John R.Catch

G)S: THE ETYMOLOGY

The second edition of The Oxford English Dictionary gives three meanings for this word:

1. A little cat (animal);

2. Catgut for a violin etc.;

3. A kind of surgical knife.

The usual supporting quotations are given. The preferred spelling is catling (six examples); only one example is given for catlin, and none for cat(-)line. There is no reference to any nautical use of the word, however spelt.

The terms used by seamen are given as catfall, cat-rope or cat-back rope (a number of examples are quoted). A 17th-century "Sailor's Word Book" defines these as "a line for hauling the cat-hook about", but the term "cat(-)line" itself appears to be unrecorded. It is not in Admiral Smyth's "Sailor's Word Book" of 1867, which agrees with the terminology of the OED. On enquiry, the National Maritime Museum has been unable to find any nautical use of the word.

The peculiar construction of modern "catline" strings is based solely on the ingenious conjecture of Segerman, published in "Early Music" a decade or more ago, that catlings (2) were so called because they were made in the same way as a rope used in the cat-tackle. If so, it is rather strange that the word cat(-)line is not found in the OED and that it has no example of catlin(g) in nautical use. One would suppose that a term would have to be in fairly familiar use to be transferred to a fiddle-string.

This etymological difficulty is fairly obvious and it may well have been raised and answered elsewhere; but if so I have missed it.

Does any reader know of any explicit nautical use of the word "catling", however spelt?

Can any reader tell us whether the strings called "catlings" in England had names in other languages (particularly Italian) which had any known or possible connection with the mariner's operation of "catting the anchor"?

I thank Mr.Brian Lavery, Head of Ship Technology at the NMM, for answering my enquiry.

30 August 1993 John R.Catch

 Ephraim Segerman

HISTORICAL VIOLIN STRINGINGS UP TO 1900

This Comm reproduces an NRI brochure I recently wrote with small changes to make it appropriate for a Comm, including the elimination of prices and references to them. The original brochure is available from NRI, under the same title, for the asking.

All of the information in this Comm is taken from *The Strad* (1988), pp 52-55 (Jan), 195-201 (Mar) and 295-299 (Apr), where there is further detail, information and explanation. The intention here is to offer guidance for violinists who would like to explore how the original stringings of baroque-, classical- and Romantic-period violins felt and sounded like, and how this might influence their interpretations of music from these periods.

This is the most ambitious way of attempting to eliminate the problem posed by modern listeners enjoying early-music performances using modern stringings while naively expecting them to be as historically accurate as scholarship can tell. Most violinists are unaware of the position of scholarship on this matter, and don't appreciate that there is a problem. If they come across the above-mentioned Strad articles or this Comm, they might try to avoid facing the problem by claiming that the evidence is 'not strong enough to be convincing'. As shown below, scholarship cannot accept this position. Trying to educate the public with the truth leads only to disappointment and confusion about what early music is about. The most practical honest approach is just to avoid the problem by refusing to be party to any claim of historical accuracy. An uncommon level of commitment to and curiosity about violin history is required for violinists to use the information on historical stringings that follows:

In the first Table we list the sources providing information concerning whether the four violin strings were at the same tension (equal-tension stringing) or, as is universal today, the 4th string was at the lowest tension, the 3rd had greater tension, the 2nd had greater tension yet, and the 1st had the highest tension of all (progressively-changing-tension stringing).

EVIDENCE OF TENSION DISTRIBUTION

Country	Equal-Tension Stringing		Progressively-Changing-Tension Stringing	
	Source	Year	Source	Year
England and France	Mersenne	1635	Sibire	1806
	Brossard	c.1712	Plessard	1874
	L. Mozart	1764	Bishopp	1884
	Fetis	c.1836	Heron-Allen	1885
	Savart	1840	French string gauge	c.1900
	Delexenne	1853		
	Savaresse	1869		
	Huggins	1883		
	Hepworth	c.1900		
Germany	L. Mozart	1756,1769	Spohr	1832
			Schroeder	1887
			Weichold	1892
Italy	De Colco	1690	Ricatti	1767
	Stradivari	c.1700	Ruffini	1883
	Tartini	1734		

From this Table we conclude that before the middle of the 18th century, equal-tension stringing was usual throughout Europe. At that time, progressively-changing-tension stringing was introduced in Italy in association with the introduction of a wound 4th string there, and soon became the usual type of stringing from then on in that country. This type of stringing spread to the rest of Europe by the end of the 18th century, probably in association with the popularity of Italian opera. Nevertheless, a large fraction of violinists in England and (especially) France still used equal-tension

stringing throughout the 19th century.

In the next Table, we list the evidence on the types of construction of violin 3rd and 4th strings used up to 1900. The first two strings were always of gut. None of the evidence distinguishes between low-twist and high-twist gut. Low-twist gut is necessary for the 1st string, and lasts longer for the 2nd string. Except for the Talbot ms, none of the evidence for the 3rd or 4th string distinguishes between high-twist and catline gut. A catline's rope construction is much more necessary for a 4th than a 3rd string. Where 'Wound' is listed, the source does not distinguish between open-wound and close-wound construction.

EVIDENCE OF VIOLIN 3RD AND 4TH STRING TYPES

(Not listed is all 19th century evidence indicating a Gut 3rd and Close-Wound 4th; the one exception, a German one, is listed)

Country	Source	Year	Third String	Fourth String
England	Mersenne	1635	Gut	Gut
and France	Talbot	c.1694	Catline Gut	Catline Gut
	Brossard	c.1712	Gut	Gut OR
			Open Wound	Close Wound
	Fouchetti	c.1775	–	Wound
	Laborde	1780	Open Wound	Close Wound
Germany	Meyer	1732	Gut	Wound (probably Open)
	Lohlein	1744	Gut	Wound (probably Open)
	Quantz	1752	Gut	Wound (probably Open)
	L. Mozart	1756	Gut	Gut or Open Wound
	Gunzelheimer	1855	Gut	Gut
Italy	Stradivari	c.1700	Gut	Gut
	Tartini	1734	Gut	Gut
	Ricatti	1767	Gut	Wound (probably Close)

The first evidence for the availability of wound strings is from 1664 (Playford), and the only evidence of their use before the end of the 17th century is for the lowest string of some bass instruments, usually to perform the functions of larger ones. As seen from the Table, the French started using an open-wound 3rd and close-wound 4th early in the 18th century, and this became their standard stringing through most of the rest of the century. While the Italians only used gut 3rds and 4ths, the Germans, strongly influenced by both the Italians and the French, adopted a compromise stringing with only a wound 4th. That this was open wound (or just gut) is deduced from Leopold Mozart, who indicated the the 4th was the thickest string. Since the late-18th century Italian progressively-changing-tension stringing spread to dominate Europe in the 19th century, and 19th century stringing involved a close-wound 4th, it is likely that the close-wound 4th was associated with this type of stringing from its beginning (Ricatti).

Before listing how heavy historical violin strings were, we first list the diameters or EDs (equivalent diameters in solid gut for the same weight) of all of the violin strings within the historically-indicated ranges, given at semitone-step intervals of heaviness. It is arranged so that the lettered rows are equal-tension sets. The rows marked -2, -1, +1 and +2 are needed to cover the diameters (or EDs) of strings used in progressively-changing-tension sets and not used in the equal-tension sets. Equal-tension sets will be identified by the row letters, while the progressively-changing-tension sets will be identified by the row for each string, showing well how the tension varies. The first string in each of the equal-tension sets is one semitone-step heavier than theoretical equal tension with the rest of the set would be, but it ends up close to the same tension as the others when it gets thinner from stretching.

HISTORICAL RANGES OF STRING DIAMETERS (OR EDs)

ROW NAME	VIOLIN 1st Diameter thou	mm	VIOLIN 2nd Diameter thou	mm	VIOLIN 3rd Diameter or ED thou	mm	VIOLIN 4th Diameter or ED thou	mm
-2							54	1.36
-1							57	1.44
A	19	.48	27	.68	40	1.02	60	1.53
B	20	.51	28.5	.72	43	1.08	64	1.62
C	21.5	.54	30	.76	45	1.14	68	1.71
D	22.5	.57	32	.81	48	1.21	72	1.82
E	24	.61	34	.86	51	1.28	76	1.92
F	25	.64	36	.91	54	1.36	80	2.04
G	27	.68	38	.96	57	1.44	85	2.16
H	28.5	.72	40	1.02	60	1.53	90	2.29
I	30	.76	43	1.08	64	1.62	95	2.42
J	32	.81	45	1.14	68	1.71	101	2.57
+1	34	.86						
+2	36	.91						

Listed in the following Table is the heaviness of the violin strings in the sets we have historical evidence for. In those sets with equal-tension stringing, the Set Name gives the letter of the relevant row in the previous Table plus, in parentheses, the type of the third string followed by the type of the 4th string (with 'g' meaning unwound, 'o' open-wound and 'c' close-wound). In those sets with progressively-changing-tension stringing, the rows in the previous Table are given for the first-to-fourth strings in that order. The string types for these sets are all with an unwound gut 3rd and a close-wound 4th. It is assumed that the first two strings in all sets were low-twist gut, and when the 3rd and 4th were unwound gut, they were (following Talbot) both catlines. It is also assumed that by the final third of the 18th century, wound 4ths had become so universal that rope construction catlines ceased to be made. Thus, in sets which had an unwound gut 3rd and a close-wound 4th, which date from then on, the 3rd was of high-twist gut.

EVIDENCE OF STRING WEIGHTS IN HISTORICAL SETS

	Equal-Tension Stringing				Progressively-Changing-Tension Stringing			
Country	Source	Year	Pitch Std	Set Name	Source	Year	Pch Std	Set 1,2,3,4
England and France	Mersenne	1635	-2	J(gg)	Sibire	1806	0	G,G,F,E
	Talbot	c.1694	-2 to 0	A(gg)	Plessiard	1874	0	G,F,D,A
	Fouchetti	c.1775	-1	G(oc)	Bishopp hvy	1884	0	G,E,D,B
	Fetis	c.1836	0	H(gc)	medium			G,E,C,A
	Savart	1840	0	H(gc)	light			E,D,B,A
	Savaresse	1869	0	F(gc)	Heron-Allen	1885	0	G,F,D,C
	Huggins	1883	0	F(gc)	French string			
	Hepworth	c.1900	0	C(gc)	gauge	c.1900	0	C,C,A,-2
Germany	Muffat	1698	-2 to 0	C(gg)	Spohr	1832	0	+2,J,H,G
				C(go)	Schroeder	1887	0	G,F,E,C
					Weichold mx	1892	0	H,G,D,B
					minimum			E,D,A,A
Italy	Stradivari	c.1700	-2	J(gg)	Ricatti	1767	-2	G,E,B,-2
	Tartini	1734	-2	I(gg)	Ruffini	1883	0	G,F,D,B
			FOR COMPARISON:		NRI	heavy	-1	E,C,B,A
					MODERN	medium		D,B,A,-1
					BAROQUE	light		C,A,-1,-2

When the violin began late in the 16th century, it was renowned for its loudness. This leads us to expect that the very heavy stringing in Mersenne's evidence (J sets) was universal in his time. It is possible that in Protestant Germany then, where the pitch standard (given by Praetorius) was a tone higher, the strings were two semitone steps lighter (H sets) to have the same tension and projection.

Later in the 17th century, the viol was the favourite of the French aristocracy, who insisted on playing with the violins, so violins adopted very low tension for balance. This stringing was exported to England in the Restoration, from where we have the Talbot evidence (A sets). In England then, the violin played at close to modern pitch in fiddle bands, but tuned down a tone to play with viols. Evidence from Prin (about marine trumpet and bass violin strings) implies that by 1742, French (and probably English) violin tension was up again, to that indicated by Fouchetti (G sets).

Muffat compared German and French stringing, and it is likely that the same strings (C sets) were used for all of the 18th century pitch standards. The Italians appear to have continued the early use of heavy stringing (J sets) to at least the middle of the 18th century. A piece of evidence from 1743 indicates that Tartini had recently increased his string-tension level, possibly up to the previous level which had been dropping.

There is no evidence about how progressively-changing-tension stringing progressed in Europe in the final third of the 18th century after its adoption in Italy. It was probably adopted in Germany before France. Sibire's early 19th century evidence shows a compromise between this stringing and equal-tension stringing. There is considerable evidence that violin string tensions went particularly high in the second quarter of the 19th century. This is reflected in Spohr's stringing (as heavy as the instrument could bear), and more mildly in Fetis's and Savart's stringings. The lower tensions after that are marked by similar but quite diverse stringings. Bishopp's 'light' stringing shows the beginning of a c.1900 movement in England and France for very light stringing, which developed into the Hepworth and French-string-gauge sets. That movement did not last, but the pressure for lower tension continued, presumably for less effort in playing and quicker response. Modern violin stringing has tensions very similar to Bishopp's 'light' stringing.

It is unfortunate that no stringing evidence is known for Germany in the late 18th and early 19th centuries, when much revered music (e.g. by Haydn, Mozart and Beethoven) was written. When the Italian stringing (as reported by Riccati) spread throughout Europe (with progressively-changing tension and the 3rd string unwound and the 4th close-wound), there was some compromise with local traditions in string heaviness. The Sibire stringing is an example of French compromise. The Germans were more receptive to Italian influence than the French, so one would expect the German compromise to be more Italianate. A set with string heaviness distribution such as GECA could be appropriate for this period in Germany. Since it happens to be Bishopp's 'medium' stringing, it also is appropriate as a good late 19th century stringing.

Many of the estimates made here when interpreting the evidence, and interpreting what stringings were used when evidence is lacking, can be argued with. Somewhat different interpretations might be just as valid. What is not valid is ignoring this evidence while claiming that one's modern stringing is as historically accurate as scholarship allows. The excuse behind this claim is that scholarship cannot say anything 'meaningful' about it because the evidence is so 'dubious', 'weak', 'fragmentary', or some other dismissive word or phrase.

Knowledge (other than of the personal type or of fashion consensus) is what scholarship produces. The authority of scholarship is based on objectivity in its handling of evidence and in its choosing of the generalisation that is best supported by the evidence. Judgement is very important in seeking evidence and thinking up generalisations, but is minimised in favour of objectivity when coming to any scholarly conclusion. Objectivity in handling evidence insists that, though we can think of many reasons why a piece of evidence could be wrong, unrepresentative or misleading, unless we have real evidence to the contrary, we must accept that it is true, representative and what it seems to be. This principle of conservation of evidence is necessary to avoid the maligning or ignoring of contrary evidence while promoting any theory one likes. This malpractice or false scholarship cannot lead towards objective truth. What is presented here IS the scholarly history of violin stringing until someone comes up with new evidence, or with an objectively better interpretation than this one which takes all of the evidence just as seriously.

 Ephraim Segerman

On Catlines and Pistoy Basses

I have not found a recorded use of 'Catlin', with or without an added 'e' or 'g', in a nautical context. This is in agreement with Catch in his Comm 1202. As I understand English pronunciation at the time, an added 'e' or 'g' would be silent, so all three words were homonyms. The kitten meaning (spelled with a 'g' on the end) would be appropriate for a lute string because one strokes it for pleasure. Since 'line' and 'rope' were synonyms, 'Catline' (spelled that way by Dowland) would also be understood to mean 'Cat-rope', although the latter was the traditional nautical term. This meaning would be appropriate for a thick flexible lute string with rope construction. I suggest that it was the coincidence of these two meanings that inspired the name used to describe this type of lute string.

'The peculiar construction of modern catline strings' Catch writes 'is based solely on the ingenious conjecture of Segerman ...'. Whether that construction is 'peculiar' (or the conjecture 'ingenious') depends on one's judgement, based on experience and prejudices. The motivation for postulating that construction had nothing to do with the name. We have strong evidence that gut-strung instruments did not have metal-covered basses available for them before the middle of the 17th century, and that their adoption was gradual after then. The expansion of open-string ranges by half an octave on many instruments late in the 16th century is unlikely to have been associated with increased tolerance for poor-sounding basses. Thicker ordinary gut strings, as are available for harp, demonstrate that poor sound. The motivation was to find some way besides winding metal around the gut to provide the required weight (for audibility of a clear tone) plus the required flexibility (for in-tune fretting and some in-tune harmonics) on the low-pitched strings of a late Renaissance or early baroque lute tuned two octaves and a half lower than the highest string. Rope construction is one such way, and support for its use comes from Mersenne's statement that gut strings were made and sold by rope makers. For more details, see Comm 773 (Q46).

Another way is by incorporating a slurry of metal or metal compound into the string when it is made and twisted up. Such strings would be strongly coloured, and they are now being made and sold by Mimmo Peruffo (his address is given in the List of Members 2nd Supplement, Oct. 1993). Dowland mentioned coloured strings and advised choosing the lightest colours. If the colour was associated with incorporated metal-compound loading, Dowland seemed not to have appreciated this virtue. Mace mentioned string colours, clear blue being the best. He also mentioned Pistoy Basses, which he believed were 'Thick Venice-Catlins, which are commonly Dyed, with a deep dark red colour. They are indeed the very Best, for the Basses, being smooth and well-twisted Strings, but are hard to come by; However out of a Good parcel of Lyon Strings, you may (with care) pick those which will serve very well. ... Your Pistoys, or Lyons, only for the Great Basses.'

Mace mentioned that Venice-Catlins were used for the 4th and 5th courses and most of the low-octave strings on the lower courses. There were seven of those others, so the Great Basses that used Pistoys and Lyons were used at most on the lowest three courses of the lute, all going to the special 4-course extension pegbox on his 12-course lute. The lowest course sharing the same nut as the high strings was two octaves below the highest string. So Pistoys were used only on strings tuned lower than two octaves below the highest string (on the same nut). That is just where I would switch from 3-strand catlines to 2-strand ones. Incidentally, after many years of making rope-construction strings, we at NRI have just discovered a way of putting much more twist into them, making them much brighter in sound. Being so 'well-twisted' could well be the factor that made Pistoys so good.

There are quite a few paintings which show strings of different colours. I have not seen any which show the Pistoy Bass colour where we would, from the above, expect it to be on the instrument. Whether or not Pistoy Basses were loaded with a metal compound, the evidence indicates that they were not a staple component of early stringing practices, as catlines and Lyons were.

The musicians I've talked to who have tried Peruffo's strings say that they sound very well. I'm sure that they would say the same about the open-wound and 'tigerline' strings that we make. With the evidence I am aware of, there is no difference in lack of historical justification for their use while claiming to emulate typical pre-1660 conditions.

FoMHRI Comm. 1254 John R. Catch

Catlins, Coloured and Loaded Strings

Usage is important, spelling and pronunciation less so. Catlin(g) it seems is not recorded for the cat-rope, any more than rat-rope for ratlin(e) or bow-rope for bowlin(e). "Line" and "rope" are properly not synonymous in technical use, "the name rope being given to cordage above one inch in circumference" (O.E.D.). I cannot recall any example of the term "line" being applied to a musical instrument string. On evidence, I was quoting Segerman in "E.M." 1976 ("The only evidence we have on the construction of Venice Catlines lies in their name"); and the peculiar structure is that which Segerman describes, or (to quote the NMM) "four or six parts of the line, arranged in pairs opposite one another"; not just a rope, but a rope of a peculiar kind.

I think it more probable that the name for the string never had anything to do with the mariner's cat-tackle, but is a diminutive of "cat". "Cat" and "kit" have long-standing associations with fiddling and fiddles, although the O.E.D. is non-committal about the etymology. Catling and kit can both mean a small cat; catling and catgut refer to fiddle-strings; a dancing-master's fiddle is a kit; caterwauling is suggestive of the unskilled fiddler. I am dubious of the significance of Segerman's suggestion about "stroking the strings", for strings other than catlins were also stroked. The verbal association of cat and fiddle seems to have been traced back only to ca. 1765 ("Oxford Dictionary of Nursery Rhymes") but it may be older; witness the remarkable example of "I have four sisters beyond the sea", with written records in the early 15thC and from 1838 onward, but nothing in between.

The historic evidence advanced for "loaded" strings is a) sizes of the holes in old lute bridges; b) colour; and c) "red strings especially rich in mercury" and blue with "significant traces of lead" (Peruffo, Comm. 1021; Cohen, GSJ XXXVI, 37). I comment only on b) and c).

Red, blue and green violin strings were not uncommon sixty-odd years ago; I remember them well. The colours were transparent or translucent, not those of an opaque pigment, and certainly had nothing to do with any alteration of density. In default of any other evidence it seems likely enough that Mace's coloured strings and those depicted in paintings were coloured in the same way.

c) is a mare's nest. The strings referred to were newly invented in 1798, and not of gut but of silk. "Especially rich in mercury" means, in chemical parlance, having much more than would be expected - which would be virtually nil in silk. It does not mean enough to have a significant effect on the density, any more than would a pathologist's report that a cadaver contained a very high lead content. Cohen states that the colours were to indicate pitch, and says nothing whatever about their having a density higher than normal. It was predictable (as Peruffo found on trial) that chemical binding of heavy metal atoms to gut, with or without a mordant, could not give any effective increase in density. It would be a mockery of scholarship to advance this 1798 information as evidence that gut strings impregnated with a dense bronze lacquer exemplify 17thC practice.

These observations are not meant to be destructive, or discouraging of conjecture and experiment. But let us not apply historic terms to modern fabrications with little or no evidence, let alone proof, that they correspond to the historic originals. Many musicians, I fear, accept these attributions as gospel. Let us experiment by all means, and use what we like best, calling them factually ropes or high-twist or loaded, without any illusions that we know the historic answers; for quite obviously we do not.

I thank Elaine Aldred for help in examining an "Aquila" string.

ON VENICE CATLINS, LYONS, PISTOY-BASSES AND LOADED-WEIGHTED BASS GUT STRINGS.

Eph. Segerman's comment 1235 and 1255 and J. R. Catch's comm. 1254 give me the good opportunity to answer and get deeper in to debate on all-gut bass strings in use in the 16th and 17th centuries. And while at it, I would like to invite other members too, to join in and express their own personal opinions.
I believe the hypothesy that all-gut bass strings in use during the historic period end of the 16th century - beginning of the 18th century, may have been characterized by some process of gut loading-weighting (which from c. 1660 saw a technological strategy change: gut was made heavier by twisting a thin wire thread around it) (1), deserves being taken in to serious consideration. This in the light of several important clues, which may be summarized thus:

1) Bass strings-bridgeholes in surviving instruments.
2) 17th century-iconographic sources.
3) Written sources and physical aspect of strings (colour, surface).

BRIDGEHOLES

The systematic gathering of bass strings bridgehole-diameters on historic lutes doubtlessly represent the real test bench for any theory on bass strings of the past. Come to that, I found that the bass strings holes in surviving historic lute-bridges are so small as not to hallow any all-gut string passing through them adeguate working-tensions and therefore an acceptable acoustic performance. Acoustic performance which is absolutely unsatisfactory both for plain-gut and for rope-construction strings (2) which, although more elastic (and therefore potentially functional) because of their lower specific weight (mean and apparent of c. 1.1 gr/cm^3 against 1.3 gr/cm^3, typical of normal plain gut) can absolutely not reach working-tensions sufficient to make them sound. That is all.
The measuring of the bridge-holes was carried out with accuracy, using rods of increasing exact diameters thus I have verified the maximum passing diameter.
It will be worth mentioning that by so doing we do not obtain the actual string-diameter but that of the hole, which was obviously drilled with a certain empirical oversize. In spite of such handicap (the density comes out underestimated and the working tension overestimated), the result seems still surprising to me, even talking in to account the hypothesis (Segerman, comm. 1255) of a possible, modest ovalization of the holes caused by an asymmetric contraction of the wood through collapsing, hypothesis which is all to be confirmed: I carried out most of the measuring myself, checking very accurately the holes under examination; I did notice in several bridges, some degree of ovalization external to the hole, related to wear and pressure caused by the string over a long period of time. Assuming the string's diameter to be 90% of the hole's, we should multiply the density and working-tension values by the correttive coefficients 1.235 and .81.

The most interesting data are certainly those concerning instruments built before 1664, date to which the first mention of overspun strings goes back to (3). We should in any case stress the scarce spreading, at the beginning, of this new type of string. T. Mace (4) and J. Talbot (5) do not mention or employ them yet, while from a historic and iconographic point of view, the use of all-gut strings is documented well also in to the Ist half of 18th century. Thus I have carried out several measuraments from after 1670, too. In the Table n. 1, relating to instruments tuned in Renaissance-tuning, in order to process the data in my possesion, it was necessary to fix a working-frequency for each of the courses examined. Starting from a Break-Index of 240 Hz x mt. (6), equal to the breaking-point of gut of about 32 kg/mm^2, it is possible to determine the theoretic breaking-frequency of the top string of any lute and therefore the working frequency, from which that of the basses is infered: I chose two semitones lower than breaking-frequency (7). Under these conditions the top string's working-frequency is very close to its breaking-frequency, i. e. in accordance with the general practice in use in the 16th century. In the table I also took in to account the theoretical parameters of a plain gut strings (a) which, although lacking any particular usefulness for making all-gut bass strings (I don't need to explain why), still possesses, in absolute terms, the highest specific weight for the natural material, beyond which we can only reach by means of adeguate loading process. The other model considered here is that of rope-construction, (b) which is, to date, the only acoustically valid alternative to the loading of gut. In the tables, beside the description of the type of instrument, there are some specific columns:

COLUMN A: the diameters, in mm, which a plain gut string (a) or a rope-construction (b) should possess at a tension of 3 kilos; the tendency to-day is to apply such working tension to lute strings, which allows the use of strings which are neither too stiff nor too slack under the fingers, in accordance with J. Dowland's (8), M. Burwell Lute Tutor's (9) and T. Mace's (4) recomendations.

COLUMN B: the density value which a string with a diameter equal to the bridgeholes should possess for a working tension of 3 kilos. It can be noticed that the densities are rather far from that of natural gut and especially from that of rope-construction strings.

COLUMN C: the working tension, in kilos, which either type (-a- and -b-) of string would assume at diameters equal to the bridgeoles'.

This last column seems particulary interesting for me, <u>since the only variable is the frequency assigned to each course</u>, all other parameters (density of gut, vib. string length, hole-diameter) being perfectly measurable. Such frequency, all things considered, depends solely on the breaking-point attributed to gut, which, in order to allow the maiority of strings to reach sufficient working-tensions, should theoretically rose to values of at least 45 ÷ 49 kg/mm^2, which are excessive in the light of the

considerations i am going to make on the breaking point of gut. Where Baroque-lutes tuned in d-minor are concerned (Table n. 2), since the top string is always nominally defined as f', I have avoided determining the lower courses-frequencies setting off, like I did before, from the Break-Index; instead I started from the pitch-standards in use in France and Germany in the 18th century, which were surely ranging between zero-semitones (0s), one-semitone (1s) and two-semitones (2s) lower than modern 440 Hz-standard pitch (10) (11).
Proceeding in this manner the frequency of every lower course becomes totally indipendent of the breaking-point of gut, and this drastically reduces the degree of uncertainty of the processed data. Still, a simple double check via the method adopted for instruments with Renaissance-tuning. allows to ascertain that, at the vibrating string length of each historic instrument, and with the top string in - f'-, at 0s (i. e. 440 Hz) the breaking-frequency is exceeded or dangerously close. The parameters for the 0s pitch-standard are, therefore, to be considered purely theoretical. the valutations refer exclusively to the rope-construction type of string. I should like to open a brief parenthesis now, about the breaking point of lute-treble strings of the 16th, 17th and 18th centuries.
There is no reason to believe that the universal 16th century-rule to tune the top string as high as possible on instruments, intended for "solo"-playing, (12) would not be also adopted for instruments with a given nominal pitch. Once this nominal pitch was defined, the ancients aimed in any case for the longest possible vibrating string-length, so that the top string would work, in actual fact, close to breaking-point. This way of proceeding was obviously free from masochistic tendencies and aimed only to achieve the best possible performance from the lowest all-gut bass registers. Proceeding backwords, it becomes then possible to try and estimate the breaking point of top strings of the past. It has been pointed out that a large number of German-lutes in - d - minor tuning from the 18th century, have a v. string length of between 0.70 and 0.72 mt (13).
At the range of frequencies hipothized by scholars for 18th century German-Kammerton (440 ÷ 390 Hz), and assuming the top - f'- at two semitones lower than breaking frequency, we obtain a "window" of breaking points of between 32 and 36 kg/mm^2, which is remarkably close to those encountered in many specimens of current commercial gut strings (31 ÷ 38 kg/mm^2) of the diameter of a lute's treble. With the some method I could also estimate the breaking-point of 16th and 17th centuries trebles. Several lutes built in Venice in the late 16th and 17th centuries have a v. string length between 0.57 and 0.59 mt (14). Assuming a nominal pitch of - g' -, at a Venetian pitch-standard of 450 ÷ 465 Hz, we obtain a breaking point-range of 31 ÷ 37 kg/mm^2. These results basically confirm the correctness of the choice of the working frequencies of the lower courses of instruments with renaissance tuning.
The average of these estimates is 34 kg/mm^2 and matches also that of modern commercial strings. If we apply this value to Segerman's comm. 129, we obtain a estimate of the working-tension which increases from 2.3 to 2.5 kg on Mersenne's lute.

