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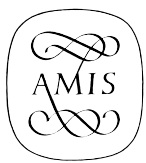

Catline Strings Revisited

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THE RECOGNITION THAT STRINGS play a pivotal role in the way earlier instruments sounded is of recent date. Only within the past fifteen years has any serious attention been given to the history of strings, their properties, and the possible effect of both, not only on instrument design but also on how composers and performers made use of the strings available at the time. Two pioneers in this area have been Djilda Abbott and Ephraim Segerman,[1] whose series of articles on such matters have shed considerable light on the subject, providing not only practical information for the performer on early instruments but also theoretical explanations for the organologist, musicologist, instrument maker, and interested observer.

Their approach has been to assume that demonstrable expansions in open-string range occurring from the fifteenth through the eighteenth centuries can be accounted for by technological innovations in string

I am indebted to Professor Neal Zaslaw of Cornell University, who read and commented on an early draft of this paper.

1. The more important of their numerous articles on this topic are: Djilda Abbott and Ephraim Segerman, "Strings in the 16th and 17th Centuries," *The Galpin Society Journal* 27 (1974): 48–73; Ephraim Segerman and Djilda Abbott, "Historical Background to the Strings used by Catgut-Scrapers," *The Catgut Acoustical Society Newsletter* no. 25 (May 1976): 24–26, also in *Fellowship of Makers and Restorers (Researchers) of Historical Instruments [FOMRHI] Bulletin and Communications* 3 (April 1976): 42–47; Djilda Abbott and Ephraim Segerman, "Gut Strings," *Early Music* 4 (1976): 430–37 (for an earlier, somewhat different version see *FOMRHI Communications 1* [November 1975]: 4–10); Ephraim Segerman and Djilda Abbott, "More on the History of Strings and Instruments," *The Catgut Acoustical Society Newsletter* no. 29 (May 1978): 29–33; Ephraim Segerman, "Some Thoughts on Gut String History before 1600," *FOMRHI Bulletin* 10 (January 1978): 22–23; Djilda Abbott and Eph Segerman, "Catline Strings," *Divisions* 1 (September 1978): 14–18 (for a somewhat earlier, less comprehensive version see *FOMRHI Quarterly* 12 [July 1978]: 26–29); Djilda Abbott and Ephraim Segerman, "On the Time of Invention of Overspun Strings," *FOMRHI Quarterly* 14 (January 1979): 24; Ephraim Segerman, "On the Number of Guts in a Gut String," *FOMRHI Quarterly* 22 (January 1981): 37–43; Djilda and Ephraim Segerman, "New Developments in Making Thick All-Gut Strings," *FOMRHI Quarterly* 27 (April 1982): 43–46; Ephraim Segerman, "Strings for the Violin Family," *FOMRHI Quarterly* 29 (October 1982): 36–49; Ephraim Segerman, "A Closer Look at Pitch Ranges of Gut Strings," *FOMRHI Quarterly* 40 (July 1985): 46–56; Ephraim Segerman, "More on Early Gut String Diameters," *FOMRHI Quarterly* 44 (July 1986): 67–69; and Ephraim Segerman, "Response to an Attack on Modern Catlines," *FOMRHI Quarterly* 46 (January 1987): 30–34.

design. Where historical evidence is lacking they have speculated, on the basis of their investigations of the physical properties of gut strings, as to what string makers might have done to accommodate these expansions in range. The purpose of the present discussion is to examine the evidence that supports their theory and to propose an alternative theory, drawing on the data they have amassed, that may more adequately explain the course of events.

Simply stated, this theory is that expansions in open-string range from 1500 to 1700 necessitated compromises in the quality of sound because of the limitations of the string material then available. Advances in string technology are, of course, part of the total picture; but so, too, are interrelationships between instrument size, tuning, and the manner in which the instrument is played. All four factors are, in fact, interdependent. The primary concern here will be historical developments for bowed instruments that used gut strings.

Abbott and Segerman argue that there were two known expansions in open-string range between 1500 and 1600, both in a downward direction, that must have required technological change in the manufacture of gut strings, the first occurring around 1500 on the lute and viol and consisting of the interval of a fourth or fifth, an expansion that must have been made possible by twisting a gut string more tightly than was previously the practice.[2] This is plausible, given the available evidence on manufacturing skills in the fourteenth through the eighteenth centuries,[3] since it accords with current information on what European makers of gut strings at the time might reasonably have thought of doing to make possible such an expansion in open-string range. That is, such a speculation is reasonable because it assumes no radical changes in what appear to be long-standing

2. Abbott and Segerman, "Strings in the 16th and 17th Centuries," 50–51; id., "Historical Background," 25; id., "Gut Strings," 431.

3. Early discussions of the methods used in making gut strings are few and far between. For one from the fourteenth century see Werner Bachmann, *The Origins of Bowing*, trans. Norma Deane (London: Oxford University Press, 1969), 81–82, or Jacques Handschin, "Aus der alten Musiktheorie," part 5, "Zur Instrumentenkunde," *Acta Musicologica* 16–17 (1944–45): 1–38; for the seventeenth century see Marin Mersenne, *Harmonie universelle* (Paris, 1636; facs. reprint, ed. François Lesure, Paris, 1975), bk. 3, pp. 3–4, or the English translation: Roger Chapman, *Harmonie universelle: The Books on Instruments* (The Hague: Nijhoff, 1957), 17–18; for the eighteenth century see Denis Diderot, ed., *Encyclopédie, ou dictionnaire raisonné des sciences, des arts, et des métiers* 4 (Paris, 1754): 205–7. This article was reproduced verbatim, including an identical illustration, in the *Encyclopédie alphabétique* (Paris, 1790), 6–9; the latter formed one part of the *Encyclopédie méthodique* of this date. I am indebted to Professor Zaslaw for this reference.

and essentially unchanging manufacturing processes throughout this period.[4]

Abbott and Segerman identify the second expansion in open-string range, also downward and again by a fourth or fifth, with the invention of a new kind of string, the *catline*.[5] They have argued that strings of this radically different design were to continue in use for 300 years—in fact, on some double basses right through the early years of the present century.[6] They indicate that such a string was hawser-laid (that is, that it consisted of two or three twisted strands of gut that were laid, i.e., twisted as in a hemp rope); that this roped string probably dates from before 1500[7] (developed, therefore, about the time that the first expansion in range occurred); and that it was in use on all gut-strung instruments before about 1660.[8] They adduce three pieces of evidence, which are reordered here to facilitate discussion:

1) "Mersenne mentions in several places that strings were made by 'Cordiers' " (Abbott and Segerman interpret this term to mean ropemakers).

2) In a later passage Mersenne seems to observe that "ropemakers sometimes twist the strings more in one place than in another. . . "

3) "The name 'Catline' most probably derives from a type of rope used on ships."[9]

4. Concerning the technology required to produce high-twist strings, Abbott and Segerman say ("Gut Strings," 430): "From the late 15th to the late 16th centuries, high-twist bass strings (as high as the straightforward traditional technology, as is still used today, would allow) offered a range up to two octaves and a tone."

