FOMRHI Quarterly

BULLETIN 15 AND SUPPLEMENT 2

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FELLOWSHIP OF MAKERS AND RESTORERS OF HISTORICAL INSTRUMENTS

7 Pickwick Road, Dulwich Village, London SE21 7JN, U.K.
LIST OF MEMBERS: The 1979 Members' List is enclosed with this issue of FoMRHI Quarterly. I hope that there won't be any errors or omissions (future tense because I'm leaving it till last so that it's as up-to-date as possible), but if there are, please let me have corrections, as well as any additional information about yourselves, as soon as possible, and anyway before July 2nd, which is the deadline for the next issue.

APOLOGIES: I ought to apologise because this looks like being a bit late, but I seem to include such an apology in every issue and I think that the time has come to stop doing so. Issues may be on time; they may be a bit late leaving here, and they may be a bit late leaving Djilda for the printer. We do our best but we both have livings to earn and so on (and we have to suffer the occasional postal or other strike), so from here on let's just say we hope to get each issue to you within the month on the headline, and that for those quarters when we don't, we hope that you'll bear with us.

OUT-OF-PRINT QUARTERLY: No.2-no.8 are now out of print; no.9 very soon will be. We've had long discussions about this and about the disappointment some new members feel at not being able to get a complete run. There are a number of problems: a) the cost of reprinting; b) problems of storage as the back-list grows longer; c) tying up capital in stocks of back issues; d) fewer and fewer (but always some) members want to buy a complete run as the list grows longer and the cost higher, which means that b) and c) are with us for longer. Of these the most serious is a). Problems on the other side are that there is a good deal of permanently useful information in the back issues; not just the Communications but also snippets of information on tools, techniques, materials and so on in the Bulletin, and also lists of plans and other such stuff.

Chiefly because of a), we have decided to leave issues out of print as they go (we shall continue to print something like a two-year stock, as near as we can judge, so that new members will always be able to buy last year's issues; those are never more than two years out of date and therefore still fairly relevant in information). However, we would like new members to be able to get any Communication they want, if they really want it, however old it may be, and to do this we need to run a one-off xerox service.

Would any member be willing to run a xerox service, preferably at cost of production plus postage, but if necessary at commercial rates for the trouble? Ideally, we could do with several such members in different countries so as to save international postal charges. If you would do this, please let me know and I can then ask members to get in touch with you direct whenever they ask for out-of-print issues. I send all new members a complete list of contents, and it would be possible to retype this to show the number of pages of each Comm. and thus the cost. But we do need your help. Djilda and I cannot afford any more time to run such a service; we have to ask you to do a share of the work.

RELIABILITY OF COMMS: I've had a comment from a member (marked 'not for printing' but I think it's important, so I'm printing it anonymously) saying: "I often find it difficult to assess the accuracy of the info. in certain communications - mostly because I don't know anything about the communicator...." This is a very real problem, and one that, as I told him in reply, is not confined to FoMRHIQ. We don't guarantee the accuracy of anything we print (how can we?); if something seems obviously wrong we either refuse it (if we know the subject) or refer it to somebody who does. But we also think that everyone is entitled to an opinion
although if we think (as distinct from 'know') that it's wrong we have sometimes said so, if only to warn you that there is more than one view of a subject. So don't take anything on trust just because it's printed in FoMRHIQ. What we print are peoples' ideas, peoples' tips, hints, advice on tools, techniques, materials and so on. If they seem worth trying, try them; if they seem worth thinking about, think about them, but don't set them any higher than that. None of us were around in the Middle Ages, Renaissance or whenever; what we say is that we think that.... or that this.... works for me.

REAMING: Philip McCrone says: "Up to now I have used flat reamers and the reaming I have done with the joint in one hand and the reamer in the other. Cutting has been fast and smooth with no problems. I can't understand all this talk of machine reaming and its attendant difficulties - it's all unnecessary".

And while I'm on reaming, Robert Bigio came round the other day and showed me some 18th century reamers that he has been using. I hope that he will write them up for a future issue.

FURTHER TO: Comm.49: Luis Esteves Pereira has measured his Viola Braguessa (closer to a vihuela than to a Spanish guitar (viola in Portuguese) and a folk instrument) and found the following figures: ABHG - 5/12 (5.1 to be exact), GHFE - 4/12 (4.6), EPFD - 3/13 (2.7).

Comm.67: Neil Buckland writes: "re Howard Brown's statement 'Players invariably use a pirouette, which is almost always visible...'. Neil's underlining - how does one determine the presence of those pirouettes which are invisible? I.E. is the 'invariable' use of a pirouette just a modern presumption? There are pictures of shawms which appear not to have pirouettes, though I couldn't point directly to any trecento Italian ones."

Bull.11, p.3: We have had the grand total of one offer to act as an area secretary (Brian Lemin for Australia). I had assumed from the lack of response that this was not required by members, but Thomas McGeary writes that he does find having to send bank drafts overseas a bit of a bother: 'each draft now costs one dollar, plus $1.50 to cover your conversion charge.... Might one solution be to have an American secretary who could collect subscriptions in dollars, saving us each a bank draft and a conversion charge?'. I've no objection, provided that you remember that there is a sliding scale for conversion charges, according to the amount (there is a top figure and I can find out what it is). Would anyone volunteer to do this? It wouldn't be compulsory to pay that way; anyone who preferred to pay direct could do so, and those who want to save the odd dollar or two could pay whoever will do the job.

Comm.119 (and my comment in Bull.13 p.8): Felix Raudonikas writes: "The discovery you wrote about in Bull.No.13 I have regarded as a joke.... Try to play on your flute with some other instrument tuned to A-415. I am sure that even in the middle register you wouldn't be able to play in the pitch, especially in the upper one." I told him that I'm no flautist and that when I found I was out of tune playing a flute I assumed that it was me rather than the flute that was out of tune. But it happened that Felix's letter arrived the day that Robert Bigio came round (see Reaming, above), so I asked him what he thought, and he said that he had found when playing one-key flutes that one needed to have the finger holes facing further forward than one instruments with more keys, so as to balance the instrument, and that one covered the embouchure only to the normal amount. The Stanesby alignment of marks thus put the finger holes in the right place if one blew with the embouchure placed normally. Felix has also sent a long note comparing my and the Leningrad Stanesbys.
Bull.14 p.5: Paul Hailpern says:

I'm definitely for trade restrictions on ivory and against endangering the future existence of elephants. But I think Cary ought to at least offer a good suggestion as to what we should do with stores in hand, if not use them. We can't make live elephants out of it. In connection with substitutes; I'm surprised to see more use of bone on keyboards (in respect to the use of bone in past centuries, might be inappropriate to term it an "ivory substitute"); I find it pleasant to the eye and the finger, and the source is a domesticated animal which seems to be in no danger of extinction. I've also seen, though very rarely, bone ferrules on old wind instruments. Those wind instrument makers who feel they can't get along without white ferrules (personally prefer making plain wood instruments to using plastic) might try bone. It obviously doesn't have the superb turning qualities of ivory.

However, there is another side to this. I had to buy some conch shells the other day (anyone who wants to hear trios for conch, serpent and didjeridu might keep an eye open for a film called The Alien) and had a long talk with F. Friedlein & Co (6-10 Tring Close, Newbury Park, Ilford, Essex; tel:01-518 1424/5). They point out that elephant herds have to be culled; otherwise they swamp the National Parks and other areas. They import ivory, all of it under licence (i.e. none is smuggled and all comes from legal and official culling) and they do it with a clear conscience (they didn't say so, but obviously with as clear a conscience as one eats venison, which also comes from culled herds if you buy it from a licenced retailer, rather than from a corner butcher who may have bought it from a poacher). They sell it at £8 a pound for offcuts and £40 and up a pound for solid (ie whole tusks or sections cut for you). They also sell shell of all sorts, including mother-of-pearl and awaki flake, which is a form of mother-of-pearl which they normally sell lm thick for inlay work. They ask to be telephoned before you visit them.

It looks as though we each have to make up our own minds about this. Obviously there is no justification at all for buying poached ivory. However, if the herds have to be kept down (if they weren't, they would starve to death in the Parks because there would be more of them than the Park could feed, and those outside the Parks would be killed off by infuriated locals whose fields were being ravaged) then I can't see any objection to using the by-products and, incidentally, providing the money to keep the National Parks going. But if you do decide to buy, then do make sure that you deal with a firm like Friedlein who only buy licenced exports and won't touch the poached ivory.

Reference (above): I forgot to say that Paul also told me:

I think the statement "that some bores were made with multiple reamers and some weren't" has a very good chance of representing the truth. I have in my shop 2 old forged reamers from a Viennese shop which was founded in the last century and terminated with the death of the last master some years ago. Unfortunately I had contact only with the widow, and learned nothing of the origin of these reamers. I can only say that 1) they are long enough to bore entire joints and 2) they have the degree of irregularities to the straight cone which we are accustomed to find in 19th century instruments.
In reply to your questions in FOMRHI Bulletin 14, here are some notes based on my experience with oboes.

1) See Bob Marvin’s article in GSJ XXV, 1972, p 55 ff.
2) don’t know
3) With reasonably good tools, reaming accomplishes polishing at the same time. Boring (which only can be considered for a final bore if it is cylindrical, which seems to be what you are interested in) more frequently gives a rough bore. I prefer to have an oboe bore, upper portion and lower, with smooth finish. The tone is freer, brighter and more flexible, so the attack more accurate. Those who prefer a rough bore are presumably thinking of the darker tone, but that can also be accomplished with less disadvantageous means.
4) The effect is more important than the explanation. As Bob Marvin says, the science of acoustics isn’t yet up to the subtleties which our ears perceive. Though in this case I suspect Arthur Benade might have the answer.
5) Undercutting all round raises the pitch more than undercutting just downwards. On an oboe it does other things too, depending on the multiple uses of the hole in cross-fingering, overblowing, etc.
6) yes.
7) If similarly undercut, yes.
8) It obviously has to be unround. But this would seem to be an extreme situation, and you ought to consider other means of raising the tone.
9) I pass.
10) My experience has always confirmed that dimensionally identical instruments of different woods are also tonally different. Also the amount of wood left on the outside of the instrument makes a difference (in agreement with Will Jansen ...). Yes, it is possible to make dimensionally identical instruments that play in unison!
11) Accuracy is a matter of degree... undercutting in particular is mostly insufficiently described, despite recent efforts by Cary Karp. And reeds and blowing can have a major effect on tuning. But any gross mistuning indicates that something is wrong with plans or instrument. In considering what to do to correct a tone, one should consider not only the pitch, which can be corrected in various ways, but also the questions 4) & 7).

Comm.186: Mark Smith writes:
The picture in POMHIQ 14, p 62, has been identified as: Michel Corette, ‘Les Amusemens du Pamasse’, Paris (c 1740), frontispiece. I am much indebted to Uta Henning for this information.
There are several other pictures of bowed instruments, between a viola and a cello in size, and held with the body against the player's right shoulder and the pegbox to the player's left. One picture is from the series of engravings by Israël Silvestre, 'Les plaisirs de l'île enchantée', performed in 1664 at Versailles. (Paris, Bibliothèque Nationale, Cabinet des estampes, Hennin 421.) Among the performers can be seen a group of string-players with instruments of at least four different sizes — violin, viola, base and one instrument of the size and held in the way described above. This instrument is of about the size given by Peronne (in his 'Harmonie Universelle' of 1636) for the largest of three different sizes of viola. Therefore, it seems that there may have been some French violas of about the same size as Bach's viola pomposa and held the same way. Perhaps, in the 1680's some instruments like this largest French viola were refretting with overspun strings, re-tuned to cello-pitch, and re-named 'viola da spalla' or 'fagott-geige'.

OILS: Neil Buckland writes: "About oil for woodwinds: in 'health food' circles, cold-pressed vegetable oils are believed to be much more nutritious than the usual oils, which are extracted with heat...cold-pressed oils do usually taste better, and in fact the ordinary ones are frequently rancid when purchased, though they're not 'off' enough to be noticed by most people. Presumably the cold-press process is the one that would have been used in 'early music' times, so could it be that the oils we use now are significantly different from those originally used? ... There is also the possibility that some of the normal supermarket varieties have chemical additives (preservatives, clarifiers, etc) or residues, so again we may not be using the right substances."

Neil very definitely has a point here. I'm not pushing for authenticity in oils (what we're after is to preserve our instruments as best we can) but the one thing that all conservation experts warn against again and again is the use of materials with unknown, and thus possibly harmful, ingredients. The oil may be good for the wood, but the added preservatives etc, while they preserve the oil, may do the opposite to the wood. So, forget the supermarkets and go either for the chemical supply places (which, if they say it's pure oil, should be selling pure oil!) or even better the health food stores, especially the ones which prepare their own stock, and ask if there are any additives before you buy.

SUGGESTIONS: Iconographic Dictionary: Luis Pereira suggests the preparation of a multi-lingual dictionary of instruments (Enzo Puzzovio had a similar idea a while back; I don't know if he had any response; none came through here). Members could give the names, etc, of the instruments illustrated in their own languages. He asks for comments, and so do I. If enough people were interested, it would then be a matter of finding a publisher (we couldn't handle so big a job) but it would be worth trying.

Woods: He also suggests that authors should always add the botanical name of a wood that they refer to; there are so many different (and, as we have seen in previous issues, contradictory) names in different languages. He also says that perhaps an international dictionary of timbers would be a good idea. But please note the suggestion; if possible please always include the botanical name of a timber you mention.

Market Survey: Christopher Allworth asks if we have any notions on the current state of instrument making in relation to instrument demand. He says that surely there must be a lot of young makers wondering what instruments to work on. I suspect that he forgets that many of our members are amateurs, making for themselves, and I think that such a market survey is more for EMIMA than us, but we, and he, would welcome your comments.
MEETINGS & COURSES: R.A. Robertson is proposing to hold a meeting in Edinburgh of those interested in lute building to discuss the various problems, sources of information, designs and other topics of interest. Neil Morrison will give a short recital on his Stephen Gottlieb lute. The meeting will be on a Saturday; if you are interested, get in touch with R.A. Robertson (address in Members List) and a Saturday will be chosen to suit the majority of those interested. It might help him if you said at least which month would suit you, from May onwards, and any Saturdays that you definitely cannot manage.

Bouwerskontakt: They are running a variety of courses. One on fiddle making from 30th June to 14th July, another on wood-turning, date not yet fixed. They also have regular Bouwerskontakt Days in Utrecht, but I usually get their material just after one of ours has gone out, so it always comes too late to tell you about it (the next is April 28th and you are not likely to have this before then). If you are ever intending to be in Holland, write to them (the address is in the List) and ask if there will be anything going on while you're there. All their members know about us, and a number of them belong to us as well as to them, so you can be fairly sure of having a network of friends and colleagues ready-made all over Holland. If writing to their office seems too formal, pick a Dutch FOMCII member who is interested in your interests and write to him and ask who he knows in whichever part you are going to.

Paul Hailperin:

Announcements of courses: May 21 - June 9, Jurg Schaeftlein/baroque oboe, information from Hochschule für Musik & Darstellende Kunst, Lotringer Str., Vienna.
June 6 - 10, Elisabeth Hahn/recorder and Paul Hailperin/baroque oboe (I hope to put the emphasis on orchestral literature, technical assistance if anyone insists), information from Gesellschaft Norddeutsche Musikpflege, Am Heiddamm 47, D-2800 Bremen 33. The basic group language will be German, but all 3 teachers speak English. (one of them an overseas disject)

OFFERS: Timbers: Maurice Briggs is researching into Australian timbers to see which are best for early instruments. He would be happy to pass any information on to others who might be interested and would also be glad of contact with anyone else working in timbers and their uses in any other countries.

Roses: Luis Esteves Pereira offers to obtain photos of the roses of any of the keyboard or string instruments in the Lisbon Museum.

Organs: He has also been making a complete inventory of the extant organs in Portugal, including Madeira and the Azores, and he has an archive of some hundreds of photos, which he offers to anyone interested at cost plus postage. If you have a comparable collection of organs from other countries, he might be interested in exchange of photos rather than cash (he suggests exchange for the next item).

Clavichord & Spinnet: He has been measuring some of the keyboard instruments in the Lisbon Museum and offers, either at cost or by exchange, blueprints of an anonymous 18th century Portuguese clavichord and of an octave spinet by Gaetanus Giannini, 1628. He also has has lots of photographs of other instruments in the museum; if you tell him what instruments you are interested in, he will tell you what he's got.

Translation: He also offers to translate into and from Portuguese, Spanish and French. We are beginning to build up quite a body of people willing to translate, and as well as the formal offers, which are
listed under General Facilities, you can reckon that anyone who subscribes to FomRHiQ must be able to read English to some extent, so that if you are ever stuck for the meaning of the odd word or phrase in any language, write to a member in that country and ask his or her help.

**Australia:** Brian Lemin offers to act as an Area Secretary for Australia. Whether he'd be willing to organise FomRHiQ Seminars (and whether such a thing is practical in a country the size of Australia) I don't know; if you think it's worth it trying, get in touch with him.

**Glues, Tools:** Alex Marx would be happy to help members get tools, glues and other materials from America, either on a cash or an exchange basis if you can get things he can't. Last time he was here, he brought a dozen bottles of Titebond glue (Bullet.10 p.9) which I passed round those nearby and interested.

**Querries & Requests:** Recorders: Miloš Pahor is looking for a replica recorder at 415 pitch for Telemann and Bach; he has a Stanesby copy but thinks that something just a little later would be better for those composers and for the Quantz trio sonata, etc. Can anyone advise him a) as to a good model and b) as to a good maker?

**Bows:** Luis Esteves Pereira asks whether anyone has tried using willow to make viol and/or rebeck bows. He would presumably like to know whether it's any good for this.

**String Lengths:** Anthony Doherty asks for advice on string length for a mean lute around 1600. He has been working through some Dowland and finds some of the left-hand stretches impossible using a lute of string length 59cm. He is thinking of making another about 55cm or even less and asks if anyone has any suggestions.

**Double Reeds:** He would also appreciate advice on double reed making for crumhorns, bagpipes, etc, especially sources of material. He has read Baines Woodwinds but needs further help. This is a request we have had before - would someone be kind enough to write us a Comm. on it?

**Wind Instrument Plans:** Jack Woodahl asks me "please publish a request for plans and measurements to build renaissance and baroque wind instruments." He gives no specific indication of which instruments he's after - perhaps all of them?

**Flute Plans:** Steve Hankin would be grateful for plans or measurements of a 4-key flute of the style popular at the close of the 18th century; he is also interested in other 18th century flutes. He would be glad of any suggestions as to where he might write for such plans.

**Bressan Treble Recorder:** Felix Raudonikas says that they have in the Leningrad Museum an anonymous treble (alto) recorder of ebony and ivory, which looks like a Bressan. He would be very grateful for any photographs or measurements of Bressan recorders, and especially for details of the foot joint because the foot on their instrument is a replacement which was copied from some other instrument, and he would like to make a new foot copied from a Bressan. Can anyone help him?

**Brush Finish:** George Bowden was interested in the egg, linseed and water finish for soundboards (Comm.173), but fears that all that water might give a severe case of raised grain. He asks whether anyone can recommend a good brush finish (preferably a traditional one that he can make up for lutes) for back, sides, neck and head. Please send me a copy for general circulation also.

**Fiddles:** Olov Gibson has made six quite different types of medieval fiddles and would like to be in touch "with others who also dare to explore these marvellous instruments by making them sound instead of regarding them as objects of art or history. I believe that there are
interesting experiences to exchange."

Galilei: Tim Hobrough asks whether anyone can give him the original wording of Galilei's comments on the 'Irish gentleman' who showed him the 'Irish' harp, in the original language.

Wood Bending: Luis Esteves Pereira asks for information on wood bending methods, for example for bridges and bentsides of harpsichords. Charles Ford's new book (see multiple reviews elsewhere in this issue) won't help him because it only covers laminated bentsides.

Filing: Geoffrey Wills says he has made a binder for FoMRHIQ from three pieces of 3-ply, two of them 9\frac{1}{2}\text{"} \times 6\text{"}, the other 9\frac{1}{2}\text{"} \times 3\text{"} (about 24.2cm by 15.3 and 7.6cm) joined with cloth binding and PVC glue. He drills 12 holes top and bottom of the 3 inch piece and leads twine through the holes and the central pages of each issue. As he raises it, I find it easier to punch mine in two places and put them in a loose-leaf binder (not a ring binder, but a Hunt & Broadhurst Loxon binder, which uses cord through the holes so that when the cords are released it will lie flat) with rigid boards. Certainly either of these methods avoids the usual hunt for wherever one last put down whichever number it is you can't find.

Aerophones: John Weston has sent me:

The Aerophone Pasted Over

While visiting a school in the Midlands this month I came across the following paragraph displayed on the wall: it was carefully written in the child's best handwriting. The headline caught my eye at once and the whole text has haunted me since. I have given the text here as it was with just one full stop added for clarity. I have nobly resisted the temptation of correcting the spelling in line three to Boehm!