STRING-COLOUR AND MUSICAL TREATISES

In the realm of musical-treatises of the 17th century, the only sources mentioning coloured strings are R. Dowland (15) and T. Mace (16). Dowland report that variously coloured treble and mid-range strings were available, (I would imagine with a merely aesthetic and commercial purposes) and suggest always to choose the ligher and in any case trasparent colours. Segerman's quote (comm. 1255) "....This choosing of strings is not alone for Trebles, but also for small and greater Meanes: greater strings thought they be ould..." does not, I think, allow a univocal interpretation. Especially in the second part of the passage, Dowland does not refer, in my opinion, to the lowest registers of the lute, with which he deal later "...for the greater sorts of Base strings....", but for the some "great Meanes" which are greater than what he has just mentioned: the Trebles. I think the use of punctuation is here recevant and above all the fact that, when referring to the different registers, he always uses capital letters (e. g. Trebles, Meanes, Base-strings). Thus, when he get down to actually describing the lowest strings, he only mentions the place of provenance: there is no mention of either colour or trasparence. T. Mace, as known, is the only one who describes colour (but not trasparence) of at least one type of bass-gut strings, the "Pistoys", whose colour is anything but light and delicate: "....a deep dark red colour...". It is hard to believe that thick strings possessing such a dark chromatic feature could be at the same-time trasparent to light! About the lowest Lyons he says nothing. On coloured strings (blue, red, green and yellow) it is not specified for which registers they should be employed, but the suggestion that the light-blue ones be the best, encourages me to think that these too, like in Dowland's case were appropriate for trebles and mid-range.

From the sizes of the bridgeholes examined (the research was carried out on about 50 historic-lutes) I cannot frankly think of any plausible explaination other than the loading of gut. But in order to reach in practice the specific weight inferred (and I wish to remind, always keeping on the safe size), a very energetic loading treatment is called for, and only with materials possessing a rather high specific weight. Other processess and other materials (and as a chemist I have tried quite a few) did not allow in any way to reach the density-values inferred from the bridge-holes. Just to give an example: in a string with a specific-weight twice as heavy as natural gut, throught a mathematical approximation estimate, assuming that the volumes of the materials add one to the other perfectly, a good 60 - 70% if its total weight (that is 40 - 50% of its volume), comes solely from the loading agent, when we assume using, as such, red lead (minium); one of the heaviest pigments known at the time. But here, it must be made quite clear, we are dealing exclusively with lower-registers strings, that is at least two octaves below a lute's treble or, in other words, from the 6th course down, and not with mid-range strings, about whose phisical aspect, "Pistoys" excepted, we know, in fact nothing. Admitting but not granting that what written by Dowland about the transparence of strings may also refer to the lowest ones, it should be pointed out that

such indications would be limited exclusively to the basses mentioned in the "Varietie". To extend them to include also "Lyons" and "Pistoys", which he never describes, seems to me to be definitely a strained interpretation, totally lacking any supporting evidence.

ICONOGRAPHY

The colour of the lowest registers of instruments depiced in the musical iconography of the 16-17th (and 18th) centuries are an important, but not decisive element towards confirming the loading of gut. It is , in fact possible to load even remarkably such material without causing any noticeable chromatic changes compared to the colour of the natural stuff. Thus, the painter could only paint all the strings as being homogeneously the same colour (of natural gut). IT is clearly a not negligible detail. On the other hand, strings were also coloured for aesthetic purposes. Be as it may, in the realm of what is chromatically distinguishable, the iconography of the time provides important dues all the same. The lowest strings, of an apparently reduced diameter, look homogeneously blackish, brown or red, and appear exatly where the acoustic short comings of plain-gut would make themselves felt. On lutes there are several relevant examples (17). Among others, Charles Mouton's portrait, by F. Le Troy (c. 1694) and the anonymous 17th-century luthenist (on the cover of the october 1982-issue of Early Music), in the Hamburg-Kunsthalle: the red or brown basses, from the 6th course down, on these 10 and 11 course-instruments suggest to me to be a not at all aesthetic use of colour, but quite simply the consequence of loading process. In the world of bowed instruments, I have found some very interesting examples, too.
The best are undoubtlly in the Germanische National Museum in Nuremberg: are two anonymous Dutch-paintings from the IInd half of the 17th c. are shown, practically life size, a number of plucked and bowed instruments of the time. Among others, a "bass" and "treble" gambas stand out, on which the 6th, 5th, 4th and (partially) 3rd strings are very dark brown-black colour; the 6th, being almost black, while the two top strings are "white", that is the same identical colour as the frets. Furthemore, the strings look perfectly smooth (it is even possible to see paint the light reflection on the bass strings of the bigger-gamba), while the visible diameter progression does not follow at all what we should expectif gut of equal or lower density were used for the basses. The violin is also interesting: while the 1st and 2nd strings are light coloured, the 3rd and 4th are both a darken colour, nearly like the gambas', and strongly bring back to mind what J. Talbot (18) wrote about the istrument: "....Best strings are Roman 1st & 2nd of Venice catlins: 3rd & 4th, best be finest & smoothest Lyon, all 4 differ in size....".
A second example worth mentioning is a large paint from the 2nd half of the 17th century by G. Martinelli - "Concerto in casa Lazzari" - in the Carpi castle, Italy. Here too, and the close similitary to the Dutch-painting is quite striking, the four lower strings of the "Violone" are a very dark-brown and the first two are light (white) and the same goes for the Violoncello in this painting: the two lower strings are brown, the first two

clearly lighter. Is the hypothesis that the lower strings on these instruments, were dyed only for aesthetic purposes, really convincing (even admitting that blackish/brown colours may have been as aesthetically appealing as red, blue, green and yellow, which are all the only colours mentioned in the treatises)? The next interesting questions is: if Pistoys were deep-red, what are the brown-black basses in these examples (Lyons, Venice catlins)?

THE SURFACE OF STRINGS

What the strings surface looks like a point of a certain relevance. An interesting feature of gut-loading processes is that they do not necessarily require any different twisting procedure from the usual ones, since the high density increase, by reducing the working-diameters, bring also as a consequence a remarkable reduction in the string-stiffness. Strings, in other words, can show a smooth surface, in accordance with all the treatises of the 17th century. Mersenne, for ex., afferms that gut strings were well-polished by the use of a grass with an abrasive proprieties, but do not says anything that leads to believe that this procedure was deserved only to thin-strings (Segerman-comm. 773: "Response an attack on Modern-Catlines"). Mace state that Pistoys were smooth. This does not imply at all that Lyons were not! In fact, nothing at all is said about Lyons. Instead, other sources are much more interesting. Talbot, in fact, says that violin-Lyons were smooth. The Burwell Lute Tutor, describing the best strings for the lute (Romans for the trebles and Lyons for the basses and respective octaves) explains that an important feature from strings is exactly that the surface should be well smooth and free from "knotte" and "rugged", Lyons included. T. Mace, in addition, states that the (thin) Venice-catlins for the mid-registers were smooth, so when he also states that "Pistoys" were but thicker Venice-catlins we must infer that they, too were smooth. The iconography of the time seems also to point in the same direction. Emblematic examples are also E. Baschenis's paintings (mid-17th century), were the strings on the musical instruments are depicted smooth, as well as rather curly and supple, and whose unused length is wound up in tight bundles like a soft cord (this last aspect should be investigated, and quite impossible with modern strings both high and low twist, lest they get damaged). One of his paintings proves his pictorial accuracy (Palazzo Pisani-Moretta, Venice): besides the musical instruments, whose strings are clearly visible, there lies on a tambour a typical taylor's spool. Whose thread's of a diameter similar to the (smooth) strings on the instruments, typical rope-like structure is accurately reproduced.

MUSICAL-TREATISES

In chap. 16 of the Burwell Lute Tutor, the author complains about the problems which the two-headed lute introduced by English Gaultier caused because of "....the confusion that the length of sound produce it alsoe..." and "...every ba(s)se sound make a confond with every string..." this statment is also makes up by T. Mace (chap. XLII, p. 208). If this two-headed lute is the one shown in the famous portrait of English Gaultier, whose diapason length is recorder by J. Talbot and a specimen of which seems to

survive in the Linhöping-Library in Sweden (19) with a vib. string-length of less than .90 mt, one wonders how such a persistent sonority can be possible excessive to the point of forcing the french-luthenists to revent to the old model, bearing all the basses on one single neck (and nut), whatever the twisting technique employed on the unloaded gut have been.

18th CENTURY-HARP STRINGS

J. Catch's remark on my quoting A. Cohen's article on Mr. Baud's patent for harp strings of 1798 (G.S.J. XXXVI, March 83) finds me in perfect agreement. I am not embarrassed to admit that it was a mistake; unfortunately I realized it too late, after comm. 1021 and also an article in Italian had already been published. AS the old proverb, goes we learn from our own mistakes.

PRACTICAL EXPERIMENTATION

The experimental production of loaded-gut strings gave me the opportunity to concretely verify their relevant acoustic characteristics, which I then related to the historical documentation at my disposal (20). The timbre of this type of string was rather deep, fundamental-heavy. The thinner diameters (less than 1 mm) gave a timbric response which was still rather rich in high harmonics, enought to enable to dispose of a Renaissance lutes 4th, 5th and 6th courses octave strings in favour of unisson stringing, a tendency which began to come in to being after 1570 ca. In the light of what can be inferred from treatises and iconographic sources, I believe that the loading of gut was, in fact, a technique reserved only to lower strings, beyond the 6th course down. For the mid-registers I would suggest the hypothesis that some particular twisting technique might have been developed, such as to endow the strings with more elasticity than high twist would, and thus allowing unisson stringing. In fact I have had the opportunity to experiment with some twisting processes (which were also commonly used for silk in the 16th century), which, granting the 4th and 5th courses of a lute a fair amount of high harmonics, a smooth surface, softness and... transparence, allow me to leave an open door to such supposition. Where extended-necks are concerned, even of a limited length, the acoustic performance of loaded gut proved bright and persistent, enought to cause, in fact, the problems which The Burwell-Lute Tutor complains about and T. Mace confirms. When used on a single neck, such as an 11 course lute tuned in - d - minor, for example, the tone acquired a certain dark deepness, almost percussive. About bowed instruments I've not encountened any particular problems, except may be the necessity to re-study the type of bow and hair (the black-type seems be very relate to all-gut basses), amount of hair and position of the sound-post.

CONCLUSIONS

I believe that the support given by each field here examined, have drawn a rather clear picture. I still hope I shall be able to abtain some more informations from Archivial research, which I have already undertaken in Italian and French cities where gut strings were produced in the past. Such research has already led to the discovery of some interesting string-makers statutes of

the 17th century (21) (22). Quite honestly I think that keeping arguing to-day about the possible mariner connections of the term "Catlins" is outdated. And also the colour aspect of bass strings, stretching it to the limit, might be overlooked: after all "Pistoys"-basses were but one commercial sort of particulary successful strings and whose chromatic aspect was just a consequence of what had been used to load the gut. Other substances could produce the same acoustic result provided they had a high enought specific weight. This remark rests at the ground of the pratical realization of bass-strings, which, although carried out in strict observance of all the informations gathered, (which seems to me to be neither scanty nor banal) and absolutely avoiding the use of toxic or dangerous substances (Segerman, Q. 61, p.p. 9-10: "WATCH OUT-IT'S LOADED!"), I am an environmentalist as well as a chemist, remains obviously confined within the realm of a pure and simple recostruction-hipothesis; exactly the way it is with those who built Medioeval and, to some extend. also Renaissance instruments today. However, we should not forget that the heart of the matter lies in what any one can directly verify (and that is probative evidence): the small diameters of bridge-holes (23); whose measuring by the way, should have been absolutely carried out; in the first place, before formulating any hypothesis what soever on bass strings of the past. Wath plausible answer, alternative to gut loading, can offer to this evidence? Or should we really believe it possible, in the face of hard facts, that a thick unloaded gut string, at working tensions of less than two kilos, could actually produce a satisfactory sound in the low-registers without sounding like a rubber-band? Those bridgeholes were certainly made by the lute-makers of the past to a size apt to accomodate any sort of bass gut strings then available on the market. Are we allowed then to assume that the technological matrix common to Lyons, Pistoys and may be, in Dowland's case, also the lowest Venice-catlins, may have been the loading-weighting of gut?

BIBLIOGRAPHY

1) M. Peruffo: "Il mistero delle corde gravi del liuto: nuove ipotesi di lavoro" in "Società Italiana del Liuto" Bollettino n. 2 e 3 Ottobre 1991, Gennaio 1992.

2) Djilda Abott,
E. Segerman : "Catline strings" in FO.M.R.H.I. bull n. 12, comm. 138 July 1978.

3) John Playford: "Introduction to the skill of music". London 1664.

4) Thomas Mace: "Musik's Monument". London 1676.

5) M. Prynne : "James Talbot's manuscript", IV, plucked strings, the lute family, in Galpin Society Journal XIV, 1961 p.p. 59 - 60.

6) Djilda Abott,
E. Segerman : "STRINGS IN 16TH AND 17TH CENTURIES" in Galpin Society Journal n. 20, July 1974.

7) Djilda Abott,
E. Segerman : "GUT STRINGS" in FO.M.R.H.I. bull n. 7, comm. 3, November 1975.

8) John Dowland: "VARIETIE OF LUTE LESSONS" by Robert Dowland, London 1610.

9) "The Burwell Lute Tutor" ca. 1670, reproduction by R. Rastall

10) E. Segerman: "ON GERMAN, ITALIAN AND FRENCH PITCH STANDARDS. IN THE 17TH AND 18TH CENTURIES", in FO.M.R.H.I. bull n. 29, comm. 442, October 1982.

11) A. Mendel: "PITCH IN WESTERN MUSIC SINCE 1500: A RE-EXAMINATION" in "ACTA MUSICOLOGICA" n. 50, I/II pp 1-93.

12) There are many ex: T. Robinson in "THE SCHOOLE OF MUSIC" London 1603, "..... so high as you dare venter for breaking...."

13) Martin Hodgson: "ON CAMMER-TON AND ON SIZE OF LUTES" in FO.M.R.H.I. bull n. 41 comm. n. 662 October 1985.

14) "Giovane Hieber in Venetia" IInd hakf 16th century, 7 courses lute, V.L.= 0.59 mt; Museè Royal Instrumental, Bruxelles n. 1561.

"Matteo Sellas in Venetia 1638" liuto attiorbato, 14 courses V.L.= 0.58 mt; Museè de la Musique Paris n. 1028.

"Vendelio Venere in Venetia 1596", 7 courses lute, V.L.= 0.58 mt,Accademia Filarmonica,Bologna.

15) Op. cit. n. 8

16) Op. cit. n. 4

17) Other examples are:

"THE MUSICIANS OF LOUIS XIV" c. 1687 by F. Puget (notice the theorbe brown basses) the Louvre Museum,Paris.

"THE CONCERT by F. de Troy (1675-1752) (notice the theorbe brown basses) Perpignan Museum.

"CONCERT" by J. Van Bylert (1603-1671) Capangela Gallery, Paris.

"ADORAZIONE DI S. CATTERINA" by Jan Erasmus Quellinus (half 17th century) (ten courses-lute: notice brown basses),Tiroler

Landes Museum Ferdinandeum, Innsbruck. 18th century's iconography;

"WOMAN PLAYING A LUTE" by Louis De Sylvestre (ca. 1724) (11 courses-lute; notice orange-basses).

"ELEONORE VON KAYSERLINGK PLAYING THE LUTE" by A. Pesne (ca. 1740) (13 courses theorbed-d" minor lute; notice red-basses) Sclhos Charlottenburg,Berlin.

18) Op. cit. n. 5

19) Ole Vang: "TWO-HEADED LUTE NEWS" in FO.M.R.H.I. bull n. 13, comm. 156,October 1978.

20) Op. cit. n. 1

21) Roman String-makers' Guild: Statute, year 1642, Biblioteca Angelica, Rome.

22) Statutes of Neapolitan String-makers; years 1653 and 1685, Archivio Nazionale, Naples.

23) String-formula from R. F. Van Pelt: "A STRING-FORMULA", FO.M.R.H.I. bull n. 9 comm. 81 October 1977.

Table 1/a

LUTE MAKER & PROPRIETOR	DESCRIPTION	COURSE FREQUENCY (Hz)	HOLE DIAMETER (mm)	A: a: PLAIN GUT b: "ROPE" GUT (mm)	B: ABSOLUTE DENSITY (gm/cm^3) GUT = 1.3	C: TENSION (Kg) a: PLAIN GUT b: "ROPE" GUT	NOTES
"Wendelio Venere in Venetia, 1596"	Seven courses lute (1x1, 6x2) v.l. 0.583 m	VI = 91.69	1.60	a = 1.60 b = 1.74	1.30	a = 2.99 b = 2.53	VII course was considered a fourth under the VI
Accademia Filarmonica Bologna, Italy	Renaissance Tuning	VII = 68.69	2.00	a = 2.14 b = 2.33	1.49	a = 2.62 b = 2.22	
"Magno Dieffopruchar a Venetia, 1609"	Eight courses lute (8x2) v.l. 0.672 m	VI = 79.66	1.40	a = 1.60 b = 1.74	1.70	a = 2.29 b = 1.94	VIII course was considered a fourth under the VI
n° 144 Museo Bardini Firenze, Italy	Renaissance Tuning	VII = 70.97	1.50	a = 1.80 b = 1.96	1.87	a = 2.09 b = 1.77	
		VIII = 59.68	2.12	a = 2.14 b = 2.33	1.32	a = 2.95 b = 2.50	
"Hieber Giovane in Venetia"	Seven courses lute (1x1, 7x2) v.l. 0.590 m	VI = 90.60	1.50	a = 1.60 b = 1.74	1.48	a = 2.62 b = 2.22	VII course was considered a fourth under the VI
M 1561 Musée Instrumental Bruxelles, Belgium	Renaissance Tuning	VII = 67.87	1.80	a = 2.14 b = 2.33	1.84	a = 2.12 b = 1.79	
"Georg Gerle Furstichler Durchleuftitig Kait Chikadt zu Ynsprugg" 31 / A.35 Kunsthinstorisches Museum Sammlung Alter Musikinstrumente Wien, Austria	Six course lute (1x1, 5x2) v.l. 0.597 m Renaissance Tuning	VI = 89.54	1.50	a = 1.60 b = 1.74	1.48	a = 2.62 b = 2.22	
Lute by Anonym (Early 17th century)	Ten courses lute (10x2) v.l. 0.678 m.	VI = 78.84	1.30	a = 1.60 b = 1.74	1.98	a = 1.97 b = 1.67	
Caffagni Mirco Modena, Italy	Renaissance Tuning	X = 52.61	1.80	a = 2.40 b = 2.61	2.29	a = 1.68 b = 1.42	
"Matteo Sellas alla Corona in Venetia 1640"	Fourteen courses archlute (7x2, 7x2) v.l. 0.640 m	VI = 83.52	1.40	a = 1.60 b = 1.74	1.70	a = 2.29 b = 1.93	14th course's diameter 1.50 mm
403 Museu de la Musica Barcellona, Spain	0.885 m Renaissance Tuning	VII = 74.41	1.50	a = 1.80 b = 1.96	1.87	a = 2.08 b = 1.76	
"Matteo Reilich in Brescia, 1641"	Eight courses lute (1x1, 7x2) v.l. 0.905 m	VIII = 44.18	1.90	a = 2.14 b = 2.33	1.64	a = 2.35 b = 1.99	VIII course was considered a fourth under the VI
Museo della Chitarra Brescia, Italy	Renaissance Tuning						
"Marx Unverdorben in Venetia"	Seven courses lute (1x1, 6x2) v.l. 0.681 m	VI = 78.49	1.70	a = 1.60 b = 1.74	1.16	a = 3.37 b = 2.85	VII course was considered a fourth under the VI
408 Museu de la Musica Barcellona, Spain	Renaissance Tuning	VII = 58.80	1.80	a = 2.14 b = 2.33	1.84	a = 2.12 b = 1.79	

Table 1/b

LUTE MAKER & PROPRIETOR	DESCRIPTION	COURSE FREQUENCY (Hz)	HOLE DIAMETER (mm)	A: a: PLAIN GUT b: "ROPE" GUT (mm)	B: ABSOLUTE DENSITY (gm/cm^3) GUT = 1.3	C: TENSION (Kg) a: PLAIN GUT b: "ROPE" GUT	NOTES
Lute by "Sithoas" (Early 17th century) Museo Civico Medievale Bologna, Italy Data recording by Riccardo Branè	Eleven course lute (with ext. neck) v.l. 0.542 m 0.812 m Renaissance Tuning (?)	VI = 98.62	1.10	a = 1.60 b = 1.74	2.76	a = 1.41 b = 1.19	First six courses are on the fingerboard the others are on the extended neck
		XI = 58.63	1.60	a = 1.80 b = 1.96	1.64	a = 2.37 b = 2.00	
"Martinus Hartz Rome, 1665" University of Edimburgh Faculty of Music Edimburgh, Scotland	Fourtheen courses archlute (6x2, 8x1) v.l. 0.670 m 1.430 m Renaissance Tuning	VI = 79.78	1.38	a = 1.60 b = 1.74	1.75	a = 2.22 b = 1.88	First six courses are on the fingerboard the others are on the extended neck
"Matteo Sellas in Venetia, 1638" E. 1028 Musée de la Musique Paris, France	Fourtheen courses lute (7x2, 7x2) v.l. 0.580 m 0.840 m Renaissance Tuning	VI = 92.16	1.40	a = 1.60 b = 1.74	1.70	a = 2.29 b = 1.93	Bridge very old but not original
		VII = 82.10	1.50	a = 1.80 b = 1.96	1.87	a = 2.08 b = 1.76	

Table 2/a

LUTE MAKER & PROPRIETOR	DESCRIPTION	COURSE FREQUENCY (Hz)	HOLE DIAMETER (mm)	A: THEORIC DIAMETER (mm)	B: ABSOLUTE DENSITY (gm/cm^3)	C: TENSION (Kg)	NOTES
"Hans Frey" 29 / C.33 Kunsthinstorisches Museum Sammlung Alter Musikinstrumente Wien, Austria	Eleven courses lute (2x1, 9x2) v.l. 0.699 m Baroque d minor Tuning	X 0s = 73.46 1s = 69.34 2s = 65.45	1.50	0s = 1.81 1s = 1.92 2s = 2.04	0s = 1.61 1s = 1.81 2s = 2.03	0s = 2.05 1s = 1.83 2s = 1.63	
		XI 0s = 65.45 1s = 61.78 2s = 58.31	1.50	0s = 2.04 1s = 2.16 2s = 2.28	0s = 2.03 1s = 2.27 2s = 2.55	0s = 1.63 1s = 1.45 2s = 1.29	
"Hans Frey" 30 / C.34 Kunsthinstorisches Museum Sammlung Alter Musikinstrumente Wien, Austria	Eleven courses lute (2x1, 9x2) v.l. 0.674 m Baroque d minor Tuning	X 0s = 73.46 1s = 69.34 2s = 65.45	1.80	0s = 1.88 1s = 1.99 2s = 2.11	0s = 1.20 1s = 1.35 2s = 1.51	0s = 2.74 1s = 2.44 2s = 2.18	
		XI 0s = 65.45 1s = 61.78 2s = 58.31	1.80	0s = 2.11 1s = 2.24 2s = 2.37	0s = 1.51 1s = 1.70 2s = 1.91	0s = 2.18 1s = 1.94 2s = 1.73	
"Leonhard Pradter in Prag 1689" 45 / N.E. 49 Kunsthinstorisches Museum Sammlung Alter Musikinstrumente Wien, Austria	Thirteen courses lute (2x1, 11x2) v.l. 0.716 m 0.760 m * *for courses 12-13 Baroque d minor Tuning	XI 0s = 65.45 1s = 61.78 2s = 58.31	1.70	0s = 1.99 1s = 2.10 2s = 2.23	0s = 1.50 1s = 1.69 2s = 1.90	0s = 2.19 1s = 1.95 2s = 1.74	
		XIII 0s = 55.00 1s = 51.91 2s = 49.00	1.60	0s = 2.23 1s = 2.36 2s = 2.50	0s = 2.13 1s = 2.40 2s = 2.69	0s = 1.55 1s = 1.38 2s = 1.23	

Table 2/b

LUTE MAKER & PROPRIETOR	DESCRIPTION	COURSE FREQUENCY (Hz)	HOLE DIAMETER (mm)	A: THEORIC DIAMETER (mm)	B: ABSOLUTE DENSITY (gm/cm^3)	C: TENSION (Kg)	NOTES
"Laux Maller"	Eleven courses lute	X					
	(2x1, 9x2)	0s = 73.46	1.50	0s = 1.77	0s = 1.53	0s = 2.16	
	v.l. 0.718 m	1s = 69.34		1s = 1.87	1s = 1.71	1s = 1.93	
28 / C. 32		2s = 65.45		2s = 1.98	2s = 1.92	2s = 1.72	
Kunsthinstorisches	Baroque d minor Tuning	XI					
Museum Sammlung Alter		0s = 65.45	2.02	0s = 1.98	0s = 1.06	0s = 3.11	
Musikinstrumente		1s = 61.78		1s = 2.10	1s = 1.19	1s = 2.78	
Wien, Austria		2s = 58.31		2s = 2.22	2s = 1.33	2s = 2.47	
"Weigert Johannes	Eleven courses lute						
Blasius, Linz 1721"	(2x1, 9x2)	XI					
MIR 898	v.l. 0.716 m	0s = 65.45	1.60	0s = 1.99	0s = 1.70	0s = 1.94	
Germanische National		1s = 61.78		1s = 2.10	1s = 1.91	1s = 1.73	
Museum	Baroque d minor Tuning	2s = 58.31		2s = 2.23	2s = 2.14	2s = 1.54	
Nüremberg, Germany							
Lute by Anonym	Eleven courses lute						
(17th century)	(2x1, 9x2)	XI					
	v.l. 0.690 m (?)	0s = 65.45	1.80	0s = 2.06	0s = 1.45	0s = 2.28	
N° 1040		1s = 61.78		1s = 2.19	1s = 1.62	1s = 2.03	
Vasteräs Musikmuseet	Baroque d minor Tuning	2s = 58.31		2s = 2.32	2s = 2.82	2s = 1.81	
Stockholm, Sweden							
"Johannes Seelos 1699"	Eleven courses lute						
	(2x1, 9x2)	XI					
E.540	v.l. 0.690 m	0s = 65.45	1.80	0s = 2.06	0s = 1.45	0s = 2.28	
Musée de la Musique		1s = 61.78		1s = 2.19	1s = 1.62	1s = 2.03	
Paris, France	Baroque d minor Tuning	2s = 58.31		2s = 2.32	2s = 2.82	2s = 1.81	
"J.Tielke Hamburg 1713"	Thirteen courses lute						Last five
	with extended neck	XIII					basses on the
Staatlisches Institut für	(2x1, 11x2)	0s = 55.00	1.40	0s = 1.62	0s = 1.47	0s = 2.24	extended neck
Musikforschung	v.l. 0.726 m	1s = 51.91		1s = 1.72	1s = 1.66	1s = 1.99	
Preussischer Kulturbesitz	1.045 m	2s = 49.00		2s = 1.82	2s = 1.86	2s = 1.78	
Berlin, Germany	Baroque d minor Tuning						
"Martino Kaiser"	Eleven courses lute						
	(1x1, 10x2)	XI					
N° 1560	v.l. 0.725 m	0s = 65.45	1.80	0s = 1.96	0s = 1.31	0s = 2.52	
Musée Instrumental		1s = 61.78		1s = 2.08	1s = 1.47	1s = 2.25	
Bruxelles, Belgium	Baroque d minor Tuning	2s = 58.31		2s = 2.20	2s = 1.65	2s = 2.00	
"Johann Cristian	Eleven courses lute						
Hoffmann, Leipzig 1716"	(2x1, 9x2)	XI					
	v.l. 0.715 m	0s = 65.45	1.70	0s = 1.99	0s = 1.51	0s = 2.19	
N° 1559		1s = 61.78		1s = 2.11	1s = 1.69	1s = 1.95	
Musée Instrumental	Baroque d minor Tuning	2s = 58.31		2s = 2.23	2s = 1.90	2s = 1.74	
Bruxelles, Belgium							

FoMRHI Comm 1289 Ephraim Segerman

More on the Name 'Catline'

I am very grateful to John Catch in Comm. 1254 for providing a new angle on the origin of the term 'catlin(+e or g or)'. If 'cordage above one inch in circumference' distinguished a rope from a line, and instrument strings never reached that size, they could not have 'rope' in their name. Yet if they had the unusual flexibility and elasticity that was generally associated with 'cat ropes', an appropriate transformation of that name to take account of their small size would be 'cat line'.