5. Abbott and Segerman, "Strings in the 16th and 17th Centuries," 50.

6. Abbott and Segerman, "Catline Strings," 14. This article has on its first page the caption *article/advertisement,* and includes on its final page a price list for catline strings. The authors say of the hawser-laid strings they have developed, "At last we can experience the true gut bass sound of the late Renaissance, Baroque and early Classical periods." It is curious that they initially argued ("Historical Background," 25) that the technology required to produce catline strings disappeared in the eighteenth century, but two years later stated ("Catline Strings," 14) that it persisted into the early twentieth century. Yet another eight years later Segerman said ("More on Early Gut String Diameters," 69): "Gut strings with rope construction seem to have gone out of fashion during the eighteenth century. I've always wondered why."

7. Segerman, "Some Thoughts on Early Gut String History," 22.

8. Abbott and Segerman, "Catline Strings," 14.

9. Ibid. For the comments of another who is troubled by the suggestion that the catline was hawser-laid, see Frank Eyler, "The Modern 'Venice Catline' Reconsidered," *Lute Society of America Newsletter* vol. 21 no. 3 (August 1986): 3–4. For a rejoinder see Segerman, "Response to an Attack." See also Olav Henriksen, "Gut Bass Strings—What For?" and Herbert Myers, "Praetorius and Ropes," *Lute Society of America Newsletter* vol. 22 no. 4 (November 1987): 4.

Mersenne's References to Strings Made by Cordiers.

It is true enough that Mersenne uses the term *cordier* for the maker of gut strings, but it is also true that two seventeenth-century French dictionaries, one appearing near the beginning of the century, the other towards the end, define the term *cordier* so broadly as to suggest that throughout Mersenne's lifetime it applied to anyone who made cords or strings, regardless of the material or method of construction.[10] The first, from 1611[11], defines *cordier* as "a Roper, a Cord-maker." In the second, from 1694, the same term is defined as "artisan dont le mestier est de faire des cordes."[12] In the dictionary of 1611 the term *corde* was defined as "a cord, rope, halter; a twisted string, band, or line." In defining the same term the 1694 dictionary makes specific reference to gut (*boyau*), which would seem to confirm that *cordiers* worked with all sorts of materials: "Tortis ordinairement de chanvre. On en fait aussi de cotton, de laine, de soye, d'escoree d'arbres, de poil, de joue, de boyaux & autre matieres ployantes & flexibles."[13]

But there was another term for the maker of gut strings, *boyaudier,* in use in Paris at least as early as 1656 (eight years after Mersenne's death and almost forty years before the appearance of our second dictionary) and used by Diderot in his discussion of the craft in the 1750's. Its omission from both dictionaries—and from Mersenne's work—suggests that educated men at the time did not think it appropriate to include the word in a dictionary, perhaps because many considered the calling lowly or disgusting (in 1694 *boyaux* bring up the rear in the list of materials with which the *cordier* worked). But attitudes seem to have changed by the 1750's.

Let us pursue the matter of terminology a bit further. Evidence concerning guilds in Paris during the seventeenth century makes it clear that there were two that spun strings: one for those who worked with gut (*boyaudiers*), another for those who worked with other materials (*cordiers*). Since Mersenne describes in some detail the operations involved in making

10. Abbott and Segerman, "Catline Strings," 15, remark, "We do not know of a special word in French to distinguish a musical stringmaker from a ropemaker, and it is quite possible that the same craftsmen made both ropes and musical strings." Although Segerman seems to be aware of much that is given below on guild structure (see "Response to an Attack," 32) this evidence plays little part in his argument.

11. Randall Cotgrave, *A Dictionaire of the French and English Tongues* (London, 1611; facs. reprint, Columbia, S.C.: University of South Carolina Press, 1950).

12. *Le Dictionnaire de l'Académie Françoise* (Paris, 1694): 248.

13. Ibid., 247.

gut strings, we can presume that he had first-hand knowledge of the techniques of the Parisian workers in gut, even though in writing about them he may have followed a practice current among educated men of referring to them as *cordiers*.

The history of the *cordier* guild is the easier of the two to trace simply because it had been organized into what was known as a *corporation* in 1268 and was still identifiable as a separate guild until 1776.[14] According to the *Livre de Métiers* of 1268 members were authorized to work with hemp, flax, the bark of the Linden tree, animal hair, and silk.[15] And from the statutes of 1395 we know that they were authorized to manufacture large ropes, traces for carts and ploughs, halters, bridle harnesses, and ropes for small boats.[16] The lengthy description of their *métier* in the *Encyclopédie* indicates that in 1754 they were working primarily with hemp.[17] Not surprisingly, neither gut nor gut strings are ever mentioned, since it was the *boyaudier* who worked with gut.

It is impossible to trace the history of the *boyaudiers* before 1656, when they were first organized as a *corporation*.[18] But from this date they are identifiable as a separate guild until 1776. The fact that they had not been organized before 1656 must not be taken as an indication that they were not to be found in Paris in Mersenne's time. Like a variety of other artisans, such as *luthiers* and *jardiniers*, they had been unorganized for many years, subject only to police regulations rather than to a royal charter.[19] In fact, the earlier presence of the *boyaudiers* in Paris can be inferred from the organizing statutes, which state that they are to continue to occupy their present quarters.[20] From these statutes we also know that they were authorized to make *toutes sortes de cordes à boyau*, these strings being used on tennis rackets, musical instruments, and numeorus light machines.[21]

14. René de Lespinasse, *Les Métiers et corporations de la ville de Paris* 3 (Paris, 1897): 81–82.

15. Ibid.

16. Ibid., 82–84.

17. Vol. 4 (1754) p. 215.

18. Lespinasse, vol. 3, p. 519.

19. Étienne Martin Saint-Leon, *Histoire des corporations de métiers*, 4th ed. (Paris: Presses Universitaires de France, 1941), 200.

20. Lespinasse, 524.

21. See, e.g., the spinning wheel (*rouet*) used by the *boyaudier* for twisting gut strings illustrated in the *Encyclopédie* 14 (1765): 397–98; and the similar machine used by the *cordier* for spinning small hawser-laid ropes, also illustrated there in *Planches* 3 (1763) under *Corderie*, plate 2, fig. 1. Both machines are equipped with gut strings. Similar uses of gut strings by watchmakers, cutlers, and turners are cited under *catgut* in Ephraim Chambers, *A Supplement to Mr. Chambers's Cyclopedia or Universal Dictionary* (London, 1753). See also Lady Susi Jeans, "Manufacture of Strings in England in the Eighteenth Century," *The Galpin Society*

There is no indication that they ever worked with any material but gut.[22] We are thus led to conclude that *cordiers* and *boyaudiers* always worked with different materials, and that when Mersenne used the term *cordier* he was not necessarily referring to "ropemakers," and hence to hawser-laid strings.

But we are not through with the *boyaudier*. We must now consider whether he employed rope maker's techniques, producing gut strings that were hawser-laid. It is clear enough that the technology exists today to make such gut strings, and it is clear that rope makers used it with materials other than gut in eighteenth-century Paris; but it goes without saying that the fact that something was possible in the past is no indication that it was ever done.