THE AEROPHONE PASTED OVER

I was standing in my looking tower, when I saw an aerophone coming this way, my heart started to beat fast. I ran down as fast as I could, I ran up a rocky hill, to where there was a big bonfire. I lit it as fast as I could, and I put some fresh green leaves, to make it smoke a lot, and made SOS in big white stones on the ground. I waited hoping the plate had spotted the smoke, sadly the aerophone pasted over, how sad I was, there might not be another aerophone, how sad I was.

My Movements: I shall be here through the summer (I had hoped to go to Leipzig for the CTMCIM Conference in August, but can't afford the cost) and will be happy to see any of you who are passing through (this applies to those who live here, too); I've got a few hundred aerophones, as well as other instruments, so I shall be looking out as you pasted over. I'll leave this open for last minute requests etc as usual. There aren't any, so that's it for now.

Jeremy Montagu

Bulletin Supplement on back page. D.A.
BouwersKontakt: The latest issue includes an article on the French flageolet by Toon Moonen, with a drawing and measurements of a 17th century example (2 pp); two short descriptions of violin makers' planes and (I think) purfling cutter (1 page each) by C.v.d.Kaay; an illustrated article on hurdy-gurdies by Toon Moonen (4 pp), mostly early ones, mediaeval and early renaissance types; a brief note (1 p) on bending irons by Herman Ritter & Harrie Franken; a detailed description of the lute course at the Germanisches Nationalmuseum, Nürnberg by Peter van Rijen (11 pages) with illustrations. Djilda Abbott has the copy; if you want anything, send her enough for xerox prices (about 10p a page) and postage. Remember it's all in Dutch.

Polskie Instrumenty Ludowe by Stanislaw Oledzki, Polskie Wydawnictwo Muzyczne, Kraków, 1978, 24.135. Pierre Ducept kindly sent me a copy of this book, which includes a number of surviving early instruments which are still used as folk instruments. Among them are fiddles of various sizes, rebecs, hurdy-gurdies, dulcimers, duct flutes, whithorns (coiled bark shawms), bagpipes (some with bladders as bags and some with skin bags), drums, etc. Each instrument is illustrated with one, occasionally more, photographs. The only dimension usually is overall length. I have seen the book listed in Theodore Front's catalogue (155 N. San Vicente Blvd., Beverly Hills, Calif. 90211) at $15; if you want a copy it could also be worth trying Blackwell's Music Shop or our members Tony Ringham and Brian Jordan.

PoMRHI Comm. 188 A


General review, Jeremy Montagu

This is the first section of a multiple review. We thought that we would do it this way (and we are grateful to Faber & Faber for supplying enough review copies to make it possible) because no one reviewer could do justice to a book that covered so wide a field. There are six separate sections: The Viol, by Dietrich Kessler; The Lute, by Ian Harwood; The Violin, including the Baroque Violin, by Adam Paul; The Classical Guitar, by José Romanillos; The Harpsichord by Michael Johnson; Restoration and Conservation of Historical Musical Instruments, by Friedemann Hellwig. Each section is reviewed here by someone who builds instruments of that type, or who is a professional restorer, and can therefore judge the section professionally, but because there are many people who think that
they would like to build an instrument but don't know much about it, we thought that there should also be a general review by someone who is not an expert maker (and anyone who has seen the drums I've made will know that that description fits me).

I must start by saying that this is not a book for the beginner. For one thing, as Charles Ford points out in his introduction, the contributors have assumed that the reader already has a basic knowledge of woodworking and of the use and handling of tools (agreed that any other assumption would have made the book much longer, and yet I feel that there must be many customers, potential or actual, who have less expertise than most of the authors assume), and for another several of the authors seem to assume, or even state that they assume, that the reader already has some knowledge of building instruments - if he or she had, they would not be buying so expensive an so basic a book. This is part of the trouble: it is basic and yet does not cover all the basics. Partly this is due to its size; how can one hope to cover six such subjects in 192 pages? Certainly the book will be useful to the beginner, and to the more experienced as well; I just don't think that anybody, even an experienced woodworker, could make a decent instrument if all the knowledge he had was what he had read here (with, as we shall see, perhaps one exception). But let us look at each section.

The Viol: Someone who has made violins, and wants a crack at viols, or who has other string instrument building experience, would find this section very useful indeed, but it is not at all easy for a beginner or for someone like myself who knows what a viol looks like but who has never tried to build a string instrument. Some of the time one does not even know what he is talking about nor what he means. There is no mention of bows at all and the word 'bow' does not even appear in the index. If you did succeed in making a viol, how would you play it? Or am I wrong in assuming that viol makers (and violin makers) still make the bows as well, just as they used to?

The Lute: This is the one exception to my reservations. It is an exemplary article, excellently detailed and beautifully clear. Eph Segerman will probably clout me for saying this, but after reading this chapter I really thought that if I wanted to build a lute I had a good chance of being able to do so. Never again need anyone ask how to build a lute and even absolute beginners should be able to follow and carry out every process. All the figures are very clear and are easily understood. I suspect that the reason that this section is the best is that Ian Harwood is a professional teacher of string instrument making (at the London College of Furniture) as well as a professional maker, whereas the other authors are professional makers but not professional teachers as well - one does have to learn how to teach as well as how to make, and this section is one of the best demonstrations of that fact that I've seen.

The Violin: This section is almost incomprehensible. Many terms and tools are never defined (e.g. what is a 'diapason' (I thought it was an organ pipe, or the French for tuning fork) on the centre line of the belly? What is an 'instrument rest'? What is the trough? (it is vitally important to make it after purfling, whatever it is) What is the 'soundhole palet'? How can one 'cross thread' a tailpiece gut? I've never seen one with a screw thread and nut). Many essential processes are never described (e.g. thickening). I'm afraid that this section is useless except to people who already know how to make a violin, and they don't need it. The section on the Baroque Violin is a page and a half long(!) and what little explanation of the differences between
it and the modern instrument there are is not a great deal of help, nor, I suspect, particularly accurate. For example, why in Fig.3.6 is the belly of the baroque violin nearly twice as thick as that of the modern instrument? (Surely Vuillaume didn’t thin the bellies of all the violins he modernised?). Why is the bridge so different from known baroque models (e.g. Stradivarius)? Why are the bass bar and the fingerboard so long (there are 2mm difference between the fingerboard to bridge distances on the drawings; 1cm on the drawing equals 7mm actual, so I suppose this means that, according to Mr. Paul, the baroque fingerboard was about 3mm shorter than the modern, and I don’t believe him). There are several other things I don’t believe in his drawing of the baroque violin, but I’ll leave those to the experts. Nor do I believe that playing further up the fingerboard increased the pitch and string tension etc, nor am I certain that one can say that the E string of the baroque violin was of wire-covered gut. In fact I have a suspicion that he doesn’t know much about baroque violins.

The Classical Guitar: This is really not our concern, since what he means is the modern guitar for serious music, as distinct from the folk, steel and electric guitars. As a section it is more helpful than that on the violin, which wouldn’t be difficult, and less helpful than that on the viol, so again it’s not a lot of use to the beginner.

The Harpsichord: Better than viols and violins but not as good as the lute. There’s very little really detailed information so that one would be continually wondering how any part of the job is actually done. There are what strike me as some dubious processes, such as laminating the bent side. One random example of lack of detail is the seven lines (all there are) on cutting the rose, which in fact just tells you how to mark out a circle on the soundboard - having done that, what do you do next? Nor is there anything at all on tuning; surely you can’t just stick the wires on and leave the rest to the customer?

Restoration, etc: There is much to be said in favour of this chapter, but I can see no reason for including it in this book. If anyone who needs to read this book were to touch a genuine early instrument for such a purpose he would be criminally irresponsible. All that needs to be said to the people to whom this book is addressed is ‘Leave them alone’.

This section is followed by the plates, which are rather an odd selection. The viol, for instance, is shown front and back, but not sideways; the lute is one of Charles Ford’s, not one of Ian Harwood’s, but it is at least shown three-quarter view from both front and back and there are pictures of the insides of the Harton bass in Nürnberg; there is no violin but a viola instead, so that the proportions will confuse the reader, but there is a cross section, so that one can see inside, of modern and baroque violin – the only perceptible difference is the wedge fingerboard, and like the viol there is no profile view; the guitar is rather better illustrated, since like the lute the views are slightly oblique, this time from above, so that the ribs can be seen. The harpsichord is the best off, with three views of one of Michael Thomas’s in various states, and a vertical photo and an x-ray of an original (Giusti of 1681) and a technical drawing of the same instrument; this might be quite useful were it not that it is Italian whereas the modern one, and the text of the article, is after Taskin. There is then a brief bibliography for each section, followed by a general bibliography, by no means all of which is relevant (what has Cocks on the Northumbrian pipes got to do with this subject, or for that matter my or David Munrow’s books on mediaeval and renaissance instruments?) or useful (how much use is Agricola or Virdung going to be to people who only know this book?). The bibliography also has
an addenda, not as one might suppose books hot off the press, but some dating back to the sixties, one to 1910; why weren't they in the main section? Or does Addenda mean 'not much use but perhaps worth listing'? There is also a very useful list of relevant societies, with their addresses, some of which are out of date, one (the Galpin Society, of which Charles Ford is a member) by several years. Finally there is an index and all the woods in it are cited by their botanical names as well as the common names (not indexed under botanical names though).

We'll see what the specialist reviewers say about it, but so far as I am concerned, I have to say that it has missed its target on the whole and it doesn't do what we had hoped. There is one section which is really useful, and I would encourage any aspiring lute makers to read it (and when you consider the cost of materials for even one lute, it would be worth buying the book for that section alone). I hope that when (and I sincerely hope that it won't be long) Faber's produce a companion volume for wind instruments, they will look for experienced makers who are also experienced teachers of making. Meanwhile, I'm afraid that we still need a book on viol, violin and harpsichord making.

FoMRHI Comm. 188B

REVIEW: MAKING MUSICAL INSTRUMENTS Ed. CHARLES FORD: CHAPTERS 1, 2 AND BAROQUE VIOLIN PART OF 3. Eph Segerman

The basic approach of this book reflects an attitude rather popular amongst instrument makers today but one which saddens me. It is that they are craftsmen first (in a very contemporary sense) and specialists in early-instrument making second. The mixing of modern guitars and modern violins with lutes, viols and harpsichords is appropriate here because the same approach is used. This approach is that one gives the customer what he expects, and those aspects of design and construction methods that the customer is not sensitive to are filled in with a mixture of modern craft traditions, aesthetic and methodological creativity, and expediency. I would have preferred much more concern with, and application of, research on original design features and construction methods on the early instruments.

Modern makers of early instruments show their lack of respect for history by being very quick to decide that they appreciate the essence of an instrument and therefore can blandly make decisions about which details of original instruments and their making are important and are to be adopted, and which one can freely alter. Few have the respect for history which will lead them to know that this essence is elusive, continuously to be investigated by exploring authentic design and practices.

If the maker extensively used the fruits of modern technology to produce instruments, one would expect that these tools would generate their own methods for efficiently producing instruments. But most makers today use hand tools very similar to those used by the craftsmen who made the original instruments. Those craftsmen had a lot more experience in making these instruments than modern makers. They had the same goals - efficiently producing instruments which were right for the job. I suspect that they were more professional, taking efficiency more seriously, since modern makers, instead of researching and taking advantage of the experience of the early makers, prefer to develop their own methods. No wonder early instruments are so expensive today.

The standard of writing and editing in this book is remarkably high. It contains a tremendous amount of practical information useful for the beginning maker. It never can be enough for him though, since so much that is difficult to write about is necessarily glossed over, to keep the flow for the reading of the armchair instrument makers who will inevitably form the majority of purchasers. The professional maker will also read this book since he is always interested in comparing tricks, picking up a few new ones and congratulating himself on the ones he uses which are "better" than the ones in the book.
My comments are numbered sequentially. After my number is the page being referred to.

CHAPTER 1. "THE VIOL" BY DIETRICH KESSLER

1-15 I disagree with Kessler that this way of making viols is the right one at the moment. My argument is not in terms of philosophy but in terms of prediction of future market value.

Kessler is solidly in the best old craft tradition of doing his best to give his customers what they want. These customers have always been strongly influenced by the aesthetics of the modern string sound. They demand reserve power for special occasions even if they usually play with delicacy. Very few if any living craftsmen have the intimate knowledge of as many original viols as Kessler has. But he knows that an accurate copy will distort and wolf with the standard high-tension Pirastro strings that he believes his customers insist on using, so he makes instruments which will work with these strings. Pirastro will make strings of any gauge if properly pestered, but if the players are satisfied why should Pirastro or Kessler do differently? (Actually Kessler does not always completely succeed, since we have had to cure wolves which developed after playing-in on quite a few of his instruments by providing strings of lower tension.)

There are two schools of thought about authenticity amongst players and makers. The vast majority of them seek beauty as they perceive it first, and accept authenticity only to the extent that it contributes to this beauty. A growing minority though is interested in exploring beauty as the composers perceived it. They insist on as much authenticity as they can get in the design, construction and accessories of their instruments and will attempt to play with authentic technique and interpretation.

They have confidence that this will lead to a beauty that is at least as profound as that achieved the easy way by others. Neither of these approaches can be judged superior to the other if one plays for oneself. But there is another component in the early music scene, the audience, which is also very important. It naively expects both beauty and authenticity. This presents problems for the beauty-first majority who try to kid themselves and their audience that they are being as authentic as is necessary to communicate "the spirit" of the music. This is as true as "the spirit" of Dowland can be expressed on the guitar. Such deception has an unstable influence on the early music field today. With more knowledge, some (probably the majority) of the audience will grow to knowingly accept unauthenticity in music as they do already in historical drama, in which case special early instruments won't be really necessary. Others will insist on historical accuracy and will get close to it from performers. The instruments of only partial authenticity that the beauty-first people play today could then become as unfashionable as Pleyel harpsichords.

If this prediction is correct, then a compromise instrument which Kessler would consider "the right one for the moment" will diminish in value. So although he is giving players what they want now, in the long run he may be doing them a disservice by not at least offering an authentic alternative.

2-15 One would like to know Kessler's criteria for selecting those features of authentic instruments "worth copying" and those he rejects. I suspect that "their successes and their failures" are purely in terms of customer satisfaction. This approach could be myopic since he tends to get customers who already want the famous Kessler sound. Thus feedback would tend to relate only to consistency, and his "failures" might not be considered as such in the hands of more exploratory players.

3.15 Heron-Allen gave much practical advice about violin making and very little
of it is relevant to viol making in the baroque. Bessaraboff made an heroic attempt to understand the sizes and tunings of viols, but was unfortunately wrong. For the reason Comm 38. For conclusions more consistent with the historical data see Comms 37, 65, 103, 158 and 187.

4-18 I don't see why ebony-sycamore-ebony purfling is best. Sacconi in "Il Segreti di Stradivari" stated that in Brescian violins by Gasparo and Maggini the centre strip was of fig bark, those from Cremona and Venice generally had poplar and those from Naples, Rome, Tuscany and Bologna had beech. He also mentioned that the black strips of Stradivari's purfling were dyed pear wood.

5-19 Kessler's statement that the violin family does not need a mould and that viols do is contradicted by what little we know about early practices. Diderot's Encyclopédie plate XII on Lutherie shows three designs for violin moulds and only a set of belly and back false plates for violin construction. David Miller, the Saskatoon luthier who was at NRI last autumn on a study grant from Canada Council, made a viol by the method implied by the false plates and he found it remarkably straightforward. (A Comm. on this has been promised.) The principle is very simple. Wooden boards of the inside shapes of the ribs representing the belly and back are prepared. A wedge is glued to the back false plate and appropriately shaped. In side view the back false plate looks like the right hand drawing in Kessler's Fig. 1.7. The lower and upper blocks are temporarily attached to these false plates forming a kind of mould to bend the sides to. But first the end blocks are shaped by chiselling along straight lines between the two false plates.

6-19 The advice on model sizes is of course without historical basis. See Comms 37, 158 and 187. Once the model is chosen it would have been useful if the reader had some guidance on how to measure the instrument, if it is a real live one, or what to look for when choosing a drawing to work from. Also which factors change which way when one scales it to a bigger or smaller size.

7-19 Concerning the footnote on Renaissance violins, more recent information is in Early Music 6/4 Oct '78 p.519 and p.530, and Comm 136.

8-20 Fig. 1.7. Are corner blocks really necessary? Rose and Bertrand amongst others didn't need them.

9-21 Ditto the dovetail joint between the neck and the body. Must we incorporate 19th century violin practices into our historical instruments? Early instruments were made like good cars, to make repairs easier. Anyone who has had to repair the broken-off neck of a viol made with a dovetail joint knows about the mess. With a butt join the break is more easily repaired.

10-22 Ditto linings.

11-23 Ditto the bar over the back bend. There are better solutions to the tendency of the back bend to sink in to a concave curve. If I recall properly, David Rubio heats the back on the inside instead of the outside while bending, which does the trick. I personally don't mind a little concavity in the back.

12-25 I wonder how much of a detriment to tone too thick a soundpost bar on the back is. In our experiments with viol backs using the Chladni plate technique, we could find no strong resonances on the back with even a thin bar on it which had any significant amplitude in the region that the soundpost would rest on. I feel that a thick bar is aesthetically displeasing, but expect the acoustic effect to be very subtle indeed.
Kessler also knows that the earlier 17th century English bass viols had bellies with four lines of joins (making five pieces if the end pieces on the upper bout were the same as on the lower bout, which was not always the case). The inner joins run under the bridge feet and one of them over the bass bar. Such information wasn't included, presumably because it wasn't considered as important as the 3-piece bellies Barak Norman used. This reflects the topsy turvy situation amongst viols today, where the early 18th century viols by Norman dominate design thinking while no one plays the music these viols were originally made for. The music played is usually English music of the previous century or French music.

The modern violin-family way of constructing the soundboard out of two planks glued together and carved was actually considered superior by Christopher Simpson, but for a viol with violin shape. On page 1 of the 1665 edition we all have on our shelves, Simpson wrote: "The Sound should be quick and sprightly, like a violin; and viols of that shape (the Bellyes being digged out of the Plank) do commonly render such a sound."

On the opposite page are drawings of two viols, one of the usual shape and the other of the violin shape Simpson referred to. The implication is obviously that the other viol with its more usual shape had its 'Bellye' not 'digged out of the Plank'.

The alternative is bent staves. This construction is inherently stronger since the grain follows the stave along its curve with no end grain appearing. This makes thinner soundboards more stable than Kessler would have us believe.

According to our experiments looking at soundboard resonances, we conclude that the soundboard arching curves are tremendously important in determining viol tone. Kessler implies that arching is to be done by eye. This is appropriate for the sensitive and experienced eye, but it seems more appropriate for the beginner to make sure that he has arching curves for the model he is making, and makes templates to work with.

It is sad that soundboard thicknessing is a subject of theorising by makers. It is one of the most crucial determinants of tone, and the obvious implication is that the sound of the original viols is irrelevant to viol making today. On the Table I list the data on thicknessing of original viol soundboards I've collected from various researchers who have kindly let me copy their measurements. As far as I'm aware, most of these measurements were made on intact instruments and so the inside surface has not been closely examined for evidence of lining or thinning.

The first of Kessler's two "common" thickness schemes (4.8mm around blocks and 4.5mm elsewhere) is only mirrored in the 1760 Hintz. His second (3.5, 4, 5 and 4 mm in the sequence of the table) might be a thickened-up version of the 1677 Meares. From these data it seems unlikely that either is typically 17th century English or 18th century French, the two focal repertories for which baroque viols are now made.