A complicating factor in the situation is the term 'cats guts'. In the domestic tragic drama 'A Warning for Fair Women' (1599), probably by Thomas Heyward, appears: 'What, yet more cats guts? Oh, this filthy sound stifles mine ears... I'll cut your fiddle strings if you stand scraping thus to anger me.'. It is likely that the term 'cats guts' started out being pejorative, then became affectionate, and finally commonplace. The slang use of 'catgut scraper' to denote 'fiddler' has lasted to this century, as has the term 'catgut' to denote any kind of gut string. Some, like Mary Burwell (c 1670) wrote in her lute book 'The strings are made from sheep's and cat's guts', but others knew better, like Holme (1688), who wrote 'made of the guts of beasts as sheep, etc. though the generall name of it is cats guts'.

A browse through Appendix B of Woodfill's *Musicians in English Society* (1953) offers interesting stringing information. The earliest reference to catlines in it is 1553, where in Sir Thomas Chaloner's accounts is an item where he paid 2s.8p. per dozen for 5 dozen 'mynyken' lute strings and 14s.4d. for one dozen 'katlyns' for his lute. To put the cost into perspective, he paid 40s. the previous year for a viol 'of the finest sort' from John Rose. By 1574 Thomas Kytson's accounts show him paying a total of 7s.3d. for 2½ dozen 'mynekins' and two dozen 'cattelins' for his viols. This price drop of cattelins to a small fraction of the earlier value possibly resulted from manufacture starting up in Bologna. Apparently, mynekins were the thinner strings and cattelins the thicker strings. It seems that 16th century viols did not require strings of as high a quality as lutes did. The accounts of the Earle of Rutland in 1542 indicate that he bought two dozen lute strings called 'menekyns' at 20d. a dozen, and ten dozen of 'bressell' strings for the viols at 3d. the dozen.

Since the name 'mynekin' means Munich, and 'bressell' means Brussels, we should consider the Catalan area of Spain as a possible origin of 'cattelin' strings. This might seem unlikely since evidence of string manufacture and export from the Barcelona area in the middle of the 16th century seems lacking. Yet, Spanish vihuelas had unison pairs in the basses while lutes elsewhere generally had octave pairs. In Comm. 94 I associated unison basses with the regular availability of the brighter-sounding catlines that the Spaniards, affluent from New World gold, could pay a high price for. From evidence in the Capirola book, we expect that the catlines were probably made in Munich. Before 1557 South German merchants were running the Spanish economy, and it is possible that all of the production of catlines was contracted to go to Spain. So if noblemen elsewhere were willing to pay the price, Spain was the only place to get them. Henry II of France, in 1553 (after his imprisonment in Spain) paid 180 Livre tournois for 4 viols and at the same time paid 9 Livre tournois for a set of strings for one viol (i.e. a set of 5 gut strings cost 1/5 the average price of a viol fit for a king). The situation was all changed by the massive bankruptcy of the Spanish court in 1557, probably bankrupting many of the South German merchants as well. It is not impossible that the first catlines came to England from Catalonia, thus contributing to the name.

I propose that the 'cats guts' connection developed after the name catline was in use for some time. Fiddles were around from the beginning if the 16th century, but they did not get a reputation for being a nuisance until the end. I suggest that they became much louder late in the century when they adopted the soundpost (the first evidence of which is in Shakespeare's 'Romeo and Juliet' (1592)), and then combined it with the bass bar (previously used on some viols).

The full answer to a scholarly question is all of the possibilities of what the answer might be that are not ruled out by the evidence, with the less simple ones pruned out by Occam's Razor. If the question is one of linguistic origins, different factors can cooperate, and pruning it down to one answer could be inappropriate. With the evidence available, I see no reason for wanting to choose between a diminutive nautical rope (making it a line) and an original Spanish source of supply, with the resonance of a kitten homonym affecting subsequent linguistic developments.

FoMRHI Comm. 1307

Ephraim Segerman

On Historical Lute String Types and Tensions
(including a response to Comm. 1288)

Historical Background

Late in the 16th century, the open-string range of lutes and some viols expanded from about 2 octaves in the middle of the century to about 2½ octaves. Either the highest strings could then be made stronger so they could go to higher pitches or the lowest strings were modified or used in a way that lower pitches were able to sound acceptably. There is no evidence that hints at any change in the highest string strength, but there is evidence for changes with respect to low strings. The price of 'cattelins' dropped drastically around 1570 (see Comm. 1289), most probably implying that they became much more widely available. In 'Romeo and Juliet', Shakespeare named three servants 'Catlin', 'Soundpost' and 'Rebeck', expecting the members of his audience, most of whom could not afford to have a lute or a viol, to recognise these terms. 'Rebeck' was part of popular culture, but the other two are technical terms which would probably be known about only if they had been in the news, explaining some recent changes in the music they heard.

There was a similar but temporary expansion to about the same open-string range very early in the 16th century. Virdung mentioned 14-string lutes, and Bermudo mentioned that Luis de Guzman (d. 1529) used a 3-octave(!) range on his lute. The Bologna fragment shows a range of 2 octaves and a fourth on a 7-course viola. The Pesaro ms. specified 2 octaves and a third on a lyra da braccio. When Vitali recorded Vincenzo Capirola's compositions, he mentioned the availability of superior strings from Munich which 'give' more (i.e. were more elastic) and did not have thicker and thinner ends (i.e. were uniform). Capirola apparently didn't use them on his 6-course lute since Vitali described his way of mounting strings that were thicker on one end than the other so that they would still be in tune while being fretted.

String Technology Background

There is a limit of how little focus in a bass string's sound is acceptable in a music culture. Focus depends on the amount of higher harmonics in the sound. A bass range expansion results from a change that allows that limit to be reached at a lower pitch. The amount of higher harmonics in the sound depends on the string's elasticity (or 'stretchiness') when tuned up. Elasticity of a uniform string depends on diameter and type of string construction.

Gut strings are made from bundles of ribbons twisted together, each ribbon being a piece of the layer from the wall of a sheep's gut, made up of microscopic collagen fibres. A low-twist gut string, used for high-pitched strings on an instrument, has a bundle of these ribbons twisted just enough to form a cylindically-shaped string. This maintains maximum strength. The amount of twist can be varied, the higher the twist the lower the strength but the higher the elasticity. A high-twist string has the maximum twist it can take, and so the maximum elasticity for a single-bundle construction. In rope construction, the bundle of ribbons is split into 2 or more bundles, each of which is first twisted on its own and then the bundles are twisted together. This construction has greater elasticity than high-twist strings. The surface bumps characteristic of ropes can easily be polished smooth to feel like the other strings and look like them without close examination. A loaded string is a high-twist string where the ribbons are covered with a slurry or paste of a heavy metal and/or metal compound before being twisted together.

Early sources did not distinguish between low and high twist, so it is likely that they automatically put more twist into a single-bundle string the thicker it was (this would happen automatically if they twisted the same number of turns). Because rope construction is innately more elastic than high twist, strings can be thicker and heavier, and thus go to a lower pitch (at the same tension) before reaching the limit. Loaded strings have about the same elasticity as unloaded strings of the same diameter, so the diameter limit is about the same as for high twist. The pitch is lower because of the added weight of the loading material.

The same lower pitch can be reached and still stay within the limit by tuning a plain high-twist string of maximum acceptable diameter down to that pitch. The resulting lower tension reduces the

sound output is proposed with the same plucking displacement at the same plucking position. Sound output from a string depends on the product of the force multiplied by the string displacement at the time of release in the pluck. Most (if not all) of this output can be restored by plucking the string closer to the bridge. This increases the loudness of the plucking noise before the string tone comes through, giving a 'thunkier' sound to the note.

Modern aesthetics considers a pronounced transient noise before the resonant note comes through to be ugly in most string playing. The ideal is a purity of tone with minimum interruption by noises such as these and consonants in singing. The ideal note production, both instrumental and vocal, in the Renaissance and French baroque, was generally quite the opposite (like saying words with exaggerated consonants for maximum clarity, like an orator does), as I showed in Comm. 862. So modern lute players generally play largely over the rose, while the iconography and little-finger wear marks on surviving soundboards indicate playing was generally considerably closer to the bridge. Consequently, tension levels considered necessary for adequate tone production by modern lute players has no value in an historical investigation.

String Types and History

The possibilities of how each of the two range expansions happened are the availability of roped strings, the availability of loaded strings, or a change of technique to play closer to the bridge on strings of lower tension. Vitale's mention of 'give' favours the roped choice early in the 16th century. A combination of roped basses and plucking lower basses closer to the bridge could explain Guzman's 3 octaves. In Comm. 1289 (most of which is in Comm. 94) I presented a reasonable scenario suggesting that a Spanish monopoly later made these strings available only to the very rich, that they acquired the name 'cattelin' largely because the trickle of supply then was from Barcelona, and that later they became available again after the Spanish monopoly broke down and production started probably in Italy.

If musicians had a choice between roped and loaded strings when string types were named, their properties differ enough to have different names. In his string market survey in *A Varietie*..., Dowland wrote that bass strings made in Nuremberg and Strassburg were excellent when new, but the best were 'Venice Catlines'. The differences expressed here are smaller than we would expect between roped and loaded strings. Thus they were all either roped or loaded. If they were loaded, the name 'catline' was associated with that type of string since the days of the Spanish monopoly. Thin bass strings are certainly indicated by the narrowness of the neck (43 mm) on the only surviving (and enormous) 16th century vihuela in Paris. Consequently either loaded strings replaced roped strings in the days of the Spanish monopoly or Vitale's Munich strings were more elastic only because they were thinner (since they were loaded). But the elasticity of loaded strings is about the same as of ordinary high twist strings of the same diameter, so that would not be the obvious parameter that Vitale would mention to express what is special about them. The only viable possibility involving loaded strings that remains is that they replaced roped strings after Vitale's time.

Two-thirds of a century after Dowland's string market survey, Mace published a similar one. His recommendations amount to using 'Minikins' for the highest octave of strings, 'Venice-Catlins' for the next octave down, and 'Lyons' or 'Pistoy Basses' for the lower still 'Great Basses'. When discussing how they were sold, he wrote: 'Both [Minikins and Venice-Catlins] which, are (generally) at the same Price, and the signs of Goodness, both the same; which are, first the Clearness of the String to the Eye, the Smoothness, and Stiffness to the Finger, and if they have Those two qualities, dispute their Goodness no further.' It is likely catlines were always smooth (polished if roped). Mace mentioned that Pistoy Basses 'are indeed the very Best, for the Basses, being smooth and well-twisted Strings'. Lyons (the name obviously implying that they were French) were made in various sizes, and available from rope makers according to Mersenne 4 decades earlier. Mersenne wrote that 'the ropemakers sometimes twist the strings more in one place than another'. Such control occurs in making ropes, but not in twisting single-bundle strings. According to Mace, they were less smooth than the other types. Lyons were most likely of rope construction, unpolished.

The smooth types that Mace preferred could have been loaded or polished roped strings. The thinner Lyons 'which many use, for the Octaves [that Venice-Catlins were used for]; But I care not for Them, they being constantly Rotten, and good for little, but to make Frets of.' This seems to be a statement of physical condition (e.g. poor strength or twisting) and not one that implies that

Venice-Catlins were acoustically particularly different, as we would expect if Venice-Catlins were loaded. The case for Pistoy Basses being loaded is much stronger, especially since their 'deep dark red colour' is that of some heavy metal compounds commonly available then.

Mace's statement about the 'Clearness' of Venice-Catlins (mentioned above) supports the interpretation of the Dowland quote I gave in Comm. 1255: 'This choosing of strings is not alone for Trebles [first course], but also for small [second course] and great [third course] Meanes: greater strings [fourth course and lower] though they be ould are better to be bourne withall, so the colour be good, but if they be fresh and new they will be cleer against the light, though their colour be blackish.' Peruffo has pointed out in Comm. 1288 that the part of this passage after the colon could be interpreted as referring to the 'small and great Meanes' mentioned previously, and not to lower strings (assumed in the brackets above). He feels that the punctuation, and Dowland's consistent use of Capital initial letters for 'different registers', supports his interpretation.

The relevant punctuation is the colon. Elsewhere, Dowland did use the colon so that what followed it was to clarify, explain or particularise what was before it, but he also used it so that what was after it was to continue similarly to, or contrast with, what was before it. Thus the punctuation does not prefer one interpretation over the other. Dowland's use of Capitols here is completely parallel to his later statement 'For the greater sorts or Base strings, some are made at Nurenburge...'.

In the iconography we usually see the second course as light as the first and the third not much darker. This contradicts Peruffo's interpretation which would make them both dark. That interpretation is therefore quite unlikely, and Dowland's statement agrees with Mace's, and Venice Catlines had a degree of translucency when fresh. Their being loaded is historically ruled out unless they can have this optical property. I doubt whether that is possible with historical materials.

Whether loaded strings were ever made and used before Peruffo has recently produced them may never be known from direct evidence. None have survived (neither has any roped string), but that is not evidence against their availability and use. That is because gut strings not in use lose strength after time, and they are not attractive enough or unusual enough to want to keep once they can't be used. So we have no reason to expect any original gut strings to survive even though many instruments that used them have.

Bass String Tensions on Lutes

There has been a problem about the thickness of lute bass strings since we at NRI first produced roped strings as a solution to the previously unsolved problem of making all-gut bass strings that worked. We called them 'catlines', ignoring the difference between whether they were polished or not. It hurt to polish away all that expensive gut (we've only recently found a way of drastically reducing that waste). In hindsight, we probably should have called them 'Lyons' then. We took Mersenne at his word about equal tension and designed sets of lute strings at the 2½ - 3 Kg. tensions lute players found worked with nylon strings.

Most lute players and makers were upset by the thickness of the low basses, saying that this couldn't be right because the paintings didn't show such thick basses, and original bridges they had seen didn't show such big holes. Over 15 years ago, I was allowed to rummage in the basement of the Smithsonian Institute in Washington D. C., where there were some lutes in various states of disrepair. There I found old bridges with holes of the sizes Peruffo reports in Comm. 1288, and a few with rather larger bass-string holes that our equal-tension all-gut sets could fit into. I wondered whether hole size could be a criterion for determining whether a bridge is original.

The collection of evidence on bridge-hole diameters in Comm 1288 is compelling. It demands the objective comparison of hypotheses to come to a scholarly conclusion. Peruffo's hypothesis is that the strings were loaded and tensions were what modern players are happy with. I once considered the loaded string possibility (see Comm.773) and rejected it. The above analysis shows how historically improbable it is. The only remaining hypothesis is rope construction. The conclusion then is that early bass string tensions on lutes were lower than we have assumed they were.

If we assume that the string diameters for calculations are 85% of the hole diameters reported by Peruffo, that the highest string is tuned a tone below breaking pitch, and that the instrument tunings

were as Peruffo assumed, then the lowest string tension of the strings measured on each instrument, calculated by the method of Comm. 1255 in Kg. follow: With Renaissance tuning I get, 2.0 for the one with 6 courses, 1.6-2.0 (average 1.8) for the three with 7 courses, 1.6-1.8 (average 1.7) for the two with 8 courses, 1.3 for the one with 10 courses, 1.1 for the one archlute with 11 courses and 1.6-1.7 (average 1.6) for the three archlutes with 14 courses. With d-minor baroque tuning, I get 1.1-1.6 (average 1.5) for the eight with 11 courses and 1.0-1.5 (average 1.2) for the two with 13 courses. If an estimated string diameter is a certain percent different from what it really was, then the calculated tension would be in error by about twice that percent.

Tension Profiles

In the above evidence, there is a tendency for lower tension low strings on lutes with more courses, but no correlation with lute size. Dowland would lead us to expect a correlation with size for corresponding strings. The differences could be masked by tension variability from instrument to instrument or from string to string on the same instrument. The latter questions the validity of the assumption of equal tension across the strings of lutes. If that principle applied strictly, it would lead to first string diameters from .24-.32 mm. (9.6-12.5 thou) on the lutes measured. It is questionable whether gut strings that thin were available at that time:

The English tradition, according to Dowland and Mace, apparently was to use German high strings (Minikens) and mostly Italian or French low strings (Venice-Catlins or Lyons). The French tradition, according to Mersenne and the French lute teacher of Mary Burwell, was to use Italian high strings (Roman) and Frence low strings (Lyons). We have no information about the manufacture of German high strings, but we have a bit of information about Italian ones:

In Comm. 325, from 19th century information given by Maugin and Maigne, I calculated that the violin first string described there had a diameter of .594 mm. (cross-sectional area of .277 mm²), and it was stated to be composed of 4-6 half guts or 3-4 very thin whole guts. The thin whole guts are relevant here since Peruffo tells me that 17th century Roman statutes governing the selling of strings indicate that firsts were made of 2 or 3 guts and they could not be split.* The cross-sectional area is proportional to the number of guts if there is the same degree of twist. The diameter of 3 of the thinnest would be .51 mm. (20 thou), and of 2 of the thickest would be .48 mm. (19 thou). These probably represent an average of the smallest string diameters sold, with the smallest size (2 of the thinnest of the very thin guts) having a diameter of .42 mm. (17 thou).

Thus lute first strings had higher tension than the lowest ones. This would be expected when lutes had a single first course, with most of the others doubled. But strings for the second course couldn't be any thinner either. Using the formula in Comm. 1255 (with the first course tuned a tone below breaking pitch), a .48 mm. (19 thou) second-course string on a lute would have a tension of 2.6 Kg in Renaissance tuning and 3.2 Kg. in d-minor baroque tuning. The single second of the latter should be at a higher tension than each string of a lower doubled course. This calculation indicates that there were higher tensions on the highest strings than on the lowest basses, and that modern lute players got the tensions on the highest strings generally right.

Dowland's instructions for mounting strings imply 'equal feel'. This probably means that the same plucking force causes the same string displacement. This implies equal tension only if the plucking distance from the bridge stays the same on all strings. When tensions varies, equal feel requires varying plucking distances. Most early lute players apparently preferred the percussive effect of playing low basses closer to the bridge and/or didn't like the sound persistance of very thick strings.

* * * * *

*A string made from a single gut is not strong enough since it needs too high a twist to be cylindrical. The restriction to whole guts could be because the small variations of weight along the length of a gut string effects trueness more seriously the thinner the string is. In our experience with hand-polishing untrue strings to trueness, this is much more difficult with thin strings than thick ones (modern machine polishing with centreless grinders provide a level of uniformity never available before). The natural uniformity of whole gut ribbons was probably greater than could be achieved by splitting them. The gut starts as a tube, and for all musical strings, it is made into a ribbon by a cut opening it up for scraping clean inside and out. Then splitting can happen. This cut is not made when gut is prepared for sausage skins, where cleaning standards are lower.

Strings and their Names

Eph Segerman writes (Comm. 1289) that "an appropriate transformation [of cat-rope] would be 'cat line'". This I believe has been termed the conditional subjunctive form of argument, which can be elaborated in favour of any proposition, however fanciful. It is not evidence. Cat-c(h)ord would be more *appropriate*. It is perhaps significant that dictionaries often define "catling" as a *small* lute or fiddle string, never as a large one, as they commonly are nowadays. The many citations in the OED do not show a single spelling as "...line"; there is not a shred of evidence to support any connection with mariner's cordage.

I have not seen the Capirola lute book, but "expecting" that catlings were "probably" made in Munich does not justify a positive assertion that "the name 'mynekin' means Munich" (München). Has Eph any other evidence for it? or that "bressell" means Brussels/Bruxelles? Derivations based only on some similarity to an English word (cf Geneva, journeyman, boot and saddle, slug-horn) do not warrant such positive assertions. "Minikin" has a long entry in the OED with many cited examples from 1541 onwards. There is nothing in it to suggest anything to do with Munich (and the long and well documented entry on "catling" makes no reference to Catalonia). Perhaps the OED is wrong, but anyone challenging their etymology needs to justify the challenge on better grounds than are apparent here. We badly need more facts about historical strings. Will not someone, a good linguist, with easy access to the major dictionaries of Europe, make a start with a solid comparative study of the terminology in various languages? Do (for example) the terms Lyons (for gut strings) and Pistoys occur elsewhere than in Mace? I never heard that they do, but I may well be simply ill-informed.

On a detail of Comm. 1288, p. 73; it is unsafe to assume that Talbot had no knowledge of overspun strings. When I examined the original mss. some years ago I found a partly-illegible note on an odd leaf, which ran as follows, the parts in square brackets being uncertain; "in low[est] Basses [mixed] with Copper or [Silver] Wire in lowest [...] of Bass Violin or Viol". This note seems to have escaped the editors of the printed texts.

Mace (pp. 65-6) lists *"Minikins, Venice-Catlins...Lyons (for Basses)* and *Pistoy Basses*, which I conceive [a hint of uncertainty here; did he not know for sure?] are none other than *Thick Venice-Catlins...Smooth* and *well-twisted...*" (this last could mean either highly twisted or skilfully twisted). He adds that Pistoy basses were not readily obtainable in England and that his readers would often have to be content with Lyons for their basses. Later he writes of "a *small* sort of *Lyons*" which are of no use except for fretting.

Minikin is a dictionary word and the accepted derivation and meaning of "a little one" make sense. Catlin is also a dictionary word. The place names may be those of manufacture or marketing only. But they *may* denote methods of fabrication. If they do, and "Lyons" strings were all of the same type, it seems to me that Lyons basses must have been plain gut, for it is hard to believe that any of the other proposed fabrications would make for satisfactory frets; and that would imply that very many players in England in 1676 used plain gut for basses.

But it may be that the place names do not denote a particular method of fabrication. If so, any argument which turns on the association of place-name and type is suspect. Mace would be using the terms used by the vendors of strings, and there was no Sale of Goods legislation in those days. I can buy Cheddar cheese from half-a-dozen different countries.

"What I should hope to teach" said Howard Mayer Brown in 1993 "is how little we know and how difficult it is to know it. One should be exceedingly sceptical about whether we know anything and how we know it and of the way dogmas arise".

FoMRHI Comm. 1317 Ephraim Segerman

On the Scholarship of String Names – Reply to Comm 1308

Catch's approach in Comm. 1308 is a very ubiquitous and understandable one. It rejects a presented theory, pointing out that evidence support for it is very tenuous, and calls for more research to find more evidence to support a better theory, and advises readers not to accept the proposed theory (or, to be fair, any other) unless there is more support from evidence. Of course, if he liked the theory, he wouldn't be making any fuss.

This approach is the one we all use in our normal lives to make judgements of what to accept and reject into our subjective-reality picture of the world. In that picture, there are hypotheses that we accept since we feel they are proven true, and others that we reject since we feel that they are proven false. We feel that other hypotheses are not sufficiently supported by evidence, and we tentatively accept those that we intuitively feel should be true, and reject as unproven those that we intuitively feel should not be true. There are also areas of potential knowledge that are mysteries, and we don't expect any evidence to appear to support any resolving hypothesis, and we think what we like about them.

Scholars, being people, have the same feelings about what they accept and reject. But scholarship, as formally performed and reported, involves the discipline of a very different approach. Objectively, there is no proven truth, just the best we can now do to approach truth. The process involves, as objectively as possible, to pick the hypothesis that best fits the evidence available. There is no non-arbitrary objective criterion for distinguishing between an hypothesis that is supported by mountains of evidence and one supported by one piece of tenuous evidence. All are chosen as the best scholarship can do at the time to approach truth.

Scholars should be trained to recognise the existence of a formal objective scholarly choice of an hypothesis for the truth in spite of a differing judgement of what the truth is most likely to be. Such differences provide the motivation for research to find or generate new evidence with the object of changing the scholarly choice. They cannot claim that there is not enough evidence for a scholarly choice to be made. There is no criterion for 'enough'. They are free to claim that there is not enough evidence to convince them of the scholarly choice's truth, and hope to collect (or that others will collect) evidence to change it to one that they find acceptable.

Etymologists are scholars, and their choices of word histories are often (perhaps usually) based on very tenuous evidence. They can only include hypotheses of word origins in their dictionaries that are based on the evidence they are aware of. If the future writers of dictionaries become aware of the discussions of string names that we have been indulging in here, the choices of our scholarship will appear in their work.

For instance, the dictionary writers apparently never read Dowland (1610). If they had, they might have included the spelling 'catline'. Also, they would not have chosen the hypothesis that the origin of 'minikin' was the obsolete Dutch word 'minneken' meaning 'little loved one'. The evidence they worked with apparently was that minikins were very thin strings, the words seemed similar, and 'minikin' was occasionally used for other things that were small. If they had read Dowland, they would have noticed that he did not use precisely this term, though they would have expected him to use it since it was apparently in continuous wide use from well before to well after him. Consequently, when Dowland wrote that a type of string (that minikins were) came from 'Monnekin' in Germany, they would have concluded that 'Monnekin' and 'minikin' are sufficiently alike to be the same, and that according to a contemporary source (and not modern conjecture), the word's origin was a German place name, most probably Munich.

Dowland was trying to be comprehensive, and apparently to him minikin was a string from Munich. But as with gut strings being made from the intestines of sheep, those less well informed thought that the meaning was more generic. In May 1622 a consortium of musicians (including Orlando Gibbons) applied for a monopoly (not granted) on string making. In the application the strings were 'called Venice or Romish minikin and Catlin strings' (see Holman's *24 Fiddlers*, 1993, p.49).

