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Bulletin no. 4
July, 1976

First, apologies to any U.K. members who were charged postage due on the last Bulletin & Communications; it was the Post Office who weighed it and told us the wrong amount! If you have to write either to me or to NRI (who do the posting), let us know if you were charged and we'll send you a shilling stamp - it's not worth writing specially and paying 6jvp to receive 5p, so please accept our apologies herewith.

COMMUNICATIONS: You will find this issue thinner than the last and it is your fault. We cannot print what we're not sent. The last issue (72 pages) was the ideal size to give you the proper value for your subscription and I don't like giving you less than you pay for - FELRIH is not designed to make a profit. Please write up your research and your work and send it to us. Communications don't have to be long; they have to be accurate and they have to tell your colleagues something that they don't know, whether it's information about sources, materials, tools or technical wrinkles and know-how.

MEMBERS: We now have over 200 members, some of them recommended by existing members - please keep it up. New list of additions and a few changes herewith.

NEWS ITEMS: John Betts, who is a cosmetic and detergent chemist who has done a lot of work on polishes (see further under other headings below) has acquired some Liquid Gold (members may recall long arguments between Michael Zadro and me about this in Early Music). I have suggested that he writes a letter to Early Music about this, but a brief summary of his conclusions would be: be very, very careful if you're thinking of using it; it contains one chemical which is both highly toxic and highly inflammable and another which is a very powerful solvent of varnishes and waxes.

Stephen Taggart has sent a recipe for an ivory substitute which I will type separately as a brief Communication. I'm not certain how good it will be and I would welcome comments from anyone who tries it. Deadline for next issue will be 1st October.

Trevor Robinson asks us to publish the following corrections to his book on wind instruments:

Fig.7 Overall length of the fife should be 347 mm, with the extra 17 mm inserted between the 6th hole and the bottom end.

Fig.8 Distance from shoulder of top tenon to centre of mouth hole is 44 mm. The modified mid-joint should be 270 mm overall with 231 mm between shoulders.

Table 3-2 In the modern pitch version the hole distances should be: 216, 248, 284, 343, 380, 410 and 462.

Fig.14 The mouthpiece should be lengthened by 11 mm. This will make all the hole distances in Table 5.1 greater by 11 mm.

Fig.19 The funnel-shaped socket at the top end is 25 mm long, narrowing to 6 mm in diameter where it joins the main bore.

Fig.20 The minimum bore diameter is 5.7 mm.

Stephen Taggart recommends the following suppliers:

Fitchett & Collacott, Willow Road, Lenton Lane, Nottingham NG7 2PR who may still have some Indian Rosewood, 3"x 2", 2'6" long at £2.50 per piece.

K.R. Whiston, New Mills, Stockport SK12 4PT, who are very good for small items of metal, brass sheet and tube, nickel silver, etc.
(NEWS ITEMS continued)

Mr. J. Holleran, Obsolete Engineering, 218 Astley Street, Dukinfield, Cheshire, SK16 4QD, who seems very helpful and willing to make small cast parts in a variety of metals such as brass keys for small pipe chanters, he was highly recommended to him as producing high quality parts for vintage cars at a very reasonable price, so it sounds as though he can manage much bigger items than small pipe keys if required.

There is a short Communication herewith from John Horley about EMIMA, the Early Music Trade Association, who are preparing for Exhibitions among other activities. He will help any FoMRHI members who have queries about EMIMA.

There is an even shorter Communication from Djilda Abbott and Ephraim Segerman on Instrument Plans. I would particularly draw your attention to their third (A), just over halfway down the page. I know that a number of people have hesitated to make their own drawings and plans available to others because of fear of infringing copyright belonging to a museum, and this should make it clear that if you have prepared a plan, or have commissioned and paid someone else to do so (or to take photographs) the copyright in these plans is yours and you can, if you wish to, make them available to others without any worry. This does not apply to plans you have bought from a museum or from someone else but it does apply to plans you have made from someone else’s instrument or photographs.

Christopher Page and Lewis Jones have been investigating the instruments in the Cantigas de Santa Maria; their investigations are by no means complete but they already have some interesting conclusions regarding materials.

I have (without any authority, but hope nobody objects) instituted an exchange membership with a Dutch group with similar aims to FoMRHI; they can reprint our Bulletins and abstracts of our Communications (or the whole Communication subject to the author’s permission) and we can do the same to theirs. Copies will be available from Djilda Abbott at whatever they cost. The group is called Werkgroep Louwers-Kontakt and they have issued so far three Bulletins (July, 1975; November 75; May 76). Each includes a list of members (or additions to the list), a list of useful books, articles, periodicals, a list of suppliers of tools and materials (by no means confined to Holland, though much of it seems to be taken from Early Music), and a list of courses etc. They have also published a lengthy Technical Word-list (by R. F. J. van Pelt) in three sections: French-Dutch; English-Dutch; German-Dutch. Also short Communications on: Heat-bending of wood (Nov. 75); Making violin varnish (R. van Pelt), Finishing and polishing wood and Varnishing wood (both C. van der Kaay), Polishing (V. Kuiper), How to make joints in sound tables (Toon Hoonen) (all in May 76). For their Communications write to Miss I. Jellewa at the address given for Louwers-Kontakt in the membership list herewith; for those they will probably expect you to join them (and you will need to read Dutch).

MUSEUM NEWS: The Royal College of Music tell us (Elizabeth Wells, their curator, is one of our members) that the museum is temporarily closed while they build a small extension. They hope to reopen at the end of September, but since we all know builders I would suggest ringing them before you visit (01-589 3643) up to the end of October. They have also sent a list of plans available:
1 Cittern by Campi; Italian late 16th c.; RCM 48
2 Chitarrone by Magno Tieffenbrucker, Venice 1608; RCM 26
3 Harpsichord, ? Italian c.1575, single manual, originally 1 x 8', now 2 x 8'; RCM 175
4 Spinet, English 1708; RCM 5
5 and forthcoming:
6 Harpsichord by Alessandro Trasuntino, Venice 1531? BCM 2.

A series of photographs of each is (or will be for 5-7) available also. Further details available from the Royal College of Music, Prince Consort Road, South Kensington, London S.W.7. They have said that they will keep us up to date with future publications.

James Kimbel has offered to keep an eye on the Metropolitan Museum of Art, New York and let us know of what they are doing.

Any more similar offers? There are many more active museums.

MATERIALS AND HELP AVAILABLE: I have found a source of reasonably priced quills, which may be useful to anyone working on plucked instruments. This is P.& H.Flashing Tackle Co., 11 Louisville Avenue, Gillingham, Kent ME7 4BJ. If you write to them, say you are a FOKPHI member (their request). They sent me some samples of Goose and Turkey primaries, prices ranging from 12p-14p a pair for Goose and 16p.-18p a pair for Turkey (plus p&p at least 15p). They also sent a catalogue which includes crow and raven quills. I distributed the primaries that they sent to some members whom I knew were playing early plucked instruments, asking them to report on the quality by 3rd July, but so far (3rd July) I have heard nothing. So I can't tell you what the quality is like, but you can always order a few on spec.

Charles Ford offers a plan of the Stradivari guitar in the Ashmolean and details of the lute, now a chitarrone, by Venere Tieffenbrucker in the Victoria & Albert Museum. He also says that Faber & Faber are publishing a book, probably next year, on instrument making which he has edited with articles from Adam Paul, Dietrich Kessler, Friedemann Hellwig, José Romanillos, Ian Harwood and Michael Johnson and an introduction by Anthony Baines.

Lewis Jones has been measuring in detail, photographing and where possible recording the playing characteristics of most of the pre-1750 recorders and transverse flutes in English public collections and would make this data available to those who are interested.

Trevor Robinson offers plans at prices varying between £2 and £5 of:
- Soprano Dulcian (Brussels 2329; Baines 586 - all the references to Baines are to his European & American Musical Instruments)
- Bass Baroque Racket (similar to Baines 518)
- Bassett Recorder by I.C.Denner (sim. to Baines 424)
- Bass Crumhorn (Brussels 2312)
- Lescant, tenor & bass Rauschpfeifen (Berlin 74, 299 & 666)
- Chorstflagott (Berlin 654)
- Tenor recorder, renaissance type
- Mute cornett
- Galoubet (tabor-pipe)
- Oboe by Cahusac (Dayton Miller 33)
- Picco pipe (Dayton Miller 128)
- Serpent (Boston Museum of Fine Arts)

He says also that because 7/16" o.d. brass tubing is difficult to get in lengths suitable for making trumpets, he is thinking of laying in a stock;
anyone interested should get in touch with him. He recommends a supplier of wood for wind instruments: A.I. Eppler, 1921 Fifth Avenue, Seattle, Washington, USA 98101, who has many varieties in stock and also stocks ivory.

Trevor Robincon has also sent a list of the European wind instruments in the Museo Civico, Bologna. These are not on public display and the list is not for publication without his permission, but copies are available from him or from Djilda Abbott at cost for copying 4 pages.

Thomas Beeston says that he has some tool and jig designs which make his life much easier and which he would be glad to share. One is a jig that cuts out lute ribs to the exact shape and bevel and another is a jig to make perfect lute end blocks quite easily; he says that he will try to make time to draw up a description for a Communication, but meanwhile any queries to him.

John Betts has bought a stock of Benzotriazole (see my report of the Restorers Conference at Humber in Early Music; Benzotriazole greatly inhibits tarnishing of brass and other metals). This he will sell to members in small quantities (I have been totally unable to buy it from any supplier) at cost, which comes to £1 per 50 grammes including UK postage. He has written a Communication (herewith) on its use. He also offers advice and help on polishes in general and I hope will have a longer Communication in this issue on metal polishes. He is working on a longer article, which I hope we shall be able to issue as a Special Communication, on polishes in general.

Alpha alumina and 0.6 micron pumice (which I also mentioned in the same report in Early Music) are available from Djilda Abbott; write for a sample to start with if you want a fine metal abrasive and polish.

Serge Bischler knows of a source in Switzerland for "epicea" for lute bellies and will be glad to help anyone.

Emul Edmon offers to translate from Italian to English for anyone.

REQUESTS: I put a note about an audio-visual archive in Cambridge in the last Bulletin. Harvey Turnbull says that this is not yet established but that he would welcome expressions of interest in it. It has been advertised in the Bulletin of the British Universities Film Council as an Ethnomusicological Audio-Visual Archive (Bulletin no. 28, May 1976) but it is by no means restricted to non-European instruments and music. I have seen some of his video-tapes of players at the recent Festival of Islam, which include detailed close-ups of playing technique, and he is very interested in including comparable material of European instruments, and also of film and video-tape of instrument construction from all areas. He would be interested to hear from people who would like to use such material for teaching purposes and also from people who could contribute film and video-tape and other people who could suggest other forms of cooperation.

Pauline Uhrenich was interested in the note about early transverse flutes in the last Bulletin and would be interested in corresponding with anyone playing such instruments, especially anyone who has a reproduction baroque flute by Richard Hahn. She is interested especially in "accepted playing techniques" and in "current theories of the 'ideal' sound for these instruments".

(MATERIALS etc. AVAILABLE continued)
(REQUESTS continued)

Ian Watchorn asks if anyone can give him more details of the Würzburg Tielke 11 course lute of 1696 then are available in the museum's X-ray and photographs, particularly details of the back of the neck and of the peg-box. He would also like a detail photograph or drawing of the rose of the Luxx Maler (ill 54) in the same collection. He asks if anything more has been heard of the ivory bank mentioned by Friedrich von Huene in the January 1975 Early Music. And finally he asks if anyone has any information of a lute said to have belonged to Anne Boleyn and now belonging (or recently belonging; his information is a photo-credit in a 1975 book on Henry VIII) to Lord Astor of Hever; this is a 5 course lute similar to a lute belonging to Laurence Witten, described by Friedemann Hellwig in the 1974 Lute Society Journal. Since nobody that I have asked seems to have heard of this instrument, at least in any detail, and since 15th century lutes are pretty rare, I hope that anyone who can help him on this will also write it up for a FoMSHI Communication.

Per Bergström asks if anyone can give him a source for tools for turning the inside bores of great bass recorders and similar instruments (over 30 mm diameter) and also for bores of variable diameter and irregular bores.

Enni Edmon is seeking information on the lira da braccio: the stringing, tuning, playing technique etc. He is also interested in literary references and, because there is no major library within his reach, asks if anyone can provide him with photocopies (for which he will pay) of such works as Lanfranco’s description of the instrument’s astrological associations and particularly with a copy of an article by B. Discoriri, "Pratica e tecnica della lira da braccio" (Rivista musicale italiana, vol. 45, 1941). He would also be interested in any other material on the lira da braccio in correspondance with anyone who has built one.