It is currently assumed by most observers of bowed instrument acoustics that purfling affects tone by increasing edge flexibility. The most pronounced effect of this flexibility is increased sound volume in the bass. Overspun strings provide a rich set of harmonics for each bass note, so strength in the true bass fundamental is not essential in the perception of sound volume of those low notes. But with the all-gut bass strings used in 17th century England there are very few higher harmonics in the tone and the fundamental is relatively much more important. It is thus probable that the advantage of double purfling over single purfling on the soundboard will be much more evident on an English type of viol with authentic stringing than with modern stringing.
<table>
<thead>
<tr>
<th>NOTES</th>
<th>MAKER</th>
<th>LOCATION</th>
<th>DATE</th>
<th>SOUNDBOARD LENGTH (cm)</th>
<th>MEASURER</th>
<th>NEAR EDGES min max av.</th>
<th>INSIDE UPPER BOUT min max av.</th>
<th>INSIDE CENTRE min max av.</th>
<th>INSIDE LOWER BOUT min max av.</th>
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<tr>
<td>(1)</td>
<td>Rose (big)</td>
<td>Ashmol.</td>
<td>pre 1611</td>
<td>70.6</td>
<td>J.P.</td>
<td>2½ 4 3.0</td>
<td>1½ 3 2.5</td>
<td>2½ 3 2.8</td>
<td>2½ 3 2.7</td>
</tr>
<tr>
<td></td>
<td>Rose</td>
<td>V&amp;A</td>
<td>pre 1611</td>
<td>70.5</td>
<td>J.P.</td>
<td>3 3½ 3.2</td>
<td>3 4 3.5</td>
<td>3½ 3½ 3.5</td>
<td>3½ 3½ 3.3</td>
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<td></td>
<td>&quot;</td>
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<td>S.G.</td>
<td>2½ 3½ 2.8</td>
<td>3 3½ 3.1</td>
<td>3 3 3.0</td>
<td>2½ 3½ 2.9</td>
</tr>
<tr>
<td></td>
<td>Blunt</td>
<td>Ashmol.</td>
<td>1605</td>
<td>55.5</td>
<td>M.P.</td>
<td>2½ 3½ 3.0</td>
<td>2½ 2½ 2.4</td>
<td>2½ 4 3.2</td>
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</tr>
<tr>
<td></td>
<td>Jaye</td>
<td>Hill</td>
<td>1619</td>
<td>-</td>
<td>J.P.</td>
<td>2½ 3½ 3.2</td>
<td>2½ 3 2.8</td>
<td>3½ 4½ 4.0</td>
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<tr>
<td></td>
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<td>Paris</td>
<td>1624</td>
<td>63.0</td>
<td>J.P.</td>
<td>2 2½ 2.2</td>
<td>2 3 2.4</td>
<td>- - 3½</td>
<td>2½ 3½ 2.8</td>
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<tr>
<td>(2)</td>
<td>Meares</td>
<td>V&amp;A</td>
<td>1677</td>
<td>67</td>
<td>J.P.</td>
<td>3 3½ 3.4</td>
<td>3½ 4 3.6</td>
<td>4½ 4½ 4.5</td>
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<td>J.P.</td>
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<td>3 3½ 3.1</td>
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<tr>
<td></td>
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<td>V&amp;A</td>
<td>1688</td>
<td>68.5</td>
<td>J.P.</td>
<td>2½ 6 4.0</td>
<td>3½ 6 4.3</td>
<td>3 3 3.0</td>
<td>2½ 3½ 3.1</td>
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<tr>
<td></td>
<td>Norman</td>
<td>Dolm.</td>
<td>1696</td>
<td>-</td>
<td>J.P.</td>
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<td>2½ 3½ 3.3</td>
<td>3½ 3½ 3.3</td>
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<td>Bertrand</td>
<td>Paris</td>
<td>1720</td>
<td>71.7</td>
<td>J.P.</td>
<td>3 4 3.5</td>
<td>3½ 4 3.6</td>
<td>3½ 4 3.8</td>
<td>3½ 3½ 3.5</td>
</tr>
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<td></td>
<td>Hintz</td>
<td>V&amp;A</td>
<td>1760</td>
<td>67</td>
<td>J.P.</td>
<td>3½ 4½ 4.1</td>
<td>4 5 4.7</td>
<td>4 5½ 4.8</td>
<td>4 5½ 4.5</td>
</tr>
</tbody>
</table>

**KEY**
- J.P. John Pringle
- S.G. Stephen Gottlieb
- M.P. Michael Plant

**NOTES**
- (1) Inside centre measurement is for full length of centre strip, ignoring big patch under bridge; other measurements avoid centre strip.
- (2) On loan to Oxford City Museum.
17-31 Many makers would consider that a final sandpaper finish leads to a dull look of the wood underneath the varnish coating. They would recommend a scraped finish all over.

18-31 The nails that strengthen the traditional body-neck join are not mentioned in the argument attempting to justify the dove-tail alternative. The dove-tail was introduced in violins in the 19th century when string tension was much greater than it had ever been before or has ever been since. The current standard Pirastro set of viol strings probably does produce more tension than any historical viol was made to withstand, but the difference is not a factor of 2 as it was with the violins.

19-32 The exclamation mark after the statement that Barak Norman sometimes used sycamore painted black for the hook bar seems to imply a conclusion that components of instruments coloured black, if not ebony, are inferior substitutes for ebony. Historically this is often not true. Ebony is stiff and hard-wearing but also heavy and hard to work. When its advantages are not needed, other materials were often preferred. Examples are ebony veneers on fingerboards rather than solid ebony fingerboards, and black lute bridges which were hardly ever of ebony.

20-33 Many makers, as stated on the next page, have cabinets fitted out with ultraviolet tubes to aid varnish drying. An instrument in the white can get an attractive sun tan if left in such a cabinet for a couple of weeks.

21-33 A primary coat of dilute glue (used also by Gasparo da Salo and Maggini according to Sacconi) penetrates the wood and after application the surface is then sanded or scraped back to the top layer of wood. The subsequent varnish needs to be keyed into that surface. The sandpaper scratches can provide such a key. If the surface is scraped, rubbing over with a damp cloth dissolving the glue out of the surface pores will provide the key. In both cases the keying is into the wood structure and not into the glue. The varnish will not then come off if damp softens the glue.

22-34 Beginners should be encouraged to use oil varnishes rather than be frightened off by them. As stated, they are much easier to apply, but they need not take more than a day per coat.

Traditional oil varnishes contain a drying oil, usually linseed oil, which keeps hardening for decades. This may be an advantage in that its properties may then continuously match those of the wood which matures and becomes more brittle. After application the varnish needs to harden fast enough initially to soon be handled and rubbed down, and this requires either ultraviolet light or dryers. With either of these one coat per day should be possible, with an added few days before rubdown. If the dryers will cause decay in the varnish film after some time (as it is traditional to claim), one can be fairly sure that the same would occur to the varnish without the dryer after a longer time. We have not been able to detect any detrimental affect on a Fulton type of varnish during accelerated aging tests after adding a very excessive amount of dryer. A high quality varnish such as this type is recommended.

Modern varnishes are plasticized without a drying oil, and so when the turpentine evaporates the varnish is in its final state. Dryers and ultraviolet light won't affect such varnishes, but warmth speeds up the drying (as it will do to any varnish). Some viol makers use "pale oil varnish" of a modern type available from any paint-supplies shop with great success. They add standard dyes to get the colours they want.

Oil varnishes available from luthier-supply houses can be either traditional or modern and they rarely state which. Quality varies widely and price is not a guide to it. Kessler's instruction to thoroughly test out a varnish before applying it to an instrument should be taken very seriously.
Cello toes on viol bridges look worse to me than belly marking by bridge feet. It is an aesthetic choice because no one claims that the "damaging" of the varnish and wood does the viol any structural or acoustical harm. The "damaging" can be avoided by, after carefully fitting the feet, rounding off the outer and inner edges very slightly. If this is done unevenly it can cause wolf-like effects on some notes. If it is suspected that this is the cause of such effects, check by wedging a piece of thin card in each rounded-off edge in turn and see if the effect is stopped.

CHAPTER 2. "THE LUTE" BY IAN HARWOOD

It is clear that Harwood's article and MacLeod-Coupe's booklet come from the same stable. They both refer to a 7-course 'tenor' lute tuned with g' first course. This terminology corresponds with no early source I know of. The English terms used were 'treble', 'mean' and 'bass'. The most usual lute used in England was the 'mean' nominally tuned in g' but clearly larger and probably tuned lower than the 'treble' used primarily in consorts with the same nominal tuning. Praetorius listed a 'tenor' lute but it was tuned in e'. He listed a lute tuned nominally in g' which he called 'Chorist' or 'alt'.

Frets were tied rather than fixed so that they could be adjusted, the eighth fret included. Thus the body-neck join was generally between the 8th and 9th fret positions. Then 5/8 of the string length for the distance between the nut and the body-neck join is too small.

Most of the data on real lutes indicates that one-sixth for the ratio of distances between the bottom of the body and the bridge, and from the bridge to the body-neck join, was more of an upper limit than a typical value.

The ratio of maximum width to body length is about 3/5 for the 'pear' shape of lute and 3/4 for the 'pearl' shape.

A 60.0 cm length for a gut string tuned to modern g' will involve rather frequent breakage of first strings. In Elizabethan times (see J. Lute Soc. of America X (1977) p.117) each string cost 3 to 5d. (presumed to be selected for playable quality) while a lute would cost from 6s 8d to 50s. An amateur player with probably more than one lute spent about 12s per year on strings. Assuming 2 lutes and 2/3 of the strings being to replace broken first strings, we can estimate that a first string lasted an average of 3 weeks. To match this rate I would drop down a few cm in string length (or a semitone or 2 in pitch or a bit of both). A string length of 57 or 58 cm seems to have been an early string-length standard, but probably for a different pitch standard (probably g' at almost a semitone below modern pitch or for a' at almost 3 semitones low).

The given shape is not 'quite typical'. It is closest to a Hartung or Tieffenbrucker shape, but these H-T lutes have an extra curve giving more rounded shoulders. The longer 'pear' shapes and the shorter 'pearl' shapes, each of which was at least as typical as the H-T shape, usually didn't have the extra curve.

The elevation is smaller than half the plan for circular cross-section lutes. As seen in Fig. 2.2, the elevation involves the radius to the flat of the central stave while the plan involves the radius to a corner between staves.

Early lutes rarely had backs with circular cross section. This and the variation amongst rib widths usually found indicates that early makers used a very different method of construction from the one Harwood gives. The shape of each rib was dictated by the mould instead of by a former. Any slight error in making a former is cumulative with respect to the total back shape. The former needs to be made with great accuracy and is quite inflexible if one wants to use stringing of different widths between ribs or if
one wants to vary the number of ribs. Early makers probably used a template to mark out the ribs, then cut them, bent them and planed the edges in mid air to fit. John Duncalf in our workshop has used both methods and finds the free-hand method faster and just as accurate.

Generating the rib template can be simpler than the method given here if one had a more substantial mould with the ribs marked on it. One bends a piece of paper over the mould and traces the markings onto it.

9-42 Close examination of the curves of the ribs on a chitarrone that Harwood has restored shows regions of flatter curvature and regions of sharper curvature. This is most easily explained if the maker used a mould made up of say a half dozen bulkheads rather like that used by Arnault von Zwolle. The sharper curvature is over the mould bulkheads and the flatter curvature comes from the ribs being pulled a bit tightly, straightening out between bulkheads. This type of mould could have been that generally used by early lute makers. It is quick to make and modify, thus giving the maker model flexibility.

10-43 The first paragraph of section 5 is inconsistent in its sensitivity to differences between American and English English. Americans usually don't know that drawing pins = thumb tacks.

11-43 I suspect that the mould that the early makers used had the bulkheads fixed to a board that was shaped to fit just inside the edges of the back. The blank for the block was then temporarily attached to the end of the board butting up against the end bulkhead. It would then have been shaped by eye using the edges of the board and the shape of the bulkhead as guides. That they didn't bother to get ^angle on the block as it approaches the bulwark is evident on many surviving instruments.

21-44 It is easier to plane figured wood if the motion is in a direction at a considerable angle to the grain.

13-45 Hot hide glue works well as an impact adhesive. (Ordinary furniture-makers' Scotch glue can vary considerably in strength from batch to batch; a specifically skin glue is safer.)

14-45 X-rays of early lutes show holes in the ends of ribs between the end clasp and the end strip. This implies that the ribs were pinned (with headless nails) to a lower end block (probably fitted like the neck block) during assembly, after which the end clasp is glued on. The back is then taken off the mould, the lower end block pulled off (to be re-used) and the end strip glued in. During Medieval times the lower end block remained in the lute.

15-46 On old lutes the final ribs onto which the soundboard is glued were often left wider than the other ribs. See Comm. 29 point C5.

16-46 The decoration on the capping strip was very simple and traditional (usually a simple C-shape like that in Fig. 2.6), and makers are to be encouraged to express their creativity and individuality in its design only if they are hard to restrain and otherwise might express these urges in more detrimental ways. I just can't wait till 'progressive' or 'moderna' early music gets popular so that these makers will have something else to do than confusing the public about what early instruments look like.

17-47 In discussing making the neck Harwood assumes that the pegbox will be attached by a simple butt join as shown in Fig. 2.8. All of the early lutes I know of used the alternative rebate joint shown on that Figure. The rebate joint has several advantages: 1.) If the strings touch the pegbox block between the nut and the pegs then the pegbox will stay in place without glue to hold it. This is useful if one has used animal glue for
the joint and it accidentally gets soaked with water. The main reason for using animal glue for the joint nowadays is to facilitate repair (avoiding cracking the pegbox block during removal, as Harwood reports).

2. Since the neck is narrower at the point where the pegbox fits in than at the top of the fingerboard, the pegbox itself is narrower, making it lighter and more graceful. Pegboxes made Harwood's way look gross to me.

18-47 The necks of late 16th century lutes often had a parabolic shape to their backs (more curvature in the middle of the back than to the side of the middle). This tells the thumb where the middle is, and I find this an aid to accurate fingering when shifting positions.

19-48,49 In early pegboxes the thickness of the sides tapers as well as their height.

20-51 If the two halves of the soundboard plane very differently this is indicative of poorly cut wood. The sound quality of the soundboard is very dependent on the accuracy with which the direction of the grain (i.e. the direction of tree growth) falls along the soundboard. The quality promised by close even straight (apparent) grain seen to be spot-on the quarter (along the end) can be quite ruined by a couple of degrees of angle between the soundboard and the true grain direction. It is safest to use split wood.

21-52 Theoretically, the total amount of edge created by the rose design affects the width of the pitch range of the lower strings that are acoustically supported by the air resonance (as a damped Helmholtz resonator) of the air enclosed in the lute's body. (The total amount of hole area of the design affects where the centre of that pitch range is.) With overspun strings where we mostly hear the higher harmonics of the lower-string notes, the effect might not be noticeable. With all-gut stringing I suspect that the more complicated the rose design is (without diminishing the hole area) the better the lower basses will sound.

22-54 The number of very small bars underneath the rose is not specified. At least 2 in each space between full-length bars is appropriate. These bars are important for acoustic coupling between parts of the soundboard on different sides of the rose.

24-55 The only glue found on the ends of bars of old lutes is that dripped down from glueing the soundboard to the back. That is enough to avoid any looseness that might cause buzzing. This makes later removal of the soundboard much easier.

(Repairability is a factor makers do not take enough into consideration, especially in their use of modern glues. The latest terror for instrument repairers is Titebond.)

25-allover. Harwood must be a secret agent in the employ of the Association of Manufacturers of Adhesive Tape. Incidentally, by 'adhesive tape' he means 'Sellotape' to U.K. readers and 'Scotch Tape' to Americans. To Americans 'adhesive tape' usually means a cloth-backed type used mostly in medical applications.

26-57 Figure 2.12 looks wrong to me in two respects. Firstly on most old lutes with 'points' (or beards) the continuations of the shoulder curves on the soundboard edge come quite close to the right-angled corners on the end of the soundboard extension over the neck. Secondly the illustrations of 7-course lutes and surviving ones I know of have either no 'points' at all or very thin ones.

Both of these observations are related to the original function of these points which was to decoratively 'make good' after a conversion from an original (usually 6-course) state to a more-course state. This conversion required a wider neck, so the neck block on the body was cut back to accommodate it. For some reason the full
original length of the soundboard was retained. This could have been to show maker's marks or other marks which would indicate that the body had not been 'cut' (see Comm. 141), though it could be argued that this was for added strength. Whatever the reason, since the original soundboard edge near the neck could have been worn or rounded,

\[ \text{ couldn't be made to look good, so } \text{ was adopted.} \]

As a result of this the length of the end of the soundboard extension represented the width of at least a 6-course neck. The difference between this width and that of a 7-course neck would be small, so the points on a 7-course lute would be correspondingly thin.

Against my first point one can argue that the original 6-course lute might have had a soundboard extension like \[ \text{ This is true, but it still looks very unusual on a bearded lute to me.} \]

27-58 France and Germany seem to have converted directly from 6-course to 9-course instruments. Italy and England were the main users of 7-course instruments. When such instruments were in vogue (about 1580-1605) both these countries usually had unison basses and a double first course. The single first course on the bridge design is not typical for these instruments.

28-59 Why encourage makers to varnish their soundboards?

29-59,60 Glueing the bridge on with animal glue is very simple. Heat the glueing surface of the bridge as hot as one can while still holding the upper part with the fingers. Apply the hot glue to this surface. Press against the soundboard with finger pressure. Hold it there for about 2 minutes then leave it. One can string and tune up the instrument 6 hours afterwards, or even sooner.

Unglueing a bridge glued on with animal glue is just as easy. Place the lute so that the soundboard is horizontal. Encircle the bridge with a dam of wax or plasticene and put a mm or two of water in it. In a few hours the bridge will be floating on the water.

30-63 A common c. 1600 peg shape besides the 'heart' and 'crescent' is a simple ellipse (with the shank along the minor axis). The peg heads rarely if ever had the inward curving surfaces that are standard on modern violin pegs. Those surfaces were usually flat or slightly convex. Peg-head thickness tapered only a small amount away from the shank.

31-64 Though both Robinson and Dowland mentioned the occasional practice of adding wooden frets past the tied frets, they are not seen in paintings till the end of the 17th century. Frets are only needed on an instrument to improve intonation either when the player is a beginner (traditional for the violin family till late in the 18th century) or when an advanced player is multiple-stopping (as in chord-style playing on Renaissance and Baroque viols). Advanced players can play single-line melodies better in tune without frets than with them. Frets above the 8th fret are useful if multiple-stopping beyond that fret occurs in the music. This is not generally the case for the 7-course lute. When beginners insist on frets to play on past the 8th, we fix them on with double-sided 'adhesive tape' so as not to mar the soundboard surface.

32-64,65 The instructions for fretting are rather inadequate. The 8th fret should be tied first, normally using a very thin piece of gut (eg. a treble string like Dowland
suggests). You then work your way back one fret at a time, selecting the thickness of each one to give the action you want (the strings should just not quite buzz - or they should buzz if you're a disciple of Capriola - when you pluck them as hard as you might in normal playing). The nut height adjustment follows the same principle, but is got by shimming up the nut with paper (Burwell). If you had started at the first fret you might well find there was no gut thin enough for the last few frets. Dowland's fret-thickness scheme works nicely if the neck is straight in line with the soundboard and the bridge holes are just the right height, but if these things aren't so or if there are other problems (eg. the rose bulging up) it is better to select the fret thicknesses to give a good action than to slavishly follow Dowland: Incidentally a Basel manuscript from about 1575 prescribed third strings for the first three frets, seconds for the next two, firsts for the next two and "a very small string indeed" for the 8th fret.

33-65 Single frets of gut are not to be recommended since they get worn so quickly.

24-66 The best gut for frets is the prestretched variety - usually available as broken or worn strings.

35-66 I know of no data supporting the contention that bass strings wire-wound on gut were used extensively in Europe as soon as they were invented early in the second half of the 17th century. The evidence from the Burwell Lute Tutor and the Talbot MS. (both English) argues against it. It is possible though that the lengthening of the second neck of Italian archlutes is related to these strings (being used in the bass of the fingered strings, so that the lengthened neck narrows the difference in tone quality between the covered, fingered short basses and the uncovered long basses while bass valued.

36-66 Sensitive guitarists and modern-type lutanists testify to the great difficulty in finding nylon monofilament strings which are true.

CHAPTER 3 'THE VIOLIN" BY ADAM PAUL

1-95 (Drawing of Baroque violin) The bass bar shown is about 9 1/8 inches long. This is shorter than any of the examples of bass-bar measurements given in the table on p.190 of the 'Antonio Stradivari' book by the Hills.

2-95 The fingerboard is too long.

3-95 The neck angle is too high. The bottom of the nut was usually close to the plane of the tops of the ribs.

4-98 I don't know of any change in the soundpost. The Talbot MS. (ca. 1690) gave the thickness of the soundpost as that of a goosequill. The stems of the goose feathers I cut my cittern quills from have an average diameter of 5mm. This is the figure given in this article for the modern violin soundpost.

5-98 The argument that because players played further up the fingerboard, there was an increase in pitch, string tension, bridge pressure, and strain on the neck makes no sense. In general Chapter 3 was not written with as much intelligence as the first two chapters.

6-98 I don't see why both the back and the belly need to be removed to nail the neck.

7-98, 99 On p.98 it is stated that the surface curve of the modern fingerboard is slightly flatter. Six sentences later on p.99 it is stated that the surface curve of the Baroque fingerboard is flatter. I choose the second statement.

8-99 The Baroque bass bar was more than "slightly" lower than the modern one.

(Continued at the end of John Barnes's review - p.28)
Making Musical Instruments, edited by Charles Ford, Faber & Faber, London and Boston 1979, 175pp, 13pl, £15. The following review is of Ch 5, The Harpsichord by Michael Johnson and Ch 6, Restoration and Conservation of Historical Musical Instruments by Friedemann Hellwig.

John Barnes.

Michael Johnson’s chapter on the harpsichord describes how he makes a French two-manual. I am often asked for advice on the kind of harpsichord to choose for a first attempt at harpsichord construction and I always recommend a simple instrument with one keyboard and two sets of strings. I also advise the purchase of a good full-sized drawing, of which there is now a wide choice. After reading this chapter that would still be my advice, since this chapter lays two unnecessary obstacles in the path of a first-time builder. The first is the making of a pian after obtaining access to a suitable old instrument. Ten years ago that advice would have been useful. Today, when plans can be bought which show the shape and size of every part, inside as well as outside, and when access to museum instruments is liable to be discouraged because of the number of builders wishing to take measurements and the consequent risk of damage, the advice is surprising. How many readers of this chapter will be able to gain access to a suitable old harpsichord to draw? Many will live hundreds of miles from a suitable specimen. This chapter would have been much more useful if it had provided adequate scaled-down plans or explained where to obtain those drawn full-size. Drawings are not quite ignored in the book, in fact a reduction of one appears at plate XII. But builders would hardly guess from a reading of this book, at the amount of detailed and accurate information they contain or the range of available designs.

