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NEWSLETTER

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Good Gut Strings

Modern Criteria versus Historical

by Dmitry Badiarov

An idea of writing this article came[1] when I was working together with the string maker Mimmo Peruffo on the strings for my *violoncello da spalla*. The amount of simple and practical information on baroque gut was overwhelming. At the same time it was exactly this kind of information which is clearly unavailable in the more scientific articles on the history of gut strings. Thus, I am delighted to share my experience with the reader in this simple article.

Being a maker of historical violins I often face musicians arguing about the quality of gut strings. Universal opinion which emerges from their discussion reinforces the idea that good gut should be smooth and translucent. This is undoubtedly correct in the light of historical sources such as those of Galeazzi[2], Spohr[3], Maugine and Maigne[4], Labulaye-Savarez[5] and Hart[6]. However the question is how smooth and translucent should they be. Will the natural properties of gut suffice, or should it be not only smooth and translucent but also transparent like nylon? Should it be even smoother and more transparent than fiberglass?

We shall assess this problem by the comparison of historical and modern manufacturing techniques. These will be outlined in a simple manner. The aim of this article is not to give an accurate description of the manufacturing process, but to help string players to make correct conclusions about the attributes of good historical gut strings.

The *materia prima* of a string maker - gut – is sold by slaughterhouses in 6-7 meters long ribbons preserved with salt. The salted guts are consequently washed in water and degreased by soaking in different alkaline solutions. Soaking renders the gut softer and also produces desirable chemical reactions which facilitate removing impurities from the membrane[7]. Membrane is the part of the intestine which is used for making strings. Alkaline solution is essentially a potassium carbonate, which laymen usually call potash. Potash of the 17th-19th centuries was spoiled by the presence of ash, because it was obtained from washing vegetable ash in water. Modern string makers use a pure salt available from chemists. The salt reacts in exactly the same way as the ash-washed potash without the drawback of spoiling the gut.

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1 I am indebted to Mimmo Peruffo of Aquila Corde Armoniche S.a.s. for introducing me to the mysteries of baroque gut string making techniques and to Daniela Gaidano for her wise revisions of this article. I would like to express my deep gratitude to Richard Sutcliffe for proof-reading this article.

2 FRANCESCO GALEAZZI, *Elementi teorico-pratici di musica con un saggio sopra l'arte di suonare il violino*, (Pilucchi Cracas, Roma 1791).

3 LOUIS SPOHR, *Violinschule*, Original Ausgabe. (Wien, T. Haslinger, 1832).

4 JEAN-CARL MAUGIN - WALTER MAIGNE, *Nouveau manuel complet du luthier, 2nd edition*, (Roret, Paris 1869).

5 PHILIPPE SAVAREZ, "*Cordes pour tous les instruments de musique*", in CHARLES-P.-L. LABOULAYE, *Dictionnaire des arts et manufactures, 3rd edition, vol. I*, (Lacroix, Paris 1865).

6 GEORGE HART, *The violin: its famous makers and their imitators*, (Dulau and Co., London 1875).

7 DANIELA GAIDANO, *Manifattura odierna della corda in budello, Come sceglierla e riconoscerne la qualità*, unpublished manuscript article, (to be published in *Orfeo*, 2004).

Alkaline solutions can also contain certain amounts of roche alum[8] in order to stiffen the gut, when required. Nonetheless, the amount of alum has been carefully measured because it increases the density and fragility of the gut[9].

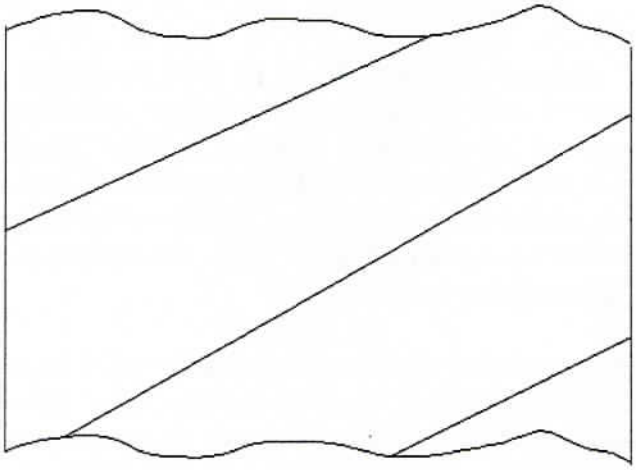

Fig.1 – Direction of the fibers in a low-twist string.

