

# FOMRHI Quarterly

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CONTINUED ON BACK COVER.

Fellowship of Makers and Restorers  
of Historical Instruments

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With this issue you will find the request for 1979 subscriptions. We think that we can afford to keep them the same as last year; provided that there are no sudden increases in paper/printing/postage costs, we should be OK, so let's all hope for the best. In case you lose the separate sheet, the rates are: UK/Europe £3.50, overseas £5.00. A new service available by special request from a few members: Airmail to Europe for £1 extra (£4.50) - it seems that the surface mail we use can be slow to some countries, so if yours is among them, please send the extra pound if you want to get your copy as soon as they do in America or Australia. Also by request our bank account number etc is: 6025878. The name of the bank is Clydesdale Bank Ltd, 30 Lombard Street, London EC3, but do NOT send subscriptions directly to them and do NOT allow your bank to do so; if you do, I won't know that you have paid and you will not receive any FomRHIGs.

The following methods of payment work: 1) your own cheque, made out to FomRHI. If paying in currencies other than sterling, please add 7p (about US \$1.50) for bank charges for conversion. 2) GIRO cheque through your and our post offices; they make no charge at this end for currency conversion, so don't add anything. 3) A Bank draft, ie a cheque sent by your bank addressed to their London branch, made out in sterling. Again they don't charge at this end, so don't add anything. 4) Eurocheques. They do charge for conversion, sometimes quite a lot, and they seem to take months to clear, so do add at least 75p (see 1 above) for conversion. This method does not seem to be very useful, so it should only be used if it is a lot better than 1-3 at your end. 5) Cash. Not to be encouraged for several reasons: it is illegal, there is no redress if it gets stolen on the way, I have to take it into town to get it changed. Only worth using if all the other methods are too difficult. Again please add something for conversion (ie round up the total, rather than rounding down); I can't say how much because the exchange places vary in their charges.

If you have any friends in countries which are forbidden to send money out, you are welcome to pay their subscriptions. We have quite a few such members, and also some that FomRHI has paid for out of the profits of the 16th century Seminar; that profit is running down and anyone who is feeling generous and would like to support such memberships would be greeted with thanks from this end.

Do please remember to send in your subscription. Each year so far we have wasted between a dozen and twenty subscriptions reminding people that they have not paid. This is not fair to those who do pay, but equally it seems wrong not to remind people. If you have not paid by January 1st, you will be wasting some of your sub.

APOLOGIES: Once again we're late. My fault (or to be more exact, David & Charles's - they suddenly decided that they wanted the next book a year earlier than they had said originally) as a book had to be finished before I could think of this. We do try to keep to deadlines, but it's never easy with things like this which get done in spare time.

Apologies also to anyone who had blank pages in the last issue, FomRHIG 12. I have spare copies of the sheets that we heard about; if you have a blank and haven't told me, please do so and I will send a replacement sheet; tell me which pages are blank, but don't send the whole issue.

CHANGES in FomRHIG: Everybody who wrote said don't change. Improvements are desirable and so is legibility and the avoidance of blank pages, but the informality and so on seem to be what you like. Anybody who wants to include the proper apparatus with their Comms. (footnotes, bibliography,

etc) is welcome to do so, and anyone who just wants to say 'this is how I do it' is equally welcome. Do look at the Notes for Contributors, though, as it makes our work easier if you can conform to them. One particularly interesting reply on this matter, from John Rawson, will be found herewith as a separate Comm. in the hope that it will persuade others of you to get down to writing that note you keep meaning to send us.

NEW FELLOW: Pat McNulty has been elected.

ANOTHER SEMINAR: Tim Hobrough suggests that we should run a Seminar on the history of science and technology, and their application to musical instruments, perhaps in conjunction with some other organisation. Has anyone any ideas on this? We would need people able and willing to talk on all sorts of subjects (metals, wire and wire-drawing, gut (including the problems of animal feeds and their effects on the guts), availability of arundo donax and/or substitutes for it, woods and seasoning methods, and no doubt many more; these are what occur to me as I write). Who would be interested to talk, who would be interested to listen? And who would be willing to take a piece of wood, for instance, and start hollowing it out or shaping it to show what can be done with an adze or a bow-lathe (I sometimes think that one of the reamer problems is that all our machinery goes too fast; a bow-lathe might allow one more control. See, for instance Laurence Picken's descriptions of Turkish flute and shawm making in his Folk Musical Instruments of Turkey; it's a lot nearer to what happened in the Middle Ages and Renaissancethan most of what goes on now. Or am I talking through my hat? I suspect I may be right; Paul Hailperin says that he had two oboe da caccia bells made by spinning and two by hand-hammering to the same dimensions; the bell is a fairly small and simple part of the total oboe da caccia, and yet the difference in tone quality is enormous". I was unkind enough to ask which sounded better; he replied: "Of course the hand-hammered bell sounds (to my subjective ear) far better. Maybe some would prefer the spun bell. I note that some like to have a modern horn bell annealed. But the point is, there is no difference in the finished dimensions one would normally measure. There was a time when the difference in the dimensions of the crystals went unnoticed. The same applies, probably more subtly, to woodwind. There are also differences of 'finish' in oboes which I can clearly identify". Notice that Paul says nothing of the brass itself, and yet brass is an alloy consisting of what? I think that we could do with such a Seminar. Please write and say if you agree.

ASHMOLEAN MUSEUM: David Hill of W.E.Hill & Sons tells me that they are producing working drawings over the next two years of the majority of the instruments in the Hill Collection at the Ashmolean Museum. They have done the two John Rose viols and the Stradivarius guitar so far. They are using X-ray machines and electronic depth measures where necessary. He said that he would send me a note, but nothing has arrived yet; if it does, it'll be in the Comms herewith, and if not I'll ask for more information for January. He has not told me whether copies of the plans will be available from Hill's or from the Museum; if you're in a hurry write to either; otherwise wait for further news.

HORNIMAN MUSEUM: Access there has greatly improved. Harry Vas Dias says they rushed him through and only allowed him 5 hours with the instruments instead of 7, but a couple of years ago they turned him away, so as I say, access is much improved. Frances Cooper is in charge of the instruments and seems very helpful; she was at the V&A and there is now nobody there with any special interest in the instruments, but on balance the Horniman is probably the more important museum for us, so we have benefited by the change.

BRYAN TOLLEY asks me to thank everyone who helped to support his sponsored marathon for the school crumhorn fund; they raised £230 and were treated very generously and have got a complete set of crumhorns including a Moulder bass.

PAUL HAILPERIN asks me to say that the Zell in his new address (see List of Members Supplement herewith) is the one in Wiesental, about 35km north-east of Basel and that all are cordially invited to try to find him there (and his new wife). We congratulate him (on the new wife rather than on the new address).

DIVISIONS ask me to say that the first issue of this new periodical is behind schedule but all those who have expressed interest in it will hear from them as soon as it's ready.

COURSES etc: Uta Henning says that Walter Sallagar's course in Grossrussbach near Vienna in playing renaissance clavichord and regal and in making 18th century clavichords was very successful; something similar is planned for 1979 and details will be available from Walter.

Ian Gould has sent me a notice of a three day Ancient Music Gathering on April 7,8 and 9 1979 for all interested in playing, listening to and discussing music written before c.1750. Ian suspects that those for whom the course is ostensibly designed would be interested to meet makers, and probably vice versa. There is no charge for the course; food will be available at a reasonable charge; Ian might be able to help with advice etc. on accomodation. All interested should let him know and should write to the Music Organiser, Centre for the Arts, University of Aston in Birmingham, Gosta Green, Birmingham B4 7ET before November 30th, giving brief details of themselves (interests etc presumably) and a phone number.

The Early Music Centre have sent me their prospectus for this academic year. They are primarily interested in playing, of course (and singing and dancing) and cover very nearly all early instruments (no percussion and wind is covered by one course and I suspect really means woodwind). There is one lute making course under Michael Sprake. If interested, the address is: 62 Princedale Road, London W11 4NL.

TOOLS & MATERIALS: Vice: Tim Hobrough recommends a Fuchs vice with jaws that swivel through 360 degrees on a head that swivels through 360°, controlled by two of the best-made screws he's ever seen; he got it from Woodcraft in Woburn, Mass. He says that for anyone who does a lot of work with irregular shapes it's more valuable than three assistants and for a professional builder would pay for itself in a month. It doesn't have a bed to stop vertical movement, so that a large drill-press vice/pillar-drill such as Geoff Kime recommends would be more useful for drilling lute peg-boxes. The Fuchs is heavy and generally stays where it is put and is easy to move and it doesn't have that annoying side-to-side wiggle that swivelling engineer's vices do. He's been told that one can get a model with the capability of dropping the head sideways over the bench-top, but he's not seen one.

Saw-blades: Paul Williamson says that T.C.T.sawblades (Bull.11, bottom of p.10) can be obtained from Gomex Tools, Ltd, Orchard Road, Finedon, Northamptonshire, tel: Wellingborough 680492, who specialise in sawblades and router cutters and can supply blades of varying kerfs and tooth styles to suit different needs and also have an efficient regrinding service.

Götz: Fred Robin has sent their address, for purfling etc: C.A.Götz, Postfach 1709, 8520 Erlangen, West Germany.

Artificial Ivory: Stephen Taggart has been sent a sample from Catalin Ltd, Waltham Abbey, Essex EN9 1NL which he says is excellent; it is a cast phenolic resin. The trouble is that they have a minimum order of 23kg at £1.85 per kg. Anyone interested in going in for a batch with him should get in touch with him.

Bending Metal: Paul Hailperin sent me a leaflet from Cerrobend and a letter in which they say: "There are no health hazards in using this material so long as the melting temperature is kept around 100° C. which, if water is used as the heating medium, can easily be achieved. A maximum temperature of 150° C. should not be exceeded during the working process, for above this temperature drossing may occur, which will limit the life of the alloy and also cause the alloy to give off a small amount of fumes....so long as the working temperatures are kept to a minimum and no other alloy or metal is added to the Cerrobend, it can be used continuously without need of replacement."

Cary Karp says: "The 'Concise Chemical & Technical Dictionary', 3rd edn, H.Bennet ed, Chemical Pub.Co., N.Y., 1974 lists the formulation of Cerrobend as 50% Bi, 27% Pb, 1% Sn, 10% Cd. It also lists Wood's metal as 50% Bi, 25% Pb, 12.5% Sn, 12.5% Cd. The melting point of both is given as 71° C. (Does anyone know if there is any practical difference in usage?)"

The Cerrobend leaflet gives the melting point at 70° and stresses the importance of quenching it; if it is allowed to cool slowly, large crystals form and then it won't bend properly. If you are going to use Cerrobend (but read the next paragraph first), this leaflet will be useful to you. It is called: Properties & uses of Cerro Fusible Alloys, and (there are two) Tube & Section bending, Information Sheet No.1, and they came from: Mr.L.G.Morrison, Production Manager, Mining & Chemical Products Ltd, Alperton, Wembley, Middlesex, HA0 4PE; their German associate company is: Hek GmbH, 2400 Lübeck, Postfach 1810 and they can supply German language versions (Mr.Morrison was writing to Paul in Vienna; there are probably other languages available also).

Cary adds: "Anyone who will trust manufacturer's assurances that their poison containing products are 'safe when used as directed' has only himself to blame. I certainly wouldn't hesitate to use Cerrobend instead of molten lead to reduce health risks, but I wouldn't try to convince myself that the former was risk free". I would add to that that I agree with Cary (both Cerrobend and Wood's metal contain, as you see, lead and cadmium) and that the low melting point is a very considerable risk reduction - I have melted lead on the kitchen stove, and I have had it spatter when I made a mistake; I have also melted Cerrobend sitting in a tin in a saucepan of hot water and when that spattered it was no worse than putting a hand in a bath that was too hot. Cerrobend and Wood's metal are more expensive than lead but they are nearly as heavy and so much safer that I'd have thought them better than lead for almost any job, include keyboard weights. It is worth remembering that Cerrobend expands on cooling and will therefore not shrink and fall out of a key etc and that if one needs to remove it, one can put the key or whatever into hot water and melt it out that way. But remember what Cary says: it's safer than lead but it is not safe.

Further comments on this and other materials will be welcomed; we like having you as members and the fewer of you who are poisoned/cut/electrocuted/etc, the better.

FURTHER TO: Bull.12, p.8, query on clavichords: Anne Frazer Simpson says "Buzzing/fluttering may be attributable to performer, not instrument. Given a relaxed low-wrist position, direct, sensitive and infinitely adjustable fingertip/string contact is possible. Much buzz/flutter is caused by ricochet effect induced by hit-it-from-above pianistic technique, or as Howard Schott has it in his 'Playing the Harpsichord' (Faber, 1971): 'Dive-bombing the keyboard generally does not work'." To which I'd add that when I taught myself on a rather unresponsive modern instrument, I found that playing on the front of the keys worked much better than playing on the back; I didn't mention this before because I thought it too obvious.

Comm.84, Bull.11 p.5, Bull.12 p.4: Paul Hailperin writes:

"Both in the GSJ and in POLRHI, Cary Karp speaks of tool marks. I hope he hasn't cut open the Haka oboe. This is the only way you could normally see tool marks in the upper joint of any oboe, otherwise you are only peering along the bore at a very steep angle, chewing out the points where a different surface texture gives a different light scattering or where a change in taper gives a marked difference in angle of reflection. These are features very easily created with a "complex", or perhaps inaccurately made reamer. The steep viewing angle makes any slight discontinuity of taper seen sharp. I would also point out that there are a number of excellent oboes, though a minority, with perfectly straight taper: C. Schlegel in the Basel museum; P. Paulhahn belonging to M. Harnoncourt; and if I remember correctly, the top joint of an oboe by I. Denner in the Germanisches Nationalmuseum, MIR 370. Also the oboe d'amore by I. Denner in Cincinnati. It certainly would be strange if the long straight sections in these instruments were made with multiple reamers. This aside: Cary has clearly shown with the Golde text that at least from the 19th century on multiple reamers were used. I certainly would not claim that this technique was not used earlier, but it was not used exclusively - even by excellent makers - and I wonder if the drastic narrowing of the bore (which occurred as the result of a continued gradual narrowing over a long period of time) might have made the bore in Golde's time more sensitive. The straight taper bores mentioned above, on oboes with excellent tone, belie also Golde's insistence on forming the bore packig oder gewölbt. Many of the tuning and voicing operations Golde talks about, I do by manipulating the undercutting of holes; N.B. on wide bore oboes of an earlier type. By "manipulating" I mean adjusting a great number of variables on a free cut form, not just cutting in more with a fraise, and so I also wonder if the introduction of the fraise for undercutting perhaps reduced the flexibility of the maker in tuning an instrument and made him more dependent on adjustments to the bore. The earliest instruments I know where a fraise was clearly used, are traversi by August Grenser. On the subject of adjusting bores, I would like to point out that I do this frequently by sticking a layer of paper to the rounded side of a long reamer at the point where I wish to enlarge the bore.

Cary's article in GSJ XXXI: p. 11 'Values obtained near finger holes and other local irregularities...' On a smallish instrument like an oboe, there are few points which are not near a finger hole or a tenon or an irregularity in the wall thickness.

'If this results in an unacceptable fit between the extrapolated tenon bore and the bore in the adjacent joint...' What is unacceptable? One should be aware of the fact that there are cases of oboes where the bore at the top of the middle joint is much narrower than the bore at the lower end of the top joint, e.g. the oboe by I. C. Denner in Venice, and the tenor oboe by Hummel in Basel."

Cary Karp replies:

Fortunately for the Haka oboe there are ways of examining a bore surface for tool marks other than the one which Paul regards as normal. The upper joint of an oboe may be very narrow as woodwind bores go, but it is not by a longshot the narrowest tube for which endoscopic examining devices are available. Despite this, I will agree that peering into the upper joint of an oboe usually won't reveal much in the way of unambiguous tool marks. Simple examination of the lower joint, however, very well may. If, for example, there are sharp and clear lines of transition between one reamer and another in the bottom joint of an oboe, there is good reason to believe that the instrument was made by the use of "multiple reamers". The appearance of the upper joint bore won't alter this fact. If, however, the "light scattering" characteristics of the upper joint bore can conceivably be interpreted as indicating the use of multiple reamers, and the lower joint bore does indicate their use, it would appear all the more likely that the entire instrument was made with multiple reamers. It should also be noted that the existence of a few older woodwinds with "perfectly straight taper" bores says absolutely nothing about the techniques which were used when making instruments with complex bore profiles.

Tool marks generally include more than differences in bore surface texture and rings of demarcation between different reamers. If, for example, a reamer is used to remove a small amount of wood from a short segment of the bore it will often leave a spiral track. There can be several such helicoid marks on a bore surface and unless their periods are identical they will give positive evidence of the use of multiple reamers.

The most convincing way that I can suggest for checking out an individual maker's practice is to compare the bore profiles of several instruments of the same type. If the number of simple-curve segments of the bore remains constant but the relationship of the segments to each other varies, it is highly unlikely that single complex reamers were being used.

As far as I know, 18th and 19th century woodwind reamers were always forged. Tools survive, and there is iconographical evidence as to their configuration. High-precision turned metal reamers, or for that matter "wooden" reamers, seem to be relatively recent inventions. What direct evidence is there for the use of complex reamers in pre-20th century practice? The facts that excellent instruments can be made by their use, and that not all older instruments have complex profiles are totally irrelevant to this point.

As to Golde's practice: The toneholes of the Golde instruments in Stockholm were undercut freehand and his text also refers to this practice. Thus, Golde was tuning and voicing both by bore adjustment and free-form tonehole undercutting. I would be hard put to describe the bore of Golde's oboes as drastically narrower than a typical early 18th century oboe and doubt that he was much more obligated to fine-tune the bores of his oboes than Haka might have been. The tool marks on the bore of a Golde oboe in Stockholm are, by the way, considerably less well defined than those in most earlier instruments, including the Haka oboe.

The "continued gradual narrowing over a long period of time" of the oboe bore seems to me to be prime evidence of controlled bore manipulation long before Golde's day. It would thus seem nearly impossible that all of a sudden in the 19th century oboe makers became aware of a necessity for tuning and voicing their instruments through bore chambering, etc. As nearly as I can judge, bore chambering and free-form tonehole undercutting were both standardly used techniques from at least the end of the 17th century through well into the 19th century. The fact that some makers may have preferred the one technique to other makes little difference.

As to the GSJ articles: p. 11- The irregularities are those of bore surface ("bumps and pits") not wall thickness. The total surface area of an oboe bore is much larger than the surface area of the tenon bore plus the area of the "holes" in the bore surface. With the exception of data points which are lost in the toneholes themselves, and tenons, the matter is of little consequence. p. 12- Examples of unacceptable fits: 1) The extrapolated tenon bore results in an outside tenon diameter which is larger than the socket. 2) The step between the bores in the adjacent joints is in the wrong direction; e.g. a wider oboe upper joint bore fitting into a narrower lower joint bore.

My thanks [jm writing now] to Cary for typing this out - it helps when there are long comments to be able to stick them straight in like this instead of having to type them myself. Can't anyone else join in this correspondence; surely Paul and Cary aren't the only ones with opinions on this matter?

Comm.99: Charles Johnston writes: "The traditional way of treating violin family timbers is to dip the ends about an inch into a tin of molten paraffin wax. A worthwhile precaution to prevent insect and mould damage is to spray before storing with 'Dipsar Clear' from Wykamol Ltd, 21 Hyde Street, Winchester, Hampshire. This treatment does not affect gluing or varnishing but is a little dear at £17 for 5 gallons."

Comm.119: Rod Cameron came round with his new electronic bore measuring apparatus (a very impressive gadget which I hope he'll be describing for us when he gets home from the tour he's on round Europe) because we thought it would be interesting to compare the figures he got on my Stanesby with those already published in the Comm. referred to. He says on the tone-holes and embouchure: "blow hole undercut 11° front, 9° back. Tone holes, from top: 1 heavily undercut, 2 and 3 similar, 4 and 5 medium undercut, 6 lightly undercut; all about as usual for a one-key flute."

While he was at it I noticed (for the first time!) the alignment of the maker's stamp (Halfpenny type 4 or 6, GSJ 13; the same as Brügger's flute in Langwill 5, p.222). This not under the embouchure but about 15° round the head, so far as I can judge by eye. If all the maker's stamps are aligned (and I am sure that this was intended) and the hands held in what seems to be the natural position, the embouchure is turned well towards the face, resulting in a very covered embouchure and a pitch of around A-415, thus re-opening the whole question of the pitch of this instrument and of whether it was cut down. I would be interested to know whether anyone else has met flutes with offset embouchures/makers' marks; no others in my collection have these. And I would also be interested in experienced baroque flautist's reactions to this instrument with the embouchure position which this alignment suggests.

Comm.131: Cary Karp says that the German periodical *Maltechnik/Restauro* vol.84 no.3, July 1978, has an article by Ruth Vuilleumier on 'Historische Holzbeizen' (The Development of Wood Stains) and he has sent me the English summary of the article. He says: "... a thirty page article on the kind of wood-staining technique that has of late been discussed in *FoMRHIQ*, plus a twenty page third article in a series on Historical Varnishes and Polishes, part 2 of which (last issue [presumably it's a quarterly, jm]) dealt specifically with musical instrument instrument varnishes. That issue also contained a long illustrated article by Friedemann Hellwig on the Radiographic Examination of Musical Instruments [doubtless you are all aware that the Germanisches Nationalmuseum, Nürnberg, at which Friedemann Hellwig works publishes a series of X-ray photos of their instruments, jm]. Issue before that had the first of the varnish articles and a long article (illustrated) on the history of veneering immediately applicable to keyboard instrument veneering. Anyone who would still argue the need to follow conservational periodicals should at least consider subscribing to 'Studies in Conservation' if for not other reason than to get the 'Art and Archaeology Technical Abstracts' (twice a year, current issue 477 pages) in which 'Maltechnik' and everything else under the sun is abstracted. If all instrument people should read GSJ, all restoration/conservation people should read AATA." Judging from the English abstract that Cary sent me, anyone working with stains should read that article.