Dowland stated the places where strings came from whenever he could. When he could not

associate a place of origin with a type of string for sale, he said 'we call them ...'. This applied to 'Gansers' and the 'Catline' part of Venice Catlines. If these names were reasonably new at the time, they most likely would have been place names (since all others were). But they were very old, and if they were place names originally, that was forgotten (as minikin was by many).

The earliest source that distinguishes between string types that I know of is the manuscript of lute music by Vincenzo Capirola written by his student Vitale, dating from about 1517. A modern edition (1955), was edited (with the Venetian dialect translated) by Otto Gombosi. Vitale mentioned that there were 'corde da ganzer' which were thicker on one end than the other, and 'corde da monaco' that were of uniform thickness and give more ('le camina piu'). Gombosi translated 'ganzer' as 'hooker', but wasn't sure about it, while he translated 'monaco' as Munich with confidence.

So we know that Munich was a source of lute strings then, and all sizes appear to have been made there (since the uniformity particularly required of minikins and the elasticity particularly required of catlines were both mentioned). This seems to still have been the case in 1542 when the Earl of Rutland (Woodfill, 1953, p. 268) bought 'menekyns' for lutes and 'bressell' strings for viols. But by 1553, Sir Thomas Chaloner (Woodfill, p. 256) bought 'Mynyken' strings and 'Katlyns' for lutes. This seems to imply that bass strings from Munich were no more available, and they were replaced by 'Katlyns'. My hypothesis is that either the Spanish contracted to buy all of the bass strings made in Munich (see Comm. 1289) or the specialist bass string makers from Munich transferred their manufacture to the Barcelona area.

Since the name 'menekyns' was in use before 'Katlyns' appeared, and 'menekyns' was a place name, this is evidence favouring 'Katlyns' being a place name. The model presented in Comm. 1289 is consistent with the Spanish historical situation and so is evidence in favour of 'Catalan' being the original meaning of catline. Other associations with the term meaning 'unusually flexible thickish string' or 'kitten' ('catling') could easily have developed later when Catalonia ceased to be where these strings came from.

Similarly, the fact that Brussels is a place name is evidence supporting the word similarity for it to be the meaning of 'bressell' strings (Woodfill had no doubt about it). Only the origin of 'ganzer' or 'ganser' remains undetermined. Vitale wrote that they were thicker on one end than the other, and Dowland wrote that they were not strong enough to be first strings. One may be tempted to consider that it means 'whole' in a Germanic language, perhaps implying that they were made of whole guts. But according to Peruffo (Comm. 1307), Roman treble strings were made of whole guts, and Dowland didn't complain about them. This, and it not being a place name, are evidence against this meaning. Gand is an alternative name for Ghent or Gent (in Belgium). I wonder what someone or something from Gand was called in the 16th century. Any further ideas?.

Catch (or anyone else) is free not to accept any of my hypotheses about string history and names. I claim that each is the scholarly choice, being more consistent with the evidence than any alternative that has so far been offered (in some cases none other has been offered). The appropriate procedure for those that don't like any particular hypotheses of mine is to offer an alternative one that at least equally well fits the evidence. Finding more evidence would be very constructive. It could easily change the scholarly choice (because we have so little evidence now), and we would then be closer to historical truth. Though a scholarly choice is particularly vulnerable if it is based on little evidence, this does not detract from its validity at the time. That vulnerability decreases as research attempting to change it fails to do so.

At the end of Comm. 1308 is a quote from Howard Mayer Brown: "What I should hope to teach is how little we know and how difficult it is to know it. One should be exceedingly sceptical about whether we know anything and how we know it and of the way dogmas arise". It is very true since it refers to the 'proven' knowledge that we accept in subjective reality. This has nothing to do with the objectivity of scholarship where all scholarly choices are knowledge, so we know something about everything we have objectively studied. Instead of being unhappy about how ephemeral scholarly knowledge can be, we should rejoice that changes in scholarly knowledge are closer to truth. Brown argued against the arrogance of our believing that we already know the truth, and because of this belief, dogmas arise because we will not look at challenging evidence or valid alternative hypotheses.

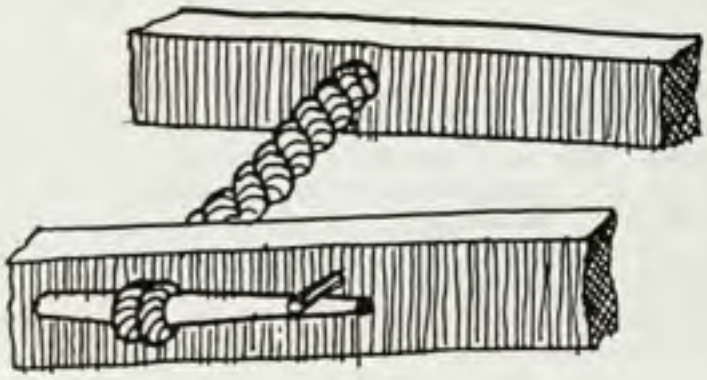
FoMRHI Comm. 1318

John Downing

Roped Gut Bass Strings - A 16th C Reference

Recently, while reading through an English translation of a 16th C technical treatise about machines of war and other mechanical devices, I was amazed to come across a direct reference to the construction of thick strings used for bass viols.This work was originally published in 1588 by Agostino Ramelli, military engineer in the employ of Henry III of France at the time. It contains many detailed engravings of ingenious machines such as pumps, mills, winches, coffer dams, fountains as well as military machines (1).

In chapter 190, Ramelli describes two versions of a trebuchet, a war machine designed to propel heavy objects a considerable distance.The trebuchet is simply a strong beam pivoted in a support frame with a massive counterweight on one end and a cradle to hold the projectile at the other.An essential part of the machine, apart from a release mechanism,is a resilient buffer which is employed to arrest the downward motion of the beam and counterweight after release causing the projectile to be forcefully ejected and also to prevent the force of the impact destroying the frame.
This buffer is made from a double loop of rope stretched across the frame and tensioned by twisting the ropes together torniquet fashion, thus:



This part of the machine is described in the text as -"a thick double rope made in the same way as the thick strings of a bass viol ..... it should be tightly twisted and made taut."

I am no string maker but, as I understand it, the roped gut bass strings manufactured today and called catlines are made the same way as a multi--strand rope, the individual strands being bundles of fibres that are twisted before before being wound together as a rope - the resulting assembly of twisted strands being stable with no tendency to unwind. Ramelli's observation, if the English translation is true to the original text, implies that the thick gut strings of bass viols were made up from the equivalent of four modern catlines simply twisted together to form a complex rope which I imagine presents no problem to manufacture today if a little costly.

On the other hand, Ramelli's statement may mean that the ropes of the machine were made in the same way as the strings of a viol i.e. from gut and constructed like a rope.
Whichever way is chosen to interpret this passage, I believe that it is posi--tive evidence confirming roped string construction was being used, at least on viols, before the end of the 16th C. Historical information describing string construction from this period is sparse and ambiguous and I do not recall having read about any references until now that clearly support the proposition that roped gut strings were in use during the Renaissance in Europe.

1. "The Various and Ingenious Machines of Agostino Ramelli" translated from the Italian and French by Martha Teach Gnudi with technical annotations and glossary by Eugene S. Ferguson. Published by Dover Publications Inc. 1994.

POST SCRIPT

In my hasty preliminary reading of the Agostino Ramelli book, I had over--looked some additional information concerning the above.

In chapters 191 and 192, Ramelli describes two other machines of war designed to throw projectiles. The motive power for these machines, unlike those described in chapter 190, is an arrangement of twisted bundles of rope providing a powerful torque to an actuating arm which, in turn, propels the projectile.
At the end of both chapters 191 and 192, Ramelli adds the following notes: "If the ropes are made of the same material described in the preceding chapter, they will be much better than if made of any other material" and "Note that if the ropes are made of the same materials as that described in Chapter 190 they will be much better and will have a greater effect than if made with any other kind of material".
As far as I can determine, the only reference to the ropes themselves in chapter 190 is that they were "made in the same way as the thick strings of a bass viol" unless, of course, some information has been left out of the original text relating to rope material.
Therefore, the twisted ropes used on Ramelli's machines, were made of the same material as the thick strings of a bass viol of the period.

Does this mean then that the ropes of the machines were best made of gut? If so, why does Ramelli specifically mention the similarities to thick bass viol strings rather than gut instrument strings in general? It would seem that the thick bass viol strings of the late 16th C were quite different from other instrument strings of the time. The question is, what made these strings different from other types? Is it possible that thick bass viol strings were made of a fibrous material other than gut - sinews (tendons) for example.(I have vague recollections of reading in the past that the early war machines of the type described by Ramelli were powered by twisted bundles of sinews).
While Ramelli seems, in his statements, to be primarily refering to the material of his ropes, I still believe that his analogy extends to include the similarities of the construction of the rope to a thick bass viol string. Indeed, if it were the case that gut was the preferred rope material then the similarity between the rope and a viol string would be in the way they were constructed.

More ambiguity I'm afraid!

FoMRHI Comm. 1319

John Downing

Chinese Catlines

A number of years ago, on a visit to London, I purchased some silk instru--ment strings from a shop selling traditional Chinese musical instruments. As I recall, the strings were for the Chinese lute or pipa, a shallow bodied fretted stringed instrument played with a plectrum. This instrument is, apparently of ancient origin and was originally strung with silk strings but is now strung with nylon overspun strings. I assume, therefore, that the strings that I bought were of traditional construction and most likely had been made in this form in China for centuries.
The strings have been sitting in my workshop, unused since the day that I bought them and I decided the other week to take a closer look at them.

The strings were made up in coils of about 50ft maximum length with string diameters of 0.51mm, 0.56mm, 1.07mm and 1.1mm, these being the only sizes in stock at the time of purchase.
The strings were well made and even, a pale amber in colour (similar to gut strings) and springy yet flexible. On examining the strings under low mag--nification, it could be seen that they were made like a multi- strand rope i.e. they were the silk equivalent of a modern catline string.

By twisting each string in the opposite direction to the way in which it had been wound,it was possible to readily separate the individual strands for examination. The smallest diameter string was made from three strands twisted together and the largest from four.
Each strand was made from a multitude of individual silk fibres gathered into a bundle and formed into the strand by twisting. The twisted strands were then wound together to form a rope which was the form of the finished string.
Separating each strand into its individual fibres required some force as the fibres appeared to have been combined together with some kind of glue or varnish as a binder. Under high magnification, small particles of an amber coloured material could be seen adhering to the fibres. (This could also have been debris remaining on the raw silk after processing ?)

If the strings in my possession are of traditional construction, then it is is possible that the catline string had been invented by the Chinese many centuries before the Europeans began using similarly constructed strings in gut for their instruments and that the whole idea originated in China. Indeed it may be that roped silk strings from China were used on European instruments prior to the 16th C and that the gut version came about in an attempt to make a string more suitable to the climate of Europe or, perhaps, a more durable or cheaper string than the silk import.

Just a thought!

FoMRHI Comm. 1320 John Downing

All at Sea with the Ship's Cat

Re: Comms. 1284,1289 and 1308, and some other speculative observations con--cerning Catlines and instrument strings made like ropes.

It is likely true that musical instrument strings made like cords (small ropes) were being used in Europe by the 16th C. and that it is possible Catlines might have been strings of that type but, associating the rope of a ship's cat tackle with a Catline string as evidence of rope like construct--ion of the latter, may be a bit of a red herring although, as is proposed later, the connection may not be entirely irrelevant.

Anthony Deane, Master Shipwright at Portsmouth, in his treatise on ship design of 1670(1) included a comprehensive tabulation of the names, sizes, lengths and weights of all cordage used to rig a British warship of the period. Rope sizes (stated in the usual convention of circumference in inches) measured from 7/8 inch to 17 inches. In Comm. 1254 it was suggested that ropes called lines were restricted in size to less than one inch. It is apparent, however, that no such demarcation was known to Deane for the smallest rope size is given as 7/8 inch and lines (Clewlines, Buntlines, Leechlines and Bowlines) ranged in size from 7/8 inch to 4.1/2 inches.
Deane listed Cat Ropes,ranging in size from 2.1/2 inches to 5.3/4 inches, but made no reference to "Cat Lines". The cat rope was part of the block and tackle (the cat) used to hook and lift an anchor from the waterline to the cathead (a short beam projecting outboard) so that the anchor might then be swung alongside the gun ports and secured before putting to sea (see Fig 2). The upper pulleys of the cat were built into the cathead and the end of the beam was often decorated with with the carved mask of a cat. To "cat the anchor" was to hook and raise the anchor to the cathead.

As Deane did not discuss rope construction, we do not know, from his account, if cat ropes were specially made to be resilient (extra elasticity being the reason for the proposition that gut instrument strings might have been of roped construction). The technology of making hemp cordage for marine appli--cations, however, is well documented elsewhere and the information readily accessible. From this information and knowledge of the duty required of a cat rope, we can be fairly certain how a cat rope was constructed. To digress for a moment:

Hempen ropes were were built up from a basic yarn spun from the short, hemp fibres which were then twisted together to make a uniform, coherent bundle of fibres known as a strand. Three or four strands twisted or laid together formed a basic rope. The direction of twist of strand lay was counter to that of the strands themselves in order to create a stable assembly with no tendency to unwind. The resultant rope was pliable (easy to bend), strong and, to a certain extent, resilient (able to stretch elastically) by virtue of its construction.
The pliability of a rope could be varied during manufacture by adjusting the degree of compression of the fibres and degree of twist in the lay - known as hardness. A hard rope was less pliable than a "soft" rope but was able to resist absorption of water better. Hard ropes were, therefore, used for duties such as anchor cables, where the rope was subject to water immersion.(2)

A rope made from three or four strands was called a hawser-laid rope or simply, hawser. Hawsers were rarely made from more than four strands and did not exceed 10 inches in size.
Larger ropes, up to 24 inches in size, were made by laying three or four hawsers together (again, with counter twist). These ropes were called cable-laid ropes or simply cables. A basic cable made from three hawsers therefore, contained nine strands. (see Fig 1).
Cables were made very hard and compact and lacked pliability but were resilient (3), a useful, shock absorbing, feature for anchor cables and the like, subject to impact loadings. As cable construction was water resistant, cables were also made in sizes down to an inch.
Four strand hawsers and cables were often also made with a centre core of fibres laid straight which acted as a non load bearing filler. (3). (see Fig 3). These were known as shroud hawser-laid or shroud cable-laid.

To return to the cat rope, such a rope would have to be pliable (to negotiate the relatively tight radius of a pulley) and strong (to lift an anchor and its cable weighing a ton or so). The cat was not subject to water immer--sion. This duty was suitable for a simple three strand hawser which, if it was specially made at all, might have been made softer than usual for extra pliability and strength (but reduced resilience). (4)

Remaining unconvinced that "catline" was anything to do with "cat rope", I looked for other words in nautical terminology that incorporated "cat".
"Cat holes" - were holes in the stern of a sailing vessel through which cables were passed to draw the ship astern or to secure the vessel.
"Cat's paw" - was a double looped hitch made to receive a lifting hook.
"Cat-o-nine-tails"- was a 'rope's end' used to flog errant sailors. Its name suggests that it may have originated from an unwound, nine strand cable.

"Cat" (meaning the feline animal) appears in old English and is also to be found in the Celtic, Slavic, Arabic and Finnish languages but is of obscure origin.(5)
The use of "cat" in the above words, seems to have an association with ropes (particularly cables) or with cordage being pulled, stretched or otherwise put under great tension (as opposed to ropes used for,say,tying up a sail) or perhaps for hooking or catching something with a rope (e.g cat tackle). If these are obscure meanings of "cat" they may have originated from the observed stretching or extending behaviour of a cat or its ability to catch and secure its prey with its claws?
Other examples might be:
"Cat's cradle" - an arrangement of cords stretched tight between the hands.
and, of course:
"Cat gut" - an instrument string stretched to breaking point, made from gut.

If "cat gut" means an instrument string made from gut,as it surely does, then "cat line" (or "catlin" or "catling") might mean an instrument string made from flax fibre? ("line" being an obsolete word meaning flax or flax fibre - "lin" in French or old English. "Ling" is Scots for line (the rope) e.g. Bowling v.s. Bowline). (5)
I am not qualified to say if a successful instrument string might be made from flax but, if it could, then it would have been made like a hemp rope (hemp and flax fibres being relatively short and having similar microscopic features). As spun flax thread, presumably, does not have the same inherent

elasticity of gut (or silk, that other instrument string material), the cord could, of necessity, have been made like a cable for maximum resilience. Such a cord would also have been hard and springy like a gut strand.
Flax grown in the favourable climate of Northern Europe could yield fibres as fine as silk filaments and spinning of flaxen threads was an ancient technology by the time of the Renaissance.The manufacture of instrument strings like tiny cables would have presented little difficulty and such strings may have been an economically viable alternative to gut or silk for certain instrument string applications.
Furthermore, such a string construction might easily lend itself to the manu--facture of loaded instrument strings - fine annealed wires being incorporated as a core of a shroud cable-laid cord or incorporated into the strands them--selves. The spinning of metal wires into fancy cords for decorating clothing was an established industry described by Diderot.(6) European fairy tale tra--ditions include stories of flax workers spinning gold thread ...

To return to Deane, his inventory of ropes includes "viol cables" or "viols". These cables were used to engage the anchor cables on the largest 1st and 2nd Rate warships to aid in the release of an anchor stuck fast to the bottom. "Viol" could be a corrupt spelling of some other word with no connection to the musical instrument but the possibility that a viol cable described the construction of a Viol string seems to echo the observations of Agostino Ramelli concerning the huge, shock absorbing, ropes (as thick as a man's thigh) fitted to his catapults (no! no connection with cats!) and other war machines. (7)

In conclusion, it would appear that there is some evidence to support the view that instrument strings of roped construction were in use by the 16th C in Europe (for bass viols at least). We do not know if these strings were made from gut or some other material and we do not know if Catlines were strings of this type. Dowland(8), does not say what his strings were made from although his use of adjectives such as "clear","old","fresh", and "rotten" implies a material of animal origin - probably gut.Perhaps it was not always possible, short of tearing a string apart, to say what material it was made from, partic--ularly if the strings were dyed different colours?
If it could be confirmed that Catline strings were used for the largest strings on bass viols then we would know not only that Catlines were made like a cable (Ramelli) but that roped basses were also used on lutes (Dowland).

The problem is that there seems to be no evidence to confirm that gut strings were ever made in any other way than by simply twisting the gut fibres into strands (see Fig 4).
Silk strings, on the other hand, were made like miniature hawsers by the Chin--ese and silk strings were used both by the Chinese and Arabs on their lutes from very early times (9) . In Europe, however, there does not appear to be any record of silk strings having been used on instruments although silk filaments were used later as a core for overspun strings.
Of flaxen strings or loaded strings made from flax there seems to be no record.

The proposition that early gut strings were of much greater elasticity than we can imagine today - the breed of sheep, its age, its food, the climate and its physical condition and the way gut was prepared - all being critical factors that might have resulted in a very elastic gut fibre - has its attractions.

For a string made from such a material, it may not have been necessary to use the expedience of roping the gut strands together to gain additional elasticity. The expertise on how to produce this special gut, unlike rope making technology, could easily have been kept a closely guarded secret that has now been lost. Indeed, it may now be impossible to replicate the early gut strings because the breed of sheep providing the gut, like many other old domesticated breeds of animal, could well be extinct - victim to changing demand and economic condit--ions. Such is progress.

Notes:

(1) "Deane's Doctrine of Naval Architecture,1670", edited by Brian Lavery, Conway Maritime Press Ltd 1981.

(2) "..as cable-laid ropes are very hard and compact, ropes of no very great size are made in this way, if intended to resist the action of water" Tomlinson's Cyclopaedia of Useful Arts, London 1866.

(3) "In old worn out ropes the core is always found to be broken in conse--quence of the stretching of the strands: for the strands being twisted spirally, and the core straight, the strands will give more under load than the core, which cannot therefore be relied upon for adding strength to the rope; but it assists materially in keeping the strands in position during manufacture of the rope by hand" Dictionary of Engineering by Byrne and Spon, London 1874.

(4) A rope on a 19th C pulley system in my barn is a 3 inch, three strand hawser-laid rope, with 16 yarns per strand. This rope is very pliable and used with 6 inch diameter pulleys.

(5) "Chambers's Twentieth Century Dictionary" ed. W. Geddie, Edinburgh, 1965.

(6) "A Diderot Pictorial Encyclopaedia of Trades and Industry" ed. Charles C. Gillispie, Dover Publications Inc, New York. See under"Passementerie".

(7) Under CATAPULT in the Byrne and Spon "Dictionary of Engineering" 1874 is a description of a war machine taken from the German edition of Ramelli's work published in Leipzig in 1620. The relevant passage relating to viol strings is rendered by the 19th C translator as "The cords should be made of the same material and in the same manner as the counterbass strings of a violoncello". It should be noted that Ramelli's ropes were simply twist--ed together - an unstable assembly that would unwind if not restrained at the ends. It would be possible to use such an arrangement on an instru--ment but, as it would require that the string be twisted up on the instrument, it is not very likely that this exact arrangement was a prac--tical proposition. Ramelli's rope would have looked just like a cable made from four hawsers - perhaps this is what Ramelli meant?

(8) "Variety of Lute Lessons" Robert Dowland 1610, facsimile by Schott & Co, 1958.

(9) The Chinese lute strings in my possession are of three and four strand construction - just like a tiny hawser-laid rope. Presumably, the inherent elasticity of the silk filaments did not require these strings be made

(9 cont.) like a cable?
There are many references to the use of silk lute strings by the Arabs in " Studies in Oriental Musical Instruments" by Henry George Farmer, The Civic Press, Glasgow, 1939 - translated from texts dating from the 9th to 14th Century, for example:
"With silk strings, they should be white, smooth, of equal gauge and well finished. These are boiled in water and ashes, and are then washed two or three times in pure water and dried in the shade. The strings are then twisted into the following gauges ... made from 64 threads, 48 threads, 32 threads, 24 threads and 16 threads...A paste of moderate consistency is then made of gum and a little saffron. This is rubbed on the strings with a piece of linen until it has penetrated into all the parts, when the string is dried"....."silk when stretched taut, is finer in tone than gut"....."these strings require a tautness, on account of their high pitch, which one or two strands of gut are not capable of sustaining".

(10) Tomlinson's Cyclopaedia of Useful Arts, 1866, describes gut string manu--facture in 19th C.London. It is stated that Italian (violin) strings were much better than the English strings and is suggested that this was due to the different way in which the sheep were fed - emaciated sheep being better than fat.
Also, the following quotation from Otto's 'Treatise on the Violin' is given:
"The best strings which have come under my observation are those from Milan. The Milanese strings are as clear and transparent as glass. The third string should be equally clear as the first. They must by no means feel smooth to the touch, for they are not ground or polished off by any process, as other manufactured strings are. If a good string be held by one end in the finger and opened out, it will recoil to its former posit--ion like a watch spring .....; those which are of dull and opaque appearance are useless. Their elasticity is after all the best criterion, as no other strings which I have tried have that strength and elasticity for which the Milanese are so much esteemed".

Fig. 1

Construction of a cable-laid rope made from three, three strand hawsers.

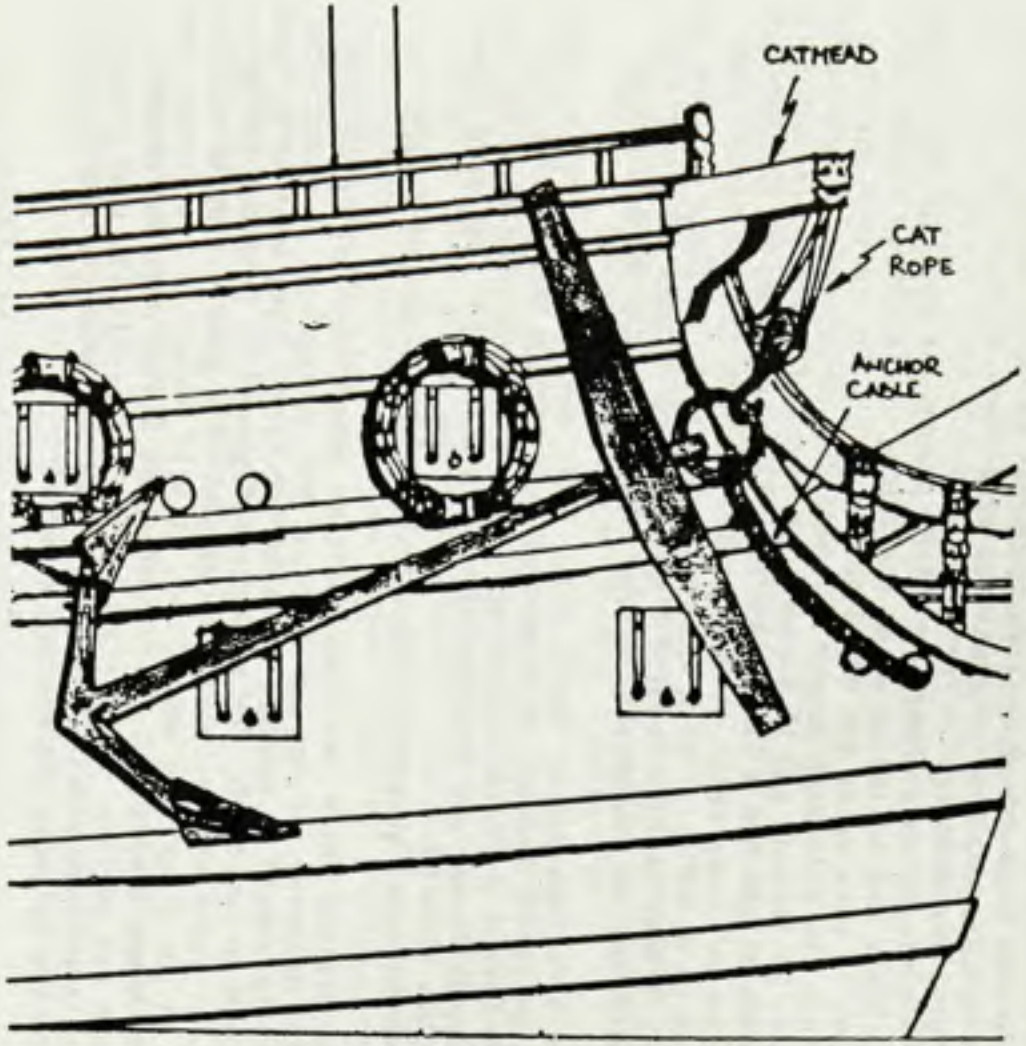
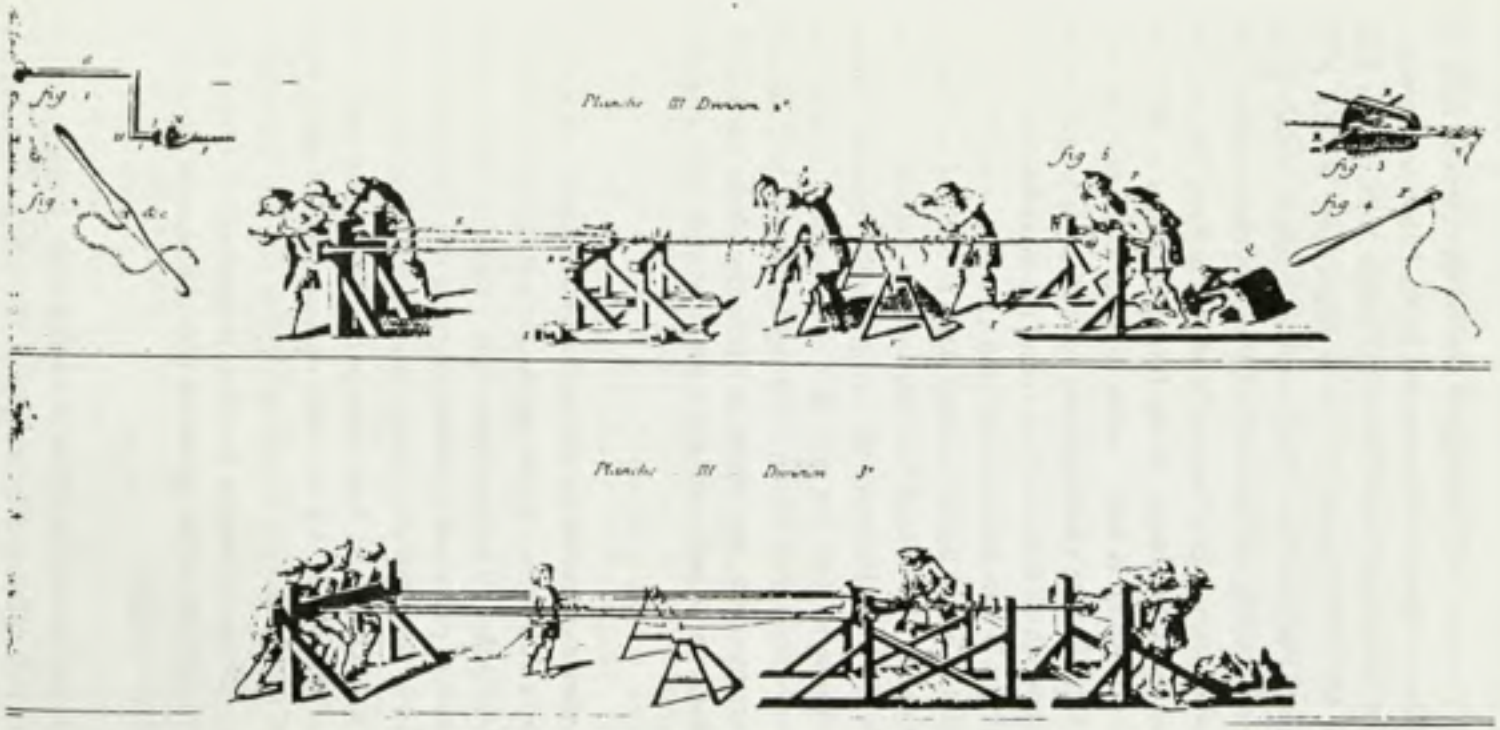


Fig. 2

Sketch of ship's anchor and anchor cable suspended by the cat from the cathead and swung into position for stowing.