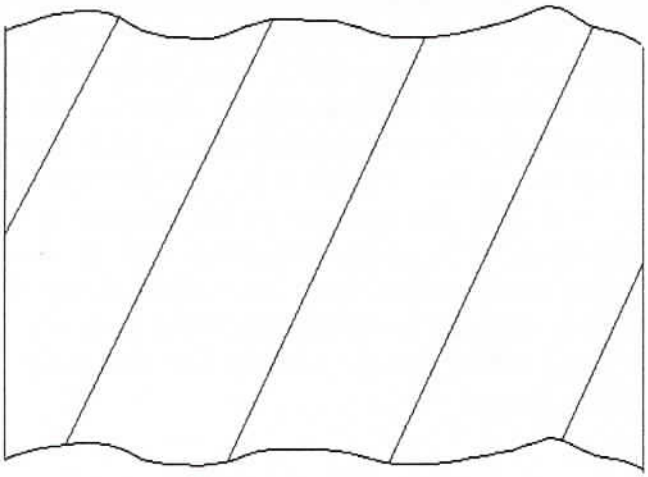

Fig.2 – Direction of the fibers in a high-twist string.

Gut stiffness can be altered by the amount of alum and by the degree of twisting. Low twist strings are stiff, and high twist are soft. The stiffer the string, the higher the tensile strength and the poorer the sonority, and vice versa. Baroque strings were considerably softer than most of the modern baroque strings. Therefore, baroque music in the 17th-18th centuries was possibly more sonorous than today.

The natural color of dried and unbleached gut is brown. The greyness of unused historical gut may originate from the presence of ash. The brownness originates from the natural oxidation of the gut itself and from the oils rubbed over the finished strings. Oxidized oils, such as olive or almond oils, tend to change its color from light yellow to dark red-brown, and this is a matter of time – the older the oil, the more oxidized and therefore the darker it is. In order to lighten the natural brown color of gut, string-makers in the mid 17th century bleached it in sulfur gas (SO_2). This technique is referred to by Skippon, and English traveler, who appears to have seen a Paduan string maker using it in 1670s[10].

Other references include De Lalande (see sources on page 23) in 1765, and a few of the other late 18th century methods including Diderot & d'Alembert[11]. Sulfur-bleached guts are colored from light to intense yellow, and this is what R. Dowland[12] communicates as the color of good gut strings.

Sulfur treatment is a dangerous operation, which is not diffused among modern string makers. Since its main goal is an aesthetic one, i.e. bleaching, modern makers replaced it with a much safer oxygenized water treatment, which brings the same aesthetic results without the burden of extra costs involved in the use of sulfur with its environmental, health and

8 PHILIP SKIPPON, *A journey thro' part of the Low-Countries, German, Italy and France*, A. & J. Churchill, A collection of voyages and travels, London, 1732, pp. 532-533; cited by Jan Woodfield in the Lute Society Bull, as referred to by MIMMO PERUFFO, *"The mystery of gut bass strings in the 16th and 17th centuries: The role of loaded-weighted gut"*, published in *Lute Society of America Quarterly*, (Vol. XXIX n. 2, May 1994, pp.5-14). Skippon describes his observation of a Paduan string maker using roche alum. The purpose of use of alum is not entirely clear though. From the middle ages it was used as a purifying agent. A source which talks about alum as a stiffener is that of Savarez in the 2nd half of the 20th century.

9 Over-stiffened strings loose their flexibility and can not be bend or bundled. Historical gut strings were flexible as this can be seen in a number of paintings.

10 PHILIP SKIPPON, *Op.cit.*

11 DIDEROT & D'ALEMBERT, *L'Encyclopédie, ou dictionnaire raisonné des sciences, des arts et des métiers,* 1751-1772, Paris.

12 ROBERT DOWLAND, *Varietie of lute lessons*, London, 1610.

other safety issues in modern times[13].

Fig.3 - Intestines in buckets of water at Aquila Corde Armoniche S.a.s.

Washed in water, degreased and softened in potash, the gut is ready for twisting, however, it first goes through a bleaching procedure in oxygenized water.

Without it the finished strings look intensely brown. However, over-bleaching results in colorless, nylon-like fragile strings with a higher tensile strength and a lower sonority.

Before twisting the guts are grouped by 3 to 4, 5 to 8 or more ribbons depending on the desired final diameter. These are tied up on both ends and stretched on a frame between an immobile hook and a twisting wheel. Such a wheel can be seen in Diderot & d'Alembert *Encyclopedie*.

