant instruments to the last detail,untill I am satisfied that different features are wrong for tone, for example, designs like this, kill the bass projection,



But when made like this, the whole projection is much better:-



I have found both these methods used in lutes which I have examined.

I would be very greatful for any comments,points suggested for me to think about,and criticisms upon what I have related here. Moreover though, I do hope that none of this is misconstrued. Nothing here is deliberately intended to be at variance with what has already been sent into the quaterly,indeed I hope I will be as much help to others as they have been to me this far.

FoMRHI Comm.261 (continuation of Comms.171, 190, 210 & 245)

Review of: Will Jansen, The Bassoon — Jeremy Montagu

The next fascicle has arrived, Part IV, which completes the Biography of Makers (from Strehli, J.G. - Specimens known: no bassoons, to Zuleger, Hermann - Specimens known: about 30 bassoons in private possession). Mr.Jansen then goes on to a lengthy, rambling, incoherent, confused and laudatory account of the House of Heckel, reminiscent in its adulation of Kastner's remarks on Sax in his Musique Militaire of 1848. Briefly, Savary wasn't too bad, Buffet is tolerable, Triébert an ass, and there is only one real bassoon maker, only one firm that really knows anything about it, and that's Heckel. This may even be true, but the more often it is said and the wilder the claims that are made, the less convincing it becomes. There is then a section on the materials used in making bassoons, which contains surprisingly little information for its length. Finally, the development of the Contrabassoon, which, like so many other sections of this magnum opus, wanders vaguely and circuitously round and round its subject, repeating itself here (and here and here and here), contradicting itself there (three quite different bore lengths are given for the Stanesby contra in Dublin), and seldom really coming to grips with the subject, if only because what information there is on any one type or make is scattered here and there through the chapter.

Some of the information in the Biography section is both useful and entertaining, that on the vagaries of the Thibouville clan, for instance. Jansen leaves out three or four of the firms listed by Langwill under this heading, but he seems to make a good deal more sense of those he does list, despite what he refers to as their 'mad antics'. There are considerably more misprints in this fascicle than in the previous one, but it's by no means as bad as the first.

FoMRHI Comm. 262 — Jeremy Montagu

Review of: Zeugnisse alter Musik XI, 1980.

Uta and Rudolf Henning's illustrated calendar is with us again, with an engraving or woodcut for every month of the year. I must confess to some disappointment this year; whether for the sake of entertainment or because material is running short after ten years, I don't know, but all but one of the pictures here are fairly non-representational. It may be useful to know that one could smooch a lady while having one's hair combed to the accompaniment of a pipe and tabor, but we know from other sources and from suriving instruments that the pipe didn't look like this and that neither it nore the tabor were played with this technique. Other illustrations are similarly uninformative of organological detail, though all are pleasant enough as pictures to have around for a month and to keep thereafter. The one representational picture is The String Maker by Christoph Weigel. As always, the captions are on a separate sheet at the back of the calendar, and thus slightly less useful if one is to tear them out and file them than the Bärenreiter sheets, which are usually captioned on the back; still, one can always write them on or cut and paste. Copies available from Uta; address in the Members List.

FoMRHI Comm. 263 — Jeremy Montagu

Review of: Divisions, Vol.I Number III

Several interesting articles in this issue. The first is on the Renaissance Thumb-under Lute Technique, by Bruce MacEvoy, which may well stir up some arguments and controversy. The second, by Martha Lewis, is

Investigating Rhythmic Structure in Renaissance Music, an interesting discussion of accentuation and grouping of notes in long melismatic passages, where word-accent alone cannot indicate stress patterns. William Bullfish, in an article on Crumhorn Repetory (sic), begins: "In my opinion, it is far more important to give the crumhorns some good music to perform than to worry about historical accuracy" - in that case, let's go back to playing viol consort music on the string quartet. However, he does go on to point to some good music for which there is some historical evidence for the use of crumhorns. That opening is a very dangerous one, though; what is the point in reviving all these instruments, getting them as right as possible, and then using them in the wrong music? Eugene Enrico contributes an article on the Performance of Banchieri's Madrigal Comedies, with notes on the instruments used in them, the commedia dell'arte and the Florentine intermedii. There is a rather inconclusive summary of the results of the Divisions Early Music Survey, in which readers were asked to list various subjects as most important or least important in their opinion. The last and most important section is a a translation by Pauline Dürichen of Corrette's tutor for the Vielle à Roue (not Vièlle, incidentally, though Terrasson does use the spelling Rouë). No date or title of original publication is given and, curiously enough, the instructions with the musical examples (e.g. Diezes en montant, or Le même tour de Roue) are given in French and not translated. There is no textual apparatus and it is sometimes unclear whether material in ( ) is Corrette's or the translator's. The musical examples through the text are included, but those at the end are not - there is a note: (Here follow fifteen pages of music), which for those who would have preferred an original tutor to Doreen Muskett's must be very frustrating. Those who are taking up the instrument will find this text useful and will get added value both from it and from Doreen Muskett's by comparing the two. The issue ends with an anonymous review of Klop's Harpsichord Tuning; it is not the custom for reviews to review reviews, but I would like to make the point that anonymous reviews are a mistake, even when they are favourable as this one is. Divisions is available through Walton Mendelson - address in the July List.

FcMRHI Comm. 264 Jeremy Montagu

Review of: David Fuller, Mechanical Musical Instruments as a Source for the Study of Notes Inégales, Divisions, 1979 (reprinted from The Bulletin of the Musical Box Society International, Summer, 1974). 20pp, illus, 7" 33 rpm record. No price stated.