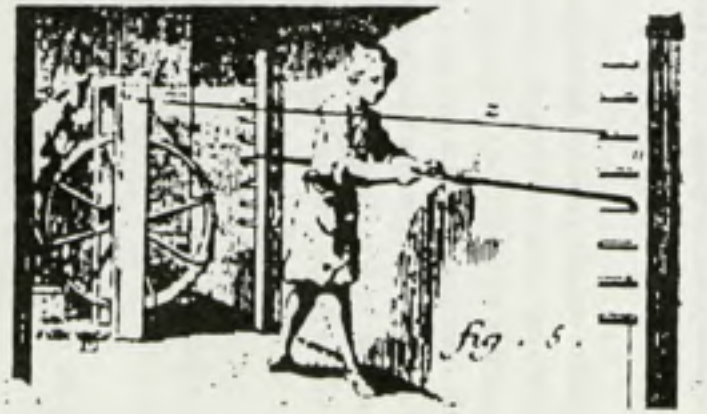


Fig. 3 above

The manufacture of a cable-laid rope from three hawsers and a shroud cable-laid rope from four hawsers.(Diderot)

Fig.4 left

Gut string manufacture. Twisting and polishing the gut strands. (Diderot)

FoMRHI Comm. 1350

German baroque lutes and overspun strings

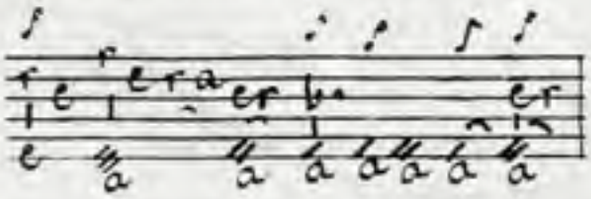
by Mimmo Peruffo

Introduction

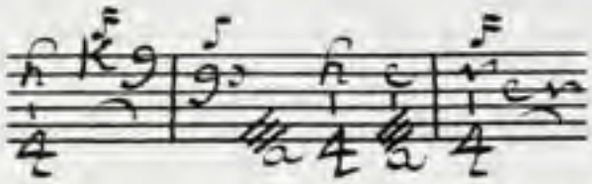
In his introduction to *Comm. 737 (Q44)* M. Hodgson put forward the hypothesis that also in the 18th century lutes may not have used overspun strings. In fact there are serious difficulties to render with clarity bass lines of authors like Hagen, Falckenhagen, Kohaut and many others, because of the long acoustic persistence typical of such strings.

Today it has been necessary to develop a special technique, suitable to the need of damping out the excess of sound, to the point that we might say that a lutenist spends more time stopping the basses than actually playing them! On the other hand, without such a solution passages like these:

F. Daube (1773 - 1797): Allegro



K. Von Kohaut(1726 - 1782): Allegro



would be hardly intelligible and as regards the last five basses of an extended 13 courses lute the problem becomes unbearable. Both the way of composing (e.g. the 9th course is never fretted, unlike the 8th) and the portraits of some lutenists from the 18th c. (Falckenhagen, for example) seem to confirm that it was the latter version of the d-minor lute which characterised the 2nd half of the 18th c., all the way to its final extinction. Today's lutenists use overspun strings, but did they do it in the 18th c. too?

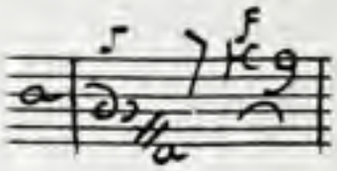
Some elements seem to support such a hypothesis: when in 1664 J. Playford announced the existence of the new type of strings he included also the lute like a potential beneficiary. On Raphael Mest's 12 courses lute (*Comm. 156*) survive some fragments of overspun-strings, but whose dating is uncertain. Nevertheless several various hints favour the opposite hypothesis, that is overspun strings where not employed on the lute.

Musical documentation

The association *overspun strings - sound damping* technique is today a must, the penalty being a great harmonic confusion in florid bass passages (so frequent in late baroque tablatures) but curiously enough, in spite of this rather obvious consequence, no 17th or 18th c. source available to us today suggest that any damping technique may have been used, with the exception, maybe, of Radolt's lute instructions (*Comm. 737*).

We do find pause signed in some tablatures:

K. Von Kohaut: Allegro



but meant as musical effect rather than as indication of playing technique. It is in any case hard to believe that the big harmonic confusion caused by the excessive acoustic persistence of overspun strings could be tolerated by the lutenists of the past, unless damping the basses while playing was generally taken for granted, to the point of not being bothered to mention in the treaties, or simply was not required since overspun string where not used.

For the eleven course lute this supposition holds well considering the abundance of written and iconographic evidence. As known, the earliest mention of overspun strings dates back to J. Playford's in 1664, followed some decades later by other documents which fully confirm (C. Perrault's "Oeuvres de Physique" 1727; D. Speer's "Grund Richtiger Unterricht" 1687, also J. Talbot, 1696 c.a.) but the eleven course lute did not exploit this novelty. In fact both M. Burwell's lute tutor (c. 1670), T. Mace (1676) and J. Talbot (c. 1696) recommend all-gut strings for the lute: Lyons or dark red Pistoys.

Iconographic sources, too, leave no room for doubt and among the many examples available I shall only mention the famous portrait of the French lutenist C. Mouton in the Louvre, painted towards the end of the 17th century. Right at that time, in any case, the first examples of overspun bass strings begin to make their appearance in

iconographic sources, especially as violin's or cello's 4th string, or as seven strings gamba's last three basses (e.g. F. Puget's "Luis XIV's musicians", 1687?, in the Louvre Museum). They are clearly distinguishable because of their "white" colour (i.e. the silver wire) from the higher strings, which are "dirty yellow" natural gut colour.

String vibrating lengths: treble pitch

According to Segerman, with the advent of overspun strings, the necessity to tune the trebles close to their breaking frequency in order to safeguard as best as possible the acoustic performance of all-gut basses till then in use, could be dispensed with. By tuning the trebles in such manner it was possible to reduce the working diameters to the minimum possible, thus gaining in elasticity and therefore in sonority.

The same rule was essentially applied also to bowed instruments (see Playford and Mace). On the other hand, the new type of bass strings gave such remarkable acoustic performance as to allow the top strings to work at last under conditions less critical to their integrity. The practical consequence was a general reduction of the strings vibrating length (at equal pitch, that is) which Segerman estimated at around 10 - 15 %. This favoured also a more agile performance (*Comm. 65* etc.).

But, surprisingly enough, all this did not happen for the d-minor lute, whether 11 courses or the two types of 13 courses (with peg box bass rider or with neck extension). Surviving instruments built in Germany, Austria and Bohemia in the 18th century have strings vibrating length, for the major part, between 70 and 74 cm, against the 62 - 66 cm one would expect following the criteria applied to other instruments which adopted overspun strings for good (plucked ones included).

Assuming a treble tuned in Kammerton "f" (Baron, 1727), half a tone lower than today's standard pitch of a'=440Hz (*Comms. 891, 1098*), we obtain a break index for gut between 231 and 244 Hz/m with an average value of 237 Hz/m, for a string vibrating length of 72 cm. This corresponds at about two semitones lower the breaking critical frequency for a gut string possessing a breaking point value of 34 Kg/mm^2, a coefficient which, from a historical point of view, I consider more likely than the 32 Kg/mm^2 so far proposed by Segerman. The latter, in relation to actual evidence, that is surviving d-minor lutes but also Renaissance ones present in Museums, appears to be surely underestimated.

On such basis the working frequencies would almost coincide with the theoretic breaking frequency, leaving practically no safety margin (incidentally 34 Kg/mm^2 is also the mean breaking point of modern commercial gut strings). The conclusion is that d-minor lutes trebles worked close to breaking frequencies, which is exactly the same criterion applied both to Renaissance and Baroque lutes which, as we know, aimed at the safeguard of the sound of the basses, which, at the time were not overspun.

Finally, it should be noticed that the transition from 11 to 13 courses did not modify the usual strings vibrating length, fit for all-gut basses of the traditional types (Lyons, Pistoys etc.)

Open strings ranges

The transition from 11 courses lute, with an open-strings range equal to a 8 courses Renaissance lute's, to the 13 courses lute with the last two carried by a bass rider (for which the earliest surviving tablatures date back to after 1715) did not change things as regards the early 17th c. lutes. The overall frequency range between first and last open courses is the same, in fact, as that of a 10 course's with Renaissance tuning (8 courses, according to Scipione Cerreto) and all course lying on a single neck (i.e. at equal string length). To be picky, the 13 course's overall open strings range is half tone lower, but this excess is counterbalanced by the slightly longer string length of the last two courses due to the bass rider which approximately equals a semitone.

So, since there is neither real expansion since the early 17th c. (which seems to has always been a direct consequence of some technological progress in the manufacturing of the bass gut strings), nor any noticeable reduction of string vibrating lengths (as was the case for the other instruments) it seems legitimate to query whether d-minor lutes even employed overspun strings.

Bridge holes

An interesting element of recent acquisition regards the bass strings bridge holes measurements. Diameters of 18th c. German lutes bridge holes (without extended neck, see my *Comm. 1288*) so far recorded are never less than 1.6 mm and mostly fall in the 1.7 to 1.9 mm Ø bracket. This is too small, in fact, to allow plain-natural gut strings (if not loaded-weighted) to reach a sufficient working tension but certainly too large for overspun strings.

Maybe it is worth noting that the lute makers choice of holes size was not haphazardly done. The diameters recorded are generally between 1.1

and 1.3 mm Ø for the highest strings and, for the octaves coupled to the basses between 1.2 and 1.4 mm Ø. The ancient lute makers may have exceeded in drilling the bass string holes of course, but why make the whole operation more complicated (and pointlessly weaken the bridge, too) using various "drill-bits" if every thing could have quite simply done with just one bit, the same one used for the higher courses? After all an overspun string on lute rarely exceeds 1 mm in diameter and this is certainly true for extended necks.

But here things become interesting. In Tab. 1.1 have recorded the VIII course (the lowest fretted) and XIII course's bridge holes sizes of some extended neck 13 courses lutes. It can be observed that the diameters are consistently larger that the ones recorded on 11 and 13 (not extended) courses lutes, so large in fact as to allow all plain gut strings to reach sufficient working tensions (pitch a'=415Hz).

More over d-minor lutes with extended neck maintains the use of coupled octave strings, whose function may certainly depend on the aesthetic tradition pertaining to lute, but also on the need to add the high harmonics which the basses were lacking: exactly what an overspun string (in general, but especially if on an extended neck) does not need.

A constructional trait common to the instruments listed in the table is the fan bracing below the bridge, which seems to favour a dynamic enhancing of the lower registers (see *Comm. 334*), if compared to the "classic" J-bar disposition in the same area of the belly.

This topic actually needs deeper examination. Still the amount of information gathered so far allows us to attempt to formulate an interesting working hypothesis: After the early decades of the 18th c. it became impossible to find any supply of traditional all-gut bass strings (Lyons, Pistoys etc.) because bowed instruments, which in the 18th c. must have dictated the market trends, were by then quite satisfied with overspun strings. The terms Lyons, Pistoys, Catlins do not appear at all in the otherwise accurate description of gut string manufacture both in Diderot's "Encyclopedie", 1754, and DeLalande's "Voyage", c. 1765. This probably changed the string makers' manufacturing attitudes, with negative consequences for the lute which was, by now, less important and in use than bowed instruments.

So, in order to be able to use normal (not loaded-weighted) plain-gut, the remedy was to extend some of the bourdons and related octaves, to recuperate sound. At the same time a fan bracing system below the bridge was adopted, disposing with the J-bar, favouring the acoustic performance of the low registers. Naturally the bridge holes were sized to accommodate such strings. Should they not have been the case, the only alternative, in the middle of the 18th c., would have been overspun strings, which, however in conjunction with the other measures just described, would have acquired such an acoustic exuberance as to heavily impair the instrument's balance in terms of dynamics, tone and sound persistence.

Iconography

Some iconographical sources show with no possible doubt the use of all-gut basses, in support of the above exposed hypothesis. I shall mention here the portrait of E. von Kayserlingk (1742) playing an extended 13 courses lute whose basses are all dark red (Pistoys?) and out of Germany, in Italy, a portrait of Count Giovio (after 1770) playing a 10 courses lute "Arcileuto alla francese" (Dalla Casa's type), were the use of natural gut is absolutely clear, both for fretted and extended strings in the bass ranges.

Other interesting examples of 18th c. lutes string with all-gut are: Kohaut portrait, by Carmotelle at Chaintilly, museé Conde, and (by anonim) "Die familie Mozart" (?) c. 1770, in Staatsarchiv, Augsburg. Does anybody know of other good examples?

Conclusions

What so far exposed can certainly put into question the use (or at least the generalised use) of overspun strings on lutes in the 18th century. The feature pertaining to such strings would appear to be a concentrate of all the negative qualities which lutenists of the past always tried to avoid:

a) serious tone dishomogeneity from the higher all-gut registers

b) excessive acoustic persistence of the basses, such as to cause harmonic confusion in flond bass-line passages

c) heavy dynamic unbalance in relation to top strings.

These feature are obviously present all at the same time, but each one alone goes in opposite direction to what always expected from the lute (I do not consider here the chitarrone or tiorba): dynamic balance and homogeneity of tone. On the other hand, are there alternative arguments in defence of overspun strings?

Appendix

The "Arcileuto alla francese", in use in Italy in the 2nd half of the 18th century, probably represents a case of adjustment of the lute to the use of plain-gut strings. We know from DallaCasa's tablatures (1767) that the instrument had ten courses (but Stradivari in his drawings shows 12 courses), six of which were fretted and the other four were on the extended neck. DallaCasa has left us a drawing of the instrument which allows us to determine the relationship between the two string lengths, and that turns out to be in a 1:1.5 ratio. This means the 10th bass, at equal working tension, has the same diameter of the 6th fretted string.

From the portrait of DallaCasa playing the Arcileuto (1759) it is clear that the strings were all gut and since they are coloured red or blue (I think, here, for aesthetic purpose only), it can be inferred that the 6th course and the extended basses had coupled octave strings, while the higher courses were unisons (the treble being single at nominal g'). The tuning was the same as the Renaissance lute's. (At Museo Civico di Bologna there is an archlute labelled "Hans Frei in Bologna 1597". This instrument was modified by adding an extended neck in the half of 18th century. The proprietor in the 1st decade of 19th century was the Liceo Filarmonico, were DallaCasa worked and gave his archlute's manuscript. Is this instrument his "Arcileuto alla Francese"?).

Even without the iconographical evidence, it can not escape us that the arcileuto alla francese was to use all plain gut strings. It had only six fretted courses, the last of which with an octave coupling, exactly like the lute of the 1st half of the 16th century, a time when basses did not yet benefit from any of the technological improvements which took place after c. 1570. The extended neck on this instrument grants the last bass string's diameter to remain within limits where a plain gut string can still give a satisfactory acoustic performance. Such limit, exactly like for its 16th century forefather's, was the diameter of the 6th course's bass string. Thus, taking in due account the advantage of the extended neck in terms of diameters reduction and the overall open string range, it becomes evident that the arcileuto's reference is, in actual fact, the Renaissance 6 courses lute. It could not really be otherwise, since the strings seem to have the same acoustic limitations that they had in the 16th c. (high twist?).

What so far said is also valid for the 13 courses d-minor lute with extended neck (here again, taking in due account the effect of the extension on the bass strings' diameters), although it has a semitone wider open string range in comparisons to the arcileuto alla francese. In fact, all in all, the diameter of the 13th course's bass string falls within the limits of a Renaissance 6 courses lute which, let us bear in mind, exploited to the highest degree the mechanical and acoustic characteristic of all plain gut strings, corresponding to an open string range of two full octaves,* with a 6th course's bass string of 1.5 mm more or less.

* Which is the same open string range of the first eight fretted-courses on a d-minor lute with ex.neck.

Table 1

LUTEMAKER & PROPRIETOR	DESCRIPTION	COURSE	HOLE Ø (mm)	TENSION (Kg)	NOTES
"Laux Maller" MI 54 Germanische National Museum Nuremberg, Germany	Thirteen courses lute with extended neck (2x1, 11x2) v.l. 0.700 m 0.950 m	XIII	2.00	4.05	Modified by Widhalm in 1757 Fan bracing
"Leopold Widhalm ... in Nürnberg fecit anno 1755" MIR 903 Germanische National Museum Nuremberg, Germany	Thirteen courses lute with extended neck (2x1, 11x2) v.l. 0.738 m 0.995 m	VIII	1.50	3.46	Fan bracing
		XIII	1.85	3.02	
"Sebastian Schelle ... Nürnberg, A.1721" MIR 902 Germanische National Museum Nuremberg, Germany	Thirteen courses lute with extended neck (2x1, 11x2) v.l. 0.705 m 0.903 m	VIII	1.90	5.07	
		XIII	1.75	2.80	
"Christoforo Hoch lauter... " MI 55 Germanische National Museum Nuremberg, Germany	Thirteen courses lute with extended neck (2x1, 11x2) v.l. 0.700 m 0.952 m	VIII	1.40	2.71	Modified by Widhalm in 1757 Fan bracing
		XIII	2.07	4.36	
"Martin Hoffman in Leipzig, 169..." MI 245 Germanische National Museum Nuremberg, Germany	Thirteen courses lute with extended neck (2x1, 11x2) v.l. 0.690 m 0.960 m	VIII	1.40	2.64	Modified in the II half of 18th century? Fan bracing in the treble side?
		XIII	1.70	2.99	
"Hans Frei in Bologna, 1597" nº 1814 Museo Civico Medioevale Bologna, Italy	Ten courses lute with extended neck (6x2, 4x2) v.l. 0.584 m 0.930 m Reinassance Tuning *	VI	1.60	3.20	Modified in the half of the 18th century Arcileuto alla Francese ?
		X	2.00	5.64	

* Top string two semitones below its breaking frequency (breaking point of gut 32 Kg/mm^2)

Fo

More on Ramelli, loaded gut strings and gansars

by Mimmo Peruffo

To my great surprise I found two original copies of Ramelli's "Le Artificiose Macchine ..." (Paris 1588) in my own town's library. This enabled me to verify the bilingual text, French and Italian, and more precisely Chap. 190 where a type of strings for bowed instruments is referred to. The relevant passage reads: "... una doppia e grossa corda fatta nella maniera che si fanno le grosse corde dei bassi di violoni: e che la sia ben ritorta ..." and, in French: "... une grosse corde et double, faicte en la façon des grosses cordes des basse-contres des gros violons; qui soit bien retorte ..."

The author suggests to follow the manufacturing method used for making the bass strings of big violoni (that is, he does not refer to bass gambas). In Chap. 191 Ramelli states: "... e facendosi le corde della medesima materia che s'è detto nel capitolo precedente saranno molto miglior che di qualunque altra sorte di materia." The modern edition of Ramelli's work quoted by J. Downing in his *Comm. 1318* unfortunately makes the mistake of translating this passage as though it were from modern Italian: "... if the ropes are made of the same material described in the preceding chapter ..." But in Chap. 190 there is absolutely no mention of what sort of material should be used to make strings. It is, in fact, an old Italian form of expression meaning: "... if the ropes are made in the same *manner* as said in the preceding chapter, they will be better than in any other system". Downing, rightly, wonders why Ramelli should take, as an example for catapults, only the bass strings of one specific musical instrument and not strings for musical instruments, plucked and bowed, in general.

The only logical explanation is that only those specific strings made use of a rope construction system. The just as logical conclusion is that the basses of lutes and most bowed instruments did not make use of such system. For the violoni, the largest of bowed instruments, the reason seems to be simple: to increase the strings elasticity as much as possible because of the thick diameters involved; elasticity which is of great importance also for the ropes which must absorb the blow coming from the arm of Ramelli's catapult.

In Preatonous drawings, such as the fifth for example, the last four strings of the five string "groß contraball" seem to indicate just such rope twisting method. I say "seem" because at such thick diameters, also a high twist string clearly reveals its twist.

One should never overlook the fact that, no matter what twisting process is employed, it never leads to any density increase of the material (if anything the opposite is true). But the increase of gut specific weight is the only logical explanation that can justify the small diameters of bass strings bridge holes on extant historic lutes (*Comm. 1288*), this totally independent of other elements supporting the loading of gut, such as the colour of lutes and bowed instruments bass strings in the 17th century iconographic sources, bearing also in mind that it is possible to load gut without changing its natural colour in any noticeable way.

The colour of bass strings in 17th century iconography deserves a deeper investigation. Their colour, although in paintings by different artists and from different times and geographical regions, remains surprisingly constant: very dark red or various shades of brown, down to black.

If the colouring of those strings was meant as merely aesthetic, why do we never find them depicted with more aesthetically pleasing colours, like green, blue, or rosy, which are the only examples mentioned in treatises of the time, with an obvious aesthetic goal in mind?

Another point to bear in mind: the coloured strings appear on the instruments where we, today, employ overspun strings (e.g. 3rd and 4th violin and bass violin strings, 4th 5th and 6th viola da gamba and violone strings and, on lute, all basses from the 6th down): a pure coincidence, common to all the iconography examined?

And now some observations on the transparency/translucence of strings. From Mace's and Dowland's treatises it is clear that the concept of "transparency" is only applied to trebles and mid-range strings. About bass strings we know nothing beside the fact that one commercial type was dark red; but about their transparency nothing. Iconographical evidence shows also strings of lighter or darker shades of brown: can a thick string of such chromatic characteristics be at the same time "transparent", when even a rope structured string, because of its high twist, is not transparent? For the sceptics I suggest to take notice of whether a well twisted harp-string of a certain thickness stained black or dark red can be "transparent". An increase in twist always reduces the degree of "transparency" of any string, and a bass string is always high twisted.

On the other hand, if the colouring of bass strings was actually consequence of a gut loading process, why were they never green, blue etc.? The answer may be a technical one. I have ascertained that in 16th and 17th centuries, just like today, there existed no inorganic/organic pigments, natural earths, etc. of a green, blue or rosy colour possessing so high a specific weight (and therefore apt to be used for the purpose of gut loading) as can be obtained from the inorganic compounds of mercury and lead, such carbonates, oxides and sulphides, or of partly oxidable impalpable metal powder such copper, for example, whose technique of preparation was widely known since the early Middle Ages. These heavy pigments has a density of some 7.0 ÷ 11.0 gr./cm^2 and a chromatic aspect which spans from white and light yellow (practically the colour of natural gut) all the way to black, via all shades of yellow, orange, red and of course brown. No traces of green, blue or rosy colours. Any other compound produced with other metal salts than mercury or lead compounds do absolutely not guarantee a comparable specific weight: in practical terms could not be used to load gut to the level which must be inferred from the bridge hole sizes on historic lutes.

To confute the hypothesis of gut loading, the only other possible way is to maintain that the basses of lutes (whose bridge holes diameters were recorded) worked at a tension between 1 and 2 kilos (Segerman's *Comm. 1307*). I leave it to the reader to judge the credibility of such a theory, maybe after trying to play a lute with basses set at such tensions, even playing with the right hand as close to the bridge as it will go; this seems to be, all in all, Segerman's proposed remedy to the "rubber band effect" hinarmonicity and to the extreme poorness of sound which gut strings at such tension values unavoidably give (1).

One could stop here, but there are still other elements worth considering. As is well known, the universal custom of the 16th-17th centuries entailed aiming for a feeling of equal stiffness through the strings of an instrument, which can be assured, broadly speaking, as a situation of equal working tension. I say broadly speaking, because strings of different diameter have different longitudinal elastic displacements index, strongly dependent, as well as the diameter, also on the type and degree of twist: maximum in a [possible] rope construction, minimum in a low twist. Such a difference in elastic displacement obviously affects the feeling of stiffness. Then, considering a condition of equal tension between strings, Segerman worked out the diameters of a lute's treble: 0.24÷0.32 mm a (1).

[illegible] in Rome (which, I wish to remind, was an important official document, regulating the profession of the city's string makers quite strictly over a period spanning from 1599, when the first statute was undersigned, to the end of the 18th century, when the string makers guild was suspended) disposed absolutely, with severe penalties against transgressors, that 2 whole lamb guts must be employed and forbid explicitly to make trebles out of a single gut (I assume here 7 to 9 months old lambs, which has always been considered to be the best age for cooking the "abbacchio", the typical Easter delicacy, in Rome).

Segerman estimated (I believe quite correctly) a diameter of about 0.42 mm for such trebles (2). Thus, in the light of this important historic and practical evidence (it is easy to verify today too, that with two whole guts from young lambs it is impossible to obtain diameters smaller than 0.40÷0.50 mm), the only other viable path is to assume that lutes of the past worked under conditions of very unequal tension from string to string: low for the basses (to fit to the bridge holes diameters) and much higher for the trebles (as consequence of the minimum diameter obtainable from two whole lamb guts)(3).