We cannot at present supply a definitive answer, since Mersenne (our sole source of information on gut string making for the period in question) does not provide information in sufficient detail. Nor, perhaps, can we ever hope to, since Diderot's *Encyclopédie,* begun in the 1750's, appears to be the first systematic attempt to describe in detail the workings of such lowly crafts as that practiced by the *boyaudier*. But the extensive discussion on the making of gut strings in the *Encyclopédie,* which covers strings serving several purposes, gives no hint that the *boyaudier* was making hawser-laid strings in 1754, or that he ever had.[23] Only the spinning of a single strand is described and pictured, an operation that agrees with the description in Mersenne and in all other sources discussing the making of gut strings, both earlier and later.[24] In fact, Diderot's *boyaudier* was not even involved in overspinning gut strings with wire. This operation was carried out by the *luthier* in eighteenth-century Paris,[25] and by the button maker in

Journal 13 (1960): 90. She cites another English source of 1752 that confirms that workers in gut made strings "for musical instruments and other purposes."

22. According to the extensive descriptions of the two *métiers* in the *Encyclopédie,* except for the process of spinning (or twisting), the manufacturing operations performed by the *cordier* and *boyaudier* were very different, reflecting the fact that the former worked exclusively with vegetable matter (with one exception, animal hair), the latter solely with animal matter.

23. Vol. 4 (1754), pp. 205–7.

24. For earlier descriptions see n. 3 above; for several later ones see Edward Heron-Allen, *Violin-Making as It Was and Is* (London, 1889), 208–15; Alberto Bachmann, *An Encyclopedia of the Violin,* trans. Frederick Martens (London: D. Appleton and Co., 1925), 140–53; Willi Albrecht, "Vom Schafdarm zur Saite," *Zeitschrift für Instrumentenbau* 22 (August 15, 1940): 184–86; Oskar Schuster, "The Manufacture of Strings for Musical Instruments," *Journal of the Violin Society of America* 2 no. 4 (Fall 1976): 89–103.

25. Diderot, *Encyclopédie* 27 (1765): 319. The machine he used is pictured in fig. 33.

the south of Germany in the late seventeenth century.[26] Finally, the technology involved in manufacturing hawser-laid rope, as can be seen from the description and illustrations in the *Encyclopédie*,[27] requires additional skills and machinery far beyond those needed in spinning single strands, and would thus represent a marked departure from long-standing traditions for the gut string maker. Considering the simple mechanical skills required in his trade, such a development seems unlikely. Both terminological and technological evidence therefore suggests that gut string makers did not make hawser-laid gut strings.

Mersenne's Reference to the Cordiers' *Twisting of the Strings*

We turn now to the second piece of evidence and begin by giving here Chapman's translation of Mersenne's text for the entire paragraph from which this statement has been extracted.[28]

> It would be possible to deal here of many other difficulties which pertain to strings, but I have spoken of them elsewhere. I add only that the gut strings are even more subject to deformity and inequality than those of metal, and their fibres are more or less [thick],[29] and stronger or weaker in one place or the other; this can be easily proved by the differences that the Anatomists make between the intestines to which they give different names, as much for their dif-

26. Daniel Speer, *Grundrichtiger . . . Unterricht der Musicalischen Kunst* (Ulm, 1687), 91: "Es werden auch theils Brazen-Saiten mit silbernen oder küpffernem zarten Draht von den Knöpffmachern übersponnen . . . " Button makers were doubtless involved since they made buttons that were covered with very fine gold or silver wire, and their *Zunftrecht* (guild prerogative) assured that they were the only ones permitted to work with these materials. I am indebted to the late Professor Thomas Colby of Hamilton College for this observation.

27. Vol. 4 (1754), pp. 215–17, and *Planches* 3 (1763), *Corderie*, plates 1–5.

28. "L'on pourroit icy traiter de plusieurs autres difficultez qui appartiennent aux chordes, mais i'en ay parlé ailleurs. I'adjouste seulement que les chordes de boyau sont encore plus sujettes à la difformité, & à l'inegalité que celles de metal, d'autant que les boyaux, dont elles sont faictes, ont leurs me[m]branes, & leurs fibres plus ou moins espesses, & fortes, ou foibles dans vn lieu que dans l'autre, ce que l'on peut aysement prouuer par la differe[n]ce que les Anatomistes mettent entre les intestins, ausquels ils donnent des noms differents tant à raison de leurs differentes longueurs, & grosseurs, que pour d'autres raisons qu'ils apportent. Et puis les Cordiers tordent quelquefois dauantage les chordes dans vn lieu que dans vn autre, ou n'apportent pas vne égale diligence à toutes les parties, soit pour les frotter, pour les ratisser, pour les polir, & pour les conseruer, soit pour les autres circonstances, ausquelles on peut rapporter la fausseté des chordes qui vient le plus souuent de leur inegalité, ou de quelqu'autre semblable qualité." Mersenne, bk. 3, p. 4 (Chapman, 18–19).

29. In his introduction to the facsimile edition of Mersenne's *Harmonie universelle* (bk. 1, p. vii) Lesure explains that the edition is based on Mersenne's own copy and contains his inked-in corrections. As printed this word (which Chapman left untranslated) is *espoisse*. Mersenne corrected it to *espesse*. According to Cotgrave *espesse* means "thickened, compacted, closed hard together, ingrossed, made big;" the modern spelling of this word is

> fering length and thickness as for other reasons they cite. And then the [string makers][30] sometimes twist the strings more in one place than in another, or do not bring the same diligence to all the parts, be it for rubbing, for scraping, for polishing, for preserving them, or for other circumstances, among which can be mentioned the defect of the string that comes most often from their inequality or some other similar quality.

Here Mersenne discusses a variety of defects in gut strings, some of which result from the material used, others from methods of manufacture—defects with which he surely had personal experience as he carried out his various experiments. But it is clear from more recent accounts of string making that uneven twisting is not peculiar to strings that are hawser-laid, nor to Mersenne's time.[31] Thus it is highly improbable that the phrase "string makers sometimes twist the strings more in one place than in another" refers to hawser-laid strings.

But we should consider briefly another passage from Mersenne that bears on the matter of hawser-laid strings. This one concerns the methods of testing a string before it is mounted on an instrument. Mersenne states that there are three: by eye, hand, and ear. Our concern here is with his second method, that by hand, which Mersenne appears to view with some disdain; but we also include his final judgment on the matter, which involves testing by ear:[32]

> There are those who have no use at all for looking at them [i.e., strings], and are content with touching and handling them with the fingers, which they run and pass along the length of the string, and claim the string good and even when it has no unevenness at all and is like a [polished][33] cylinder. But if it occurs that

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épais. See Algirdas Julian Greimas, *Dictionnaire de l'ancien Français* (Paris: Larousse, 1969), 259.

30. In accordance with our discussion above concerning how Mersenne used the term *cordier*, and how it could be defined in 1611 and 1694, I have substituted "string maker" for "ropemaker."

31. See J. C. Maguin & W. Maigne, *Nouveau manual complet du luthier* (Paris, 1869), 234–35: "Il ne rest plus alors qu'à mettre le rouet en mouvement, et, pendant qu'il tourne, on promène les doigts sur la corde . . . , a fin d'empecher qu'il s'y forme des inégalités." See also Heron-Allen, 212, apparently based on the above account, which mentions that the process of spinning single-strand strings of gut required that the maker's fingers be "passed back and forth along it meanwhile to prevent the formation of inequalities in its length."