Fig.4 - Mimmo Peruffo twisting strings at Aquila Corde Armoniche S.a.s.

Strings are twisted by hand using a manually powered wheel in repetitive twisting sessions of two, three or more times. This is done because the strings, as they dry, tend to loosen and a string maker will wake up several times at night to add more twists to each string. The number of twists is counted and accurately recorded in order to always produce identical quality of three types of strings: low, medium and high twist gut strings.

Twisted strings are left on the frame for a few days for thorough drying. As they dry, their diameter reduces and the color goes from opaque paper-white to the translucent yellow of bleached gut.

13 Webber affirms that "The action of sulphur on strings not only whitens them but *may* [my italics – D.B.] also strengthen them by forming cross-links in the collagen; it also *seems* [my italics – D.B.] to allow more twist to be added to the string". OLIVER WEBBER, *"Real Gut Strings: Some New Experiments in Historical Stringing"*, in *The Italian Viola da Gamba, Proceedings of the International Symposium on the Italian Viola da Gamba*, edited by Susan Orlando, (Angolo Manzoni, Torino, 2002). Peruffo writes: "...the sulphuration process, a millenary silk bleaching technique, also used by the anonymous Paduan string maker from the first half of the 17th century mentioned by Skippon, which seem to go well beyond the function of merely bleach [sic] the material, which is achieved in a matter of a few hours, any way. Instead the ancients kept this operation going for days, even; one could suppose a function similar to vulcanization of rubber, causing a loss of plastic properties in favour of elastic ones. A partial answer to this question *will perhaps come from the results of chemical tests under way* [my italics – D.B.], which aim at verifying weather [sic] sulphur can actually fix itself into the collagen, the basic stuff of gut, thus building up disulphide links between the proteid [sic] filaments", MIMMO PERUFFO, "*The Mystery...*", (see selected bibliography on page 23).

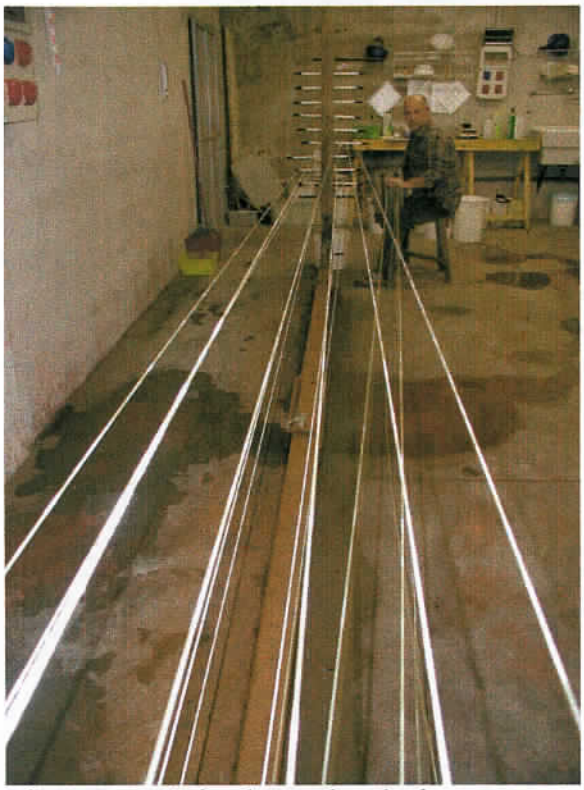

Fig.5 - Strings stretched and twisted on the frame.

The more ribbons of gut which constitute a string, the more regular the final diameter is. A common violin e"-string is made of three ribbons. Paganini in his letter[14] asked for e"-strings made of four ribbons instead of three, requesting them to be as thin as possible. An e"-string made of four thin ribbons instead of three is more regular in diameter, purer in sound and more durable. Paganini's "as thin as possible", i.e. 0.70mm ca[15], is by far thicker than what today's "baroque" violinists consider as thick.

When the strings are completely dry, they go through the process of rectification or polishing. These two terms should not be taken as synonymous! The process of the modern rectification sharply differs from the process of the baroque superficial polishing. Rectification is a modern technique, which modifies the diameter of an initial string which was never done in the baroque. Baroque superficial polishing does not modify the diameter but only smoothen the surface.