But how can such a statement be justified when confronted to all the 17th century's treatises, where, in any case, the search of feeling of homogeneous stiffness among strings is recommended, if not quite the same working tension (see Mersenne, for example, although his scope was probably didactic)? Mace (Musik's monument, 1676) is absolutely definite: "... another general observation must be this, which indeed is the chiefest, ... and here note, that when we say a lute is not equally strung, it is when some strings are stiff, and some slack ...". The title of the chapter where he makes this statement read, quite eloquently: "The very principal observation in the stringing of lute".

But there is more: some sources referring to the violin suggest even that one should apply the same weight to the strings, experimenting with different diameters, until the fifths are perfectly in tune (Serafino di Colco 1690, and Leopold Mozart in his violin tutor, 1756).

All this to reaffirm, once more, the historical credibility of gut loading, in other words, it does not justify itself only the basis of a name given by the ancients to a commercial type of bass strings in the 17th century! In fact the contrast between the gut loading and the rope construction never existed, and this apart from the fact that modern reconstruction take only high twist into account: may I remind that we are trying to carry out a research based exclusively on historical elements

here, free, that is, from any

constructive) reference, which should be foreign to the spirit of the bulletin (and to this spirit definitely I intend to remain true). These two techniques are all but incompatible and if used simultaneously they enable us to obtain the maximum acoustic performance from a bass gut string: was this the case for the violone basses of Ramelli's time?

Both Capirola (c. 1517) and Dowlands mention "ganzer" or "gansars" strings. This is what I found in Diderot's Encyclopedie (c. 1754) under the entries "cor" (p. 176) and "gal" (p. 422÷423):

* GANSE, (*Manufact. en ſoie*) petite poignée de gavaſſines auxquelles les lacs ſont arrêtés, & que la tireuſe attache avec une corde. *Faire les ganſes*, c'eſt arrêter la même poignée de gavaſſines, afin que tous les lacs ne tombent pas ſur la main de la tireuſe.

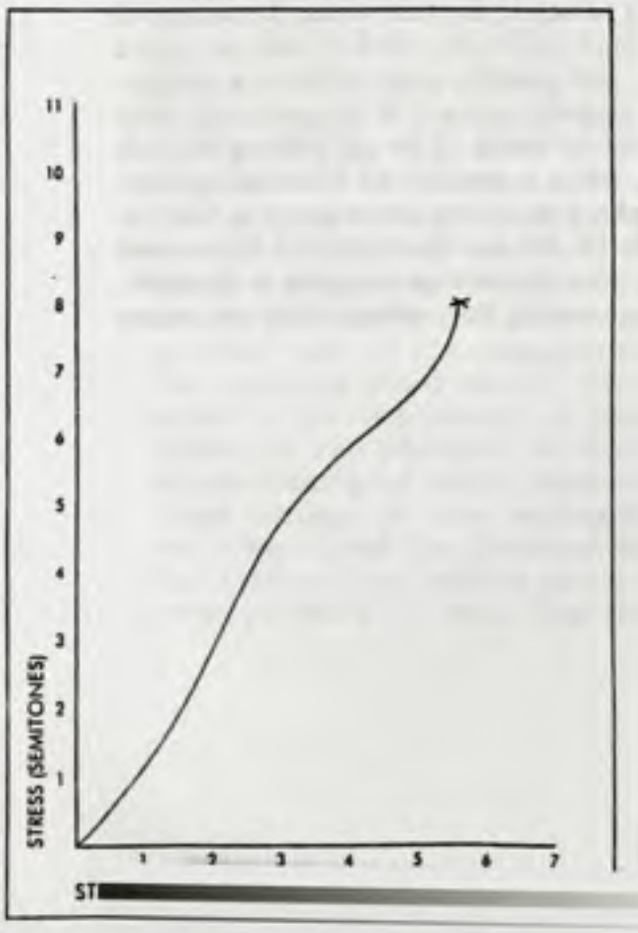
GANSE, ſ. f. (*Rubanier*) eſpece de petit cordonnet d'or, d'argent, de ſoie ou de fil plus ou moins gros, rond, & même quelquefois quarré, qui ſe fabrique ſur un oreiller ou couſſin avec des fuſeaux, ou ſur un métier avec la navette.

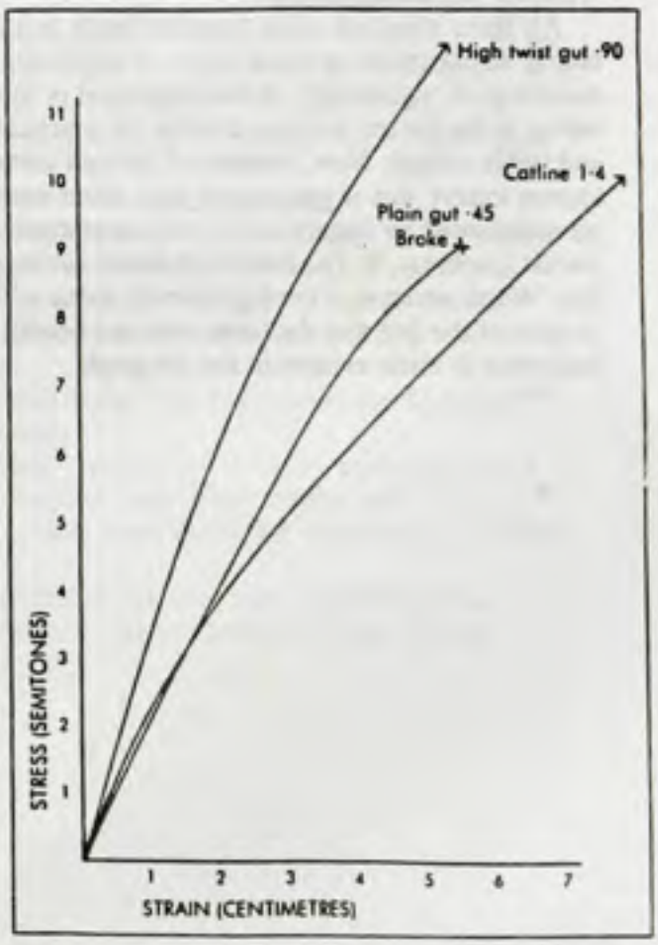
Les *ganſes* ſervent de boutonnieres pour arrêter & boutonner les boutons; on en décore auſſi les habits, ſur-tout aux environs des boutonnieres.

Les Chapeliers s'en ſervent pour retrouſſer les chapeaux, & les femmes pour lacer leurs corps & corſets.

On fait un commerce aſſez conſidérable de *ganſes* en France: les marchands Merciers les vendent; mais ce ſont les Tiſſutiers-Rubaniers & les Paſſementiers-Boutonniers qui les fabriquent.

CORDE, (*Gazier.*) Le gazier ayant à-peu-près le même métier que l'ouvrier en ſoie, a preſque les mêmes *cordes*. *Voyez ci-après* CORDES (*Manufact. en ſoie.*)





Notes

1) In his *Comm. 1307* p. 55 Segerman states: "A combination of roped basses and plucking lower basses closer to the bridge could explain Guzman's 3 octaves". About strings, we must tackle the problem of even justifying its actual existence. Bermudo states that it is a normal six courses vihuela with one more course added one fourth above the chantarelle (and that makes two octaves and one fourth and not three octaves). How that can be is a mystery, when we bear in mind that on the vihuela, just like on the lute, the top string was already tuned as high as it would go, short of breaking. It is impossible, of course, to go any further.

2) This datum find confirmation in the values given by Mersenne: Segerman (*Comm. 325*) has calculated for each single gut a cross section area of 0.054 ÷0.0675 mm². Thus the diameter of a treble string made out of two guts turns out to be 0.37÷0.415 mm ø; 0.41 mm ø according to M. Namreges (*Comm. 343*, 53 guts = 2.10 mm ø).

3) If anything, it should be the other way round, on the basis of both ascertained historical elements and experimental ones. The style of playing which strongly established itself as from the beginning of the 17th century and lasted till the end of the 18th century prescribed that the right hand thumb be outstretched towards the rose. Thus, on merely physiological ground (and unlike what was common in the Renaissance) the fingers engaged with the higher strings find themselves close to the bridge, where one has a feeling of higher stiffness as opposed to the basses, which are plucked further away, where the amount of "give" is noticeably higher.

Like D.Van Edwards made evident graphically ("Lute strings and angled bridges" in "The Lute", XXV 1985, Fig. 1), a treble string made of a whole gut, when close to its breaking frequency (that is the normal playing conditions for lutes and bowed instruments trebles in the 16th and 17th centuries) loses almost completely its stretch capacity (exactly the opposite of modern trebles made out of split gut strands, which close to breaking begin to show clear sign of fatigue).

Furthermore, it is quite probable that the trebles were of the low twist sort and therefore possessed a no high stretch capacity: in his "Varieties", Dowland states that the end of a good treble must be hard and sharp to the thumb, and break neatly when cut with the teeth. Such features are totally alien to a good high twist string but typical of low twist ones. Mace, on the other hand, states that lute basses go more easily out of tune than the higher strings, and this is a typical predisposition of high twist strings. Another characteristic of basses is that they work at a small fraction of their break point, thus retaining a certain amount of "reserve" stretching capacity.

All these elements taken together result in a feeling of stiffness (which is, in other words, the amount of lateral displacement at equal point of application and amount of force employed) which in order to reach a condition of "equalness", as recommended in the 17th c. treatises, quite probably made necessary a compensation in the basses working tension (in practical terms, a certain diameter increase) in comparison to mean and treble strings. Now, because of its high stretch capacity (the highest among all the gut twisting methods known today), this is particularly true about rope structure strings, which is precisely the historical hypothesis maintained by Segerman (!). An experimental verification of what I am saying can be found in Van Edwards' graphic n. 2. The diameters tested correspond roughly to the 1st, 4th and 6th strings of a Renaissance lute. Worth noticing it the high stretch index of the thickest string (rope structure) as compared to the treble, in spite of the fact that the latter does not benefit from the advantage coming from using a whole gut, whose behaviour is made evident in the 1st graph.

More on Roped Strings and other Knotty Problems

Following Comms 1318, 1319 and 1320, Mimmo Peruffo sent me photocopies of part of the original texts from Ramelli and Diderot which reference roped string construction.

Ramelli's work of 1588 was published in Italian and French. In chapter 190, Ramelli compares the massive double rope of his trebuchet war machine to the contra bass string not of a bass viol, as reported in Comm 1318, but of a bass violin. The relevant passages read "...fatta nella maniera che si fanno le grosse corde de i Bassi di violoni..." and "...faicte en la façon des grosses cordes des basse-contres des gros violons..."

In Comm 1320, I commented that there appeared to be no evidence to confirm that gut (instrument) strings were ever made in any way other than by simply twisting gut fibres together as shown by Diderot in his engraving of the gut string maker's workshop. Mr Peruffo advised me that Diderot, in another volume of his encyclopaedia, does in fact refer to gut strings of roped construction and suggested that the spinning wheel shown in the engraving of the gut string maker's workshop, which is furnished with two spinning hooks, might have been used for making strings of roped construction.

Following his description of gut string making in general, Diderot goes on to state "C'est de la meme maniere que se préparent les grosses cordes a boyau, avec cette difference ..... qu'on les tord & file comme le chanvre ...." which I take to mean that large (diameter) gut strings are made in the same way (as small strings) except that they are spun and twisted like hemp fibre.
Although Diderot is clearly saying that the large gut strings were made like a hempen rope, he does not say at which diameter strings were made in this fashion or, indeed, if these large strings were intended for use on musical instruments (I only have part of the original text, so perhaps this is made clear elsewhere?). Note that Diderot's gut string maker manufactured strings for a variety of end uses - not just for instruments. He does, however, also say that the large strings were made from ordinary (quality) gut and that less attention was paid to the cleansing of the guts compared to those used in small strings. This might suggest that the large roped strings were not made for instrument use?

The spinning wheel illustrated in Diderot's engraving (see Fig 4, Comm 1320) is fitted with two twirls or spinning hooks one of which is being used to twist a single gut string. In his general description of gut string making above, Diderot also states that the spinning wheel of the gut string maker is like that of the manufacturer of cordage.
The spinning wheel could, therefore, have been used in two ways as Diderot shows in his engravings of cordage manufacture.
There are two distinct branches of the cordage industry - that specialising in the making of small diameter cordage or twines and that involved with large cordage or rope making (by the 19th C, rope was cordage measuring greater than 1 inch in circumference).
Fig 1 shows the way in which the basic component of cordage manufacture (known as yarn), is spun from hemp fibre. Worker B is attaching hemp fibre

from a bundle (chanvre) wound around his waist, to one of the nine twirls on a large spinning wheel. A second worker, at the same time, is paying out the fibre into a spun yarn as he walks backwards. This wheel, therefore, was able to accommodate up to nine workers spinning yarn at the same time in the interests of increased productivity.
Fig 2 shows the manufacture of twines where spinning wheels with four twirls are being used to make twine by twisting together two yarns (bitord) and three yarns (merlin). A four yarn twine could also be made on this wheel. Hence, the two twirl wheel of the gut string maker could have been used to twist two gut strings at the same time to improve output or to twist two strings together to make a two element twine.

So what was the construction of the large diameter gut strings described by Diderot as spun and twisted like hemp fibre? Were they simply two element twines or something more complex like a cabled rope?
Gut instrument strings, by virtue of their relatively small diameter, are not ropes but twines - if we are to use hemp cordage terminology. It is probably better, in fact, to avoid reference to rope constructions for instrument strings as,for example, a cabled twine is of less complex construction than a cabled rope due to the difference in scale between them. Twines may be made from two, three, four, or five individual yarns. A cabled twine or cord is made by twisting or laying together three twines.
A rope, on the other hand, is made from strands or bundles of yarns twisted or laid together to form three or four strand hawsers. A cable laid rope is made by laying together three or four hawsers.
In Comm 1320, I described the Chinese silk instrument strings as being made like a miniature hawser. As these strings are made from three or four bundles of silk filaments individually twisted and laid together like a rope, I equated each filament bundle to a rope strand and hence the complete assembly to a hawser laid rope whereas these strings would be more accurately described as three and four element twines.
A gut string is a special case in that each simply twisted gut string, made from a single gut, is a bundle of fibres equivalent to a filament bundle of a silk string or a spun yarn in hempen rope terminology.
Diderot's large gut strings were most likely twines, laid up from two, three, or four (perhaps five?) simply twisted strings or, cords made by laying up three of these twines.
His gut string maker's workshop was, however, only equipped to make a simple two element twine.

Before moving on, it is ,perhaps, interesting to note that 'yarn', 'cord', and 'rope' are all derived from words in Old English and Greek meaning gut or entrails (Shorter Oxford English Dictionary, 1959).

Ramelli's Ropes

Following his description of gut string making, Diderot then talks about "Des cordes de tendons" which, he says, were used by the ancients on their machines of war. This type of rope was made, not only from tendons, but also from veins, arteries, ligaments and nerve fibres - the properties of each depending upon the type of animal they came from.
This again raises the question about the materials Ramelli used on his machines which he implies were the same as the material used for the counter bass strings of a bass violin. Is it possible that these instrument strings were made from tendons as suggested in Comm 1318? Does this material have proper--ties, such as greater density or elasticity that would make it more suitable for the very largest strings?

If the bass violin strings were made just like the huge rope on Ramelli's trebuchet, then they would indeed have been extraordinarily complex for such a relatively small diameter instrument string. Perhaps, Ramelli only meant that they looked like a trebuchet rope just as I thought my silk instrument strings looked like tiny hawsers?
My guess is that this type of string was made like a four element twine, each element being a simply twisted gut or tendon or fibre bundle of whatever material was used. Such an assembly would have looked like a downsized version of a trebuchet rope.

Mersenne's Knots

In his second book of Harmonie Universelle of 1634, Marin Mersenne,in his corollary to proposition 2,lists various knots used by instrument makers and lute players to tie frets, strings to bridges and horsehair to bows. With the exception of the latter application, Mersenne does not say how each knot was made or what was its specific application.
His list includes "le noeud du Marinier, dont il nouë ses cables" or the Marinier's (Bargee?) knot which he uses to tie his cables (ie to tie to something rather than together). Could this knot have been used to tie bass strings of roped construction to a bridge or tailpiece and is this further evidence of the existence of roped instrument strings in the early 17th C?

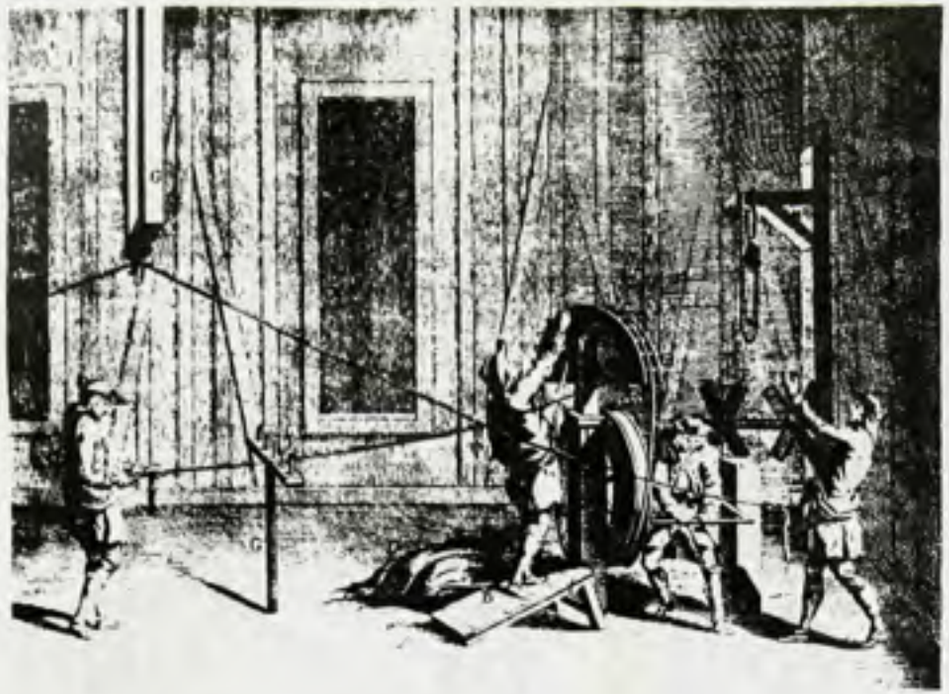


Fig 1 - Spinning yarn for cordage manufacture (Diderot)

B - Fileur..... attachant son chanvre à la plus haute des molettes, pour commencer un fil.

1 - Chanvre à terre.

(B - Spinner .... tying his hemp fibre to the topmost twirl in order to start spinning.
1 - Hemp fibre on the ground.)

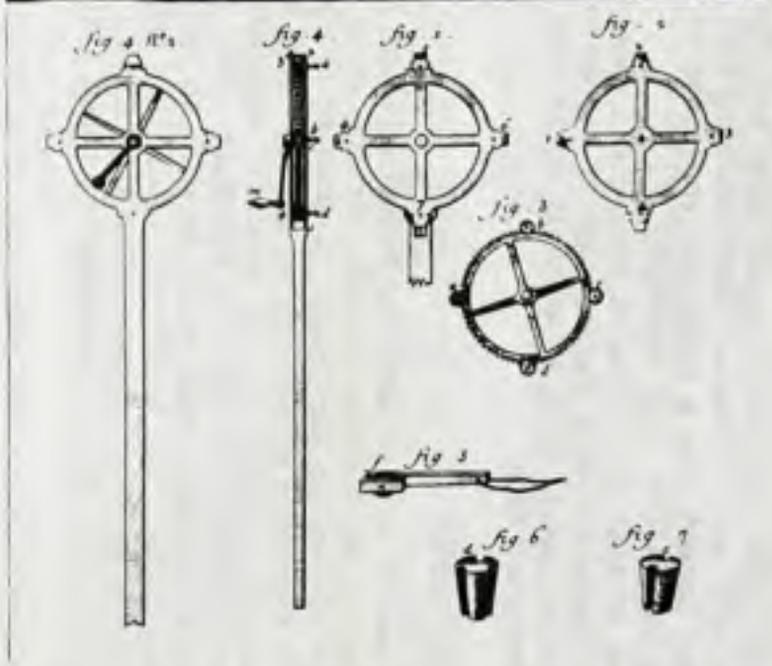


Fig 2 - Twine making (Diderot)

FoMRHI Comm. 1393

John Downing

Gansar Lute Strings

In Comm. 1351, Mimmo Peruffo brought to our attention the reference from the Diderot Encyclopedie concerning the meaning of the French word 'ganse'.

Out of curiosity, I spoke to some of my French speaking collegues at my place of work to find out what they knew about the word , its pronunciation and meaning.

Apparently, the word has a number of meanings, in current usage, for a flexible cord used on clothing. For example, it can describe the small cord loop fixed to the collar of a coat so that the coat may be hung from a peg. It can also mean the tie cord of an apron. It also means a decorative braid or piping for clothing or a rope handle or loop.
A'ganse de cheveux' is a plait of hair.
The construction of a 'ganse' is rope like or, more specifically, of braided or plaited construction for maximum pliability.
In Diderot's time, this type of braiding could be made from a variety of thread materials including silk, and silver and gold wire, or a combination of these materials depending upon the decorative effect required.

In English phonetic, 'ganse' would today be generally pronounced as 'gans' i.e. without any emphasis on the final 'e'. However, in parts of South-West France the pronunciation would be 'gansa' - with strong emphasis placed on the final 'e' - a pronunciation that might have been widespread in earlier times.

The Capirola Lute Book MS mentions 'le corde da ganzer' and Robert Dowland talks about 'strings of a more fuller and larger sort than ordinary (which we call Gansars). These strings for the sizes of the great and small Meanes, are very good, but the trebles are not strong.'
A string of plaited construction would be very pliable and more elastic than a string of simple twisted form but would be less strong due to the extreme distortion of the fibres.

Strings of plaited construction were made by the catgut manufacturers in Britain during the 19th C. for use as sash cords and clockmaker's cords. These cords had to be very pliable in order to run over small diameter pulley wheels and were made from sheep's intestines.

It is possible, therefore, that "gansar" lute strings of the 16th C (and earlier) might have been of plaited construction to provide a better performance than simply twisted strings for lute second and third courses. In Capirola's time, at the beginning of the 16th C, these strings were made from sheep's gut as they may well have been in Dowland's time also. However, the possibility exists that they were later made from other, more uniform fibres than gut for the early 'ganzer' strings, like the small diameter strings, suffered because of the natural taper in the gut which affected their tuning . On this, the Capirola MS says 'Ma sapi che patis piu le corde sotil che le grose, et masime le corde da ganzer et altre, che non fa quelle da monaco ut supra'. The strings from'monaco' being more elastic than the ordinary type of lute string, did not suffer from this fault.

[Continued on p. 22]

FoMRHI Comm. 1394 John Downing

Catapult Cordage - PART 1, Manufacture and Properties

"They delight much in musicke, but chiefly in harps and clairschoes of their own fashion. The strings of the clairschoes are made of brass wire, and the strings of the harps, of sinews; which strings they strike with their nayles, growing long, or else with an instrument appointed for that use. They take great pleasure to decke their harps and clairschoes with silver and precious stones; the poore ones that cannot attayne hereunto, decke them with christall. They sing verses prettily compound, contayning prayses of valiant men. There is not almost any other argument, whereof their rhymes intreat. They speak the ancient French language altered a little". (Anon 1597 (1)).

The word 'sinew' meaning tendon, originated from Old English. During the Middle English period (1150 - 1475), it was also used as a term for a musical instrument string (2). While this word may have been used to describe strings made from a variety of materials such as silk or gut, it is apparent that strings (for plucked instruments at least) made from tendon fibre, were in use at the end of the 16th C. and may have been commonplace for many centuries before that time.

According to Diderot (3), ropes made from tendon fibre were extensively used by the ancients to power their machines of war such as seige catapults etc. - machines that, according to Ramelli (4), were still of military importance at the end of the 16th C.
The preparation and processing of tendon fibre to manufacture cordage is similar to that of flax in that the fibre must be mechanically separated by beating and combing before being spun and twisted into cord or rope. No doubt the manufacture of tendon fibre ropes was, therefore, a specialised branch of the rope making trade which may well have been, because of its military importance, a closely regulated and controlled operation.
No doubt, it is this trade that also provided the smaller diameter twines, cords or lines that were used for musical instruments.

By the middle of the 18th C., it is would appear that the manufacture of cordage from tendon fibre was an obsolete trade for Diderot does not include it in his description of the trades dealing with cordage manufacture. Instead, he describes the preparation of tendon fibre rope according to the accounts of a M.le compte d'Herouville, an entrepreneur who, through his researches and experiments had discovered how these ropes were originally made with a view to using them, because of their great strength and elasticity, in the suspension systems of horse drawn carriages.

The following translation summarises Diderot's commentary dealing with the manufacture of cordage from tendon fibre :-

Tendon cordage was extensively used by the ancients for their machines of war. They preferred sinews taken from deer or cattle and selected those tendons subject to the greatest stress and use such as the leg tendons of a stag or neck tendons of oxen. The ropes made by M. le compte d'Herouville used the latter material which was more readily available than the former from the Parisian abattoirs at that time.
The tendons were drawn in their entirety from the still warm carcass of the slaughtered animal.

The handling and storage of the tendons was critical. To prevent excessive hardening, their exposure to the sun was to be avoided. On the other hand, high humidity and freezing temperatures caused deterioration and weakening of the fibre.
The condition of the tendons at the time of working was also of importance for if too dry, the fibres would break and if too fresh, they would be too greasy. These two extremes were to be avoided.

In order to separate the fibres from the membrane, the tendon was beaten thoroughly with an iron hammer,weighing about half a pound, on a stone block with a polished surface measuring about eight to ten inches square. Prior to beating, the hardened ends of the tendon were cut off. The beating of the tendon was continued until the memmbrane was seen to be completely detached from the fibres.
The fibres were then separated from each other and the membrane by drawing a bundle of them through an iron comb furnished with eight to ten teeth set about a centimeter apart (six lignes).
The fineness of the processed fibre was dependant upon the thoroughness of the beating operation. Insufficient beating would result in broken and unseparated fibres during the combing process.

The prepared fibres were then spun, twisted and layed together like hemp cordage.

Before use, it was essential to preserve the cordage by soaking it in a greasy oil.

Tendon ropes were very elastic and very strong (17% stronger than a hemp rope of the same size).
Under load, these ropes would reduce in diameter in proportion to their extension and, after rupture, would return to their original dimensions in the unloaded state.

Diderot noted that this type of cordage was easily damaged by moisture which could largely be avoided by protecting ropes with a wrapping of animal skin. He also suggested that treatment of the fibres with a caustic solution (in the manner of gut strings), might serve to further improve their durability and increase their elasticity.

From Diderot's account, the following conclusions may be drawn about some of the characteristic features and properties of sinew instrument strings.
Sinew strings were "very strong". The strongest cords would have been made up from single lengths of tendon fibre which, if taken from a large animal, might be four or five feet or so in length.
They were "very elastic" - a property that would allow their use for larger diameter bass strings.
They were sold saturated in a presevative oil - presumably to prevent drying and hardening of the fibres and their subsequent loss of elasticity.
They were made by spinning and laying together the fibres in the same manner as cordage made from hemp. (A process necessary primarily to produce a coherent, uniform and smooth cylinder of fibres rather than a more elastic assembly). These small diameter strings would have been classified as twines in rope making terminology. In Britain, they may also have been called "lines" (from Old English originally meaning a spun linen thread but later used as a general term for small diameter cordage).

The oil treatment combined with the twined construction would likely have resulted in a string that was quite pliable - one that could be bound up in tight knots or bundles without damaging or otherwise weakening the string. These strings were easily damaged by moisture or damp conditions.
The fibres of the string could also be weakened by freezing temperatures during manufacture - a risk for strings manufactured during the Winter months in Europe.