32. "Il y en a qui n'vsent point de la veue, & qui se contentent de les taster, & de les manier auec les doigts, qu'il font courir & couler tout au long de la chorde, & tiennent qu'elle est bonne & esgale, lors qu'ils n'y rencontrent point d'inesgalité [original: *dlinesgalité*], & qu'ils la trouuent comme vn Cylindre poly. Mais s'il arriue que ces deux sens se trompent, l'oreille juge de la bonté, ou de la fausseté de chaque chorde en dernier ressort." Mersenne, bk. 3, p. 51 (Chapman, 79–80).

33. Chapman does not translate *poly*, "polished."

these two senses are mistaken, the ear judges the goodness or the falseness of each string as the last resort.[34]

It should be noted that Mersenne's tests are intended for any string, regardless of design, and that all have the appearance of a polished cylinder, a description that hardly fits a hawser-laid string.

The Derivation of the Name "Catline"

The term "catline," spelled variously "katlyn," "catlin," "catteline," and "catling," is found in connection with gut strings only in English sources from 1553 through 1833[35]. In three of the fourteen known sources, all from the seventeenth century, it is called "Venice Catline."[36] The earliest of these three, John Dowland, identified the string with Bologna.[37]

In an early study[38] Abbott and Segerman indicated that catline derived its name from the flexible line or rope that was used in an operation on sailing ships called "catting the anchor," and that the gut string bearing this name must therefore have been hawser-laid. They later argued that though a hawser-laid gut string was developed before 1500, it was initially very expensive, and that only when Bolognese string makers found a way to bring down its cost, which they suggest occurred around 1570, did it come into widespread use.[39]

34. See n. 51 below, for Abbott and Segerman's argument concerning the smoothness of at least some of their hawser-laid strings.

35. See the *Oxford English Dictionary* (Oxford: Clarendon Press, 1933) 2:188. Additional references are as follows: *1553,* a book of household accounts, in Walter Woodfill, *Musicians in English Society* (Princeton, N.J.: Princeton University Press, 1953), 256; *1568,* in John Ward, "A Dowland Miscellany," *Journal of the Lute Society of America* 12 (July 1978): 116, 28, or Brian Dietz, ed., *The Port and Trade of Early Elizabethan London: Documents* ([Leicester:] London Record Society, 1972), 68; *1573,* another book of household accounts, in Woodfill, 263; *1610,* John Dowland, "Other Necessary Observations belonging to the Lute," in Robert Dowland, *Varietie of Lute Lessons* (London, 1610; facs. reprint, ed. Edgar Hunt, London: Schott and Co. Ltd., 1958), 14; *1660,* Guy Oldham, "Import and Export Duties on Musical Instruments in 1660," *The Galpin Society Journal* 9 (1956): 97–98; *1676,* Thomas Mace, *Musick's Monument* (London, 1676; facs. reprint, Paris: Éditions du CNRS, 1958), 65; and *ca. 1690,* Robert Donington, "James Talbot's Manuscript," *The Galpin Society Journal* 3 (1950): 30, or the slightly revised version of this article in *Chelys* 6 (1975–76): 46.

36. Dowland, Mace, and Talbot.

37. Dowland, 14.

38. Segerman and Abbott, "Historical Background," 25.

39. "It seems likely that some time around 1570 the string makers of Bologna learned how to reproduce the very true and elastic bass strings made in Munich and soon were making them in quantity at relatively low cost" (Segerman, "Some Thoughts on Gut String History," 22–23). There may be some support for a presumed decrease in price for the catline

We need not venture far into the treacherous waters of marine terminology, a daunting operation since mariners, at least in the West, have long had a language of their own that few landlubbers have understood without guidance.[40] It will suffice to note that a close study of marine terminology from the seventeenth through the nineteenth centuries shows that the term "catline" was never used for those lines required to cat an anchor, which suggests either that the writers were unfamiliar with the correct term or, just as likely, that the term "catline" had nothing to do with a sailing ship.[41]

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Let us assume for the moment that Venice catlines *were* hawser-laid strings, and that it was only because of this invention that a second downward expansion in open-string range became possible on instruments using gut strings. With a development of such critical importance to practicing musicians, one could reasonably expect to find at least one discussion by a Continental writer of the merits of such a string, by whatever name, at some point during the 330-odd years that the term catline was in use, particularly since the string was made in Bologna.[42] This is demonstrably the

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in England about this time, assuming that the term can be associated with Bologna as early as 1553—that is, some fifty-five years before Dowland made it explicit—and assuming that the figures we have are trustworthy, however bizarre they may seem. Towards the end of 1553 Sir Thomas Falconer (Woodfill, 256) recorded that he had "bought five dozen of 'Mynyken' lute strings at 2s.8d the dozen and one dozen 'Katlyns', 14s.4d." In December 1573, exactly twenty years later, the household accounts of Thomas Kytson (ibid., 263) record the following payment: "For two and a half dozen 'mynekins' and two dozen 'cattelins' for the viols, 7s.3d." Segerman asserts that there is evidence that "mynekins" were made in Munich ("Strings for the Violin Family," 37).

40. Few landsmen are at home with such terms as pintels, gudgions, breaming, fids, fetching home, warping, and housing, all taken from Captain John Smith's *Accidences, or the Pathway to Experience* (London, 1626). (These terms are also to be found in other seamen's manuals through at least the nineteenth century.) For this avowed reason Sir Henry Mainwaring prepared his *Seamen's Dictionary* (London, 1644) to acquaint those landsmen who went to sea as naval officers (principally second-born aristocratic sons with little hope of inheriting the family lands) with the language they must use with their crews.

41. To "cat an anchor" entailed the use of two lines, the first of which was variously called "cat," "cat-fall," "cat-back-rope," "cat-rope," or simply "rope"; the line referred to by Segerman and Abbott ("Historical Background," 25) had other names: "stopper," "ring-stopper," or "cat-head-stopper." In no case were any of these lines ever called simply "catline." Sources consulted, in addition to Smith and Mainwaring, are: Darcy Lever, *The Young Sea Officer's Sheet Anchor* (London, 1808); A. H. Alston, *Seamanship* (London, 1860); William Henry Smyth, *The Sailor's Word Book* (London, 1867).

42. Stephen Bonta, "From Violone to Violoncello: a Question of Strings?" this *Journal* 3 (1977): 96.

case with the wirewound string, a verifiable example of new string design; within a period of forty years it was accurately described by practicing musicians in England, France, Germany, and Italy[43], and pictured as early as 1681 in one Florentine painting.[44] Yet the fact remains that such an important and informed writer as Praetorius gives no evidence, either written or pictorial,[45] of such a hawser-laid string, by any name, and this in spite of the following considerations: (1) as a practicing musician with a demonstrable concern with developments in instrument design and string technology,[46] he could be expected to take a keen interest in any string of radically different design; (2) born in 1571, just as this new string is presumed to have been coming into widespread use, Praetorius could be expected to have witnessed at first hand the advantages it held over earlier strings or to have heard older musicians comment on them, and to have mentioned it in *Syntagma Musicum*; and (3) since Praetorius's *Syntagma* is replete with information on Italian performance practice and instruments of his time, one may assume that he would have been aware of developments in string technol-

43. For England, France, and Italy, see ibid., 96–97; Segerman, "Strings for the Violin Family," 45–46; and Claude Perrault, *Oeuvres de Physique*, 2nd ed., (Amsterdam, 1727), 224–25, cited in Abbott and Segerman, "On the Time of Invention of Overspun Strings" 24. (Abbott and Segerman observe that the first edition of Perrault's work, published in Paris, 1680, may contain an earlier reference to wirewound strings, though this has yet to be verified). For Germany, see Speer, 91.