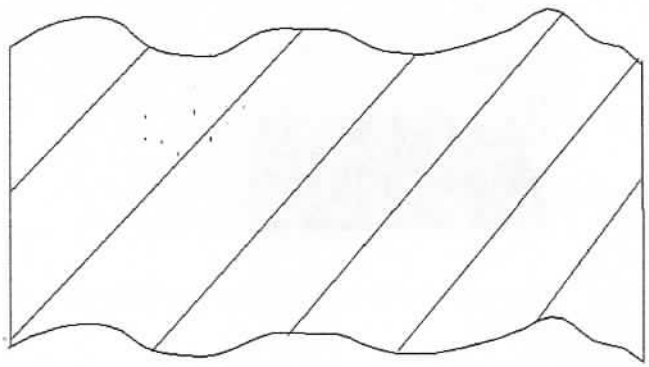

Fig.6 - Raw twisted and dried gut (section). The surface is rough.

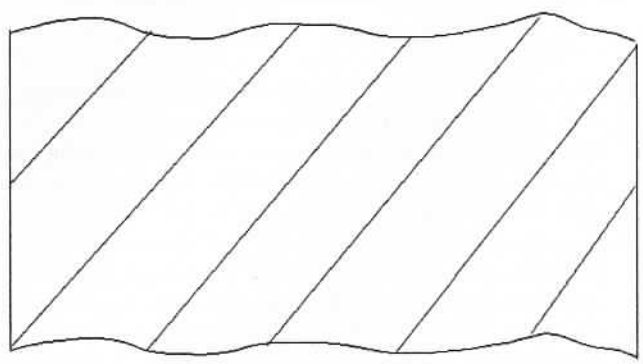

Fig.7 - Polished gut. The surface is smoother than it is in case with the raw gut. The fibers maximally preserved. This is what was called a smooth string in the 17th to the early 20th centuries.

14 Paganini wrote: "Ho bisogno di un favore: ponetevi tutta la cura, e la diligenza. Mi mancano i cantini. Io li desidero sottilissimi [] . Quantunque tanto sottili devono essere di 4 fila per resistere. Badate che la corda sia liscia, uguale, e ben tirata [] . Vi supplico di sorvegliare i fabbricanti e di far presto e bene." (I need a favour: to be done with care and solicitude. I am without chanterelles []. Even if they are very thin they must be made of four strands to endure. Make sure the string is smooth, even and well stretched [] . I beg you to keep an eye on the makers and do this soon and well) as quoted from MIMMO PERUFFO, « *Nicolo' Paganini and gut strings: the history of a happy find* », (this *Newsletter*, 2003, Vol.1, No.2).

15 MIMMO PERUFFO, *Op.cit.*

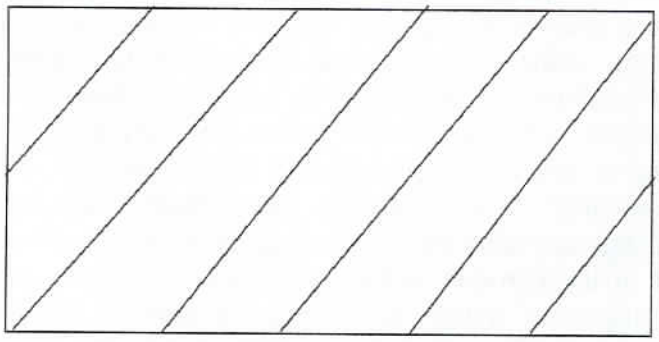

Fig.8 - Rectified gut. The surface is smooth, the fibers are cut off of the surface of the gut.

Why should a string need to be rectified or polished? Falseness occurs when the diameter is not equal, and the diameter of a raw just twisted string is often unequal. Here are typical measurements of a thoroughly dried raw gut string prior to rectification or polishing. Which of the two strings below is false?

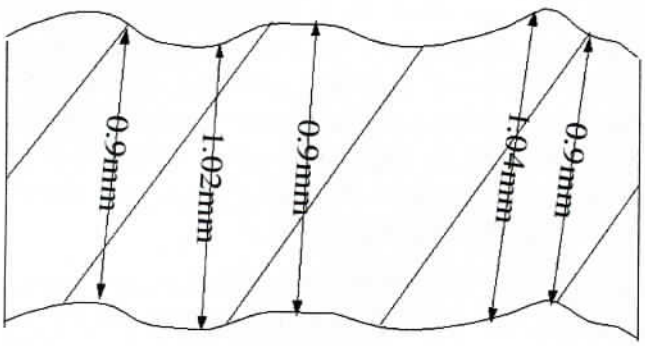

Fig.9 - Raw gut string typical measurements.

