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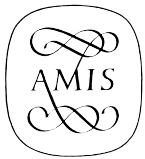

The Colonna-Stella *Sambuca lincea*, An Enharmonic Keyboard Instrument

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BETWEEN 1540 AND 1560, writings on music tended to present a marked divergence between radical and conservative styles. This tendency coincides with the beginning of the dissolution of Renaissance musical thought and the emergence of Baroque doctrine, a period best characterized by the concept of mannerism. Theories that support this musical concept generally espouse either the refinement or the distortion of the past-perfect art, or else they discard entirely the iron-clad rules usually associated with composition. But musicians of the sixteenth century inherited from antiquity and the Middle Ages strong traditions of music theory, and when the humanists rediscovered the classical treatises on music theory, the mathematical traditions were given new validity. It would appear that mannerist theory, which stresses aesthetic experience, would be diametrically opposed to a mathematical theory that indulges in abstract speculation. To a degree this statement is true. Mannerist theory treats music as an art independent of numerical systems, and if mathematical schemes are used, they have to be justified in relation to compositional or performance methods. In the sixteenth century, writers who treated both speculative and practical concepts were humanistically oriented. They used humanistic theories, quoting from ancient Greek sources, to support both conservative and radical ideas.[1] Often identical sources were cited to support quite different ideas simply because there were no known surviving Greek musical examples to prove or disprove whatever theory was being discussed. It was an age of intense musical experimentation,[2] characterized by interest in acoustics and tuning and fascination for unusual harmonies. Experiments along these lines sometimes led musicians to develop instruments capable of producing the three genera on which the ancient Greek musical system was based.

One of the first theorists to express such manneristic thoughts was

1. For a discussion of mannerist theory in music see Maria Rika Maniates, *Mannerism in Italian Music and Culture, 1530–1630* (Chapel Hill: University of North Carolina Press, 1979), chapters 15 and 17.

2. Robert E. Wolf, "The Aesthetic Problem of the 'Renaissance,' " *Revue belge de musicologie* 9 (1955): 91.

Nicola Vicentino in his treatise of 1555, *L'antica musica ridotta alla moderna prattica*.[3] This treatise was written primarily to support Vicentino's thesis that the three genera of the ancients were relevant to contemporary compositional practice. Central to this idea is Vicentino's treatment of the accidental as an individual entity and not as a result of hexachord mutation. He provides the reader with a definition and musical illustrations of each genus. In the last of the six books that make up the treatise, Vicentino also describes the *arcicembalo*, an instrument capable of producing the tones of the diatonic, chromatic, and enharmonic genera. The arcicembalo was based on a system in which the whole-tone was divided into five equal parts, yielding a system of thirty-one tones to the octave. In reality the system extended the usual meantone temperament by one-quarter comma until it formed a closed system of thirty-one tones to the octave. Inspired by the arcicembalo, several other composers, theorists, and enthusiasts constructed similar instruments during the second half of the sixteenth century and the early seventeenth century.[4] Yet, in spite of the widespread enthusiasm for recreating the chromatic and enharmonic genera of the Greeks and attempting to make them compatible with modern performance, very few compositions were written for these experimental instruments. John Bull's fantasia on the hexachord "Ut, re, mi, fa, sol, la"[5] was written for Charles Luython's *clavicymbalum universale*, and several musical exercises survive for the arcicembalo. But for a true "enharmonic" composition, one that modulates through all thirty-one possible keys, we must look to Scipione Stella, co-designer with Fabio Colonna of the *sambuca lincea* and composer of the musical examples included by Colonna in his treatise about this enharmonic instrument.

Scipione Stella was a Neapolitan organist and composer of some importance during the last quarter of the sixteenth century. For ten years, from 1583 until 1593, he served as principal organist at the Annunziata in

3. Nicola Vicentino, *L'antica musica ridotta alla moderna prattica* (Rome, 1555). For an English translation see Henry William Kaufmann, *The Life and Works of Nicola Vicentino,* Musicological Studies and Documents, vol. 2 ([Rome]: American Institute of Musicology, 1966).

4. The Belgian Charles Luython (1556–1620) had an instrument built by Jacques Buus that was similar to the arcicembalo. It was called the *clavicymbalum universale* and had eighteen keys to each octave: the diatonic tones C through B, plus C♯ and D♭, D♯ and E♭, E♯, F♯ and G♭, G♯ and A♭, B♭, and B♯. In 1548 Domenico de Pesaro built an enharmonic keyboard instrument with twenty-four keys to the octave, and in 1601 Vido Trasentino constructed an instrument capable of producing twenty-eight different tones to the octave. About the year 1596, Fabio Colonna and Scipione Stella began their collaboration on the sambuca lincea, which was basically patterned after the arcicembalo of Vicentino.

5. J. A. Fuller Maitland and W. Barclay Squire, eds., *The Fitzwilliam Virginal Book* (New York: Dover Publications, Inc., 1963; reprint of the London, 1899, ed.), 1: 183–87.