44. The painting, by Antonio Domenico Gabbiani, is reproduced in Alan Kendall, *The World of Musical Instruments* (London: Hamlyn, 1972), 35. I am indebted to Professor John Hill for furnishing evidence on the date of Gabbiani's painting.

45. *Syntagma Musicum* 2 (Wolfenbüttel, 1619; facs. reprint, ed. Willibald Gurlitt, Kassel: Bärenreiter, 1958). Concerning the difficulty of using iconographic evidence to prove or disprove the existence of a hawser-laid string, Abbott and Segerman say ("Catline Strings," 16): "We expected the rope construction, if it was used, would be seen in detailed paintings showing instruments of the period. Now that we have made some Catlines we find that from a little distance away they look just like plain gut strings." I agree that pictorial evidence is inconclusive when it comes to the matter of hawser-laid strings—though not wirewound strings (see n. 44 above). Lines on the bias across the strings pictured in Praetorius and Mersenne that might be construed to indicate hawser-laid construction could just as easily be construed to show the twist normal in a single strand of gut.

46. See his references in *Syntagma Musicum*, (1) to the use of metal strings on the violin (vol. 2, p. 48) and (2) to a *musicus* in Prague who, "troubled by the great distance between the uppermost frets" on the *gar gross bass geig* or violone (and doubtless also by perennial problems with the bass string) had tried to solve the problem by employing the arrangement for strings used on the orpharion: dispensing with constant string length, the highest string on the instrument was about twenty-three centimeters shorter than the lowest, and the frets (and, we assume, the bridge and nut) were arranged as in a fan (vol. 2, p. 45)—a valiant attempt that proved unavailing, since there is no evidence that others ever adopted it.

ogy in Bologna. Yet nothing Praetorius says can be construed to refer to a hawser-laid string. And we have already seen that this is true for another contemporary, Mersenne.

Since the two expansions in range in question were both in a downward direction, it can be presumed that developments in bass-string technology made them possible. (It was of course the bass range that was to be so well served by wirewound strings later on.) But if it was the development of catlines that allowed the second of these expansions, one might expect to find this string generally recommended for the bass by English writers of the time. Such is not the case. In fact, only John Dowland recommends the catline as a bass string. The Burwell tutor, Mace, and Talbot all recommend French strings made in Lyons for this purpose, the first two for the lute, the last for the violin.[47] Furthermore, though both Mace and Talbot recommend Venice catlines, Mace does so solely for higher strings on the lute (the fourth and fifth), Talbot for all strings on the bass violin.[48] Questions abound: were all strings on Talbot's bass violin hawser-laid, even though, as Abbott and Segerman convincingly argue,[49] the increased elasticity furnished by a hawser-laid string is of the greatest importance for attaining lower pitches, those on the lower strings? And if hawser-laid construction reduced tensile strength, as they also say,[50] how could such a string be used for the treble, where strength, not flexibility, was the important property? Also, if Pistoy basses and Lyons strings were also hawser-laid, as they be-

47. Thurston Dart, "Miss Mary Burwell's Instruction Book for Lute," *The Galpin Society Journal* 11 (1958): 15; Mace, 65–66; Talbot, 30. These are not the only recommendations that Mace and Talbot make for bass strings.

48. Though Segerman suspects ("Strings for the Violin Family," 45) that catlines were used not on the bass violin Talbot describes, but rather on the six-stringed bass violin he mentions, one of the two instruments used catlines for *all* its strings.

49. "Strings in the 16th and 17th Centuries," 50; "Gut Strings," 431, 437; "Historical Background," 25. For more on the question of strings, see Stephen Bonta, "Further Thoughts on the History of Strings," *The Catgut Acoustical Society Newsletter* no. 26 (November 1976): 21–26.

50. Personal communication: "The use of gut as a string material for musical or other purposes (such as for archery bows) has always been mainly for its superior tensile strength. Roping gut increases flexibility but reduces tensile strength." The importance of tensile strength to treble strings is mentioned in Abbott and Segerman, "Gut Strings," 433: "It is possible by very careful polishing to get good uniformity, but the more polishing a string is subjected to, the more the microscopic fibres are broken down when they appear at the surface. This tends to lower the tensile strength and invites more breakage of higher strings." It will be remembered that ca. 1690 Talbot specified catlines for *all* strings of the bass violin, including the treble.

lieve, how is it that both Talbot and Mace refer to these strings as smooth?[51] And why does no English or continental writer of the time mention their radically different design? All the evidence thus far presented suggests that the invention of a hawser-laid string, whatever its name or wherever made, was unlikely.

* * *

If neither the catline nor any other string, however named, was hawser-laid, we are obliged to offer some other explanation of how the proposed second expansion in range could have been accommodated. In our search for an answer let us focus on the bass member of the violin family,[52] since it is known to have existed at least as early as the 1530's, and there is evidence of various sorts that its early history was both troubled and inextricably bound up with the kinds of strings then available.

One clue to a troubled history is the name violoncello, which can only be reckoned as bizarre. More complex etymologically than names for any other member of the violin family, it contains both superlative and diminutive suffixes, *-one* and *-ello*. Since the diminutive suffix was doubtless added last, the original name of the instrument must have been violone. Therefore, by reading the suffixes in reverse order we will retrace its history. Literally, it means "a small, large viola." The history of another, equally bizarre word in American English, "superette," suggests the same order of events; this term has been applied to the small neighborhood grocery store in an effort to compete with the everspreading and increasingly popular supermarket.

51. Talbot, 30: "3rd & 4th best be finest & smoothest Lyons." Mace, 65–66. Abbott and Segerman disregard Talbot's comment on smoothness when they say concerning Mace's remarks ("Catline Strings," 16): "We interpret this as implying that Lyons strings (which of course also had rope construction) were polished very little and that Pistoy Basses and Venice Catlines at this time were polished so extensively that close examination was required to discern the original construction." In "Response to an Attack," 31, Segerman adds: "So what we produce now under the name of 'catline' would be better called 'Lyons.' " By "Pistoy" Mace probably refers to Pistoia, a town just seventy kilometers distant from Bologna, across the Apennines.

52. Evidence bearing on the early history of the bass violin is given in Bonta, "Further Thoughts on the History of Strings", 21–26; id., "From Violone to Violoncello: a Question of Strings," 64–99; id., "Terminology for the Bass Violin in Seventeenth-Century Italy," this *Journal* 4 (1978): 5–42; id., "Corelli's Heritage: The Early Bass Violin in Italy," *Atti del quarto congresso di studi Corelliani* (forthcoming).

The order of suffixes in the term *violoncello* supplies another clue in that it confirms what we already know about the early history of the bass violin, namely, that all the earliest bass violins have been cut down in size,[53] effectively converting a violone into a violoncello. Such a drastic operation might suggest that early makers of larger sizes like the Amati were inept when it came to making such an instrument. But it could equally well suggest that there was some other reason concerned with strings, which vanished with the development of the wirewound string.