or

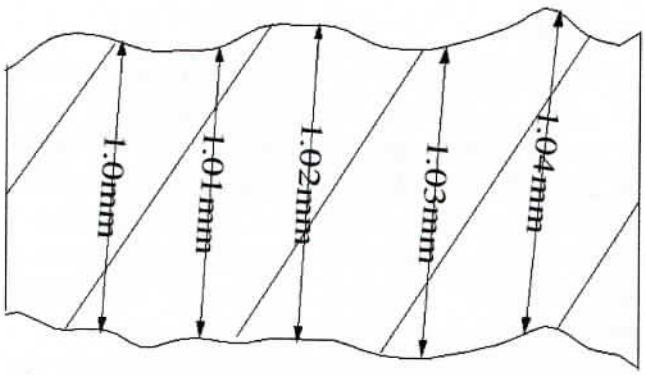

Fig.10 - Raw gut string typical measurements.

A string 1,00mm at one end and 1,04mm at another end (Fig. 10) is more likely to be false than an even string (Fig. 9), but it is not granted that it is false.

A string which has regularly alternating sections between ca.0,9mm and ca.1,04mm most likely is pure, but it is not granted either.

In both examples the average diameter is 1.02mm. Early string makers polished the strings by hand, rubbing them with various abrasive powders made from pumice stone or horse tail (*Genus Equisetum* – lat.)[16].

Polishing does not modify the diameter, thus a string such as in our example still preserves its average 1.02mm diameter and remain somewhat irregular by the modern standards. Furthermore, if the raw string is conical, it remains as such. Why did the early string makers never polish their strings until they became ideally smooth? There were two reasons. First, excessive hand polishing results in an oval and inevitably false string. Second, excessive polishing removes a substantial amount of the gut fibers. A string with destroyed superficial fibers is less resistant to wear, and has a tendency of being false from contamination from dust and hand perspiration. The aim of baroque polishing was an attempt to eliminate false strings and to smooth them, but since it did not modify the diameter, a number of strings remained false.

Modern rectification is done in order to smooth the surface, rendering it perfectly smooth and to sort out any false strings. Indeed, a string of a perfectly even diameter can not be false[17], furthermore, it yields better contact with the bow.

However, the main purpose of rectification is to produce all commercial gauges, such as in mm with a step of 0.02mm - 0.54-0.56-0.58-0.60 etc, or in Pirazzi-meters - 11, 11 ½, 12, 12 ½ etc. Such grades of diameters never existed in the baroque, as well as measurements in mm (as is still the case in some countries). What unit did they use instead? Quantity of strands or ribbons of guts, as Paganini did not ask for a *cantino* – the treble string - of 0.70mm, but for a *cantino* made of four strands.

16 Oliver Webber additionally mentions hemp rope as a polishing agent. "... Baroque string makers used a mild abrasive such as hemp rope or horse hair [sic!]", note 28 reads, "For example, Mersenne, *op.cit*, p.3,...One polishes them with both linen rags and hemp strings which are pressed all along upon them, as well as with a herb which is a species of horse-tail, which they call shave-grass..."; *op.cit.*

17 Although, even that can not be taken for granted.

Unfortunately rectification is not always aimed at obtaining a better compromise, but with the aim of obtaining the desired quantity of strings with a minimal effort. Such a purely commercial approach can be observed when a thick raw string is used to obtain a large range of diameters. This can be considerably improved by painstaking preparation of slightly thicker raw strings for each commercial diameter. The depth of rectification would be minimized, and the sonority of a finished string improved. Can baroque sonority and resistance be reproduced in the strings manufactured today? The answer is yes. The raw strings can undergo a process of semi-rectification, in which only a minimal amount of gut is removed with minimal or no damage of the gut fibers[18].

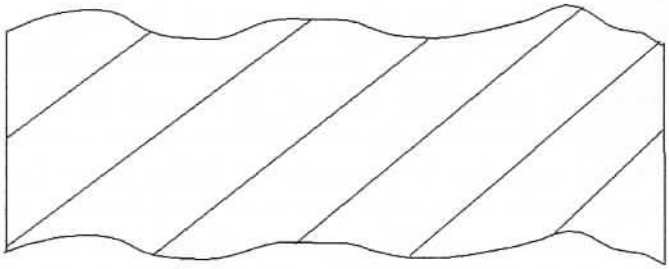

Fig.11 - Raw string. The surface is rough.