Naples. Then, in 1593, he entered the service of Don Carlo Gesualdo. The musical world of sixteenth-century Italy was quite closely knit,[6] and it seems likely that a musician who traveled from city to city and court to court soon had an intimate and comprehensive knowledge of the music, the styles, the performance practices, and the personal vagaries of his more important colleagues in Italy. It was on such a journey in 1594 that Stella accompanied Gesualdo to Ferrara for the latter's marriage to Eleonora d'Este.[7] On this occasion Stella had the opportunity to examine the Vicentino arcicembalo. In the same year that found Gesualdo and Stella in Ferrara, Ercole Bottrigari[8] described this arcicembalo as a museum piece, for only the Ferrarese organist Luzzasco Luzzaschi could play it with any degree of competence.

When Stella returned to Naples he had a similar instrument constructed by Fabio Colonna. Colonna is known as a Neapolitan mathematician, botanist, scholar, and musician,[9] and in his treatise of 1618, *La sambuca lincea overo dell' istromento musico perfetto di Fabio Colonna linceo,*[10] he describes quite clearly the instrument Stella commissioned, as well as two different keyboards for it. Unfortunately, he is considerably less clear in his description of the derivation of the enharmonic genera from his study of the ancients.[11] The treatise consists of three books, the first two of which discuss in great length the proportional systems of the ancients and the division of the monochord to obtain diatonic, chromatic, and enharmonic tones. It is not until book 3 that he actually describes "the perfect instrument" he built for Scipione Stella.

The collaboration of Colonna and Stella resulted in the instrument popularly known as the *sambuca lincea,* a fifty-string keyboard instrument capable of producing tones in the diatonic, chromatic, and enharmonic

6. Anthony Newcomb, "Carlo Gesualdo and a Musical Correspondence of 1594," *Musical Quarterly* 54, no. 4 (October, 1968): 409.

7. For biographical information on Gesualdo see Glenn Watkins, *Gesualdo: The Man and His Music* (Chapel Hill: University of North Carolina Press, 1973).

8. Ercole Bottrigari, *Il Desiderio ovvero de' concerti di vari stromenti musicali* (Venice, 1594), trans. Carol MacClintock, Musicological Studies and Documents, vol. 9 (Rome: American Institute of Musicology, 1962).

9. Sir John Hawkins, *A General History of the Science and Practice of Music,* 2 vols. (London, 1776), 2: 498.

10. Fabio Colonna, *La sambuca lincea overo dell' istromento musico perfetto di Fabio Colonna linceo* (Naples, 1618). A facsimile edition of book 3 of this treatise was issued by Bärenreiter (Kassel, 1980).

11. For a summary of Colonna's discussion of the proportional system of the ancients and the derivation of the enharmonic genera, see Lynn Wood Martin, "Fabio Colonna's *La sambuca lincea,* Book III: An Annotated Translation" (M.A. thesis, Kent State University, 1975).

genera. An illustration of the instrument from Colonna's treatise is given here in figure 1. Colonna consistently refers to the sambuca lincea as a *cembalo,* but it was actually constructed according to the clavichord principle. The strings were disposed in pairs as on the monochord, and a system of tangents was used: when a key was depressed, a tangent made of either wood or iron was raised to strike and rest against the strings. Colonna provides woodcuts to illustrate the ranks of the keyboard, the orders of the keys, and the positioning of the tangents (fig. 2). A rank of keys always consists of two levels or orders one-fifth of a tone apart. On the sambuca lincea there were four ranks of two orders each, and the third rank was tuned one enharmonic level higher than the first rank.

Colonna's treatise also includes a table that tells the exact location at which each tangent must be placed to strike its string in order to produce a certain tone. This information was the result of Colonna's studies of ancient proportional systems and his own experiments with a monochord. Colonna calls this his "universal table," because it shows the division of the monochord according to both ancient and modern systems, how much of the string is sounding at a given time, what the remainder of the string is, the proportion between the two parts of the string, and the proportion between the sounding part of the string and the whole string (the *grave,* the string divided into 2000 parts). He also provides his readers with the Greek terminology for each corresponding pitch. The information for the diatonic octave *a'* to *a"*, taken from the "universal table," is reproduced here in table 1. Table 2, also derived from Colonna's "universal table,"

TABLE 1
The Divisions of a String *(grave)* of the *Sambuca lincea* Tuned to *a'*, Producing the Diatonic Tones in the Octave from *a'* to *a"*

(Derived from Colonna's "Universal Table")

Tone	Sounding part of the string	Remainder of the string	Proportion between the two parts of the string	Proportion between the sounding part of the string and the whole string
a"	1000	1000	1:1	2:1
g"	1111 1/9	888 8/9	5:4	9:5
f"	1250	750	5:3	8:5
e"	1333 1/3	666 2/3	2:1	3:2
d"	1500	500	3:1	4:3
c"	1666 2/3	333 1/3	5:1	6:5
b♭'	1882 6/17	117 11/17	16:1	17:16
a'	2000 *(grave)*	0		