Chapter 1 has a viol plan approximately $\frac{3}{4}$ full size, chapter 2 has detailed directions for drawing a full-sized lute plan, chapter 3 has violin plans approximately $\frac{3}{4}$ full size and chapter 4 has plans for a guitar in which the body is $\frac{3}{4}$ size and the head and bridge are full size. All these chapters aim to provide complete basic information for a builder who wishes to follow the suggested plan.

Why is the harpsichord builder alone sent to measure an old instrument before he can start? This is presumably because a comparably thorough treatment of even a simple harpsichord design like the Giusti in plates X - XII would need more space than that given to other instruments. In this egalitarian age, one hesitates even to suggest that allocated space ought to relate to the complexity of the subject. But if one accepts, almost without question, that 22 pages were all that could be spared for describing the making of a harpsichord, it would surely have been more useful to assume that the reader, besides being skilled in woodwork, had access to Three Centuries of Harpsichord Making by Frank Hubbard (Cambridge, Mass., 1965) and to a suitable full-sized plan. Then the 22 pages could have been devoted to an explanation of all the techniques involved, a description of the special tools used and advice on the choice of materials. Such a chapter would have filled a conspicuous gap in the literature and could even have covered more than one tradition.
The other obstacle is the making of elaborate templates. Old harpsichords have numerous construction lines, e.g. along the lines of balance pins on top of the keys, along the lines of tuning pins on the wrestplank, and on the faces of jacks. When these lines are present, we can be sure that templates were not used for laying out these features, since any template would have concealed the line. Many professionals make little use of templates, and the person who wants to make just one harpsichord would be much better served by the old methods of layout using construction lines, simple jigs and a definite order of construction so that dimensions on one part can be copied on to another.

The methods described in this book can be divided into three categories: 1. those personal to the contributor, 2. those widely used nowadays, 3. traditional methods. The Editor's Preface states that "The contributors to this symposium describe how they themselves make musical instruments". This is, I think, a correct decision, being safer than expecting contributors to conjecture on old methods. Some indication of which category the method described happens to be would, however, have been useful to readers.

Examples of the first category in chapter 5 are the making of a joint about 2 octaves from the treble of the 8ft bridge, (most old harpsichord bridges are unjointed without any serious disadvantages) and Michael Johnson's jack making methods. Old makers usually used identical jacks for the left- and right-hand facing 8ft jacks, so that one row had dampers on the side nearer the player and the other had dampers on the further side. It is therefore a personal choice that Michael Johnson has his dampers always on the far side of the plectra. The old way of mounting the bristle (see Hubbard, plate XXII) has advantages over the one drawn in fig 5.8 on pl51, which presumably involves gluing the bristle, though glue is not actually mentioned. Michael Johnson's method of making bentside is a common modern practice but solid wood is not difficult to bend and this saves the trouble of planing and gluing the laminations. There is, of course, no harm in modern methods as such. Very often, however, the advantage of the old method is discovered when the method is fully understood and it is then found that the old method is today still convenient and cost-effective. For this reason I think the personal and modern methods should have been identified, so that builders could make up their own minds whether to follow them.

On pl45 Michael Johnson states that the string gauge remains constant over the portion of the scale which doubles the string length for each octave. This is not borne out by gauge markings on old harpsichords, which usually change several times in this part of the scale, in spite of the just scaling. Naturally, the gauges change more frequently when the scaling is also changing.

I am sure that Michael Johnson is well aware that a string of a given length whose tension is gradually raised, breaks at a pitch which depends on the material and the drawing history of the wire but it is only marginally affected by the string diameter. A different impression, however, is given on pl45: "It therefore follows that if a string keeps breaking because of too much tension, the remedy is a thinner string to reduce tension, and not a thicker one because the string is not strong enough".

The oak plank veneered top and bottom with soundboard wood is, of course, the wrestplank, though by a mistake on pl35 it is
called the soundboard leader (which is anyway a piece of unnecessarily non-standard terminology for a part which is usually called the bellyrail).

There appears to be a misprint on pl47 in the recommended diameter for keyboard balance pins. The 4 mm which is mentioned makes them bigger than the standard modern piano size. Figure 5.8 shows the 4 ft damper slot the same depth as the 8 ft damper slot, but it should be deepened by the same amount as the tongue slot. The tongue cross-section is drawn with its front face vertical and the plectrum horizontal, though when mounted in the jack, it is more usual for the front face to slope slightly backwards and the plectrum is usually sloped upwards at 5 - 10°.

This chapter gives a rather random selection of tools and procedures, some of which are more fully explained in Hubbard's book, but leaves the reader in ignorance of many details which are difficult to discover, such as what size to make plectrum holes, how to make perfect key balance mortices without using a chisel and how to shrink the soundboard before gluing it in. The best kit manuals will be found to be much more informative on the subjects of assembly and finishing, though they do not, of course, cover selection of materials or the making of the parts. These manuals have a much greater circulation than their writers intend, so the builder who has a problem not covered in this chapter may be able to find the answer by borrowing one.

Chapter 6 on restoration and conservation is packed with useful quantified information, simple explanations and wise comments. Priority is given to advice likely to help owners and restorers to save the remaining instruments as much as possible from the unfortunate effects of inadvisable treatments (which often includes restoration).

It is curious that reversibility and irreversibility seem to be difficult to discuss. The bald statement is made on pl62 "All the restorer's work should be reversible". There is an implied contradiction here with the statement on pl68 "The use of modern synthetic adhesives in the repair of musical instruments should be restricted to special cases demanding an exceptionally strong joint without the necessity of eventual reversibility". In other words, a restorer is sometimes led to act irreversibly and in some cases it matters less than in others. The important consideration is that he should use the most nearly reversible techniques available to him which achieve the desired end. A careful consideration of a problem from this point of view will often suggest a process which is more nearly reversible. Cary Karp makes a good point in Restoration, conservation, repair and maintenance, Early Music Jan. 1979 p83: "It is interesting to note that such basic operations as cleaning and disinfecting are by nature hardly ever reversible". However, on the same page he also advises "Do nothing, or permit nothing to be done which cannot easily and completely be undone in the light of future improved knowledge". I do not condone the use of irreversible processes when the same result can be achieved reversibly. But I advocate a more frank assessment of the extent to which the processes we use are reversible and irreversible, and I feel that the injunction to work
always in a reversible way involves a simplification which to some extent inhibits a clear discussion of the problem.

The interesting account of a repair carried out below a soundboard without removing it (pl65) will serve as an illustration. If it had not proved possible to repair the soundboard in this way and the soundboard had been taken out, this removal and subsequent replacement would have been performed in a reversible way in the sense that all the wooden parts would have been preserved. The reason that it was much better to avoid disturbing the soundboard is that as far as the old glue was concerned, the process would have been irreversible, and glue is sometimes valuable evidence as is shown by the caption to plate XIII. One can sometimes make valuable deductions if one is sure that a soundboard has never been removed. If however it has been removed once it is almost impossible to know whether it has, in fact, been removed twice and it becomes more difficult to reconstruct the instrument's history.

Future restorers will probably have the benefit of present-day restoration reports but if they are scientists they will not believe every word unreservedly but will seek corroborative evidence in the instrument itself. This makes it desirable that the instrument should be restored in such a way that a future restorer can understand as much as possible of what has happened independently of the restoration report. This, in turn, suggests the concept of "open" restoration, analogous to the political concept of "open" government. The restorer should take note of all the internal evidence which he is using to reconstruct the history of the instrument, and proceed in such a way that this evidence remains for the future restorer and so that additional evidence of his own restoration is clear and easily understood. This is why the marking of new parts with the date, and if there is room, with the restorer's mark, is desirable even if they are identified in the restoration report. "Open restoration" will also sometimes involve gluing on new leather in such a way as to leave traces of old leather intact, and attaching new cloth with new tacks in old tack holes, including with the tack a slip of paper under the cloth giving the date and restorer's name. Restorations then become, to a large extent, self-explanatory, an aspect which is not mentioned by Friedemann Hellwig.

The suggested headings for a technical report given on pl74 are excellent, though heading 6 should in appropriate cases include a complete history of alterations and previous restorations of the instrument rather than just a reconstruction of the original state. One of our harpsichords in the Russell Collection (Ruckers 1637) revealed evidence for the original state, states 2, 3, and 4 (ravalement), minor alterations before 1950, and a restoration 1950 - 52, all of which are written into the report before the account of the most recent restoration.

Chapter 6 would stand well by itself as an important and authoritative statement of modern attitudes to restoration and conservation. Whether it exactly suits the rest of the book is less obvious. The other chapters will be most valuable to those
who want to decide whether to make instruments as a career or as a hobby and are uncertain what to make or how much is involved. Such people will tend to be particularly interested in restoration and conservation if they have bought a 19th century mandolin or square piano that needs repair. Chapter 6 gives most of the advice they need, but the conditions under which they will work will differ considerably from those of the conservation laboratory of a well-equipped museum and their previous experience of repair is unlikely to deal with antiques. It would therefore have been helpful if a section had been added which showed how good restorative principles are based on assumptions entirely opposed to those which govern the repair of contemporary instruments. The latter often makes use of factory-made replacement components. Readers of this book would, I think, be particularly interested to know how good restorative principles should be applied to well-made instruments of no great rarity with access to only simple equipment. It could also have been emphasized that the most common form of damage nowadays is due to low humidity in winter. In the past, the heating of houses was attended by a certain amount of drudgery, and the temperature would be low except for times when a room was actually in use. Nowadays, most institutions and public buildings and many private houses are strongly and continuously heated which can give relative humidities of 30% for several days at a time. This can damage old instruments and it is astonishing how difficult it is to get the fact recognised, and once recognised, the situation corrected. In Britain, it is often the museums who are the worst offenders, closely followed by the Music Schools. Heating plants without thermostats, ill-fitting doors and windows and temperatures of about 70°F are usual. The production of conditions tolerable for old wooden instruments is largely a psychological and organisational problem, and it would have been worthwhile to have emphasized that, whether in the home or in a museum, it is wrong to proceed with restoration before the problems of maintaining a suitable climate have been solved.

(Continued from p.23)

9-99 It is stated that the "strings were of gut with the E (sic!) string covered. We have not yet published our researches on the history of violin stringing, but in brief the choices seem to be: - the 18th century French type with a fully overspun G string and an open-wound overspun D string, or the Italian type (also used by others including Leopold Mozart) involving all-gut strings throughout.

Another example of the errors riddled throughout this chapter is the statement on p.93: "The peg should grip in the small hole while the large hole acts as a guide when tuning".
Review of:


Martyn Hodgson

This is the latest addition to the Lute Society's booklets on the Lute and contemporary plucked stringed instruments. It is also the first published work wholly devoted to the construction of a Lute (discounting a booklet also entitled 'Lute Construction' by Robert S. Cooper, Savannah, U.S.A., 1963, which is concerned with the construction of a Lute/Guitar type of instrument based on plans drawn up in 1921/2 by the German Guitar maker Hermann Hauser). For their initiative in taking the first step towards filling this serious and long-standing gap in contemporary Lute literature, the Lute Society and in particular Mr. Macleod-Coupe are to be applauded.

The booklet has clearly been written for complete beginners, both to the Lute as well as to instrument making, but naturally assumes a reasonable degree of woodworking competence. By following the written instructions together with the associated Working Drawing, of which more later, such a beginner should be able to construct the 7 course Lute described.

Although the booklet is entitled 'Lute Construction', Mr. Macleod-Coupe points out very early on that it is, in fact, an introduction to the subject; certainly some of the techniques described in the booklet would be unsuitable for the construction of copies of many extant authenticated Lutes. Nonwithstanding this and bearing in mind the class of readers, to whom the work appears to be addressed, it would be inappropriate to review the book as though it purported to be the definitive work on all aspects of Lute Construction. Indeed, Mr. Macleod-Coupe very fairly states that his techniques of construction are not offered as the only way to make Lutes and mentions that present day makers use a variety of techniques. Further, nowhere does he state that the aim is to produce a completely authentic Lute representing any one particular period or style and mentions that his drawing is not of any particular instrument, but embodies features of earlier 6 course Lutes with those of later instruments. It is therefore, no criticism of the contents of the booklet to suggest that it may have been better entitled 'A method to construct a 7 course Lute'. However, for the complete beginner these objections may only be of academic interest; most certainly if he requires a 7 course Lute he should be quite able to make the instrument described from the instructions in the booklet and the Working Drawing.

Accordingly, whilst not proposing to quibble over many details of design and construction, some of which may still indeed be the subject of speculation (e.g. barring, wood thicknesses, pitch standards, etc.), it would clearly be inappropriate in a review for FoMRHIQ to omit comment on some of the more obvious areas of difficulty and/or problems arising out of an examination of the work:

- Of all the constructional procedures described in the booklet, the technique for constructing the back is likely to present the most substantial problems to anyone wishing to make this and other Lutes. The method assumes that "the end elevation is such that the facets
(i.e. ribs) lie on a semi-circle, the soundboard being the diameter of the circle. The ribs are therefore all of the same shape and size. This is fine for the Lute in the drawing, but is not (fine) for the majority of extant old Lutes, many of which are asymmetric at least at some point along the longitudinal axis of the body. Further, no mould, other than a thin base board, is employed; each rib being trimmed to exactly the same size using an aluminium template and glued to the adjacent rib with no support other than the neck block and the thin inner counter-clasp. This approach is possible if the Lute is to be made with only a few ribs, but with multi-ribbed instruments and/or those with decorative fillets between each rib this technique presents considerable (if not insuperable) difficulties in execution. Many extant old Lutes could not therefore be constructed using the method described. A good example, which well illustrates both these problems is the Chitarrone depicted in Lute Society Booklet No.1 labelled 'Magno Dieffbrucher a Venecia 1608' (No. 26 in the Donaldson Collection at the Royal College Of Music, London). This large instrument is significantly asymmetric and has a back made up of 51 ribs separated by thin ivory fillets.

The Lute in the drawing (open string length 59cm., top course tuned to g') is described as being a 'Tenor' Lute. This widespread and unfortunate modern identification of a nominal g' Lute as a Tenor Lute is based on a false analogy with the Viol family and has no historical justification whatsoever. Praetorius describes the 'Tenorlaute' as being in c'; the instrument in g' he calls the 'Chorist- oder Altlaute'. In contemporary English sources plain Lute is used to identify the common (nominal g') Lute, only being qualified where a specific distinction is required: 'Treble' (a g' Lute required for the Consort Lessons of Rossiter and Morley and presumably a smaller, thus higher pitched, instrument than that normally employed, so as to enable the Lute to play at 'Consort' pitch with flutes; possibly also equivalent to the 'Diskantlaute' in a nominal a' of Praetorius and to the descanting parts found in contemporary Lute tablatures); 'Bass' (most frequently a nominal d' Lute); or, more rarely, 'Meane' (where a special distinction is required to differentiate between an ordinary Lute and a Bass Lute).

Although it is said that the booklet may be read in conjunction with the Working Drawing of a Lute drawn up by Mr. Macleod-Coupe for the Lute Society (incidentally, not the old Lute Society Drawing, but a new and greatly improved one dated September 1978), in fact this drawing is referred to in the book and is essential for a proper comprehension of the text and a complete understanding of the constructional techniques described.

The shape of the body of the Lute in the drawing is stated as being based on an instrument by Wendelio Venere (A.P. Bologna). However, the whole body has been scaled up by 2.3%, said to be necessary to accommodate a wider neck. Such a scaling up would only increase the width of the neck at the body by about 1mm. If such a tiny increase was really considered essential, surely a better answer is to decrease the neck/body angle by a few degrees from 72° (at present) to 69°, thus effectively increasing the neck width at the body. This practice was historically common being employed when converting earlier Lutes to carry more ranks (sorry - courses). Indeed, on conversions to 11 and 13 course Lutes, this angle is frequently around 40° or even less.
- Since the general shape of the instrument in the drawing is based on an extant old Lute, it would have been helpful for those more adventurous and skillful persons to indicate the original decoration, materials, number of ribs, precise shape and size, etc.

- There are some quite noticeable differences between the photographs of the Lute in the booklet and the instrument depicted in the Working Drawing (e.g. size of counter-clasp, bridge, placing of 8th fret, pegs), these could possibly confuse a complete beginner.

- Although a list of papers is given for further reading, these are all taken from the Lute Society Journal or the Galpin Society Journal and therefore exclude some very helpful contributions in the Journal of the Lute Society of America, Early Music, not to mention FoMHRHQI Reference could also usefully have been made to Pohllmann 'Laute Theorbe Chitarrone' (for all its faults, still the only work of its kind) and to the drawings of original instruments available from Museums and other Collections.

- Some of the woods suggested are either anachronistic (e.g. Mahogany, Rosewood) or unsuitable (e.g. Cedar for bellies). Other woods are not mentioned despite clear evidence for their widespread use (e.g. plum for pegs).

- The graduation of fret sizes does not agree with known early fretting rules. This is not just a question of authenticity, but directly effects the ease with which the instrument may be played. Also, surely very few makers are still using a single loop fret of nylon; the advantages of a double gut loop are well known, as well as being historically preferred (always excluding the eccentric Thos. Mace, who, when it comes down to it, describes a double loop).

- The lace is glued on after all the varnishing is completed; it is not stuck onto the bare wood and varnished over.

To summarise: This booklet should certainly enable a beginner to construct the 7 course Lute shown in the associated Working Drawing and provides a useful introduction to Lute making in general.

Finally, whilst as a member of the Lute Society, I applaud the price (perhaps it may help to keep subscriptions down), it does seem a little on the high side for such a slim volume.
Will Jansen, The Bassoon. Since writing the review which appeared in the last issue, the first fascicle of plates has come to hand. This consists of eight binder's sheets, each of which unfolds to make eight double-sided pages. The reader is presumably expected to have his separate fascicles bound, and to have these fascicles of plates bound in with the text. The problem, of course, is that this is a long-term project, for the book is appearing over a considerable period of time, and until they can be bound it would be dangerous to separate the sheets. In the meanwhile, one has to open each sheet right out to find any particular plate.

Each plate (i.e. page of plates; plate number is used as though it were page number) contains a varying number of figures, so that references in the text to fig.xxx may be to almost any plate; to take a random example, plate 62, the back page of the 4th sheet, has on it figs.187 to 192. This will be no problem once the sheets are bound up, but it does cause problems at the moment, since it is by no means easy to find the figure one wants. The illustrations themselves are usually informative (I'm not sure that a view of part of the garden, dustbin, pump and back steps of the 'House of Heckel' tells us much), though some are on the dark side (none as bad as those in poor Mary Remnant's book - see Comm.149). There is one fold-out plate (publishers usually hate these) to show the fingering system of the Heckel bassoon on one side and the Oubradous fingering chart on the other. There are a number of cross sections from makers' drawings and other sources. There are some micro-photographs of reed cane. There are a number of pictures of bassoons in use, and therefore also of bassonists, some but not all of whom are identified (it is always difficult to identify everyone in a group photo), and of course a vast number of bassoons and parts of bassoons not in use.

Reviews of this magnum opus will continue to appear as the bits arrive.


The first edition of this book, which consists of articles and other papers on acoustics by L.L.S.Lloyd, selected and edited by Hugh Boyle, with a number of other articles on relevant matters by Boyle, ran to 246pp and cost 50/- when it was published in 1963. The new material is all, apart from some footnotes, in Hugh Boyle's part of the book and includes a good deal of useful material.

Certainly anybody interested in intervals and temperaments (and I assume that everybody involved in early music is interested in this subject) should be familiar with Lloyd's work and we must be very grateful to Hugh Boyle for bringing together these articles which first appeared in various musical journals. Lloyd was prejudiced in favour of equal temperament, naturally enough before the early music movement really got under way, but there is a great deal of very valuable information here, much of it very simply laid out and easy to use to show those who are not yet aware of the differences, just how great the differences between different temperaments are. There are a number of illustrations of different sections of the musical slide-rule (though that article of Lloyd's is not reprinted here) on which anybody, however untrained their ear may be as yet, can see the differences.
Hugh Boyle's section includes a chapter on the construction of a monochord (I have never thought quite as accurate as mine - he uses a wooden metre rule, whereas I prefer an engineer's steel rule, and he stops the string with a pair of hand-held round-nose pliers so that any tremble of the hand will be transmitted to the string and thus to the pitch. For details of mine, see Comm.21), followed by a number of chapters on its use, so that the pictorial and written descriptions of scales and so on in Lloyd's section can be heard, and the ear trained to perceive them. There are a number of Appendices, new in this edition, which include relevant passages, usually a page or two, from the works of other authors. The book ends with the invaluable table of cents.

For every cent, from 1 (from 0 in fact) to 1200, Boyle gives the savarts, the ratio (decimal ratio) and the string length in millimetres to one decimal point for a 1 metre string length monochord. This table used to save me hours of work with pencil and paper, and it saves a good deal of time and work even now with a pocket calculator. One still needs to calculate herz to cents (see Comm.21. I gave 3986.3 as the constant there; this is for ordinary logs, and for natural logs the constant is 1731.234) but once this is done, and appropriate notes made in the margin of the book, one just looks it up. The table is also a very useful conversion table for savarts/cents (for those who haven't met them, savarts are a French equivalent of cents, but rather coarser and thus less useful; there are 301 to the octave and thus about 4 cents to a savart and just under 25.09 to an equal tempered semitone. They are about as useful for pitch measurement, compared with cents, as inches are for linear measurement when compared with millimetres).