Comm.140: Stephen Taggart says that you can save materials by turning lute pegs from a flat billet [rectangular section]: "'head' end to be gripped in 4-jaw chuck or in block of softwood screwed to face-plate and morticed (shallow) to receive billet. If you turn your tapers first, to match the reamer, then the procedure is to turn a thick disc of softwood to a cone, on the face-plate, then drill it centrally in the lathe, and ream the hole out to take the tapered section of the peg already turned. (re p.32, lines 5/6, I always turn highest reliefs first, to avoid mistakes) For turning the tapered part a short 'cut-down' tool rest is useful, for then a revolving back-centre can be used, which lessens the chance of splitting the workpiece. I would add that if the decision is to save material and use oblong section billets, then very light cuts have to be made when turning the head or it will split badly. If concave bevels are needed, the easiest way is to stick some fairly coarse abrasive paper, green grit seems best, to a dowel of suitable diameter. If a long thin

strip is wrapped round in a spiral, then there is no seam. The abrasive dowel can then be spun in the lathe and the peg heads can be touched against it till the required bevel is achieved."

He adds that he has just drilled a  $5/32$ " hole down a 15" long dowel of lignum vitae  $7/8$ " round (surely he must mean diameter? perhaps not) with only a slight deviation from true over the whole length, by running the long drill, a twist drill silver-soldered to a silver steel rod, in an electric hand drill while the work piece was spinning in the lathe in contra-rotation. The drill runs through a female centre which must be drilled to the same size as the bit.

Comm.145: Jacques Leguy writes:

The method described is well known in France (Laboratoire d'Acoustique Musicale, Université de Paris VI) and the band width available on each fingering is here called 'frequency freedom bandwidth'. But its use is subject to discussion (apart of the player himself who does what he can on any instrument.) especially on double reeds instruments and on cornettlike instruments, the frequency bandwidth being able to be up to 1 octave on cornetts! Furthermore, some experiments have widely shown that this bandwidth is modified with the characteristics of the reed, and especially the 'tuning' of the partials (especially the octaves) according to the scraping of the reed which can give, everything else equal, octaviations too great or too small as intervals. This shows that the theory of conical pipes with (finger)holes is only valid for an excitor being of a weak energy against the standing wave in the pipe, which is nearly the case for a recorder or a flute. But for a reed pipe, this method is not the solution for knowing the pitch of an original instrument: I managed, in some collections, to make such or such instrument to sound one full tone higher with a small reed than with a great one, the whole range being in tune in each case! So the problem stays for the reed instruments, except perhaps for the cylindrical bores which are more influenced by the bore itself (crumhorns and so), because a long narrow bore has a great effect on a reed and obliges the reed to vibrate according to the pipe and not to the fancy of the reed. Anyway the discussion is open ... I wait for more information.

Comm.146: Paul Hailperin writes: "I would not want Bob's prayer rug to come flying at me, but I do think he grossly under-estimates the influence of 'processes' on the musical properties of an instrument, on the tone and playing qualities. It may well be that a recorder bore is less sensitive to finish than an oboe bore (which is proportionately much narrower) and a recorder is certainly less flexible in pitch, which may account for Bob's greater interest in reasonable dimensions. On an oboe the performer can correct a large degree of mistuning, but poor tone and response can never be completely masked. It is easy to build an oboe that is at least as well in tune as many of the oboes by the old masters (sorry Bob!) and which suffices in this respect for concert use, but contemporary makers are hard put to come anywhere near the tone and response of an average museum oboe. And this tone and response is, according to my experience, dependant to a large extent on the 'finish' of the instrument. Makers of string instruments, stringed keyboards and brass instruments have told me of similar experience. I have two oboe da caccia bells made by spinning and two hand-hammered to the same dimensions. The bell is a fairly small and simple part of the total oboe da caccia, and yet the difference in tone quality is enormous."

Paul adds (which I should put in as answer to a query above): "I make narrow conical reamers the same as for wider bores, and I assume the same applies to those who prefer multiple reamers. One obvious point is that you don't have the choice of making a wooden reamer. For a soprano shawm I divide the length into two parts, making the reamer for the narrow part in steel and the wider reamer in wood. Cf. Bob Marvin's coming comm. on him."

Comm.149: In my review of Mary Remnant's book I commented on the quality of the illustrations, or rather of the way in which they had been printed, and in my review in *Early Music* I suggested that readers should tell Batsford what they thought of them. I had a letter from Uta Henning saying that she had done so and enclosing a copy of the letter that they had sent her in reply. They say: "...It is also the case that the offset process by which the book is printed does not permit the same clarity of definition as the letter-press method which has now become unacceptably expensive. Taking it all round, however, we were ourselves not displeased by the general standard of the printing". They then had the impertinence to congratulate Uta on "the impeccable quality of your English" - a pity that we cannot congratulate them on the impeccable quality of their printing. Clearly there is nothing that can be done about this; publishers are going to use the cheapest methods that they can get away with, and I only hope that David & Charles do me better than Batsford did poor Mary, but unless and until every dissatisfied purchaser complains they will go on producing lousy plates. And I don't believe him when he says that it happens because of offset printing; plenty of other books have been printed with this process and good plates, and this includes books like mine and periodicals like *Early Music*. We are all customers and customers have some rights; if you don't like what you get, complain.

Uta also sent me some comments on the viola pomposa (p.57 in Mary's book; see p.48 in *FOMRHIQ* 12). There was a violino pomposo, roughly a violin with a low C or a viola with a high E, whichever way you like to look at it; either way a combination of the two instruments. There was also a viola pomposa with a low F or G, the instrument I referred. But Uta, like Sachs in the *Reallexikon*, equates this with the cello piccolo, which was in fact quite different in that it was a cello with a high E.

OFFERS: Harps: Tim Hobrough has measurements of several triple-strung and three double-strung harps and anyone interested is welcome to get in touch with him and copy them out. Telephone him first - 01-994 6477. He is trying to organise them for publication and apologises to the owners and to anyone who has already asked for help for having had insufficient time to do so.

Lute, viol, violin plans: Ian Watchorn will soon have plans ready of a 17th century Italian viol (Sydney), a 5 course guitar (Perth) and an 18th century German violin. Note his new address in this issue.

Plan drafting: Larry Lundy says that I should not have listed him as offering plans; what he offers is to draft plans for any members who have data but not drafting skills - limited to strings, preferably lutes.

Comm. preparation: Pauline Dürichen offers minor editing (spelling, grammar etc - she is an English graduate (subject not country)) and facilities for getting a nice dark printout. She "regularly uses a computerized text-formatter called 'SCRIPT' which will conform exactly to your guidelines. The offline printer used in conjunction with the computer produces a dark and elegant print-face and I will have enough computing time to do a few communications in time for the December issue. Costs would cover only my time and effort since I have a student computing allotment; I'd estimate no more than \$1 Can. perpage."

REQUESTS: Viols: Peter Tourin called in here and left me with some copies of his request sheet for information on viols. We did print an abstract of it in *Bull.3*, but he is still seeking information and I think we have room here to include both sheets. Since he makes copies of the computer print-out available to everyone, it is really worthwhile sending him all the information you have. We could do with people who would do the same job on other instruments. See his note elsewhere in this issue.

Bibliographies: Ricardo Brané feels that "nuts & bolts" Comms don't often appear, and are of limited use unless they are very long and detailed; much of the information is already available [I'm not sure that he's right there, jm] and that would be more useful would be more bibliographies like Eph's on the lute in PomRHIQ 2. "Much has already been written on instrument making, books and booklets, articles, notes in magazines, etc, only they don't know it. There are handbooks at all levels on wood, varnishes and varnishing, wood turning, whatnot, that often teach more than many instrument makers know (me included), only they haven't thought of it, and there are bookstores in London or in Boston that will send you any book anywhere in the world. It sounds more difficult in this way but it isn't, and I am firmly convinced that that is the only way of acquiring knowledge, earning it." And he asks whether we could not provide more such bibliographies which would list such books. Who will compile them for us? It's not the first time that we have been asked for bibliographies, but nobody except Eph has produced one. Personally I think that we need the nuts & bolts Comms as well, because they so often include the odd tips and ideas which makers have learned for themselves and which help to cut corners and lead to safety, and also on so many instruments we are only beginning; on my own instruments, several makers produce far better drums than mine, but none of them have told us how they make them; perhaps now that Paul Williamson is a member he will give us some details!

QUERIES: Flutes: Filadelfio Paglisi has finished measuring all the 24 renaissance flutes surviving in Italian collections and would like to do the same to all those surviving elsewhere. Would anyone who knows of such instruments let him have the details? He knows that Eric Halfpenny's bass now belongs to Bob Rosenbaum, and presumably he knows of the Brussels Rafi. He would like to be in touch with any researchers or performers on the renaissance flute.

Harps: Tim Hobrough asks whether anyone can suggest why the old harps are all black or very dark brown when they're mostly made from light-coloured woods? "Renaissance harps I'm talking about, not the later ones. Would this be from intentional staining, and with what that would not be worn off where the wood has been worn away from centuries of use? It would have to penetrate awfully deep. Or is it years of fish-oil or beer?" My own guess is that the harper sat next to the fire so as to keep his fingers warm enough to play and that he and the harp got kippered.

Ranworth Antiphon: George Higgs asks whether anyone has looked at this. It is in St.Helen's Church, Ranworth, near Norwich and looks as though it might repay attention. The date is 1440-60.

Perseus freeing Andromeda: Neil Buckland asks whether anyone has noticed the instrument being played by a dark-skinned man towards the lower right of the painting of this name by Piero di Cosimo? "It looks a bit like a combination of a bladder pipe and some kind of lute, the pipe's holes being fingered with the right hand and the strings plucked with the left, while a long crook leads from the player's mouth to the bladder.... The instrument appears to have remarkably realistic details."

NEXT ISSUE: Deadline for this is Tuesday, Jan.2nd. Remember that you won't receive it unless we've had your subscription renewal.

Jeremy Montagu  
7 Pickwick Road  
Dulwich Village  
London SE21 7JN

Just as I had finished everything and was about to send this off, a letter arrived from Helsinki, from Peter and Tina Tourin who have just been in Leningrad and Moscow. No news from Moscow, but several details from Leningrad, where there are many viols: several trebles, several basses, a

pardessus; no tenors except for one big instrument which could be used as a high tenor. Most of the viols are easily restored to playability, but all are strung with metal strings because no gut strings are available, and tuned way down to protect them. There are beautiful bows, including an ivory bow which actually plays. Peter has black & white photos of all the viols, which a friend of Felix Raudonikas took for him.

Felix does all the wind research in the museum with an audio oscillator and a frequency counter; all calculations have to be done by hand because there are no pocket calculators available. His wife, Natasha, is an organist and he plays flute. Felix has made a treble and bass rebec which a violinist and cellist from the opera are playing with them, but again they only have metal strings and very little music to play. Only modern bows, too. There are no instruction books for any early instruments. Peter is going to see whether he can send Felix any music or strings, but posts are not very reliable. If anyone knows of anyone who is going to Leningrad, will they please get in touch with Peter and me, and also with Eph and Djilda, and we'll see if we can make up a parcel of useful odds and ends. Anybody who wants to chance posting music or anything else to Felix would be much appreciated. Don't worry about duplication - early music does seem to be getting under way there, and I'm sure that Felix would be able to pass any duplicates on to other groups. We found a good deal of interest when I was there with Musica Reservata and it does seem to be spreading. The music they need is for consorts of 4-6, including keyboard.

Peter has brought out a couple of Comms. from Felix; if they arrive in time, they'll be in this issue, and if not they'll be in the next.

#### BULLETIN SUPPLEMENT compiled by Djilda Abbott

MY APOLOGIES. Jeremy wasn't all that late with the Bulletin. Most of the lateness this issue is due to me. Last week I had 'flu, a workshop to keep going, and no car.

#### LETTER FROM JOHN RAWSON

Just a note of support about keeping the Bulletin essentially as it is. I do feel that we should preserve it as an informal information exchange at all costs and avoid going up-market and 'respectable'. That is different from becoming respected which is obviously happening if it is being cited in Bibliographies.

Nowadays makers are very scattered across the world and we do need an exchange of information which approximates to what might have happened in the past with a closely-knit workshop tradition. The knowledge needed, at any rate in keyboard making, is the collection of many hundred hints and tips. No one item is abstruse or resistant to research, but there is not time in one lifetime to research each item. However if different people work on different items and swap results progress is quite rapid.

The trouble is that people are wary about being abused. In particular the commercial side arises. Why should one part with information that has taken years to discover just so that a competitor can overtake one commercially? Should one try to draw a line somewhere between scholarly knowledge and business - such as by publishing hand methods of making things but not faster machine methods? Or do you publish what needs to be done but skate round how to do it (not much use)? Or do you go half way and give some tips about the approach and leave the rest for the maker to work out for himself - if he is good he will manage, if not - bad luck.

Probably an established maker will be very free with information that he himself regards as elementary. But will he want to actually publish it? What would happen if I wrote 20 Coems on basic instrument making for FOMRHI and then someone else used them to write a book? Maybe if I didn't write them I could write the book myself without someone else getting in first? But if I did write them I might get comments on them which would make it a better book. Or I might never write the book at all but just give a lot of help to backwoods craftsmen and gain a lot of friends.

Maybe Fellows of FOMRHI should undertake to write Coems on demand on any items within their field of knowledge. They, if anyone, should believe in information exchange. An example is parchment roses. Why has no-one come forward to write half a page? Where are all those Fretted makers who do it all the time? Harpsichord makers do it less often and the work is cruder but I enclose a note on what I know.

I don't think that in practice one can protect and monopolise information by not communicating it. You cannot patent old ideas. And when other people find out what you are protecting they will research it and walk right round you. You keep ahead by hard work, study and experiment, not by secrecy.

And I think that people should have the courage to communicate their mistakes, so as to warn other people off doing the same things. For this reason I enclose a draft Comm on Machine Accidents.

#### ANNOUNCEMENT OF FOMRHI RESEARCH CONFERENCE

DATE: Weekend of Feb. 10 - 11, 1979

VENUE: Oxford or Manchester, but will move to London if enough southern members are involved. Preferences concerning location should be communicated to any of the organizers or the Hon. Sec.

PRACTICAL ARRANGEMENTS: Whatever expenses are incurred in using a meeting room will be shared by the participants. Life-support systems will be the responsibility of the individual. Informal help on this may be available in cases of ignorance (of locale), poverty, infirmity, great wisdom, or extreme congeniality.

ORGANIZERS: David Fallows, Chris Page, Eph Segerman.

TOPIC: Notes towards a History of European Plucked Fingerboard Instruments

FORMAT: Formal papers (in the hopes that the author will prepare lots of pretty pictures to project) and subsequent discussion.

PAPERS ALREADY OFFERED: Instruments before 1270 -- Christopher Page  
 Instruments from 1270 - 1500 -- Lawrence Wright  
 The early development of tablature systems --  
 David Fallows  
 Instruments from 1500 to 1600 -- Donald Gill  
 Instruments from 1600 to 1700 -- Eph Segerman

Offers of further papers should be communicated to any of the organizers.

(The first and third papers on the list are expected to be comprehensive, and the organizers would be surprised (pleasantly) if other contributors in these areas materialized. The other fields listed involve much more source material, and have attracted more scholars, so offers to take over chunks would be welcomed.)

It is hoped that each contributed paper will have:

- 1) New unpublished information and/or insights,
- 2) A review of generally accepted "knowledge" in the field and summaries of the various approaches in the more speculative areas,
- 3) A listing of further knowledge which is needed -- divided into those areas worth pursuing with available sources, and those needing a lucky break before any reason-

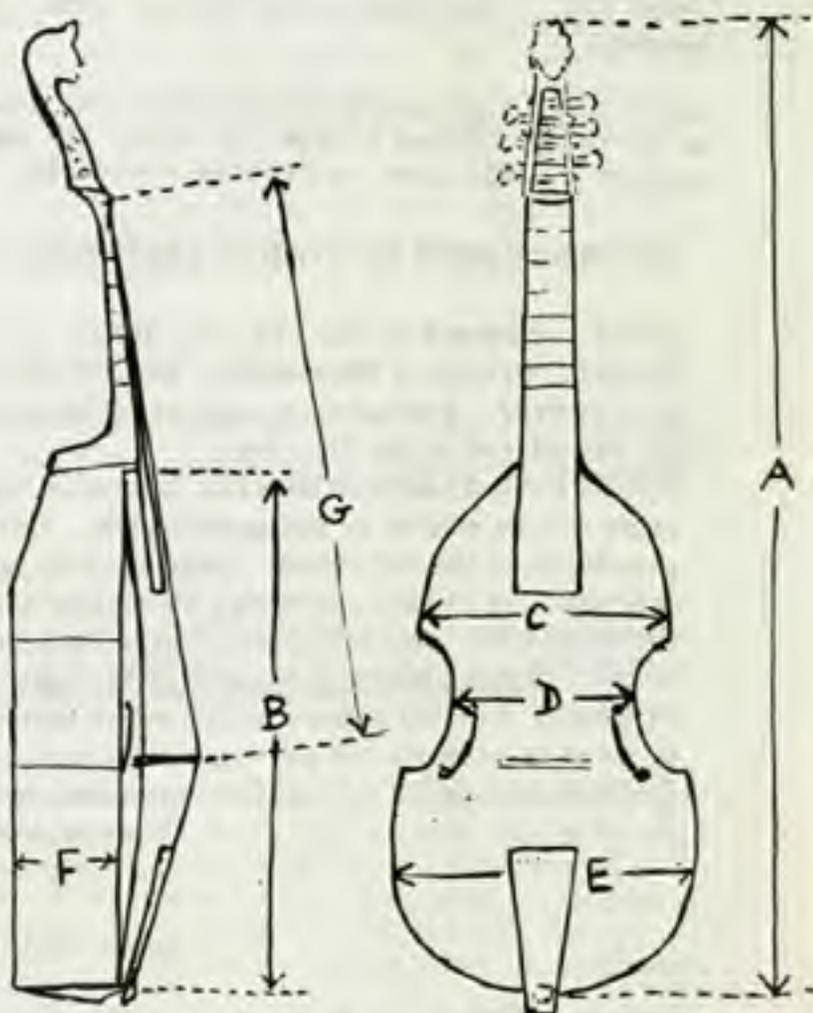
## REQUEST FOR INFORMATION ON VIOLS. FROM PETER TOURIN

I am in the process of compiling a listing of extant historical viole da gamba in public and private collections. This listing contains information on size, maker, country, date and dimensions, and is computerized such that it can be sorted by any of the above characteristics; thus, for example, it would be easy to find all viols made in Italy during the 16th century. I am also compiling two subsidiary lists, one of viol makers, and one of collections that contain historical viols.

These lists are becoming rather sizable, presently containing some 675 viols and 250 makers, and representing about 70 collections. Most of these collections are in museums, such as the Ashmolean Museum at Oxford, the Paris and Brussels collections, and so forth.

I now wish to solicit information on privately owned historical viols. For any viol, I would need to know as much of the following as possible:

1. Size of viol (quinton, pardessus, treble, alto, tenor, bass, violone)
2. Maker (full name, exact copy of label, if any)
3. Country of origin
4. Date
5. Number of strings (if instrument once had more or less strings, describe)
6. Dimensions
  - A. Total length (not including hook bar or end pin)
  - B. Body length
  - C. Max. width of upper bout
  - D. Min. width of middle bout
  - E. Max. width of lower bout
  - F. Max. height of ribs (if ribs are not of even height, describe)
  - G. String length (if bridge markings on belly show a range of past string lengths, give me max. and min.)



In addition, I would welcome any detailed description of the instrument; woods, internal construction, hookbar or endpin, varnish color and description, decorative work, etc. Pictures are valuable to me for comparison purposes. Finally, information on the history and past ownership of the instrument is extremely useful.

I would prefer all measurements to be in centimeters, but if supplied in inches, I will convert to metric.

I'd appreciate any assistance in the compilation of this listing, which will be a useful reference tool for anyone researching the history of viols and their makers. Send me information and measurements, or send me the names of private instrument owners with whom I should correspond. I will list the names of individual owners in the list of collections, unless an owner wishes to remain anonymous, in which case I will not print the name.

Should anyone wish a current copy of my listings, I will be glad to make copies, with several conditions. I will have to charge \$10.00 per copy, as the lists are already running up to about 40 pages. I wish it to be clear that these will be copies of my current working listings, and subject to inaccuracies and incompleteness (inform me of any such and I will quickly correct them!). Finally, these lists may not be printed or published, in whole or part, without my permission; the reason for this is that I am applying for grants to support this research, and when the lists seem complete and accurate enough, I'll probably wish to print them either as part of a magazine article or part of a book on viols.

Thank you for your assistance.

Peter Tourin, The Tourin Musica, P.O. Box 575,  
Duxbury, Vermont, 05676 U.S.A.

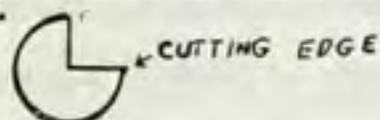
Measurements (in cm. if possible):

Number of strings _____	Max. width, upper bout _____	Max. depth of body _____
Total length _____	Min. width, middle bout _____	String length _____
Body length _____	Max. width, lower bout _____	

Comments:

#### "NUTS AND BOLTS" INFORMATION. Trevor Robinson.

Over the years I have noticed that correspondents send in quite a few questions that receive answers in my book The Amateur Wind Instrument Maker. For example, there are the "nuts and bolts" questions of Whinray and Hawker in the April 1978 issue and of Watson in the July 1978 issue. This is not a place to advertise my book, but I don't see any point in sending in a communication that merely repeats what is in the book. I might say some more about making reamers, though, except that a Communication from Bob Marvin is promised. I will say that I have now pretty well settled on reamers with a cross-section as shown below, either made entirely of steel for small diameters or of wood with an inserted steel blade for bigger ones. Such reamers do a smooth job faster than any other type I have tried.



FELLOWSHIP of MAKERS and RESTORERS of HISTORICAL INSTRUMENTS1978 List of Members - 2nd Supplement, as at 18th October 1978.

\* in left-hand margin denotes a change of address from the main List.