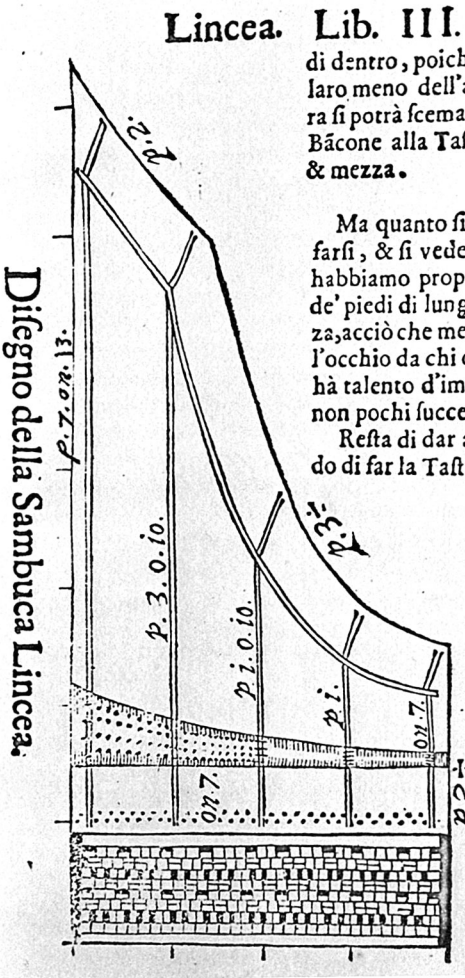


FIGURE 1. Illustration of the *sambuca lincea* (plan view). Measurements are in *piedi* (*p.*) and *oncie* (*o.*), corresponding generally to feet and inches. From Colonna, *La sambuca lincea*, book 3, p. 77. Photograph courtesy of the Library of Congress, Washington, D.C.

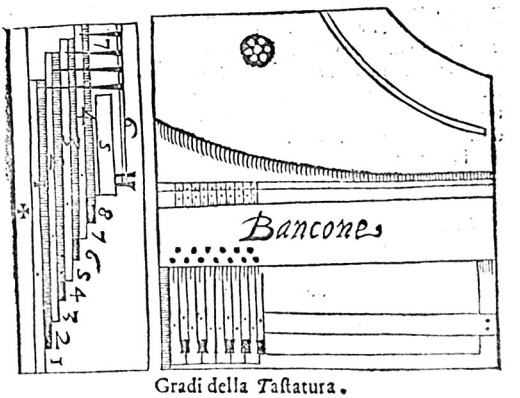


FIGURE 2. The *sambuca lincea*: two partial diagrams of the four ranks of the keyboard and the eight grades or orders of keys. From Colonna, *La sambuca lincea*, book 3, p. 79. Photograph courtesy of the Library of Congress, Washington, D.C.

The diagram on the left is a side view that also shows how the tangents are positioned. Colonna gives the following explanation of the symbols at the top of this view:

✠ The lower keyboard, which extends as far as the raised bridge. It can be pulled out from beneath the lowest order of keys and raised to the enharmonic rank of keys. It rises along the width of the pin block (*bancone*) and to the height of the string.

1. The first rank of keys, containing two orders or levels, the ordinary diatonic tones and the minor semitones.
2. The second rank of keys, containing two orders or levels, the flat keys and the grade above the flats.
3. The third rank of keys, containing the order that is an enharmonic grade above the diatonic order and its semitones.
4. The fourth rank of keys, containing the seventh and eighth orders.
5. The pin block (*bancone*), which can be raised and lowered.
6. The height at which the string should be placed.
7. The tangents.

Likewise, the eight grades or orders (*gradi*) are indicated:

1. The diatonic grade.
2. The black minor semitones.
3. The chromatic accidentals.
4. The green level, fourth part of the tone, enharmonic accidentals.
5. The red level, first enharmonic grade.
6. The minor semitones of order 5.
7. The enharmonic accidentals of order 5.
8. The diatonic order one tone above the first level.

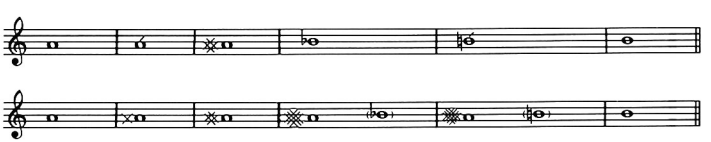
TABLE 2
The Divisions of a String of the *Sambuca lincea* Tuned to *a'*, Producing the Diatonic Tones and Some Enharmonic and Chromatic Tones in the Octave from *a'* to *a''*

(Derived from Colonna's "Universal Table")

Tone	Sounding part of the string	Remainder of the string
a''	1000	1000
g♯''	$1090^{10}/_{11}$	$909^{1}/_{11}$
g''	$1111^{1}/_{9}$	$888^{8}/_{9}$
f♯''	1200	800
f''	1250	750
e''	$1333^{1}/_{3}$	$666^{2}/_{3}$
d♯''	$1428^{2}/_{7}$	$571^{3}/_{7}$
d''	1500	500
c♯''	1600	400
c''	$1666^{2}/_{3}$	$333^{1}/_{3}$
c♭''	$1714^{2}/_{7}$	$285^{5}/_{7}$
b♯'	$17777/_{9}$	$222^{2}/_{7}$
b♮'	$1818^{2}/_{11}$	$181^{9}/_{11}$
b♭'	$1882^{6}/_{17}$	$117^{11}/_{17}$
a♯'	1920	80
*a**x**'*	$1949^{47}/_{197}$	$50^{150}/_{197}$
a'	2000	0

shows the same diatonic octave, but with information on some enharmonic and chromatic tones included.