The increase in price in sixteen years is a bit horrifying, but I suppose that that is the way things are today. I think the book is useful enough to be worth it.

FoMRHI Comm.192

Jeremy Montagu


A welcome to a new contemporary, edited by one of our members, and frankly based on FoMRHI (except that Paul, being either more energetic or more of a sucker than Djilda or me, has typed most of it out himself - he does ask future contributors to type for themselves, with instructions much like ours). I'm not sure that I should be the one to review this, since much of it consists of an article of mine on the use of authentic mouthpieces on all brass instruments, which was designed to stir up controversy, and the first results of the controversy which it has certainly succeeded in stirring. Responses come from Christopher Monk, Edward Tarr, Professor Dr. D.L. Smithers (we used to call him Don Smithers), Ralph Bryant and Bruce Dickey. They are all worth reading (the responses, I mean), and there is an entertaining pictorial commentary by Julian Drake.

There is a useful list of available reproduction and, if I may coin a new term, resemblant instruments, with brief description and prices, covering all the so-called lip-reed instruments (I suppose cornett and serpent players dislike the use of the word brass). Paul Gretton has contributed a table of useful and useless alternative fingerings for cornett and serpent; the useless ones are a good idea to save others wasting time and effort. Philip Tate gives the details of his reconstructions of the Purcell/Talbot flat trumpet, the Neuling draw-trumpet and the Huns Veit tromba da tirarsi, with some photographs. Julian Drake has two articles, one a brief one on how to make a cornett (though if you don't already know I'm not sure how much help it'll be), and
the other a description of the Christ Church, Oxford, corretta, with
fairly detailed measurements of one of them. Jacques Leguy contributes
a revised version of FoMRHI Comm. 80, and his wife Sylvette the first
part of a brief history of the cornett in Germany and England in the
16th and 17th centuries.

Obviously if you are involved in cornettas or sackbuts (sackbuts don't
get much of a look-in in this issue) at all, you need to subscribe to
this. Paul is hoping, despite the title, to cover all brass instruments,
so if you have any interest in horns and trumpets as well, write to him
and ask if there is anything in the next issue in your line, and if
there isn't, encourage him by writing something or by subscribing in
any case. If he had told me what the subscription was, or if there was
any indication on this issue, I'd tell you, and I might subscribe my-
self, but he hasn't - perhaps he'll let me know in time for our next
issue, in which case I'll tell you.

FoMRHI Comm. 193

Jeremy Montagu

Review of: Musikinstrumenten-Museum der Karl-Marx-Universität Leipzig,
Katalog - Band 1: Herbert Heyde, Flöten. Deutscher Verlag für
Musik, Leipzig, 1978, 160pp, 16 plates (showing many flutes),
numerous line drawings of keys and constructional details.

DDR Marks 25.

This is the first of a series of catalogues from the Leipzig Museum
and replaces, with infinitely more detail and of course covering all
the instruments acquired more recently, the old Kinsky/Heyer catalogue.
There is a lengthy introduction with numerous mensural and constructional
details (proportions of conicity, etc). The catalogue itself lists
every instrument in the museum in detail, and includes whatever details
are available of the instruments that were in the museum but were lost
in and after the war. The details include the maker's (or other's)
mark, and many of these are photographed on the plates, the pitch and
range and brief description, details of the keys, detailed measurements,
materials of which the instrument, and its keys, are made, a brief
historical description of the instrument and its type, and where known
the history of the individual instrument. The catalogue is followed
by a list, with details, of all the makers represented, and the usual
cross-reference table for catalogue number to page number. There are
then a series of pages of outline drawings showing: all the instrument
types in separate joints; all the fingering systems; the shapes of all
the key touches; the profiles of all the key types; all the different
shapes of key head; all the different types of key linkage; cross-sec-
tions of all the different types of finger/key-holes (but not the under-
cutting); the different types of head caps and tuning screws for the
corks; the profiles of different ferrules, foot-ferrules and body
turnings. These are followed by the plates.

The catalogue covers all types of flute, not just recorders and traversi
but also ocarinas, children's duct flutes, czechans, flageolets and
so on. There isn't much point in my saying how good I think it is
(don't get me wrong; it is good); if you have the slightest interest
in flutes of any sort, you have to have this catalogue and of course
it is essential for everyone who needs to know where things are and
which museum has what. I have no details of agents and stockists and
so on; DVfM usually work through Breitkopf und Härtel in London and I
suppose through whoever handles Breitkopf in other countries. Internal
DDR prices usually go up about 25% for export, and DDR marks are then
equated with DM, on top of which in London anyway a grossly inflated
marchange is placed. In other words, get it from the DDR if you can.
THE DEVELOPMENT OF THE CALLACHON
—FURTHER TO COMM. 175.

1. Transition from the long necked 17th Century 2/3 string instrument to the shorter necked 18th Century 6 course instrument.

I am most grateful to Donald Gill, who redrew my attention back again to the Talbot Ms., and in particular to the relationship between body length and the open string length of the Colachon described therein.

A more detailed examination of the measurements of this instrument would appear to belie the comment I made regarding the restricted geographical distribution of the 6 course/string Calachon. Clearly Talbot's own comments are very largely taken from Mersenne and Kircher and bear little relationship to the instrument belonging to Mr. Finger, which he actually measured. This instrument had a string length of 98.4 cm (depending on how the figures are interpreted), which is almost ideal for gut strings tuned as Talbot indicates: A or C, D, G, e, e, a. Further evidence for the 6 course/string configuration is given by the width of the nut and neck (48.4 mm), which easily allows 6 courses.

The body length of Mr. Finger's Colachon is 58.4 cm, giving a body length/open string length ratio of around 0.60. Although this ratio lies outside the vast majority of instruments analysed for Comm. 175, it does, nevertheless, fall just within the extreme range and is quite significantly different to the ratio found from Mersenne's drawing of the 'Colachon'. This latter ratio is 0.35, or 0.38 if corrected assuming the nth fret is the octave (incidentally, the rather unusual fretting of Mersenne's Colachon could well repay some serious attention).

Some interesting features of the instrument, which Mersenne describes are: overall length 4 or 5 pied, thus giving an open string length of 120.4 cm; three strings tuned C, e, g, with gut strings at modern pitch the string length could not have exceeded 110 cm thus supporting Mersenne's rough indication of size; body length about 42 cm.

In view of the above, I believe that there is only one obvious conclusion, which may be drawn: that is that Mr. Finger's Colachon represents a good example of a transitional instrument between the extremely long necked 2/3 string instruments of the earlier part of the 17th century and the shorter necked 6 course instrument common in the mid 18th century, this in turn suggests that the large 6 course instrument was more widespread than I had previously suggested in Comm. 175, and was not just confined to Germany and Italy. Accordingly I would now speculate that around the turn of the 17/18th Century both types of Colachon coexisted in many countries, but were dropped in most fairly early on in the new Century only being further developed and utilised in parts of modern Italy and Germany. Indeed, Ernst Gottlieb Baron as late as 1727 in 'Historisch-Theoretisch und Praktische Untersuchung des Instruments der Lauten' says "that he (Mattheson) forgets that it (the Colascoine) is only the bass of a Lute and could not be more than the whole instrument, especially since it is quite clear that more can be accomplished with many than with 3, 4 or 6 courses".

Of course many questions remain: why did this rather odd instrument...
in use in Italy in the first half of the 17th century spread to many other parts of Europe by the end of the century?, why were more strings added and in such an unusual tuning? Perhaps it is in this very tuning itself that a hint may be found; certainly Talbot's given tuning of the 6 string Colachon is identical with that of the Bandora and this wire strung instrument was very highly thought of around the end of the 17th century for Through Bass. Is it not possible that it was felt that a gut strung instrument, tuned the same as the admirable Bandora, would be an extremely useful addition? – perhaps not.

Probably these transitional instruments were quite large (in open string length as Mr. Finger's Colachon) and were only reduced in size with the increasing use of overwound strings and the consequent reduction in open string length possible, thus allowing greater ease of playing. This decrease in open string length to around 70cm would have then allowed the whole pitch of the instrument to be raised to give the tuning given by Mattheson in 1713: D, G, c, f, a, d', and thus the transition to the classical 18th century Calachon would have been complete.

2. The eclipse of the 18th century Calachon and Mandora, and their conversion to use as Guitars.

Many thanks to those Members, who contacted me to point out that there are at least two other extant Lute-shaped instruments by the maker Stautinger. This is not surprising for, as I mentioned in Comm. 175, it is highly probable that a substantial number of similar instruments exist, other than those listed by Pohlmann (1975).

Indeed, I have since found reference to yet another; this was in the Collection of Musical Instruments of the 'Konigliche Hochschule fur Musik' in Berlin, no. 704 in the catalogue of that collection prepared by Dr. Oskar Fleischer and published in 1892. The instrument is listed under the general heading of 'Lautenarten' as a Lute by Mathaeus Wenceslaus Stautinger in Wurzburg (Wirceburgi being the latinised version of Wurzburg) and dated 1775. It is described as possessing 11 strings in 6 courses (the highest being single), rose cut out of belly wood, peghead type as on the York instrument, loose frets. Unfortunately, to my knowledge, it is no longer in any of the Berlin Collections and would appear to have been lost or destroyed in the 2nd World War, as were so many other instruments and much music.

However, on to the other extant instruments by Stautinger:
- The first of these is, in fact, listed in the 1972 edition of Pohlmann, but strangely absent from subsequent editions. It is listed as a 'Laute' by Matheus(sic) Wenceslaus Stautinger, me fecit Wirceburgi 1772, no. 42-173 in the Munchner Stadtmuseum. the present disposition is for 6 single strings, but Pohlmann makes one of his rare comments and says that the peghead has been shortened for 6 single strings. Open string length 69cm, Body length 47cm (body length/open string length = 0.68). There is no other relevant information available, but Pohlmann clearly believes that the instrument has been converted.
- A description of the restoration, or rather as I see it the reincarnation, of the second instrument appears in a book 'Guitar Repair' by a Mr. Irving Sloane (First published U.S.A. 1973,
U.K. 1974). Actually, I do now recall seeing the book on its first appearance in the U.K. and well remember my astonishment at the procedures described as 'restoration'. I had, hopefully, thought that this type of unscholarly work had long been given the old heave-ho, but alas it was evident that there were still persons bent on the obliteration of valuable organological data by employing 'overkill' restoration techniques. It shouldn't really have surprised me, since I have seen quite a number of early 19th century Guitars, which have received similar treatment.

This particular instrument is part of the Collection of the University of Pennsylvania Museum (Curator Agi Jambar, who incidentally "authorised the reconstruction of the Lute for Baroque ensemble playing")? It is labelled 'Mathaeus Wenceslaus/Stautinger, me fecit, Wirceburgi 1768'. The last two numbers are inked in and the remainder of the printed label is identical with that found on the York instrument. There is also a printed 'repairers' label reading 'Johann Roeser / Instrumentenmacher in Wursburg / Reparirt'; the word 'reparirt' is inked in. In its pre-'restoration' state the instrument possessed a 'knot' type rose (of a familiar pattern) let into the belly, back of 11 ribs, neck with 8 inset frets and 3 frets glued to the belly, peghead for 6 single strings in the pseudo 'classical' style popular in the early 19th century, belly of spruce (said by Mr. Sloane to be a replacement for an earlier one), early 19th century Guitar barring in the French and German manner (i.e. two heavy bars between rose and bridge, one between rose and neck block), inner lining, pin bridge for 6 single strings, no points on the fingerboard end. No measurements of the instrument are given, but the body looks to be the same size as the York instrument and accordingly I would estimate a string length of around 62/63cm.

I will say little about the so-called 'restoration' other than to echo the admirable sentiments of Mr. Sloane "Much of the difficulty in restoration work is undoing the crude handiwork of unskilled repairmen" and to mention the complete replacement of the existing belly, the new "traditional" barring (actually of the type found on late 16th century Lutes), the placing of a new massive rosewood bridge for 6 strings ("fashioned in the style of eighteenth century lutes to replace the bogus pin bridge") said to be incorrectly placed but then placed higher still, the scraping away of the existing finish, the glueing of cracks with a synthetic irreversible glue, the routing of the edge of the belly and part of the original back for a binding, etc. The work was undertaken by one Garo Takoushian ("a luthier with a special interest in the lute") apparently employed by C.F. Martin Inc.

It is quite clear to me that the instrument was converted to be used as a Guitar (probably by Roeser) in the early decades of the 19th century. The major evidence for such a conversion is: pin bridge for 6 strings (did not appear until c.1800); type of belly barring; shortened neck (hence missing points) to give a string length typical of early 19th century German Guitars; peghead type; set-in rose; inner lining.

In the pre-penultimate paragraph of Comm. 175 I said "With the introduction of the 6 course/string Guitar around 1780, the Mandora and Calichon came increasingly to be used as Guitars and single strung versions were specially made". Perhaps I should have emphasised that many of the earlier double strung instruments were also converted to be used a single strung Guitars.
Due to the lack of surviving unaltered instruments, the study of lutes in use before the last quarter of the 16th Century may only be undertaken through examination of contemporary paintings and prints. In view of the extensive nature of this source of evidence, it is perhaps surprising that this remains a neglected field of study. One of the reasons for this may be a general reluctance to believe that the Renaissance painters portrayed the instruments in their paintings as they actually were perceived. Without doubt the artists of this period were bound by certain conventions and the craftsmanship of some, reflected in the quality of the detail executed, may be suspect. Another factor may also be that already we are conditioned, through the understandable emphasis on the study of surviving instruments, to have a fixed concept of what a lute should look like. Against this background some of the portrayals of early instruments appear distinctly odd.

To some extent these views may be justified. However, accepting the artistic conventions in vogue at the time, it is proposed here that the majority of Renaissance painters recorded a fair representation of what was to them a common, everyday object. That, despite the questionable accuracy of the detail, the relative geometrical proportions are more or less correct. If this is so, we could believe what we see concerning body shape, relative length of neck to body length, relative positions of bridge and soundhole(s), relative size of soundhole. Conversely we would suspect details of strings and pegs and possibly even the relative sizes of instruments.

Working on the above assumption, this paper examines one of the apparent variables in lute design - the position of the soundhole relative to the body. This particular feature has been studied because significant differences in the soundhole positions of lutes are evident in paintings dating from the 14th Century to the 18th Century and because the relative position of the soundhole is important as it will have a major influence on the barring arrangement of the belly and hence the response of an instrument.

Fig 1 gives examples of what appears to be the extreme range of soundhole positions, taken from paintings and engravings dated from around 1400 to 1650, and some of the more common types to be found within this range. The sources from which these have been drawn are as follows 1-

B. "Angel with Lute" - Stefano di Giovanni Sassetta (1392 - 1450)
E. "Madonna and Saints" - Giovanni Bellini (1430 - 1516) - Academy of Fine Arts, Venice.
F. "Allegory of the Moon" - Hendrik Goltzius (1558 - 1617)
G. "The Serenade" - Judith Leyster (1609 - 1660) - Rijksmuseum, Amsterdam.

The relative position of soundhole to body is given by the ratio $A/L$ where $L$ is the length of the body and $A$ is the position of the soundhole measured from the bottom of the body. This ratio ranges from around 0.33 to 0.66.
NOTE (1) - MALER LUTE, RECONSTRUCTED PROFILE (SEE COMM. 128, FIG. 1)

NOTE (2) - MALER LUTE, MODIFIED BY THOMAS EDLINGER, C. 1700 (SEE COMM. 128, FIG. 2)
Fig 2 Gisves a plot of ratio A/L against year for about 60 examples and indicates the approximate earliest and latest dates that each particular soundhole configuration appears in paintings. No attempt has been made to segregate paintings from different countries or regions of a country to determine what affect (if any) this may have on the measured geometry. As it is often difficult to date a painting accurately, the life span of each artist has been taken as the relevant earliest and latest date for each example examined. This approach helps to compensate for the uncertainty of the age of each instrument when painted.

The curves in Fig 2, therefore, form an envelope the lower boundary of which may be taken as the line of innovation and the upper boundary that of obsolescence. The shape of the envelope is as expected indicating the high degree of change and development in the design of the lute that took place during the Renaissance. Wide experimentation with the form of the lute appears to have ceased around the middle of the 17th Century, consistent with the rapid demise in the popularity of the lute from about that time.

The original low position of lute soundholes may have been influenced by the presence of the small, secondary, soundhole apparent in many (but not all) of the early instruments. The secondary soundhole, as a feature, does not appear to have been used after about 1500.

Ratios taken from surviving instruments have also been plotted for reference. It is interesting to note that, according to this plot, the geometry of the lute described by Henri Arnault in his treatise of 1450, would appear to be well ahead of its time as a development and a direct forerunner to the lutes made by the master luthiers of the late 16th Century. It should be noted that ratios taken from surviving instruments may vary a little according to the pitch of the instruments. For example the bass and great bass lutes by Barton in the Germanisches Museum Nuremberg measure 0.575 and 0.556 respectively, and the Tenor, Treble and Descant lutes by Veneré in the Kunsthistorisches Museum Vienna measure 0.56, 0.576 and 0.585 respectively.

In conclusion, it seems reasonable, in view of the consistency of results obtained here, to treat the study of early lutes through the iconography more seriously than it has been in the past. Convincing results can only be achieved through the examination and analysis of a lot of material. To this end it would be valuable for others to contribute articles dealing with the variables previously mentioned or to expand on or confirm data already presented, even though the quantity of material examined may be limited in each case. Many hands would make light work here!

The barring of these early instruments is open to conjecture. Would anybody like to start discussions on that topic?

Postscript

As this Communication will not make the January issue, two further additions have been made to Fig 2, as follows:

(1) Triple Soundholes - a line representing the introduction of the triple soundhole has been added taken from measurements of existing instruments. (Dimension 'A' in this case is the distance from the bottom of the lute to the central "Triangle" of the triple rose).

(2) The A/L ratio for the two Maler lutes represented in Comm. 128 have been plotted. The reconstructed profile representing the proportions of a Maler lute in original form, gives a ratio of 0.575. This, like the Arnault lute, appears to be a direct forerunner of the surviving lutes of the late 16th Century as far as this feature is concerned. The other lute represented in Comm 128, is an instrument with an original body by Maler but modified by Thomas Edlinger some time after 1700. This has a ratio of 0.65, the length of the soundboard having been reduced through the addition of a wider neck than original, with the soundhole in its original position. This ratio appears to typify the geometry of lutes of the late 17th Century. Could it be that these modified lutes set the trend for instruments of this period?
It is implied in Comm 176 that the ratios given in Comms 1 and 128 are at variance with each other. As both these communications are referring to an instrument by the same maker, however, the bridge position given by these ratios is identical. The construction here is that the belly (i.e. the bit free to vibrate between the bottom edge of the belly & top block) is divided into eight parts with the rose centre on the fifth part. This is in line with Mersenne’s instructions in “Harmonie Universelle” 1636. If the bridge front edge then is placed on the first part, this position may be described as either 1/5 the distance between the end of the belly and rose centre (Comm 1) or 1/8 the distance between the end of the belly and bottom edge of the top block (Comm 128). This bridge position is to be found on the Laux Maler belly fragment in Nuremburg Germanisches Nationalmuseum.

Mersenne gives a higher bridge position than this, obtained by dividing the first two parts into three and placing the bridge upon the second part obtained i.e., 1/6 of the belly length, as found in lutes of the late 16th Century.

Further information given by Mersenne is that bars are added to the second, third, fourth, fifth, sixth and seventh parts. The neck starts (bottom edge of top block) on the eighth part. Bar cross sections are one or two lines (1/12 or 1/6 inch) thick and 1/2 inch deep (i.e., about 0.4 x 1.3 cm for the main bars). Other bars may be added below the first bars to improve sound balance, and beneath the rose to stiffen the belly in that area.

The external appearance of a lute according to Henri Arnault de Zwolle (circa 1450) has a bridge located at 1/6 of the belly length. This, however, is 1/6 of the distance between the bottom edge of the belly and the top edge of the top block and includes, therefore, both the top block and a massive bottom block (the latter being a feature that does not, as far as I am aware, appear in surviving lutes).

If, however, the vibrating part of the belly only is considered, and this is divided into eight equal parts, the Arnault construction gives a bridge position at the first part, the rose centre very nearly at the fifth part and some of the bar positions stated by Mersenne i.e., on the second, third and sixth parts. (See Fig 4)

The Arnault lute then may be classified as an example of a lute with a low bridge position. Note that deletion of the bottom block would lead to a flattening of the bottom curvature of the belly a feature most commonly found in lute profiles of the 16th Century.

I would agree that we must be careful before assuming that low bridges were positioned according to a standard rule in early lutes - at least until much more work has been undertaken in studying the iconography. There is a lot of pictorial evidence to suggest that this feature was common in lute design over a wide period.

Judging from my own experiences and I believe those of other makers, the low bridge position does work well although I have yet to try this on a narrow Maler profile.