- Gerald Adams, The Manor, Ludham, nr Great Yarmouth, Norfolk; tel: St. Benets 378 (stringed instrs; M).
- Stephen E. Bacon, 2001 Bay View Drive, Hermosa Beach, California 90254, USA; tel: (213) 372-5739 (cornett, flute, M, R, P; early wind, acoustics, iconography, res.).
- Henrik Eggild, Kroghsgade 6, DK-2100 København Ø, Denmark; tel: 01-ØB 4730 (harpsichord; M, R).
- George M. Bowden, Cl. Huerto de Torrella 13, Palma de Mallorca, Baleares, Spain; tel: 27.04.35 (guitar, M, R).
- \* Martin Bowers, 'The Volunteer Arms', 101 Wantz Road, Maldon, Essex; tel: 0621 53376.
- \* Neil Buckland, 71 Wilson St., Lawson, New South Wales 2783, Australia. Budapest National Museum - see Eszter Fontana.
- William Castle, Sunley Hill, Nunnington, York YO6 5XQ; tel: Nunnington 240 (flute, northumbr. bagpipe; M, P).
- Tina Cooper - see Peter Tourin (harps; M, P).
- Francis Cowan, 23 Ardmillan Terrace, Edinburgh 11, Scotland; tel: 031-337 6905 (guitar, lute, cello, bass; C, P).
- Albert Delva, Graaf de Brieylaan 20, 8200 St. Michiels Brugge 2, Belgium (harpsichord; M).
- \* David Van Edwards, 89 Rosary Road, Norwich NR1 1TC; tel: Norwich 29899.
- F Susan Caust Farrell, 17 High Street, Belfast, Maine 04915, USA (woodwinds; R, C)
- Eszter Fontana, 1212 Budapest, Késmárki u. 18, Hungary (curator of instrs, Budapest National Museum)
- James T. Gaspar, 3610 Valley Meadow Road, Sherman Oaks, California 91403, USA; tel: 789-3926.
- Robert Gemmell-Smith, Ford Cottage, Linden Park Road, Tunbridge Wells, Kent; tel: 0892-29810 (lute, bandora, orpharion, M; peg-making service)
- \* F Paul Hailperin, Haus nr. 23, D-7863 Zell-Riedichen, West Germany; tel: 07625/1808.
- \* F Ian Harwood, 21 Priors Close, Beeding, Steyning, West Sussex BN4 3HT.
- J.J. Hildreth, 230 Grove Acre - Apt. 204, Pacific Grove, California 93950; tel: (408) 372-6109 (violin, nyckelharpa; M, R).
- Harvey T. Hope, 64 Ashmore Grove, Welling, Kent; tel: 01-856 4876 (baroque guitar, guitar; R, C, P).
- Peter Kilroy, Coolagh Beg, Ballydehob, County Cork, Eire (viols, med. fiddles; M).
- Eugene Lambe, 30 Renmore Crescent, Galway, Eire (uilleann pipes, flutes).
- Geoffrey Lee, 2 Glen Drive, Boston, Lincolnshire PE21 7QB; tel: Boston 66923 (flute, oboe, clarinet; M).
- \* Brian Lemin, c/o Blue Nursing Service, 11 Sussex Street, Brisbane, Australia 4101.
- F.M. Longmaid, 11 Barnsfold, Fulwood, Preston, PR2 3EU; tel: Preston 717366 (viol; M).
- \* Philip Lourie, 10 Church Mount, Sutton-on-Hull, North Humberside; tel: Hull 781958.
- K.J. Moss, Wingfield House, Tacket Street, Ipswich; tel: Ipswich 212516 (pianos; M, R, C).
- \* Thomas Munck, Dept. of Modern History, 1 University Gardens, University of Glasgow, Glasgow G12 8QQ.
- \* Okechukwu Ndubuisi, Dept. of Music, University of Nigeria, Nsukka, Anambra State, Nigeria.
- \* Frederick Rubin, 796 East Sacramento, Altadena, California 91101.
- Andy Rutherford, 608 South 5th East, Salt Lake City, Utah 84102, USA (lute; M).
- Ramón Pinto, Carmen 8, Barcelona 1, Spain; tel: 317-61-36 (strings gen., violin, guitar, piano; M, R).

John E. Sawyer, Dept. of Music, University of British Columbia, Vancouver,  
B.C. V6T 1W5, Canada.

Miriam Skidan, Yaski St.6, Beersheva, Israel; tel:057-77239 (recorders;M,P).

\* Melanie Spriggs, 46 Foulden Road, London N.16.

Susanne Stahl, D-4500 Osnabrück, Schlossstrasse 63, West Germany (hurdy-  
gurdy, pandora, cittern,M,R; ren.winds, hurdy-gurdy, P).

Peter Tourin - add Tina Cooper Tourin (harps; M,P).

Ian Watchorn, 230 Rose St., Darlington, New South Wales 2008, Australia  
(lute, viol, violin; M,P).

John Weston, West End House, Long Clawson, Melton Mowbray, Leicestershire  
LE14 4PE; tel: Melton Mowbray 822586 (recorder, viol, early keybd; P).

Paul Williamson, The Red Last, Shepeau Stow, Whaplode Drove, Spalding,  
Lincolnshire; tel: Whaplode Drove 518 (perc,M; viol, bgpps, rec,crmh, n,  
psalt, P).

Henk de Wit, Buiten Bantammer str.7, Amsterdam, Holland.

Francis Jack Woodahl, 11871 Amethyst St., Garden Grove, California 92645,  
USA; tel:(714) 892-3134 (bar. & ren. wind; M).

Joseph William Worthington, 81 Millrise Road, Milton, Stoke-on-Trent;  
tel: Stoke-on-Trent 543539 (lutes; M).

- - - - -  
General Facilities:

Acoustics: Stephen Bacon (winds)                      Iconography: Stephen Bacon

Museums: Budapest: National Museum (Mrs.Fontana)

Organological Index:

Percussion: Paul Williamson

String Instrs. General: Gerald Adams                      Ramón Pinto

Peg-making: Robert Gemmell-Smith

Psalteries: Paul Williamson

Keyboards general: John Weston

Piano: Ken Moss                      Ramón Pinto

Harpsichord: Henrik Baggild,h                      Albert Delva,h

Clavichord: James Kimbel

Lute: Francis Cowan                      Joseph Worthington  
Robert Gemmell-Smith                      Ian Watchorn  
Andy Rutherford

Guitar: George Bowden                      Harvey Hope  
Francis Cowan                      Ramón Pinto

Vihuela: James Kimbel

Cittern etc: Robert Gemmell-Smith,b,o                      Susanne Stahl,c,b

Fiddle: Peter Kilroy

Violins: Francis Cowan                      Charles Johnston                      Ian Watchorn  
J.J.Hildreth                      Ramón Pinto

Viols: Peter Kilroy                      Ian Watchorn                      Paul Williamson  
F.M.Longmaid                      John Weston

Nyckelharpa: J.J.Hildreth

Hurdy-Gurdy: Susanne Stahl

Harp: Tina Cooper Tourin



3258  
Nuove Ed. Romano  
Gabiella Aruanti.

FoMRHI Comm. 151

Review of:

Bryan Tolley, *Making Musical Instruments*, Wayland, Hove, 1978, 64pp, £1.75.  
Jeremy Montagu

This will be a double review; when I've finished it I'll send the book up to Eph and Djilda for them to have a crack at.

It is one of a series called *Beginning Crafts*, addressed to children, and thus the instruments, the materials and the tools and techniques involved are all of the simplest. In addition to which, as Bryan told me in a letter, his text and instructions were also edited and 'simplified', or at least well cut, to make them ostensibly more acceptable to children. The book starts with a pair of claves and progresses via bottle chimes and similar odds and ends to psaltery, fiddle and hurdy-gurdy. The more interesting instruments, from our point of view, are much the same as those which Bryan has taught his school class to make, and which have already caused a good deal of controversy in these pages (Comm.100 and comments in every bulletin since).

For each instrument there is a photograph of the completed instrument, in most cases being played, and a group of drawings to illustrate the manufacturing process. With many of the instruments, the finished instrument in the photograph is slightly better, slightly more artistically made, than those in the drawings, but the differences appear to be slight enough that any child observant enough to spot them would be able to incorporate them in its own instrument if it wanted to. The working instructions seem to be very clear and simple and would be easy enough to follow, especially for a child who has done a certain amount of carpentry and similar work at school.

The instruments are of necessity simple (the publishers wanted a book for children to make instruments, not for budding early music ensembles); occasionally they are too simple (for instance, the advice with the triangle to use twine to hold it with will produce perceptibly less tone than using gut or monofilament nylon), and there are no references for further work to more advanced books, nor any suggestions for music to play or where to find suitable pieces. The pictures of the tabor in use show a snare, with a fiddle peg tensioner, but there is no mention of a snare in the text and, because a tin is used for the shell (woodbending would be too complicated), any attempt to use such tensioning won't work without a block behind the peg-hole. However strongly I may believe that a snare should always be used, I feel that in this case the instrument should have been shown without one, or else it should have been added to the text. Names of instruments are occasionally misleading, as for example calling the 6-hole flageolet a recorder, but I suppose that every child has heard of a recorder and none of the flageolet, and Bryan does say in the text that the instrument entitled Recorder isn't one but is a flageolet; since it is made square-section (if a logical bassoon can be, why not a recorder?) placing the little-finger hole would probably have been difficult, and as it is it has the advantage of using the same fingering as the cross-flute.

Obviously the instruments are not authentic. They are very simple to make and children should get a lot of fun out of making them and out playing them. I do wish that there had been the space to make some suggestions of where to go next in order to make better and more authentic instruments, but the book as it stands is streets ahead of various rivals on the market. All these instruments will work; most of them are good ones and they are real instruments, not toys, and are nevertheless within the capabilities of almost any child. Bryan has done wonderful work at his school, and has done his best to make his achievements there available to children everywhere.

FoMRHI Book News

Jeremy Montagu

Zeugnisse Alter Musik X, 1979. Uta and Rudolf Henning have produced another of their excellent calendars with musical subjects in engravings. Copies are available from Uta at DM 17.80 plus postage. Engravings date from 1500 to Picasso, with the 16th century being in the majority.

BOUWERSKONTAKT. Their latest issue has just arrived. There is a five page article, including plans, of a zither, the Frisian Hommel or Balk by H.Prins. A two page note on virginal making by Paul Verhaak. A four page note on flutes and recorders by Jan Bouterse with detailed measurements of a Terton treble recorder in the Gemeentemuseum. A nine page article on repairing harmoniums by Free Kroeze. A six page article on hurdy-gurdies (vieilles à roue) by Toon Moonen. I have sent it up to Djilda as usual.

FoMRHI Comm. 150    Review of:

Carleen Maley Hutchins, The Physics of Music, Readings from Scientific American, W.H.Freeman & Co, San Francisco & Reading (UK), 98 pp., 70 line illus, 28 photos, 1978. £5.70 hardcover, £2.80 paper. American price not stated.

This is an anthology of articles from the Scientific American, introduced by Carleen Hutchins, and if you don't see that periodical you are strongly advised to buy this anthology. The articles included are, with their original publication dates: Frederick A.Saunders, Physics and Music, July 1948; Johan Sundberg, The Acoustics of the Singing Voice, March, 1977; E.Donnell Blackham, The Physics of the Piano, December 1965; Arthur H. Benade, The Physics of Wood Winds, October 1960; Arthur Benade, The Physics of Brasses, July 1973; Carleen Hutchins, The Physics of Violins, November 1962; John C.Schelleng, The Physics of the Bowed String, January 1974; Vern O.Knudsen, Architectural Acoustics, November 1963.

Thus all the important musical instruments are covered! Me, I'm a drummer, but nobody else ever considers drums to be musical instruments.

Apart from that constant complaint, this is really basic material and it should be in every instrument maker/player/researcher/you-name-it's library. With a list of authors like that and with those titles there is no need for this to be a review, and anyway who is going to start nit-picking with Arthur Benade on wind instruments or with Carleen Hutchins on violins? People were asking at the FoMRHI Seminar what all this was about plate-tuning; whether you like the idea or not, all the basic information is here. The same applies to all the other instruments; if you want to know the hows and whys, and if you want to know what the best scholars think are the hows and whys, which can be just as important, buy this anthology.

Jeremy Montagu

18TH CENTURY MUSICAL INSTRUMENTS IN THE NATIONAL MUSEUM DUBLIN:  
WITH NOTES ON ENGLISH GUITAR 1764 BY GIBSON OF DUBLIN

Paul Doyle

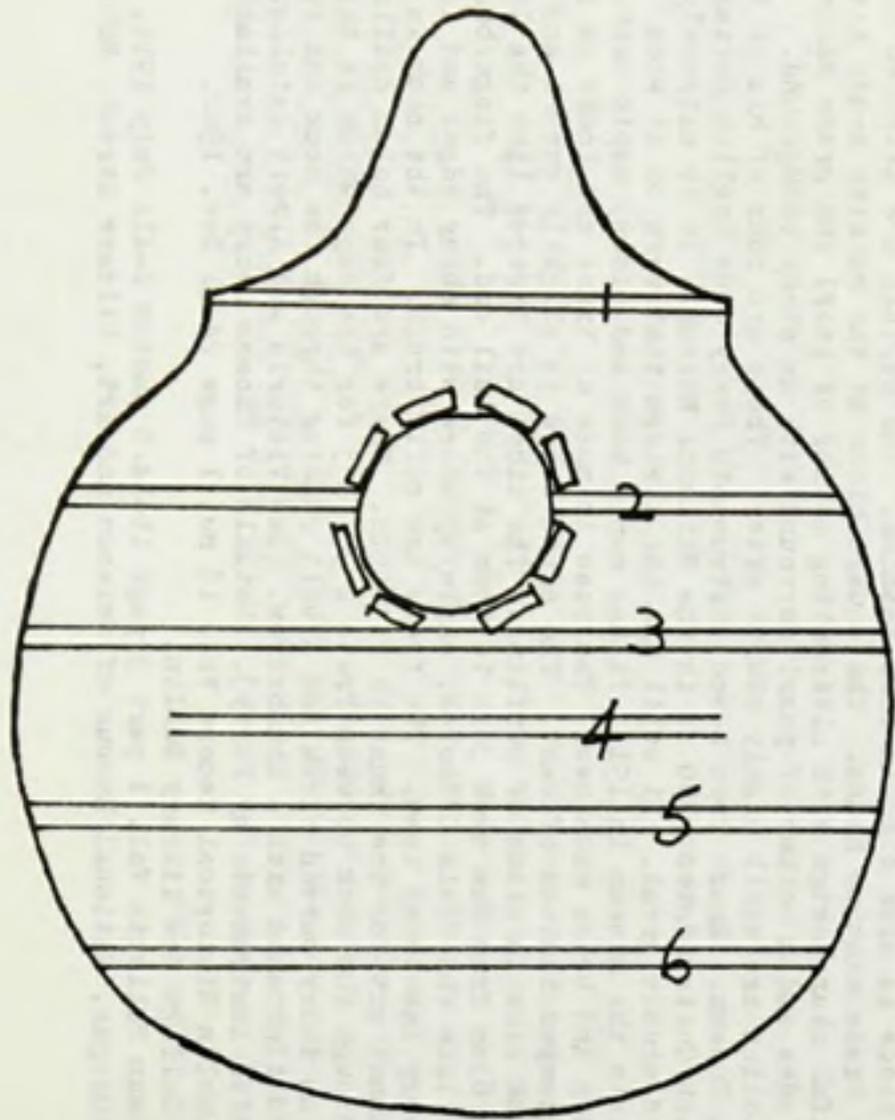
In 1770 Dublin there were six instrument makers listed in the street directory Clarke Esaw, french horn maker, Henry Street. Gibson William, teacher and musical instrument maker, College Green. Hollister William Castles, harpsichord maker, Parliament Street. Willar Henry, Organ builder and harpsichord maker, Great Booter Lane. Webber Ferdinand, harpsichord maker.

In 1775 William Gibson had dropped the teacher title and moved to 6 Crafton Street and two more makers appeared, Alex J. McDonnell harpsichord and piano maker, 2 Church Lane. Daniel McDonnell harpsichord maker, 26 Fleet Street.

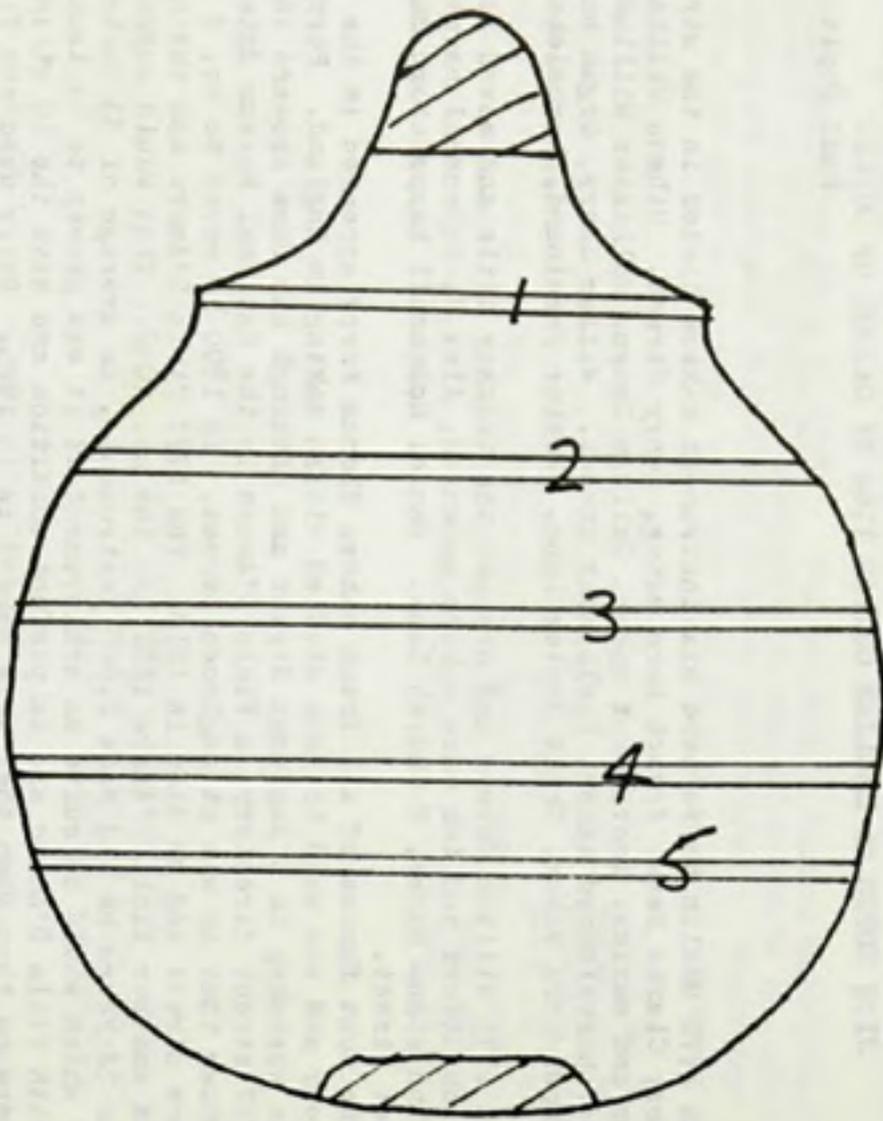
The most famous of all Irish makers Thomas Perry appeared in the 1787 directory and was said to have studied violin making in England. Perry had his workshop in 6 Anglesea Street and although his name appears in the 1787 street directory, a Viola D'Amore in the National Museum dated 1777 shows that he was at Anglesea Street. In 1800 he moved to no. 4 of the same street and he died in 1818. The 1777 Viola D'Amore has the no. 030. and another Viola D'Amore 1801 has the no. 2038. That would suggest that in 24 years he had made 2,008 instruments, an average of 83 instruments a year which would be quite an achievement if it was proven to be true.

Both Viola D'Amore are in perfect condition and have the 10 strings that were on them when they were handed in in 1925. Perry used the finest curly maple for the back and sides, spruce front, maple neck. The fingerboard has 1/16" thick ivory on the front and ebony strips on the sides. The tailpiece is also clad in this fashion. The strings are attached to, 5 a side brass machine heads. The square block at the machine heads has a beautiful star design with alternating mother of pearl and green malachite stone blades and a mother of pearl surround with an ebony background. Perry violins are still highly sought after. There are four of his in the National Museum. Apart from bowed instruments Perry made English Guitars. An English Guitar dated 1790 is in the National Museum. It is extremely light and sounds great. It still has the strings that were on it when handed into the museum in 1913. It has maple back and sides, maple neck, spruce top and brass machines. The rose is made of brass and looks as if it was stamped instead of cast. The sound-board is slightly curved and has an ink line in place of purfling. The sides are tapered like the Italian citterns 63mm from the neck joint to 55mm at the tail end. The fingerboard is again like the Viola D'Amores, maple/sycamore with ebony edges and 1/16" thick ivory inbetween them. The frets are solid brass. In the neck is a long channel cut for the thumb to fit into. There are four holes drilled right through the neck between frets 2 3 4 & 5 for the capo which in this case is an ivory curved block and a bolt running through the neck and ivory block and tightened with a thumbscrew. (See Victoria and Albert catalogue for similar instruments by Perry). Details of Thomas Perry are available in the Dublin Historical Record Vol. 18 no. 1 page 24-31 Dec. 1962. Trinity College new library Dublin.

Museum Bulletin Vol. 1 part 3, page 11-14. 8 photos X-XII July 1911, by A. McGoogan, National Museum of Science and Art, Kildare Street, Dublin.



SOUND BOARD.



BACK.

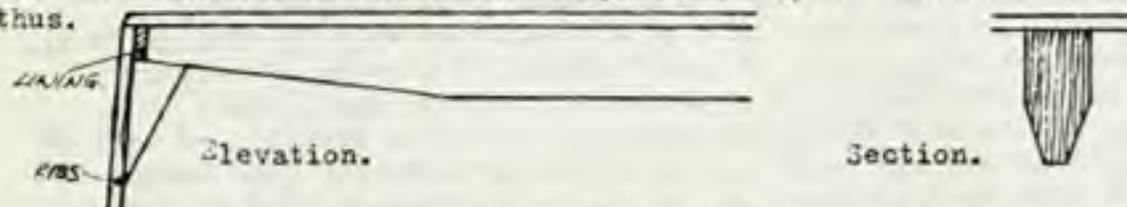
SCALE (APPROX)



There are five English Guitars by Gibson. Three of them are small bodied and the other two are larger instruments. The two large instruments were made in 1778 and 1779 and they are identical in every detail except that one of them has a different machine head mechanism.