Generally, Stella and Colonna used the same division of the tone as did Vicentino, but with different symbols, as illustrated in example 1. The whole-tone is divided into five equal parts. In the Colonna-Stella system the first enharmonic grade (one-half of a minor semitone) is indicated by the symbol "**x**," the minor semitone by a "double cross" (rendered in the present article as a sharp sign in the modern form), and the major semitone by a "triple cross" or a flat on the note above. The next enharmonic grade,

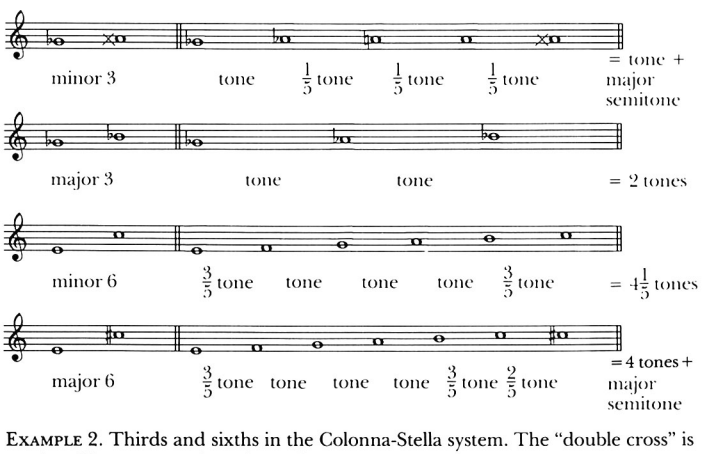


EXAMPLE 1. Symbols indicating the division of a whole-tone in the Vicentino system (above) and the Colonna-Stella system (below).

which is one-fifth of a tone higher than a major semitone, is indicated either by a "quadruple cross" on the original tone or by a natural sign on the next highest tone.

The octave is made up of thirty-one tones with five enharmonic intervals between each whole-tone and three enharmonic intervals between each major semitone. Colonna usually, but not always, indicates the two intermediate intervals of the major semitone with sharp (double cross) and flat signs. The thirds and sixths that result from this system are shown in example 2. A minor third is made up of a tone and a major semitone, a major third of two tones, a minor sixth of four tones and an enharmonic diesis, and a major sixth of four tones plus a major semitone. In his treatise Colonna devotes several pages to the discussion of thirds and sixths because portions of his keyboards are to be tuned by minor thirds.

Once the division of the tone and the derivation of the minor third is understood, Colonna's two keyboards are also easily understood. According to the treatise, four keyboards were designed for the sambuca lincea, but only the two developed by Stella and Colonna are described in the text. Both keyboards are constructed according to the same principles, and the main difference is that the Stella keyboard has eight orders of keys, while the Colonna keyboard uses only six orders. The illustrations of the two keyboards printed in the treatise are given here in figure 3. The Stella keyboard is actually two separate keyboards, one tuned an enharmonic



EXAMPLE 2. Thirds and sixths in the Colonna-Stella system. The "double cross" is rendered here as a modern sharp sign.

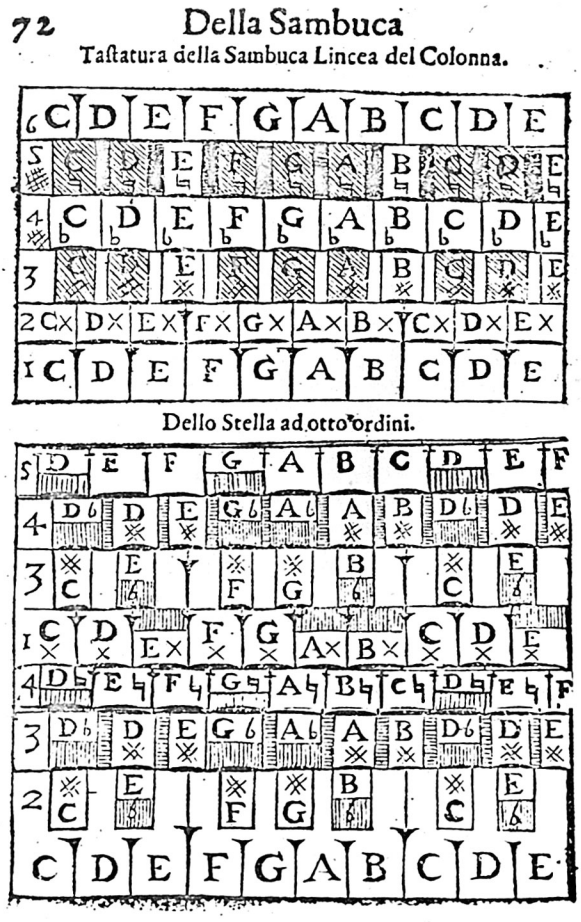


FIGURE 3. Keyboards for the *sambuca lincea* developed by Colonna (above) and Stella (below). From Colonna, *La sambuca lincea*, book 2, p. 72. Photograph courtesy of the Library of Congress, Washington, D.C.