Dowland (5) wrote "... we choose lute strings by the freshness or new making; which appears unto us by their cleere and oyliness, as they lye in the Boxe or bundle yet here we are often deceived, for Oyle at any time will make strings looke cleare and therefore this tricke is too commonly used to them when they are old ..... the string makers bring their best strings which were made in Summer to Frankford and Lypzig Martes. Contrarily at Easter they bring their Winter strings which are not so good."
Burwell (6) wrote that lute strings were "preserved in white paper dipped in oyle of Almonds or in a hogges bladder they endure no moisture nor any excess--ive heat .... but of the two moisture is the worst."
Mace (7) says that lute strings "may be very good when you buy them but spoiled in a quarter of an hour if they take any wet or moist air ... for moisture is the worst enemy of your strings."

If the oiling of lute strings made from sheep's intestines was practiced by the 17th C. string makers, it was not by the 19th C manufacturers for Heron Allen,writing about gut violin strings (8),informs us that "Some people wrap their spare strings in bladder or flannel moistened with oil ... a process which can only be described as 'horrid' ... the mess involved in putting on a new string is enough to make you touchy for the rest of the performance" and, concerning a recommendation to coat gut strings with almond oil after each performance "I do not know whether this has ever been done; it would certainly be quite impossible to play on strings so treated."
19th C string makers used olive oil and pounce to polish their strings after which they were lightly moistened with the oil before being thoroughly dried. They were not oily!
Either the 17th C makers were using a different kind of sheep's gut or process for instrument string manufacture or were using a material other than gut that required oil treatment.
There are other apparent differences between modern strings made from sheep's gut and lute strings of the 16th and 17th C that might indicate some lute strings at least were not made from sheep's gut. For example, it is clear from the iconography (9) that lute strings were made up in tightly bound hanks or knots - treatment that would surely damage the carefully coiled strings of today. The early strings were, therefore, much more pliable than modern strings. Furthermore, the performance of 17th C. lute bass strings was, by all accounts, equivalent to modern overspun strings (10). Mersenne (11) wrote that"...& que le son des grosses chordes de Luth est apperceu de l'oreille durant la sixiesme partie, ou le tiers d'une minute, c'est a dire pendent quel'artere du poux d'un homme sain, & sans emotion bat dix, ou vingt fois: ..." which I take to mean that the sound of the largest strings of the lute can be heard to last for between a sixth or a third of a minute, i.e. for the time it takes for the normal pulse of a healthy man at rest to beat ten or twenty times.
Burwell commented that " The lute makers have taken away that great string (i.e. the eleventh course) because the sound of it is too bigg and smothers the sound of the others."
As far as I know, such a performance cannot be achieved by well twisted

modern lute bass strings made from sheep's gut (I have no recent experience in using all gut basses on my lutes - I use nylon overspun basses), unless they have been loaded by overspinning with wire or other means. The alternative might have been to manufacture lute bass strings from a gut like material that was more elastic and denser than strings made from sheep's gut. Could such a material have been tendon fibre and were sinew strings used not only on Scottish harps at the end of the 16th C. but also on lutes and other plucked string instruments of the day?

Unlike some other early writers (12) who specified that lute strings were made from sheep's gut, neither Dowland nor Mace have anything to say about the material of construction of their strings. Mary Burwell, on the other hand, states that "The stringes are made from Sheepes & Catts gutte ..." Burwell was, therefore, aware that lute strings were made from two distinct kinds of material - the historically conventional sheep's gut and another material known as "catgut".

Notes:

1. Vide "Certayne Matters concerning the Realme of Scotland &c as they were Anno Domini 1597 - Lond.1603." from 'Lady of the Lake' Appendix note K by Sir Walter Scott, Adam & Charles Black, London 1893. See also 'The Irish and Highland Harps' p.140 Robert Bruce Armstrong, Edinburgh 1904.

2. Shorter Oxford Dictionary 1957.

3. 'Encyclopedie', Diderot & d'Alambert, Paris 1751 (from a photocopy of the original text kindly sent to me by Mimmo Peruffo)

4. See Comm. 1318. In Comm. 1351, Peruffo confirms that Ramelli did not specify the material of his catapult ropes - only the form of construction. Perhaps the material of construction of catapult ropes in Italy was common knowledge by the end of the 16th C?

5. 'A Varietie of Lute Lessons' Robert Dowland 1610 under 'For Chusing Lute-strings.'

6. 'The Burwell Lute Tutor' c1660 - 1672, facsimilie edition, Boethius Press.

7. 'Musick's Monument' Thomas Mace 1676, Chapter 6, p.66.

8 'Violin Making as it was and is' Heron-Allen 1885, p.208.

9. For example, see engravings of lute strings being tested for trueness in 'Musica Teutch' Hans Gerle , Nurnberg 1532 and in 'Harmonie Univer--selle' Marin Mersenne 1636, p.51 book 2, proposition 2 - Mimmo Peruffo describes the knots as being like bundles of shoe laces - an appropriate analogy.

10. See discussion between Eyler and Segerman on catlines, Lute Society of America, Newsletter May 1987, Vol.XXII, No. 2.

11. 'Harmonie Universelle' Marin Mersenne, Paris 1636, Book 3,proposition 5 p.167.

[Continued on p. 23]

Catapult Cordage - PART 2, More Speculation

" (The Highlanders) are exceedingly fond of music, and employ harps of a peculiar kind, some of which are strung with brass, and some with catgut. In playing they strike the wires either with a quill, or with their nails, suffered to grow long for the purpose; but their great ambition is to adorn their harps with great quantities of silver and gems, those who are too poor to afford jewels substituting crystals in their stead. Their songs are not inelegant, and, in general, celebrate the praises of brave men; their bards seldom choosing any other subject"(13).(G.Buchanan 1582)

The origins of the word 'catgut' meaning a musical instrument string are obscure but it appears to have come into general use around the end of the 16th C in the English language.
In Britain by the 19th C. gut string manufacturers were known as makers of catgut (14). They made not only musical instrument strings, but cordage such as Hatter's cord, Clockmaker's cord, sash cord, and rope for machinery drives and other industrial use. The industry used the treated intestines of animals as their raw material - primarily, but not exclusively, the gut of sheep. (Horse, ass or mule intestines were also used for the strongest ropes) While there are anecdotal historical references, in early times, to the use of more exotic intestinal fibres for instrument strings such as those of the wolf, the serpent or a young lion, there is, otherwise, no tradition in the trade for use of the intestines of a cat.
Heron-Allen wrote scornfully of a M.F.J.Fetis who had expressed wonderment that the ancient Egyptians had used the intestines of cats for their instru--ment strings when the animal was sacred to them. He also wrote "It is a matter of everyday occurence to hear people talk of fiddle strings as catgut - indeed a great writer alluded to a violinist as a man who 'stretches the bowels of a cat over a wooden box and rubs them with the tail of a horse'. However this may be, it is one of those carefully-persisted-in errors made on the 'lucus non lucendo' principal".
Clearly the word 'catgut' has no relationship to the feline animal and likely never did!

The word 'catline' seems also to come into use during the second half of the 16th C and ,again, its origins are obscure.
The earliest known reference to 'catline' is in the London Port Book where on 2nd of April 1568 there is an entry recording the import of '3 grs coarse catlins'.(15) - hardly a description that would fit finely made lute strings! Dowland (1610) and Mace (1676) also mention'catlines' as a kind of bass lute string.
While I have not seen the document myself, I understand that there is yet another reference to 'catlines' in the Talbot manuscript, c.1694 which is quoted as 'Bass Violin all Venice Catlines'.(16). Could there be a connection with Venice catlines and the description of the bass violin strings by Ramelli a hundred years earlier? (17)
To take this guessing game on word origins a little further, is it possible that 'catline' was an abbreviation of 'catapult line' i.e. a small diameter cord made from sinew fibre originally made as a component part for construct--ing catapult ropes of all sizes and later, in a more refined form, used for lute strings? Is it also possible that 'catline' and 'catgut' were one and the

same thing, 'catgut' or 'catapult gut' being a general term for sinew strings - a misnomer by the end of the 16th C perhaps because of its similarities to cordage made from sheep's gut?

While catapult rope making probably was originally part of the rope making trade, it is possible that, as the material lost its importance in military applications the manufacture could have been adopted, for a period, by gut string makers - the source of both gut and sinew fibre being the abattoir. The process of preparing and manufacturing sinew strings would appear to have been more complex and critical than that of a string made from sheep's gut - so the former would not only have been more expensive than gut strings but may have been less durable. They might, therefore, like any other product, only have been made to fill a market niche,lasting from the end of the 16th C. until about the end of the 17th C when cheaper and more reliable strings of the overspun type may have come into general use and the lute itself was in its final stages of decline. With little market demand for sinew strings its manufacture would have been abandoned and likely forgotten within a genera--tion by the trade - but the word 'catgut' could have been retained as a generic term for the products of the gut string makers of Britain - the word does, after all, have a jingoistic ring to it and easily rolls off the tongue! The word 'catline' did not fare so well and fell into disuse presumably coincident with the demise of this type of string again around the end of the 17th C.
By the middle of the 18th C. according to Diderot's account,the trade of sinew string manufacture was defunct and, apart from the efforts of M. le comte d'Herouville in Paris,was never again to be revived.

Notes:

13. Taken from a history of Scotland, George Buchanan, 1582, translation by James Aikman, vol i p.41 Edn 1827 ('The Irish and Highland Harps' R.B. Armstrong, Edinburgh 1904 p.140).
    The similarity between this passage and that quoted in the opening para--graph of PART 1 is obvious. I do not have access to Buchanan's history so cannot check if anything has been lost in the translation of the original.

14. 'Cyclopaedia of Useful Arts' C. Tomlinson, London 1854.

15. Comm. 138, note 1.

16. E. Segerman, L.S.A. Newsletter, May 1987, p.10.

17. See Comms. 1318, 1320, 1351, 1352.

[Continuation of Comm. 1393 from p. 16]

Capirola's solution was to rotate a string that would not hold its tuning i.e. to remove the string from the lute and refit it the opposite way round. (Were the elastic strings from 'monaco' later to be known as 'catlines'?)

The other possibility is that 'gansars' may have been an early type of loaded string with thin wires plaited into the cord as suggested in Comm. 1320.

Comm. 1396 A Correction to Comm. 1362 John Catch 30th August 1995

In Comm. 1362 I stated, correctly, that I could find no reference to overspun strings in copies of Playford's *Introduction to the Skill of Musick* dated 1655/1660/1662/1664/1666/1667 (at the Royal College of Music). Since then a reference in *The Purcell Companion* has led me to the following in an article by Michael Lowe in GSJ XXIX (1976) p. 24:

"At the back of *Introduction to the skill of Musick*, 1664 edn.: 'There is a late invention of Strings for the Basses of Viols or Violins, or Lutes, which sound much better and lowder than the common Gut strings, either under the Bow or Finger. It is Small wire twisted or gimp'd upon a gut string or upon silk. I have made tryal of both, but those upon Silk do hold best and give as good a sound...'".

Here is a disconcerting example of a 'primary source' in the ordinary sense being misleading. I should no doubt have remembered that "1664" on a 17th-C title-page would not have the definitive significance which we attach nowadays to an 'edition'. The preference for a silk core is interesting.

Another scrap of information; Mace says that he wrote his section on *The Lute made Easie* in the one year 1671/2 (p. 45). That was 12/13 years later than the Hartlib record and 7/8 years later than Playford, with four more years or so in which he could have amended his text had he wished. So, three possibilities: he did not know about covered strings; he disapproved, and refused even to mention the new-fangled gimmick; or (and we should not reject this possibility too hastily) are they included obscurely in his account? We tend to think of covered strings as a very remarkable invention, but our Restoration forebears may have seen them as a useful improvement which was briefly noted, quickly came into fairly wide use, and then taken for granted.

[Ed: Of relevance here is Comm 174]

[Continuation of Comm. 1394 from p 20]

Notes:

11. (cont). Mersenne was here referring to the strings of a ten course lute of 19 strings run from a single pegbox not the extended bass strings of the 21 string theorbo which he separately describes and illustrates.

12. For example in the Capirola Lute Book manuscript (c. 1530) is written "Sapi che le corde sono fate de bueli de castronj" or you know that the strings are made from wether gut.
From the Persian manuscript " Kanz al-tuhaf" c1350 (The Structure of the Arabian and Persian Lute in the Middle Ages' H.G.Farmer, Glasgow, Civic Press, 1939, p.95) -" (lute) Strings are made of either silk or gut.... As for gut strings, the gut from sheep is better than gut from goats. Some say that white sheep gut is better than black gut, but this is an exaggeration ...."
Note that these two references describe lutes that are strung with six courses or less, a less demanding application for the strings than would be later be required on the lutes of Dowland, Mersenne, Burwell and Mace.

Ephraim Segerman

The 'Clearness' of Early Gut

In Dowland's opening discussion of choosing strings, he wrote: 'Ordinarily ... wee choose *Lute-strings* by the freshness, or new making: the which appeares unto us by their cleer and oilinesse, as they lye in the Boxe or bundle; yet herein we are often deceived, for Oyle at any time will make strings looke cleere, and therefore this tricke is too too commonly used to them when they are old.' This was a general statement before he distinguished between different types of strings, and so should apply to Basses (4th course and lower) as well as Meanes (2nd and 3rd courses) and Trebles (1st course).

Following is: 'Now because Trebles are the principall strings wee neede to get, choose them of a faire and cleere whitish gray, or ash-colour'. At the end of this section on Treble strings is: 'then draw it hard betweene your hands, to try the strength, which done, hould it up againe against the light betweene your hands, and marke whether it be cleere as before; if it be not but looke muddie, as a browne thread, such strings are old, and have beene rubbed over with oyle to make them cleere.' This is followed by: 'This choosing of strings is not alone for Trebles, but also for small and great Meanes: greater strings though they be ould are better to be bourne withall, so the colour be good, but if they be fresh and new they will be cleere against the light, though their colour be blackish.'

In Comm.1255, I read 'greater strings' in the above passage as meaning 'greater than great Meanes', i.e. the Basses. In Comm. 1288 Peruffo argued that the meaning was the 'great Meanes', citing for support Dowland colon and lower-case g in 'greater'. In Comm. 1307 I showed why the colon and lower-case g did not support his position, and added a quote from Mace saying (without possible ambiguity) that for *Minikins* and *Venice-Catlins* 'the signs of *Goodness*, both the same; which are, first the *Clearness* of the string to the *Eye*, the *Smoothness*, and *Stiffness* to the *Finger*, and if they have *Those two [?] qualities*, dispute their *Goodness* no further.' Concerning the *Lyon* Strings, he wrote 'Their *Goodness* may be perceiv'd, as were the others'. 'Clearness' was thus a property of gut strings over the full range.

I was therefore disappointed to read in Comm. 1351: 'From Mace's and Dowland's treatises it is clear that the concept of "transparency" is only applied to treble and mid-range strings', especially since Peruffo (in the same Comm.) wrote 'we are trying to carry out a research based exclusively on historical elements'. The issue of 'clearness' is crucial in the question of whether loaded bass strings are historically possible.

Peruffo's disbelief of what Dowland and Mace wrote is understandable. If one twists up raw cleaned gut, dries it and polishes it up, there is little evidence of clearness, especially with thicker strings. But there was more to gut string making then. What Mersenne wrote (First Book, Prop. II) about making strings was: 'As soon as they have been stretched, they are twisted many times, and after they have been twisted enough, they are wiped off, rubbed, and polished, with both linen rags

and hemp strings, which are pressed all along upon them, as well as with an herb which is a species of mare's tail, called Shave-Grass, and finally they are cured so that they will be proper for musical instruments, or for the other things to which it is wished to apply them.' Then after some speculation about why the intestines of Italian sheep make better strings than French sheep, he wrote 'I am omitting the method by which it is necessary to oil them to conserve them, and many other circumstances that can be learned from the rope makers or those who sell the strings.'

As Dowland mentioned, oil makes gut strings translucent. In our experience, it confers considerable translucency to very thick high-twist and roped strings as well as thin ones. Mersenne's mentioning curing implies a process that takes time, and this could well involve the 'drying' (i.e. polymerisation) of a drying oil. I suspect that the opacity that develops in time involves the oil getting stiff enough so that when some surfaces between oil and gut shear (possibly from stresses induced by swelling under wet conditions), they can never fit together that closely again, leaving small voids that scatter light. Subsequent re-oiling of old strings fills these voids with fluid oil, some of which gets squeezed out on hard stretching.

We've measured the diffusion of water vapour through thin films of a variety of materials commonly available in the 16th and 17th centuries, and found that the material that was best as a moisture barrier was linseed oil. This is thus a likely candidate for the drying oil used. The oiling of gut strings for musical instruments was probably for better tuning stability and longevity (by resisting moisture rises in the gut that lower the tensile strength), and possibly reduced internal sound absorption.

The index of refraction of oils varies from 1.45 to 1.50. Since they clarify gut, the index of refraction of gut is not far from this range. To not destroy clarity, a loading material would have to have a similar index of refraction. Since index of refraction tends to vary the way density does, it is highly unlikely that a material that is dense enough to be useful for loading would allow clarity to remain in a gut string.

Dowland described new string colour as 'cleere whitish gray' for Trebles and 'cleere against the light' but otherwise 'blackish' for Basses. I can't imagine how grey or black pigments could be involved, and suspect that these were what we would describe as transparency when there is a dark background. He only mentioned the colour brown with respect to old strings. Surviving 19th century strings are very brown. They weren't originally since the guts were bleached with sulfur dioxide (from burning sulfur) before being twisted together (hydrogen peroxide is used for this nowadays). If we make a thick string from unbleached fresh cleaned gut, it is very brown. Treating it with linseed oil leaves it still more brown than blackish. Thus early string makers either bleached their gut or their oil treatment led to more transparency than linseed oil gives (or both). The latter could have happened if a resin was mixed with the linseed oil (making it a varnish), and it raised the index of refraction to more accurately match that of gut than linseed oil does. We need to explore this problem further. It is probably unfortunate that the more we can get the gut to look like nylon, the more authentic looking it seems it will be!

MORE ON GUT STRINGS

Mimmo Peruffo

Maria Rita Brondi (Il liuto e la chitarra, Torino 1926), reports an interesting procedure for self - making musical instrument strings, starting from the sinews of horse - backs. It is a recipe from Timotheo Rossello's book" Summa de secreti universali" printed in Venice, 1574 c (Biblioteca universitaria di Padova segn. 506 191/1-2) Which is a wide collection of recipes ranging from medicine to clothes dyeing to colinary art. Ivo Magherini has kindly translated the test "A far corde da instrumento": " Take the tendons (sinews) of a horse's back which you will have pounded in a cloth with a wooden mallet until they become soft, then have them twisted well together with animal glue. Then dried them and they will be very strong and good strings and they will been almost of silk..." (Libro sexto, cap. 123. P. 151). Although the twisting technique is not described in detail, the use of glue, recalling the method used to make silk - strings (in which case the binding mean is gum - arabic) leads us to exclude the usual rope and cable making procedures which, as well knows, do not require any gluing. This recipe remains altogheter confined within the do - it your self area. Although it is the first mention known to me of musical strings made of animal sinews.

John Downing (Comm. 1394) rightly points out that in the 16th and 17th centuries iconography, the strings look rather curly and the unused part out of the pegbox bundled up like if were a soft cord (or shoe - laces).
Modern plain gut strings, on the other hand, because of their stiffness, are as straight as pins and must be rolled up in circular shape, lest they get damaged. This present fashion of rolling up strings is already mentioned in Diderot's "Encyclopedie", c. 1760; in De Lalande (Voyage en Italie, Paris 1761 and more precisely in the description of string making in the work - shop of the neapolitan string - maker Angelucci) and in Griselini's "Dizionario", Venice 1770. The way a string can be rolled up gives an empirical suggestion of how stiff it may be and we can not exclude, during this "evolution phase" an influence coming from the spread of overspune bass strings.
From what can be inferred from historic documents from the second half of the 18th c. (See for ex. Crescenzio Ungar workshop's inventary, 1791: ..un ordegno da coprir corde di fil d'argento..."), overspune strings were not made by string - makers but by the lutemakers themselves, who could twist a metal wire around a normal plain gut string (the core). With the spreading of overspune strings, for the string - makers was no more necessary, I think, to know how to make strings of an extremely elastic and pliable nature (and, for the basses, of an increased specific weight). The new wound basses in fact covered perfectly the mid and low registers functions; thus the manufacturing processes unser went, an inevitable simplification expressed by the general increase of elastic modulus, clearly indicated by the necessity of changing the way of making them up: precisely by rolling them up in a circular shape than boundless, like in 17th century. It is true that the description of the manufacturing technique from the scanty documents from the 17th c. do not seem to be far off from the 18th is (See Jan Harwood's article:"String making in 17th c. Padua: an english traveller description", in "The lute", n. ?) never the less something still eludes us, since iconography shows, concretely, that the strings of the 16th ano 17th centuries were more pliable than our high twist ones and most probably than those produced in Diderot's and Angelucci's time, too. But in order to obtain strings with such characteristics it is not necessary to bother the sinews of animals, although the question certainly deserves serious investigation. Anyhow, having at our disposal a reel provided with two hooks (exactly like the one employed by the anonymous paduan string - maker described by Skippon), it is sufficient to modify the usual twisting technique of the fresh - gut strands (i.e. to make high - twist strings) in order to obtain a smooth string possessing the same characteristics shown in the 16th and 17th centuries' paints.

It should also be observed that in Diderot's and Griselini's tables the reels are provided with two hooks, but only one being used for the string being produced (both of them, on the other hand, being used by the paduan string - maker in the second half of the 17th c.).
We should furthermore consider the influence of the "chemical" products they employed in string manufacturing, such as "Potash" (Potassium carbonate), which was obtained by distempering in water the ashes from different plants (like vine) and used to de - grease the raw - material. On the other hand, potash is recommended, under its other name of "oil of tartar" by R. Dowland in his "Varietie" (Bring out from J.B. Besard instruction of the "Thesaurus Harmonicus, Colonia 1603), and by other recipe - books of the time, for softening the skin of the hands, and in it the gut - strands were kept for several days, before being twisted together, without pre - rinseing in running water. The fact is that this compound is still considered, at the beginning of the 19th c., to be the "secret" for obtaining elastic and pliable plain gut strings, as opposed to the function of final oiling so celebrated in Diderot's "Encyclopedie" (And which is, in fact, also important to the same purpose). Here is, for ex., a quote from Jaubert's "Dictionnaire", Lyon 1801, under Boyaudier, p. 319: "..on pense qu'il y a encore une leggere operation a' faire....elle consiste Vraisemblablement a' les frotter d'huile - pour les a doucir et les rendre encore plus souples: mais les Boyaudiers en font un mystere; ils assurent qu'ils ne se servent point d'huile..... mais ils y emploient des sels qui sont extraits de la lie de vin". (We think there is one more light operation to carry out,.... which consists of apparently rubbing them with oil in order to make them softer and more pliable: but the string makers make a secret of it, they assure they use no oil ... but employ some salt extracted from the lye of wine...).
Concerning the acoustical characteristics of such flexible strings it must be noted that they possess a higher brightness than their high twist equivalent and a higher longitudinal displacement .
Skippon, always about the paduan string maker, descaped ".... first they take the small guts of lambs, weathers, kinds, wolves (but no cats - guts)".
Now, why did skippon consider it necessary to point out to the reader that no cat's - gut was employed? Padua is some 90 km. away from Bologna, where the "Venice - Catlins" were produced: may be the manufacturing techniques in use in both cities were not unlike. Undoubtedly it could be very interesting to find - out what the old english string makers called the "Venice Catlins", but that research has been so far unsuccessful.

LIBRO SEXTO. 151

A far corde da inſtrumento. Cap. 123

Piglia li nerui della ſchiena del cauallo, liquali farai piſtare in un panno lino con un maglio di legno in ſino a tanto che ſiano uenute molle, dopoi falle filare polite, e filate lineali con colla forte & ſecca, e ſaranno corde fortiſſime & bone per inſtrumenti, & pareranno quaſi di ſeta.

A Power Law in the Stringing of Instruments with Varying String Length

The best stringing of an instrument takes into account both the varying resonance characteristic of the instrument and the expectations of the sound, look and feel by the experienced player. This is ideally done empirically by the player trying a range of heavinesses of the type chosen for each string, and choosing the heavyness that is most satisfying. The convenient measure of heaviness of a string uniformly made up of one material is its diameter, and that of a more complicated string is the equivalent diameter of a cylinder of some assumed string material that has the same weight per unit length as the composite string.

For instruments with few strings of the same material and construction, it is fine to do this for each string. But for instruments with many such strings, it is more efficient if this is done on a few evenly spaced strings and interpolating for the diameter (or ED, the equivalent diameter) of the strings inbetween. Effective interpolation can be done by guesswork, but it can usually be done more accurately by assuming that the string tension (T) is proportional to the vibrating string length (L) to some power (p), i.e:

$$T_2/T_1 = (L_2/L_1)^p$$

where 1 and 2 are any two strings, and the exponent p is the same no matter what the choice of the string pair is. The reason why this is probably more accurate is that long stretches of strings on instruments tend to conform to this law with a constant power. For instance, the power law with p about 0.6 fits the modern harp stringing just as well as the formula given in Comm. 1143, and the power law with p about 0.3 fits the top 4 or more octaves of most original harpsichord stringings in the Rose & Law handbook.

Special cases of such a power law are when p = 0 and p = 1. When p = 0 the tension is constant, independent of length. This happens most commonly when one fingers a string up and down a fingerboard. It also happens on some early keyboard instruments. When p = 1 the tension is proportional to the length. This is the tension-length principle that seems to apply to corresponding strings of different members of a family of plucked or bowed instruments with parallel nuts and bridges.

In practice, we deal with diameters and not tensions. If we eliminate tension by combining the power law with the Mersenne-Taylor law, for the same string material we get:

$$(D_2/D_1)^*(f_2/f_1) = (L_1/L_2)^{(1 - p/2)}$$

where the two empirically found strings are 1 and 2, and the ratio of f's is the ratio of frequencies characteristic of the interval between the two string pitches.

To do the interpolation algebraically, since we know everything except the exponent, we solve for it. We then put it back into the equation as a known quantity and exchange the new interpolated string with one of the original ones. We know the new string's f and L, so we solve for it's D.

It is much easier to do this using log-log graph paper. Multiply the D by the f of each of the empirically found strings. Don't worry about the sizes of numbers or the units but do not change units during the process. Shift the decimal point of the units along one axis of the log-log paper to cover the range of the D*f product, and similarly shift the decimal point of the units along the other axis to cover the range of L, and plot the two points. Draw a straight line between them. Read the interpolated product of D and f off the line where it corresponds with the interpolated L, and then divide by f to get the interpolated D.

On log-log paper, every factor of 10 in a variable is a cycle. The 4 octaves of uncovered modern harp strings cover a factor of about 6 in Df and about 10 in L, so 2x2 cycles paper will always do in this case. One can always multiply a variable by a constant before plotting, but then one must divide by that constant when reading off the graph. Judicious choice of the constant for each axis allows the use of 1x1 cycles paper in this case.