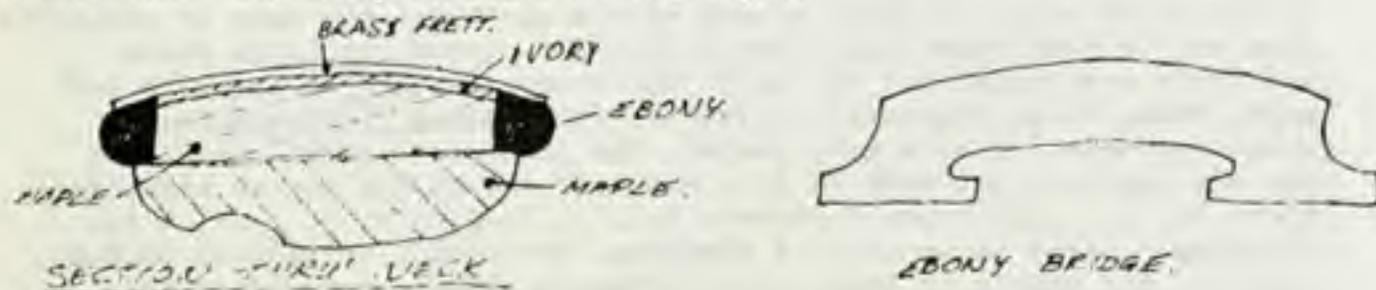
Gibson made a small bodied instrument signed Gibson and Woffington 1776 on the back of the heel in ink and then varnished over in brown varnish. In 1790 he again signed his instrument Claget and Gibson no. 100 1790.

The earliest instrument made in 1764 had the back loose which enabled me to examine the interior quite successfully. The first thing I noticed was the thickness of the bars. They are all  $\frac{3}{16}$ " thick and are shaped thus.



The first bar nearest to the neck join is  $\frac{3}{8}$ " high and like all the other bars tapers gradually for 2" into the lining where it joins a 1" long foot glued to the ribs. Bar no. 2 is  $\frac{1}{4}$ " high and stops at the centre hole. There are pieces of soundboard wood lining the soundhole. Bar no. 3 is  $\frac{3}{8}$ " high and is located below the soundhole. Next is a piece of  $\frac{1}{8}$ " high by  $\frac{3}{16}$ " wide piece that tapers to nothing before the edges of the soundboard. Bar no. 5 is  $\frac{5}{8}$ " high and is located directly below the bridge. The last Bar no. 6 is  $\frac{3}{8}$ " high. There is a small tailblock but no join in the ribs. The soundboard is  $\frac{1}{8}$ " thick at the edges and nearly  $\frac{3}{16}$ " at the rose. There is a small step in the soundhole for the rose to fit into. The rose is  $\frac{1}{8}$ " thick in cast brass 3" diameter. I took a casting from the rose in an Italian modelling clay but when it dried it ended up  $2\frac{3}{4}$ " diameter. There are four types of cast metal rose in the museum and I think that they must have been available to instruments makers of the time as three Irish makers used them and F. Hinds of London used one on an English Guitar 1760 as shown in the Galpin Society Edinburgh Festival catalogue.

The back braces are all  $\frac{5}{8}$ " x  $\frac{3}{16}$ ". The spacings are  $2\frac{1}{2}$ " from the 1st to the second brace,  $2\frac{3}{4}$ " to the third,  $2\frac{1}{4}$ " to the fourth and  $1\frac{1}{4}$ " to the fifth. The back centre join has a strip of cross grain wood  $\frac{1}{2}$ " x  $\frac{1}{8}$ " thick and has not been chamfered at the edges. The lining is very small  $\frac{1}{8}$ " x  $\frac{1}{8}$ ". The neck is maple  $2\frac{5}{16}$ " at the nut and  $2\frac{1}{2}$ " at the body join. There is a channel cut for the thumb from the first fret to the tenth fret. There are also three shallow holes behind the fourth, fifth and sixth frets. The three holes were probably used for carrying the instrument. Like the Perry Guitar there are four holes right through the fingerboard for the capo. They are placed between the second, third, fourth, fifth and sixth frets. The fingerboard is clad like all the instruments with ivory facing and ebony edges.



All the instruments had the same brass machines with the exception of one of the small Gibson guitars. This one had small boxwood pegs running through the back with a small brass insert in the end to take the strings. The square blocks on all of the instruments were edged in ivory and had a tortoiseshell background. All of Gibson instruments had a dark brown finish to the back, sides, neck and soundboard.

There was one other English Guitar by Alex McDonnell which was identical to the Gibson large bodied instruments and made in 1800. It had a clear varnish finish.

There were a few instruments which I could not examine due to the showcases being inaccessible. Among them was a small lute made in Bologna about 1600 unknown maker. An English Guitar by Preston, an arch-cittern (There was no label visible as a double-base obscured the view).

There was an instrument like an arch-cittern with 16 strings on it. In the museum reference book it said "either 18 Century 16 strings".

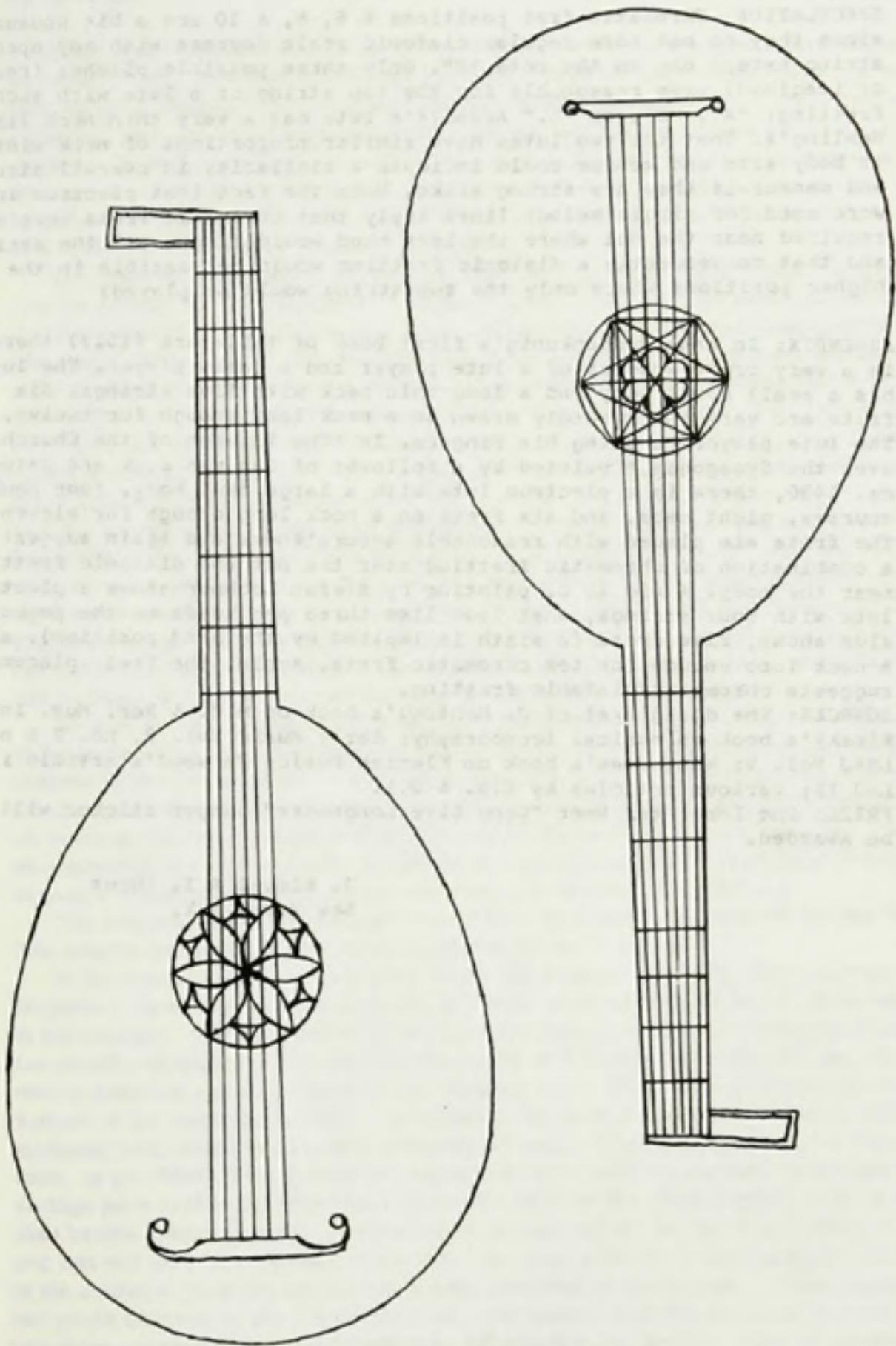
The above information is by no means complete and I shall be continuing my study at Christmas when I am again in Ireland. I will be looking into harps, keyboards and woodwind instruments. The Museum is planning a catalogue and have got as far as listing up to S in the alphabet.

FoMRHI Comm. 153

James Kimbel and I. Lupus

#### LONGNECKS

Israel van Meckenem (died ca. 1500) was a goldsmith from lower Germany who seems to have studied with a Flemish engraver. Measurement of the fret spacing on Memling's lute reveals that all but perhaps one fret are accurately painted on the fingerboard. The seven frets depicted are those which would represent chromatic frets # 1, 2, 3, 4 or 5, 6, 8, & 10. Christopher Page has pointed out that Arnault's manuscript, which contains such unusually detailed descriptions and drawings of a lute and several keyboard instruments, also includes "astronomical tables...a section on an astronomical device built by Johannes Fusoris, Arnault's teacher, several short treatises on horologia and an account of some machines." (GSJ XXXI) Using 63 mm as a measure of the inter-pupillary distance of Memling's lute player yields a mensur of about 50 cm for Memling's lute. There is another engraving by van Meckenem showing a lute player accompanying a singer. The lute has five strings and eight frets on a thin neck long enough for ten chromatic frets. The player is using a plectrum. The number of pegs is unclear. The frets are more evenly spaced than in the first van Meckenem engraving, so evenly, in fact, that they are not spaced closely enough to be accurately placed in the high hand positions near the lute body. Henri Arnault de Zwolle (d. 1466) was for a time physician & astrologer to Philip the Good of Burgundy. Memling has clearly painted six strings and six pegs on his lute, which is being played with a plectrum. The neck of Arnault's lute was to have been drawn long enough for eleven chromatic frets (no frets are shown) but had to be shortened for lack of space on the page. There is an engraving by Israel van Meckenem showing a lute player accompanied by a harp player. The lute has a small round body and six strings. The neck is thin and long enough for eleven chromatic frets but only eight are depicted: # 1, 2, 3, 4, 5 or 6, 7, 9, & 11. The player seems to be using a plectrum. The number of pegs is unclear, however, the pegbox is small. The fifteenth century Burgundian ducal court was in Dijon, but the famous Flemish painters of the time worked



in the northern, coastal cities. Hans Memling lived in Bruges. His "Altarpiece," now in the Koninklijk Museum in Antwerp, has been dated c. 1480.

SPECULATION: Chromatic fret positions # 6, 8, & 10 are a bit unusual since they do not form regular diatonic scale degrees with any open string except one on the note "B". Only three possible pitches (real or imagined) seem reasonable for the top string of a lute with such fretting: "A", "B", or "E." Arnault's lute has a very thin neck like Memling's. That the two lutes have similar proportions of neck width to body size and mensur could indicate a similarity in overall size and mensur-if they are strung alike. Does the fact that plectrum lutes were used for single melody lines imply that chromatic frets were only required near the nut where the left hand would finger all the strings and that consequently a diatonic fretting would be possible in the higher positions where only the top string would be played?

APPENDIX: In Hans Jundenkunig's first book of tablature (1517) there is a very crude woodcut of a lute player and a gamba player. The lute has a small round body and a long thin neck with five strings. Six frets are very inaccurately drawn on a neck long enough for twelve. The lute player is using his fingers. In "The Triumph of the Church over the Synagogue," painted by a follower of Jan van Eyck and dated ca. 1430, there is a plectrum lute with a large oval body, four double courses, eight pegs, and six frets on a neck long enough for eleven. The frets are placed with reasonable accurateness and again suggest a combination of chromatic fretting near the nut and diatonic fretting near the body. A mid 15 C. painting by Stefan Lochner shows a plectrum lute with four strings, what look like three peg heads on the pegbox side shown, five frets (a sixth is implied by the hand position), and a neck long enough for ten chromatic frets. Again, the fret placement suggests chromatic/diatonic fretting.

SOURCES: The dustjacket of J. Montagu's book on Med. & Ren. Mus. Insts.; Kinsky's book on musical iconography; Early Music Vol. 3, no. 2 & no. 4; LSJ Vol. V; Wangermee's book on Flemish Music; Harwood's article in LSJ II; various articles by E.S. & D.A.

PRIZE: One Lone Star Beer "Long Live Longnecks" bumper sticker will be awarded.

J. Kimbel & I. Lupus  
New York, N.Y.

David Miller

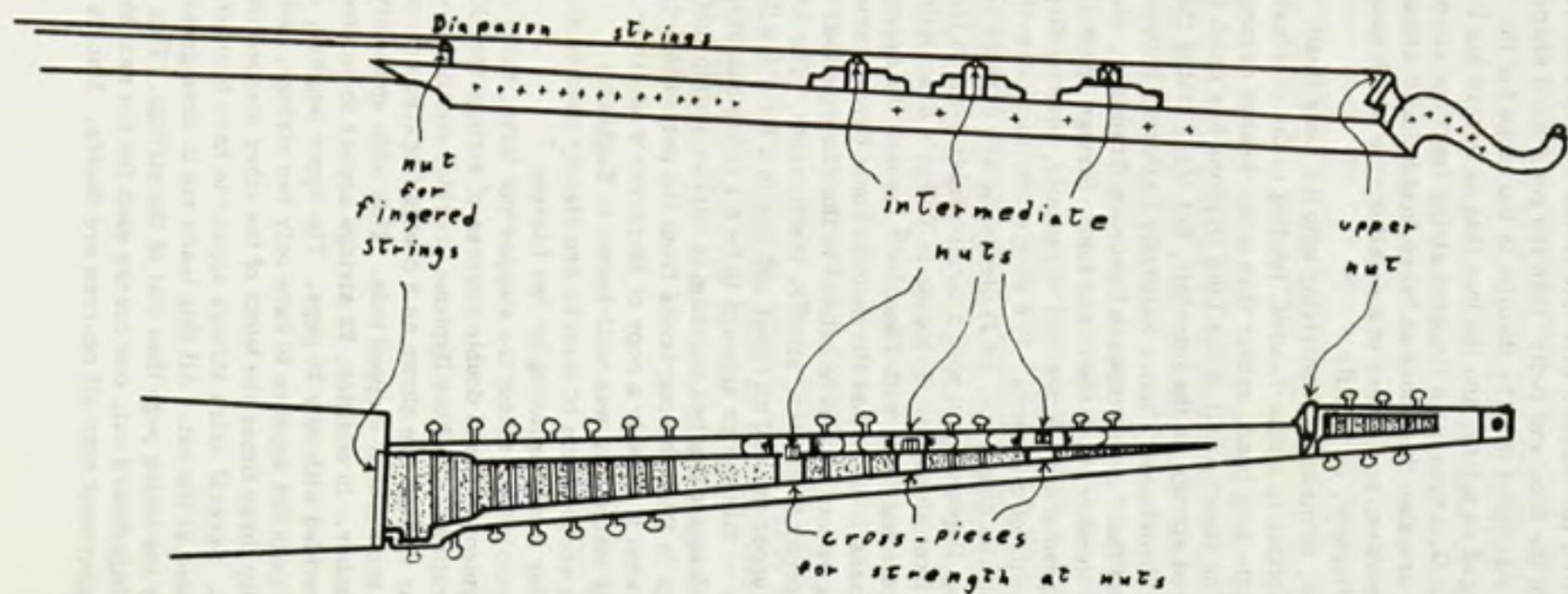
Mace describes the theorbo (or theorbo-lute the terms are used interchangeably) as "more Wide, or Broad in the Ribs and Belly" than the pear-mold shape that was used by Laux Maller. His statement that the theorbo is too large for the "nimble agitation" that can be managed on a lute, and the fact that he lowers his first course an octave in order to tune to G, argue for a fingered string length of approximately 80 cm. He says that there are also theorboes of "very long Seize," which must lower both the first and second courses, and others of a smaller size which must be tuned to A if they are to "Speak Plumply, or Lustily."

The theorbo, Mace says, is made by "contriving unto It a Long Head," and the theorbo part of his Lute Dyphone is single-headed, leading to the conclusion that the theorbo generally had a single long head, rather than a two-headed arrangement like that of Mace's lute. The theorbo-half of the Lute Dyphone has much the same ratio of diapasons to fingered strings as the lute-half, but Mace states that it is "much Shorter, than most Theorboes," "more Naturally Uniform, Proportionable, and Even, (as to Sound)" and that "each Diapason Descends Gradually, Step by Step, by which means, the whole Number, both Short and Long, Strings Speak Uniformly..." If the normal theorbo's diapasons did not descend "Gradually, Step by Step," there are two possible arrangements of diapasons: 1) a single nut, located well beyond the fingerboard nut, carries all the diapasons, or 2) diapasons are carried on a series of small nuts, as in the Lute Dyphone, but with a considerable jump in length from the fingered strings to the first diapason. Evidence in Talbot's description of the English theorbo<sup>1</sup> and the painting "lady with Theorbo"<sup>2</sup> favours the second arrangement, but both Talbot and Mace make it clear that the theorbo could have a variety of forms and tunings, so both arrangements may have existed in the same period.

Each of the two forms occur in earlier, smaller instruments. The Arciliuto of Mersenne<sup>3</sup> has a single upper nut and an upper peg box in a form similar to Mace's theorbo in the lute dyphone -- this design appears to be a French characteristic, in contrast to the swan-neck upper peg box common to earlier Italian instruments. (A common printer's design in English song-books from the period 1651-1702<sup>4</sup> bears an engraving of a viol and what is clearly a copy of Mersenne's arciliuto; this may or may not indicate that the instrument was well-known in England.)

The stepped nuts of the second form of theorbo are clearly used on the two-headed lute held by Jacques Gaultier in an engraving by Jan Lievens.<sup>5</sup>

In the event of the theorbo's head taking the stepped-nut form, there is room for conjecture as to the deployment of the 13 double courses of strings that Mace calls for in his tunings. The illustration of the Lute Dyphone provides contradictory clues for theorbo-stringing. The strings are shown as 8 double fingered courses, and 1 double diapason course to each of four stepped nuts. This adds up to only 24 strings, 2 short of the requisite number. In addition, 22 strings appear to be tuned from the main peg box, which is provided with only 20 pegs. The upper peg box, on the other hand, is provided with six pegs but appears to have only two strings, and these two strings pass over a nut fully three times the width of the other stepped nuts, which also handle 2 strings each. Several extra strings appear to have been drawn in the upper peg box and then discontinued at the nut. All this leads me to have greater confidence in the evidence provided by the tuning pegs than that of the strings. This arrangement has seven courses on the fingerboard nut, one course each for the next three nuts, and three courses to the uppermost nut; all courses are double. Mace's tablature



SPECULATION OF "STEPPED NUT" FORM  
 OF MACE'S THEORBO-LUTE — UPPER NECK  
 (Drawings not to scale)

for the theorbo has only the first 7 courses stopped, which is consistent with this stringing.

The fingered courses and the first three diapason courses are all tuned from the main peg box, and the three courses which pass over the uppermost nut are tuned from the upper peg box.

If we place the first diapason nut above the tuning pegs of the fingered strings, as in "Lady with a theorbo,"<sup>6</sup> we find that the first diapason is about 1.3 times the length of the fingered strings. (Measurements taken from Talbot, from theorbo No. MR 905 in the German National Museum, Nurnberg<sup>7</sup>, and from several illustrations of stepped-nut lutes indicate that diapason length increases in steps by a factor of about 1.07, except for the last step which is often larger -- 1.15 in the case of the theorbo-half of the lute dyphone.) This puts the theorbo's first diapason nut where theoretically the fourth nut should be -- fulfilling Mace's comment that ordinary theorboes have diapasons which don't descend "Gradually, Step by Step..."

Increasing diapason lengths by factors of 1.07, 1.07, and 1.15 (see above), we arrive at the following disposition for Mace's theorbo: fingered strings -- 7 x 2 at 80 cm; diapasons -- 1 x 2 at 105 cm, 1 x 2 at 112 cm, 1 x 2 at 120 cm, and 3 x 2 at 138 cm.

#### Footnotes

1. M. Prynee, "James Talbot's Manuscript: IV Plucked Strings The Lute Family," *Galpin Society Journal* XIV (1961) pp 59-60.
2. R. Spencer, "Chitarrone, Theorbo, and Archlute," *Early Music*, October 1976 p 347. Painting "Lady with a theorbo" by J. M. Wright, from Columbus Gallery of Fine Arts, Columbus Ohio.
3. M. Mersenne, "Harmonie Universelle" reprint in translation. The Hague, 1957 Page 74.
4. Day and Murrie, "English Song-books, 1651-1702" Oxford 1940
5. R. Spencer, op. cit.
6. This instrument, with an approximately 66 cm string length, could have been one of the small theorboes tuned in A that Mace mentions, or it could have been an archlute tuned to a particularly low pitch standard. In any case, its peg box construction is of a type that may well have been common for English theorboes of the time, and is consistent with descriptions by both Mace and Talbot.
7. E. Pohlmann, "Laute Theorbe Chitarrone" 4th edition, Bremen 1975. P 347.

FoMRHI Comm. 155

#### A Red Herring on Praetorius's Foot

E. Segerman & A. Young

According to the State Museum in Brunswick, 1 "Elle" is 570.7 mm. Embedded in the outside wall of the Town Hall there is an iron bar representing 1 Elle, and it has been there since before the 30 Years War. An Elle is the length from the elbow to the tip of the fingers, and each self-governing region had its own different Elle standard. An engineer student of Arthur's remeasured and confirmed the figure given by the State Museum.

According to the Museum, 1 Elle = 2 1/8 feet, so Praetorius's foot would be 268.56 mm instead of 285.36 mm as given by Bessaraboff. Following from this, depicted instruments should be 6% smaller than we had thought using Praetorius's scales and Bessaraboff's conversion factor.

It is obvious that Bessaraboff's figure is half that for the Elle given by the State Museum, so the difference is whether the Elle was 2 or 2 1/8 feet long at Praetorius's time. The former figure was given by the early 19th century

scholars Bessaraboff referred to, and the latter by the State Museum currently. Which is right?

Fortunately, one does not need any scholarly foraging to decide this issue, since Praetorius himself offers us the answer. At the very beginning of the plates in *De Organographia*, Praetorius printed a full size 6 inch ruler under which he wrote that it was half a foot or a quarter of a Brunswick Elle.