I am fairly confident that a successful reconstruction can be made of this type of lute providing the critical features, of the belly, in particular the barring and soundhole, are in the correct geometrical proportions.
LUTE SOUNDBOARD BARRING - HENRI ARNAULT DE ZWOLLE
C 1450

Fig 1
5. On average a belly thickness of 1.5 to 1.7mm would seem to be about right. The belly thicknesses of surviving lutes can vary between about 1.0mm to 2.5mm and are not related to instrument size necessarily. Belly thicknesses never seem to be uniform, and can vary by up to 0.8mm on an individual belly.

It is my opinion that the early luthiers "fine tuned" their completed instruments, to achieve the correct response and sound balance, by scraping down areas of the belly - a technique that can be applied to unvarnished bellies. I have used this technique with success although I would admit that the assessment of any improvements were entirely subjective.

I would accept the measured thicknesses of surviving bellies as being correct as I find it difficult to believe that shrinkage over the years on these very thin sections would have been significant.

6. Turning to the string arrangements of the narrow Maler lutes, Comm 1 gives a construction that relates placing of the bars to the body (i.e. a bar is located at the widest part of the belly). Although this may give acceptable constructions, it can give rise to significant error as it is difficult, on these narrow instruments, to locate the widest part of the belly with accuracy. Also I feel that it is more logical to relate belly component placement to geometrical divisions of the belly length and, therefore, suggest the following construction. (This applies only to the Maler/Frei profiles)

The vibrating length of the belly is divided into eight equal parts, the front edge of the bridge is placed on the first part and the rose centre on the fifth part. A bar or pair of bars is placed on the fifth part. The rose diameter is very nearly a quarter of the distance between the bottom of the belly and the centre of the rose (i.e. smaller than on later lutes which have a diameter generally about 1/3 belly width at the rose). A bar is placed a little below the lower edge of the rose and the distance between this bar and the rose centre gives the spacing of further two bars above the rose. The lower section of the belly below the bottom edge of the rose is divided into four equal parts and a bar is placed on the first two parts below the rose.

The drawing in Fig 2 shows this construction on the Nuremberg Maler belly. Note that the eighth part extends beyond the lower edge of the top block slightly. I am unable to confirm this here but I would expect to find that the top block in this instrument has been cut away to correct this apparent discrepancy (see Fig 4(a)). I have noted this feature on a Laux Maler lute body but I am not sure from my notes whether it applies to this particular instrument.

The drawing in Fig 3 shows another example of this construction in a lute by Hans Frei in the Vienna Kunsthistorische Museum. The profiles of this instrument and the Maler lute are almost identical - both instruments have been renecked and rebridged.

Again the eighth part of the construction extends beyond the lower edge of the top block slightly which would indicate a cut out in the block. Again I am unable to confirm this. This feature does however appear on the Frei lute in the Warwick County Museum and may have been used in other instruments by this maker.

Cutting away the top block in this fashion would allow the block to extend further into the body of the lute and give increased rigidity to the neck - necessary because of the narrow proportions of the body profile at this point.
Lute Belly by Laux Maler. - Nuremberg, Germanisches Nationalmuseum
Cat. No. M.1.54

Fan bracing below bridge omitted
Bar cross section constant - 0.4 x 1.5 cm. deep.
Belly thickness - 1.0 - 1.6 mm (at bridge)

Fig. 2.
Lute Belly by Hans Frei – Vienna, Kunsthistorisches Museum

Lower Bridge Position is Conjectural

Belly Thickness 1.5 mm. (at Rose)

Bar Section Constant – 0.4 x 1.3 cm Deep (approx.)

Fig 3.
**Fig 4(a)**

**Fig 4(b)**

**TOP BLOCK AND NECK JOINT.**

- ORIGINAL
- MODIFIED
The drawing in Fig 5 is yet another example of this construction in a lute by Hans Frei in the Warwick County Museum.

Note the low bridge position (although the present bridge is not original).

Note also that the diameter of the rose appears originally to have been smaller than it now is, the later carving being less fine in tracery detail. The central portion of this rose is identical in pattern to that on a lute by Maler in the Prague National Museum. The diameter of the original rose is proportionally the same as those on the instruments described above.

Traces of bars at the rose slope down towards the treble side of the belly and the rose pattern is slightly tilted to compensate for this asymmetry. Bar tracings on the Nuremberg Maler belly slope in a similar fashion.

I would, therefore, support the view that, although altered, this belly is original.
7. Whilst on the subject of top blocks, it is my opinion that the neck to top block joint in the Maler and Frei instruments was originally almost perpendicular to the fingerboard. (This arrangement may be seen in many paintings of lutes of the period). This feature facilitated later modification of these instruments to take wider necks - the neck joint angle was increased to achieve the required neck width without affecting the depth of the neck. (See Fig 4(b)).

In describing modifications to these instruments in Comm 128 I feel in retrospect that this point may not have been clear enough.

Woodwind Making Techniques. FoMRHI Comm. 197

Drilling deep holes accurately in wood. Rod Cameron

One of the most important techniques to master in woodwind making is the apparently simple process of drilling a deep cylindrical pilot hole down through the centre of a wooden billet. This process is usually done in preparation for subsequent reaming in the case of, say, recorders, or as the finishing operation for cylindrical bored renaissance styled flutes.

When a lathe is available, two approaches are possible: a) hold the billet (workpiece) steady and revolve the drill, b) hold the drill steady and revolve the workpiece. If the lathe is equipped with a 3 or 4 jaw chuck, it is often more straightforward to spin the workpiece, advancing the stationary drill held in the tailstock.

The common twist drill is a metal cutting tool which is fast cutting in wood, and it performs well on short holes. It is not a good design to use reliably in very deep holes, as it is inclined to wander off the revolving axis. The twist drill will usually work well for, say, recorder foot joints, and is sometimes acceptable on middle joints of 200-250mm length. Beyond this length, the runout can be such as to cause a curving bore which the reamer tries to follow, producing an oversize bore. To allow for a possible runout, a thicker billet is necessary so that the outside can be turned concentric with the out-of-line bore. If the woodwind batch is large, the cost of the thicker billets can be significant. If the pilot hole can be drilled reliably straight down the revolving axis of the billet, then smaller billet cross-sections may be used in the first instance.

Ridgeway augers and compressed air gun-drills have advantages over twist drills for deep holes. My experience of Ridgeway augers is that they are more accurate than twist drills and less accurate than gun-drills. Gun-drills are normally used in conjunction with a supply of compressed air to clear the cuttings, and they are used industrially for deep drilling metals. They are difficult to make in the home workshop and expensive to buy. Gun drills work well in hardwoods and have advantages when working with large batches.

The following is a description of a deep drilling technique which works well using drills that can be made with the use of a hacksaw and grindstone. The drills are more accurate than Ridgeway augers and cheaper (and slower) than gun drills, and just as accurate.
For example, the technique can be used to drill reliably 800mm long billets to 17mm diameter with a runout of less than 1mm.

I base the design of the drill point on drills used by early bagpipe makers. Examples are preserved in museums in Inverness and Newcastle. Tim Hobrough and Allen Finch first described them to me a few years ago and I have applied the design with success using diameters from 4mm to 19mm. It can be appreciated that the accurate boring of a bagpipe chanter having a diameter of about 4mm and length of about 500mm is at least as difficult as boring a 17mm diameter bore 1200mm long, since the accuracy is partly dependent upon the stiffness of the drill, i.e. the ratio of diameter to length. What works well in chanter boring also works well in renaissance flute boring.

**Drill shape**

The end of the drill is hemispherical with some modifications. As a first approximation, imagine the end of a long straight steel rod with a hemispherical end. Now remove metal to create a half round cross-section at the end for a length equal to about six diameters. Next, remove half of the remaining end as shown in figure 4 and marked 'cutaway'. The result is the basic drill shape. The quarter round edge which does the cutting is shown with arrows in figure 5. The portion removed by the cutaway need not be too deep. It is sufficient to remove enough material so that the dotted quarter round portion is relieved. To allow the drill to bite into the wood and cut a little faster, grind the cutting angle a bit sharper than if it remained a true sphere underneath the cutting edge as shown in figure 6. The final shape is shown in perspective in figure 7.

**Making the drill**

The drill will cut about 0.1mm larger than its body diameter. Select a suitable 36inch length of 'drill rod' (German silver steel) which is available in many standard sizes ground straight and accurate to .001 inch of its nominal size. Drill rod is made from high carbon steel and can be hardened and tempered easily.

If a milling machine is unavailable, mark out and hacksaw most of the material to be removed to give a half-round section for a length equal to about six diameters, or more. Grind the flat surface shown in figure 3 until an exact half-round section is achieved. Use the periphery of the grindstone to create a slightly hollowed surface (figure 3) making the final honing easier. Grind the end to be a quarter sphere having its centre co-incident with the centre line of the drill rod. This is done by holding the rod at an angle to the grindstone (figure 9) and revolving it back and forth as the angle is varied slowly. Now grind the cutaway.

Drill rod is supplied as either water, or oil quench. I use water quench, as it is cheaper. Heat the end to a bright red and quench vertically in water using a stirring motion. Check with a file to see that the end is now very hard (and brittle!), tempering is now required to soften and hence toughen the steel allowing it to resist drilling forces. Polish the steel bright with emery cloth. Apply a torch flame about 5cm from the end of the rod. Watch the coloured oxides form on the surface of the steel, first light straw, dark straw (brown), and finally blue. These colours indicate temperature and when the light straw (yellow) reaches the cutting tip of the drill, quench in water as before. The heating may have
aulled the cutting edge so touch it up again with the grind stone and hone the top face.

The drill is now ready to cut wood. The drill tip is not suitably designed to start the hole without wobble, unless it is rigidly supported. The hole can be started using a twist drill going in about two diameters, or the following set-up can be used:

**Procedure for drilling a long billet**

Prepare the wood billet by turning it to a cylinder. Measure the diameter of the billet. Now make a wood disc having the same diameter and about 2 cm long. Drill the disc accurately to the same diameter as the long drill. Make two wood bushes bored to fit the drill. Remove the barrel from the lathe tailstock and fit one bush into either end of the tailstock body. Slide the long drill through each of these two bushes (figure 10). With the tailstock in correct alignment, the drill will now be securely held on the axis of rotation, and the billet must now be aligned to revolve on the axis while supported in the three-point steady. To do this, slip the first mentioned wood disc onto the drill. Extend the drill fully from the tailstock while still held by the two bushes, and grip the end of the drill in the three jaw chuck. At this stage it is best to have the drill back-to-front so that the uncut end is held.
in the chuck. Mount the three point steady on the lathe bed, positioned where it will eventually support the end of the wood billet. Bring the wood disc to the three point steady, and adjust the points so that they securely hold the disc around its periphery. In these last operations the long drill has been used as an alignment guide to ensure that the chuck, the point steady, and tailstock are all on
the same axis, and the steady has been adjusted to fit the long wood billet.

Remove the long drill. Open the hinged arm of the steady, grip the wood billet in the chuck and close the steady over the billet. Rub beeswax and then oil on the wood to lubricate it near the steady. Slide the drill into the tailstock bushes with the cutting end facing forward. Grip the other end with 'vice-grips' or some suitable cross bar. Note that this type of cross-bar should be long enough to bear against the lathe bed and not spin freely, should the drill jam in the wood billet. When used to hold drills or reamers, short cross-bars are highly dangerous, and should never be used since they can spin freely if the tool jams, and will easily remove fingers.

Typical drilling speeds are about 600 rpm for 15mm dia. and 1500 rpm for 12mm dia. If only a high speed wood lathe is available, fix up a speed reducing countershaft to allow speeds down to 200 rpm. Never drill or ream at too high a speed. (By the way, I ream at 200 rpm holding the billet in my hand and the reamer in the headstock. A properly made reamer can ream an alto recorder nose joint, for example, in about two minutes, without step-drilling.)

Leave the tailstock clamped about 10 cm from the end of the revolving billet. Feed the drill into the workpiece gently at first, by holding the vice-grips fastened to the end of the drill, and pushing forwards. Once the full diameter hole has been established, the drill can be pushed harder and drilling will proceed smoothly until wood chips completely fill the available space at the drill point. Remove the drill and allow the chips to clear. Repeat the operation until the billet has been completely drilled. Beeswax is a good lubricant to apply to the drill.

In some instances, it may not be possible to pull out the wood chips with the drill, to clear the hole, especially in very deep drilling. Two modifications are shown to provide a sharp step at the drill point which helps pull the chips out with the drill. The tighter the chips are packed, the better the process works.

If the drill does not cut easily and quickly, it may not have been ground with enough clearance, so that some part other than the cutting edge is rubbing against the wood. To check for this, paint the end of the drill with toolmaker marking-out blue, or some equivalent,
like a black felt pen, then try drilling. Remove and examine the drill point. The blue will be rubbed off from areas touching the wood and a correctly ground drill will show bright steel only at the cutting edge. If areas underneath the cutting edge show signs of rubbing they should be ground off to give proper clearance.

Soundboard Finishes

Ian Harwood hit the jackpot in the last issue with his note on lute soundboard finishes. In this comm I want to amplify the idea a little as well as to demolish very largely the reasoning that lead Ian to it! But first I should say that this problem is also shared by harpsichord makers: only the 18th century English harpsichords had varnished soundboards (Diderot notwithstanding), the rest are obviously sealed, and its odds on its the same finish as the lutes.

On the subject of the colour of the finish and ageing, I want to argue that the colour of Ian's finish is mostly due to the linseed oil, and that on ageing the linseed oil and perhaps the egg white will darken more than the oil in the egg yolk. (The catch is that the yolk is an emulsion, and hence quite opaque; the actual amount of pigmentation when it comes to painting it on something is pretty negligible). My main source of information is Robert Massey's book 'Artists Materials and Methods' (1). This is much more up to date and scientific/scholarly than Doerner. His conclusion is that the fine art work of the tempera period (that is up to Botticelli) was done using pure egg yolk as the medium,
other media being considered inferior. Cennino Cennini (2) describes pure egg yolk as the universal medium and continually refers to it, while in his brief treatment of a whole egg medium (beaten together with clippings from fig tree shoots) he fails to mention any special properties. Now the point as I understand it is that these egg tempera paintings although older sometimes by many centuries than the oil paintings that followed them are generally in better condition. There are two reasons for this, one is that the oil in egg yolk does not darken nearly as much with age as does linseed oil, and the other is that it polymerises to a much harder paint film. When we leave the domain of painting for that of wood finishing another factor comes in, namely the darkening of the wood, which is quite marked even after a year or two. With this in mind another possible soundboard finish might be

1 egg yolk
an equal quantity of water

Pass the yolk from palm to palm wiping traces of excess white from the free hand until the yolk is free of white. (This method comes via Massey from some early source; you have to keep your palms flat or the yolk breaks.) Then holding the yolk between thumb and first finger puncture it at the bottom to drain the yolk, throwing away the sac. Add the water. I haven't tried this (yet) as a clear finish but from my experience with it as a paint medium, it may be necessary to adopt small hatching strokes to get an even finish. Perhaps the most important point for the modern maker is the hardening time (it will dry in seconds, but it is so soft at first that a further brush stroke is sufficient to pick it up); for something as exposed as a lute belly I would guess that some months hanging in the sunshine would be desirable, perhaps even years depending on the degree of scratch resistance required. This finish is purely speculative, but it would certainly account for the large number of lutes Laux Maler had in stock. Harpsichords are easier in that respect; I've done tempera paintings with this medium, stringing the instrument immediately after, which has sufficed to protect the paintwork until it hardened. (I tried waxing that soundboard, to poor effect, while Ian's solution was staring me in the face . . .)

Egg-linseed oil 'mayonnaise' such as Ian describes, may have two advantages, and one disadvantage. It is probably easier to apply and while hardening rapidly at first its ultimate hardness is less than that of pure yolk. (Somehow I shy away from the idea of a finish so hard you can rub it with the milled edge of a coin). The snag to it is described in Massey and actually happened to me some years ago when using this emulsion as a paint; some little while after I had finished the paint work the emulsion 'went wrong' giving shiny patches. Massey says this happens occasionally and is not controllable; It hasn't happened on the clear finishes I've been trying since reading Ian's comm.

To change the subject someone asked about instruments with double soundboards, I'm currently making virginals with double soundboards (mid 16th century Flemish), but I haven't yet come to any conclusions about what they may be for.

(1) An American book with an English edition, I haven't got a copy to hand but it can be found in quite ordinary public libraries.
(2) Transl. in 'The Craftsman's Handbook' by Daniel V. Thompson Jr reprinted by Dover
MERSENNE UNTWISTED - a counter-carp to Comm 183.  E. Segerman

We trust the quality of Mersenne's experimental technique and of his reporting what he observed. His theory was sometimes wrong. We usually can tell the difference between the numbers which come from his theory and from observations. Hubbard complained about calculations from a wrong theory. We are concerned here with observations. If Mersenne was cheated by his goldsmith (as we assumed and Cary seems to agree) this affects the reliability of his data only so far as we need to depend on his stated compositions to interpret them. We believe that he was probably cheated on his silver as well.

What Cary calls "the real problem with Mersenne's metal string data" is that when one calculates the density of the string material from his values of diameter, length and weight of particular strings, the densities are apparently 40% too high. This "problem" affects Mersenne's tensile strength data only to the extent that the 1/6th line string diameter may be in error. As Cary points out, there is no question about the length of Mersenne's foot. That 12 inches = 1 foot and 12 lines = 1 inch is indicated by Mersenne on P.518 (Chapman's translation) where he states that 1 foot $10\frac{2}{3}$ inches = 268 lines. If all of the error was in Mersenne's measurement of the diameter, it should have been 18\% bigger than reported, resulting in the tensile strength calculated from this data being 40\% higher than previously thought. This is highly unlikely since the tensile strengths calculated from the 1/6th line string diameter are reasonable and those with the +18\% correction in diameter aren't. Since Cary's point is that Mersenne was incompetent and that his tensile strength data are not to be trusted, Cary must then be assuming that the error in string diameter and in breaking load somehow compensated to give somewhat reasonable though unreliable tensile strengths.

The other possible sources of error in the density calculation are the string weight and the string length. Mersenne's weighing technique was pretty good since he got reasonably good densities by weighing in and out of water. There is no reason to question how well he could read a ruler.

What we have always assumed when reading the passage in question was that the string length was about 30\% longer than the distance between the two bridges, and that the particular length Mersenne mentioned was the distance between the two bridges. His argument at this point in the book was that heavier metals give deeper sounds. He listed string weights and pitches for comparison, and documented other factors only to show that they were constant. These constant factors were: string diameter, loading weight, total length of string (that the string's weight relates to) and the distance between the two bridges. Mersenne gave all of these parameters except for one of the lengths. Since Mersenne was concerned with comparative pitches in this section, we would consider that the length being the length between the two bridges would perhaps be more likely. This choice makes none of Mersenne's data inconsistent with any of his other data or with modern data. There really doesn't need to be a problem with Mersenne's data at all.

There is nevertheless a problem with Cary's understanding of string physics since he writes that Mersenne's sequence of tensile strengths contradicts his sequence of highest pitches for different metals. He should have been aware that the highest pitch for a material depends on the ratio of the tensile strength to density, and not just the tensile strength alone, and it turns out again that Mersenne is pretty right. The proof is in our 1974 GSJ paper, but it is simple and short so we'll repeat it here. If Cary can get it wrong, others might also, so it may be worth the space.
Frem Mersenne's law, \( f = \frac{1}{2l} \sqrt{\frac{T}{m_1}} \) where \( f = \) vibrating frequency, 
\( l = \) vibrating length, \( T = \) tension and \( m_1 = \) mass per unit length. The maximum tension at breaking is \( T_m \) and the frequency when this happens is \( f_m \). Also \( m_1 = \rho A \) where \( \rho \) is the density and \( A \) is the cross-sectional area. So

\[
f_m = \frac{1}{2l} \sqrt{\frac{T_m}{\rho A}}
\]

Now the tensile strength is the maximum stress \( S_m \) which is defined as \( T_m/A \). Therefore

\[
f_m = \frac{1}{2l} \sqrt{\frac{S_m}{\rho}}
\]

Using Mersenne's data as given by Cary, we get:

<table>
<thead>
<tr>
<th>Material</th>
<th>( T_m )</th>
<th>( \rho )</th>
<th>( T_m/\rho )</th>
</tr>
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<tbody>
<tr>
<td>Gold</td>
<td>23</td>
<td>17(\frac{1}{2})</td>
<td>1.3</td>
</tr>
<tr>
<td>Silver</td>
<td>23</td>
<td>10(\frac{1}{2})</td>
<td>2.2</td>
</tr>
<tr>
<td>Iron</td>
<td>19</td>
<td>7(\frac{1}{2})</td>
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</tr>
<tr>
<td>Copper</td>
<td>18(\frac{1}{2})</td>
<td>8(\frac{1}{2})</td>
<td>2.2</td>
</tr>
<tr>
<td>Brass</td>
<td>18(\frac{1}{2})</td>
<td>8(\frac{1}{2})</td>
<td>2.2</td>
</tr>
</tbody>
</table>

Since \( A \) is constant, \( T_m/\rho \) is proportional to \( S_m/\rho \) and so the order of materials according to highest pitch should follow these values. Thus iron tunes the highest and gold the lowest and the others about the same in between. This corresponds with Mersenne's observations except that he included silver with gold as tuning lower than brass, while this calculation gives silver about equal with brass. In our Strings Calculator Range Guide we place silver slightly higher than brass, resulting from our use of modern values for density.