A very useful study on the evidence for inequality which can be studied on the equivalents of the gramophone records of the period. On the record one can hear some of the examples at half speed and at quarter speed, as well as at full speed and one of the most fascinating things, brought out in the musical examples in the text, where Mr.Fuller gives lengths of notes measured in millimetres on a 7½ ips tape, is the irregularity of the inégalité. For example, with six quavers (eighth notes) is a 3/4 bar, we have, in millimetres, 31, 30, 31, 26, 25, 24 and in the repeat, 32, 23, 33, 30, 25, 20. How does one square this with what we think of as authentic performance practice? The one thing that comes out with absolute clarity is that we are far too rigid in our interpretations - we need the jazz approach of 'swing it boys'. Also on the record is a computer realisation of Engramelle's pinning instructions for Balbastre's Romance in Dom Bédos and a Handel Concerto, op.4, dating from about 1790, of which Mr.Fuller is preparing a complete transcription, which should well be worth studying. The final track is the most perturbing; an 1830 pinning of the Marriage of Figaro Overture, from Mirecourt. If they were pinning Mozart inégal

in France in 1830, how were they playing Berlioz? This booklet and its record are a must for all performers of Baroque and Classical music, and they make it quite clear that we have neglected barrel organs and other mechanical instruments for far too long. I must confess to having had the attitude that I was only interested in instruments that people played, forgetting that people pinned the barrels of the mechanical instruments. With the exception, so far as we know, as Mr.Fuller points out, of the Balbastre Romance, mechanical instruments were not pinned under the composer's supervision, so that the 1790 Handel Concerto is not as Handel played it (anyway he was dead well before that date). Nevertheless, there are many barrels contemporary with the composers, and if we cannot hear the composer himself, as we can hear Rachmaninoff on piano roll and disc (rolls are usually better because they were not limited to the duration of a 12" disc at 78 rpm) and John Cage on tape, at least we can hear how his contemporaries played him. As for the previous review, further information from Walton Mendelson.

FoMRHI Comm. 265 Gwen & Jeremy Montagu

Review of: Marco Tiella, Indirizzi di Ricerca su Strumenti Pre-Rinascimentali (Lines of Research on Pre-Renaissance Instruments), offprint from Studi Musicali, VI, 1977, Accademia Nazionale di Santa Cecilia, Roma. 15pp, 1 plate.

I must apologise to Marco; I had this in time for the last issue and forgot about it until too late. It is an interesting paper, an expansion of one that he read at the Perugia conference celebrating the 6th centenary of the death of Guillaume de Machaut. The Pre-Renaissance is the period between the end of the 15th century and the Renaissance proper, when the climate of thought had changed from that of the Middle Ages but the real Renaissance had not been established. He discusses the interest of the theoretical writers of the period in the tuning of keyboard instruments which, as he says, suggests a considerable change in the techniques of construction of instruments. He mentions two instruments of the period which have survived, the violeta of St.Catherine of Vigri, now in Bologna, which he described in detail in GSJ 28, 1975, with a further note and plates in GSJ 31, 1978, and the positive organ of Lorenza di Pavia, now in Venice. He points out the impossibility of generalising from so little material and he stresses the value of working from iconographical evidence and experimenting with the instruments that result. A fascinating footnote lists an enormous number of reconstructions made under his supervision since 1966 at Rovereto, made both for performance and for technical experiment. I hope that in due course he will describe some of the experiments and their results for us.

FoMRHI Comm. 266 Jeremy Montagu

Record Review of: Bernard Brauchli, The Renaissance Clavichord I & II, Titanic Records Ti-10 & Ti-27, stereo 12", 33 rpm. No price stated. Titanic Records, 43 Rice Street, Cambridge, Mass.02140.

The first of this pair of records begins, very oddly when one considers the title, with a pair of mediæval estampies, rather oddly edited, too. Then comes a piece by C.Paumann (1410-1473) (when does the Renaissance start, anyway?). Everyhting else (Newsidler, Byrd, Attaignant, Milan, Cabezón, et al) is 16th century. Original sources are given but editions used are not. The instrument is by Peter Kukelka, based on lightly fretted Austrian or South German instruments from the late 17th century, so that's not very Renaissance either. Tuning is mean-tone, it says, but not which; could be right for the music, if not for an instrument [illegible] that which might be irregular by then.

The second record is a much more interesting one. For one thing, the sleeve is a double one so there is room for a good deal more information, including the editions used for the music as well as the original sources. More important, it is recorded on the Tosi clavichord of 1568 now in the Boston Fine Arts Museum (Bessaraboff, 299; Edwin Ripin, Musical Quarterly LIII,4, Oct.1967, etc). I am not certain whether FoMRHIQ is the place to review records in the normal way, but it is certainly the place to tell you where you can hear original instruments on records. One does not often get the chance to hear an instrument over 400 years old and still in good working order. There are problems with this one, as there always are with clavichords. It seems to me that it has been rather over-recorded (there is distortion in a few places, sounding a bit as though the tangent has hit the microphone as well as the string), but with the volume turned well down to what one might call a quiet harpsichord level (the fretted clavichord, especially the heavily fretted ones like this, produces more than twice the volume of the 18th century instrument) one gets a very good impression of the instrument. If one is comparing it with one's own instruments, then one has to judge the playing technique and imagine Bernard's touch on one's own clavichord. More difficult to do on a clavichord than on other instruments, I think, but this record is one that should be in any keyboard maker's library. The music ranges from Aston and Bull, through A.Gabrieli, Attaignant, Cabezón, Coelho and Pablo Bruna to Pablo Nassarre, roughly from 1500 to 1700 (getting a bit late both for Renaissance and for Tosi), but at least it gives one a very good chance to hear the instrument in a number of moods and styles.

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