This was confirmed by Ellis late in the 19th century, who measured his copy of Praetorius and found that it was  $1\frac{1}{2}\%$  smaller than  $\frac{1}{4}$  Brunswick Elle (Thomas and Rhodes remeasured the copy around 1970 and found the same difference.) This is just what one would expect from paper shrinkage over several centuries. If the Brunswick foot was 6% smaller, one would have to imagine some mechanism which would have expanded the paper  $4\frac{1}{2}\%$ . We can't think of any, but we are not trying very hard since we tend to trust Praetorius.

FoMRHI Comm.156. TWO-HEADED LUTE NEWS

Ole Vang and E.S.

The two-headed lute seems to have been invented by Jacques Gaultier in the second quarter of the 17th century. It had a short vogue in France (where it was rejected because the basses were too strong), but it was popular in England and throughout northern Europe for the rest of the century. All of the lute tunings current at the time, including the old Renaissance tuning were used on it. The major part of Mace's book is about this instrument.

Michael Lowe,<sup>1</sup> when writing of this lute, said, "No lute of this type seems to have survived..." William B. Samson<sup>2</sup> in an article about this instrument echoed this: "not one of them has survived." Michael Saffle<sup>3</sup> illustrated one by Jonas Stehelin (Leipzig 494), and Pohlmann<sup>4</sup> lists a likely candidate made by Johannes Rehm (Nürnberg MIR 905). The stopped string lengths of these two survivors are  $75\frac{1}{2}$  cm and 68 cm respectively. If we compare these string lengths with those written about by Mace and Talbot, and those to be seen in the paintings (see Comm. 59), they seem atypically long. We thus welcome the appearance of a previously unrecorded two-headed lute which has more typical dimensions (almost identical to W in Comm. 59).

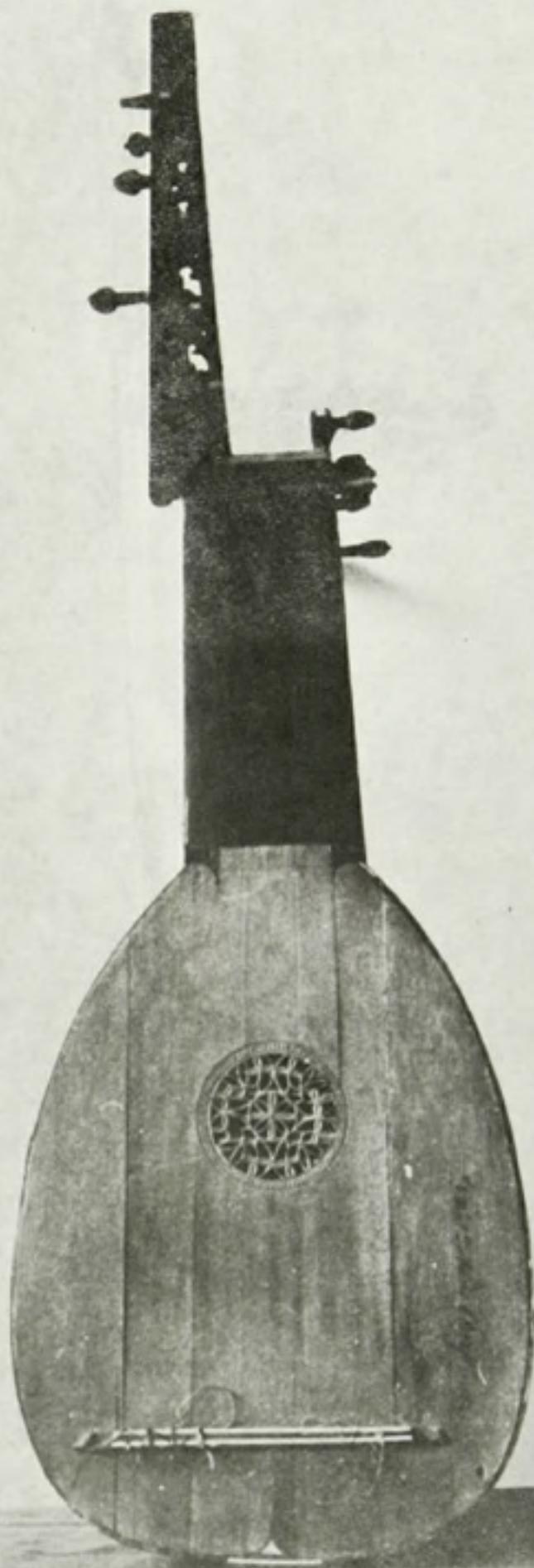
The printed label of this lute reads:

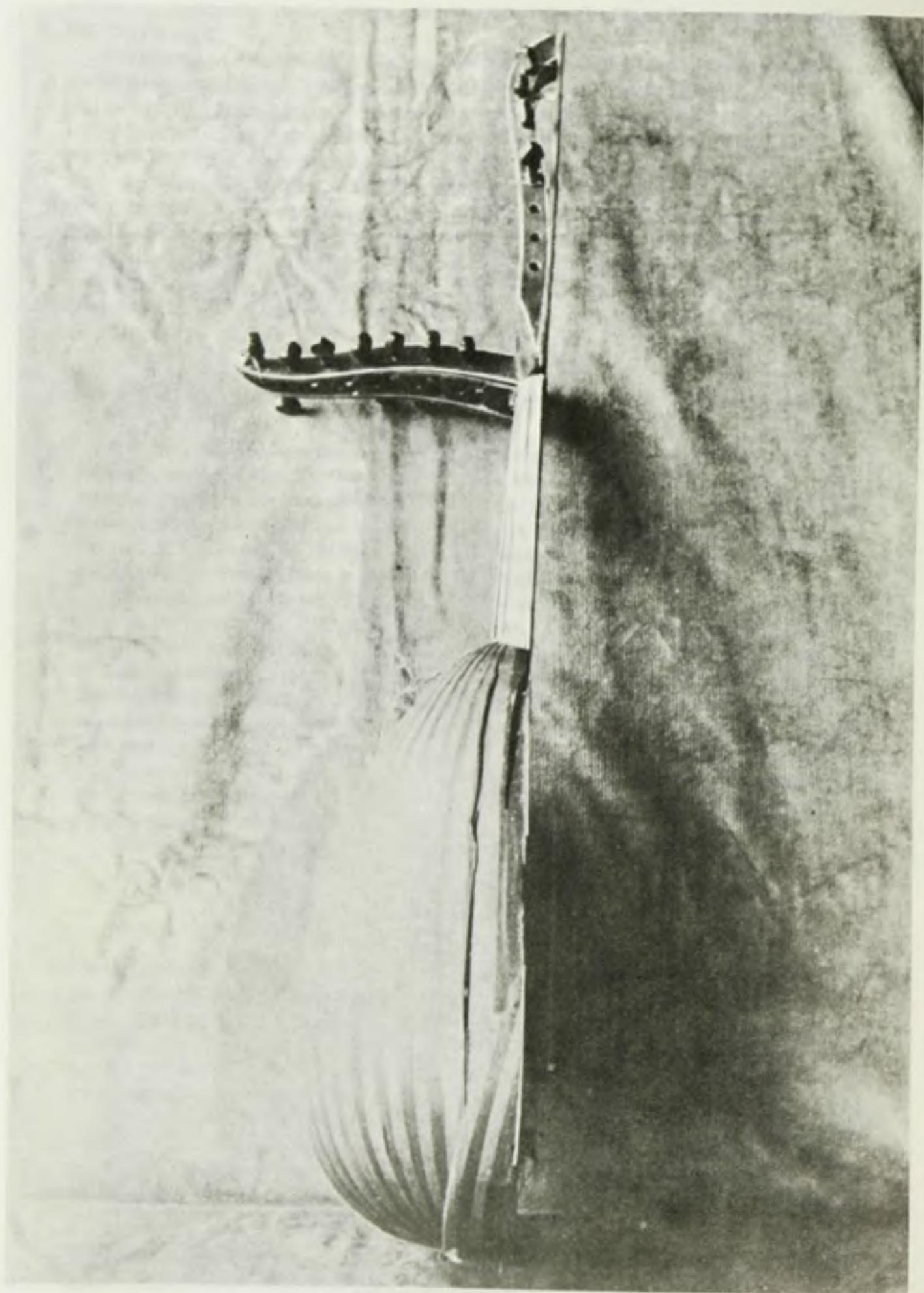
Raphael Mest in Fieffen, Imperato  
del Mifier Michael Hartung in Pa  
dua, me fecit Anno 162

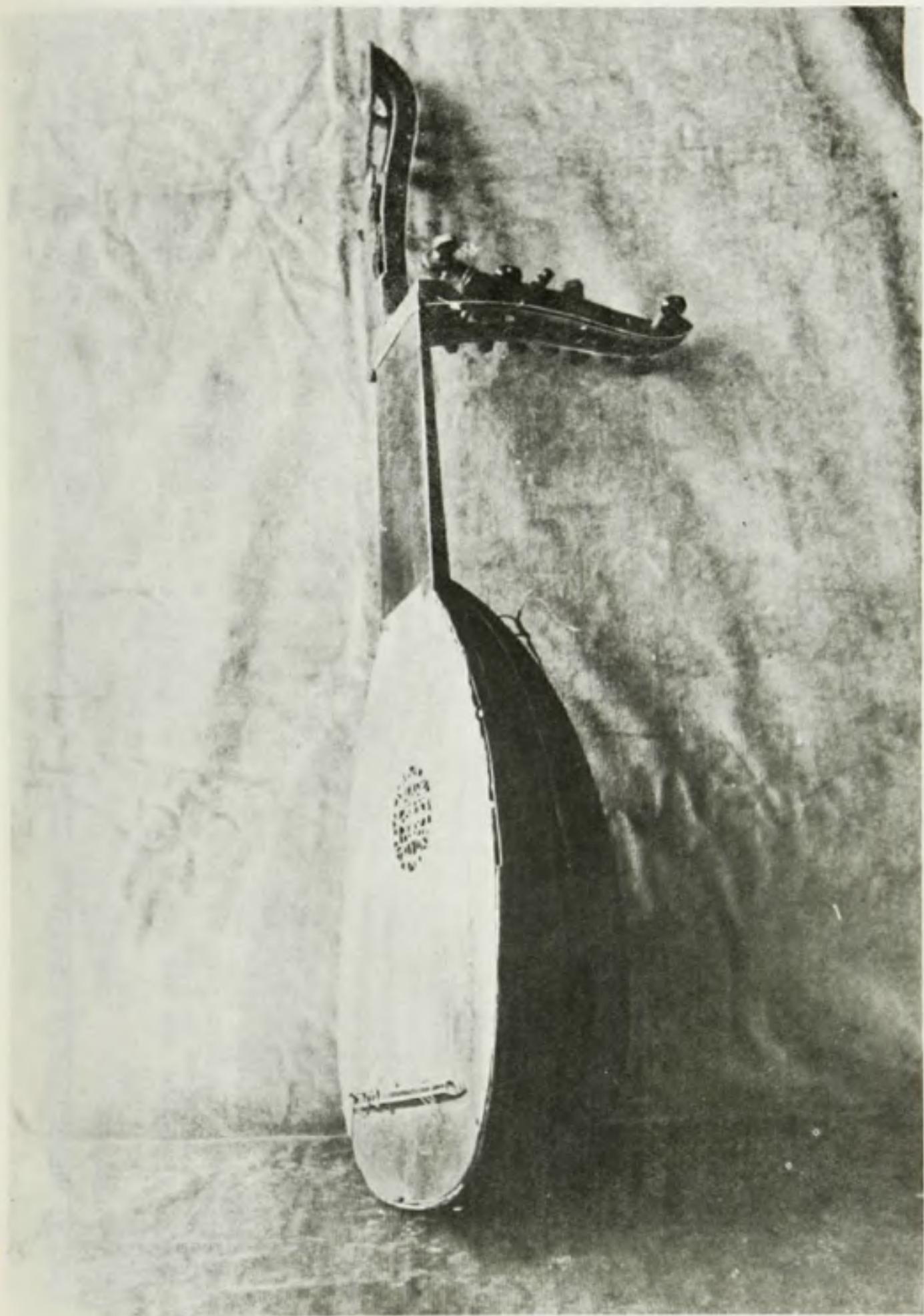
The 2 in the date has been inked to read 3, and a 3 in ink has been added. The stringing is  $1 \times 1 + 7 \times 2 = 50.0$  cm plus  $4 \times 2 = 54.2, 58.7, 63.7$  and  $70.7$  cm. The body is  $36.0 \times 26.2$  cm with 23 ribs of plum or yew. Bits of very old gut strings still remain on the bridge. The four unstopped courses are octave-tuned and the thick string of each pair is open-wound with metal. It is possible that these strings date from as early as the 18th century.

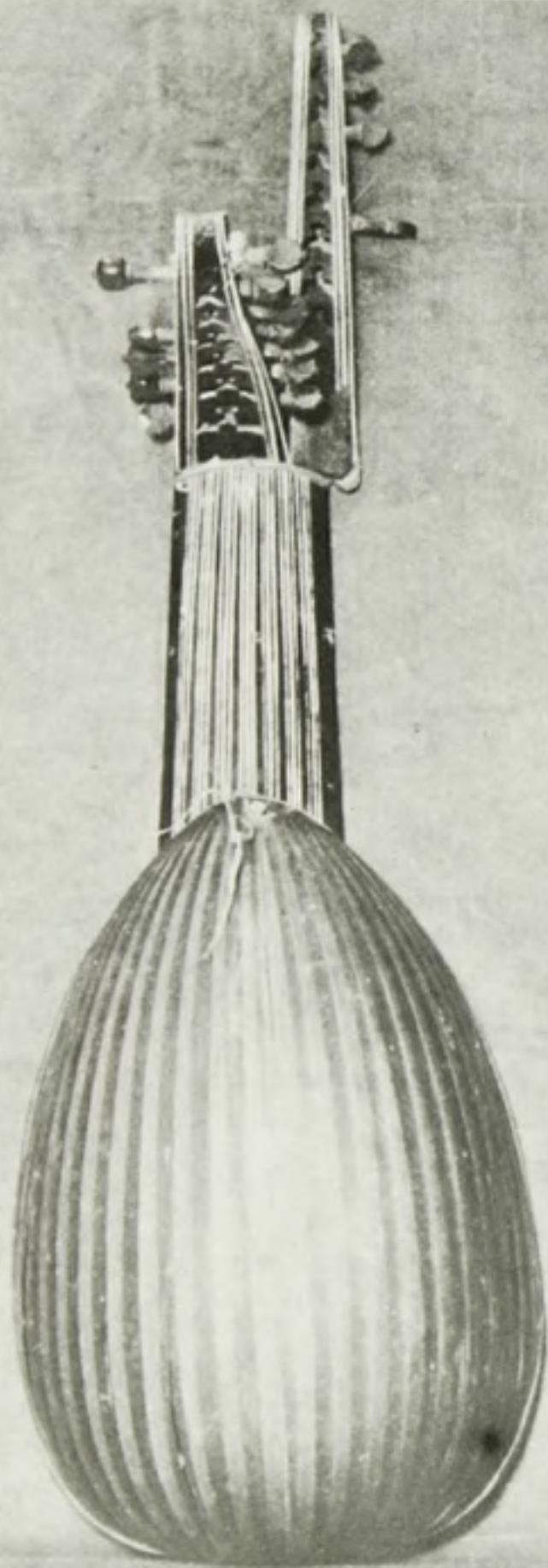
The instrument is located in the Linböping Library, and shows no sign of modification from its original condition. Its current state of togetherness is so poor that it is likely that all structural details needed for making accurate copies can be readily measured. A drawing giving these details is in preparation.

1. Lowe, Michael GSJ XXIX (1976) p. 16
2. Samson, William B. LSJ XIX (1977) p. 50
3. Saffle, Michael JLSA VIII (1975) P. 36
4. Pohlmann, Ernst "Laute, Theorbe, Chitarrone" 4th Ed. (1975) p. 347











AutunCathedral St.-Lazare:Gislebertus of Autun, c. 1120)

Outside, west doorway, tympanum: The Last Judgment.  
 " " " " , Left and right: 4 angels blowing horns (only 1 mouth-piece extant).  
 " " " " , frieze, below right: one of the damned with a barrel or possibly a drum.  
 " " " " , Jamb on the left: Apocalyptic Kings with 6 rebecs (⊕; the curved back of 1 instrument can be clearly seen).  
 Inside, nave, 3rd pillar (free-standing) from W., E. capital: 4th mode with bells on a frame (⊗).

Musée Rolin:Martinus (after 1146)

Sculpture of the tomb of St. Lazare in the Cathedral: King David with small harp.

VézelayAbbey Ste.-Madeleine:anon. (French, 2nd quarter of the 12th cent.

Inside, narthex, centre doorway, tympanum: The Descent of the Holy Ghost.  
 " " " " , 1st archivolt, bottom left hand: 2 musicians with organistrum.  
 " " " " : Scenes of the Life of Christ after the Resurrection.  
 " " " " , southern jamb: 2 modes (trumpet-marine, bells on a frame: ⊗).  
 " " " " : Scenes of the Christmas story.  
 " " " " , northern jamb: Odysseus and siren, Odysseus with rebec (⊕); angel with horn hanging down from his side.  
 " " " " , southern jamb: angel with horn in his left hand.  
 " " " " Gallery (museum, at present not yet open to the public): fragments of 2 Corinthian capitals (lion with rebec: ⊕; ass with unidentified wind instrument, badly mutilated).

## BULLETIN SUPPLEMENT, CONTINUED

## WORKSHOP VACANCIES AT NRI

There are facilities for 3 to 4 instrument makers at NRI headquarters in our (Eph and Djilda's) house in Manchester. They are now occupied by John Duncalf who has been here making lutes for years, David Miller an established lute and guitar maker from Saskatchewan who is here on a 3 month grant from Canada Council to study instrument design and Luis Emilio Rodriguez a student in viol making paying his way by part-time string making. By mid December David must return home, and John is expanding his lute-making for NRI being joined by his brother in their own workshop in Northwich. The resultant vacancies could be filled by established craftsmen (like John), or by students or researchers either paying their own way (like David) or earning their keep by part-time string making (like Luis Emilio). Someone wanting to work full-time on strings craft and technology also would be welcome. Anyone interested please contact me: Djilda Abbott, NRI, 18 Moorfield Road, Manchester M20 8UY, phone 061-445 0525

WALNUT. Eric Franklin tells us that his brother has some unwanted blocks of what is thought to be American walnut, and they are available for the taking. Also two paper sacks of odments and a number of thinly-sawn planks of a soft redwood, about 3' x 6" x 1/8". Contact Mr. M.H. Franklin, 53 Sullivan Road, Courthouse Green Coventry, phone Coventry 665499.

RAVENS QUILLS. P and H Fishing Tackle Co. (whose address appears in an earlier Bulletin) have a limited supply of ravens' quills about 18" long. Anyone interested should contact them immediately.

BONE. Alan Clarke recommends bone from Abbey Horn Works, Kent Works, Kendall, for lute nuts etc. Pieces can be bought cut to size. The ones Alan had were (like timber) a little smaller all round than the stated sizes.

" nave, 3rd pillar from W., W. capital: the conversion of St. Eustace (horn-blower on horseback).  
 " south aisle, 6th pilaster from W., E. side: secular music (rebec and bow: ⊕).  
 " " " : secular music and demon of lust (musician with unidentified wind instrument, rebec: ⊕hang- ing down from his side).

0000000000

Peter Tourin's computer listing of surviving viols is fertile ground for analysis. This comm. is just a bit of a start which is already out of date since he has just been on a tour including Eastern Europe where he has been picking up much more information. There are still some viols close at hand that he happens to have missed (like those in the Henry Watson Collection, and in the Hill Collection that didn't go to the Ashmolean) and some that he doesn't have dimensions of (like those in the Dolmetsch Collection). So if you happen to have measured such viols, please fill out his forms (see Bulletin Supplement p. 14 & 15) and send them to him.

All that we have done is to take his printout (the one we have is from April 1978) and picked out the 47 English viols in it which have the maximum body width and body length listed, and plotted each viol as a dot on graph paper against these two parameters. This plot is shown on the next page. Included also are crosses which indicate the viols that Talbot measured around 1690 with the names he gave them. Also included on the left are the modern ranges of sizes (body lengths only) and names, as given by Nathalie Dolmetsch in *The Viola da Gamba* (1962).

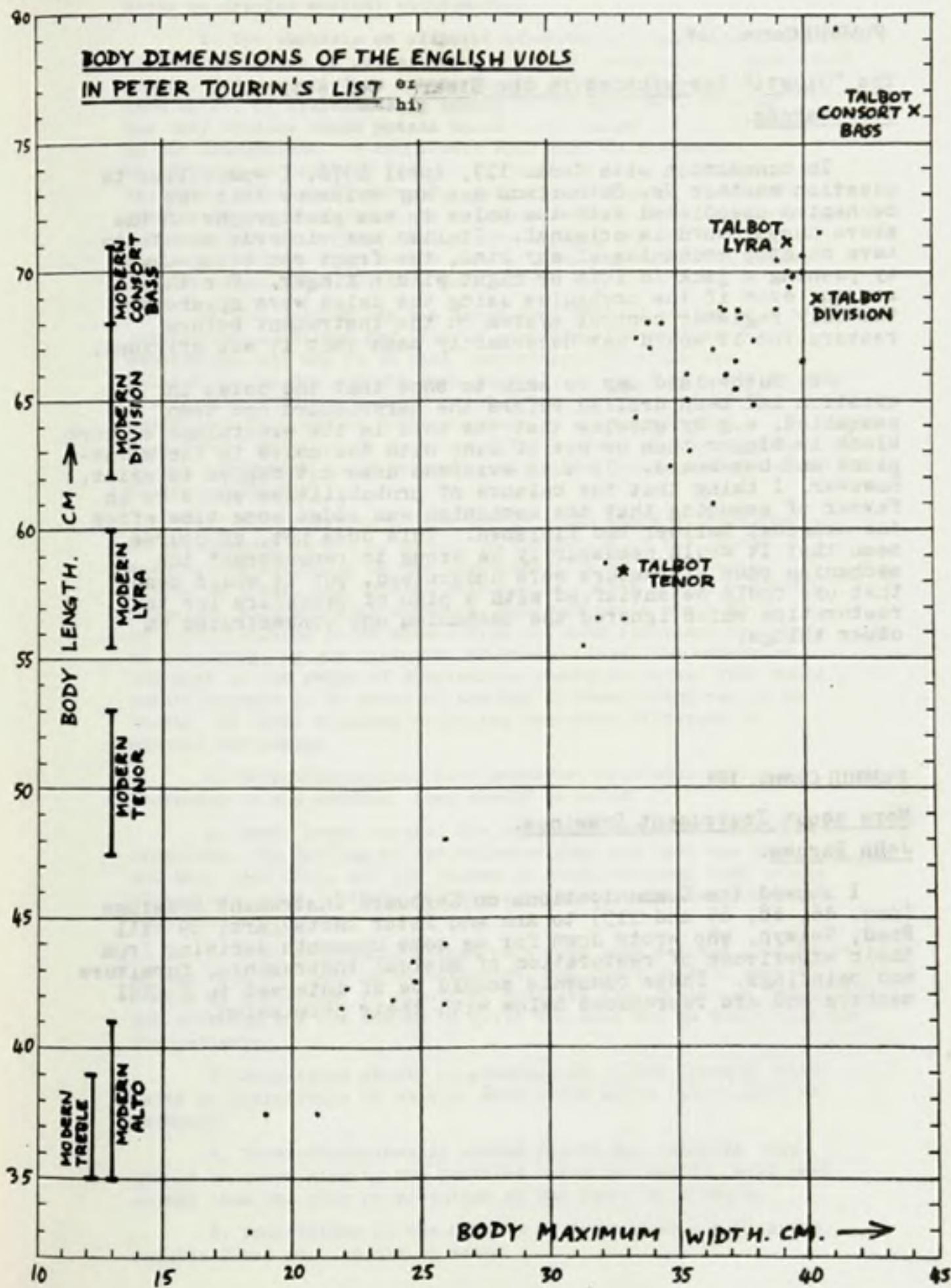
There is some ambiguity concerning the body length figures because they could have been of the back, with or without the heel included, or they could have been of the soundboard, with or without the tailpiece pillar included. Nevertheless these differences should not affect the general picture.

