a journal of the Society for Music Theory

Volume 10, Number 1, February 2004

Syntonic Tuning: A Sixteenth-Century Composer's Soundscape

Roger Wibberley

KEYWORDS: Aristoxenus, comma, Ganassi, Jachet, Josquin, Ptolemy, Rore, tetrachord, Vesper-Psalms, Willaert, Zarlino

ABSTRACT: This Essay makes at the outset an important (if somewhat controversial) assumption. This is that Syntonic tuning (Just Intonation) is not—though often presumed to be so—primarily what might be termed "a performer's art." On the contrary it is a *composer's* art. As with the work of any composer from any period, it is the performer's duty to render the music according to the composer's wishes as shown through the evidence. Such evidence may be indirect (perhaps documentary) or it may be explicitly structural (to be revealed through analysis). What will be clear is the fallacy of assuming that Just Intonation can (or should) be applied to *any* music rather than only to that which was specifically designed *by the composer* for the purpose. How one can deduce whether a particular composer did, or did not, have the sound world of Just Intonation (henceforward referred to as "JI") in mind when composing will also be explored together with a supporting analytical rationale. Musical soundscape (especially where voices are concerned) means, of course, incalculably more than mere "accurate intonation of pitches" (which alone is the focus of this essay): its color derives not only from pitch combination, but more importantly from the interplay of vocal timbres. These arise from the diverse vowel sounds and consonants that give life, color and expression. The audio examples provided here are therefore to be regarded as "playbacks" and no claim is being implied or intended that they in any way stand up as "performances." Some care, nonetheless, has been taken to make them as acceptable as is possible with computer-generated sounds.

Received July 2003

---

[1] During Adrian Willaert's time at St Mark's Venice, from 1527 until his death in 1562, the sound of his music performed there must have been striking and unique. It was remarked upon by a number of commentators including Zarlino who called Willaert "the new Pythagoras who corrected numerous errors." Silvestro Ganassi also wrote in 1543 that Willaert was "the new Prometheus of celestial harmony." That Willaert labored long and hard when composing his music is well known, as is the fact that each one of his singers was required to attend regular counterpoint lessons. Since it is unlikely that Willaert wished to turn each of his singers into a composer, we might speculate upon his reason for requiring them to attend for such regular instruction. So the following questions will form the technical focus of this essay:

1. how did the sound world of Willaert's music differ so strikingly from that of other composers;
2. what were the technical compositional challenges that this sound world posed for Willaert, causing him to labor so hard to meet them; and
3. why did his singers need specialized individual instruction in order for them to be able to meet the demands of the

music they were required to sing?

[2] The answers to all three of these questions point inexorably to the fact that the very sound of Willaert's music offered something new and exciting when compared with that of other composers' music. In short, with Willaert's compositions there now existed a new soundscape that contrasted with, and was inevitably compared to the prevailing and traditional Pythagorean sound world normally assumed by the everyday composer, performer and listener. This explains why the compositional methods were more challenging, why the sound of the harmonies was so strikingly different, and why those singers who were of traditional Pythagorean training needed specialized coaching in order to sing a new kind of music to which they were not by habit accustomed.

[3] In my last essay it was proposed that Willaert's motet *Quid non ebrietas dissignat* confirms the above status quo. First, Willaert there asserted—in one single piece—the coexistence of Pythagorean and non-Pythagorean soundscapes. Second, in order to arrive at the new (Syntonic) sounds he labored hard to create a sophisticated melodic structure that evinced through its Pythagorean application the new Syntonic sound world. Third, he then carefully instructed the singer in the art of performing with "the new skills" by introducing to him the new intervals required for correct execution. In one didactic composition, therefore, Willaert made the following comments:

1. the non-Pythagorean sound world was new;
2. it existed alongside the use of traditional Pythagoreanism;
3. the accomplishment of the new sound required new skills in composition; and
4. new performance skills were also required.