John Betts is experimenting with various 'anti-bug' agents (see the note on p. 4 above) and would be very grateful for any scraps of instrument wood which he can protect and then try to infect. He would be very glad of any scraps from postage stamp size upwards if members would be kind enough to tip any out of their bits and pieces boxes. One wood that he has been experimenting with that he thinks might be worth trying for instruments is "a very hard hardwood called 'massamuju' or something similar, very dense, hard and with a good straight grain. It is of a deep chocolate-purple colour and polishes and burnishes very easily. Also I believe it is fairly cheap" he says.

He also makes the point that FoMSHI's policy of printing Communications from members' own typing is a bit hard on people who can't type and asks if there might be any volunteers to type contributions. At 1 am and with the note on synthetic ivory still to type tonight, I sympathise with this. Are there any volunteers? We could have typing done professionally, of course, but it seems a waste of FoMSHI funds.

R.F.J.van Pelt has a query about maple. If sycamore is Great Maple or Yellowish-green Maple or Greater Maple or Hare wood or Acer pseudoplatanus, what is Maple? Is it Norwisch Maple (Greenish-yellow maple, Acer platanoides) or is it Field Maple (pale green maple, common maple, Acer campestre). And is Hare wood the same as Air wood and what is Rosemary Airwood?

Lewis Jones asks for sources of thin cane for making single reeds, about 5mm to 9 mm external diameter for hornpipes, bagpipes etc. Highland bagpipe tenor drone reeds are too large (and I would think too heavy).
He says also "I have searched in vain for information on early augers, drills, etc. . . . Can you point to any early sources or modern studies which would help?" Can anyone help him with anything detailed? I assume that this is connected with the work on the Cantigas which I mentioned above, i.e. 13th century.

CONCLUSION: I am not suggesting any meetings or other get-togethers at this time of the year, but I expect to be in London through the summer and any out-of-town visitors who want to see my collection are welcome, as always, to get in touch. One of the reasons that I find it important to have an up-to-date list of members is that wherever one goes one has the opportunity to meet one's colleagues and to make new friends with the same interests. The list is there, of course, for serious contacts when you need help and advice from your colleagues, but it is also there for social contact, a gossip and a glass of beer with someone who has the same problems and the same interests as you have.

Jeremy Montagu
7 Pickwick Road
Dulwich Village
London SE21 7JN
tel.01-274 8104

PS I have included the telephone number this time because of the invitation in the previous paragraph, but please don't use it for queries about FoMRH; these are much more easily dealt with at leisure in writing.

AMENDMENTS TO PREVIOUS LISTS OF MEMBERS

New Fellows (F in left-hand margin): Martin Edmunds (first List)
Ian Harwood, Uta Henning, Nicolas Meeus, Harvey Turnbull (all in first Supplement).

Changes of Address (all in first List):
R.V.Linklater, Field View, New Buildings, Thrumpton, Nottinghamshire.
Michael Saunders, 92 Hanover Street, Brighton; tel:Brighton 687699.
Stephen Taggart, 1 Mill Road, Lincoln, LN1 3JJ.

Add to Addenda to first List:
Florence Gétreau (Mme Pierre Abondance) (restorer Paris Conservatoire Museum).
FELLOWSHIP of MAKERS and RESTORERS of HISTORICAL INSTRUMENTS

1976 List of Members - Second Supplement, as at 4th July 76.

Thomas H. Beeston, 405 N. Granada #4, Tucson, Arizona 85705, USA; tel: (602) 622-0041 (lute, M, P).


John A. Betts, No. 1 Second Avenue, Sherwood Rise, Nottingham NG7 6JJ; tel: Nottingham 610104 (keybd, str., perc, M, C; polishes).

Werkgoep Bouwers-Kontakht, Vereniging voor Huissmuziek, Catharijnesingel 85, Utrecht, Netherlands; tel: 030-316769 (exchange memb).

Alan S. Brody, 29 Heathbloom Road, White Plains, NY 10605, USA; tel: (914) 948-4926.

David Bryant, 3338 Victoria Avenue, Regina, Saskatchewan, Canada S4T 1L6.

Simon Chadwick, Meadow End, Meadow Lane, Dudbridge, Stroud, Gloucestershire; tel: Stroud 6563 (lute, K).

Werkgroep Bouwers-Kontakht, Vereniging voor Huissmuziek, Catharijnesingel 85, Utrecht, Netherlands; tel: 030-316769 (exchange memb).


Richard Earle, Winkler Drive, Dover, Ohio 44622, USA; tel: 343-0003 (lute, M, P).

Early Music Centre, 62 Princesdale Road, London W.11; tel: 01-229 5568 (all ren. instrs., M, P, teaching).

W. T. Elliott, 190 Marsden Road, Dundas, New South Wales, Australia 2117; tel: 65565 (bar. keybd, wind, M, R, P).

Charles Ford, Salutation Cottage, Castle Combe, Wiltshire; tel: 0249-783232 (lute, vihuela, guitar, M, K).


Stanley C. Grigg, "Landfall", Iden Green, Benenden, Kent TN17 4ER; tel: Benenden 788 (viol, violin, rebec, lute, bows, M).

Daniel Hachez, 10351 4th N.W., Alameda, New Mexico 87114, USA (rem. lute, M, P, Z).

Ronald J. Hachez, P.O. Box 5171, Newport Beach, California 92661, USA; tel: (714) 646-5794 (guitar, M).

Robert Hadaway, Coedmawr Isaf, Llanio Road, Tregaron, Ceredigion, Wales (lute, citern, orpharion etc, K, R, W).


Alan & Yvonne Hamilton, 26 Princes Park Mansions, Liverpool 8; tel: 051-727 4408 (strings & cornamuse, M, P).

C. Dudley Hanson, 23 The Crescent, Hipperholme, nr. Halifax, Yorkshire.

Lewis Jones, High House, Kingsmoor Road, Great Parndon, Harlow, Essex; tel: 0279-25865 (keybds, bowed & plucked strings, K, M, P, C).

L. A. Kirk, 18 Nursery Road, Radcliffe-on-Trent, Nottingham NG12 2lm; tel: Radcliffe-on-Trent 2988 (harpsichord, K).

B. V. Kras, Homoergatunstraat 50, St. Jocst, Echt, Netherlands; tel: 04754-2746.

Richard J. Lee, 75 Homer Ave, PO Box 277, Palo Alto, California 94302, USA; tel: (415) 528-5044 (harpsichord, K).

Philip Lourie, Ivy Cottage, Watson Street, Hull HU7 4UR.

Lawrence Lundy, 911, Waukomis, Wisconsin 55560, USA (percussion, P).

James G. Mackie, 4812 Upton Ave., So., Minneapolis, Minnesota 55410, USA; tel: (612) 929-7415 (lute, M, R).

J. C. Macpherson, 85 High Street, Fochabers, Moray IV32 7HD; tel: Fochabers 238 (lute, M, P).

Josef Marx, 201 West 86th Street, apt.706, New York, NY 10024, USA
(all instrs, esp. oboe, C,P,W).
Walton Mendelson, 2905 Hampton Road #12, Cleveland, Ohio 44120, USA;
tel: (216)561-3036 (flute, oboe).
Ray Nurse, 3370 West 23rd Ave., Vancouver, British Columbia, Canada
V6S 1K3 (lute, M,P).
Guy Oldham, 10 Newton Grove, Chiswick, London W.4.; tel:01-995 9029
(all instrs, esp. organ, C,P,W).
R.F.J. van Pelt, Hendriklaan 11, Ocs, Netherlands P 4202 (violins, guit-
tars, harpsichord, M).
Philip S. Plumbo, 950 Ashland Avenue, Saint Paul, Minnesota 55104, USA;
tel: 222-3542 (lute, viols, baroque guitars, M,R).
Professor John Poynter, University of Melbourne, Parkville, Victoria,
Australia 3052; tel: 81 5382 (viols, P; keybd, C,R).
Trevor Robinson, 65 Pine Street, Amherst, Massachusetts 01002, USA;
tel: 549-0287 (wind, M,W).
Roger Short, 75 Knutsford Road, Wilmslow SK9 6JH; tel: Wilmslow 23171
(lute, guitar, P).
David Skulski, The Town Waytes, 2325 West 15th Avenue, Vancouver, Bri-
tish Columbia, Canada V6K 2Y9; tel: 732-7501 (winds,P,L,W).
B.T. Stafford, White Lee Farm Cottage, Friesland Lane, Greenfield,
Oldham; tel: 456 6375 (guitar, P).
Ian W. Strang, The Burgh Waits, 23 Partickhill Road, Glasgow G11 5BP;
tel: 041-554 5239 (rem.wind, brass, strings).
Bryan Peter Tolley, 1 St. Johns Road, East Molesey, Surrey KT6 9JE
(med.ww, strings, perc, M).
Peter A. Turner, 13 Cyprus Drive, Bradford, West Yorkshire BD10 0AJ;
tel: 0274-615713 (harp, keybd, M).
Brian Vale, 7 Garden Lane, Heaton, Bradford, West Yorkshire BD9 5QJ;
tel: Bradford 42984 (plucked str., M,C; ww, keybd, C).
Eric Williams, 21 Lime Tree Road, Norwich, Norfolk (viols, bar.bowed
strings).
Kurt Wittmayer, D-8190 Wolfratshausen/Obb., Obermarkt 8, West Germany
(harpischord, M).
Denzil Wraight, 1 Aston Street, Oxford OX4 1EW; tel: 0865-724539
(keyboards, M).
Nigel Wyatt, 55 Tong Street, Walsall, West Midlands.

Additions to original list:

p.4: General Facilities:
Translation: Emil Edmon (Italian); Martin Geeson (med. French, Ital)

Museum curators: Florence Gétrau (Abondance)

New category: Polishers: John Betts

p.5: Percussion: John Betts (M,C), Martin Geeson (M), Lawrence Lundy (P)

Membranophones: Bryan Tolley (M)

Chordophones: General: John Betts (M,C), Emil Edmon (M)

Psalteries: Alan & Yvonne Hamilton (M), Bryan Tolley (M)

Misc. Zithers: Bryan Tolley aeolian hp (M)

Keyboards, general: John Betts (M,C), W.T. Elliott (M,R,P), Martin
Geeson (M,P), John Poynter (C,R), Peter Turner (M), Brian Vale (C),
Denzil Wraight (M)
list of members; 2nd suppl. p.3

(Additions to p.5 of original list continued)

**Piano:** Lewis Jones (C,R)

**Harpsichord:** Alan & Yvonne Hamilton - a (M,P), Lewis Jones - h,v (M), L.A.Kirk - h (M), Richard Lee - h (M), R.F.J.van Pelt - h (M), Aurt Wittmayer - h (H)

**Clavichord:** Bryan Tolley (X)

**Plucked strings, general:** Lewis Jones (M)

**Lute:** Thomas Beeton (M,F), Simon Chadwick (M), Richard Earle (M,P), Charles Ford (K,R), Stanley Grigg (M), Daniel Hachez (M,P), Robert Hadaway (M,R,W), James Mackie (K,R), J.C.Knopherson (M,P), Kenneth Marshall (M), Ray Nurse (M,F), Philip Plumbo (M,R), Roger Short (P), Ian Strang, Brian Vale (M,C)

**Guitar:** Charles Ford (M,R), Ronald Hachez (M), Kenneth Marshall (M), R.F.J.van Pelt (M), Philip Plumbo (M,R), Roger Short (P), B.T.Stafford (P)

**Vihuela:** Charles Ford (M,R)

**Cittern etc:** Robert Hadaway - all (M,R,W), Ian Strang, Brian Vale - c & band. (M,C)

**Bowed strings, general:** Lewis Jones (M), Eric Williams

**Bows:** Stanley Grigg, Lewis Jones (both M)

**Cryth:** Alan & Yvonne Hamilton (K,P)

**Rebec:** Stanley Grigg (M), Alan & Yvonne Hamilton (M,P)

**Tromba Marina:** Bryan Tolley

**P.6:** Violin family: Stanley Grigg (K), R.F.J.van Pelt (P)

**Viols:** Stanley Grigg (M), Alan & Yvonne Hamilton (M,P), Philip Plumbo (M,R), John Foynter (P), Ian Strang, Eric Williams

**Hurdy-gurdy:** Bryan Tolley (M)

**Harp:** Alan & Yvonne Hamilton (K,P), Peter Turner (K)

**Hogulus:** Ture Bergström (K,M,P)

**Wind in general:** W.T.Elliott (M,R,P), Josef Marx (C,P,W), Guy Oldham (C,P,W), Trevor Robinson (K,M), David Skulski (P,L,W), Ian Strang - ref.