Another clue is the fact that there appear to have been three sizes of bass violins in use in Italy between the 1550's and the 1660's, with two groups of tunings. The fact that both smallest and largest sizes coexisted for more than a century suggests that none of the three, regardless of tuning, proved entirely satisfactory. The smallest, identifiable as early as the 1530's, appears to have had a string stop (i.e., a sounding string length from nut to bridge) of about sixty centimeters. Tuned a fourth or fifth higher than both later sizes of the instrument, it served the bass register less well than even the tenor viol or seven-course lute of its time. The largest, in existence as early as the 1550's, must have had a string stop of seventy-four centimeters at most. The middle size, first identifiable in the 1630's, probably had a string stop close to that of the present-day violoncello, that is, some sixty-eight centimeters. The strings available throughout these years probably account for such a series of sizes.

One more indication that the early history of the bass violin was troubled is found in Italian prints of music. Most prints of sacred music from 1615 to 1640 that specify the violin as the treble instrument call for either a bass wind instrument or an unspecified bass instrument rather than the violone.[54]

Yet another clue, our final one, is the fact that the term violoncello appeared within a year of the first known mention of wirewound strings, and that both events can be traced to Bologna, a city known for its strings, not its instruments. And it was only with the invention of the wirewound string that the development of a virtuosic solo repertory for the bass violin, as a violoncello, began in earnest.

53. W. Henry Hill et al., *Antonio Stradivari* (London: William E. Hill and Sons, 1902), 297: "We are only able to give the approximate dimensions of the Violoncello as made by the successive generations of the Amatis, as no example is known to us, the proportions of which have not been diminished."

54. Bonta, "From Violone to Violoncello," 68.

As we turn next to a consideration of what determines the size of a bass violin, our primary focus will be the largest size, that is, the one with a string stop of seventy-four centimeters. In so doing, we must bear in mind the obvious but easily overlooked fact that the size of any instrument results from a number of compromises, often painfully achieved, between the conflicting and perhaps even mutually irreconcilable requirements of its various components. With bowed string instruments there are five different factors that must be taken into account in determining its size: (1) the limits of the human body, (2) the design and physical properties of the string used, (3) the manner of playing the instrument, (4) the uses made of the instrument, and (5) the body resonances of the instrument.

In order to be useable in virtuosic passagework, any instrument must, of course, be small enough so that the reach of the arms and fingers will be comfortable; a limit is thus set both on its body size and on the length of string that can be used. On the other hand, the bottom string must be long enough to produce a useable sound, and this will affect the uses made of an instrument. And the body size of any bass instrument must be large enough to ensure that Helmholtz and wood resonances will in some purposeful way reinforce the tunings used.[55] But the most important constraints, at least until the 1660's, appear to have been the first four: the necessity to maintain human scale, the fact that these instruments were bowed rather than plucked, the design and physical properties of the strings, and the uses made of the instrument.

The use of a bow necessitates having strings that are all of the same length. If this were not so the performer would be forced to change the span of the left hand in moving from string to string in order to maintain proper intonation—and this on an instrument without frets. Similarly, bow position relative to the bridge would have to be shifted in order to maintain the same dynamic level and tone quality. Hence one variable in Mersenne's law on vibrating strings, length, is unavailable in attempts to accommodate strings whose normal tunings must span the interval of a thirteenth. If the bottom string of the largest size of bass violin, that with a string stop of seventy-four centimeters, was made of a single twisted strand of gut, as the available evidence suggests it always was, there were therefore only two

55. See the discussion of this and other matters pertaining to the physical properties of the violin family in Carleen Hutchins, "The Physics of Violins," *Scientific American* 207 (November 1962), 83–88, reprinted in Carleen Hutchins, ed., *Musical Acoustics*, part 1: *Violin Family Components* (Stroudsburg, Pa.: Dowden, Hutchinson and Ross, 1975), 17–21.

ways in which it could be made to produce the proper pitch: it had to be either longer or thicker than the present-day wirewound string.[56]

Increasing the length of bass strings is of course the solution adopted on the long-necked chittarone and theorbo; but so far as we know, such a solution was never tried on a bowed instrument. If the length of strings on a bass violin was increased in order to accommodate the bass, one ran the risk of exceeding the reach of the fingers. On an instrument tuned in fifths, the left hand must be able to span a major third easily if one is to play a simple scale without changing position. This is of course the reason the contrabass is tuned in fourths: with its longer strings, the left hand spans only a major second. The fact that all three bowed bass instruments pictured by Praetorius (*bass Geig da braccio,* bass viola da gamba, and viola bastarda)[57] have the same string stop, seventy-four centimeters, suggests that this is as long as instrument makers of his time *dared* make strings for bass instruments, especially for those that were fretless and tuned in fifths.[58]

If, on the other hand, strings were made shorter for the sake of the span of the fingers, this meant that they had to be thicker in order to achieve the pitch desired. But the thicker the string, the more it suffers from inharmonicity, a decided drop-off in upper partials, difficulties in intonation, and the necessity for a much greater effort with the bow.[59] Here is the dilemma that faced instrument and string makers of the time—a dilemma that is succinctly summarized by Abbott and Segerman:

> If we used modern criteria, we would want to use a thicker string to increase output of the fundamental and reduce pitch instability, but would want to use a

56. See the fuller discussion of the problem in Bonta, "From Violone to Violoncello," 90–95; id., "Further Thoughts on the History of Strings," 21–26. The one matter not taken into account in these discussions is the fact, demonstrated by Abbott and Segerman, that through tighter twisting the elastic modulus of a gut string can be reduced, thereby reducing pitch instability at lower tensions. With a string of tight twist it is thus possible to produce a lower useable pitch with a better sound for any given string length. See Abbott and Segerman, "Strings in the 16th and 17th Centuries," 62–65; id., "Historical Background," 25; id., "Gut Strings," 430–31; id., "More on the History of Strings," 30, 32.

57. *Syntagma musicum* 2, "Theatrum Instrumentorum," pll. 20, 21.

58. An instrument with just such a sounding string length, made in 1717 by a Fleming, Hendrik Willems, survives today in the *Musée Instrumentale du Conservatoire Royal de Musique* in Brussels (no. 2876). No bass instrument with a longer sounding string length has been located; there is a difference of twenty-nine centimeters in sounding string length between existing bass instruments and the smallest contrabass pictured by Praetorius.

59. John Schelleng, "The Bowed String and the Player," *The Journal of the Acoustical Society of America* 53 (1973): 30–31, 37–39, reprinted in Hutchins, *Musical Acoustics,* 229–30, 236–38. Schelleng worked with present-day strings.

thinner string to reduce inharmonicity and to increase output of the higher partials. We would strike a balance, and we presume that early instrumentalists struck their own balance according to their own aesthetic criteria.[60]

We turn now to a consideration of the kind of bottom string that could have been used on the three sizes of the early bass violin. The earliest and smallest form, with a string stop of some sixty centimeters, could well have been served by the high-twist strings that Abbott and Segerman have developed. They suggest that the lowest "acceptable pitch" on such a string of this length is F,[61] which is the lowest note to which this instrument was ever tuned. Clearly, its string stop would also allow an easy span of the major third, though, as we have already noted, the instrument served the bass register less well than the two larger forms of the instrument, or even than the tenor viol or seven-course lute of its time.