[4] The sound of JI arises from the intervals of the tetrachords that are used to construct the Syntonic diatonic scale. These tetrachords are subtly different from those of the Pythagorean scale, having the superparticular ratios prescribed by Ptolemy for his Syntonic diatonic genus. As outlined in my previous essay, these consist of the following rising sequence: semitone (16:15)—tone (9:8)—tone (10:9). This system is the one described in some detail by Willaert's pupil Zarlino.(1)

[5] The compositional employment and control of these specific tetrachordal intervals is what determines whether or not a composition uses JI at all. As posited in the Abstract above, JI is primarily (and structurally) a *compositional* procedure, and its actual performance is then simply a routine matter of realizing the composer's intentions. In some cases the intention is clearly the sound world of JI, while in other cases it is obviously not. It will become clear in the following analyses that music designed for JI has quite different aesthetics from that employing Pythagorean intervals, and that such aesthetic considerations bear upon the relative views of the musical function of consonance and dissonance. Indeed the very concept of "in-tune singing" is variable and relative. That Willaert and his followers came to regard "in-tuneness" as being a succession of harmonies consisting of pure consonances only is clear. But it is equally clear that other composers and theorists judged "in-tuneness" not only as a quality that defined pure consonance but also one that characterized accepted dissonances.(2)

[6] The first analysis to be offered is a phrase from *Ave Maria*, the four-voice motet by Josquin Desprez.(3) In exploring the composer's sound world in order to determine which of the two systems applies in this piece, I shall first illustrate the phrase using Pythagorean tuning (which tuning I believe to be correct for this piece), and then assess the consequences of performing the same phrase using JI. **Example 1** presents the notation, while the associated audio example offers a performance using Pythagorean tuning.(4) In this example, the normal Pythagorean intervals are preserved including the ditone and semiditone (together with their compounds and inversions). All major thirds and sixths are wide (compared with their "pure" equivalents) while all minor thirds and sixths are narrow. Such intervals, which are, in this rendition, still to be regarded as "colored dissonances," help to articulate an underlying musical aesthetic whose foreground consists of alternating dissonance ("tension") and consonance ("relaxation"). The 6-5 chain employed in voices 1 and 3 gives a clear feeling of direction and impetus through the continual dissonance of the sixth resolving on to the pure consonance of the fifth. The purpose of these "colored dissonances" is, supposedly, to focus upon the ensuing purity of the consonance. For a composer using the Pythagorean sound world such dissonances are perfectly "in tune," and a normal property of the soundscape.

[7] If, however, they are performed "out of tune" by Pythagorean standards and are made instead to be "in tune" by the standards of JI, something unplanned by the composer will happen to the structure: what is known as "comma depression" will take place and—as will be demonstrated—this short sequence will fall by an entire semitone. **Example 2** shows graphically all the adjustments in pitch needed to achieve total purity of consonance. The playback effect of these

adjustments can be heard in the accompanying audio file. The conclusions to be drawn from this are not merely speculative but very practical. While the first (Pythagorean) version maintains the pitch exactly, the second (JI) version undergoes a pitch depression that is patently audible, severe and irreversible. An interesting but (to me) ultimately unconvincing proposal for rectifying this comma depression, while still it is argued using JI, was offered by Jonathan Walker in 1996.[(5)] Here Walker offered two differing versions that purported to remain "pure" in tuning, one that held the pitch and another where the pitch dropped. Even though the graphic he provided in version 1 is sufficient to show that the effect of his analysis retains most of the Pythagorean pitches and intervals he was trying to eliminate, he actually adds to these further unforced dissonances by making comma adjustments in one voice that are unmatched in others (creating "wolf" intervals).[(6)] His biggest misjudgment, however, is the assumption that the Syntonic comma could—and would—have been used as a *melodic* interval.[(7)] Having made this assumption, several of the tenor notes held across changes in harmony are inflected upwards by a Syntonic comma after half of their written duration. Yet this inflection cannot be viewed as being the *outcome* of harmonic need because the harmony that is supposedly satisfied does not exist until the moment the inflection occurs. So the only way a singer could accurately judge the magnitude of the change in pitch is by having acquired the ability (which was never recognized or needed) of taking the Syntonic comma as a *melodic* interval.[(8)]

[8] The caption for Example 2 (above) deliberately does not use the term "Syntonic tuning" for the very good reason that the example itself does not apply it. Even though all the moment-by-moment harmonies are entirely pure, none of them arises from the use of the Syntonic diatonic scale. As shown above, this scale arises from tetrachords whose rising intervals are: semitone (16:15)—tone (9:8)—tone (10:9). But a comma analysis of the performance given in Example 2 proves that these were not the intervals that Josquin Desprez used. The three-way combination of alternating 6-5 intervals occurring between voices 1, 3 and 4 proves (since even the spurious application of melodic Syntonic commas does not rectify matters) that Josquin's entire harmonic structure is based upon the (quite normal) presumption that all tones must be of the *same* size. This simply cannot happen in Syntonic tuning, whose structural demands make it inevitable that some tones will be major, and others minor. Example 2 does, however, show that it is still perfectly possible (for anybody so inclined) to remove all the dissonances and fine-tune the harmonies so that they are all pure. But this will be achieved at a heavy price.