If we examine the plot we see an isolated cluster of 5 surviving viols with body width 31-33 cm and body length 55-59 cm, into which Talbot's tenor viol fits. The viols are by Rose, Blunt, Addison, Hinds and Hintz. As far as we know Talbot is the only early writer in England who associated names with actual viol dimensions, and there is no reason to doubt that this name was used for this size throughout the 17th and 18th centuries. However there is also reason to accept the modern "lyra" name for this size when considering the early years of the 17th century (but no reason to accept the alternative modern name of "small division bass"). The reason is that it is hard to imagine playing the stretches indicated in the lyra tablatures of composers such as Corkine and Ford on an instrument longer than this. Tobias Hume indicated that instruments tuned like tenor viols and played from tablature were called "small basses". In his *Poetical Musicke* (1607), the following quote concerns a part written in mensural notation for a bass viol obviously tuned in D, and it goes with two tablature parts for viols tuned a fourth higher: - "The Viole that playeth this part must bee set fowre Notes lower then the other, and he must bee somewhat longer then the two Basse Viols which play the Tableture being alwaies tuned alike and set as the Lute."

There is another cluster of viols with body width 22-26 cm and length 41-44 cm which neatly falls outside any of the modern ranges. It includes four Jayes, a Barak Norman and a Duke. We can only think that these were called "treble viols" in the 17th and 18th centuries.

There are two viols within the modern treble range. We have seen one of these, a Jaye belonging to Francis Baines, with width 19 cm, which has clearly been cut down from a larger instrument. The other one is owned by L. H. Lock and was lent to the 1951 and 1968 Galpin Exhibitions. We would like to hear from anyone who has examined this instrument to determine whether it really could be English and from 1580 as is claimed. If the date is correct then it is contemporary with the Juan Maria da Brescia viol of similar dimensions in the Hill Collection, and which we identify with the sopranino viol played by Striggio in the 1589 *Intermedii* to "La Pellegrina". The smallest viol on the plot is in the Hart House Collection in Toronto and sports a Bergonzi label. Tourin rightfully questions the claim that it is English.

BODY DIMENSIONS OF THE ENGLISH VIOLS  
IN PETER TOURIN'S LIST <sup>02</sup>  
<sub>bl</sub>



FoMRHI Comm. 159

The "Giusti" Harpsichord in the Steary v Collection.John Barnes.

In connection with Comm. 117, April 1978, I would like to question whether Mr. Sutherland has any evidence that the mechanism associated with the holes in his photographs of the above harpsichord is original. Italian harpsichords sometimes have no stop mechanism of any kind, the front row being moved by pushing a jack to left or right with a finger. For this reason, even if the mechanism using the holes were apparently the only register control system on the instrument before restoration it would not necessarily mean that it was original.

Mr. Sutherland may be able to show that the holes in question had been drilled before the harpsichord had been assembled, e.g by showing that the hole in the wrestplank support block is bigger than or out of line with the holes in the wrestplank and baseboard. If such evidence does not happen to exist, however, I think that the balance of probabilities would be in favour of assuming that the mechanism was added some time after the original builder had finished. This does not, of course, mean that it would necessarily be wrong to reconstruct the mechanism once its nature were understood, but it would mean that one could be satisfied with a plan of procedure for the restoration which ignored the mechanism and concentrated on other things.

FoMRHI Comm. 160

More about Instrument Drawings.John Barnes.

I showed the Communications on Keyboard Instrument Drawings (nos. 46, 68, 85 and 115) to Ann and Peter Mactaggart, 19 Mill Road, Welwyn, who wrote down for me some comments deriving from their experience of restoration of musical instruments, furniture and paintings. These comments should be of interest to FoMRHI members and are reproduced below with their permission.

## Notes on drawing musical instruments.

1. The emphasis on official measured drawings should not be made an excuse to prevent access to the instrument by interested people. Quite apart from errors in the drawing, the quality, or lack of it, of craftsmanship cannot be conveyed, <sup>and</sup> in a drawing can only include those points which were thought to be relevant by the draughtsman. A completely open mind is impossible and the drawing is bound to reflect the beliefs and prejudices of the time. If re-examination is seriously restricted these will largely become fossilised. We all think we know what is relevant, and we all think we know what we are looking at, but I see no reason to believe that we are likely to be any better at seeing pitfalls than those who have gone before us.

2. The drawing has two functions. That of acting as a working drawing for a builder and that of recording information for a scholar who can use it to make comparisons. (Builder and scholar may be one and the same person). It could be sound to make the drawing with the builder in mind and confine such of the additional information and commentary to a separate text. Some detail which needs to be recorded as part of the construction of the instrument could be confusing to the builder but is essential to the researcher.

3. An indication of the degree of accuracy of each type of measurement should be given. An indication of the method of examination which led to the identification of any material should be given. (eg. visual observation, which may be perfectly adequate; microscopical sections, chemical tests etc.) Where an identification or an observation are made regarding the state of something, eg the direction of growth rings, the extent of the area or the point of observation should be noted. This would enable someone to be aware of how far an observation was to be trusted if later evidence indicated something different in another instrument.

4. Where distortions have occurred, even when they are corrected in the drawing, they should be noted.

5. Where items repeat, the degree of variation should be indicated. The drawing of one baluster does not tell one what a set will look like, and the degree to which turnings have become elliptical could indicate the green or partly-seasoned stock had been used.

6. When drawing mouldings that have been painted, the shape of the wood may have to be estimated, and where this is done it should be indicated. It should be realised that mouldings intended for painting are not shaped in quite the same way as those intended for polishing.

7. Decoration should be recorded as it now appears, with notes of indications of earlier states (of which there could be several).

8. Three-dimensionally shaped pieces eg, cabriole legs, should be drawn showing the profiles which the builder will want rather than the plan or elevation of the piece as a whole.

9. Indications of the methods of production - tool marks, scratch lines etc, should be noted.

## COMPUTING CENTS WITH A POCKET CALCULATOR

Nicolas Meeùs

In Comm. 21, Jeremy Montagu described how to compute cents from logarithms. His method is based on the fact that any two logarithmic series are related to each other by a constant factor. Cents form a logarithmic system; they relate to common logs by the factor 3986.314, to natural logs by 1731.234. In order to find the value in cents corresponding to an interval expressed by the decimal ratio  $x$ , one takes the log of  $x$  and multiplies it by the constant factor. This method is perfectly correct and very accurate. It has one major defect: the constant factor must be memorized.

Actually, the factor is very easy to compute. It may be defined by the equation

$$k = \frac{\text{cent } x}{\log x} \quad (1)$$

where  $k$  is the constant and  $x$  a decimal ratio expressing an interval. It will not be possible to dispense oneself with a calculator giving logs (or at least a table of logs), so that  $\log x$  in (1) may readily be known for any  $x$ . It becomes clear then that if the value of cent  $x$  is known for any given  $x$ , equation (1) will lead to a numerical value for  $k$ . The obvious choice is  $x=2$ , hence cent  $x = 1200$ , since there are by definition 1200 cents in the octave. Equation (1) may then be rewritten as

$$k = \frac{1200}{\log 2}$$

which is easy to memorize, is valid for any logarithmic system (as Jeremy noted, FoMRHI Q. 12 p. 54, natural logs are often more accurate than common ones) and involves no approximation.

The procedure to find the value in cents of a decimal ratio  $x$  is as follows: take the log of  $x$ , multiply by 1200 and divide by the log of 2. On most calculators, so doing will at no moment display the value of  $k$ , which it is no more needed to know; on the other hand, this procedure will usually involve depressing one key less than if the value of  $k$  has to be inscribed. It goes without saying that one should consistently keep to one logarithmic system. If the logarithm of  $x$  is taken in common logs and that of 2 in natural logs, or inversely, the results will be wrong.

A final point. With this method, the accuracy reached is that of the calculator utilized. With a 12-digit display, one may get 9 correct decimals. In this respect, it should be considered that it is always ridiculous to give cents with more than one decimal and most often useless to give any decimal at all.

## A STRING CALCULATOR

Djilda Abbott and Ephraim Segerman

## INTRODUCTION

The String Calculator in the centre of this issue of FoMRHI shows the relation between the vibrating string length, the string diameter, its tension and the note it gives. It short circuits all the maths normally associated with the string formula. Instructions for its assembly are below, and instructions for working it are on the Calculator itself so that they will always be to hand. In addition to the string formula there is a Range Guide which indicated the workable pitch ranges of various types of strings depending on the string material and the string length. The range guide is to be taken either with a pinch of salt or with the large dose of instructions found below.

## INSTRUCTIONS FOR ASSEMBLY

Glue the whole sheet to suitable backing material (cardboard, plywood, perspex, aluminum, boxwood, quartered Swiss pine, etc.). Cut along the vertical lines to separate the strips titled Tension, String length/Note, Diameter, Density of String Materials, and Range Guide.

On another sheet of backing material, reassemble the strips titled Tension, String length/Note, Diameter, and Density of String Materials in their original relationship, with the dotted line at the bottom of the strips in accurate alignment. The outer strips (Tension and Density of String Material) should be permanently attached to the new backing material in their present positions, leaving just enough space for the String length/Note and Diameter strips to slide freely between them.

The Range Guide strip should be the same width as the Diameter strip, since the two are interchangeable for different calculations.

## NOTES ON THE STRING FORMULA

The formula for the fundamental vibration frequency of a string is:-

$$f = \frac{1}{2L} \sqrt{\frac{T}{m_L}}$$

where:

$f$  is the frequency of vibration of the string in cycles per second,

$L$  is the length of the string that is free to vibrate,

$T$  is the tension in the string,

$m_L$  is the linear density of the string.

In the case of a simple cylindrical string,  $m_L = \frac{1}{4}\pi D^2 \rho$  where  $D$  is the diameter and  $\rho$  the density of the string, so:

$$f = \frac{1}{LD} \sqrt{\frac{T}{\pi \rho}}$$

Before this Calculator, the usual methods of working with the formula were either the NRI Nomogram (and its imitators) or doing the arithmetic. The Nomogram did a good job but was cumbersome to use. Arithmetic is practical provided you have a pocket calculator with square root, or a good head for figures, or a tame computer and plenty of shelf space for the printout, and always provided that care is taken to express all the quantities in compatible units. This Calculator beats them all on speed and being easy to use. Its accuracy is OK to half a semitone which is ample for most stringing calculations.

If greater accuracy is needed, the string formula can be used in either of the following forms:-

$$f \text{ (cycles/second)} = \frac{5,588}{L \text{ (cm)} \times D \text{ (mm)}} \sqrt{\frac{T \text{ (Kg)}}{\rho \text{ (gm/cc)}}$$

$$f \text{ (cycles/second)} = \frac{220,000}{L \text{ (cm)} \times D \text{ (thou)}} \sqrt{\frac{T \text{ (Kg)}}{\rho \text{ (gm/cc)}}} \quad \text{"thou"} = \frac{1}{1000} \text{ inch.}$$

The calculator was in fact made by putting numbers in these formulas and then rounding them off.

### THE RANGE GUIDE

The upper limits of range were arrived at directly from the tensile strengths and elasticities of the materials:

$$\text{breaking frequency} = \frac{1}{2 \times \text{string length}} \sqrt{\frac{\text{breaking stress}}{\text{density}}}$$

and allowing a back-off of two semitones below the breaking pitch. Upper limits are subject to:-

- (i) the material properties of tensile strength and density which can vary with method of manufacture, and sometimes with age of the string.
- (ii) user factors: the method of attaching the strings and the instrument setup, especially any sharp corners which the string has to go around, and corrosion of the string eg. from sweaty fingers or damp atmosphere.
- (iii) psycho-economic factors: how often one is prepared to replace broken strings.

The upper limits given for twisted strings including Catlines are not where it is likely to break. They are put where, in our experience, consistent with that of early writers, there is no advantage over cheaper, less-twisted types.

The lower limits are from two causes. One is the sound getting dull and unresonant because of an effect called inharmonicity where the harmonics in the tone are both weak, and out of tune with the fundamental. Let us call this lower limit ILL (inharmonic lower limit). The other is pitch instability where the pitch of the note is very sensitive to string stretching depending on how hard one plays on the string and the pressing of the string against a fingerboard. The sharpening of pitch by stopping a string is the more serious part of this effect. Let us call this lower limit PLL (pitch-instability lower limit).

The range between breaking and the ILL depends on:-

- (i) the material properties of tensile strength and elasticity

$$\text{frequency ratio proportional to } \sqrt{\frac{\text{breaking stress}}{\text{elastic modulus}}}$$

- (ii) the user properties of tension and string length

$$\text{frequency ratio proportional to } \sqrt{\frac{\text{tension}}{\text{string length}}}$$

- (iii) the aesthetics of the hearer as to how much inharmonic is too much.

The ranges given in the Range Guide are based on an octave and a 5th for plain gut, which we hear as just tolerable on an instrument with 2 $\frac{3}{4}$ Kg tension and 61cm string length. The PLL for plain gut is much lower than the ILL, so we can in this case respond to the inharmonic effect unhampered. With the same aesthetic response, the theory indicates that the ILL gets one semitone lower than that given by the Guide for every two steps (lines) on the Calculator longer than 61 cm that the string length is, and also for every 2 steps on the Calculator that the tension is less than 2 $\frac{3}{4}$ Kg. The ILL gets higher with shorter string length and higher tension by the same proportions.

The range between breaking and the PLL depends on:-

- (i) the material properties of tensile strength and elasticity

$$\text{frequency ratio proportional to } \sqrt{\frac{\text{breaking stress}}{\text{elastic modulus}}}$$

(ii) the user property of how much one stretches the string (depending on how far one pushes it from its original position and where along its length this happens)

frequency ratio proportional to  $\sqrt{\frac{\text{change in length}}{\text{original length}}}$

(iii) the aesthetics of the hearer as to how much sharpening is too much.

The ranges given in the Guide are based on a six-semitones range for iron as we deduced from the 16th century French cittern in our 1974 GSJ article. If one's action or frets were higher than was the case for those citterns or if one plays the strings harder or if one is fussier about intonation than 16th century Frenchmen, then the ILL would be higher than that given by the Range Guide.

Assuming constant user and aesthetic factors, the relative ranges of the various types of plain strings were calculated from their material properties with reference to the data on gut and iron given above, with the resulting ranges in numbers of semitones as follows:-

	gold	silver	brass	copper	iron	steel (piano wire)	gut	nylon
pitch instability	16	16	13	11	6	18	33	34
inharmonicities	16	16	13	12	10	22	19	20

The lower limits given for high-twist gut and Catline strings are ILL's consistent with both the increased elasticity resulting from the twisting, and historical data discussed in our GSJ paper.

When the range resulting from pitch instability is smaller than that from inharmonicity (copper and iron), on the Range Guide we give the PLL labelled for stopped strings and the ILL labelled for unstopped strings. When the range resulting from pitch instability is greater than that from inharmonicity (gut and nylon), on the Range Guide we only give the ILL. When the two ranges happen to be identical (gold, silver and brass) we give no label because there is no ambiguity, but if the ILL is to be lowered by longer string length or lower tension, then the PLL remains where it is, labelled "stopped", and the new ILL should be labelled "unstopped".

The © sign on the String Calculator is purely to protect us against being exploited by other people copying it to sell. We want to encourage FoMRHI members to make copies for their own use or to give as presents.

Our thanks to David Miller who checked it out for usefulness to a practising luthier and wrote the instructions for assembly.

There has been some discussion on the pages of this quarterly concerning the inadequacy of the formulae given in the literature by us and others for determining the main vibration characteristic (i. e. the frequency for any given string length and tension) of a composite string made from a solid core (with known density and diameter) wrapped around with a winding wire (of known density and diameter). At issue is the situation when the winding turns are all touching. We call this the "close-wound" case, distinguishing it from the "open-wound" case where the windings do not touch each other. We will here derive a new formula which serves for both cases and is accurate as far as we can measure.

We express the main vibration characteristic of the composite string as its "equivalent diameter," which is defined as that diameter of a simple uniform string made of the material of the core which has the same mass per unit length, and thus, with the same vibrating length and tension, gives the same fundamental pitch as the composite string does. The old formula<sup>1</sup> is

$$\left(\frac{D}{D_c}\right)^2 = 1 + \pi \frac{\rho_w}{\rho_c} \frac{D_w}{D_c} M,$$

where  $D$  is the equivalent diameter,

$D_c$  is the diameter of the core of the composite string,

$D_w$  is the diameter of the winding wire,

$\rho_w$  is the density of the winding wire,

$\rho_c$  is the density of the core,

and  $M = 1 + \frac{D_w}{D_c}$  in the close-wound case, and  $M = \sqrt{\left(\frac{D_w}{P}\right)^2 \left(1 + \frac{D_w}{D_c}\right)^2 + \frac{1}{\pi^2} \left(\frac{D_w}{D_c}\right)^2}$  in the open-wound case where  $p$  is the advance along the string of one turn of the winding.

These formulae were derived using the assumption that the winding wire had a circular cross-section. The following new derivation makes no shape assumptions and thus is not subject to the errors inherent in them. There is a new assumption, which is that as the core turns during string-making and rolls the winding over it, there is no slip between the winding wire and the core. As the core pulls the winding wire into a curve, the parts of the wire away from the core must stretch, but the part in contact with the core does not.

For the length of one turn the volume of the equivalent string is  $\frac{\pi D^2}{4} P$ , the volume of the core is  $\frac{\pi D_c^2}{4} P$  and the volume of the wire is  $\frac{\pi D_w^2}{4} \sqrt{(\pi D_c)^2 + P^2}$ , where  $D_w$  is the diameter of the winding wire just before it gets pulled around the core. The mass of each of these is the volume times the density, and the mass of the total equivalent string is the sum of the masses of the core and the winding wire. Thus

$$\frac{1}{4} \pi D^2 \rho_c P = \frac{1}{4} \pi D_c^2 \rho_c P + \frac{1}{4} \pi D_w^2 \rho_w \sqrt{(\pi D_c)^2 + P^2}$$

which reduces to the form of the old equation

$$\left(\frac{D}{D_c}\right)^2 = 1 + \pi \frac{\rho_w}{\rho_c} \frac{D_w}{D_c} M,$$

but where  $M = \sqrt{\left(\frac{D_w}{P}\right)^2 + \frac{1}{\pi^2} \left(\frac{D_w}{D_c}\right)^2}$ .

This formula is valid for both close-wound and open-wound strings. In our experience with close-wound strings the second term is generally less than 1/10 the size of the first. When this is true, the square root can be expanded into a binomial series with terms past the second insignificantly small. Thus, for close-wound strings, we can use

$$M = \frac{D_w}{P} + \frac{1}{2\pi^2} \left(\frac{D_w}{D_c}\right)^2 \frac{P}{D_w}.$$

In the following table we give measurements in thou (thousandths of an inch) for a half dozen strings of copper wound on gut that we recently made. In the calculation of  $D$  it was assumed that  $\rho_c = 1.3$  and  $\rho_w = 8.9$ .

$D_c$	$D_w$	$p$	$D_{calc}$	$D_{meas}$	% difference	overall diameter
34.5	5.25	5.25	71.3	72	-1.0	44.5
33.5	5.3	5.25	70.6	72	-1.9	43
36.5	7.5	7.2	86.5	86	+ .6	49.5
37	7.5	7.2	87.2	87	+ .2	50.5
45.5	15.5	14.5	135.6	135	+ .4	71.5
44.5	15.5	14.5	133.9	135	- .8	70.5

For the strings measured, the second term in the M expression  $\frac{1}{2\pi^2} \left(\frac{D_w}{D_c}\right)^2 \frac{P}{D_w}$  made less than a .6% difference in the value of M, with less error contributing to the calculated D. So in many cases this term can be ignored and we need only use  $M = \frac{D_w}{P}$ .

It is important to measure the right  $D_w$  and  $D_c$ . We found that, when compared to the diameter in storage, the gut core lost about  $1\frac{1}{2}$  thou (3-4.5%) on drying, pre-stretching, and undergoing the tension in the winding jig. During winding the string stretched about  $\frac{1}{2}\%$ , so our  $D_c$ 's as measured before winding were  $\frac{1}{3}\%$  too high. We chose to ignore this effect, considering the level of precision in our data. We found that at the tension with which we fed the wire to be wound, it stretched and lost 3 - 6% of its diameter, so this is a most important effect to monitor if accurate predictions of the equivalent diameter are to be made.