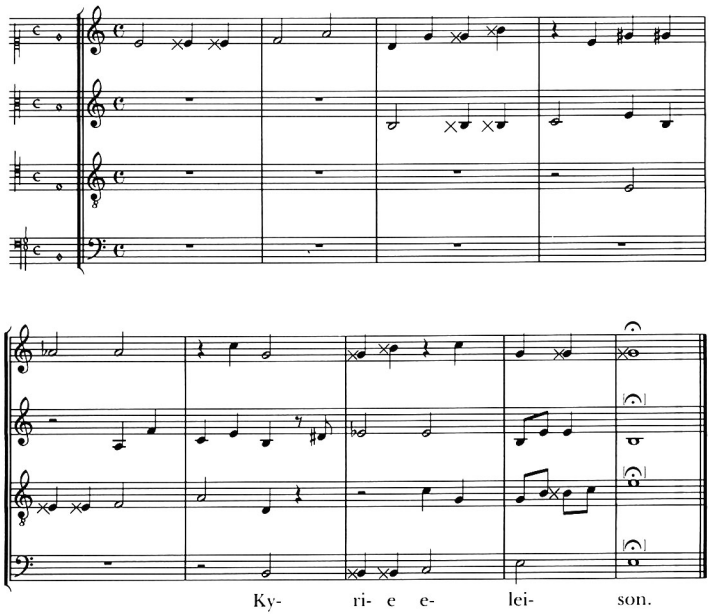
grade higher than the other. In figure 3, orders 1, 2, 3, and 4 (the numbers are given at the left) constitute the lower keyboard and orders 5, 6, 7, and 8 the upper keyboard, tuned an enharmonic grade higher. The same relationship between orders 5 and 6 exists between orders 1 and 2. If the six enharmonic notes between C and D were to be played, the following keys would be used: C in order 1, C**x** in order 5, C♯ in order 2, either C triple cross in order 6 or D♭ in order 3, either D♮ in order 4 or D♮ in order 7, and D in order 8. D♮, G♮, and A♮ are found in both orders 4 and 7. The substitute tones for C triple cross, F triple cross, and G triple cross (D♭, G♭, and A♭, respectively) can be found in order 3. Stella claims to have included these substitutions for the player's convenience. However, Colonna apparently felt that they were unnecessary and therefore devised a keyboard that eliminated these repeated tones. Colonna calls his keyboard a "regulated" keyboard because the orders proceed in order by enharmonic grades: C, C**x**, C♯, D♭, D♮, and D, and so on.

Both keyboards are tuned in basically the same way. On the Stella keyboard orders 1, 2, and 3 are tuned first, as they can be tuned by major and minor semitones. Order 5 is tuned next, as it can be tuned by the minor third: D♭–E**x**, G♭–A**x**, A♭–B**x**, D♭–E**x**, A**x**–C**x**, B**x**–D**x**, and D**x**–F**x** are all minor thirds. Once the fifth order is tuned, the same relationship exists between orders 5, 6, and 7 as does between orders 1, 2, and 3. Order 4 can also be tuned from order 5 using minor thirds: C**x**–E♮, F**x**–A♮, G**x**–B♮, E♮–G♮, A♮–C♮, B♮–D♮, and D♮–F♮ are all minor thirds. Order 8 is a whole tone above order 1 and can be tuned diatonically.

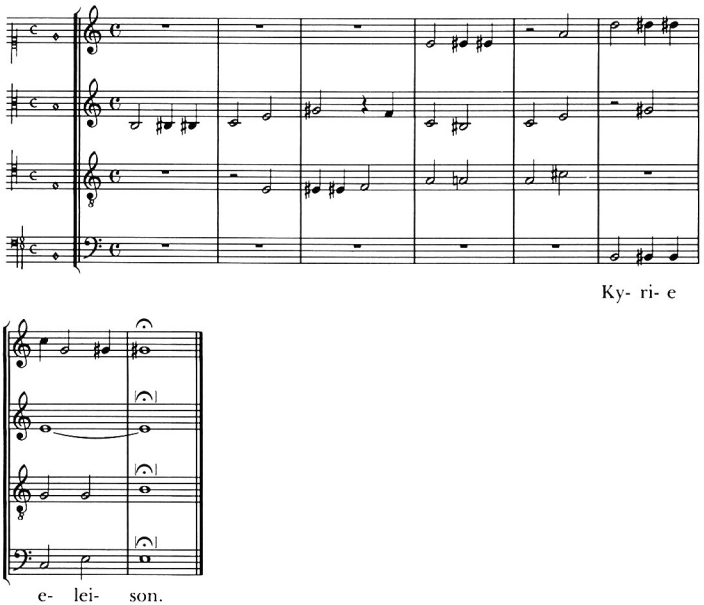
The Colonna keyboard is tuned to the same principle. Order 4 tunes order 2, which in turn tunes order 5. This keyboard can also be tuned by minor semitones. The fifth order is a minor semitone from the third order, and the second order is a minor semitone from the fifth order. The orders of the keyboard can therefore be tuned in the following sequence: 1, 3, 5, 2, 4, 6. Colonna is very particular about the coloring of the keyboard designed by Stella and discusses it in great detail. The upper keyboard is red, with the exception of the triple-cross notes, which are colored black. Orders 1, 2, and 3 are yellow, except for the sharp pitches, which are black. Order 4 is green. Both keyboards are similar to the keyboard on the Vicentino instrument.