[9] As argued in [6] above, the musical style of this extract (like that of any Pythagorean harmonic structure) embodies by default an element of harmonic dissonance essential to the direction (by "tension" and "release") of the musical phrase. This dissonant aspect, inbuilt from the moment of conception, cannot be removed. All that happens when the "colored dissonances" are changed into pure consonances is that the dissonance aspects that were formerly part of the local moment-to-moment foreground are now merely *shifted* to the global background level. So what formerly remained "in tune" globally (giving pitch stability) but was dissonant locally, has now become "in tune" *locally* but dissonant *globally*. The extent of this global dissonance is clearly audible and highly disturbing since not only does the base pitch of the piece sink inexorably, but this sinking (which in only a few measures amounts to a semitone) stems from the ever-present local inability of melodic cells that should span a perfect fourth to do so. The reason why such fourths are smaller than they should be (giving rise to continual sinking of pitch) is because the one element of Josquin's melodic structure that cannot by any means be changed is the irremovable fact that all tones must be of the same size. Merely making them all minor instead of major simply causes the pitch to drop. This is because a perfect fourth, when broken into its Syntonic components, still requires at least one major (9:8) tone. Even though Example 2 correctly converts all the semitones to 16:15 (major) semitones, all the fourths are still a comma short in magnitude (because all the tones used have become only minor tones).

[10] It is often mistakenly thought that (as in the above Example 2) comma depression is the natural outcome of singing harmonies that are purely in tune. It is also sometimes argued that such pitch fluctuation would not have mattered, and that it is probably only something that bothers *us* since we have become used to fixed pitch standards and have come to regard equal temperament as normal. I shall be taking serious issue with both of these views. First an example will shortly be given of a composition that suffers "comma elevation" through the misapplication of pure tuning. Later a more detailed analysis will be offered from the music of Willaert (who, I propose, did specifically write for the sound world of JI by applying carefully and rigorously the correct pitches and intervals of the Syntonic diatonic scale) to demonstrate the quite extraordinary lengths to which he went in order explicitly to assert that the pitch must remain constant throughout a composition. For Willaert, in utilizing "celestial harmony," the universe which gave birth to such harmony was evidently viewed as what we might call a "steady-state universe" rather than one whose shape and spatial dimensions could be changed at the whim of the composer or performer. It would be unthinkable for him (or any of his circle) to believe that a universal "natural order" had been found, but that its utilization should then disturb this "natural order." (Such would indeed be a self-*unfulfilling* prophecy!) Pitch classes selected from a fixed (Syntonic) scale were to be used with care, but their "fixedness" was itself part of the "natural order" of the universe that itself provided the celestial harmony that was being borrowed and

used by the composer. Merely to "steal" such units of celestial harmony and to misappropriate their use so as to create an "unsteady" universe in which melodic fourths were no longer perfect, melodic octaves were too large or small, and the starting pitch (upon which was based all the relative "fixed" pitches of the scale) was consistently changing by oppressively audible magnitudes, was not the ethos of the "real" JI sound world. For this reason, Willaert expended much time and great care in constructing his music; and he expected his singers (through the training he gave them) to spend no less time and care in preparing to perform it.

[11] The technical reason why Example 2 drops in pitch by a semitone is simple to explain: because the wrong soundscape has been applied, and all the major thirds have accordingly been narrowed in an attempt to provide purity of consonance (where this was not originally envisaged by the composer), such major thirds have constantly been tuned downwards to close the interval gap. Since this is what might be termed a "major-mode" piece,[9] the major thirds (as shown by the graphic) will constantly become lowered. As each settles, it will assert a new base pitch against which succeeding thirds will be further lowered in pitch. But a rather different scenario arises when the same incorrect soundscape is applied to a "minor-mode" composition.