But it would appear from Abbott and Segerman's investigations that such a high-twist string cannot serve as the bottom string of either larger form of bass violin. An investigation of Italian prints of music calling for either form of the instrument shows that the bottom string was most often tuned to C. And as we have seen, pictorial evidence and surviving instruments of the time indicate that the larger of the two had a string stop of at most seventy-four centimeters, the smaller, some sixty-eight centimeters. It is Abbott and Segerman's judgment that a high-twist string that will produce an "acceptable" sound at this pitch must have a string stop of eighty-one centimeters.[62] But in supplying these numbers they say nothing about how thick these strings must be. "Acceptable" is of course a relative concept that represents a value judgment made in our day; it is apparently based in this case on the kind of sound now available on the wirewound string.[63]

Let us look more closely at the supposition that increasing string thickness was the primary option available to instrument and string makers for the bottom strings on bowed instruments before the 1660's—even if thick strings meant a sacrifice in tone quality. Pictorial evidence from the early

60. "More on the History of Strings," 30.

61. "Gut Strings," 637, table I. Missing from this table, (but not from its original version in *FOMRHI Communications*) is the fact that $a' = 440$hz has been assumed.

62. Ibid.

63. In "Catline Strings," 14, Abbott and Segerman say: "We know of no other way of making all-gut thick strings that will successfully compete with overspun strings in musical effectiveness;" ibid, 15: "We have assumed that the musicians would not have accepted any loss in tone quality with the increased ranges;" and in "New Developments," 45: "We raise the trueness of the string to meet *proper musical standards* [italics mine]." On the other hand, they say in "Gut Strings," 430: "And there are perhaps differences between expectations of tone quality and intonation accuracy common at that time and earlier, and our own."

seventeenth century clearly indicates that there was a wide disparity in thickness between top and bottom strings of bowed instruments, and that bottom strings were very fat.[64] But just how much tone quality was sacrificed by using such thick bottom strings remains to be determined. There is always the possibility that makers of gut strings at the time possessed skills that still await rediscovery, though Abbott and Segerman's several discussions of the physical properties of gut strings make this seem unlikely, at least for the moment.[65]

But there surely must have been some sacrifice in tone quality. The mere fact that early composers writing for the violin family tended to avoid the bottom strings, and that someone felt impelled to invent the wirewound string, implies that the bass strings then in use were less than ideal by the standards of the time.[66] But the fact remains that these unsatisfactory bottom strings were used, which indicates that the sounds they produced were acceptable—at least to some composers.[67] Expansion in range was clearly a secondary concern in the invention of the wirewound string, since only one instrument, the viol,[68] appears to have used the string for this purpose.

64. See the bass viol pictured in Praetorius, *Syntagma musicum* 2, "Theatrum Instrumentorum," pl. 20, and the *Still-Life with Instruments* by Pieter Claesz (1597/8–1661), reproduced in Alan Kendall, *The World of Musical Instruments*, 35, where the largest instrument shown is probably a five-string violone. On the same page with the latter is the earliest-known illustration of a wirewound string in use on a bass violin, painted in 1681 by Anton Domenico Gabbiani (1657–1726).

65. See "Catline Strings," 16: "It is possible that there is another way of processing the gut to give the required elasticity, but we cannot imagine what it might be." (One can imagine similar comments being made by those seeking to achieve heavier-than-air flight in the late nineteenth century.) In "New Developments," 46, they add: "Scientific models of real situations are bound to be oversimplifications. Though they usually help to solve problems, they can sometimes . . . lead in one direction which misses a better solution."

66. Abbott and Segerman, "Gut Strings," 430: "Before the introduction of overspun strings, instruments usually used plain gut for every string. The lower strings were thick and suffered from pitch distortion." But in "Response to an Attack," 31, they state that "the initial use for wound strings was to allow smaller, more agile instruments to tune as low as larger instruments and thus usurp their musical function (it was not to give 'better' bass sound)." Playford's comment on wirewound strings, the earliest we have (Bonta, "From Violone to Violoncello," 94), specifically mentions that these "sound much better and lowder than the common gut strings."

67. See Bonta, "From Violone to Violoncello," figs. 2 and 4, for examples of rather demanding writing for the violone by Merula and Cazzati. For examples by Legrenzi see Stephen Bonta, ed., *The Instrumental Music of Giovanni Legrenzi: Sonate a due e tre, Opus 2, 1655* (Cambridge, Mass.: Harvard University Music Department, 1985).

68. Abbott and Segerman, "Strings in the 16th and 17th Centuries," 52; id., "Gut Strings," 430.

Inferior bass strings could also be the reason for the demonstrated reluctance of composers to write for the seventh course of the lute at the end of the sixteenth century. Abbott and Segerman observe that "the extra [i.e., seventh] course [on the lute] is comparatively rarely used, as if the composers did not really know what to do with the added range."[69] This suggests that while some composers found the sound of the seventh course acceptable, most did not. Only with the invention of long-necked lutes, which appears to have occurred in the 1580's[70] and which also clearly implies that there was a need for better sound on bass strings, was an expansion in range really exploited on instruments of this family.[71] As we have seen, this was made possible by using longer, thinner bass strings that lay off the fingerboard and were attached to a second pegbox further up the neck.

It thus appears probable that composers, performers, and instrument makers—at least some of them—were willing to expand the range of an instrument even at the expense of the quality of bass string sound. This would not be the only instance in music history in which composers exceeded the limits of available instruments, and were willing to sacrifice sound quality for the sake of other musical considerations.[72] It also follows that if performers on the early bass violin possessed the requisite skill to deal with less than ideal bass strings, and if they tolerated such strings, there is no reason to doubt that this situation might have persisted over a period of many years—possibly even as late as the 1660's, when wirewound strings seem to have been invented. Thus it may not be at all necessary to postulate the development of a string of markedly different design in order to account for the second expansion in open-string range.

If we assume that musicians lived with less than ideal bass string quality over a period of years, having no choice if they opted for an expansion in

69. "Strings in the 16th and 17th Centuries," 50.

70. The first known use of the chitarrone was in the Florentine intermezzi of 1589: Douglas Smith, "On the Origin of the Chitarrone," *Journal of the American Musicological Society* 32 (1979): 441.

71. Vincenzo Giustiniani reported from Italy about 1628 that the lute had been all but abandoned there since the introduction of the theorbo: Sibyl Marcuse, *A Survey of Musical Instruments* (New York: Harper and Row, 1975), 421. The lute was of course still in use in other countries at this time.

72. Several famous forte passages in the first movement of Beethoven's *Eroica* come to mind: mm. 123–27, where the trumpets and timpani leave gaping holes in a *tutti* passage simply because their limited palette of pitches will not fit some of the harmonies Beethoven chose to use; mm. 655–63, where in peroration Beethoven employs the trumpet on the principal melody even though it is incapable of continuing in the passage on the dominant—unless conductors rewrite the passage for the valve trumpet.

range, we also have an explanation for the variety of strings recommended for the bass by English writers of the seventeenth century. Not one of them was wholly satisfactory. Dowland recommends three kinds, including those made at Nuremberg or Strassburg, but calling Venice catlins the best. The Burwell tutor recommends only those from Lyons.[73] Mace recommends Venice catlins, Lyons strings, or, as the very best, Pistoy Basses, which he says are "none other than thick Venice catlins."[74] Though Talbot recommends a wirewound string for the bass violin,[75] he recommends a Lyons string for the bottom string of the violin. Significantly, there was more general agreement among these writers on another problematical string, the treble, which came from either Rome or Munich.