In his treatise Colonna provides examples and exercises whereby a new player can try the instrument and "adjust himself to the sounds." These examples consist of tetrachords and octochords. Following these rather simple one-line passages are a series of four-part exercises that were provided by Ascanio Mayone, a Neapolitan contemporary of Stella and a

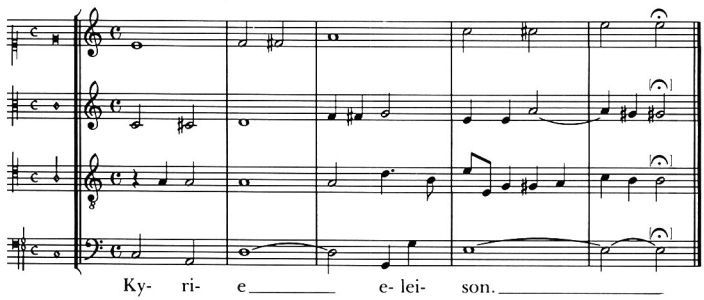
composer whose keyboard compositions are forward-looking in that they treat the accidental as a separate entity. It was probably Mayone's interest in chromaticism that prompted Colonna and Stella to ask him to provide examples illustrating how the various forms of the tetrachord (the soft enharmonic, the intense enharmonic, the soft chromatic, and the intense chromatic) could be used in actual practice. Four such examples are included here (exx. 3–6). All four examples begin with a tetrachord. The first and last tones of the tetrachords are diatonic tones, unchangeable and immutable. The two inner tones are varied according to the tetrachord implied. The soprano of example 3 moves from *e′* to *a′* by means of E**x** and F, called the "soft enharmonic." This should be compared to the first entrance of the tenor in example 4: here the tetrachord *e′* to *a′* is filled in with *e*♯*′* and *f′*, considered the "intense enharmonic." Examples 5 and 6



EXAMPLE 3. Exercise in the "soft enharmonic" by Ascanio Mayone. Transcribed from Colonna, *La sambuca lincea,* book 3, p. 93. The "double cross" is rendered here as a modern sharp sign. Barlines are original.



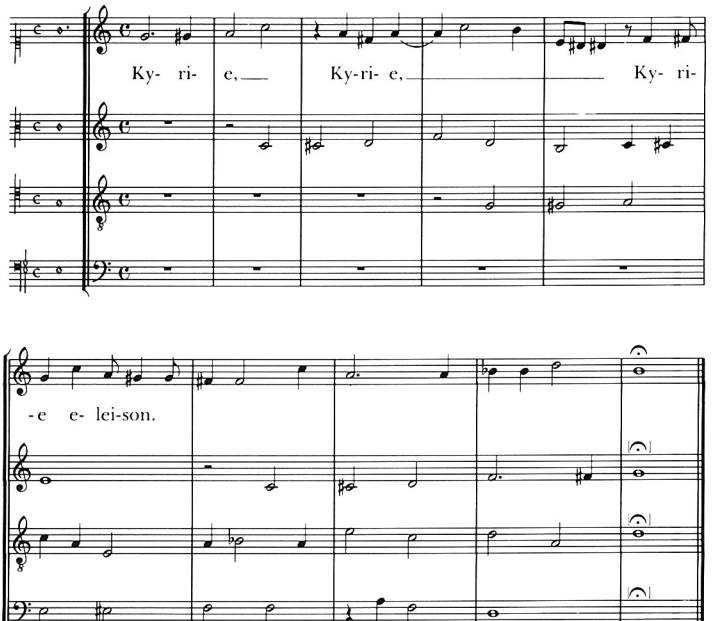
EXAMPLE 4. Exercise in the "intense enharmonic" by Ascanio Mayone. Transcribed from Colonna, *La sambuca lincea*, book 3, p. 94. The "double cross" is rendered here as a modern sharp sign. Barlines are original.