[12] Unlike major thirds (which in JI are narrowed from their Pythagorean defaults), minor thirds are widened. In the Syntonic diatonic tetrachord, the reason why the inner two notes are raised by a comma is not only to narrow the span of the major third (e.g. F/A in the tetrachord E-A, where the F is raised along with the G) but also to *increase* the magnitude of the minor third (here E/G). Syntonic minor thirds, therefore, are comprised of a major semitone (16:15) added to a major tone (9:8). For this reason, when JI intervals are wrongly applied to a "minor-mode" composition conceived for the Pythagorean diatonic scale, the pitch will inexorably rise: as each new minor third is deliberately (but erroneously) raised by a comma, the pitch it asserts will become the new base pitch. Succeeding minor thirds will require further sharpening, which need will become insatiable as the composition progresses. To some extent this tendency for the pitch to rise will be counterbalanced by the inevitable (but equally erroneous) imposition of equal *minor* tones since it will be discovered that when realizing a composition that predicates the equality of tones (though conceived by the composer only as 9:8 tones) the only option left in order to achieve the erroneous purity of consonance sought will be to render all the unassailably equal tones as is they were all *minor*. This will render all the melodic fourths as being smaller then perfect by a Syntonic comma, and the octaves too will be smaller than perfect. The only difference between "comma elevation" and "comma depression" will be that the narrowing of intervals will always be from the bottom upwards rather than from the top downwards. The overall result, however, will be that the pitch will continually rise.

[13] A clear example of this can be observed in the opening of the motet *Tribulatio et angustia*, formerly attributed to Josquin Desprez. **Example 3** shows the first 15 measures, together with comma annotations, and the associated audio file provides a tuned playback. What will be obvious to any listener is that the short extract ends a semitone higher than it begins. The only thing that has been editorially applied is Syntonic comma adjustment so that every successive harmonic unit is pure. The rise in pitch is immediate and its progressive accumulation inevitable. Even after the first four measures, where the chord reached is exactly the same as that of the opening, there has been a rise in pitch of one Syntonic comma. This can be observed in **Example 4** and heard in the associated audio file (which plays the phrase three times in succession in order to demonstrate that the rise in pitch is clear, audible and inevitable). This immediately audible rise in pitch merely indicates what inevitably is to follow. Had the performance retained the correct Pythagorean pitch standards and intervals, the pitch would have remained constant, and the global dissonance (i.e. the rise in pitch by a semitone) would be replaced by the (correct) local dissonances (thirds and sixths) thereby restoring the integrity of a dissonant/consonant ("tension/release") harmonic structure. Such is shown in **Example 5** together with its sound file.

[14] My previous study of Willaert's motet *Quid non ebrietas dissignat* led me to propose in [3] above that the Pythagorean sound world coexisted with the Syntonic world of JI. That Willaert not only showed an awareness of Pythagoreanism but actually employed it in that piece for structural reasons has been shown. But there are other less didactic and more functional compositions that demonstrate a coexistence of the two soundscapes, and I shall pass on to one such example in order to explore this interrelationship.

[15] Willaert's collaboration with another composer is shown in the *Vesper-Psalms* of 1550.[10] In this collection Willaert joined forces with the composer Jachet of Mantua: Jachet composed the music for Choir 1 and Willaert that for Choir 2 in settings of Psalms that were designed to run continuously by the use of antiphonal singing between the two groups. Jachet's setting was of the odd- and Willaert's of the even-numbered verses. As such the performances were intended to flow from the music of one composer into that of the other without a break. The proposition here asserted (that will presently be

supported through analysis and performance) is that Jachet's music was designed for the Pythagorean diatonic scale while Willaert's was for the Syntonic diatonic. In the music of the former, therefore, the thirds and sixths function as "colored dissonances" leading to the perfection of consonances of the fifth and octave. These dissonances are deliberately abrasive, though given perfect control in a harmonic framework that again progresses through the alternation of dissonance and consonance. By comparison, however, the sections composed by the latter (Willaert) provide a fundamentally different aesthetic that is realized by a euphonious flow of pure consonances in which a clear Syntonic pitch matrix is asserted and retained throughout while still retaining stability of base pitch.

[16] Their joint setting of Psalm 109 ("Dixit Dominus") provides some interesting and simple examples of these different methods. Verses 5 (Jachet) and 6 (Willaert) are here selected as an illustration of the differences. **Example 6** shows the two verses in succession as they would have been performed without a break. The accompanying audio file provides an accurately tuned playback of these short sections. Particularly noticeable will be the exceptionally pure consonances that emerge when Willaert's setting arrives, and this will inevitably be contrasted with the slightly longer, more dissonant setting by Jachet that preceded it.