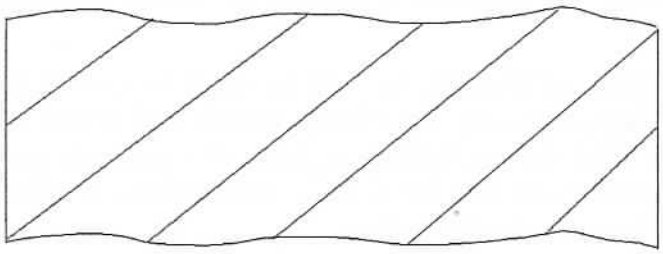

Fig.12 – Hand-polished string. The surface is smooth enough. The diameter and the conicity if any are basically unchanged. The risk of being false is high.

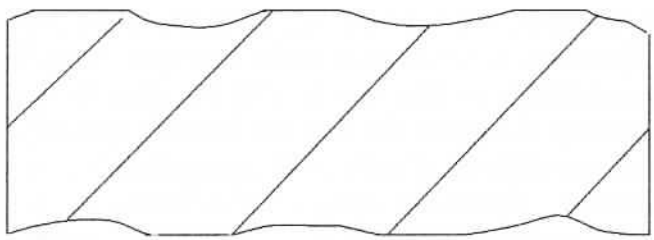

Fig.13 - Semi-rectified string. The surface is smooth enough. Average diameter is even, the risk of being false is minimized by the slight modification of the diameter. The look, feel and the sound of such a string is very similar to hand-polished baroque strings.

18 E-strings do not usually need any polishing: EDWARD HERON-ALLEN, *Violin-making as it was and is [...]*, (Ward, Lock & Co., London 1884), p. 212: "When dry they are polished, an operation which first or E strings are frequently allowed to go without".

Rectification is not a manual procedure. It is done on a precision rectifying machine without any risk of the string becoming oval, however there is a risk of breaking the gut fibers by cutting too deep. The problem with rectification is that the best part of the gut is removed, and together with it its baroque resonance and durability. Additionally, modern strings are often bleached to an extent never aimed at in the baroque and these extremely smooth and transparent nylon-like strings dominate today's market by their appearance. Why this is the case? There are a few reasons. Firstly, players believe that a difference of two hundredths of a millimeter may have some importance in such a material as gut, the diameter of which changes considerably depending on the humidity. This is why the market gauges vary with a step of 0.02mm. Secondly, modern string makers use rectification because modern players believe that good gut string are perfectly smooth and translucent. There is nothing wrong with this belief in itself, as it fits tightly into the historical ideals. The question is – how smooth and how translucent should they be, and should the sonority and durability of baroque guts be sacrificed to modern appearance. If the reader has the answer by now, or at least an impulse to come over his or her criteria regarding good baroque strings, than the aim of this article has been reached.

Once the idea of semi-rectified strings, the modern equivalent of hand-polished baroque strings, is accepted by modern baroque players, there would be just one step left towards a more historical view on the early strings, the abolishment of the modern micrometer.

Finished strings in the 17th-18th centuries were oiled with olive or almond oil. Modern baroque strings can be oiled or varnished. Varnish was introduced after the WWII, probably by Savarez, on the strings made for harps. Varnish covers an entire surface of string rendering it more resistant to the fingers and bow abrasion, however it makes the strings somewhat less responsive[19]. The purpose of varnishing, in short, is repairing the damage caused to the fibers by deep rectification. This can be seen on some modern baroque strings, over-bleached, over-stiffened with alum solutions and over-impregnated with varnish.

19 DANIELA GAIDANO, *Op.cit.*

Wound strings are made on a base of strings described above[20]. The process of winding a wire, namely a pure sterling silver or silver plated copper wire, is very simple. A piece of gut string of a desired length rotates in a winding machine, while the wire is being fed manually. Nonetheless, the modern and the baroque wound strings also sharply differ one from another. Firstly, the cores of baroque wound strings were always one order thicker than today. Modern violin g-strings contain a stiff e"-string inside. This is also the case with today's baroque g-strings, which commonly contain a thin e"-string as its core. Secondly, modern violin wound strings usually contain a layer of silk, plastic floss or another similar material between the gut and the wire.