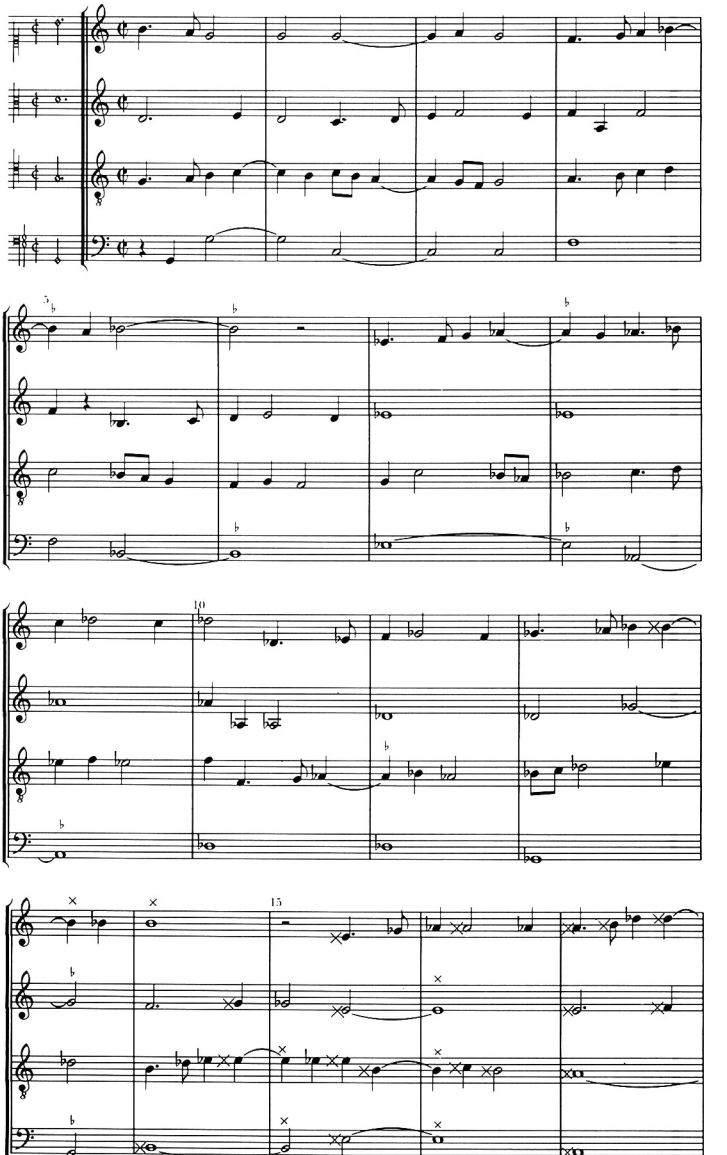
EXAMPLE 5. Exercise in the "intense chromatic" by Ascanio Mayone. Transcribed from Colonna, *La sambuca lincea*, book 3, p. 95. The "double cross" is rendered here as a modern sharp sign. Barlines are original.

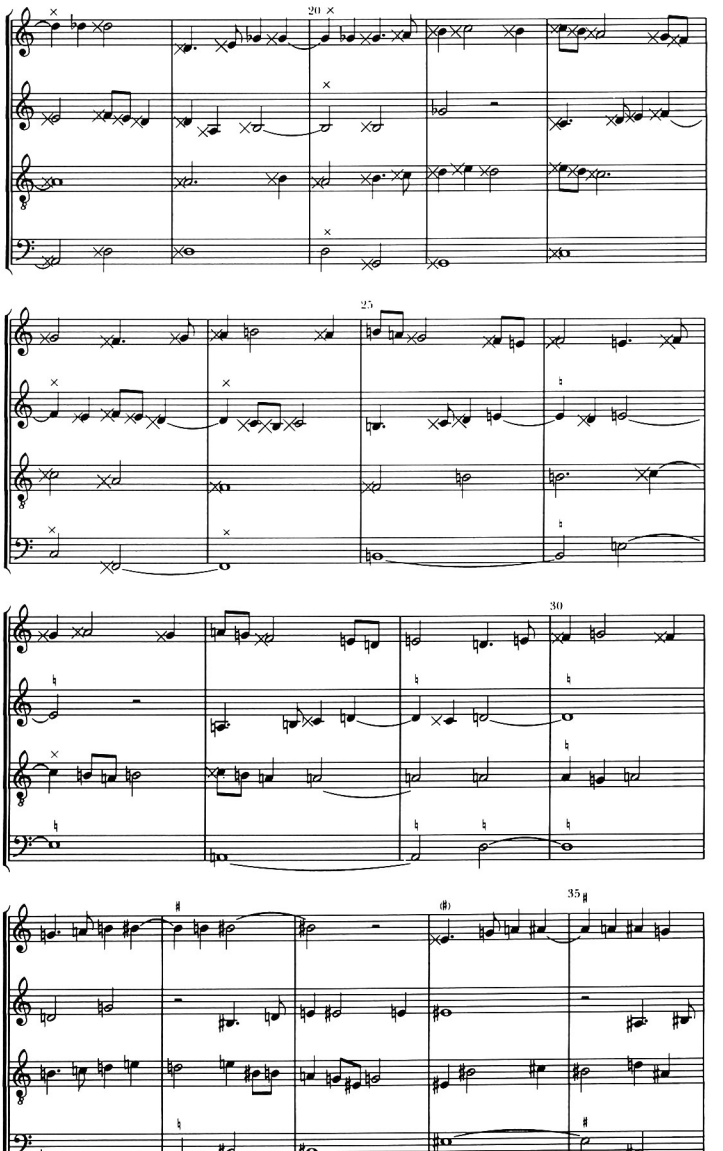
illustrate the "intense chromatic" and the "soft chromatic" in much the same manner.