Clearly musicians and instrument makers did not passively tolerate inferior bass string sound over the years, though their efforts toward improvement were not in the realm of string technology. The history of the early bass violin is but one example of this—we have already witnessed two others: (1) the invention of long-necked lutes, and (2) Praetorius's *musicus* in Prague.[76] Less than ideal bass string sound probably also explains the very large size of so many early contrabasses,[77] and the preponderance of bass instruments in the performance of early operas.[78] In large public performances one made up for weak bass sound by increasing the number of instruments.

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What remains to be addressed is the central question: why would musicians, for the sake of expanding open-string range, be willing to tolerate poor bass sound—poor at least from our perspective?[79] One possible an-

73. See n. 47 above.

74. Mace, 65–66.

75. See n. 43 above.

76. See n. 46 above.

77. Eric Halfpenny, "The Double Bass," in Anthony Baines, ed., *Musical Instruments through the Ages* (Baltimore: Penguin Books, 1961), 153–55.

78. Anne Schnoebelen, "Performance Practices at San Petronio in the Baroque," *Acta Musicologica* 41 (1966): 44.

79. Abbott and Segerman hold a very different view on the matter of tolerance for poor-quality bass strings: "We have assumed that the musician would not have accepted any loss in tone quality with the increased ranges" ("Catline Strings," 15); "As marketing men today well know, people don't readily change their likes and dislikes when new opportunities are

swer is that the performer of the time employed different "body English" than is required with present-day strings. Performers were accustomed to compensating for the intonational and tonal deficiencies of their instruments: in the eighteenth century flute players were often referred to as "woodpeckers," since they had continually to bob their heads, changing the angle of attack at the mouthpiece, in order to ensure proper intonation for individual notes. Even today performers on ensemble instruments are accustomed to making such accommodations; beginning 'cellists, when playing on the bottom string, are told to bear down with the bow and to change its angle on a down bow in order to ensure that the string will begin to sound properly. Their predecessors on the bass violin in the seventeenth century could easily have shifted the left-hand position in order to compensate for the change of pitch that inevitably results when a string under low tension is bowed.[80] And they could well have employed other techniques that passed out of use with the invention of the wirewound string, and that await rediscovery.

Other evidence of a practical nature is supplied by Adrian Le Roy, who points to the difficulty of intabulating for the six-course lute a vocal piece that descends to *F*, one step below its lowest string.[81] He dismisses *scordatura* as an option for the lowest string, since "it would make the play a great deal harder, because it would cause a change of all the letters of the great Bass." Upward transposition is also dismissed, at least for the beginner, since "it would be harder for the hand, and the grace of the play would be worser." The answer, at least for him, was a seventh course on the lute. It is

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offered. They exploit those opportunities according to their old aesthetic criteria. Historically, we are not justified in assuming that people ever were dissatisfied with something that they used out of choice rather than necessity" ("More on the History of Strings," 30). Commenting on Schelleng's judgment on the poor quality of sound produced by solid gut bass strings (note 59 above), Segerman says in "New Grove DOMI: ES No. 1: A entries," *FOMRHI Quarterly* 40 (July 1985): 17, "Such a speculation itself is a historical absurdity—people would not bother to acquire and use an unsatisfactory component in a creative art. Schelleng hadn't imagined that the elasticity of gut strings can be varied by amount of twist and rope construction."

80. Abbott and Segerman recognize this possibility for the violin ("Historical Background," 25: "On the violin false intonation is readily compensated for in fingering." The most concise discussion of the problems faced by the performer on bowed instruments in dealing with gut strings under low tension is given in "Gut Strings," 430–31.

81. Adrian le Roy, *A briefe and plaine Instruction to set all Musicke of eight diuers tunes in Tablefure for the Lute* (London, 1574) fol. 33v. This is an English translation of a lost French original that dated from 1567; see Howard Brown, *Instrumental Music Printed before 1600* (Cambridge, Mass.: Harvard University Press, 1965), 1567^3.

clear that Le Roy's advice was directed to the beginner, for he also says "cunning masters (to give remedy to this defect) [that is, the lack of the low *F*] heighten their play upon the Tablature, as many notes as they think good." But there is no indication from Le Roy that the sounds of the seventh course on the lute were in any way unacceptable.[82]

All these reasons for tolerating poor bass sound are practical. Others are on a different plane, and appear to grow out of the vision of a new style that emerges in Italy at the end of the sixteenth century. This was a style that could be accommodated well on long-necked lutes, because of their long bass strings, but only (from present-day perspective) in an imperfect fashion on existing bowed instruments. But there is clear evidence that professionals were willing to tolerate these imperfections for the sake of the new style.[83] One aspect of this style in particular concerns us: the growing prominence of the bass line. This is evident in the increasing use of instrumental bass lines in collections of sacred music, which from 1609 on began to be assigned to a bass member of the violin family.[84] Though until 1650 there were options as to the bass instrument to be employed (which in itself suggests that not everyone believed that the bass violin was the best instrument for the purpose), Praetorius makes it clear that even as early as 1619 the violone—that is, the bass violin—was to be preferred,[85] doubtless because it was capable of the same expressiveness as the violin, and in spite of what appears to have been a less than ideal sound on its bottom string.

What we have been witnessing is but one instance of the perennial conflict between the ideal and the possible—between vision and reality—in the arts. In the pursuit of the ideal, professional musicians are accustomed to coping with imperfection, whether it be in tuning systems or in the size of the instrument they must play—or in the acoustics of the hall or the quality of the instrument the touring pianist today may encounter.[86] We may not

82. For further discussion of the problem of the seven-course lute see Bonta, "Further Thoughts on the History of Strings," 21–24.

83. As a later visionary, Beethoven did, (n. 72, above); see also the works of Edgard Varèse, many of which clearly anticipated the development of electronic music.

84. For specific evidence see Stephen Bonta, "The Use of Instruments in Sacred Music in Italy, 1560–1700," *Proceedings of the Boston Early Music Festival Conference, 8–12 June 1987* (forthcoming).

85. Robert Donington, *The Interpretation of Early Music*, new version (New York: St. Martin's Press, 1974), 360–61. The options Praetorius offers are bassoon, dolcian, trombone, or violone.

86. Another well-known instance of long-term tolerance of imperfection in musical matters has to do with the proper size for the viola. Even today it is generally acknowledged that

have been aware hitherto of just how far professionals, whether composers or performers, may have been willing to go in the early *seicento* in making compromises for the sake of realizing their vision of a new style. Further investigations of methods of manufacturing solid gut bass strings, and how they can best be bowed and fingered, may show just how far this is. *State sani.*

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the body of the viola is too small to allow proper reinforcement of its tuning by Helmholtz and wood resonances. To make it of a proper size would be to restrict its use to professional basketball players—unless the vertical form of the instrument recently developed by Carleen Hutchins were to be adopted. Segerman also acknowledges that this problem exists ("Strings for the Violin Family," 43): "Slightly greater [string] tension on a viola could have the advantage of partially compensating for its lower innate response than a violin. This is because it is much smaller than a family member at its pitch should be and because instrument makers have traditionally taken rather less trouble in getting maximum resonance out of the violas than of the violins they make."