In spite of his being more quarrelsome, we take the same attitude towards Cary as we do towards Mersenne. Though his theory is sometimes shaky, we trust his experimental observations, and these are very welcome additions to our body of knowledge on string technology. They seem to challenge Mersenne only in the comparative tensile strengths of red brass and yellow brass. David Rubio tells us that in a preliminary study on early metal strings done for him at Harwell, they found phosphorous as an impurity. It is thus possible that the red brass strings Mersenne measured might have had a phosphor-bronze type of composition and Cary's didn't have the phosphorous impurity. We need more samples from diverse early sources to be analysed chemically and mechanically.

The tensile strength data included in our Range Guide is only that given in our GSJ article, most of which is based on Mersenne's measurements.

We are interested in the sounds that listeners heard in Mersenne's time and not how far we can now push the materials he had, even using technology of his day. Cary started with the thickest wire he could get and stopped at the smallest hole in his die. Early string makers would have stopped at the appropriate diameter for that string on an instrument and did not necessarily strive for maximum tensile strength. They might have actually avoided highly drawn wire because of brittleness which could make breakage at knots and bends more likely.

We would appreciate more tensile strength measurements on the early wires Cary has at his disposal, but have no idea about whether his redrawing of this wire has any historical relevance other than that this could have been done then if they wanted to and thought of it.
A METHOD FOR MAKING TRADITIONAL HARPSCICHORD TUNING PINS.

JOHN BARNES.

I make tuning pins from mild steel rod of 3.2, 3.9 and 4.7 mm diameter, cropping the rod to length with an inexpensive wire cutting tool as used for outdoor work on fences (Record 915). The rod feeds through under its own weight every time a blank is removed by the shears and the blanks drop into a box.

These blanks are mounted one by one in the mandrel illustrated and locked with the setscrew. The locknut and arm used with the setscrew are arranged so that centrifugal force tends to tighten the setscrew. The mandrel has two ends drilled for different diameters of tuning pin and the end not in use has a dummy tuning pin with a block of wood attached to act as a flywheel. The bearing holes in the frame fit the two sizes of pin.

The frame is made from 3 x 13 mm mild steel (also used for the locking arms) screwed to a block of wood which can be held in a vice, and the mandrel is made from 13 mm round or square mild steel 100 mm long. The dummy tuning pin is hammered through the flywheel block (e.g. 100 x 100 x 40 mm) so that its flattened part is embedded.

The protruding part of the tuning pin blank is attacked with the file and the flywheel should allow it to spin, but provide rotational inertia sufficient for the file to bite on the blank and cut it. The filing should be done at about 60 to the axis and towards the tip of the blank. When the end is correctly tapered it is a good plan to roughen the blank slightly as far as the bearing of the frame. Otherwise the mild steel rod is too smooth and the wire tends to slip as it is being wound on, a problem which did not arise in the 17th and 18th centuries.

When a batch of blanks has been filed the mandrel can be removed from the frame and used as a convenient handle to hold each blank in turn, this time gripping the filed end with the setscrew, so that the unfiled end can be flattened cold with a hammer and anvil. 2 lbs or 1 kg is a suitable weight for the hammer. The resulting rough top edge should be ground or filed.
Sixty tuning pins can be cut, hammered and ground in about seventy minutes.

**TUNING PIN DIMENSIONS**

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Treble</th>
<th>Middle</th>
<th>Bass</th>
<th>Horn</th>
<th>Foot</th>
<th>Shoulder</th>
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</thead>
<tbody>
<tr>
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<td>9</td>
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<tr>
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<td>4.8</td>
<td>2.4</td>
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<td>10</td>
</tr>
<tr>
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<td>2.2</td>
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<tr>
<td>&quot;           8ft</td>
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<td>4.0</td>
<td>5.0</td>
<td>2.4</td>
<td>16</td>
<td></td>
</tr>
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<td>4.4</td>
<td>1.8</td>
<td>7</td>
<td>2.3</td>
</tr>
<tr>
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<td></td>
<td></td>
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<td>4.9</td>
<td>2.4</td>
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<td>5</td>
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<tr>
<td>&quot; middle</td>
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<td>4.3</td>
<td>5.4</td>
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<tr>
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<td>Dulcken c1750</td>
<td>44</td>
<td>4.7</td>
<td>5.5</td>
<td>2.7</td>
<td>15</td>
<td>9</td>
</tr>
<tr>
<td>Gregori 17(2)6</td>
<td></td>
<td>5.7</td>
<td>6.3</td>
<td>3.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shudi 1761 4ft (painted</td>
<td>57</td>
<td>4.4</td>
<td>3.9*</td>
<td>2.7</td>
<td>13</td>
<td>17</td>
</tr>
<tr>
<td>black</td>
<td></td>
<td></td>
<td>2.7</td>
<td>16</td>
<td></td>
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<tr>
<td>&quot;   8ft</td>
<td>62</td>
<td>4.7</td>
<td>3.9*</td>
<td>2.8</td>
<td>22</td>
<td>20</td>
</tr>
</tbody>
</table>

*shoulders are chamfered

FOMEHI Communication n° 201
L. A. Esteves Pereira

**Artificial ivory made from milk**

Take 5 Kg of coagulum (from a cheese maker) and mix with 1.5 Kg of borax (diluted in 1.2 l of water). The whole mix is put in a recipient, over a low fire up to it is separated in two parts: one liquid like water and another like gel. Discard the liquid and add to the gel a dilution of 500 gr of copper or iron sulphate in 1,5 l water. With this addition, there will be a further separation of the gel in a liquid part and a more solidified gel. Discard again the liquid by compression or filtration. This final product will be white, because it is formed, basically, by the milk casein. The final product should be pressed in appropriate moulding, according the use and solidified in oven, not very hot.

Note - I, myself, did not tried yet this process I found in a book edited in the pre-plastic era. I shall be not responsible for the results. Anyway, it will be no toxico. Any member who experiment this recipe will be so kind to communicate the results?
Inventory of the workshop of Bartłomiej KEJCHER, born in Kraków in 1548, dead in Kraków in 1599, the 9th January.

Translation: Pierre DUCHAR.

...A black box in which are the following things
-24 swiss-pipes /pisczołaek szwajcarskich/ of different dimensions
-4 big swiss pipes put together
-3 shawms /szalamaiet/ and a fourth one little,
-I big gauge or measure for mute cornetts /muty/ in yew wood and 2 others, similarly, for swiss-pipes.
-26 cornetts finished and covered with black skin.
-27 mute-cornetts finished.
-8 curtals or tarots, ready /sztort/ only the brass parts are to be fixed.
-2 consorts /sztywmwerk/, probably of curtals, each of them having 7 pieces, in green boxes, with locking systems.
-2 regals from Nürnberg /or in the Nurnberg way/
-16 war trumpets from Nürnberg /or in the Nurnberg way/ /oobiema dziurami wylwiercianemi i spuntami/
-30 white curtals roughly bored.
-212 pieces of wood, roughly prepared for mute cornetts and cornetts.
-I family of curtals /sztywmwerk sztortów/, white, not finished, in which are 7 instruments. /note that "white" is singular.
-2 violins, one bass, the other diskant, in a box. /2 skrzyniec, jedne basowe, drugie diskantowe.../
-I instrumenczik maly /"little instrument" was very often used when speaking of clavicord or spinett/ made by the father of BK
-I clavicord /klawikordium/
-18 mute-cornetts, turned, white, without fingerholes.
-15 white cornetts, not finished.

In the following part of the inventory are tools....
-Boring tools and knifes of different dimensions, big for curtals cornetts and "pomort"/germ: Pomer/, for BK’s workers /or work/ with or without handles, straight, long, short or curved:120.

-4 gauges or forms for "s". /4 miar do esów/

Doctor Włodzimierz KAMINSKI, in his book "Instrumenty muzyczne na ziemiach polskich" /musical instruments on the polish territory/F&Wk 1971, p 134 writes that probably, BK was working as a string instruments makers and that wood wind were made by BK’s workers. I think it would be more logical to understand "crooks for winds" instead of "sound holes for strings"
-10 old swiss-nipes, thin and thick.
-I new shawm /szałamajka/.
-7 pairs of little, white, not finished recorders /piszczałek/.

-.. a black box, not very big, where are not finished flutes and cane for reeds. /..piszczałki i trzcina zamorska/
-Reeds for curtals, of different sizes and tools for turning, in a white box.

-.. in a white box, old, 8 flutes /fletów/not finished.
-in a similar box, 8 schreierpfiffen /szrayfayffen/not finished.
-Bass shawm or bass pommer? /szałamajowy pomort/ with 4 keys /4ma regestroma/
-Tenor shawm or tenor pommer /tenorowy szałamajek/ with 4 keys.
-2 tenor shawms /tenorowy szałamajek/ with 1 key.
-/dyskantowy excellencik/ soprano recorder?

Fragment of the inventory made after the death of the widow of BK in 1604.

....a consort of curtals /stymberk sztortów/, which are to be sold for 150 zlotych, 10 trumpets.....In the workshop are curtals /storty/ begun, and other instruments /piszczałki/ that I pray to be conserved until the maturity of my children....

NOTE: In old polish language, the word "piszczałek" was used to denominate all kind of wood-wind instruments. In this inventory, almost all the instruments are called by their name. Polish musicologists usually consider that "piszczałek" and "fistula" were commonly used when speaking of f?corder. Piszczałek is also used when speaking of organ flutes.


"Do historii muzyki..."/

Naprzód spisano czasy i robotę tokarską i instrumenta rozmaite do tego należace, jako niżej... Naprzód czarna skrzynka, potarta, w której się kładły rzeczy niżej opisane.

- 24 piszczałek szwajcarskich rozmaitych
- Składane szwajcarskie wielkie cztery piszczałki
- Szałamajet 3, czwarta mała
- Miara mutów cisowa wielka i dwie mierze także piszczałek szwajcarskich.
- Kornetów gotowych 26 w czarnej skórze.
- Mutów gotowych 27.
- Sztortów gotowych 8, tylko mosiądze do nich przybić.
- Sztymwerków 2 w zielonych skrzynkach po 7 sztuk, ze wszystkimi aparaty zamcżyste.
- Regały 2 norymberskie.
- Tręb wojennych norymberskich 16.
- Sztortów białych z obiema dziurami wywiercianymi i spuntami 16-é
- Item białych ze dwoma przędzonymi dziorami 30.
- Na muty i na kornety z próby otoczonego drzewa 212 sztuk.
-Sztymwerk sztortów biały niedogotowany, w nim sztuk 7.
- Skrzypiec dwoje, jedne basowe, drugie diskantowe w ouzderku.
- Instrumencik mały ojca nieboszczykowskiego roboty.
- Klavikordium.
- Mutów wytoczonych białych, przez małych dziurek.18.
- Kornetów niedorobionych białych 15.

Te rzeczy się w płaską skrzynkę drugą włożyły, aby się nie poterały.

- Świderków, dłutek rozmaitych, wielkich do sztortów, kornetów, mutów, pomortów i do roboty nieboszczykowskiej przymalierzących z trzonkami toczonymi i prostemi, także też i przez trzonków, tak krótkich jako i długich, prostych i krzywych 120.
- Piłek i raspel 17 w pudełku białym i małych dłoteczkek, Świderków i szydełek 17 par.
- Cylków 8.
- Bicągów troje.
- Miar do esów czworo.
- Pił stolarskich 3, szlisara jedna i dwie domowe piłe do rzezania drew.
- Heblów małych i wielkich 16.
- Starych szwajcarskich piszczałek cienkich i mięszych 10.
- Szałamajka jedna nowa.
- 7 par małych białych niedogotowanych piszczałek.
- Manubria z mosiądem na końcach, rzezane 4 do dłotek.
- Starrego rozmaitego naczynia tokarskiego kilkadziesiąt sztuk, które rdza pojada, że się nieboszczykowi do roboty nie godziło, każdego z osobna nazwiskiem mieli nie umiano, to się opatrzywszy w skrzynię trzecią włożyły i zamknęło.
- Skrzynka czarna nie bardzo wielka, w którą się niedorobione piszczalki i z zamorską trzcinę włożyły.
- Stroje do sztortów rozmaite i z naczyniem drobnem do rzemiosła tokarskiego przymalierzącem w pudełku białym.
- Szrusztak wielki z ławą na czterech nogach.
- Ambusak mały i młotek.
- Warsztat dembowy tokarski ze wszystkimi aparaty do niego zupełnie należącymi i z szraubbratami dwiema dembowemi.
- Szraubpraska niewielka.
- Tygliczak mosiądzowy do kleju. Insze drobiazgi warsztatowe.
A recent communication (which for some reason I am unable to locate) posed some questions about the psaltery shown in the left panel of Hans Memling's triptich, "Christ Surrounded by Angel Musicians" (see Plate VIII, p. 79, of Jeremy Montagu's The World of Medieval and Renaissance Musical Instruments). As I recall, the author noted that there were far more strings shown than one would expect and, spaced equidistantly, would imply an impossibly large compass. Further, a group of what appear to be 4' strings are attached to a row of pins pegged into the soundboard.

My friend and colleague Frederick Crane has an excellent set of photographs of the triptich, with enlargements of several of the instruments portrayed. One of the enlargements of the psaltery is about 1/4 size, and another is more than 2/3 life size. Several years ago, with the help of these photos, I built a Memling psaltery (or psaltery after Memling, if you prefer) for use in my Collegium Musicum at the University of Iowa. I believe it will be useful to anyone who wishes to attempt to construct one if I present the characteristics of the psaltery portrayed by Memling, discuss the problems involved in designing a working model, and present the ways in which I dealt with these problems.

Memling's Psaltery

The instrument in the painting is a petite and unusually graceful porco, or psaltery in the pig's snout shape. There are no bridges on the soundboard; the strings simply pass
over the shoulders of the moulding on either side (thus I will refer to this type as a "shoulder psaltery"). There is no sign of bridge pins, string grooves, or any other device to cleanly terminate the vibrating portion of the string.

The strings are easily counted on Prof. Crane's photos: there are 61 of them. Although not spaced with absolute equality, they are obviously not grouped in pairs or triplets. Further, the wide (bass end) of the psaltery shows another 22 strings, each roughly 2/3 the length of its neighbor in the major string band. There can be little doubt that this is a set of 4' strings. Each of these shorter strings is wound to a tuning peg which disappears into the soundboard (and presumably into a wrest plank) below.

A row of tuning pins runs down the left side (angel left) of the psaltery. On the opposite side, less visible but clearly indicated, are a row of nail heads to which the strings are hitched. One can assume that hitch pins for the 4' band would be found on the left side.

The soundboard has 4 sound holes into which rosettes have been mounted (the 4-holer porco seems to have been fairly standard). The details of the rosettes are so clear that they can be duplicated with little trouble. The middle one is a trefoil design, while those in the 3 corners are based on an 8-pointed star. One can also make out the detail and shape of the moulding of the sides, and enough of the sides can be seen to allow some estimate of the depth of the instrument.

Using the now-famous inter-ocular standard of 65 mm., the psaltery appears to be approximately 14" long X 14" wide.

Designing the Psaltery

The instrument in the painting looks convincing, and Memling is known for his attention to detail; nevertheless some of its characteristics are open to question:

1. The absence of bridges on the soundboard.
2. The absence of bridge pins or string grooves.
3. The presence of 22 4' strings (and with them the tuning pins on the soundboard and, presumably, a wrest plank to receive the pins).
4. The presence of 61 strings in the major band. If tuned chromatically, one string to a note, they would give a compass of over 5 octaves, and almost 2 octaves would be doubled with 4' strings.

The absence of bridges. Although we have come to expect that any plucked string instrument have one or more bridges, the bridgeless shoulder psaltery is not uncommon in medieval iconography. I may be mistaken, but I get the impression that they are seen more often than porco psalteries with bridges. Of the 12 illustrations of psalteries in Jeremy's World, 4 are clearly shoulder psalteries, 4 probably are, 3 do not show sufficient detail to make a judgement, and only one clearly has bridges. At any rate shoulder psalteries seem to have been ignored by modern builders, and we have all seen pictures of porcos with bridges advertised as Memling psalteries!

The absence of bridge pins or grooves. This instrument aside, are there any illustrations of psalteries that show pins or grooves? I can't recall seeing any, but I'm
not that much of an iconologist. Certainly Memling shows nothing on this instrument, although its detail is so complete that he no doubt could have had he wanted to. Letting the strings run over the rounded shoulders is not the way we were taught to make string instruments -- this is simply not the most efficient way of transmitting the vibrations of the strings to the instrument. Perhaps it was expected that the wire strings would wear their own grooves? Perhaps, but the painting does not show it.

The presence of 4' strings. In theory, why not? Certainly the concept of a string instrument with its lower notes reinforced by octave stringing is valid in the 15th century; one need look only as far as the lute. Also, in theory, there should be no objection to a sizeable block of wood (the wrest plank), uniting bottom and top, running up almost half the length of the instrument. It certainly would add solidity to the structure.

The tuning pin for each 4' string is carefully centered between the 2 adjacent 8' strings; nevertheless, things are so closely spaced that the 8' strings would almost certainly buzz against the 4' tuning pins. It is always possible that this sound was considered desirable: on the other hand, the tops of the 4' tuning pins could have been sunk below the level of the 8' strings. This would avoid the buzz.

Thus far, in theory, there can be no objection to the 4' set of strings. But, in practice, who needs 22 more strings when he already has 61 he can't explain? And if the instrument is strung chromatically, one string to a note, he is adding almost 2 full octaves of 4' strings. It would seem that a decision about the 4' strings will depend on how we deal with the compass.

The presence of 61 strings. It is difficult to accept the concept of a psaltery strung chromatically, and it's impossible to imagine one 14" long with a 5-octave compass. The physical properties of metal strings (or any other kind) will not permit it, even if such be possible (made by angels, for angels!) in heaven. One seems to have two choices here. He can ignore the number 61 and decide on a workable compass which he can string singly, in pairs or in triplets; or he can assume that there are indeed 61 strings (60 would have been so much better!), but that they are really grouped in pairs or triplets. Pairs of strings tuned chromatically would result in a 2-1/2 octave compass -- quite reasonable. If, however, one assumes that the instrument was tuned diatonically (with both hard and soft B's) one arrives at a compass of 3-1/2 octaves: better than 5 octaves, but still scarcely possible. Grouping the strings in triplets yields a chromatic compass of an octave and a half, or a diatonic compass of 2-1/3 octaves -- or just 3 notes short of Guido's gamut!

My Solutions

I found the design of this disarmingly simple instrument a difficult task. My experience is mostly with harpsichords and lutes; the shoulder psaltery is clearly neither. First of all, I accepted the evidence of the bridgeless psaltery -- I really had little choice. But I found it difficult to imagine the massive sides of the instrument
doing anything except damping the delicate vibrations of the strings. The sides of my instrument have the following cross-section:

![Diagram of psaltery](image)

I made these members out of maple. A hard wood was obviously called for since the sides need to hold tuning pins and hitch pins.

I used various highly scientific methods to determine the exact size of the psaltery. These included calculations based on the size of the average hand, the width of the average fingernail, the probable scale of the lute played by the psaltery angel's once-removed neighbor, and the average size of angel's wings. All these calculations came to naught, since I arrived at a dimension of 17" X 17" -- considerably larger than the inter-ocular 14" X 14". Nevertheless, though my psaltery is not as petite as Memling's, it certainly is within the range of sizes shown in other illustrations.

Intuition told me to forget any analogy with the thin soundboard of a lute, so I made my top of 1/8" spruce. The grain runs parallel to the strings, since that's how it goes on any other string instrument I can think of (also, I just happened to have a piece of soundboard wood that fit that way). Intuition also told me to make the bottom of 1/8" soft poplar rather than maple (although I really think I did that because I had a suitable piece of poplar). I put two diagonal braces across the bottom. This turned out to be a wise move since the pull of the strings tends to bow the bottom in both directions.

I used hitch pins, and the darn things are always catching on clothing. I duplicated the rosettes and stained the instrument as shown in the Memling painting. It makes a handsome appearance.

I decided on a compass of 23 diatonic notes with both hard and soft B's. This is Guido's gamut, from G to e'. (I say I decided on this compass, but I goofed somewhere and only made it to d'.) I used brass wire and strung the Psaltery in triplets.
I used tapered threadless harpsichord pins for tuning pins. They work well, but protrude more than I would like. Also, 66 tuning pins add a lot of weight to the psaltery. Were I building anew I would use the thinner tuning pins now used for the 4' registers of Zuckermann harpsichords.

I solved the problem of the 4' strings by ignoring them. I hang my head, because I have no doubt that Memling was painting a real feature of the instrument. As I said earlier, this instrument has a lot of strings to deal with: nevertheless, I might make a different decision if I had it to do over. Perhaps I would provide a 4' string in place of one of the triplet strings for the 8 notes of the bottom octave.

