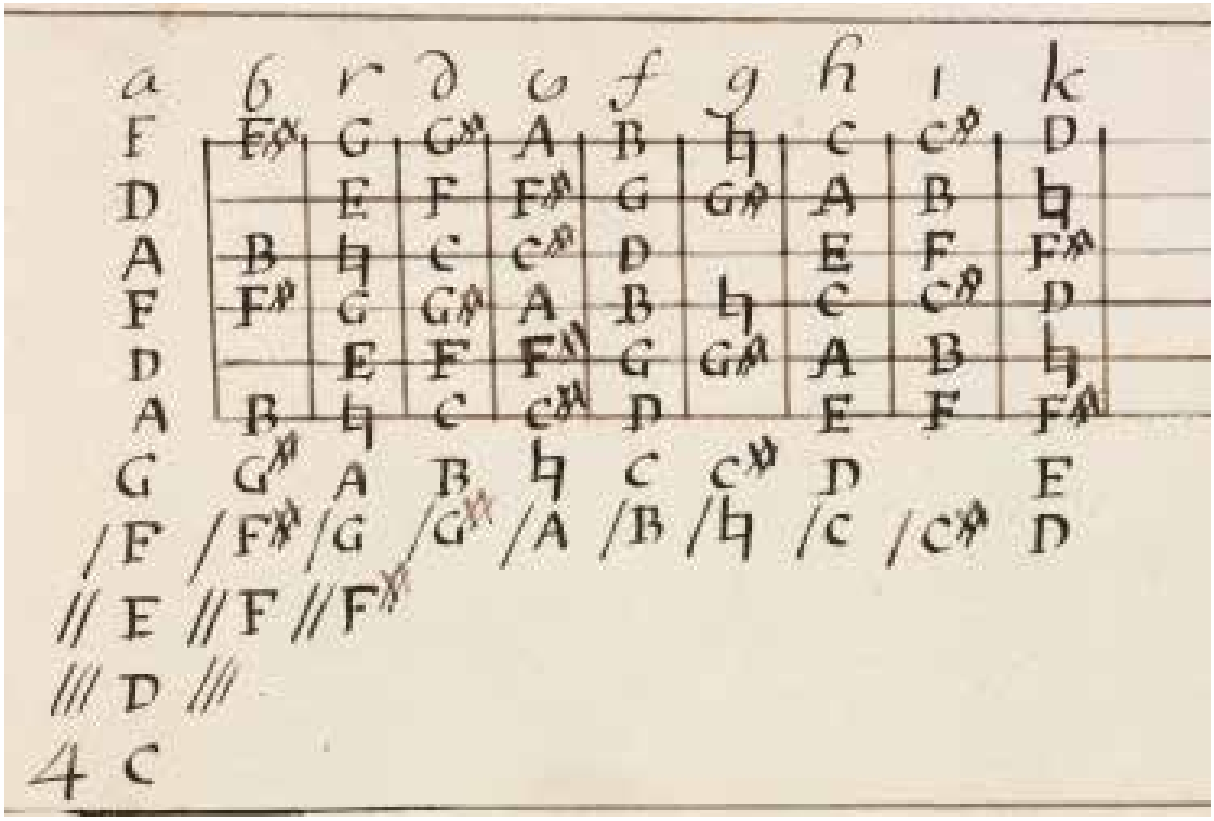
## The first known stringing table for baroque lute? Oxford Bodleian MS Mus.Sch.G.621

For some years François-Pierre Goy and I have been working on an edition of all 33 pieces in the hand of the second scribe of the tablature entries in the Rhétorique des Dieux. Because there were several text scribes (in German 'Schreiber"') and two musical scribes (in German 'Notatoren'), we refer to this person as 'Notator B' of the Rhétorique des Dieux. During these studies, I discovered that the Parisian specimen of Denis Gaultier's *Pièces de luth* also has manuscript additions.[1] Consequently, we decided to investigate and compare all four preserved copies of this print. I knew that typeset prints were often corrected and / or changed during the several print-runs from my research on the editions of Nicolas Vallet and Newsidler books.[2] It is not widely known however, that music prints, executed with copperplate engravings were also sometimes corrected. Until now, only Bruce Gustafson has published observations on such corrections in the editions of Chambonnières.[3] In our forthcoming edition you will see examples for the corrections in Denis Gaultier's *Pièces de luth*.