**Woodwind in general:** Ture Bergström (M,R,P), Lewis Jones (M,P)

**Transverse Flute:** Lewis Jones (C,P,Res), Walter Kendelson, Bryan Tolley (M)

**Recorder:** Lewis Jones (P,Res), Bryan Tolley (M)

**Tabor pipes:** Bryan Tolley (M)

**P.7:** Trumpet: Guy Oldham (C,P,W)

**Oboe:** Bryan Tolley (M)

**Obec:** Paul Bailperin (K,R,C,P,W), Josef Marx (P,C,W), Walter Kendelson

**Trumpet in general:** Ian Strang - ref.
THE CONSTRUCTION OF A MONOCHORD

Jeremy Montagu

The accurate measurement or demonstration of pitch and of intervals has always been a problem for those of us who cannot afford one of the various electronic machines that are available, especially since it is only the more expensive such devices that are capable of producing an infinite range of pitches, and thus any temperament, with any accuracy. After a certain amount of experiment, I have evolved a monochord which, when tested against a Strobocomm both when new and after being under tension for six months, is accurate to one cent over a range of three octaves, from A 220 Hz, a third below middle C, to A 1760 Hz. (The cent is the unit of measurement devised by Alexander Ellis in about 1880 for the precise expression of intervals, necessary because hertz (which used to be known as cycles per second or double vibrations) double at the octave so that, for example, the semitone A 440 to Bb is 26.2 Hz, the semitone above, Bb to B natural is 27.7 Hz and so on, whereas both are 100 cents, for the cent is one hundredth of an equal-tempered semitone (i.e. there are 1200 to the octave) and an equal-tempered semitone will always be 100 cents in any part of the compass. Equally, very few of us can resolve ratios in our heads). Since I am certain that I am not the only person interested in different temperaments who cannot afford the cost of an electronic device of similar accuracy and versatility, the details of the construction and use of such a monochord may be of value to my colleagues.

The base is the wrest-plank for a grand piano. This is a baulk of 13-ply timber five feet long, four and three-quarter inches wide and just over an inch and a half thick. The piano factors who sold it to me (H.J. Fletcher & Newman) guaranteed that it would not bend and so far it has not done so, whereas earlier models of lighter construction did bend and thus became inaccurate. The bridges are square-section brass rod (I use half-inch) and should all be cut from the same bar to ensure that all are exactly the same height. The two fixed bridges run right across the base, about five inches from each end; the sliding bridges will be described later. Beyond the fixed bridges, nails are hammered in obliquely at one end to act as hitch-pins; at the other end are the tuning pins, for which I use harpsichord pins as being slightly more sensitive than piano pins, particularly with thin wire. So that I can compare intervals, as well as measure or express single pitches, I have built my 'monochord' with two strings and two scales; hence the plural hitch and tuning pins, but with the result that the cost is nearly doubled.

The scales are engineers' one metre steel rules. These are 1.5 mm thick and this is the only height difference between the three bridges and one of the main reasons for the accuracy of the instrument. The rules already have a hole at the 1 metre end, but it is necessary to make another near the zero end, somewhere within the first five centimetres, so as to fix them securely. In my experience, this requires a drill bit for each hole unless you can sharpen your own, for the steel is very hard. I fitted the scales about half an inch in from each side of the base. Between them I have fixed a strip of brass scrim on which I can scribe marks for ten-cent steps or other useful intervals; alternatively, one could fit a strip of the 'ivory' used for the white notes, dull side upwards so that it would take pencil marks which could be erased. The
sliding bridges are billets of the same brass as the fixed bridges, cut to the width of the rules. The strings are steel harpsichord wire, .008" diameter (00 piano gauge). I am advised that this is the best size for A 220 at one metre; if a different basic pitch is required, the reader should take the advice of an experienced piano repairer and also do some experimenting. The requirements are a string as thin as possible which will be not far from breaking strain at the desired tension. It goes without saying that the best quality is needed, hence the use of music wire rather than of anything cheaper. The only other requirements are some screws, a handle for carrying, some scraps of felt and a tuning key. Most of my readers will have a harpsichord tuning key, but if not a clock key of the right size will serve very much more cheaply, though not quite so easy to use accurately.

In making the monochord, the first thing to do is, with an accurate square, to draw a line across the base about five inches from each end to mark where the fixed bridges will go. Then draw lines along the base from each end so that they project beyond the bridge markers to show the line of the strings. On these lines hammer in the hitch pins at one end, at least four inches beyond the bridge marker, hammering them at the usual angle, not vertically. At the other end, drill holes for the tuning pins at a similar distance from the bridge marker beside the line (remembering that the string comes off the side of the pin) and again at an angle of 45° or so, since a sloping pin seems to work better with a low bridge than a vertical pin. Saw off lengths of the brass square-section rod for the fixed bridges half an inch or so shorter than the width of the base (this quarter-inch rebate allows for the fitting of a lid if required; I have not fitted a lid but have suffered as a result by catching the string on a door handle and breaking it), place the bridges on the base and mark carefully where the string is going to run across them. It may be found that one corner of the brass rod is a sharper angle than the others (I have found this to be so with what I have been able to buy; some of the corners tend to be rounded); if so, this sharper corner should be the edge which will terminate the string length. Having marked the line of the string, scribe this across the bar on what is going to be the upper surface, making sure with a square that the line is exactly 90° to the edges. With a file about an eighth of an inch thick make a groove, very deep at what is going to be the back of the bridge, nearly half the thickness of the bar, but only just touching the front edge; the ideal is to leave a knife-edge the full height of the bridge at the front. A slight drop on the bridge nearest the tuning pins will not matter; the same error on the hitch-pin bridge will be catastrophic, so make the tuning-pin bridge first. Drill three holes in each bridge, one outside the filed slot on each side, the other in the centre, to take screws for fixing. The bridges can now be fixed to the base; it is essential that they run at exactly 90° to the sides of the base since a slight slope will invalidate all measurements. The wrest plank is a very tough piece of wood, so all screws need a receiving hole drilled for them.

The rules can now be fixed to the base. The zero end must butt exactly square on to the hitch-pin bridge, since all measurements are taken from the front edge of that bridge. I used round-headed screws since the rules are barely thick enough to countersink. Before fixing, check that all angles are exact because this is another point at which any error will throw the whole thing out. You will now find that there is about ten inches of wasted string between the 1 metre end of the rule and the tuning-pin bridge. In fact, this is not wasted; any less will mean that the string is distorted at this end and that all measure-
ments for the first few semitones will be inaccurate — this I learned on the first model. This is why a five-foot wren plank is necessary, instead of a shorter and more portable base, and is another main reason for the instrument's accuracy. Now fix the brass scrim or the 'ivory' strip between the rules. This is not essential but it is useful to have a rough scale in ten cent steps for quick work and it is, of course, very handy to have the equal tempered scale and any scale that one uses regularly quickly available without having to look up the measurements. Hugh Boyle has published a table of string lengths by cents, savarts and ration, giving the metric length for every cent (in 11.3. Lloyd and Hugh Boyle, Intervals, Scales and Temperaments, Macdonald, London, 1963), from which you can take the measurements for this scale.

The sliding bridges now have to be filed. First make an arch under the bridge with a round file so that the bridge will slide easily over the screws that are holding the rule down. When this is done, place the bridge at the 1 metre line, to fix its position over that screw, and at precisely 90° to the line of the string, and scribe carefully the line that the string will take. File a slot for the string as before, being very careful with the knife-edge on the front of the bridge; the slot does not need to be as deep at the back edge as on the fixed bridges. Brass clogs a file, but this can be removed with a wire brush.

The strings are fitted in the normal way, with a twisted loop over the hitch pins. I find it worth tying a bit of soft felt round each string between the tuning pin and the sliding bridge, on the same principle as the listing of a clavichord; the bridge tension is so low that vibrations can carry across it so that both halves of the string are sounding, which causes confusion. I have found it best to pluck the string with a sitar plectrum on one finger (a guitar plectrum will do but the sitar is better). Bowing is most inaccurate and distorts the pitch intolerably. Ernest Heins of the Centrum Jaap Kunst in Amsterdam tells me that some colleagues of his use an electromagnet on each side of the string to force it into vibration; this should give greater accuracy than plucking, since there is no initial distortion, combined with a sustained tone and seems an idea well worth adopting. Because the base is solid and the bridges heavy, the sound of this monochord is faint. I place a guitar microphone under the strings between the hitch pins and the hitch-pin bridge and use this with a small amplifier and speaker.

Since the instrument is cumbersome and heavy, it is necessary to fix its carrying handle at the point of balance. Put the instrument on its side on the floor; place a round rod such a pencil under it and slide it along until it balances; mark the point of balance and fix the handle with its centre opposite that point. The handle should, of course, be fitted on the side of the instrument, and it should be large enough to carry the weight comfortably in the hand and strong enough to take the weight, which on mine is over 15 lbs.

Now move one of the sliding bridges so that the front edge is exactly on the 50 centimetre line; tune the string to an A 440 fork, and you are ready to go.

I published some years ago (in MAN 1963, article 226) a method of deriving cents with little knowledge of arithmetic and of measuring pitch using such a monochord and a slide rule, but this has been outdated by the development of the inexpensive pocket calculator. To derive cents from herz or from ratios, set the higher figure on the calculator; divide it by the lower figure; find the logarithm of the
result, and multiply that by the constant, 3986.3 (the constant is taken from Fred Lieberman's article, Working with Cents: A Survey, in Ethnomusicology, Vol.XV, no.2, May, 1971). To derive herz from cents, set the cents figure; divide it by the constant; find the antilog and multiply it by the base herz (220 on this monochord); for cents below 1,000 (a minor 7th), set 0200 or whatever the figure, rather than 200. To go directly from herz to string lengths, set the base herz (220); multiply by the full string length (1000) and divide by the desired herz. As a mathematical ignoramus, I would express my thanks to Iphraim Segerman for giving me a calculator on which I can do these things just by pressing buttons, and to my pupil Jonathan Wright for spending a lesson in which I should have been teaching him working out the problems and teaching me which buttons to press.

To save some initial calculations, I append at the end of this Communication some basic measurements in herz, cents and millimetres for Pythagorean, Meantone and Equal temperaments. The Pythagorean was calculated by adding 5ths (702 cents) to A until B-flat was reached, and then adding 4ths (498 cents) (slightly easier than subtracting 5ths) until F-flat was reached, two steps further but done to give a second figure for E and E. This is really for interest; nobody, least of all Pythagoras, would suggest tuning in pure fifths all the way and the impracticability of doing so is the reason that we have to have temperaments. The Meantone is derived from Aron's of 1523, which seems to have been the first; many others will be found in Murray Barbour's Tuning and Temperament, Da Capo Press, New York, 1972 (the U.K. agents are Eurcspan of Kershaw House, 5 Henrietta Street, London WC2E 8LU), the only book that I know that gives all the tunings which have been used historically. Equal temperament was derived by adding 100 cents to 100 cents. These tables are all based on 220 A; for a different base nearby, such as Kammerton, the cents figures still apply of course, and the measurements will probably still be accurate if the string is tuned down a semitone, but the herz will all be wrong. Beyond a whole tone, I would think it advisable to use a different gauge of wire, since the lower tension with CO gauge may upset the accuracy of the instrument.

For those who, like myself, find it interesting to be able to show the reasons for the necessity for temperament, I also give the figures for the so-called just tuning, with the ratios of the natural harmonics from which it derives, omitting those notes (e.g. 7th, 11th and 13th harmonics) which have no place in our scales and using instead the normal steps of the just scale. For those who have not encountered this before, the basic problem in a scalar tuning is not so much the Pythagorean comma (the distance by which twelve fifths exceed seven octaves - 24 cents - and the reason why a series of fifths will never return to an octave of the starting note) as the fact that a series which begins Major tone (8:9), minor tone (9:10), semitone (15:16) produces chaos when one tries to use the same pitches on a fixed pitch instrument such as a keyboard for a scale starting on a different note. In A major, B to C-sharp is a minor tone, but in B major it must be a major tone. Hence the Pythagorean temperament which uses all major tones and a much smaller semitone (90 cents instead of 112) so that the same pitches may be used in different keys.