Also included in *La sambuca lincea* is an untitled composition, written by Stella, that makes use of all three genera and modulates through all thirty-one keys. It is written in sambuca notation and was composed specifically for this instrument. It is reproduced here in example 7. The composition begins with a G-major chord and proceeds diatonically for most of four measures. Then, starting with the fourth beat of meas. 4, the flats are introduced in order: B♭, E♭, A♭, D♭, and G♭. Each new accidental is used in the melodic pattern first illustrated diatonically by the tenor in meas. 1–2. Measures 14–24 introduce the "**x**" tones also according to the circle of fifths: B**x**, E**x**, A**x**, D**x**, G**x**, C**x**, and F**x**. B♮, E♮, A♮, D♮, G♮, and C♮ are then used in meas. 24–32. The first sharp (B♯) is introduced in meas.



EXAMPLE 6. Exercise in the "soft chromatic" by Ascanio Mayone. Transcribed from Colonna, *La sambuca lincea*, book 3, p. 97. The "double cross" is rendered here as a modern sharp sign. Barlines are original.

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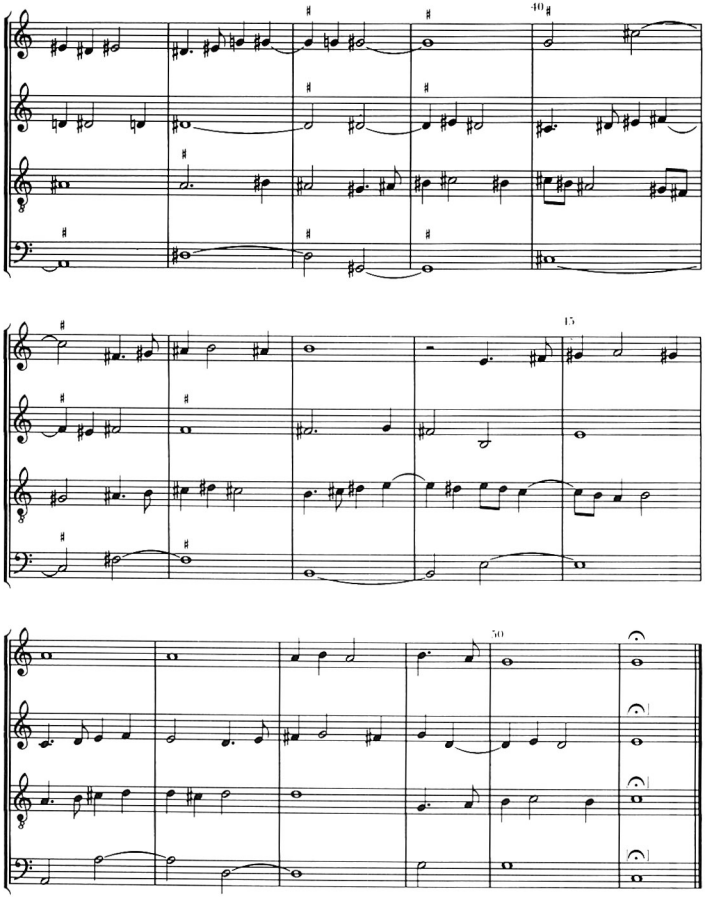

EXAMPLE 7. Composition for *sambuca lincea* by Scipione Stella employing the three genera. Transcribed from Colonna, *La sambuca lincea,* book 3, pp. 103–110. The "double cross" is rendered here as a modern sharp sign. Barlines are original.

31, and E♯, A♯, D♯, G♯, C♯, and F♯ all follow. Having utilized all the enharmonic grades at this point, Stella then cancels the sharps in the same order (meas. 42–51) and brings the composition to a close with a dominant-to-tonic cadence in C major.

* * *

An examination of madrigals and keyboard works written in Naples in the 1590s shows that Neapolitan musicians of the time were very concerned with the musical effects of chromaticism—*consonanze stravaganti.* The concept of "extravagant consonances" (or sounds extraneous to a consonance), as employed by such composers as Scipione Stella, Don Carlo Gesualdo, Giovanni Maria Trabaci, Gian Domenico Montella, Ascanio Mayone, Scipione Lacorcia, Scipione Dentice, and Giovanni de Macque, needs further study as an important aspect of musical mannerism in the stylistic transition from the Renaissance to the Baroque Era. Designed by two Neapolitan musicians in the early seventeenth century, the sambuca lincea was a barometer of its time: its capabilities reflected the contemporary interest in expressive chromaticism that itself was based on musical views and theories prevalent from the time of Vicentino, half a century before.

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