FoMRHI Comm. 1466

Mimmo Peruffo

More About gut strings

I would like to further contribute to the discussion about gut strings:
-Comm.1440 (Mace and overspun strings). I find myself in total agreement with Segerman's argumentation in his answer to J. Catch's comm.1396: we can exclude that the bass strings described by Mace (Lyons and deep red Pistoys) may have anything to do with overspune strings and it seems to me that he gives in no way any hints in that direction.
To support this argument we should pay particular attention to iconographical sources: the great absent from the various coments and **much richer**, in terms of quantity, than the exant historic written documentation.
May I stress the fact that iconography shows unequivocally and "objectively" (written documents express always, for better or worse, the author's personal opinion) through many examples from different European geographical areas, that the Lute had all-gut strings, and not only in Mace's time and Country, but also well beyond the end of the 17th century for a good part of the next one, as I tried to demonstrate, with arguments of an organological character, in my comm.1350.
In fact, it would be really interesting if we could find some pictorial evidence showing the use of overspune strings on the Lute, as so evidently happens for bowed instruments.

For the latter, the earliest iconographic examples known to me are G. A. Gabbiani's portraits of some musicians at the Medici's court in palazzo Pitti in Florence: one among them, dated 1685, stands out in particular (see the cover of the Nov. 1990 issue of Early Music) where it is possible to perfectly identify (because of its white colour) the Violin's 4th string, presumably overspun with silver wire. The remaining higher ones are dark yellow, the typical colour of natural gut.

The pictorial precision of paintings of musical subjects is certainly known to all and even surprising when we consider that in the portraits of some instruments it is possible to distinguish rather clearly even "dèmi filèe" (open wound) strings from close wound ones (see, for ex., the details of the viola da gamba in Forqueray's portrait).
The 4th, wound, strings of a Violin should be of a diameter comparable to the hipotetic wound bass strings of a Baroque Lute tuned in d-minor; therefore, if such were really the case, the latter should be noticeable exactly like the Violin's fourt, in the paintings of that time.

-Comm.1442 (Sinew strings...Yet again!). Somehow, J.Downing managed to convince me to try and experiment with the recipe for making strings with the sinews of horse's back (comm.1417); but here it must be made clear that is a procedure of an exquisitely domestic nature, just like all other recipes in Rossello's book (c.1574).
In others words, one things is the "professional" procedure followed by the string makers of the 17th c., another thing is the do-it-yourself recipe, which may well be totally forein to the real procedure used by the Italian (in this case) professional string makers.
For the instance, in the recipe book the d. i. y. methods suggested for dyeing clothes require dyes and dyeing techniques that often have nothing to do with the artisan's procedures normally employed.

That the strings obtainable through this recipe are not of the rope type can be inferred from a passage in the original ancient Venetian version where "...e filate lineali..." means "spun so as to obtain a smooth and uniform string".
On the other hand the typical wool spinning weel to be found in almost every household of the time allowed only simple twisting - no rope construction - of the fibers obtainable from the sinews of animals: hence the importance of employing glue as binder (in the recipe there is no mention of plastifying additives).

The reference to Italian string makers is no coincidence, since what the English called "Venice Catlins" was in fact manufactured <u>only in Italy</u>, in an area arround Bologna and Venice, from where they were shipped to England and, I suppose, to the rest of northern Europe (may I remind that also the compiler of the Burwell's Lute Tutor was English: underandable then his reference to the term "cats gutte" which finds no confirmation, together with the use of tendons or sinews to make harmonic strings, in any authentic French source of the time.
The research should then be preferably directed, in my opinion, towards the historical documentation coming from Italy.
The fact is, we do not know what Italian musicians and makers in the 17th century called the Catlins strings: what we managed to document so far is a certain specialization in the gut string production centre.
Thus the thicker strings came preferably from Florence (means Pistoia?) and Bologna, whereas the thinner ones from Rome and Naples.
In August 1617, for ex., the Florentine lutist Michelangelo Galilei wrote his brother Galileo from Munich asking him to send "four thick strings from Florence for his own needs and his pupils...".
In Alfonso II d'Este's expense list for the period 1587-97 we read: "...210 dozens thin strings sent from Rome to serve Music..." and "...denari 4 for four buckets of thick strings spe-

cially made in Florence..." (Elio Durante e Anna Martellotti: "Un decennio di spese musicali alla corte di Ferrara", Schena editore; Archivio segreto Estense, Camera Ducale, Registri dei mandati fattoriali).
In the ten years covered by the expense list, the associations "Rome" to thin strings and "Florence" or "Bologna" to thick ones are repeated many times.

The gut strings production centers in 17th century-Italy were actually much more numerous; summarily listed: Modena, Milan, L'Aquila, Rome, Naples, Pistoia, Perugia, Salle, Bolognano, Venice and, not least, Padua.
Padua is of rather particular importance for our investigation not only because of its proximity to Venice and the active presence there of lutemakers such as Venere and Railich, but especially because it was exactly there that the English traveller Skippon (c.1660-70) described **the only example known to us of the manufacturing process followed by an Italian string maker active in the area and at the time where Venice Catlins were produced.**

Now, the Paduan string maker employed **exlusively** the guts of animals (lambs, weathers, kinds, wolves) and not sinews or tendons.
Skippon was, and I stress that, an Englishman and, for us a very intereasting point, he felt obliged to point out to his readers (obviously English) that among the various sorts of gut employed by the string maker in question (who, I suppose, was also able to make, seen the area and period, what the English called Catlins) no "cats guts" were used.
The other Italian sources from the 1st half of the 17th century like the string makers' Statute in Rome and Naples (1642 and 1653/78: see at the end of this comm.) mention directly or indirectly the guts of lambs, certainly not tendons or sinews of any animals.

Skippon's remark to his readers deserves our attention.
In other words we would be tempted to think that the English at that time were somehow curious to know whether the term by which they (and I underline **they alone**) called those strings had any connection with the actual raw material employed by string makers of that region, the only ones who produced Catlins strings in the whole of Europe (the French, as we know, produced exlusively the Lyons basses: unfortunately we have no way of knowing whether the manufacturing technology may have been somehow similar).

A second interpretation key revolves around the fact that maybe Skippon meant to explain his readers that among the guts of the sundry animals used by the Paduan string maker "...no cats guts" are used (and here I might add: "...like we do in England...").
This interpretation would do justice to the question of English harp strings made of animal sinews, as reported by J.Downing (comm.1395) and which I believe rather unlikely since, apart from

the historical reference to such harp strings, it is well documented that England imported large quantities of musical strings from Italy and France; in other words it was not a producer country, at least not to the extent of covering its own market with any appreciable local production.
Curiously enough we find a remark on the subject in Virdung's "Musica Getutsch...", Basel 1511: "...all Lute strings must be of guts or entrails of sheep, although Boetius and other Musicians call them "nervos" as though they were made out of animal sinews...".
This source is about half a century earlier than the first mention of Catlins.

Kircher, in his "Musurgia Universalis", Rome 1650 (pp. 440 and 476) remarks that musical strings can be made of gut from ram, lamb, sheep, cat (!) and other animals, but the best are always those made of ovines, sheep and...felines (!).
Oxen and cow guts are too flaxid, while those of wolves are stronger.
To be noted that Kircher, on top of having had his book printed in Rome, where he mentions the number of single guts necessary to make up the strings for the five - string Violone or for the Lute he refers exlusively to the production of Roman string makers.
Thus the term "cats guts" used by Skippon to describe the strings produced in the city of Padua stringly indicates the type of animal gut employed rather than tendons or sinews, also in consideration of the animals he mentions in his list, where in a logical continuation of it the cat would be missing.

Concerning the question from Sakespeare I think it must be regarded purely as a poetical licence, maybe a recall to the famous mythological event of Orpheus tripping over an empty turtoise shell, thus causing the dried up "tendons" to vibrate; I have some doubts that Sakespeare may have been also an expert in stringmaking technology (which was, by the way, covered by secret in the guild; as is clear from the Roman and Neapolitan string makers' Statutes) of a Country, Italy, that was a month's a journey away by ship; but this is, of course, an unsupported opinion.
About the 2nd edition of the Oxford English Dictionary, allegedly mentioning overspune Lute strings (comm.1442, note 1) I shall directly verify the original text and its context before expressing an opinion.
The news that also in the 17th century gut strings (Minikins?) were sometimes varnished will certainly make modern string makers happy, me included.

Next summer I am planning to carry out a research through the archivial documents in Florence, Pistoia and Bologna; with a pinch of luck I hope I can find something useful to the continuation of our debate.

CHESVS, MARIA, ERASMVS.

A' 12. Marzo 1653. Nap.

Congregati l'infrascritti huomini dell'Arte di far corde di Leuto auanti il Sig.re Gioseppe Vulturale Eletto dal Fidelissimo Popolo, prauio ordine di d.o Sig.re cioè

Francesco Siuo.
Gioseppe della Moneca.
Antonio Siuo.
Gioseppe de: Magistro.
Gio: Iacouo Monetta, e
Berardino di Giouanne.

Hauendo considerato essi di detta Arte che dal ritrouarsi quella senza regola, e modo di viuere, non può riceuere augumento alcuno, anzi uà in dies deteriorandosi, e ne sono nati, e nascono altri inconuenienti; Per tanto acciò possa augumentarsi; & obuiarsi à detti inconuenienti, hanno conclusa, e stabilita la seguente Capitolatione, da roborarsi con il beneplacito della Maestà

Li consignarranno come sopra.

Cap. XIX. Della distributione delle Budelle fozastiere.

Di più si stabilisce, che venendo a Renia le budelle forastiere per lauorare, e li lepozoli, in tal caso dd.e budelle, e lepozoli si debbiano distribuire tra tutti ad'ognuno doze la sua zata parte, cioè, tanti per uno e non altramente, e le porzioni siano uguali.

Cap. XX. Delle parti assignate à Cordari.

E perche l'ognuno di d.i Cordari, che al presente sono, e saranno per l'auuenire sappia la parte che gli douza toccare, stabiliscono, che alle cinque Bouegghe in passato più vecchie siano date diece parte cioè.

Tibuzio Tutio parte diece p.e 10:
Piero Pollacchi parte diece p.e 10:
Fulvio Valenti parte diece p.e 10
Francesco Valenti parte diece p.e 10:
Pompeo e Doniaso Todeschi par diece p.e 10:
Michel Ang.o Tedesco part cuo p.e 8:
Santi de Santi parte sette p.e 7:
Seuser.o di Tonso parte cinque p.e 5:
Nicola Mazzino Nouizio che hà esercitato non so che anni p.e 4:
e queste siano sempre le parti, e non più

Cap. XXI. Chi debba succedere in caso di Morte d'alcun Mastro

Che venendo il caso che mancasse qualche Mastro delli sopra d'i vecchi dei Le dieci porzioni, in tal caso debba succe-

bers, I don't intend to go into detail here, though I cannot but be pleased that the use of the Ellis for measuring the pitch of non-European instruments is recommended, for I was the first to do so (in the Bate Collection Gamelan Handbook), though I am sorry that Bob Stuckey, who invented the Ellis, is not mentioned.

There is a full bibliography, where much detailed information on conservation and relative subjects can be found. There is also a section on resources which gives the full address, including phone, fax, and email, of each author, which very few authors have the courage to do. And finally an index.

I have gone into much more detail than I usually do in a review, simply because this book is of such importance. There are very few FoMRHI members who could not benefit from it – you don't have to be involved in a museum to handle historic instruments. As they say in the chapter on the maintenance of playing instruments, 'Period material now includes virtually all instruments not in current production.' This applies, too, just as much to outmoded 'early' instruments, even to your own models which have been superseded by improved ones, as it does to 1930s saxophones or 1960 synthesizers. All are part of the history of instruments. Nobody would play a Steinkopf cornett or crumhorn today, nor a Pleyel or a 'modern' harpsichord, but all are an essential part of our history.

At somewhere between £20 and £30, this book isn't expensive – in fact for the amount of information it includes it's a real bargain. As well as direct from CCI in Ottawa, it's probably also available from Tony Bingham, museum shops, etc. In case of any problems, you can email Christine Bradley at: cci-icc_publications@pch.gc.ca

FoMRHI Comm. 1567 John Downing

Pepys's Minikin

In Comm 1442, I made reference to an entry in the diary of Samuel Pepys concerning the use of a minikin string for angling - a quote that I now find was incomplete.

The diary of Pepys - covering the period from January 1659/1660 to May 1669 - was written in shorthand. One transcription of this work - deciphered by the Rev. John Smith in the early 19th C. - includes the following entry for March 18th 1667 :

'This day Mr Caesar told me a pretty experiment of his, of angling with a minikin, a gut string varnished over which keeps it from swelling and is beyond any hair for strength and smallness. The secret I like mightily!'

Did Pepys mean that Mr Caesar himself varnished over a minikin so that it might be used for fishing or was a minikin a gut string distinct from other gut strings by being varnished by the makers - perhaps because it was of such small diameter? And what is the diameter of a hair according to Pepys?

both his pupils made every detail the same? Clearly not, for one thing such identity is impossible and for another there are many other Bressan recorders which are quite different in such details. Did Bressan churn out blanks to the trade? Surely not, for the same reason. Did Urquhart do so, and finish and put his own VR-QVHART stamp on a few of them? Perhaps. Or was there 'a little man', sitting in a small backstreet workshop with a lathe, knocking them out for any maker who wishing to save time by starting with a shaped body and a pilot bore. To me this seems the answer. I remember just after the War, before Birmingham was flattened by the planners far more disastrously than the Luftwaffe had ever managed to do, that one could get parts for pretty well any machine or object one wished in one back alley or another. Little workshops everywhere. And I'd be willing to bet that the eighteenth century was not so different.

Whoever he was, he was a master craftsman with an unerring eye for beauty of shape and curve. Perhaps we should follow the example of the art historians who have to give a name to the illuminator of a manuscript or the painter of a masterpiece, and refer to him as the Master of the Bressan Recorder.

FoMRHI Comm. 1589 **'What Say You, Simon Catling?'** John Catch
(Romeo & Juliet, Act IV, Scene V)

There are three Catlings and two Catlins in my local telephone directory; it is not a particularly uncommon name. Sampling ten UK directories more or less at random I found:

64 Catlings; 40 Catlins; 3 Catlyns; 3 Cattlins: 3 Catlines.

These figures are consistent with the preferred spellings of the OED. Another significant point is that the large and ancient seaport of Bristol has 2 Catlins (only), while smaller inland towns of more recent growth have often many more (Barnsley, 13 Catlings; Rotherham, 7 Catlings).

Late 17th century English bass violins, and catlin highest pitches

Bass Violins

In Comm. 1574 Catch questions my deduction in *G.S.J.* XLVIII (1995) that the 'usual bass violin' mentioned by Talbot (c.1694) in connection with his description of Lewis's bass violin was the same as the bass violin that he provided measurements for. I will be glad to explain the logic of it, and while at it, take the evidence a bit further than I have previously in print. The measured bass violin had a string stop of 24.5 inches (62.2 cm). This was the Italian bass violin that Banchieri listed with a tuning an octave below the treble violin. According to Table 1 of Comm.1545, the possible string pitches in all-gut stringing for this string stop at a'=430 and 383 Hz is *C* to *f'* and *D* to *g'* respectively. All-gut stringing on bass violins was not universal at the time though, since Talbot mentioned that the lowest string on a bass violin or bass viol could be wound with metal. If such a wound string was used, the lowest pitch could be considerably lower.

The only tuning that Talbot offered for the bass violin, given in a section largely copied from Mersenne, was *BBb F c g*. That was the French bass violin which, according to Comm. 1545, would have had a string stop for this pitch range in all-gut stringing of at least 77 cm. That the French bass violin still used all-gut strings in 1742 is indicated by Prin's description of the string diameter of his trumpet marine (containing 60 guts, which implies a diameter of about 4.2 mm) as a little thicker than a '*basse*' 3rd and somewhat finer than a 4th. In *L'Encyclopédie* of the 1750's, the '*basse*' was the *basse de violon* tuned in 5ths upwards from *BBb*.

The French bass violin was played in the Royal violin band in Restoration England. Roger North (ed by Wilson, pp. 304 and 352), when writing around 1720 about the beginnings of public concerts in London in his youth, mentioned that 'There was a society of Gentlemen ... that used to meet often for consort after Babtist's [Lully's] manner; and falling into a weekly course, and performing exceeding well, with bass violins (a course instrument as it was then, which they used to hire), their friends and acquaintance were admitted, and by degrees as the fame of their meetings spread, ...'. Since these gentlemen had to hire the bass violins that were needed to play the French music (presumably hired from the Royal violin band), they did not own such instruments themselves.

This indicates that French bass violins were not the usual bass violins in England then. The only other bass violin we have evidence for is the type measured by Talbot. We still need to deduce how that instrument was tuned. One possibility is that, using a wound 4th string, the tuning was the same as the French bass violin, which was also the tuning Talbot reported. To find this out, we need to look at what Talbot wrote about Lewis's special bass violin:

Talbot wrote: 'Lewis has a Bass Violin (made for Lord Abergenny) which has 6 strings: its neck is somewhat shorter than that of the usual B. Violin to bear a pitch: he says the treble string is of the same sound and size with the 3rd of B. Violin (or B. Viol) it is louder than either. And tuned B. Viol way.'. Also on that page was: 'Bass violin all Venice Catlins.'.

This says that the 3rd strings of the usual bass violin and of the bass viol had the same 'sound and size'. We know that the pitch of the bass viol's 3rd string was *e* at what Mace called 'Consort Pitch' (at about a'=383 Hz). Talbot's Violin Treble had a string stop of 13 inches (33.0 cm), and Playford wrote that the *e''* highest string of the violin was tuned as high as it could go, so Table 1 of Comm. 1545 leads us to conclude that the pitch standard of the violin (and the rest of the violin band) was about a tone higher than that of the viols. Then the 3rd string pitch called *e* on the bass viol was called *d* on the bass violin. Thus the bass violin tuning was an octave below the violin, as Banchieri specified. It is likely that a wound 4th string was mainly used on the bass violin to use French bass violin tuning when people wanted

to play 'after Babtist's manner' without hiring the appropriate bass violin.

The neck length on Lewis's bass violin

We are considering an instrument called a 'bass violin' even though it was tuned like a bass viol. This most probably implies that it played with the violin band at its pitch standard. Its tuning at that standard was *D G c e a d'*. For each semitone (fret length) of neck shortening from the usual bass violin, the lowest pitch of the lowest catlin bass string rises by a semitone. A neck shortening of two fret lengths is as far as one can go because it brings the lowest acceptable pitch up from *C* to the lowest actual pitch of *D*. The shortest string stop of about 55 cm represents a maximum reduction of about 3 inches in the original 10 inch neck length of the usual bass violin.

String tensions

Since the string pitches and diameters were the same on the usual bass violin (with a 24.5 inch string stop) and the bass viol (with a 32 inch string stop), the ratio of the tensions of the two strings equals the inverse square of the ratio of string stops. Thus the string tension on the bass violin was 1.7 times that of the bass viol. A string of the same diameter was the first string of Lewis's bass violin and was tuned an octave higher. The ratio of tensions of strings of the same diameter between Lewis's (the 1st) and the usual bass violin (the 3rd) equals the square of: the ratio of frequencies (2/1) divided by the ratio of string stops (8/9 or a bit more). Thus the string tension on Lewis's bass violin 1st was up to 5.1 times that of the usual bass violin 3rd. No wonder Lewis's instrument was louder. The comparisons above just refer to individual strings, but the more that the stringing tended towards equal tension, the more the above gives a general indication of the relative string tensions on these instruments.

The highest pitch of catlins

The information from Praetorius used in Comm 1545 defined the highest pitch for a string stop (or the longest string stop for a pitch) for a low-twist highest string, and the lowest pitch for a string stop (or the shortest string stop for a pitch) of a catlin lowest string. Under investigation here now is the highest pitch for a string stop (or the longest string stop for a pitch) of a catlin.

Lewis's special bass violin gives us some information on this since all of the strings were supposed to be catlins. Assuming that the neck length was shortened so that the highest string catlin wouldn't break, and the lowest string was at or close to the lowest limit for a catlin, the pitch range for catlins was close to the pitch range of open strings on this instrument,.which is just two octaves. The total bowed range of instruments with catlin basses and low-twist treble strings was two octaves and a fourth. So the highest pitch of a catlin would have been about a fourth (5 semitones) lower than the highest pitch of a low-twist string at the same string stop.

Now let us consider other relevant evidence. Talbot indicated that the lowest two strings of the treble violin were catlins. The first string was as high as it could go, and the highest catlin was tuned a ninth (14 semitones) below it. So if the deduction from Lewis's bass violin is correct, the second string could easily have been a catlin as well as the 3rd and 4th. Why wasn't it?

Dowland had two categories of string for a lute: Great and Small. Venice Catlines were in the Great category. The highest-pitched Great string was on the 4th or Contratenor course, which was tuned a ninth (14 semitones) below the first course. Dowland did not write that the treble strings of the lute were tuned as high as they could go without breaking, but Robinson did. If they could go higher, the highest catline would be tuned even lower than the highest pitch of a low-twist gut string on the same string stop. Here again, if a catline could be tuned up to a fourth below the highest that a low-twist string could go, why were not catlines on the 2nd and 3rd courses of Dowland's lute as well?

Mace mentioned 3 sorts of strings: Minikins,Venice-Catlins and Lyons, with a 4th (seldom

available) called Pistoy Basses that were like thick Venice-Catlins. Minikins were for the high pitch range, Catlins for the middle pitch range, and Lyons and Pistoy Basses for the lowest range. The highest Catlins were on the 4th course, tuned a minor 7th (10 semitones) below the first and highest course. There is no statement that the highest string was as high as it could go. If the highest a catlin can go was only a 4th below the highest a low-twist gut string can go, why was the 3rd course of Mace's lute not also of catlins?

There are two obvious possibiliies for a solution of our problem. One is that the statement 'Bass Violin all Venice Catlins' was not strictly true. With the *d'* first string of stronger gut, we can have the neck shortening being to avoid breaking the *a* second string (a catlin) if the highest pitch a catlin can go was 10 semitones lower than that of a low-twist string. With the first two strings of stronger gut, and the 3rd string catlin as high as possible, this figure would be 15 semitones lower than a low-twist string.

The other obvious possibility is that catlins had variable highest pitches depending on how much twist was put into the rope construction of the gut. For the lowest strings and almost all others, maximum twist is usual today and probably would have been usual then. This is because, as the twist gets less than maximum twist, the advantages over high-twist gut of richness and focus in the sound rapidly disappears (as tensile strength increases). The only reason for making catlins of lower-than-maximum twist is that musicians want them for higher strings than usual because of the superior-sound reputation of lower catlins. We at NRI have a small but steady market for lower-twist catlin violin 2nds and bass viol 3rds, where the customers are willing to tolerate a particularly high rate of string breakage for an improvement in sound that few beside themselves can notice.

The second possibility is to be preferred because it does not assume an error in the evidence, as the 1st does. The conclusion then is that the highest pitch for maximum-twist catlins is usually about 14 semitones below that of low-twist gut, but lower-twist catlins could be tuned higher.

FoMRHI Comm. 1591 Ephraim Segerman

Catch's non-view on the construction of catlins

I think that Sherlock Holmes was supposed to have said that once you have eliminated all of the other possibilities, the remaining one, no matter how unbelievable, must be true. I was using this approach in Comm 1557. I also mentioned the direct evidence of rope construction from Ramielli. Yet in Comm 1574 Catch persists in promoting the idea that early bass gut strings were not of rope construction by claiming that there is not a shred of evidence for that construction of catlins. He does not try to defend any of the possibilities that I claimed to have eliminated. He does not try to offer any alternative type of string construction that could be consistent with the historical evidence. Nor does he try to debate the vast majority of the points I make. He appears just to be trying to undermine acceptance of the scholarship results.

This reminds me of the anarchists whose primary aim is to make current society break down because it is so terrible. They don't try to think about what type of society should replace it, but they believe that any different society that would emerge from the chaos they hope to create would have to be better than this one. Too often, this philosophy is just an excuse for indulgence in destructive behavior.

Catch is no anarchist, but I do believe that his objective here is to impede the acceptance of an advance of knowledge in this area by keeping the issue publicly controversial. Thereby he creates an excuse to pursue an agenda that is contrary to the results of good scholarship while still claiming to remain within its mantle. There is nothing wrong with being sceptical about a result of scholarship. That is a very good reason to pursue further scholarship that might lead to a more acceptable result being better. But promoting rejection of a valid result as 'wrong' or 'not proven to my satisfaction', without exploring any alternative, has no place in scholarly discourse.

BULLETIN SUPPLEMENT

Ephraim Segerman

Catline, *catlin* and *catling*

Any half-decent scholar abandons an hypothesis he or she had previously considered to best fit all the evidence, in favour of a new one that fits the evidence better, no matter how long he or she had considered the previous one best. *Catline*, *catlin* and *catling* were all pronounced the same in late 16th century England (i.e. they were homonyms), so they invited replacement of one by the other, initially in word play, and eventually in ambiguity. Thus *catling*, which originally meant a small cat, was sometimes used for the musical string, leading eventually to the term *catgut*. The abandoned hypothesis was that the primary origin of the string name *catline* was a nautical rope. The better hypothesis is that the origin of *catlin* was *Catalan*, since string names appear consistently to have been where they came from. This was all explained in Comms 1289 and 1483. The use of *catline* by Dowland was apparently a variant of *catlin* that could well have had a nautical association (*cat rope* transformed to *cat line* because it was too thin to be called a 'rope').

Bengt Lönnqvist has written, suggesting that the cat-o-nine-tails might possibly be involved in *catline* etymology. It was a 9-stranded whip, usually made by unravelling a 3x3 rope. He thinks that it would have been particularly effective if made from 9 catlines, like the similar Russian nagaika was made of sinews. It seems to me that a more probable *cat* association here is that the tails come off the cat, which is the handle that is not unravelled, and that could have been a piece of cat rope.

A neighbour, George Stoppani, a well-known Manchester maker of violin-family instruments, is interested in historical strings. He has been looking at some spare gut violin *d* strings found in cases that have been left in attics for most of this century. With a bit of a soak they can be easily unravelled, and one can see how they were made. He found most were of the expected high-twist construction, but surprisingly, he found some with 2-stranded and some with 3-stranded smooth catlin construction. It seems that the end of the availability of commercial catlin strings was not in the 18th century, as I had assumed. The construction was just not noticed any more.

Re 'nuts & bolts' Comm. 1469

Peter Forrester has written. He says: "I've since discovered a reference to an adjustable plane similar to my design, in Holtzapffel - a 'reglet' plane - though not toothed (reglets are part of the furniture used as white space in printing)".

Response to Jeremy's Comm 1582 (on tympany)

I apologise for misinterpreting Jeremy's request for information by assuming that he had an expectation about tympany usage that he did not have. I am happy that I was wrong and needn't have made the suggestion that I had. Nevertheless, I'm glad I provoked him to write Comm. 1582. Too often he saves his more important stuff for publication elsewhere (e.g. his excellent tabor-pipe one in *GSJ* L). This tympany problem was an interesting one, and I wanted to know what it was all about. I don't mind his pointing out my ignorance on the subject. His Comm. has reduced it.

Facts and speculations people

Most people think in terms of facts, which are knowledge, and speculations, which are not. They find my writings on scholarship annoying because they don't think the way I suggest. They present two problems for our field: Firstly, when a new theory conflicts with what they have in their 'facts' category, they can't give it a fair hearing, and if it deserves it, the support it should have. I'm still upset about the loss of Lawrence Wright from our field, largely because of the doubts about his gittern/citole work by the respected leaders. Secondly, when an unexpected new theory is offered that fits all of the available evidence, and has no apparent rival that does the same, they can still keep it in their 'speculations' category because they are not yet convinced, and so it does not get the respect it deserves. They should think about accepting that there is a category between facts (which are really secure) and speculations (for which there is no clear evidence). That is where special efforts need to be made to be objective and open-minded, to appreciate and encourage new ideas of value.

Indexes

Try not to be late in paying the subscription because there won't be room in the April mailing to include the January Q plus the Index volumes everyone else would have received by then.