My Memling psaltery has an amazingly loud, bright, rich, ringing, zingy sound. It can be plucked with plectra or, with equal effect, played with wooden hammers. I realized immediately that the sides of the psaltery did not damp the string vibrations as I had predicted, but rocked back and forth, transferring energy in a most efficient manner to both top and bottom. Thus the bottom functions as another soundboard, and the volume and tone quality of the instrument suffer when it is played on the lap, where the clothing damps the bottom board. It must be played on the chest, Angel fashion. Bracing the bottom proved to be a doubly effective intuitive move, since it lowered the main wood resonance of the bottom to about a fourth from that of the top.

I am certain that this marvelous little instrument has subtleties I've not even dreamed of. I would be interested in hearing from others who have built the enigmatic Memling psaltery.

FoMRHI Comm. 204  MAKING A FRAIZE - Philip McCrone

Here is a simple and cheap way of making a fraize. Buy a countersink bit, the sort made for a carpenter's brace not the high speed type used in electric drills. Soften and cut the head off as shown in the diagram. Clamp a piece of wood to the base plate of a pillar drill and with another countersink bit in the chuck, drill a countersunk depression in the wood. Without disturbing the position of the wood or the alignment of the drill, place the cut off countersink (which shall now be called the fraize head) in the depression and a tapping drill in the chuck and drill right through the fraize head. This method should ensure that the hole goes through dead centre (it did for me).

The snag in all this is that because the fraize is an upsidedown countersink bit, the cutting flutes are now angled for a left handed cutting action. The answer, of course, is to use a left hand tap and die. If you have access to these there is no problem, but if not I do not advise buying as I did; they are very expensive. Write to me and I will lend my set. The size I used was ¼ in. Whit. The ¼ in. shank of the fraize handle allows it to be employed in all but the smallest tone holes and the coarse thread allows the tool to be unscrewed easily after use. For handle and shank I used a very small boxwood handled screwdriver, cut off the flat, threaded sufficient shank to screw right through the head without protruding from the other.
side. The use of the fraize is made very easy by taking a length of dowelling - 5/16 or 1/4 inch - and fixing in at one end a small metal peg at right angles to its length. The peg engages in the hole of the fraize head and the whole thing is inserted up the bore of the instrument till the required hole is found. It is simplicity itself to screw in the handle from the outside; the dowelling is then withdrawn. To what extent the fraize is used is another story!

FoMRHI Comm. 205

A GAUGE FOR MEASURING THICKNESS OF MUSICAL INSTRUMENT SOUNDBOARDS

Many musical instrument makers and researchers have at one time or another wished to have some means of measuring the thickness of soundboards. This is, of course, no problem when an instrument is disassembled for repair or restoration, but is often nearly impossible on the assembled instrument. On violin-type instruments, one can make a set of calipers that reach inside the sound-holes, but aside from problems with the accuracy of such devices, many museum curators do not approve of large, unwieldy metal objects being introduced into valuable historical instruments. On lutes and harpsichords, this method would not work at all.

Until recently, I had seen only one alternative method. This method employed a modified 0-1" micrometer which had a magnet mounted on the end of the shaft. The arm of the micrometer was cut off, and the shaft moved up and down inside a plastic tube. The tube was placed against the belly of the violin (or other instrument), and the shaft lowered until the magnet almost touched the belly. A ball bearing was introduced into the violin and held to the underside of the belly by the magnet at the end of the micrometer shaft. Then the micrometer was unscrewed, raising the magnet from the surface of the violin until the ball bearing dropped. With reference pieces of different thicknesses, a calibration curve could be drawn for this device. The device worked fairly accurately, though again, there might be museum objections to its use.

I first became curious about electronic thickness gauges when I read Martin Edmunds' article in the Journal of the Fellowship of Makers and Restorers of Historic Musical Instruments (Communication no. 4, October 1975) on an Inductive thickness gauge for measuring thicknesses of non-metallic surfaces. This device was claimed to work over 0-10 mm., and to an accuracy of about 0.2 mm., which is a fine range and sufficient accuracy for my work with bowed string instruments.

I took the schematic for Mr. Edmunds' device to a friend who is involved in electronic circuitry design (Dr. David Griesinger of Cambridge, Mass., USA). Using it as a starting point, he began to build a thickness gauge for me. He immediately ran into difficulties: the gauge was not stable; it was very frequency- and noise-sensitive, and thus demanded very stable oscillator circuitry and quiet preamps. After much experimentation, he ultimately built a working gauge using the general idea of an inductance bridge. Like the micrometer device, the transducer used a magnet outside the instrument and a ball bearing inside, with the assumption that the ball bearing would track the magnet as one moved the transducer. The magnet was from a small transis-
tor radio loudspeaker, and a coil wrapped around the magnet acted as the inductance in the bridge circuit. The device fit into a 7"x5"x2" box, and thus was quite portable. Unfortunately, it never was very easy or reliable to use. Even though the transducer with its magnet was rather bulky, it was not strong enough to hold the ball bearing on the underside of the belly of the instrument to be measured, so one always had to work with the instrument held upside down. Experiments with different magnets and ball bearings did not cure this problem. In addition, the transducer was slightly sensitive to the earth's magnetic field, and there was a certain amount of inherent drift in the device, so that one had to zero the meter fairly often as one measured an instrument.

At this point I became sidetracked by the possibility of using ultrasound equipment, and thus measuring thicknesses without introducing any object into the instrument to be measured. I wrote a number of letters to ultrasound equipment manufacturers and designers, with rather discouraging results. Most of the thickness gauges on the market were designed for measuring metal thicknesses, and would not work on wood. A trip to a local hospital with a scanning X-ray tomograph produced absolutely no results with wood. Branson Industries in Connecticut, a company which designs and builds ultrasound equipment, worked on the problem and concluded that there was an inherent difficulty. Since one is working with relatively small thicknesses, one needs to go to rather high frequencies in order to have a distinct pulse and bounce. Wood, however, is a very good insulator at these high frequencies. Branson was convinced that they could design a device which used a lower frequency pulse, and separate pulse and bounce with data processing techniques, but they expected that it would take them several years to design and build such a device. There was also a second inherent difficulty in the ultrasound methods: One needed some sort of conductive gel for good conductance at the transducer-wood interface, and I couldn't imagine that museum curators would allow conductive gels on their instruments, any more than they would allow calipers!

With this setback, I turned again to my friend David Griesinger. My viola da gamba building teacher, Donald Warnock, had asked if one could build an inductance bridge using two small, light ceramic magnets for the transducer instead of a magnet and ball bearing, thus reducing the tracking difficulty. David had also thought of this possibility and had already located a source of ceramic magnets. A grant from the National Endowment for the Arts allowed me to pay David enough so that he could devote more time to the project, and he soon developed the gauge which we now use.

The current thickness gauge is housed in the same box as the previous one. It can be operated either from AC (with an external power pack) or batteries. The internal battery pack uses eight AA cells in series, and the external AC power pack which we use supplies 22 VDC at 140 mA, although the gauge is regulated so that any DC voltage from 5 to 40 volts will safely power it.
The magnet which we introduce into the instrument is 1/2" in diameter by 1/4" thick, and the magnet in the transducer is rectangular, 1"x3/4"x3/16" with a 3/16" hole in the center (this hole is rather important, as you will see). We found these magnets at Radio Shack stores.

The sensor itself is a Hall Effect sensor; i.e. a sensor which measures changes in magnetic field. This sensor has a substantial current drain, and changes its resistance as it heats up, so the transducer is packaged in a thin copper case for heat dissipation; epoxied in the case directly next to the sensor is a thermistor which corrects for the sensor's resistance change.

In our first attempts to use this transducer, we discovered that the transducer had a memory effect. When we made several measurements of thick surfaces, a subsequent measurement of a thin surface would read thicker than it should. In our second transducer, the sensor was mounted by the hole in the rectangular magnet, exactly at the point of zero field, and the memory problem disappeared.

At present, there is still a bit of drift, and our transducer packaging is a bit awkward, so we have to move the transducer around very slightly to find the maximum meter deflection at each measurement point (or else our measurements read too thick), but it is otherwise easy to use. The internal magnet tracks the transducer nicely, and is relatively easy to introduce into and remove from the instrument. The accuracy seems to be about 5%, or about 2.5 mm., which is a bit large, but quite usable for measurements of the sort I wish to make. I expect that when we make a transducer which is physically better designed and packaged, the accuracy will improve and the measurements will be even easier and quicker to make.

In addition to accuracy and ease of use, I feel that this type of gauge is the safest device for thickness measuring, as both the internal magnet and the transducer are small and light, and unlikely to damage a valuable instrument, when used carefully.

David suggests that two simple modifications would make the gauge much easier to use. First, he suggests that the meter should be changed to a peak-reading meter, and second, that a small oscillator circuit and loudspeaker be included, so that one can "hear the thickness," and need not always watch the meter for maximum deflection.

The following schematics should be self-explanatory. They employ no unusual components, except for the Hall Effect sensor itself. I would like very much to hear the experiences of anybody who tries this circuit.

Peter Tourin
Duxbury, Vermont USA
March, 1973
METER AMPLIFIER

REFERENCE POINT AMPLIFIER

BATTERY OR PWR. SUPPLY INPUT: 8.5 - 40VDC

POWER SUPPLY REGULATOR

SELECT FOR ~ 2.00 MA MAX CURRENT
ON CHLADNI-PLATE TUNING OF BAROQUE VIOL SOUNDBOARDS. E. Segerman

We at NRI have not yet done any experiments to determine what differences in viol sound result from tuning the belly resonance modes, either by the traditional tap-tone technique or by its modern version, the Chladni-plate technique. We use the Chladni-plate method with our viol soundboards because it is very easy to do, and because we are very satisfied with the sound of the viols we've made using it.

The equipment needed is:— (1) a variable-tone generator that produces a sine-wave output from about 30 to 2000 Hz which can tune to differences of less than $\frac{1}{2}$% (available from NRI for £35, but cheaper—less than £10 in parts—from your local electronics enthusiast who will insist on designing it his way) (2) a high-fidelity amplifier (only a few watts are used but more than 50 watts is recommended to avoid distortion in the amplifier caused by feedback at low frequencies from the oscillating speaker) (3) a good-quality speaker of about 6 inches diameter (try to get one with its own resonance as low as about 50 Hz) (4) a table with a hole in it, to the underside of which the speaker is attached (5) sound absorbing ear coverings so that you can turn up the volume without discomfort (6) some pieces of flexible plastic foam and a light granular substance (Christmas glitter seems to be the best). We measure frequency with a calibrated tone generator we happen to have, but for our use so far all we would have needed is any fixed-pitch instrument such as a guitar and a good ear to estimate fractions of a semitone.

One places the pieces of foam around the speaker hole, and places the soundboard on them, concave side up. Make sure that the soundboard is close to the table but not touching it. The glitter is then sprinkled over the soundboard. When the speaker emits a frequency that matches a resonance mode, the soundboard comes to life, with the grains bouncing violently over most regions and collecting over lines (called nodal lines) which are not vibrating. The pattern of nodal lines and the frequency at which this occurs characterises each resonance mode. There are many of these modes, but one works with only the few lowest-pitch ones.

We haven't tried it, but suspect that the resonance modes can also be made visible using entirely Renaissance or Baroque type equipment. The soundboard could be placed on a table, raised above it by little balls of wool, sprinkled with fine sand or seeds, and excited with a trombone the bell of which is just above it. Another possibility would be to hold the soundboard in the same horizontal position (to hold the sand) by clamping it somewhere along an expected nodal line with a vertical G-clamp, grasping it with the fingertips at another point on a nodal line, and bowing the soundboard with a fiddle bow at a point on the edge far away from a nodal line.

There are several reasons for using such a method of visually displaying plate resonances:

1. If it has been decided (on purely aesthetic grounds) that a particular instrument's acoustics are desirable and one wants to duplicate them, and one assumes that these acoustical properties are embodied in the soundboard (plus perhaps also the back), one determines the resonance modes on the desirable original soundboard (and perhaps back) when separated from the rest of the instrument, and then uses the plate-resonance method to monitor the carving and thicknessing of the copy, attempting to duplicate the resonance modes (i.e. patterns of nodal lines and the mode frequencies) of the original. This method will compensate for differences in stiffness between the wood of the original and the copy, but not differences in sound absorption.

2. If one wants to maximise the power output from a particular soundboard (and we cannot be certain about when early makers had this goal in mind), and one assumes that what happens with violin plate tuning is relevant, then one can adjust the thicknessing of the soundboard and its barring to get a particular "ring mode" where
the only nodal line is a closed curve with the bridge position inside.

3. The symmetry of the nodal lines of various modes can be used to monitor the symmetry of thicknessing and arching (but it seems that this is much more sensitive to asymmetry in the latter than in the former).

4. Since the intention of the instrument maker is to build a machine that makes beautiful sounds, and the main part of the machine that throws the sound into the air is the vibrating soundboard, it is fascinating to see how that soundboard can vibrate.

Our experience is with English viols patterned after the John Rose in the V&A Museum, using measurements of soundboard shape, thicknessing and arching made by Stephen Gottlieb. The soundboard thickness is about 3mm all over on a soundboard 79.8cm long. It is made of 5 pieces or staves, with the central stave planed flat and bent to the curve of the longitudinal arch before jointing and final carving to thickness.

On the last soundboard we tuned we decided to look at the vibrating modes as we were thinning the soundboard. At about 4mm thickness all over there were three main modes at frequencies about 90 Hz (Fig. 1), 135 Hz (Fig. 2) and 150 Hz (Fig. 3). The pattern of the first was twisted somewhat to one side but the other two were quite symmetric. To test the effect of thicknessing on the symmetry, we thinned half of the soundboard down to 3mm. It did not affect the shapes of the patterns in any noticeable way. This leads us to suspect that the arching is the important factor in pattern symmetry.

When thicknessed evenly down to about 3mm, the three mode frequencies were at about 85, 125 and 140 Hz. The second mode then took the shape of Fig 4. On previous soundboards we had found that the second and third modes generally look like Figs. 4 and 5 respectively. By judicious placement of plasticene we could lower the frequency of the highest mode and raise that of the middle mode, and when they meet we get the "ring mode" which looks like Fig. 6. The upper bout switches to the ring-mode shape before the lower bout. When we glue in a bass bar the frequencies of both modes increase. The second changes frequency faster with differences in bass-bar depth than the third, so with an over-deep bass bar the second mode has higher frequency than the third. The process of tuning the soundboard involves cutting down the bass bar till the frequencies are the same and we have the ring mode.

The ring mode involves the same type of soundboard flexing (ignoring the soundpost) as happens in the main soundboard resonance mode when glued on the instrument, but is at a frequency about a fifth lower. That main resonance causes the wolf when too strongly excited. One might expect that soundboard tuning would thus increase the tendency to wolf in the assembled instrument, but we seem to have no problems with wolves so far. The distorting effect of the soundpost on the soundboard vibration may be involved here.

APPENDIX. A kind of scheme which ties together our results and those of others is as follows:-

Let us first consider that the soundboard's fundamental modes fall into two classes. "Bell" modes have the antinodes (i.e. the lines of maximum vibration amplitude) radiating out from a central point, and "bar" modes have the antinodes running in an essentially parallel array. When excited by a range of frequencies (like giving it a knock), a soundboard can vibrate with more than one mode at a time. When this happens the amplitude of each pure mode just adds its contribution to the combined amplitude at each point. If excited by a single frequency, more than one mode can add together only if all of them have nearby resonant frequencies. The higher modes we observed on viols include bar-mode components, but the lower ones which we work with involve only bell modes. (There is an ambiguity since the first pair of bell and bar modes are identical.) Let us designate each bell mode by a number which is half the number of antinodes one encounters during a circuit of the periphery and a letter which is "a" if an antinodal line coincides with the soundboard central axis, and "b" if one
About Felix Raudonikas' comments on Comm. 145 and Comm. 90. I have read in bulk. It seems useful to add some more comments. First, about the method spoken about, I think it is necessary to let the priority to Paris upon somebody else: the important fact is that it exists and is used for investigation on musical instruments.

As Felix asks me some questions, I shall try to give him some ideas which have come to me as I am now working on the acoustical problems of Renaissance double-reed instruments for a thesis. Felix's conception of "absolute pitch height widebandness" in regard to changes of reeds seems to me a little artificial since the pitch depends not only on the reed used, but especially on the way of blowing the instrument. I have personally recorded in my experiments that the same instrument blown with a wind cap or a 'pirouette' or the reed alone has different 'freedom frequency bandwidths' according to the blowing technique, the smaller with a wind cap and the wider with the reed alone. Another experiment shows without any doubt that changing the reed on a given instrument changes the pitch of the 2nd octave in regard to the 1st one: i.e., the tuning of the partial 2 is higher or lower than that of the fundamental according to the size of the reed: so, if we go on, it is clear that the reed (s) which gives a good tuning of octaves indicates the pitch (at a precision of about less than 1/4 of a tone or 5 savants) in which the instrument was probably built.

The publications in the Newsletter shall call R. Their difference is minus Rb is mode 2a. The other a modes added in nodal pattern. The first 5 pairs of bell modes are shown in Fig. 7, with lines denoting nodes and the + or - designating antinode phase. Modes 1a and 1b are also bar modes and they differ from the other bell modes in that they have high-amplitude motion in the centre. The mode for this is minus 1b is mode 2b. The other a modes added to and subtracted from R are shown in Fig. 9. On our violin soundboards we have seen a weak 1a and as mentioned above, R and 1b.

In our tuning procedure we add R and 1a to obtain R. The basic work on resonance modes of violins has been done by Carlton Hutchins and her colleagues in the Caedig Acoustical Society. The publications in the Newsletter
played, it partly answers the first question raised by Felix. And so it seems that
his second question is secondary, at least on instruments which overlap at
the opposite this second question is very interesting for instruments with a
cylindrical bore such as crumhorns and rackets, on which reasonably tuned scales
are obtained within a minor third sometimes... when changing reeds and staples.
As a matter of fact, I must say that I don't agree with Felix's statement 'As for the
reeds breaking the integrity of frequency ratios between modes... this problem
concerns the sphere of correct reed-making, rather than the investigation of instru-
ment pitch.' I have partly discussed this above, but I pray Felix to refer to my
Handbook of Renaissance Reed Making (with English text) which will be published
in next June (in principle!). After having made hundreds of reeds (large, small,
thick, thin, and other variations of their geometry) and tried them on many kinds
of instruments, it appears that for a given instrument a single design (or many
but in a very narrow range of uncertainty) gives a well tuned instrument on 2 octaves.
This is peculiarly true for shawms and Hautbois du Poitou (capped shawms) and
partly for Rauschpfeifen. But of course, it is less true for cylindrical-bored
instruments as I said above.
It is otherwise obvious that the staple(s) joining the instrument to the reed has
a prime importance but its selection is as great a problem as the reed itself. For
my own sake, I have not yet heard of any valuable literature upon this topic con-
cerning Renaissance instruments. My way of doing it is both based upon mathemati-
cal and experimental principles which can be found in any good book dealing with
musical acoustics, but I have my own ideas which can't be said yet, because of
many experiments I have not yet made and which are needed.

Talking of this, I have read Dave Skulski's fight story with his crumhorns. I must
say that I've found it rather fun (though it is a critical problem) but I can per-
haps give him an explanation: roughly speaking, cross-fingering is conditioned by
the ratio of the bore of the finger-hole. So, on cylindrical bores especially,
the cross-fingerings are efficient if this ratio is about 2.5 or more. In that way,
original crumhorns having a fairly narrow bore and fingerholes rather large in re-
gard to that bore don't cross finger. But some Körber and Moëck crumhorns, with
very small finger-holes can cross finger... even with a plastic reed! If we accept
this idea, it is obvious that genuine Renaissance crumhorns were not meant to
cross finger... as it occurs on rackets and similar instruments. It is a property of
the pipe and not of the reed; but on expanding bores, the problem is more diffi-
cult since all the parts of the pipe react with the hole. This problem is for the
moment under study, because the tuning of the octave can be changed by undercutting
or so and the data are not exactly the same.

Jacques LEGUY
"MAKING MUSICAL INSTRUMENTS". Faber and Faber have very generously agreed to give FoMRHI 3 copies of this book, which correspondingly led to 3 reviews in this issue. In the same spirit we agreed to enclose copies of their leaflet. Though we are full of high principles we are not above engaging in deals like this if it is for the common good.

CONTRIBUTIONS TO FoMRHI. PLEASE read the Notes to Contributors on the back page before preparing your Comm. Today I am cursing one fellow whose Comm. has had to be put sideways because he didn't take note of point 2. Tomorrow our printers will be cursing several others of you who haven't taken point 4 seriously enough.

In future, in order to keep within our postal budget we are going to have to limit each issue to 64 pages. (This Spring issue falls within the next postal range because of the Membership List and can be bigger and still come within that range.) We'd hate to have to postpone anyone's Comm. due to lack of space, so please try to present yours as briefly as possible - a minimum of surplus words and blank paper, and let's hope there will still be room for everyone.

GLUE. A visiting instrument maker remarked that a new fast-setting white woodworking glue made by Bordens which is available in the shops around seems to be identical to Titebond. Have others tried it? Do they agree?

PLANE BLADES. Martin Edmunds is having some toothed blades made which will fit the Stanley 09½ block plane, price hopefully around £3 to £4. Anyone interested contact him.

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