A further use for the monochord is as a demonstrator of natural harmonics, a table of lengths for which up to 16 is also appended. The string should be touched at the indicated point with the blade of a knife, or Hugh Hoyle's (reference above) method can be used. He suggests the use of a thread with nut tied to each end as a weight and the thread hung over the string at the indicated points. This works well,
whereas his suggested use of a pair of round-nose pliers for stopping the string normally I find less stable than a sliding bridge; I also find his design for a monochord less rigid and so less accurate over a period of time, than mine. Harmonics will be more easily heard if the string is bowed, rather than plucked and since the string is coerced into vibrating into its aliquot parts by the thread or the knifeblade, accuracy will be maintained. The sliding bridge must remain at the 1 metre mark throughout when inducing harmonics.

The materials for my monochord cost me, in about 1965, £8 in all. The wrest plank cost about £1, the rules £2.50 each, and the tuning key just over £1. Even with the substantial increases we have suffered in the past decade, it should still cost far less than any electronic tuner, even one that will produce only one temperament. As stated, I used harpsichord tuning pins; whether machine heads such as are used on guitars would work, I am not sure and feel disinclined to try. Wire of the specified gauge is essential for accuracy at this pitch. There is, of course, no necessity for using 1 metre rules; they merely make calculation a great deal easier than fractions of a yard or whatever other equivalent is used. If a different length is used, then a different wire will be necessary, as stated above; a chosen pitch at 1000 mm. makes calculation as easy as possible. The obvious next best will be A 440 at 500 mm., but don't try to do this with a base half the length; you will still need a safety factor of about ten inches between the tuning-pin bridge and the end of the rules. The main disadvantage of a half-length scale is that all distances are also half the length so that it is not so easy to be quite so accurate. I think that even a wrest plank would bend if one tried to use A 440 at 1 metre, and one would have to use a much heavier string to produce reasonable tension for A 220 at 500 mm which I am advised would lead to errors in other directions.

<table>
<thead>
<tr>
<th></th>
<th>Pythagorean</th>
<th>Meantone</th>
<th>Equal</th>
</tr>
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<tbody>
<tr>
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<td>herz mm</td>
<td>cents herz mm</td>
<td>cents herz mm</td>
</tr>
<tr>
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<tr>
<td>Bb</td>
<td>231.8 949.3</td>
<td>A#</td>
<td>229.9 957</td>
</tr>
<tr>
<td>A#</td>
<td>235 936.2</td>
<td>Bb</td>
<td>235.4 934.7</td>
</tr>
<tr>
<td>Cb</td>
<td>244.1 901.2</td>
<td>B</td>
<td>246 894.5</td>
</tr>
<tr>
<td>B</td>
<td>247.5 888.8</td>
<td>B#</td>
<td>257 856</td>
</tr>
<tr>
<td>C</td>
<td>260.7 843.8</td>
<td>B</td>
<td>262.9 835.9</td>
</tr>
<tr>
<td>Db</td>
<td>264.4 822.2</td>
<td>C</td>
<td>275 800</td>
</tr>
<tr>
<td>C#</td>
<td>274.6 801.2</td>
<td>C#</td>
<td>281.6 781.4</td>
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<tr>
<td>D</td>
<td>278.5 790</td>
<td>D</td>
<td>294.2 747.7</td>
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<tr>
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<tr>
<td>D#</td>
<td>298.5 763</td>
<td>D#</td>
<td>314.8 698.8</td>
</tr>
<tr>
<td>Fb</td>
<td>307 750</td>
<td>F</td>
<td>329 668.8</td>
</tr>
<tr>
<td>B</td>
<td>313 740</td>
<td>B</td>
<td>335 656.7</td>
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<tr>
<td>F</td>
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<td>F#</td>
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<tr>
<td>E#</td>
<td>347.6 650.4</td>
<td>E#</td>
<td>352 600.7</td>
</tr>
<tr>
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<td>G</td>
<td>367.8 598.1</td>
</tr>
<tr>
<td>Ab</td>
<td>366.1 600.7</td>
<td>Ab</td>
<td>376.6 584.1</td>
</tr>
<tr>
<td>G#</td>
<td>371.2 592.5</td>
<td>G#</td>
<td>393.5 559.1</td>
</tr>
<tr>
<td>Bb</td>
<td>392 580</td>
<td>Bb</td>
<td>411.2 535</td>
</tr>
<tr>
<td>C#</td>
<td>417.6 526.6</td>
<td>C#</td>
<td>421.1 522.4</td>
</tr>
<tr>
<td>D</td>
<td>440 500</td>
<td>D</td>
<td>440 500</td>
</tr>
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</table>

\[
\begin{array}{|c|c|c|c|}
\hline
\text{Pythagorean} & \text{Meantone} & \text{Equal} \\
\text{cents} & \text{herz mm} & \text{cents herz mm} & \text{cents herz mm} \\
\hline
A & 220 & 1000 & A & 220 & 1000 \\
Bb & 231.8 & 949.3 & A# & 229.9 & 957 \\
A# & 235 & 936.2 & Bb & 235.4 & 934.7 \\
Cb & 244.1 & 901.2 & B & 246 & 894.5 \\
B & 247.5 & 888.8 & B# & 257 & 856 \\
C & 260.7 & 843.8 & B & 262.9 & 835.9 \\
Db & 264.4 & 822.2 & C & 275 & 800 \\
C# & 274.6 & 801.2 & C# & 281.6 & 781.4 \\
D & 278.5 & 790 & D & 294.2 & 747.7 \\
Eb & 284 & 778 & Eb & 307.5 & 715.5 \\
D# & 298.5 & 763 & D# & 314.8 & 698.8 \\
Fb & 307 & 750 & Fb & 329 & 668.8 \\
B & 313 & 740 & B & 335 & 656.7 \\
F & 325.5 & 735.9 & F# & 343.8 & 624 \\
E# & 347.6 & 650.4 & E# & 352 & 600.7 \\
G & 352.5 & 624.2 & G & 367.8 & 598.1 \\
Ab & 366.1 & 600.7 & Ab & 376.6 & 584.1 \\
G# & 371.2 & 592.5 & G# & 393.5 & 559.1 \\
Bb & 392 & 580 & Bb & 411.2 & 535 \\
C# & 417.6 & 526.6 & C# & 421.1 & 522.4 \\
D & 440 & 500 & D & 440 & 500 \\
\hline
\end{array}
\]
There is one problem with just intonation to which I must confess I don’t know the answer. The order of pitches is usually given as Major tone, minor tone, semitone, Major tone, minor tone, Major tone, semitone. However, it is also sometimes said that the scale should consist of two tetrachords of Major tone, minor tone and semitone, separated by a Major tone (disjunct tetrachords); if so, then the steps after the first semitone would be Major tone, Major tone, minor tone, semitone. This affects the position of the 6th degree of the scale, and for that reason I give below two listings for F♯ as that readers can try whichever they prefer; my own preference is for the two disjunct tetrachords (F♯ at 906 cents).

<table>
<thead>
<tr>
<th>Just scale</th>
<th>Harmonic series</th>
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<tbody>
<tr>
<td>cents</td>
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<td>220</td>
</tr>
<tr>
<td>B</td>
<td>204</td>
</tr>
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<td>C♯</td>
<td>386</td>
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<tr>
<td>D</td>
<td>498</td>
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<td>E</td>
<td>702</td>
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<tr>
<td>F♯</td>
<td>884</td>
</tr>
<tr>
<td>F♯</td>
<td>906</td>
</tr>
<tr>
<td>G♯</td>
<td>1088</td>
</tr>
<tr>
<td>A'</td>
<td>1200</td>
</tr>
</tbody>
</table>

I have given the harmonic series their names on a C base, although they will sound on an A base, because this is the way in which they are always read by instrumentalists who use them. The series will sound two octaves higher than it would if written for A horn (4th harmonic would actually sound A 220 and be written as middle C). Higher harmonics are barely audible on this monochord but can be found if required by dividing the string length of 1000 by the number of the harmonic. These string lengths are, of course, arbitrary in that 750 works just as well as 250 for the 4th; 400, 600 or 800 as well as 200 for the 5th, and so on, but it seemed easier to give an ever diminishing series, and when demonstrating harmonics this can be the simpler way of showing what is happening.
THE POLISHING OF METAL SURFACES

John A. Betts

Introduction

The object of polishing any surface is more than merely that of producing a pleasing surface; polishing is of considerable importance in prolonging the useful life of an article by making it easier to clean, and in this way helping to stop the ingraining of dirt and possible corrosive agents.

Metal polishes can be divided into two types, chemical and abrasive. By far the most widely used are the abrasive polishes, which act not by replacing large scratches with smaller ones but by a complex physical process involving "plastic flow" and possible local fusion of the metal surface.

Chemical polishes are mainly used industrially and usually involve the use of either corrosive acids, alkalis or strong poisons (cyanides).

Abrasive Polishes

Abrasives should be used as infrequently as possible, as, by definition, some of the metal surface is removed and will eventually cease to exist. The use of an antico/orrosive or lacquer, where suitable, on the surface will do much to preserve the metal.

Diamond

This is the almost perfect metal polish. It is still the hardest substance available and possesses all the attributes of the perfect abrasive. The particles are sharp, remain so during use, and when they do break down the broken pieces are as sharp as the original. Diamond is expensive, but not as expensive as might be expected. For polishing a really fine or valuable piece the superior properties and carefully graded particle size could make it worth while. Diamond is very quick-cutting and will polish and colour the metal easily and with little manual effort. Diamond is sold as powder and as a paste - the pastes are convenient to use and result in little or no wastage. They are colour coded according to the particle size, and are sold in tubes or plastic syringes.

For cutting down in preparation for colouring a grade of about 50 microns is used, then a gradual progression through finer grades to about 5 microns, which is the 'colouring' or finishing grade. It is useless progressing from coarse to fine without intermediate grades as the results will not justify the work involved in removing the large scratches.

Oxide Abrasives

Various metallic oxides have been used for many centuries for polishing metals, ivory and some types of very hard wood.

Almost all oxide abrasives are now produced synthetically and are available in closely controlled particle sizes. The oxides that have stood the test of time (and some more recent ones) are:-
Rouge
This is the traditional material for polishing precious metals. It is an excellent polish for gold, silver, copper, brass and bronze. It is available both as a powder and compressed into a brick.

Chromium oxide
Very similar to rouge in its polishing action. Both rouge and chrome oxide are very dirty materials to use and stain the skin badly. The choice between them depends on whether one wishes to be stained red or green! Must never be used on ivory.
A relatively new polishing oxide is Ceric oxide - cerium oxide
This, as normally sold, is a mixture of ceric oxide and other rare earth oxides and varies in colour from a reddish brown to white. Though similar to rouge in its polishing properties, ceric oxide has the big advantage that it does not stain. An excellent polish.
Stannic oxide - tin oxide. Putty powder is an impure form.
Sometimes used as an abrasive for special purposes but of little general use.
Zirconium oxide - zirconia
Very similar in properties to ceric oxide q.v.
Aluminium oxide
This is available under many trade names and is usually manufactured by powdering synthetic ruby or sapphire. Very widely used in industry but somewhat difficult to obtain in small quantities. Has a good abrasive action and is very clean to use.
Magnesium oxide and calcium oxide. Both of these materials have a gentle action and are generally used on plated articles. Calcium oxide (quicklime) is very sensitive to moisture and decomposes to calcium hydroxide which has poor polishing action. Vienna lime is a mixture of calcium and magnesium oxides obtained by roasting dolomite rock and is used in industry for polishing bone and ivory. Pharmaceutical grade magnesium oxide is available in two forms - light and heavy. The light form has the smaller particle size. Both abrasives have a soft gentle action suitable for ivory and soft metals.

Other Abrasives
Silicon dioxide
There are many forms of this compound, which is probably the most widely used of all the abrasives, especially in domestic type metal polishes.
Diatomaceous silica
This is a natural product being a soft, earthy rock consisting of the skeletons of fossil marine plants. The particles are soft, porous and friable; in a single application they demonstrate the almost unique property of acting as a relatively coarse abrasive in the initial cut, quickly breaking down to give a finer cut and finally providing an effective colouring action.
The material commonly sold as an abrasive is known as tripoli or rottenstone. Other grades are available, equally suitable as abrasives, but intended for different purposes and are often of a better colour.

Not suitable for use in restoration work, unless a large amount of material requires removing, but as a polish on new metal it is almost ideal.

Crystalline silica

Prepared by powdering sand, flint, agate or quartz - not easily available in small quantities. Has a rapid initial action but quickly wears to rounded particles with little cutting effect.