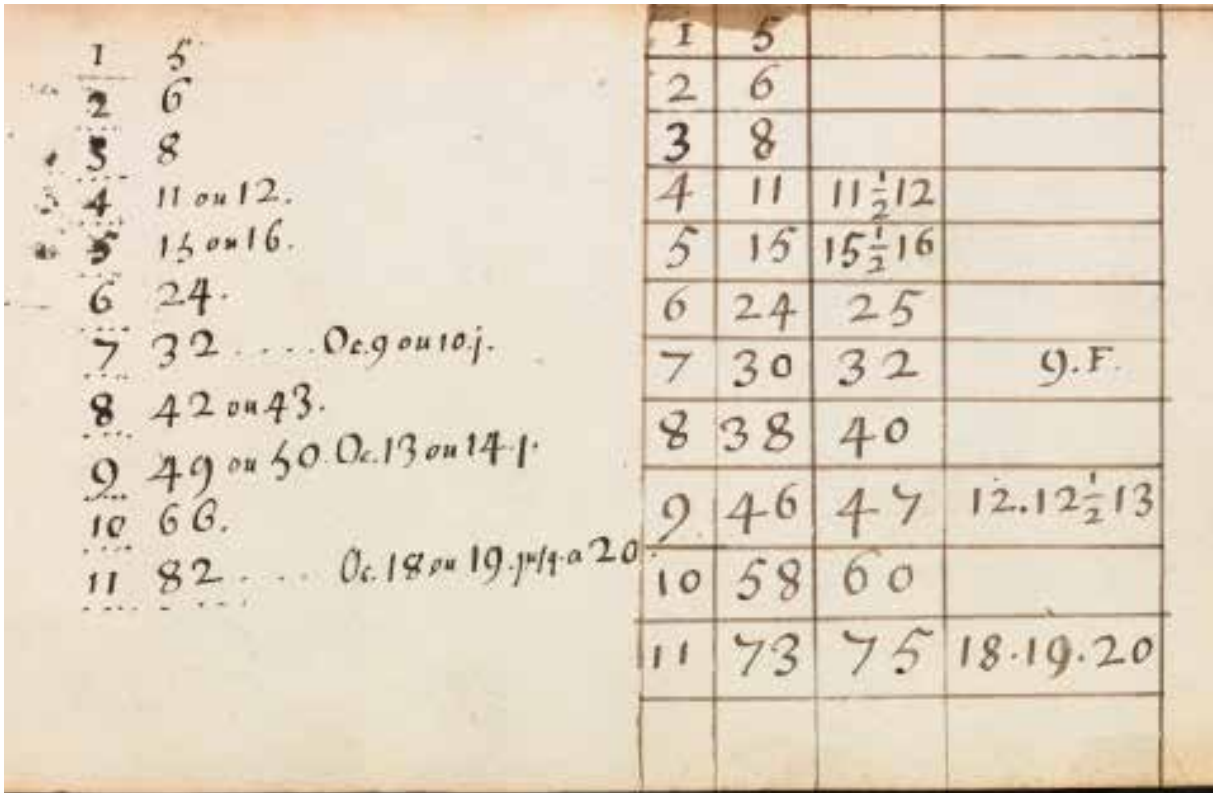
Matthew Spring kindly investigated and photographed details from the Oxford specimen of *Pièces de luth* (Mus.Sch.G.621) and he also took pictures of the fly-leaves (ff. iii-iv) which include two pages with interesting handwritten entries.[4]

One entry is a drawing of the lute fingerboard with the fret note names indicated. Interestingly there is no E flat written in this table—those places on the fingerboard are blank. Only 11 different notes are given: C, C#, D, E, F, F#, G, G#, A, Bb and B.



In the *Pièces de luth* the keys of G-major and E-minor are used (as well as A-minor). And the unsigned note D-sharp is used as the dominant to E-minor in the B-major chord. We find that the D-sharp on the first fret of the fifth course and on the sixth fret of the third course appear already in the first Prélude in G-major and also on the first fret of the second course in subsequent pieces. However, the sixth course is only used up to the fifth fret. So perhaps we have an open question?

The second page gives two tables: the left-hand one is in the form of a list and the right-hand one in the form of a table with numerical entries.



| | | | |
|---|---|---|---|
| 1 | 5 | | |
| 2 | 6 | | |
| 3 | 8 | | |
| 4 | 11 | 11 1/2 12 | |
| 5 | 15 | 15 1/2 16 | |
| 6 | 24 | 25 | |
| 7 | 30 | 32 | 9.F. |
| 8 | 38 | 40 | |
| 9 | 46 | 47 | 12.12 1/2 13 |
| 10 | 58 | 60 | |
| 11 | 73 | 75 | 18.19.20 |

1 5
2 6
3 8
4 11 ou 12.
5 15 ou 16.
6 24.
7 32 . . . . Oc.9 ou 10.j.
8 42 ou 43.
9 49 ou 50 Oc.13 ou 14.j.
10 66.
11 82 . . . Oc.18 ou 19.j.j 1/2 a 20.