[17] It might be thought by those who are skeptical that my distinction between the two composers is an illusion only, and that my claim to have identified a difference in structure and aesthetics rests only upon my having fine-tuned the Willaert excerpt while having neglected to apply the same tuning principles to Jachet. In order, therefore, to reassure readers that there is indeed a fundamental difference I shall now provide a further version of the Jachet setting as **Example 7**, also accompanied by an audio file. Unlike the annotation applied to the Jachet verse in Example 6 above (which retained a pure Pythagorean tuning, as indicated by the application only of plain letters to the notes with no operands or suffixes), Example 7 now shows Syntonic comma adjustments. If the score is analyzed carefully, it will be seen that all harmonies are now pure: thirds are either 6:5 or 5:4, all fourths and fifths retain their purity, and all inversions or compounds are of equivalent purity. All diatonic semitones are now major (16:15), and some tones are major and some minor. These intervals are stable either as harmonic or melodic entities. *But they cannot possibly be the ones intended by Jachet.* This is because the entire extract undergoes, like Josquin's *Ave Maria* (above), severe comma depression. Indeed the movement terminates a semitone lower in pitch than it began.

[18] While some readers may still be persuaded that musicians of the day would not have minded (as we do today) that the pitch had fallen in this way, I should like them to consider the practical implications this would have posed for Willaert and his singers. They would be expected to take over with their verse 6 from the terminal chord of Jachet's verse 5, and we can clearly note from Willaert's careful adherence to the Syntonic diatonic pitch classes that *his* sections predicated that starting pitch would always equate with ending pitch. It would have been bad enough if this inadvertent comma depression had only affected the way in which verse 5 ends (posing the conundrum for Willaert that has been identified), but the reality is that Jachet has provided no fewer than *five* such verses, each of which is immediately to be followed by a setting from Willaert. Even if Jachet's singers were trained to be sufficiently versatile so as to contend with such progressive and severe comma depressions over a longer time span (and there is no evidence that they were), it seems unlikely that Willaert's singers would have been trained in this way (especially since he was meticulous about his pitch stability). I have to conclude, therefore, that the portions set by Jachet belong to the Pythagorean sound world, and those by Willaert to the Syntonic.

[19] If (as I believe) this is correct, it would seem that both sound worlds still enjoyed a happy coexistence, and also that the respective composers did not in any way mind the concurrence of differing tuning practices within the same performances.(11) The different scales used in these two short sections are shown in **Example 8**. That of Jachet remains strictly Pythagorean, while that of Willaert is Syntonic. The latter undergoes a change of structure in its sixth measure as the music shifts from the initial use of the synemmenon tetrachord, with its B-flat, to the diezeugmenon tetrachord where the B-flat is cancelled. The pitches on G consequently begin with their Pythagorean values so as to permit pure harmony with the raised B-flat; but as the B-flat changes to a B-natural the G is also raised by a Syntonic comma to permit pure harmonies with B, E and C).

[20] Before leaving this setting of Psalm 109 it is worth considering the music Willaert provided to the final short verse of the doxology ("Sicut erat in principio"). In this section Willaert demonstrates a sophisticated use of comma control more commonly to be found in his longer compositions.(12) During the course of this short movement, what begins as a straight Pythagorean C gradually rises in pitch (due to Syntonic inflection) reaching a point where it lies two Syntonic commas higher (C+2). Other surrounding pitches are also inflected upwards accordingly. But towards the end Willaert cleverly restores the base pitch by audible comma control so that the final pitch is again Pythagorean.

[21] **Example 9** reveals the acoustic engineering employed. As with other settings of the Doxology, this movement employs canon (here between voices 1 and 3). Canonic requirements have posed a particular challenge to Willaert in his handling of consonance and comma control, and a brief survey of the main events (verifiable from Example 9) can be offered. (I shall indicate comma inflection here, as in Example 9, simply by "+1" and "-1" symbols attached to the tetrachord pitches. Where a note is inflected upwards or downwards by 2 commas, this will be shown as "+2" or "-2.")