Pumice

The powdered lava from certain types of volcano. Pumice is a soft gentle abrasive highly suitable for delicate work.

There are many more abrasives in use for special purposes; some which are suitable for ivory and very soft or delicate metals are:-

Calcium carbonate

Either in the form of powdered natural chalk or as precipitated calcium carbonate.

Magnesium carbonate

Two forms are available in pharmaceutical grade magnesium carbonate, light and heavy. As with magnesium oxide the light form has the smaller particle size.

Talc

The softest of all minerals. Used only if there is any danger in using any more effective abrasive e.g. in articles of great value, or delicacy.

The efficiency of an abrasive is greatly enhanced by the presence of a lubricant. In domestic polishes the lubricant is soap, a synthetic detergent, an oil or a combination of these. Soaps and detergents have the added action of cleaning oil and dirt from the surface of the metal, and it is often difficult to distinguish between a metal cleaner and a metal polish. The following two formulae indicate the composition of commercial versions of this type of metal polish:

(1) Colloidal clay 15
    Coconut fatty acids 36
    Ammonia (20%) 39
    Diatomaceous silica 180
    Solvent naphtha 13
    Water 450

(2) Polishing Wool
    Cheap cellulose wadding soaked in a mixture of
    Oleic acid 5
    Kerosine 50
    Turpentine oil 25
    Ammonia solution 1
    Diatomaceous silica 20
In both these formulations the ammonia reacts with the acid to form a soap.

Although soaps are widely used in metal polishes they can have a corrosive effect on certain metals if not used with caution. This is because soap solutions are invariably alkaline in reaction; in fact extra alkali is frequently added to enhance the cleaning action. This alkali is capable of dissolving tin and zinc and their alloys, with resultant corrosion. This corrosive action is of little consequence if the polish is used correctly and excess is completely removed after satisfactory results have been obtained. However this is not always easy to achieve; especially on intricate work.

Synthetic detergents are non-alkaline and certain types are without any chemical action whatever (nonionic detergents). For this reason the use of a high quality washing up liquid or hair shampoo as the lubricant/cleaner has much to commend it, and is preferable to soap. (But beware of cheap versions of these products, which contain appreciable quantities of common salt).

Metal polishes ready prepared in liquid form are convenient to use and a general formula for a polish having no harmful effects is:

| Detergent (washing up liquid or shampoo) | 5 - 15 |
| Bentonite | 2 |
| Abrasive of choice | 25 |
| Anticorrosive to suit | |
| Water | 63 - 58 |

**Preparation**

Warm the water slightly, slowly add the bentonite and stir until smooth. Damp the abrasive with the detergent and stir into the water/bentonite mix. Stir well and add the anticorrosive, if used. Store in non-metallic containers. Shake well before use.

Bentonite is a natural clay which swells in water to give a viscous suspension. Its function in the polish is to prevent the abrasive forming a hard cake on the bottom of the container.

This polish can be applied by hand from a chamois or soft cloth pad, or can be used as a liquid buffing compound on a rag buff. The article should be washed in clean water and carefully dried after polishing.

**Buffing Compounds**

Although liquid polishes can be used in buffing operations it is more common to use an abrasive embedded in a wax or fat base, which serves as a binder for the abrasive and as a lubricant.

The wax base of a buffing "compound" is commonly tallow, stearic acid or paraffin wax. The safest material is probably stearic acid (although an acid, this material has absolutely no corrosive properties on any of the metals likely to be encountered). The action of the compound is enhanced by the addition of a small amount of synthetic detergent which also
Aids removal of compo residues on the polished article.

A suggested formula is:-

<table>
<thead>
<tr>
<th>Component</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abrasive of choice</td>
<td>45</td>
</tr>
<tr>
<td>Detergent</td>
<td>5</td>
</tr>
<tr>
<td>Stearic acid</td>
<td>50</td>
</tr>
</tbody>
</table>

Carefully melt the acid and mix in the detergent, add the previously warmed abrasive and mix well. Allow to set in suitable moulds (these can formed from paper rolled into a tube).

It must be remembered that power buffs cut and polish much more quickly and severely than hand methods and the abrasive selected should be of the softer kind, especially on delicate surfaces.

Chemical Polishes

The use of "chemical" agents for cleaning and polishing metals is very ancient. The original materials consisted of such things as urine, cow dung; acid materials like fruit juices; vinegar, wine; and extracts of sorrel, spinach and rhubarb plants. The development of the heavy chemical industry pushed these materials from common use to replace them with highly corrosive or highly toxic substances e.g. strong acids, alkalis and cyanides. Whilst these chemicals are very effective most of them, in addition to dissolving the tarnish and oxide coatings, will dissolve the underlying metal with equal ease. There is nowadays an increasing tendency to revert to the natural type of chemical, albeit they are now mostly produced synthetically.

The fruit juice type of cleaner in the form of solutions of citric acid and tartaric acid are widely used industrially in the cleaning of many different metals. The advantages of these cleaners are ease of handling, low corrosion and absence of toxicity.

Citric acid and tartaric acid and their salts will clean copper, copper-based alloys and silver successfully. A solution of 0.5 - 3.0% of the acid in water is adequate for removing tarnish and oxide. Where it is desirable to "brighten" the metal surface in addition to cleaning it, solutions of 0.5% cream of tartar and 0.5 - 3.0% tartaric acid are often used.

A thin paste of cream of tartar is an excellent cleaner for copper, brass, silver etc. Because of the low solubility of cream of tartar, the small size and hardness of its crystals combined with its mild acidity, this paste acts as both an abrasive and a chemical cleaner.

The addition of a small amount of detergent as a lubricant is also beneficial in these chemical polishes. Soap must never be used as it will be decomposed by the acid and form a greasy scum which tenaciously clings to the metal and may prove difficult to remove.

Silverplated articles must be polished with great care to avoid breaking through the thin outer skin of silver. The use of silver "dip" cleaners has the advantage of dissolving only the tarnish, leaving the metal surface clean and bright. Originally these dip type polishes were based on potassium or sodium cyanide, but nowadays newer material, chiefly thiourea, is used. At the concentrations employed this material is practically non-toxic.
A typical formula for this type of preparation is:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thiourea</td>
<td>8.0%</td>
</tr>
<tr>
<td>Hydrochloric acid</td>
<td>5.0%</td>
</tr>
<tr>
<td>(or Sulphuric acid)</td>
<td>5.5%</td>
</tr>
<tr>
<td>Detergent</td>
<td>0.5%</td>
</tr>
<tr>
<td>Water</td>
<td>to 100.0%</td>
</tr>
</tbody>
</table>

In use the silver is simply dipped into the liquid, left for sufficient time for the tarnish to dissolve and then washed in clean water.

**Application of Polishes**

The pads used for polishing should be more than "any old bits of rag", but chosen and made with care. Polishing pads can be made from pieces of well washed cotton cloth (old, clean cotton shirts with stiffening and buttons removed are ideal) stuffed with the same material or with cellulose wadding or surgical rayon wool; cotton wool is not suitable as it tends to form hard lumps when wetted. The pad is formed into a shape which is comfortable to hold and appropriate to the article to be polished. Much better pads are made from soft leather, sewn into the form of bags with the rough side outwards, and stuffed with old cotton cloth or rayon wool. Leather has the advantages that it is longer lasting than cloth; the soft rough surface holds the abrasive better and, being less absorbent than cloth, results in less wastage of polish.

Small intricate articles, repoussé, engraved and carved work can be polished with abrasives applied from small pads; wooden sticks (match sticks, cocktail sticks) that are "flayed" at the end by chewing or beating with a hammer; or with small brushes e.g. cosmetic mascara brushes, toothbrushes etc.

In use the polish is applied to the pad or brush, damped if necessary, and gently rubbed on to the surface requiring cleaning. The abrasive should be kept slightly damp, but not wet enough to squeeze liquid from the pad. A slight resistance or drag to the rubbing motion gives the better polish.

Citric and tartaric acid polishes can be applied from a cloth or by immersion of the article in the solution. These acids, although completely non-toxic, will cause a stinging sensation in contact with cuts and abrasions. Cream of tartar polish is applied in the same way as an abrasive.

**Polishing and Restoration**

The first advice would be "don't". With exceptionally old and corroded instruments it may be solely the tarnish and corrosion products that are holding the instrument together.

With more robust metalwork the polishing sequence might be:

1) Clean the metal parts with warm water containing a little
neutral detergent.
2) Try immersion in a citric or tartaric acid cleaner or, if silver, a thiourea cleaner. If unsuccessful try abrasives in the order—talc; magnesium oxide or carbonate, or calcium carbonate; pumice; ceric oxide or zirconia; aluminium oxide; until a suitable abrasive is found. Diatomaceous silica is too coarse in its initial cut and has no place in restoration work.

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**Polishing Virgin Metal**

Here the abrasive of choice, if it can be justified, is diamond. Diatomaceous silica is next, with its 3 in 1 polishing action, followed by a final colouring with an oxide. Maintenance treatment consists of an oxide or cream of tartar polish. The use of an anticorrosive treatment is recommended. This will significantly reduce the maintenance polishing required and greatly prolong the life of the instrument.

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**Special Treatment of Ivory**

Ivory, bone and horn are porous materials and highly coloured polishes (rouge, chrome oxide) must never be used on them if staining is to be avoided. For the same reason oily materials must not be used. Compared with metals, ivory is soft and polishes very easily. Soft abrasives like magnesium oxide, magnesium carbonate, calcium carbonate should be successful. Ivory does not tarnish and old ivory should therefore not require polishing. The yellow colour that ivory acquires with age can be lightened with a bleach consisting of

Hydrogen peroxide 20 vol 5
Ammonia solution (20%) 2

This practice is not recommended and should not normally be carried out.

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Note: It is essential that before any cleaning or polishing is carried out, the abrasives or chemicals to be used are tested on a relatively unimportant area of the metal to assess the suitability on that particular surface.

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**Sources of Supply**

Amateur gemmology suppliers for Diamond, rouge, stannic oxide, ceric oxide, chrome oxide.

Winemaking suppliers for Diatomaceous silica, known as filtering powder. Bentonite.
Pharmacies for Citric acid, tartaric acid, cream of tartar, magnesium oxide, magnesium carbonate, calcium carbonate.

Amateur candlemaking for Stearic acid.

Jewellery craft suppliers for Tripoli, rottenstone, rouge.

"Trade" paint shops for Pumice (difficult to obtain).

Cosmetic grade talc is of very high quality and eminently suitable as an abrasive.

References:

J.A. Betts July 1976
SOME NOTES ON THE USE OF BENZOTRIAZOLE AS A PRESERVATIVE FOR COPPER AND ALLOYS OF HIGH COPPER CONTENT

John A Betts

Introduction

Benzotriazole has been recommended by Odell (Nuremburg Conference on Restoration 1974) as a suitable treatment for the inhibition of corrosion on copper and brass instruments. It is a highly effective organic agent widely used in industry for protecting copper and many copper alloys eg. brass, bronze, nickel silver etc. from the corrosive effects of the atmosphere, and from galvanic corrosion induced when copper is in contact with other metals.

Benzotriazole acts by forming an inert, insoluble, transparent protective film on the surface of the metal. The film is tough, extremely thin and, for all intents and purposes, invisible. Being chemically combined with the metal it will not peel off or affect the tone of an instrument in the way some varnishes and lacquers will do. The film is resistant to the damaging effects of water, oxygen, marine and tropical air and to the sulphur dioxide and hydrogen sulphide found in industrial atmospheres. It is removed by heavy abrasion and continued handling (but see below).

Methods of Application

Before any benzotriazole treatment is carried out it is important that the metal surface be clean and free from grease. If alkaline cleaning agents have been used they should be removed by rinsing well in clean water. Benzotriazole is best applied from a dilute water solution either by immersion (preferred) or by swabbing from a soft cotton pad. The effective concentration of a working solution is in the order of 0.05 - 0.1%.

As benzotriazole is only slowly soluble in cold water the 'stock concentrate' method of solution preparation is recommended. This also avoids the difficulties of preparing small quantities of extremely dilute solutions.

Stock solution

Dissolve 25 gram (1 oz) benzotriazole in 1 litre (2 pints) alcohol. Mineralised methylated spirit (purple meths) is suitable but industrial alcohol is better, if available. The solution is quite stable if stored in a well stoppered bottle.

Working solution

Dilute one part stock solution to twenty parts with clean water, add a few drops of a mild detergent eg. washing up liquid or shampoo and use slightly warmed (25 - 30°C). The metal to be treated is immersed in the solution and gently brushed to remove any adherent air bubbles. The treatment is continued for about 10 - 20 minutes. The article is then removed, rinsed in clean water and dried with a soft cloth.