My first impression was that here the string gauges of an 11-courses lute are given with the number of strands (*budelli* in Italian) used to make up each string. I was confused because of the character '1/2' in the right-hand table. It seemed improbable that the strands could, or would be further divided/split in half to make an intermediate string gauge. I consulted several persons,[5] and it was suggested that the '1/2' could be an alternative for the written French word 'ou' (=or) seen in the left-hand table, so I accepted this possibility.

Octave strings are apparently indicated by the abbreviation 'Oc.' in the left-hand table. The courses for which the same string as for the 'fingered courses' can be used as octave strings have no additional cipher or other indication for the octave. So I conclude that they really used the same strings for the octave and the fingered courses for the A, F and D.

There remains the question as to what the 'j' at the end of the octave indications for the 7th and 9th courses mean.

We know Mersenne's quotation from his 'Traité des instruments a chordes', published as a part of his *Harmonie Universelle,* (Paris 1636), livre premier, p. 3:

> Par exemple les plus deliées des raquettes sont composées de sept boyaux, & les plus grosses de 12. que l'on appelle les montans, & les traversans chez ceux qui montent les raquettes: d'où il es aisé de conclure que les sixiesmes des Basses de Viole, & les dixiesmes des grands Tuorbes sont faites de 48. ou de 50. & 60. boyaux, car elles sont du moins 4 ou 5-fois aussi grosses que la plus grosse des raquettes.

So the bass viol sixths and large theorbo tenths are made of 48, 50 or 60 guts, being four or five times as fat as the fattest racquet strings. The numbers of strands used for making particular strings was known to Mersenne and that as they increase in number so does the string diameter.

It is also useful to know that metal strings were described with the number of 'drawing' processes through the drawing die (*Ziehstein*). We have a relevant table for the Theorbenzister in PL-Kj 40145, f. 96$^{v}$, which gives the 'Nuremberg' string numbers, Metal strings are thinner, if the reference number is higher:

> No. 8 vom Stahl auf den 1sten Chor. No. 6 vom Stahl auf den 2ten Chor. No. 4 von Mößing 3ten Chor. No. 2 von Mößing 4ten Chor. Zu den Bässen werden folgende Saiten genommen und zwar alle von Mößing [:] No. 4 auf den 1sten Chor, No. 3 auf den 2ten Chor, No. 2 auf den 3ten Bass. Der 4., 5., 6., 7., 8. und 9. Bass müssen mit Silber umsponnene Saiten seÿn, und zwar von der klärsten bis zur gröbsten, wie bei andern kann gesehen werden.

Gut strings are produced and built up using multiple strands, so the string diameter increases with the number of strands used. How can one calculate the final diameter of a string given the number of strands used?

For my first book *The Lute in Europe, A History to Delight* I consulted Mimmo Peruffo (in 2006) about the thinnest possible gut string and the number of strands it would require. He indicated that 4 *budelli* (strands) would give a diameter between 0.40/0.42-0.45mm. So I took 0.42 mm and 4 *budelli* as the basic information for my calculations. This takes note of the fact that the intestines were used in 'split' form and not as whole intestines. It seems that the French string-making tradition was radically different from the Italian one. In Italy, the splitting of the intestines was forbidden.[6] If this flyleaf table gives the number of strands per string, it must be in the French tradition of production and the table apparently supports the argument that French strings were made from split strands at the time it was compiled. The date of the table can beaccepted as 'later than 1670'—but we don't know exactly when the tables were written or by whom. The language fragments suggests that the author was French because of the French words 'ou' (or) and 'jusq. a' (until).

However, the interpretation of the ciphers as numbers of strands is of course only one of several possibilities. At the present it is still not generally known how the strings were classified for trade: by weight (in this case the length of the string has to be the same for all diameters), by thickness (which regional measure was used?), by number of strands or by another specification.

**Calculations**

I took a French lute with 695 mm string length and the known contemporary French pitch A=395 Hz. as the model on which to base calculations of the string diameters.