Baroque, classical, and early romantic strings contained a core considerably thicker than modern strings. The core of historical g-strings was a soft medium-twist a'-string instead of a low-twist stiff modern e"-string[21]. Additionally, there was no intermediary layer of silk or plastic floss, a layer which was first referred to by Savarez only as late as in 1952[22]. Wound string with the correct core without an intermediary layer is more resonant, allowing a better blend with the sound of the plain guts, in short, a sound which is less modern and more historical[23].

In the year 2004 there is enough knowledge and craftsmanship to reproduce these better baroque strings. However, the demand for them should come from historically informed musicians. Will more historical strings come back?

Selected bibliography

- MIMMO PERUFFO, « *The Mystery of gut bass strings in the 16th and 17th centuries: The role of loaded-weighted gut* », in *Lute Society of America Quarterly*, Vol. XXIX n 2, May 1994, pp.5-14.

- MIMMO PERUFFO, « *Nicolo' Paganini and gut strings: the history of a happy find* », this Newsletter, 2003, vol.1, no.2.

- MIMMO PERUFFO, « Italian Violin Strings in the Eighteenth and Nineteenth Centuries, Typologies, Manufacturing Techniques and Principles of Stringing», *Recercare*, 1997, vol.9, pp.155-201.

- OLIVER WEBBER, « *Real Gut Strings: Some New Experiments in Historical Stringing,* » in *The Italian Viola da Gamba, Proceedings of the International Symposium on the Italian Viola da Gamba*, edited by Susan Orlando, (Agnolo Manzoni, Torino, 2002).

- DANIELA GAIDANO, « *Manifattura odierna della corda in budello, Come sceglierla e riconoscere la qualità* », MS (due to publication in *Orfeo*, 2004).

- EPHRAIM SEGERMANN, « Strings Through the Ages » (part 1), « Highly Strung » (part 2), « Deep Tensions » (part 3), *The Strad*, vol.99, 1173, 1175 and 1176, January, March and April 1989.

Selected primary sources (see appendix on page 24).

- DE LALANDE, J. J., *Voyage d'un François en Italie fait dans les annéees 1765 et 1766*, Venice, 1769.

- String maker Angelucci referred to by UBERTO ANDREA: L'antico abitato di Salle, vol. I, Tipografia dell'Abbazia, Casamari, n.d., p. 77: "Tra i cordari che lavoravano spessissimo fuori paese o vi tenevano negozio, si distinguevano Carlo Antonio Ruffini, Domenico Antonio De Dorninicis, Domenico Antonio Angelucci e Giosafatte Di Rocco" (Among the string makers who very often worked outside the town or had a shop there, those who stood out were Carlo Antonio Ruffini, Domenico Antonio De Dorninicis, Domenico Antonio Angelucci and Giosafatte Di Rocco). From the document Chieti, Archivio di Stato, Regia Udienza di Chieti, n. 77, Catasto di Salle del 1746, it would appear that the Angelucci, though working in Naples, were from the Abruzzi. Quoted from Mimmo Peruffo, « Italian Violin Strings... ».

- GIORDANO RICCATI, *Delle Corde ovvero fibre elastiche schediasmi fisico-matematici.* Bologna, (Stamp. di San Tommaso d'Aquino, 1767).

- GIOVANNI FOUCHETTI, *Méthode pour apprendre facilement à jouer de la mandoline a 4 et a 6 cordes [...]*, n.p., Paris (ca. 1770).

- BAUD C., *Observations sur les cordes a instrumens de musique, tant de boyau que soie; suivres d'une lettre du C. Gossed au C. Baud; et de l'extrait de procès verbal de l'Institut national, relatif à ce rapport,* Versailles, (Ph. D. Pierres, 1803).

- SEBASTIEN-ANDRÈ SIBIRE, *La chélonomie, ou Le parfait luthier*, (Sibire & Millet, Paris 1806).

- FILIPPO FODERÀ, MS violin method dated 1834 (see Peruffo, « Italian Violin Strings... ».

- LOUIS SPOHR; Violinschule [...], (Tobias Haslinger, Wien 1832).

- CHARLES-EDOUARD-JOSEPH DELEZENNE, *Experiences et observations sur les conies des instruments à archet*, (L. Danel, Lille 1853).

- PHILIPPE SAVARESSE: « *Cordes pour tous les instruments de musique* », in CHARLES-P.-L. LABOULAYE, *Dictionnaire des arts et manufactures*, 3rd edition, vol. I, (Lacroix, Paris 1865).