The solution can be applied by swabbing or brushing but here extreme care must be taken to ensure that all parts of the instrument are covered (not easy as it tends to run off) otherwise some very unpleasant tarnish patterns will appear after a short time.
The solution is reasonably stable and can be used again and again but, as the benzotriazole is consumed during use, its effectiveness will be reduced unless additions of concentrate are made from time to time. A rough guide to the efficiency of the working solution and the need to add concentrate is to treat a small 'test piece' of freshly cleaned scrap copper in the solution and hang the piece near a coal fire or a gas or oil fired heater and note the degree of tarnish produced.

Benzotriazole is slightly volatile and if left in an open container will eventually evaporate. This property allows another method of treatment suitable for the maintenance of a bright finish on instruments subject to handling and use. A small amount of benzotriazole in a cloth bag or even sprinkled in an instrument case will act as a vapour phase inhibitor and prevent tarnishing on freshly exposed surfaces. I would point out though that the immersion method is more reliable and should be used for the initial treatment.

The solubility of benzotriazole in most lubricants is low but sufficient for the preparation of an anti-tarnish lubricant for slides, valves etc. A small amount, about enough to cover half a new halfpenny is added to 1 pint of lubricant, shaken well, and any excess allowed to settle. The oil is decanted from any precipitate which can then be used for further quantities of oil.

**Precautions in Use**

Benzotriazole is non-toxic and there is no risk of poisoning from treated mouthpieces etc. However the chemical does not taste very pleasant and due precautions should be taken if, like mine, your workshop is sometimes a kitchen.

Benzotriazole should not be added to chemical metal cleaners as it will prevent the action of the cleaning agent. (The addition to abrasive cleaners is recommended in the amount of about 0.1% but a final immersion should be given for the best results). It should under no circumstances be used mixed with strong hydrochloric acid cleaners (the instrument may dissolve rather quickly).

Benzotriazole is not a copper cleaner and is completely ineffective for this purpose. In fact, instead of removing, it will stabilise tarnish causing difficulties in subsequent removal, although this can be useful for special effects.

Solutions of benzotriazole, especially the working solution, should be stored in non-metallic containers in a cool place.

J.A.Betts June 1976.
A SUBSTITUTE FOR IVORY
Stephen Taggart

I have been experimenting with making my own ivory substitute, being dissatisfied with the "greasy" appearance of nylon and other plastics. Procedure is as follows, for a rod about 5" x 1 1/4".

Pour appropriate amount of polyester (glass-fibre) resin into a mixing-cup. Mix in a small amount of white pigment (about 1/4" on the end of a thin stick) followed by the 'minutest' spot of yellow (very powerful), about as much as will go on the head of a pin.

Catalyst is then added, and mixed in very slowly. The amount of catalyst can be found by trial and error, but must be very much less than that recommended by the manufacturers, in order to extend the curing time to one or two days.

The mix is then poured slowly into a suitable mould, such as a cardboard core from a toilet-paper roll standing on a sheet of glass with plasticine round the bottom to hold it upright and to prevent leakage between the bottom of the tube and the glass.

The main bugbear is the formation of air bubbles, which may remain invisible until the final polishing, when they appear as unsightly black spots. Air bubbles can be avoided by:

1. Stirring very slowly.
2. Under-catalysing - thus allowing all bubbles to come to the surface before the resin sets.
3. Pouring the mixture very slowly into the mould, and bursting the bubbles with a small stick as they flow over the rim of the mixing cup.

When set (after about two days) the whole block (including the cardboard mould) can be quite easily turned in a metal-turning lathe, but goggles must be worn as the material can shatter if too heavy a cut is employed.

Polishing can be done at high speed with various grades of "wet and dry", finishing off with Brasso.

This method produces a most acceptable ivory substitute, at minimal cost. I have used it for the "ivory" fittings on Northumbrian smallpipes and it looks very well.
A 16th-CENTURY FRENCH DESCRIPTION OF GUT STRINGS IN TURKEY

Pierre Belon's *Observations de plusieurs singularitez* were first published in 1553. They were the fruit of an extensive journey through Greece, Egypt, Palestine and Turkey and contain many interesting and detailed descriptions of places and people in these countries. His remarks on the making and use of gut strings are instructive not only for what they tell us of Turkish practice but also for the light they throw on European lute- and guitar-strings. Our translation is based on the edition of 1588 (Book III, chapter 47).

**On Bow- and Lute-Strings in Turkey**

Late in the evening a man carrying a basket will come round the butchers' shops and take the guts which have been kept for him that day; and he carries them to those who make them into all kinds of strings. They are singularly proficient at making those for bows. Moreover, they are much used, for their bows are strung with gut strings. As for lute strings, they make all sorts, very-fine, and chanterelles which can go just as high as our own ones; but they are not so silvery, especially as they are made of three threads. Nevertheless, they can be used on a Venice lute, for want of others. Such chanterelles are found in many types and colours, red, blue, green, yellow, white; and there is not a mercer who does not sell some in his shop, as also other types of lute-strings which are found throughout Turkey. They are more frequent there than in Europe, and the reason for this can easily be given: it is that the Turks have four sorts of guitars and lutes, and not a few of them can play one or several kinds, which is not the case in France or in Italy: for few people in villages indulge in playing the lute or guitar. But in Turkey not a few are able to play them in their fashion.

1. *arc, i.e. bows for archery.*
2. *argentines, literally "silvery", probably means "translucent".*
Instrument makers assembled at the Royal College of Music in 1973 for Richard Woods "Early Music Fayre" and realised, possibly for the first time, the size and diversity of their craft, recognised the need for a regular exchange of views and organisation to further their common aims.

The last years had seen, in this Country especially, an unparalleled growth of interest in Early Music, the coming together of makers and players, craftsmen and theoreticians, amateur enthusiasts and professional musicians to provide a framework for very rapid development of a previously neglected area of knowledge. It was therefore essential that new facts or theories and refound knowledge be disseminated as quickly as possible and that overlap and duplication of research be avoided. Jeremy Montagu was among the first to recognise this and to his enthusiasm we owe the Fellowship of Makers and Restorers of Historical Instruments, FoMRHI., broadly based - with membership open to anyone interested in the Objects of the Fellowship, irrespective of nationality and domicile.

The proposed Objects of FoMRHI "the promotion of co-operation and mutual assistance between members in the interests of authenticity in manufacture, design and reconstruction, restoration, repair and use of historical musical instruments" etc., are academic rather than commercial.

The growing need for concentrated action by the craft, to promote instrument making and marketing, extend the boundaries of craft knowledge and maintain craft standards, prompted Dr. Carl Dolmetsch to propose at the 1975 Early Music Fayre an Association for professional makers and restorers of Early Musical Instruments.

In November 1975 the Early Musical Instrument Makers Association Limited was incorporated with an initial membership representing a wide and comprehensive cross section of the craft. The formalities of Incorporation are now complete, an Annual General Meeting has been held and Officers and a Council elected.

Subsequently the Council has met on two occasions and established a Programme for 1976 and 1977 which includes participation by Associate members at the 1977 Festival at Brugge. Subject to Association negotiations with the Board of Trade, it is expected that a "joint venture" will be possible with substantial assistance to exhibitors becoming available from the Board of Trade. It is expected that the Early Music Fayre which has grown with Richard Woods inspiration and endeavours will in 1977 be even bigger and better and for this purpose an Exhibition Committee with Richard Wood as Chairman has examined a number of possible sites and details to follow as soon as available. During the coming year the Association will through meetings and correspondence bring for the attention of members some of the growing legislation with which they must become acquainted, in particular the Health and Safety Acts and the new Consumer Credit Act.

It is hoped that the Association members will consider ways and means of making their instruments better known and more easily available overseas so that the advantages of existing exchange rates can be gained.

The two Societies, EMIMA and FoMRHI, are complementary, each has a distinct and essential role to play and is open to all who qualify under the Articles. EMIMA membership is for the professional maker and restorer, the formalities surrounding the construction of an Association are now complete, the purpose of the Association and the benefits of membership will become apparent over the next years and valued by the membership.

Applications for membership are available with abridged details of the Association from:

J. O'Driscoll, Hon. Sec. EMIMA,
Arnold Dolmetsch Limited,
King's Road,
Haslemere, Surrey.

Council meetings take place at St. Peters Organ Works, Warner Place, Hackney Road, London E.2. and The Association is indebted to Mr. Noel Mander for the provision of a suitable venue.
A LETTER TO EDITORS OF PERIODICALS WITH INTERESTS IN HISTORICAL INSTRUMENTS

Djilda Abbott, Jeremy Montagu and Ephraim Segerman

We are thinking of sending a copy of this letter to editors of other periodicals; what do members think of it?

We want to make the intention of FoMRHI "Communications" clear to editors of scholarly journals. It is an accepted and ancient (but admittedly not universal) practice amongst scholars in all fields including music to circulate drafts or "preprints" of articles intended for formal publication amongst specialists in their field before submission to the editor. This informal system keeps one's most concerned colleagues up to date on work more-or-less completed and insures against stupid errors and failing to consider important relevancies. The recipients of these preprints are usually friends while the referee that the editor might send the paper to afterwards might not be (it is pleasanter to accept criticism from friends than from others).

FoMRHI "Communications" is intended as an organized version of this practice. There are enough journals appropriate for formal publication of papers on musical instruments already and we have no intention of adding another. We may well enter the formal publications field if the length or format of a contribution is unacceptable to the established journals, but this will be unrelated to the "Communications" and will be sold individually. The "Communications" are produced in the cheapest possible fashion because their intention is purely ephemeral. We have no library subscribers and would prefer not to have them. The thought of binding "Communications" for preservation seems to us silly.

We want to encourage the use of FoMRHI "Communications" as a showcase of studies made, which editors of established journals can scan for items of interest for their journals. They would then suggest to authors how they foresee the articles could be modified to best fit the style and purposes of their journal. We see the "Communications" as a preprint and kite-flying medium that supplements the services to scholars provided by the more formal journals.

It would be most unfortunate if editors of these journals refused papers which had in essence appeared in FoMRHI "Communications", thus creating it as a rival journal. This would eventually denude "Communications" of contributions, forcing us either to quit or "go glossy" and become a rival journal. Neither of these possibilities would make anyone seriously interested in furthering early instrument research happy.

We have no interest in competing with established journals or organizations and only want to perform needed communication functions which they choose not to provide. If they decided to expand their services into areas which we have been covering, we would be only too glad to leave them with these areas. We are all people whose creativity is better expressed in research than in building publishing empires.

We would appreciate your general views on the question of subsequent publication in your journal of appropriately polished versions of FoMRHI "Communications".
A Note on the Preparation and Distribution of Instrument Designs

Several people have written to us offering their services in making drawings of instruments. They include Brian Rattray in Edinburgh, Ian Theakston in Nottingham, Ian Watchorn in Sydney, Australia and Laurence Lundy in Wisconsin USA. We would like to encourage:

A) people with raw data or original instruments to get together with draughtsmen to produce designs,
B) a high standard of scholarship in the preparation of drawings for scholars and instrument makers.

To facilitate this we suggest:

A) anyone interested in participating can get in touch with one of the above if that's appropriate, or else write to Jeremy Montagu who will place a note in the next Bulletin which hopefully will lead to collaborations.

B) We propose that an instrument design should be accompanied by the following notes:

- Main source(s) of model,
- Provenance (range of times and places of similar instruments),
- Data and speculations, or references on each of:
  - Materials and construction methods including finishing,
  - Design details not from the main source(s),
  - Tuning, stringing, fretting, type of intonation or temperament etc.,
  - Playing hold, hand position, fingering, plucking or bowing position, embrochure etc.
  - Appropriate music and social environment.

If any of the above checklist is not known by those making the design, FoMRHI can help.

Before being distributed a design should be checked over both by a scholar and an instrument maker.

On questions of relationships with owners of instruments in private collections and curators of museums, we want to point out:

A) According to copyright law (Museums Association Information Sheet IS No. 7, 2nd edn revised 1974 'Copyright law concerning works of art, photographs and the written and spoken word' by C. H. Gibbs-Smith) the person who drew or photographed an artefact (or paid for such work to be done) owns copyright on the drawings or photos, and does not in law need permission to publish or sell copies.