The calculations were made by my brother-in-law, the physicist Dr. Dominik A. Tröster. and are based on the same material density for all strings and on the same diameter for all individual strands. There are some open questions about the formulation of these calculations, but at least the approach gives preliminary, provisional results that can promote further discussion and research.

| Course | Gut strands | Gauge | Tension (Newtons) |
|---|---|---|---|
| 1, f’ | 5 | 0.47 mm | 43.1 |
| 2, d’ | 6 | 0.51 mm | 36.6 |
| 3, a | 8 | 0.59 mm | 27.4 |
| 4, f | 11 or 12 | 0.7 / 0.73 mm | 23.7/ 25.9 |
| 5, d | 15 or 16 | 0.81/0.84 mm | 22.9 / 24.4 |
| 6, A | 24 | 1.03 mm | 20.5 |
| [6 octave, as per 3rd course] | | | |
| 7, G | 32 | 1.19 mm | 21.7 |
| 7 octave | 9 or 10 | 0.63 / 0.66 mm | 24.5 / 27.2 |
| 8, F | 42 or 43 | 1.36 /1.38 mm | 22.6 / 23.2 |
| [8 octave, as per 4th course] | | | |
| 9, E | 49 or 50 | 1.47/1.48 mm | 23.5 / 24 |
| 9 octave | 13 or 14 | 0.76 / 0.79 mm | 25 / 26.9 |
| 10, D | 66 | 1.71 mm | 25.2 |
| [10 octave, as per 5th course] | | | |
| 11, C | 82 | 1.9 mm | 24.8 |
| 11 octave | 18–20 | 0.89-0.94 mm | 21.8-24.2 |

The following surprising features are noted:

- The first course has a very high tension compared with current practice. However, this seems to be a logical consequence of the possibilities of that time: The supposed diameter for a string with 4 strands would be 0.42 mm,
  for 5 strands it’s 0.47mm,
  for 6, 0.51mm,
  for 7, 0.56mm,
  for 8, 0.56mm,
  for 9, 0.63mm,
  for 10, 0.66mm,
  for 11, 0.70mm and
  for 12, 0.73 mm (rounded to 2 decimal places).
  So, the diameter difference is first 0.05mm, then 0.04mm and later 0.03 mm, as each strand is added.
  As a result, the difference in tension between the 5, 6, 8, 11 strands specified for the first four courses and a theoretical 4, 5, 7, 10-strand specification instead would give 8.6, 6.1, 3.4 and 2.1 Newtons less tension with the thinner strings—a completely different balance.
- Explanation of the physical aspects that apply to a string under tension: Having F as force on the string, ρ as density of the material and A as area of the cross section of the string, the wave equation resolves with c as propagation speed being $c=\sqrt{F/(\rho \times A)}$.
- The wave speed, divided by the length of the string, defines the frequency of the string, when plucked.
- With same material, in order to obtain the same frequency, the tension per unit area is constant F/A = const. Twice the diameter results in four times area, hence four times the force!
- Four times the density ρ (tungsten, gold?) results in half the propagation speed and, accordingly, half the frequency when maintaining the force on the string and the area the same.
- The musician may select thinner strings for less force on the instrument; he or she may use heavier gauge for sustain; he or she may tune the string lower than nominal force to extend the lifetime of

the string. These choices affect the brilliance of the sound, but the physical reality is a highrope walk of compromise.

- To cut a long story short: everything is restricted by the square root of stored energy in the string and the speed of propagation along the string. Go and calculate!
- The octave strings have a much higher tension than their bass-string companions. This difference decreases towards the lower courses and in the variants written in the left-hand column, the octave of the 11th course has a lower tension than its bass companion. However, in the right-hand column, with the fatter, lower-tension basses, the octaves remain at higher tension than their respective companions.
- The calculated diameters for the bass strings are not as large as expected: The strings f' and f (1st and 4th courses) are made with 5 and 11/12 strands giving 0.47mm and 0.70/0.73 mm diameters—no direct proportionality is evident. Similarly d' and d (2nd and 5th courses) are made with 6 and 15/16 strands respectively, giving 0.51mm and 0.81/0.84 mm diameters. The a and A strings (3rd and 6th courses) employ 8 and 24 strands giving 0.59mm and 1.03 mm diameters respectively.

At the lute symposium in Utrecht (31. August 2013) it was possible to present the table to a wider public. In *Lute News* 107, Chris Goodwin published first thoughts and some statements I gave at Utrecht. There are some interesting open questions and we hope that the publication of this material will help to find some answers.

1. Under what nomenclature were strings ordered and traded and in which regions, in the 16th, 17th and 18th centuries? Was it done by specifying the number of strands, as apparently in our flyleaf string table?