Our data give some indication of the actual shape of the windings. The overall diameter of the wound string was less than the sum  $D_c + 2D_w$  by an empirical factor which was about  $0.6 \left(\frac{D_w}{D_c}\right)^2$  in the range measured. This indicates that the winding wire is flattened against the core or that the winding is imbedding into the core, or (most likely) both. It will also be noticed from the table that the length along the string for each turn ( $p$ ) is usually less than  $D_w$ . In the range measured,  $\frac{D_w}{P}$  can be approximated empirically by  $1 + 0.2 \frac{D_w}{D_c}$ . We could expect  $p$  to be slightly greater than  $D_w$  because the angle the winding makes with the string axis is less than  $90^\circ$ . The fact that  $p$  is less than  $D_w$  indicates that the winding is flattening against the previous winding and gets flattened by the next winding. The amount that  $\frac{D_w}{P}$  differs from 1 depends on the angle of feeding and the feeding tension that the string-maker uses for each  $D_w$ . The value of  $D_w$  also depends on the feeding tension. Thus, if the string-maker wants an accurate prediction of the D from a given diameter of core and winding wire in stock, he must empirically determine how  $\frac{D_w}{P}$  and  $D_w$  vary over the range of stock wire diameters for his style of winding (and try to keep this style consistent) as well as empirically determine the relationships between the core stock diameters and the true  $D_c$ 's under tension in the winding jig.

## REFERENCES

1. D.A. & E.S. Strings in the 16th and 17th Centuries, GSJ XXVII (1974) p 73

## APPENDIX I -- ERRORS

If we let  $\{ \}$  mean the absolute percent error, a simple analysis of our equation gives  $\{D\} = (1-N)\{D_c\} + N[\{p\} - \{D_w\} + 2\{D_w\} - \{P\}]$  where  $N = \frac{1}{2 \left[ \frac{D_w}{D_c} + 1 \right]}$

For strings measured here, N was about 0.3 ( $\pm .05$ ). (A statistical analysis of random errors would involve the square root of a sum of squares.) It is remarkable that our maximum error was less than 2%, and the average error magnitude was 0.8%. An error of 0.2 thou on the estimation of  $D_w$  of our thinnest wire

could easily be the case, and this would affect D by well over 2%.

The value of 1.3 for the density of gut is subject to much variation, but this does not affect the comparison fully as seriously as it might seem to. The measurement of D was deduced from a sounding frequency (f), using a standard length (l) and tension (T), and the same assumed value for the gut density was used. For this measured D,

$$\{D\} = \frac{1}{2} \{T\} - \frac{1}{2} \{\rho\} - \{l\} - \{f\} . \quad \text{This expression}$$

says that the measured D is reduced by a percentage which is 0.5 times the percentage that  $\rho_c$  is too big. The calculated D is similarly affected, but by a factor N (approximately 0.3) instead of 0.5. Thus the comparison of measured and calculated D's is only affected by the difference, or a factor of 0.2.

#### APPENDIX 2 -- The winding parameters in the close-wound case

We assume that, when viewed perpendicular to the string axis, the position of the centroid of the winding cross-section lies along a sine curve  $y = r \sin \frac{2\pi x}{p}$

where x is along the string axis direction. This curve crosses the axis at an angle  $\theta$ , and this is given by  $\tan \theta = \frac{2\pi r}{p}$ . The amplitude r of the sine

curve is less than  $\frac{D_c + D_w}{2}$  because of flattening of the winding wire on the core surface, and its embedding into the core. It is probably greater than

$\frac{D_t - D_w}{2}$ , where  $D_t$  is the total overall diameter, because of the stretching during winding of the parts of the winding wire away from the core. We shall estimate r as the average between these two values, so that  $\tan \theta = \frac{\pi}{2} \frac{D_c + D_t}{p}$

We define  $\delta$  such that the  $D_w$  of the winding is reduced to  $\frac{D_w}{1+\delta}$  by compression with other windings in the close-wound string. This reduced value divided by p is  $\sin \theta$ , so  $\frac{D_w}{p} = (1+\delta) \sin \theta$ . Combining this with the expression for  $\tan \theta$  given above leads to  $\left(\frac{D_w}{p}\right)^2 = (1+\delta)^2 - \left(\frac{2 D_w}{\pi(D_c + D_t)}\right)^2$

The second term is so small compared to the first that, when taking the square root, the expression can be approximated by the first two terms of a binomial formula expansion  $\frac{D_w}{p} = 1 + \delta - \frac{2}{(1+\delta)\pi^2} \left(\frac{D_w}{D_c + D_t}\right)^2$ .

We would expect  $\frac{D_w}{p}$  to deviate from 1 most strongly when we had a relatively thick winding on a relatively thin core. Such a case would be when  $D_w = D_c$ , when the last term in the above equation becomes about .012. This indicates that when high accuracy is not required, this term can usually be ignored.

Data on the experimental comparison of  $D_w$  and p with such thick windings needs to be taken to follow the behavior of  $\delta$ . Our empirical equation  $\delta = 0.2 \frac{D_w}{D_c}$  may not hold here. Similarly, our empirical equation  $\beta = 0.6 \left(\frac{D_w}{D_c}\right)^2$  where  $D_t = \frac{D_c + 2 D_w}{1 + \beta}$  could also fail to apply. We would not expect these equations to be relevant to other string materials and other string-makers.

We must be thankful that Cary experimentally tested Benade's statement on various metals, while our practical experience with it was only with gut and nylon. Our theory assumes that the main bearing of force in the string is by structures which become helical on twisting. It is a pity no tests have been reported of the effect of twisting on strings of wrought iron, a material which is characterized by long thin inclusions of impurities which would become helical on twisting. If the inclusions are frequent enough, it is possible that their effect on the iron in between them might be to give some elasticity on twisting. We don't say it would work, but only that it might be worth a try.

We see no fishiness in Mersenne's tensile strength measurements. His anomalously low value for gut is very easy to explain, in that strength in gut is very dependent on age and original quality. His comments which allow us to calculate a tensile strength were incidental when he was not concerned with the issue of tensile strength, as he was when giving the data on metals. Therefore one shouldn't expect him to have used fresh prime gut for the reported experiment.

Mersenne's values for silver, iron, and brass are perfectly consistent with modern data, assuming that he used a 25% copper-silver alloy, plain iron, and a 25% zinc brass (as has been analysed in old brass strings by Odell and Goodway at the Smithsonian Institution.) Odell and Goodway also determined that old red copper strings were not just copper, as had been previously supposed, but a 10% tin brass. Mersenne's measurements may well be correct for such an alloy. Similarly, Mersenne's measurements for "gold" strings may be explained if the gold were alloyed with copper. (Perhaps 75/25 would bring it up to Mersenne's measurements of tensile strength, as it does in the case of silver alloy.)

We'd like to hear from anyone with data on tensile strength in hard-drawn wires of such alloys.

I guess that I should have been more expansive in my Comm. 86 regarding the effect of wood swelling on instrument bores. When I assumed "uniform" swelling of  $\frac{3}{8}$ %, I intended to mean uniform in the two directions --- radial and tangential --- and not uniform across the thickness at any point, as Paul Hailperin inferred. He correctly points out that the bore gets smaller because it is moistened more on the inside. As a practical experiment I soaked a bored cylinder of cherry wood in water for 24 hours. The dry dimensions were o.d. 63.5 mm. and i.d. 33.5 mm. The wood swelled by  $\frac{7}{8}$ % in the radial direction and  $\frac{4}{8}$ % in the tangential direction. The bore was increased by  $\frac{1}{8}$ % in the radial direction and by  $0.6\frac{1}{8}$ % in the tangential direction. These numbers are, of course, greater than the change that would be expected from changes in atmospheric humidity, but they are in the same direction.

John Rawson

Many people making Instruments are using machines but have not worked in commercial workshops or with other people. Working with others does let one have experience of accidents without being injured oneself.

In Britain there are now Health & Safety Regulations that apply to even self-employed people, but there is little to prevent such people obtaining and using machines which do not comply with them. This is particularly the case with old industrial equipment which may be cheap and very suitable for the work involved.

A knowledge of the most dangerous things will give one a better chance of survival. Obviously one is assumed to be competent and careful, but danger lies in starting up unfamiliar machines for the first time, and in undertaking certain operations with the guards removed, because they get in the way.

1. Bandsaws. Modern enclosed saws are reasonably safe. The main danger lies in cutting your fingers off by pushing on a piece of wood that turns out to have a defect in it which lets it rush past the saw. Use a push-stick or put your hands beyond the blade. Also there are some old machines around which are not properly guarded so that a broken blade can fly out.
2. Cross-cut and radial-arm saws. Hold the wood well clear of the blade. When cutting wide planks beware of the saw running forward onto the work, but this will usually result in a stall. Normally pieces that are cut off and thrown will go away from the operator.
3. Saw benches. If the wood pinches on the blade it can be thrown. So stand out of the line of fire and use a guard and splitter if you can. Repeated feeding will widen a closing cut, but be careful.
4. Belt Sanders. If you must use them face up to sand small objects keep your fingers well away from the place where the belt goes back inside the guards. A finger stuck in there will get a dreadful abraded wound.
5. Overhand Planers. If a blade comes out of a running machine it could terminate your career. The least you can do is to stand out of the line until you are sure that it is running safely. Don't imagine that a bridge guard will hold a flying knife down. Modern machines have positively fixed blades but some old ones rely only on friction. Tapering on planers with the guards off has had some well-known makers fingers. Use another method.
6. Thicknessers. The same goes for these. A flying blade might cut its cover open. More usual is cross-grained wood breaking up inside the machine. Stand away from the feeding line.
7. Spindles. Reputedly the most dangerous machine. Blades are constantly being changed, are only held in by friction, and can come out in all directions at table level. Experienced machinists put a big block of wood on the table in front of them when starting up.

8. Woodturning Lathes. Beware of turning legs with squares left on. They can be hard to see and can smash your fingers. Generally if the wood breaks up it flies away from the operator (but check where it might go).

There are some general points:-

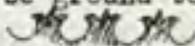
- a. Don't locate a machine so that in the event of an accident its line of fire will project shrapnel into someone else's work space. (or a parked instrument)
- b. Machines should have No-Volt starters so that they do not start up unattended after a power failure. But this does prevent you turning on a suspect machine locally with the mains off and then retiring to a safe distance before switching on. If you have any doubts crouch down below table level before you press the button.
- c. Be Extra careful if you are tired, working at night, or alone.

#### VELLUM AND PARCIENT ROSES

FoMRHI Comm.167

John Rawson

I write from the point of view of the Harpsichord maker, and harpsichords generally have cruder roses than guitars and citterns.. However, for what its worth, here are some hints.

1. Roses are generally multi-layer constructions involving glue. I have no answer to the adhesion problem (can anyone help?). It needs to be an invisible thin clear substance that will stick to the hard greasy surface of Vellum. Sandpapering the surfaces to be joined before cutting them greatly increases the chance of Titebond or white glue holding. Pressure can be applied with a vice or an old letter press.
2. Using punches makes for speed and accuracy. The trouble with ordinary hole punches is that they are ground on the outside and leave bent-down holes like this:  Old work is notably sharp-edged like this:-  For holes under 2mm diam therefore use solid pin-punches. These can be driven through the vellum into a lino backing ( better than wood as it has no grain) and leave a sharp edge. They are available in various sizes and can be ground down to make smaller sizes and non-circular shapes.
3. Ordinary hole-punches with outside bevels can be ground to a half-circle to use as cutters for D-shaped projections. So that  is made of a row of large holes, pairs of small D's and scalpel-cut points.
4. Straight lines are cut with a scalpel.
5. Multi-layer jobs are done by cutting the top layer first, gluing it to a blank sheet and then cutting through that and so on.
6. Little trees are formed of pieces stuck on a pin. Paint the head of the pin.

7. Separate layers can be held at the right levels in a well formed, sometimes perforated.
8. Wooden parts can be carved with wood-engraving tools.
9. Use of a binocular magnifier helps if your eyes are not as good as they might be. In any case it improves the quality of eye-defeating accuracy.
10. It is quite possible to copy the finest old work but you may find that it takes a very long time.

### Queries

a. Adhesives?

b. I do not know how to cut the very finest free Gothic tracery, where the vellum is not strong enough to stand the strain of cutting.

FoMRHI Comm. 168

### PLANES FOR SHAPING ARCHED BELLIES OF STRINGED INSTRUMENTS

A.F.Young

Not long ago, most FoMRHI members, I'm sure, received an ad for "the most beautiful planes in the world" but with prices that were out of this world. The planes I want to tell you about are not as fancy but you will find them worth their weight in gold.

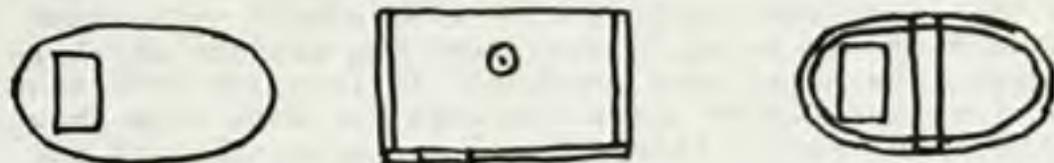
In Germany they are called "Wölbungshobel" and are absolutely indispensable to people who make viols and violins. They usually come in four sizes:

25mm	long	with	8mm	blade
30mm	"	"	10mm	"
37mm	"	"	12mm	"
46mm	"	"	18mm	"

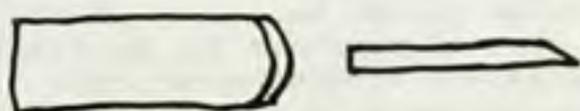
The prices here in Germany start for the smallest at around DM50,- but there is a way of getting them that will cost you only a few hours work. My sizes vary slightly from the standard but they work just as well.

For a plane with a 10mm blade, start off with a ring 17mm high cut from a piece of thick-walled brass tubing (1-1.8mm) with a diameter of about 25mm. Press this together in a vice to form an ellipse approx. 32mm x 16mm. Next, cut from thick sheet brass (1.5-2mm) a sole for the plane, taking the pattern from the elliptical ring. Approx. 5mm from the end of the sole, cut out a rectangular hole 10mm x 6mm. Braze or silver-solder the sole to the elliptical ring. Exactly in the middle of the

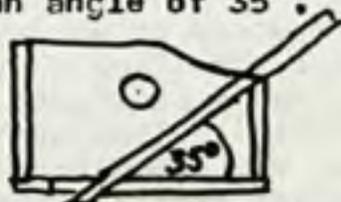
long side of the ellipse and 7mm from the top edge, drill a 3mm hole through both sides. Insert a piece of 3mm drill rod and solder in place. File and sand the sole and drill rod flush with the body of the plane.



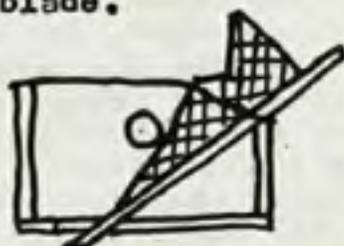
The blade can be made from a small flat file, ground down to 2mm thickness. The edge is slightly convex and is ground to an angle of ca.  $35^{\circ}$ .



With a small flat file, the mouth and the top edge of the plane where the blade lies should be filed out so the blade and the sole form an angle of  $35^{\circ}$ .



From a piece of rosewood, or any other hard wood, cut out a wedge. The wedge should be long enough and thick enough that the top end rests about on the top edge of the plane, does not come closer than 3mm from the mouth, and should fit very tightly between the drill rod and the blade.



Some people prefer to have the sole of the plane slightly arched as well. It is not absolutely necessary except on very small instruments (violino piccolo). However, the arching can be done very easily on a belt sander. Do this before you insert the blade!

The same process applies to the other sizes. If you are reasonably skillful, you should be able to make a whole set in less than a weekend.

Communication 71 makes a suggestion that timber may be "conditioned" by a process called "humidity cycling". It is important that all those working with wood should understand clearly that there is no state that wood can achieve which is entirely free from subsequent movement. It is quite true that dry timber (meaning timber which contains not more than about 20% moisture after air or kiln drying) may move after it has been sawn. It is also true that even very old timber will change its shape if the surrounding atmosphere changes. There are two ideas here; the first is that there are stresses in timber which are relieved when the timber is cut, with a resulting change in shape and the second is that there will be changes in shape as a result of changes in humidity. It looks very much as if the Authors might be saying that this second type of change is also a case where the timber has not been conditioned. Anyone working with wooden soundboards should know that there is nothing you can do to prevent this sort of movement as the cells of dry timber take in or give up moisture according to their surroundings. Perhaps the Authors do not mean to include this type of change in their category of timber which has not been "conditioned" and it should certainly be made clear that changes due to the humidity of the surroundings are inevitable. The nature of the change depends very much on how the wood has been cut with respect to the grain.

The "humidity cycling" process consists of alternate soakings and dryings. The Authors explain that: "Wetting a dry board with internal stress gives the fibres enough mobility to release some of that stress (by further warping)." (Footnote 4). Unfortunately this isn't true and my own ideas were confirmed by the Head of the Seasoning Department at the Timber Research and Development Association (TRADA). It requires several hours of steaming to achieve sufficient plasticity for slip to occur between the cells and for the stress to be relieved. This technique is used to recover compression-set timber for normal use but after treatment the timber will still be subject to the normal forms of degrade on further conversion. All that "humidity cycling" might achieve is surface checking and this process is therefore positively to be discouraged. One sees billets of wood that have this surface checking due precisely to the effects of alternate wetting and drying that occur with air drying. It is fanciful to suggest (as the Authors do) that air-dried timber will be less stress-set than kilned timber since "humidity cycling" is not capable of doing what the Authors argue.

In paragraph 2, page 46, the Authors explain exactly what they suppose to happen when they wet the wood: that there are some parts of the wood that "don't get wetted at all when we soak the wood." It is surprising that the Authors do not see that the converse of this situation is the initial drying of timber, which, as they rightly warn, leads to defects if the drying is not even. Surface checking can be caused at either the initial or subsequent drying. Thus the logic of their own explanation conflicts with the suggestion they make.

The technique of hosing down timber mentioned is intended to avoid surface checks on the outside of the timber but if it is not carried out correctly it will lead to compression-set on the surface. This has nothing to do with "humidity cycling".

E.S. and D.A. reply:

We have used our humidity cycling procedure on European spruce, Canadian Sitka spruce and sycamore. All samples of both types of spruce showed no noticeable changes after treatment. The majority of our sycamore pieces showed a noticeable warp and a small minority developed one or two splits as a result of one or two cycles of treatment, with no change occurring on subsequent cycles. We have gone up to five cycles to determine whether there were any progressive effects on the wood, and found none. The only surface checking found was an insignificant bit on the end grain of the sycamore.

This is our practical experience. We are sorry if this conflicts with accepted theory and with the opinions of a leading authority. The usual procedure in Science since the Renaissance, that has been used when a reported experiment conflicts with a theory, is for the defenders of the theory to repeat the experiment. They will either find errors in the original experiment which removes the conflict with the theory, or they will confirm the experiment in which case the theory is modified to remove the conflict. It is a pity that Wraight has not done this for, whatever the outcome, his communication would then have been much more constructive than it is.

We will argue his points paragraph by paragraph.

Paragraph 1. Starting on the 10th line of his Comm. he says that there are two ideas involved: relief of stress by cutting, and changes of shape with humidity changes. The main point of our Comm. is that there is a third idea: that of residual unbalanced stresses in the wood after cutting which can be relieved by a few humidity cycles. We were not concerned with subsequent reversible variations in shape with humidity changes which everyone experienced in woodworking is well aware of.

Paragraph 2. The conflict with our experience may be more in Wraight's interpretation of the theory than with the theory itself. Surely the "several hours of steaming . . . . for the stress to be relieved" is not a general property of wood as a material. It clearly depends on the size of the piece of wood, since a couple of minutes of steaming is usually sufficient for a viol bridge that has been bent by continuous string pressure to spontaneously straighten up. Our experience with lute-neck-size pieces of sycamore indicates that the many hours in the drying part of the humidity cycling when the wood is at elevated temperatures and still has plenty of moisture in it is equivalent in effect to the "many hours of steaming" on the samples that statement referred to. We are not sure whether Wraight, in writing that humidity cycling "is not capable of doing what the authors argue", was debating theory or claiming that we reported observations that we did not observe.

Paragraph 3 We are perfectly aware that the converse of the rewetting of dry wood is the initial drying of green wood. This refers to the relationship between the internal regions with easy moisture transfer to and from the outside, and those regions with much less easy transfer. It is clear that Wraight has not perceived the logical consequences of this the way that we do. In the green wood both kinds of regions are swollen. Initial drying if too precipitous can contract the easy-transfer regions so effectively that their use as passages for the slow drying of the less-accessible regions is effectively blocked, and so water-swollen regions can be locked inside. This is the reason why great care in controlling the drying rate is necessary. In the dry state, both types of region are contracted, and rewetting swells only the easy-transfer regions. The stresses between the contracted and the swollen regions are in this case opposite to those in the first case. Each type of stress can cause splitting initiated in the contracted regions. The stresses in the initial drying of green wood are to be avoided because the splitting that it produces spoils wood that will never be at risk again by that same stress configuration. The stresses in rewetting dry wood, according to our logic, are to be welcomed because they are just the stresses that the wood is likely to encounter in its subsequent use. If a region of

the wood is not strong enough to withstand these stresses and so splits, the earlier this fact is discovered, and the piece of wood rejected, the better. If it survives the rewetting without splitting we can have confidence that it will not split because of high moisture in its environment when in an instrument. As stated above, most of the warping and relief of residual internal strains occurs in the early stages of the heating cycle. In the later stages of the heating cycle the wood's low moisture content simulates the worst conditions of low humidity that the instrument would ever encounter. If the instrument is assembled with wood at this low moisture content we have no fear of splitting in dry climates.

We can see that in some circumstances humidity cycling might not be necessary. If the log were so selected that the probability of internal stresses were minimal, and if the variations in environment that the instrument is subjected to are not too extreme, good kilning or air-drying could be enough. When making instruments for export or for use by professional players on tour - instruments which could be put in the baggage compartments of aeroplanes or left in parked cars on a hot day - insurance against extremes of environmental conditions is essential.

Paragraph 4. We must thank Mr. Wraight for informing us and the readership of the reason that kilners give for hosing down the timber. He is obviously more conversant with practices in the timber trade than we are.

Comm. 158. ON THE SIZES OF SURVIVING ENGLISH VIOLS. Continued from p. 42.

We do not know what to make of the solitary specimen that fits into the modern tenor range. It is number 1/5 in the Catalogue of the Victoria and Albert Museum.

It is clear that bass viols came in all kinds of sizes. That is why Mace had to write "And be Exact in That, take This Certain Rule, viz. Let your Bass be Large" and later "add to all these 3 Full-Seiz'd Lyro-Viols:" The sizes of Mace's consort bass and lyra viols were probably similar to those measured by Talbot.