B) It is important to maintain goodwill with owners and curators wherever possible, so it is courtesy to consult with them before dissemination. If the curator or owner has objections to the drawing being associated with their instrument (perhaps because the drawing does not meet their quality standards, or because they object to commercial exploitation of their holdings, or because they are producing their own drawings) then courtesy demands that the source not be identified. Otherwise courtesy demands that the source be properly identified, with museum number and the full name of the museum.

As we see it, if these courtesies are observed, and if no other conditions were laid down when the data were collected, then there is no legal or moral basis for objection. Of course royalty payment may be negotiated with the owner in return for his identification.

C) Any claim that a drawing or an instrument is an exact copy or replica of an original is impossible in detail, and thus is both a poor reflection on the intellectual honesty of anyone who makes such a claim, and an insult to the owner of the original. Statements such as "modelled after ....... instrument" are acceptable.

We would welcome other views on this.

Djilda Abbott and Ephraim Segerman
We have often been asked for advice on lute design. Here are some of our replies. Some of what is included here is based on surviving instruments, some is based on simple acoustical theory and some is guesswork. If readers have hard facts or feel that they have better guesses that would improve this, we would welcome their contributions.

A. BEGINNERS NOT FUSSY ABOUT MODEL
2. Oh, not modifications in C. below.
3. Consider modifying bar dimensions according to Prynne (1964) or some model in Hellwig (1983).

B. OTHERS WANTING AN INSTRUMENT APPROPRIATE FOR A PARTICULAR REPERTOIRE
1. Use contemporary paintings or drawings rather than surviving instruments to determine external parameters for pre-baroque models. Follow advice of Michael Lowe (GSJ 1976) on baroque instruments.
2. For internal construction of 15th century instruments see Harwood (1960).
3. The Arnault shape is rather atypical. For another shape we suggest bars at:
   a. maximum width,
   b. about halfway between "a" and the neck-body join,
   c. about halfway between "a" and the bridge.
The rose(s) is/are either centred on bars or lie between them.
3. For internal construction of early 16th century instruments see FoMRHI Comm. 1. For kind of sound consider Abbott and Segerman in Early Music (1975) vol. 3 no. 4.
4. In late Renaissance and early baroque instruments, bar location depends on the placement of the rose centre, which seems to be related to body shape (see FoMRHI Comm. 5). Once this is determined the classical placement system can be described as follows:
   a. divide the distance between the rose-centre and the lower end of the soundboard in five and place bars 1, 2 and 3 on the upper three divisions.
   b. bar 4 is at the rose centre and bar 5 is placed above bar 4 according to the same size of division.
   c. divide the distance between bar 5 and the upper end of the free soundboard (where it is glued to the neck block) in three and place bars 6 and 7 on the divisions.
   d. place two additional bars, either exactly between bars 3 and 4 and bars 4 and 5 or closer to bar 4, and these extend to the edges of the soundboard as all of the numbered bars do.
   e. one or more additional low bars are placed in each of the four spaces between bars under the rose, and these do not extend much beyond the edges of the rose.
   f. divide the distance between bar 1 and the lower end of the soundboard in three, place the centre of the bridge on the upper division and on the lower division place a bar which in the treble direction extends about as far as half-way between the treble end of the main part of the bridge and the centre-line of the soundboard, and on the bass side curves upward as it approaches the soundboard edge.
   g. place one or (more usually) two fan bars below the bridge on the treble side; these extend to the edges of the soundboard and the inner one usually extends at full height to under the centre line of the bridge.
5. For pearl vs. pear shape see Burwell (Dart 1958), Mac. FoMRHI Comm. 5.
6. For a host of shapes and barrows of lute bodies see Hellwig (1983).
7. When scaling 16th and 17th century lutes from one size (and pitch – see FoMRHI Comm. 3) to another, we suggest that, to maintain the playing and sounding character of the instrument:

a. the belly, bar and back thicknesses remain constant.
b. the scaling factor of the string length applies to the string tension.
c. on larger lower-pitched instruments a greater amplitude of string vibrations needs to be provided for and a somewhat thicker neck may be needed to hold the greater string tension, but nevertheless player preferences can strongly influence the string spacings on the nut and bridge as well as the thickness of the neck.
d. the freedom in adjusting the position of the highest tied fret needs to be maintained, so once the neck thickness near that fret is decided on, the central intersection point between the back of the neck and the back of the body (as seen in an elevation drawing) is determined.
e. the line in the drawing between this point and the bridge end of the strings is used for scaling the body; the scaling factor will be slightly different from that for the string length, and it is the ratio of the length of this line on the scaled instrument to the length of a line at the same angle from the bridge end of the strings to the curve of the back on an elevation drawing of the original instrument.
f. relative positions of the bridge and rose centre are maintained during scaling.
g. rose diameter, bar height and bridge width are scaled with the body.
h. with the scaled body shape and the positions and string spacings of the nut and bridge on a plan drawing, the fingerboard is drawn and the intersection of its edge with the body is determined.
i. when transferred to the elevation drawing, this intersection plus the point described in d. gives the angle of the body-neck join.

8. When changing the number of courses or changing string spacings on a lute while keeping the string length and body size the same, neck width usually changes and points 7 d., h. and i. should be considered.

9. Follow NRI Design Service and other sources reported in FoMRHI for individual designs.

C. NRI MODS TO LUTE SOCIETY LUTE DRAWING

Just before going to press we heard from Philip MacLeod-Coupe who made the Lute Society Drawing. He informs us that the plan dated November 1973 which we were working from has been replaced by a later drawing which incorporates some of the modifications we suggest here. He is now preparing a new edition which we expect will be as authentic in every detail as anyone would wish. Meanwhile we include this list for those who have the November 1973 version, and we presume some of it is still relevant to the version currently available.

1. END BLOCK. Replace 2-ply composite end block by vellum or linen or an inside liner of wood no thicker than the outside end clasp.
2. FAN BAR. Extend the inner fan bar up to past the centre-line of the bridge and end it off square (this improves treble response).
3. BAR AND BRIDGE POSITIONS. Use the true end of the body to calculate bar and bridge positions according to instructions B4a. above. This shifts the bridge centre 11mm towards the end of the soundboard and adds shallow bars under the rose.
4. BRIDGE. Reduce bridge width to about 12 mm. Make the string holes about 2 mm closer to the soundboard. Make the cross section something like
Bridge ends need to be more flexible to decrease the tendency to pull off starting from the lower corner, so ends could stick out further and have less height.

5. **BACK.** The staves of the back that are adjacent to the soundboard on each side are to be left a few mm wider than the others. This allows action adjustment (lowering the bridge) after the body has settled down to the tension by removing the soundboard and cutting some away from the sides. If alternately the action comes out too low when the neck is glued on, removing material from around the body-neck join can correct the situation without visual offence.

6. **NECK BLOCK.** Cut away the top of the neck block at an angle so that only 3 mm is glued to the soundboard. This will affect the calculation of positions of bars 6 and 7, according to instructions B4c above.

7. **POINTS.** The fingerboard points can be separate pieces of wood. The joint is either covered or obscured by the 8th fret.

8. **BARS.** Bars are quarter sawn rather than slab cut and they are not glued to the inside of the body.

9. **NECK THICKNESS.** Get neck and fingerboard total thickness down to about 25 mm at the body joint.

10. **NECK LENGTH AND TUNING.** Set the 8th fret well clear of the body-neck joint and lengthen the neck accordingly - this gives a string length over 67 cm, and with gut strings the lute would be tuned to e flat (+ a semitone).

11. **FIRST COURSE.** Single first course is appropriate for octave stringing, but if unison stringing is intended, provision on bridge, nut and pegbox for a double first course (like Robinson and Dowland indicate) should be made.

12. **DISTANCE BETWEEN COURSES.** Distance between course centres on nut should be reduced to 7.5 mm, and the neck and pegbox widths are to be adjusted accordingly.

13. **WOOD THICKNESSES.** Increase the rib thickness to 2.0 mm (this gives a brighter sound). Soundboard thickness (for spruce) should be about 1.8 mm along the centre except down to 1.0 mm near the rose, with 1.2 mm along the edge of the soundboard.

14. **FRETS.** With a lower bridge one probably needs to grade the fret thicknesses. The frets should be double.

15. **PEGBOX AND NUT.** Adjust nut size or cut the inner surface of the pegbox walls away so no string touches unnecessary parts of pegbox between the nut and the peg. The depth of the pegbox and the thickness of the pegbox walls are to be slightly tapered, thinning as they approach the end.

For references see FoMRHI Comm. 7.
ON SINGLE, OCTAVE OR UNISON COURSES IN EARLY STRINGED INSTRUMENTS

Ephraim Segerman and Djilda Abbott

Most modern lutes have single first courses and unison bass courses. This is a modern tradition with little precedent in the history of the lute and other historical instruments with multiple courses. We shall try to show that in the 16th and 17th centuries, it usually seems that single first courses and octave basses go together and double first courses go with unison basses.

Instruments that come to mind which had single first courses and octave basses are:
1. The lute before the last quarter of the 16th century, plus Barley's (1596) lute.
2. The French baroque lute.
3. The 18th century French theorbo.
4. The 16th century guitar.
5. The Lanfranco cittern.
6. The Kargel and Lais cittern.

We are sure this list is not complete.

Examples where a single first course could be associated with unison basses occur in Praetorius who showed single first courses on his lute, guitar and "chor" cittern on Pl XVI (3, 4 and 6) and the 6- and 12-course citterns on Pl VII. All of these citterns had a peg available for a double first course. He seems nowhere to have discussed octave stringing even when discussing "ancient" lutes and guitars where octave stringing was the rule. When octave stringing is clear in the tuning and string spacings he gave for the Lyra de Bracio, he listed the tuning of each string as a separate course. He did not completely ignore the issue since he indicated octave tuning once, on the fifth course of the "Alt Italianer" 6-course cittern, with the comment "Elliche" (some people) associated with it. Lanfranco (1533) and Cerone (1613) indicated that the octaves were on the third course, and Praetorius's error could well be a symptom of his feeling that he had to include it for the sake of completeness but that he was aesthetically quite against octave tunings. Another blind spot Praetorius had was in excluding bourdon strings of the Lyra de Bracio (Pl XX fig. 5) and the Lyra da Gamba (Pl XVII fig. 4) on both his tuning diagrams and plates, though separate nuts for these strings are clearly drawn on the illustrations.

Instruments which come to mind that had double first courses and unison basses were:
1. Vihuela.
2. Robinson (1603) and Dowland (1610) lute.
3. At least some late 16th century Italian lutes.
4. Virchi's cittern.
5. English citterns.
We can cite a few examples of octaved basses associated with a doubled first course. Mace specified octave basses on his baroque lute, but seems almost deliberately to have been ambiguous about whether the first course was single or double. His illustration of an "English and French Lute Joyned" has double first courses for both.

1. The 16th century French cittern takes full advantage in its music of the octave ambiguity in the third and fourth courses which serve both as the highest and lowest pitches. There are two upper octave strings in each triplet, presumably to make sure that the upper octave is heard. Thus the first course, which is intermediate in nominal pitch has a rather different role than in other instruments. This parallels the first course of the chitarone.

2. The 16th century French cittern takes full advantage in its music of the octave ambiguity in the third and fourth courses which serve both as the highest and lowest pitches. There are two upper octave strings in each triplet, presumably to make sure that the upper octave is heard. Thus the first course, which is intermediate in nominal pitch has a rather different role than in other instruments. This parallels the first course of the chitarone.

3. Talbot's mention of octave bass stringing on the bandora may be a late 17th century practice associated with its then purely continuo function. This contrasts with Barley's indications a century earlier of unison stringing at a time when the bandora served solo functions as well.

4. Some baroque guitar tunings could fall into this category.

From the above it seems that bass octave stringing was very widespread and unison bass stringing was sometimes chosen when the music involved melodies ranging over the full compass. A single first course with octave basses was most common but it was rather uncommon for it to be associated with unison basses. A double first course usually went with unison stringing, but in late 17th century England it was kept when, probably because of the influence of the French lute, octave basses were fashionable.

Single, octave and unison courses sound differently. When all courses are of the same type then we call this a uniform stringing method. Bowed instruments during this period, for example, have been uniformly single-strung. Uniform unison stringing involves a double first course. All-octave stringing would offer the same uniformity, but this reduces the nominal range of notes possible for the open strings by an octave (because the total real range is restricted by the physical properties of the strings), and early musicians seem usually not to have been willing to make this sacrifice.