2. What was the actual diameter range for the component strands?

3. When and where were split gut strands introduced and used?

4. Were overspun strings, once they had been invented, sold with a nomenclatura that used 'gut-equivalent' numbers? If not, this table appears to show that plain gut strings were still used for basses after the invention of overspun strings. (Incidentally the first source I know for the use of overspun strings on lutes is the *Frauenzimmer Lexicon*, printed in Leipzig in 1715, col. 1138.)

5. Were bass strings made with 'loaded', impregnated gut strands that were more dense? The calculated diameters for the bass strings in the table are not as large as might be expected and that suggests a denser material composition or perhaps overwound strings. (see also 4 above)

Some additional points are noted here, because these discoveries could change our thinking on stringing:

- It seems that the range of two octaves and a fourth was in use since by 1490/1500. We have sources (Pesaro MS *c.*1490-1500, music; Virdung 1511, text; Judenkünig 1523, text; Gerle 1532, music) and the fact, that the use of the seventh course standing a fourth below the sixth course arises in print only in 1582 (music by Jobin) should no longer be taken as a proof that the string technology had changed and that this range was a new achievement. Perhaps a new technology improved the thicker strings, but only incrementally; if so it seems that only(!) the sound quality, the handling or the quality of the intonation were improved; the range of the later instruments had not enlarged.
- We have to distinguish between the range or compass of notes and the range <u>for the string material</u>. A theorbo has in fact a very small range for its string material of only 16 semitones: in the *petit jeu* from the highest (third) course in b down to A (one octave and one tone) and on the

*grand jeu* only from the g (like the 4th course) down an octave; so in total an octave and two full tones (=16 semitones). This is due the fact that the *grand jeu* is in the proportion of 2:1 to the *petit jeu*—and so the string material can have the same diameter as for the petit jeu.

- The 11-course baroque lute in D-minor tuning has a range of 29 semitones; this is the same range of two octaves and a fourth as the seven-course lute in vieil ton—in use since at least 1480/90! The 13-course baroque lute with a bass-rider has a pitch range of around 31 semitones—and the 13-course baroque lute with a swan-neck only 27 semitones.
- In the Vallet lute quartets for four lutes in different sizes, all lutes require 10 courses—even the smallest one(!). This seems to go against our current thinking on bass strings. Experiments need to be conducted using small instruments with a stringing regime of 10-courses to understand how such instruments functioned.

We hope that the discovery of this rare string table, in combination with this newer theoretical knowledge will lead us to a greater understanding of historical string making practice, the historical trade with strings and historical lute stringing.

I am grateful for the editorial assistance of Chris Egerton (January 2015); this version of the paper by Andreas Schlegel and by Dominik A. Tröster, March 2015

**Notes**

1 The edition will appear as soon as possible. It will include a comprehensive study on the prints of Denis Gaultier and the Rhétorique des Dieux and the other four sources wherein Notator B made entries. Two of these sources, D-Fschneider Ms. 12 and S-Smf MMS 23 will be printed as facsimile. From all 33 pieces written by Notator B there will be the modern edition and—if there are any concordances—up to 5 parallel readings of the same piece. The edition should also include the Gaultier-Werkverzeichnis, made by François-Pierre Goy, which includes 517 pieces by the five Gaultiers (Denis, Ennemond, Jacques, Pierre Gaultier d'Orléans and Pierre Gaultier de Marseille) in more than 2,220 versions, written in vieil ton, accords nouveaux or D-minor-tuning. This Gaultier-Werkverzeichnis will be published by the Deutsche Lautengesellschaft very soon as an autonomous book.

2 See: Andreas Schlegel, 'On Lute Sources and Their Music–Individuality of Prints and Variability of Music' *JLSA* XLII-XLIII (2009-2010) © 2011, pp. 91-164, especially pp. 91–105. See also the very detailled study on the Spanish prints: John Griffiths, 'Printing the Art of Orpheus: Vihuela Tablatures in Sixteenth-Century Spain' in Iain Fenlon and Tess Knighton (ed.): *Early Music Printing and Publishing in the Iberian World* (Kassel 2006), pp. 181–214.

3 Bruce Gustafson 'Chambonnières. A Thematic Catalogue', in *JSCM Instrumenta*, available online: http://www.sscm-jscm.org./instrumenta.html, especially point 2.3 and 'Exemplars of the Prints'.

4 The pages are depicted on the cover of the *Lute News* 107 (October 2013) at a larger size, and in colour.

5 Mimmo Peruffo, Annette Otterstedt, Anne Houssay, Patrizio Barbieri.

6 Patrizio Barbieri: Roman and Neapolitan Gut Strings 1550-1950, in: *The Galpin Society Journal,* Vol. 59 (May, 2006), pp. 147–181, here p. 154–5.