- MAUGIN ET MAIGNE, *Nouveau manuel complet du luthier ou traité pratique et raisonnéde la construction des instruments à cordes et à archet*, Paris, 1834/1869, (Reprint Inter-livres, Paris, 1987).

- GEORGE HART, *The violin: its famous makers and their imitators,* (Dulau and Co., London 1875), section 3: "Italian and other strings", pp. 46-7.

- WILLIAM HUGGINS, « *On the function of the sound-post and the proportional thickness of the strings on the violin* », Royal Society proceeding, XXXV 1883, pp. 241-8, 247.

- EDWARD HERON-ALLEN, *Violin-making as it was and is [...]*, (Ward, Lock & Co., London 1884).

20 As for the catlines, it will suffice to mention that they were wet-twist which allowed them to be smooth. Some of the modern catlines are dry-twist, and this is why they are obviously roped and not smooth.

21 FRANCESCO GALEAZZI, *op.cit.*, "Per fare un Cordone di Violino, si adoperà una seconda non molto grossa", (To make the 4th string (cordone) for a Violin, not very thick 2nd will be used [as its core]).

22 "Forino and Angeloni, in 1930 and 1923 respectively, do not mention any intermediary layer between the core and the wire" [my translation – D.B.]. D.Gaidano, *op.cit.*

23 It should be added that the flat wire found on certain strings was introduced only in the 20th century.

APPENDIX

Synoptic table of the string gauges from the eighteenth- and nineteenth-century sources[i]

Source	E	A	D
De Lalande/Angelucci ca. 1760 (a)	.70 mm	/	/
Riccati 1767 (b)	.70 mm	.90 mm	1.10 mm
piece of gut string (ca.1770 ?) (c)	.71 - .72 mm	/	/
Fouchetti ca. 1770	.70 mm	/	/
Baud ca. 1795 (d)	.70 mm	/	/
Sibire 1806 (e)	.70 mm / .73 mm	.98 / 1.03 mm	1.38 / 1.45 mm
Foderà 1834 (f)	.66 mm / .70 mm	.92 - 1.03 mm	1.15 - 1.19 mm
Sphor [sic] 1834 (g)	.72 mm	.92 mm	1.24 mm
Paganini ca. 1840	.71 [sic!] - .72 mm	.87 - .89 mm	1.15 - 1.16 mm
Delezenne 1853 (h)	.61 - .70 mm	.82 - .96 mm	1.02 - 1.39 mm
Laboulaye/Savaresse 1865 (i)	.70 mm	.89 mm	1.14 mm
Maugin and Maigne 1869 (l)	.63 mm	.89 mm	1.09 mm
Hart 1874 (m)	.65 / .72 / .73 mm	.84 / .89 / .90 mm	1.14 / 1.23 / 1.19 mm
Huggins/Ruffini 1883	.67 mm	.90 mm	1.17 mm
Bishopp 1884 (m)	.61 / .68 / .69 mm	.80 / .85 / .85 mm	1.08 / 1.16 / 1.19 mm
Heron-Allen 1890	.69 mm	.93 mm	1.22 mm
samples of E strings (c)	.66 - .68 mm	/	/
Aquila corde armoniche (n)	.62 mm	.79 mm	1.04 mm

(a) three guts = .70 mm.
(b) E = 6 grani; A = 10 grani; D = 15 grani; each string = 1.5 Venetian ft.
(c) very highly twisted strings
(d) silk string.
(e) for A = 415 / 435 Hz.
(f) 20/100 gauge = .70 mm.
(g) No. 18 mark on the gauge = .71 mm.
(h) commercial string-gauges.
(i) E = three guts; A = five guts; D = eight guts.
(l) weight of A = two times E string; weight of D = three times E string.
(m) light / small / thick.
(n) Aquila Corde Armoniche - baroque violin set, medium tension, 2003.

i MIMMO PERUFFO, *"Italian Violin Strings in the Eighteenth and Nineteenth Centuries: Typologies, Manufacturing Techniques and Principals of Stringing"*, quoted from an updated version of the original article in *Recercare* Vol. 9, 1997, pp.155-203; *http://www.aquilacorde.com/Violin%20strings%20and%20*stringings.htm, quotation date: 14th April, 2004.

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Mimmo Peruffo will deliver a seminar on historical strings for bowed instruments at *Koninklijk Conservatorium Brussel* on the 1st of June 2004 at 10:00. Address: Kleine Zavel, 5 1000 Brussels. For more information write to info@violadabraccio.com.

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