Talbot's measurements on the division viol are internally inconsistent indicating that there must be an error. When one tries to draw the instrument the error is easily found (3 inches in the fingerboard length). When this is corrected the string length is identical to that given by Simpson, i. e. 30 inches (76 cm). When a viol is drawn out according to Talbot's dimensions the proportions are very similar to the instrument Simpson is playing in the famous illustration, and in contrast with the more slender body shape of the other viols Talbot measured. This might indicate that late 17th century division viols had a distinctive shape - short dumpy body, corresponding with the right edge of the large cluster of bass viols in the plot.

One might question what happened to all of the large consort basses of which we presume Talbot's was a typical example. We can offer a guess. Viols were made, and therefore played in England well into the second half of the 18th century. The early 17th century Fantasies that we enjoy so much today were probably ignored in that subsequent century. Little music specifically for viols was produced in England then, but much more was being produced in France, and so it is likely that the English played mostly French repertoire.

It is thus likely that the French style of viol stringing was also adopted. This took some time. The French started using overspun strings in the 1670's, introduced by St. Colombe according to Rousseau. Yet in England, even as late as the time Talbot was writing, around 1690, all-gut strings were still preferred. Once the sound of overspun strings becomes accepted on a largish instrument, there is a tendency to make new instrument of that type smaller, and then to cut down the old

large ones . (e.g. this happened with the cello.) The smaller size makes left-hand fingering easier, and with overspun strings there is not the same sacrifice in bass tone that results from shortening an instrument with all-gut strings. T.B. in 1722 still specified a 30 inch string length for the division viol, so the use of overspun strings and shorter instruments was not universal in England even then. But eventually the French influence won out completely, and the large consort basses became redundant since smaller viols using overspun strings now performed their function more easily.

These large instruments were getting old, and old wood has always been highly prized for the making of new instruments and for repairs. We are convinced that these instruments were quickly cannibalized and that pieces of them still survive incorporated into other instruments.

The large sizes of English treble and tenor viols of all periods and the consort basses up to Talbot's time can be tuned to the pitches stated, only if the pitch standard is at least a tone below the modern standard. This is the main difficulty standing in the way of adopting authentic viol sizes today.

FoMRHI Comm.170

## BLOWN RESONANCE OF BAROQUE TRANSVERSE-FLUTE

### 1. PITCH AXIS AND WIND BANDS

Every flute has its own distinctive features inherent in given instrument type in the broadest sense. At the same time it has its own individuality expressing the musical-artistic conception of its creator. All sorts of specific instruments convey the type by its total construction and simultaneously eliminate this type by its individuality. In any case the acoustic study outcome of whatever specific instrument always connected with solving of the problem: to separate the typical features from the specific ones. The decision of this problem is not always possible. In these cases it is appropriate to use the logic of statistical investigations identifying the typical with the most possible. From comparison between several peculiarities the average is inferred in which the typical is reflected in that sort of its conception. As regards the more specific, that is fixed, finding its expression in those values which are describing a degree of data diversity used for the inference of the average. Thus together with definite conclusion we obtain the evaluation of its reliability.

Being influenced by these considerations I have conducted frequency measurements on all baroque flutes of Leningradian Musical Exhibition which were found in suitable condition for playing and which had avoided the modernizations. I venture to enumerate the instruments meeting these two requirements: 1) N°464 - the flute made by Paul Villars, ca:1750, boxwood with ivory finishing, silver key obviously placed later and having typical traits of English work (Cahusac?): 2) N°468 - the work of anonymous master, ca:1750, box-

wood with ivory finishing, original key is missing, while restoration a brass key has been made; 3) N°469 - the flute of Martin Lot's work, ca:1780, plum tree with ivory, the flute has lower c : c - and dis-keys were not preserved; there is "2" stamp on the preserved upper middle piece, evidencing the existence of several changeable middle pieces permitting to use the instrument in several pitches; with that purpose the lower hole of tube has the tuning apparatus of uncommon construction; 4) N°471 - the flute with Hotteterre stamp, ca:1700, the head and middle parts of boxwood, cap, footpiece and barrel of ivory, silver key; 5) N°472 - the flute morphologically and acoustically identical with previous one, the head and middle pieces of sandalwood(?), cap, barrel and footpiece of palisander, silver key, there is not any stamp on the flute; 6) N°853 - the flute made in 1778 by Potter Senior, tinted boxwood with ivory finishing, silver key; 7) N°855 - the flute with I.G.T. stamp (Tromlitz?), ca:1770, boxwood with ivory finishing, silver key, the flute has 5 changeable middle pieces for playing in 5 different pitches and footpiece with adjustable length. For the present work were used the data received by frequency measurements on the flute with N°3 middle piece - the most correct version by the pitch.

The frequency measurements have been conducted on the seven above enumerated flutes. Basing on reasonable requirements to obtain and compare experimental data by standard methods, I used the same fingering on different flutes, ignoring the fact that on some of them the more suitable may be used. Due to the same reason the data by upper register where, as it is known, every flute for some tones requires different fingering than other are not cited. Measurement and data treatment methods have been described earlier. (Bull. FoRMHI, N°11, com. ...), therefore I only briefly remind their principal traits. On every fingering firstly such high tone is blown as it is possible. Its frequency is measured. Then the lowest frequency of possible ones by given fingering and given frequency mode is blown and measured. Thus

the data are obtained which are logarithmarized and compared with the frequencies of equally tempered pitch tones. Proceeding from above mentioned requirements to provide the comparability of the data compared it is assumed in the present work that the absolute pitch height is such by which the frequency maximum of lower flute tone ( $d_1$ ) represents the pitch frequency. In other words, the pitch axis by this turns out somewhat higher than actual instrument pitch, in return we get rid of the pitch dependence of air temperature by which the measurements have been conducted.

As a result of comparison between the pitch frequencies by each flute the relative values of maxima and minima of every measured tones are received. Now thanks to the fact that these are not connected with concrete pitch uniform data, they are comparable. According each of these data the mean arithmetics have been obtained by the formula:

$$\bar{x} = \frac{1}{n} \sum_{i=1}^n a_i \quad (1)$$

where  $\bar{x}$  - mean value,  $a_i$  - relative frequency obtained on the base of frequency measurements of each of flutes,  $n$  - the number of the flutes measured. For an evaluation of original data dispersiveness a standard deviation calculated by the following formula is used:

$$\sigma_s = \sqrt{\sum_{i=1}^n (\bar{x} - a_i)^2 / n - 1} \quad (2)$$

where  $\sigma$  - standard deviation and the other designation are the same as in the previous formula. The data obtained as a result are represented in the Table I in logarithms and in form of diagram in Fig.1.

TABLE I  
Upper and lower limits of baroque flute tone band width in comparison  
with tone frequencies of equally tempered pitch

Tone	Fingering	MAXIMA		MINIMA		Band width
		Average $\bar{x}$	Standard deviation $\sigma$	Average $\bar{x}$	Standard deviation $\sigma$	
d	X XXX XXX	0.0000	-----	-0.0379	0.0049	0.0379
dis	O XXX XXX	0.0027	0.0026	-0.0389	0.0081	0.0416
e	X OXX XXX	0.0114	0.0023	-0.0336	0.0081	0.0450
f	X XoX XXX	0.0213	0.0050	-0.0342	0.0130	0.0565
fis	X OOX XXX	0.0029	0.0037	-0.0480	0.0121	0.0509
g	X OOO XXX	0.0149	0.0050	-0.0310	0.0158	0.0459
gis	X XXX OXX	0.0227	0.0081	-0.0328	0.0104	0.0555
a	X OOO OXX	0.0204	0.0064	-0.0341	0.0123	0.0545
b	X OXX XoX	0.0285	0.0088	-0.0276	0.0130	0.0561
h	X OOO OOX	0.0241	0.0063	-0.0428	0.0180	0.0669
c	X OOO XoO	0.0287	0.0075	-0.0285	0.0178	0.0572
cis	X OOO OOO	0.0264	0.0061	-0.0388	0.0206	0.0652
d	X XXX XXX	0.0049	0.0059	-0.0216	0.0101	0.0265
dis	O XXX XXX	0.0067	0.0061	-0.0200	0.0103	0.0267
e	X OXX XXX	0.0134	0.0058	-0.0170	0.0109	0.0304
f	X XoX XXX	0.0174	0.0065	-0.0089	0.0064	0.0263
fis	X OOX XXX	0.0077	0.0062	-0.0272	0.0093	0.0359
g	X OOO XXX	0.0183	0.0025	-0.0126	0.0071	0.0309
gis	X OOX OXX	0.0227	0.0052	-0.0073	0.0078	0.0300
g	X OOO OXX	0.0171	0.0060	-0.0127	0.0118	0.0298
b	O XXX OXX	0.0185	0.0086	-0.0134	0.0091	0.0319
h	X OOO OOX	0.0183	0.0054	-0.0165	0.0079	0.0348
c	X OXX OXo	0.0225	0.0062	-0.0107	0.0097	0.0332
cis	X OXX OOO	0.0151	0.0062	-0.0208	0.0121	0.0359

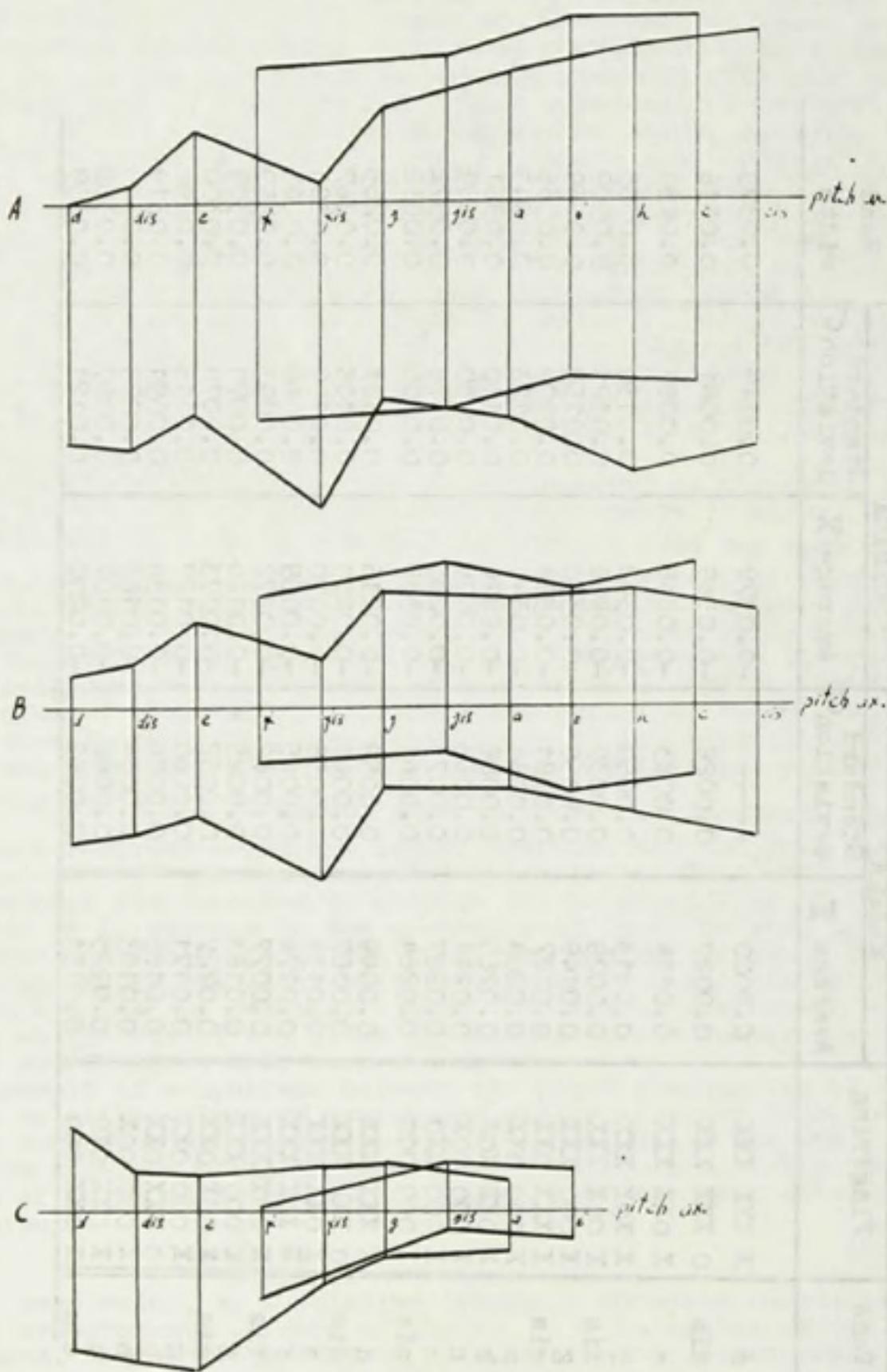


Fig.1. Diagram representing the data of Table I.

In the Fig.1a the data of Table I for the lower register are graphically represented, and in the Fig.1b - for the middle one. In spite of the fact that by the upper register the similar data have not been obtained, it is useful to place the conformable diagram for the fullness of picture. For this purpose the data obtained on one instrument - N°471 (Hotteterre) have been used. This flute by multiple playing investigation has been evaluated as very well tuned. Measurement results are demonstrated in the Fig.1c. In summary it should be said that the tones taken crossfingering are acoustically dissimilar with natural tones, so in the diagram the tones taken crossfingering and the natural ones are combined in separate groups, thus intensifying the obviousness.

It is impossible in the brief report to consider in detail all conclusions which can be driven from the data obtained, so we shall review only the general. The diagrams illustrate well the intonation problems of baroque flute and contribute to comprehension of their decision methods.

The first of these problems is the tuning out of f-fis tones in the lower register. In succession of crossfingering-tones f occupies a special position. (If reasoning pure formally then the fingering for e and Gis looks quite analogous; as for e' in the baroque flute if the presence of key is taken into account, it represents a constant key of its kind, although in genetic respect it should undoubtedly be regarded as "natural". At the same time for every lower hole of any woodwinds there are acoustical foundations to classify the tone taken from it, at least on the lower mode, as the crossfingering tone. In any case, the flute mouth only to a certain extent is subjected to a consideration in the capacity of common finger-board hole, the farther of it the lowest hole is situated, such consideration becomes less appropriate.) In given work e tone will be considered as a natural one. For the lower flute register the typical crossfingering picture is three closed holes altering a given hole. As three holes do not gather below the hole where f is taken, the problem is obvious. The diagram helps to understand the method of its solution. We see the peak on e evidencing that on the first hole from the bottom (excluding the hole with key) that part of contribution in total rise is distributed which should be brought by the second hole. Approximately by the same value the fis band is lower as expressed by the deep observed on it. This is naturally intensifies the effect of first hole closing. Owing to this it is possible to take an acceptable f, however the diagram shows that the compromise does not solve the problem completely. E has a tendency to sharpening, while for fis somewhat forced taking is necessary. This holds true also for the middle register. If to recall here Gis susceptible to sharpening, then it is clear why it is not easy to play harmoniously a descending sequence a fis Gis e especially in the middle register on the baroque flute. And if this task is comparatively easily fulfilled on the flute N°471, it represents "experimentis crucis" for the instrument N°855.

The general rule for woodwinds could be formulated as following "in order to obtain the effective crossfingering it is necessary to have sufficient number of open holes below." When there are few such openings the problem will arise. (The effectiveness of crossfingering is determined also by a number of causes which do not considered here.) An engineering-acoustic thought of baroque flute creators choose a decision considered by us. Following such course it is reasonable to have an Ionian tetrachord below. Then the altering for the next opening is unnecessary - it itself gives a rise by semitone,

As for the holes situated beyond, the above formulated rule is implemented well for them. Generally speaking from that point of view it makes more sense to use the Dorian tetrachord below, when *f* is a natural tone taken from the second hole while the third hole from the bottom is altered for *fis*.

It is seen from the diagram that the higher the tones in the registers the wider bands they have. This expansion of bands is quite natural and its causes have been considered (see e.g. Benade JASA, v.31, N°2, pp.137-146, 1959). If the dimensions of the holes are small enough and do not differ significantly one from another, then the alteration is quite possible, though it is seen by the diagram that the crossfingering tones are susceptible to sharpening in both registers considered. This constitutes one of baroque flute peculiarities and a modern flutist ought to take it into account and to correct the blowing accordingly.

It is useful to regard the location of upper band limits concerning the pitch axis. It is seen by the diagrams that the higher tone in the register, the farther from the pitch axis is the upper limit of its band. However the playing experiments show that the upper tones are not inclined to sharpening. For explanation of that fact let us recall that the wider band the tone has, the lower with respect to upper band limit the zone of timbre optimum is situated. Quite naturally that namely on this latter the band relatively to the pitch axis should be placed by the development and tuning of instrument. Besides in this one of the important sound-artistic means consist so variously used by baroque flute creators. The nearer to the pitch axis the top of timbre band optimum zone is situated the brighter is the tone and vice versa, the lower part of timbre optimum falls on the pitch axis, the softer is the sound. Taking an opportunity of this means the instrument timbre on the whole can be described, the contrasts between the registers can be smoothed out considerably etc.

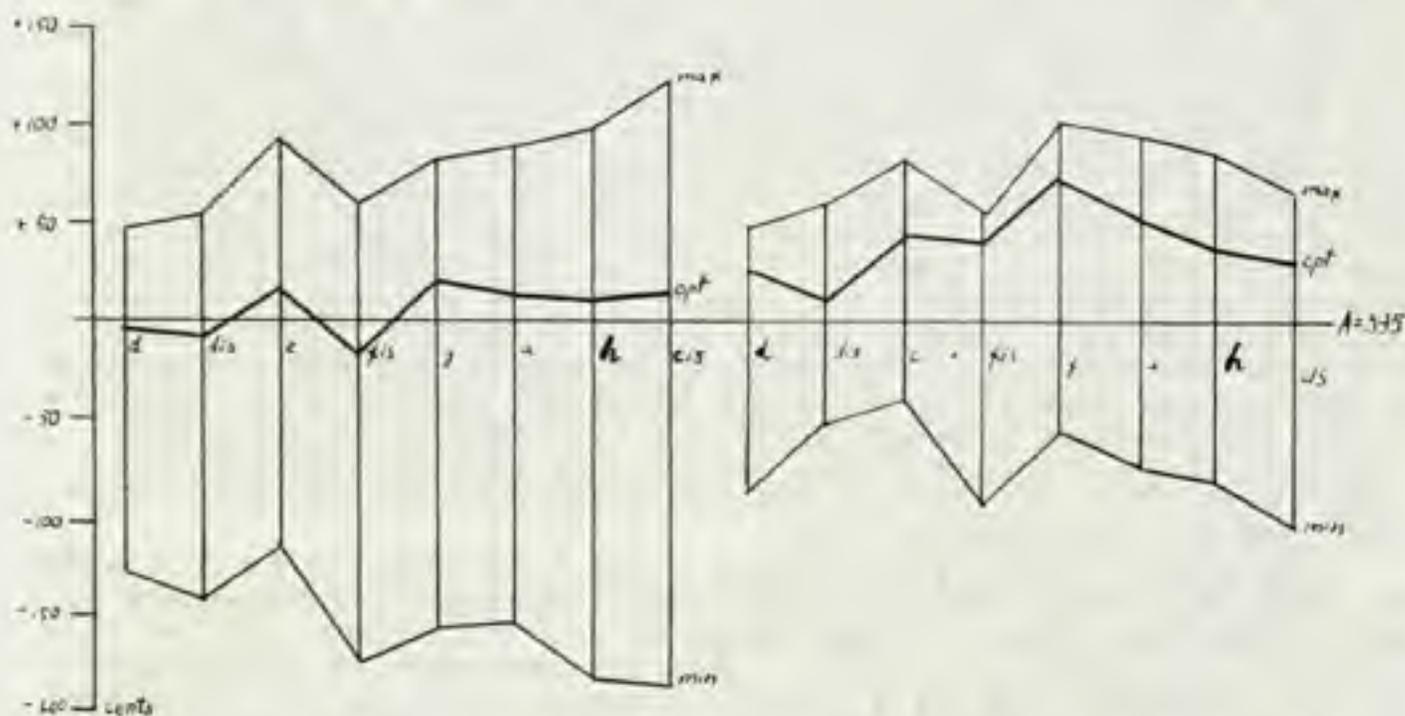


Fig.2. Diagrams of lower (left) and middle registers of the flute N°472 with band lines of maxima, optima and minima of natural tones.

If e.g. the size and position of given hole are selected in such way that the band of second tone mode taken from it will be situated somewhat higher than the band in first mode regime, then the zone of second mode timbre optimum turns out accordingly somewhat above the pitch axis. Owing to this the tone proves to be slightly softer. Thus the timbre of middle register could be softened. As an example of this idea utilization the diagrams (Fig.2) of lower and middle registers of flute N°472 (Hotteterre?) can be listed. They differ from the above cited in that that the lines of timbre optimum are marked on them. It may be seen that in the lower register the line of timbre goes nearer to the pitch axis than in the middle one. ( One of the work preparing for publication will consider in more details a data obtainment by timbre optimum frequencies.)

Let us return again to the diagrams in the Fig.1. In spite of difference in band widths a general picture of band disposition relatively the pitch axis conforms in both registers quite well. This applies in particular to the crossfingering- tones which in all cases are inclined to sharpening. Not without reason so typical for ancient baroque flute tutors was to recommend to turn the flute onto oneself while playing these tones.

For discussion of quite a number of conclusions permitted by the data described in this work it is necessary to make several preliminary considerations of some circumstances. So I permit myself to conclude now the present theme not exhausting it. However it ought to make one important reservation. The problem is that correct application of statistical methods should be based on the supposition of normal distribution of values studied. In other words, the deviations of the data obtained by measurements should be stipulated by accidental causes. Only in that case the average characterizes the typical one and the more reliable it is the greater number of input data have been used for its determination. At the same time as has been told in the beginning of this article the differences of baroque flutes of various authors testify undeniably an existence of a great number of solutions of the same problem. In that case the variation causes are accidental only to such an extent to which the master actions are accidental. Thus there are no strict foundations for application of those methods which I nevertheless ventured to use. Furthermore also the quantity of initial data obtained on the foundation even if of the most careful measurements on seven instruments not so large as the results whose respectability should be beyond any doubt require.

Since my inventiveness for the present does not give me the reliable handling of the data available, I considered for the best to obtain the conclusions well-reasoned even if to such a degree than nothing. In any case I employed repeatedly the data of Table I while tuning of baroque flute copies made by me and the practice showed that following these data more satisfactory results (at least in some cases) can be obtained than using the data by the same instrument which copy has been made.

Felix Raudonikas

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