When they used octave stringing on particular instruments they obviously preferred this to single or unison stringing. The advantage they saw over single stringing must have been only in the sound since octave stringing involved more trouble and expense. In comparing octave with unison stringing we have insufficient data to compare trouble and expense, but would expect that preference in sound was still the dominant factor. Instrument ranges were generally accomplished by mixing octave- with other types of stringing. This involved marked transitions in tone colour where the changes occurred. On such instruments people obviously thought it worthwhile having these transitions in order to get both octave stringing in the basses and a large range.

Before trying to understand this preference, we should discuss the types of sound that unison and octave stringing produce.

A pair of unison strings is not appreciably louder than a single string. Plucking two strings to the same vibrating amplitude as a single string at the same tension involves twice as much force and produces twice as much acoustic energy. This raises the acoustic intensity of the sound by about 3dB, which is just barely detectable by human ears. A more important advantage of a unison pair is that pitch blurring resulting from being slightly out of tune is considered aesthetically pleasing. The continuously changing phase relationships between the vibrations from the two strings, the harmonics as well as the fundamental notes, are probably what gives the impression of richness of tone. (Unison playing in orchestras and vibrato are examples of pitch blurring which are considered pleasant today.)

The aesthetic advantage of being slightly out of tune works of course up to a certain
amount of pitch difference, beyond which mistuning becomes decidedly unpleasant. The actual amount differs greatly amongst individual listeners, and in different acoustic environments for the same listener. Nevertheless we feel that there usually was a generally accepted intonation standard, which could vary with place and time.

When considering octave bass stringing we must be careful to avoid applying our experience with modern overspun strings. The only strings available before the latter half of the 17th century were of uniform material with all of it carrying the tension. Overspun strings, especially those with very flexible cores, have much richer harmonics than these strings.

The harmonics of the notes of early, low-pitched thick strings are relatively weaker with respect to the fundamental than those of the thinner strings on the same instrument. Adding an octave string that is not too obtrusive adds to the harmonics, putting more life into the tone. Since the octave string is much louder than the harmonics of the bass string, the interplay of phases (as in unison stringing) does not affect the ear significantly. Thus the enrichment of tone by near-equal pitches does not occur, but the imperfect tuning of the octaves makes a somewhat different contribution to tone quality. If one listens for it, it is easily discerned that two strings an octave apart are playing together, but it is also easy to listen to the combined sound as if it were one enriched string.

If heard the latter way, there is more similarity in tone quality between a bass octave pair and a single higher course than with a double higher one in unison. This would tend to explain the combination of only octave pairs and single courses on instruments such as the Lanfranco cittern and Praetorius’s lyra da bracio. But on most plucked instruments using octaved basses, the range is extended in the treble by unison pairs and then by a single first course (or sometimes first two courses). In these cases any kind of tone enrichment seems to have been preferred to a single string (except on the top course or two). The question still remains as to why the treble course was not enriched as well.

There is an answer to this question with respect to gut strings. It is stated in the Burwell book (page 5) when explaining why the second course is single, that “two seconds will seldom agree”. In FoMRH Comm. 3 and 15 we mention that poor string quality was most apparent in the treble strings and that expensive treble strings from Munich seem to have been available from Capitola’s time (ca. 1517) till after Mace’s (1676) time. Unless there were wide variations in intonation standards, we presume that instruments with double first courses used these strings, and those with single first courses didn’t.

When poorer quality single treble strings were used, the frets were moved to the best compromise position amongst the strings to optimize intonation, with the first course having the greatest influence. The amount each individual string varied from its true pitch in the compromise fret position was necessarily greater than if higher quality strings were used. Thus instruments with single first courses tended to be inherently less in tune than instruments using the Munich strings.

* The Burwell book on the French baroque lute stated (P. 5) that an octave string was thinner and thus at lower tension than a single string at the same pitch.

** When gut double first courses appear in instruments before the 16th century, we have no evidence to guide us in deciding between high string quality and low intonation standards.
Let us now consider intonation in an octave pair of strings. From classical psychoacoustic experiments it is known that the ear's sensitivity to frequency differences in pure tones progressively decreases as the frequency decreases below 500 Hz (c'). Thus the tuning accuracy required for thick bass strings whose audible harmonics are all well below c' is less than that of the octave string. Thus the ear mostly takes its pitch cue from the octave string and so intonation problems parallel those in the treble strings.

There is another factor though, especially on the lowest octave strings, which can produce pitch differences which are all too easily noticeable. This is the pitch distortion due to the string stretching which occurs both from pressing it behind a fret and from the vibration amplitude itself. This distortion is different in the bass and octave strings except for Venice Catlines as we shall show:

Pitch distortion is directly proportional to the elastic modulus of the string material and inversely proportional to the string stress (the tension per unit cross-sectional area). The string elasticity depends on the amount of twist in the gut. Before the last quarter of the 15th century we believe that the twist of high and low strings was the same (we call it "medium twist"), and so the elasticity of the octave string was the same as the bass. Between then and the last quarter of the 16th century, "high twist" basses were used and the bass had half the elastic modulus of the octave string. After that, Venice Catline basses were used and the bass had 4 the elastic modulus of the octave string. In each case the stress in the bass was necessarily 4 that in the octave string. Consequently the pitch distortion of the bass string was 4 times, twice or equal to that of the octave string when the bass was of the medium twist, high twist or Venice Catline type, respectively.

Pitch distortion from the amplitude of vibration can easily be controlled by just plucking softly enough or by plucking closer to the bridge. Pitch distortion on fretting can be compensated for by angling the bass side of the frets slightly towards the nut. When octave strings were used, a compromise fret position had to be found, and the pitch deviations of each string from the compromise point provided a degree of out-of-tuneness which players just had to live with. When unison stringing was used, the fretangling could be done without compromises, and the instrument was inherently more in tune.

It seems then, that if one was forced to accept lower intonation standards on the first course (i.e. non-Munich strings so only a single first was tolerable) one could readily accept lower intonation standards in the bass as well, if this provided richer tone. If high quality (Munich) treble strings were used, unison stringing in the basses would maintain these standards of intonation, with the sacrifice of some richness of tone, but with the advantage of avoiding stark tonal changes when a melody crosses from one type of stringing to another.

In the first three-quarters of the 16th century, only the vihuela had a double first course. The Spanish court was very rich because of the flow of gold from the Americas. They could afford the expensive but true strings from Munich, and we suspect that they cornered the market. The intonation standard for the vihuela would have been higher than for other European fretted instruments at that time.

In the last quarter of the 16th century, two changes occurred which affected this situation. Venice Catline basses were invented and they in themselves were richer in tone (the harmonics are louder and more in tune with the fundamental) than the older strings, besides producing less pitch distortion on stretching, which for the first time matched the distortion of an octave string, making compensation possible to a higher intonation standard. In addition, the vihuela had been largely displaced in popularity by the guitar in Spain, so the Munich string producers could have been free to seek other markets. The English and Italian lutenists took advantage of the better intonation of Catline strings and matched them with the better Munich strings. Their choice of unison basses could only be motivated by uniformity in stringing, not intonation.
Mace’s recollection of lutes during his 17th century lifetime (p.39) only involved an even number of strings, implying a continuing tradition of double first courses from Munich in England, which survived in spite of the overwhelming influence of the French lute which tended to promote octave basses. With high quality octave strings and Venice Catline basses, octave stringing does not present the intonation problem that it did earlier. This, with the baroque separation of treble and bass lines of music reduced the advantages that unison stringing had.

A thorough study of the types of stringing combinations has yet to be made. What we hope to have accomplished here is to focus attention on the readily-available data on stringing. The stringing of an instrument is far more important, in approaching the sounds that the early composers wrote for, than are the finer points of its construction (eg. FoMRHI 29).

NOTES
3. Eg. "Portrait of Charles Mouton" by de Troy, Louvre, Paris (RF 2469) and many other paintings.
4. Eg. the Trevoux Dictionary (1771)
5. See Dobson, Segerman and Tyler (Lute Society J. XVI, (1974), 17) for discussion and references. In his subsequent related publication (Lute Society J. XVII, (1975), 60 and Early Music III no. 4, (1975), 341), Tyler’s excellent contributions contain some extrapolations which are not warranted by the data: 1. Bermudo did not discuss octave stringing on the “old guitar” (Temple viejos) nor did he state whether the first course was single or double 2. There is no evidence for a vihuela with 11 strings.

We are not at all in sympathy with his suggestion that his version of the Bermudo type of guitar stringing "sounds best" for the French publications for which a different stringing was specified. The aesthetics of a modern performer should not be confused with historical scholarship.
6. Lanfranco, G.M., Sciintille di Musica (1533). The tuning is relatively a' c' b gg' d' e'.
8. Praetorius, M., Syntagma Musicum, II De Organographia (1619). Facs. (1964)
15. Bermudo, J., Declaracion de Instrumentos Musicales (1555) fol. 6 col. 2. When describing the octaved fourth course of the new guitar, he likens it to the lute or “vihuela de Flanders”, implying that the vihuela de mano which he described thoroughly at the same time did not have octave stringing. The Milan illustration on El Maestro (1535) fol.4 clearly shows 12 pegs, all used. Even the poorly drawn vihuela illustrations such as Milan’s "Orpheus" frontispiece, show a symmetric arrangement of pegs on the head implying an even number, though some show less than 12 (Bermudo has 12). Twelve pegs symmetrically arranged is the pattern in the sole surviving vihuela (see Prynne, M., Galpin Soc. J. XVI (1963) 22).
16. Robinon, T., The Schoole of Musicke (1603) Bl. Face of instructions, ed. Lumsdon, D. (1971). He stated "...although you, here see but six single lines [for tablature] and upon the Lute everie string double, you shall understand, that two strings are in one tune, & also hears the name but of one string: as Base, not Basses, Tenor, not Tenors."

17. John Dowland's "Other Necessary Observations belonging to the Lute" in Robert Dowland's Varietie of Lute Lessons (1610) facs. Hunt, E. (1958). On p. 14 of the facsimile, Dowland clearly refers to the strings of the first course in the plural: "...first set your Trebles, which must be strayned neither too stiff nor too slacke, but of such a reasonable height that they may deliver a pleasant sound, ...". Concerning the basses, he follows with: "These Basses must be both of one bigness, yet it hath beene a generall custome (although not so much used anywhere as here in England) to set a small and a great string together, but amongst learned Musitions that custome is left, as irregular to the rules of Musicke."

18. The illustration of an 8-course 16-string lute in Carrara, M., Intavolatura di Liuto (1585) facs. ed. Olschki, L.S. and Disertori, B.,n.d., shows appropriate string thickness variations for unison stringing. The painting reproduced on the cover of the notes shows, with the violin, a 14-string 7-course lute similarly showing unison bass stringing.

19. Virchi, P., Il Primo Libro di Tabolatura di Clithara... (1574) The double first course is indicated in his statement that his 7-course modified cittern had 14 strings. The unison bass stringing is conjectural.


21. This is in Barley, W. (see note 2) where his instructions for tuning each course on the bandora state: "wrest the stringes ... higher or lower till they agree in unitie, ...". The plural is used for the first course as well and the illustrations of the orpharion and bandora show the double first course. Unison bass stringing on the orpharion has no direct evidence in this source.

22. Mace, T., Musick's Monument (1676) Facs. (1958). On p. 53 he implies a single treble by listing "3ds, 2ds, and treble" yet on p. 41 he states "And here you must take notice, that when we say a Lute of 12 Strings, there are but 6; and likewise a Lute of 24 Strings, there are but 12, (as to substantial Use)". On p. 52 he states "For the Trebles and the Seconds, ..." using the plural. Lower on that page though he states "First you must lay your Long Nutt (which must carry seven Ranks of Strings, besides the Treble String) ...". The illustration is on p.32. Octave bass tuning is indicated on p.83.

23. In the reference of note 1 is stated "... the big strings, although being course and big, are not as loud nor sonorous as the small or high ones, the octave strings are added so that they may be heard as distinctly as the others."


25. Feldtkeller, R. and Zwicker, E., Das Ohr als Nachrichtenempfänger (1956). Described on p. 120 of Music Sound and Sensation by Winckel, F. translated for Dover by Binkley, T. (yes, the early music man) (1967).
We hear that Laurence Wright's article on the gittern and citole (mentioned in David Munrow's recent book Instruments of the Middle Ages and Renaissance) will appear in the 1977 Galpin Society Journal.

The main points are:

1. The medieval gittern was the round-backed instrument which has often been mistaken for a mandora (the true mandora had a different tuning, and was not common until after 1570);
2. The citole was the instrument which has wrongly been called gittern up to now. The article throws new light on the origins of the Renaissance cittern, guitar and chitarrone.

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