[22] The movement begins with the meson tetrachord pitches E-1/F/G/A-1 where the outer notes are lowered by a comma. Contiguous with this is the diezeugmenon tetrachord whose pitches are B-1/C/D/E-1 which has the same disposition of intervals. When the canonic voice enters in measure 2, there is a subtle change in pitch classes whereby the first of the above tetrachords (meson) now is presented as E/F+1/G/A. As the "F+1" pitch enters, although it forms a perfect consonance there is an audible comma cross-relation.(13) As the music progresses, a subtle change in pitch classes is now applied to the diezeugmenon tetrachord so that by measure 6 the pitches have become B/C+1/D/E (all pitches except the D having been raised by a Syntonic comma). This facilitates harmonic and consonance stability with the changed note patterns established for the meson tetrachord. But these changes now bring about further alterations to the pitches of the meson tetrachord (because of the new presence of "C+1") whose notes are now E/F+1/G+1/A. This has now introduced a "G+1" pitch class (needed to harmonize with the previously-introduced "C+1," which in turn had been applied because of the previous "F+1").(14) This sharpwards movement continues one stage further because Willaert at measure 9 changes the harmony from a prevailingly "minor mode" euphony to a new "major mode" one. In asserting a major chord on "G+1," Willaert now has to apply the new "D+1." Furthermore in measure 11 Willaert reverts to a "minor mode" euphony based upon his most recent "D+1" pitch class. In this harmony, the "F+1" first introduced in measure 3 must now be further raised to become "F+2," while also the long-established "A" has to be inflected upwards to "A+1." One further stage in the rising pitch inflection still has to take place: in measure 12 the already-present "C+1" has to be raised to become "C+2" to provide harmony with the now-established "F+2." By measure 14, therefore, all starting pitches have been raised, some by up to two commas.

[23] The technical challenge for Willaert is now to establish, from this point, a way to steer the music back to its base pitch while still maintaining the discipline of canonic writing and also preserving absolute purity of consonance at all times. One further significant—but utterly decisive—"comma control point" is all that is needed, and Willaert supplies this with effortless skill and economy in measure 15. Having there arrived (beat 2) at the chord D+1/F+2/A+1, Willaert now asserts a further comma control point (beat 4) whereby voice 1 descends to G+1 as voice 3 rises to E (both notes having thereby been restored to their former pitches) with voice 2 taking C+1 (also restored in pitch). Again there is a slight (but indirect) "wolf" as voice 2 descends from F+2 to C+1 (being a slightly widened fourth), but this melodic move is a quite straightforward result of the provision of pure consonance against the pitches of the other two voices. The movement can be heard with the tunings described above in the audio file for Example 9.

[24] Willaert in this piece has therefore demonstrated how the pure tuning that arises from syntonically-disposed tetrachords brings about natural variations in and further developments to these tetrachords as the music created unfolds. He has also shown that the composer's job is not only to utilize the logical changes that occur to these patterns, but also actively to exercise control over such changes so as to maintain a universal (for the piece) pitch standard. This base pitch standard can perhaps be viewed as the "universal magnitude" within and from which the "celestial harmony" emanates. But the subtle changes and inflections of pitch classes required to fulfill this ideal are not likely to be immediately obvious to persons other than the composer who devised them. For this reason we may infer that the real purpose in requiring all his singers at St Mark's Venice to attend regular instruction in counterpoint was not for Willaert to teach them how to compose, but rather to coach them in the performance requirements of the specific pieces that he provided for them to sing.

[25] As a conclusion, the influence of Willaert upon his pupils—already noted with Zarlino—must be further emphasized. For this purpose a short section from a Mass by Cipriano de Rore will be examined. Through this example it will be shown how a composer, in using the simplest Syntonic scale, can utilize the given pitches so as to produce a flowing and harmonious counterpoint in which all consonances remain pure.

[26] **Example 10** shows an unannotated short score of the section "Et resurrexit" from the Credo of Rore's *Missa a note negre [Tout ce qu'on peut en elle voir]*. The scale pitches make use of the following three tetrachords (with octave duplications) given the upward comma inflections indicated by "+" to the notes concerned:

Meson tetrachord: E/F+/G/A
synemmenon tetrachord: A/B♭+/C+/D

Added *coniuncta* tetrachord: D/E♭+/F+/G

Since the synemmenon tetrachord (as opposed to the Diezeugmenon) is specified by the 1-flat signature as being the default, Rore (like Willaert) keeps the pitch of G in the Meson tetrachord at its Pythagorean position (thereby reversing the position of the major and minor tone in this tetrachord). This enables pure consonances to be used against D, E♭+ and B♭+, but inhibits the use of consonances on C+ against which the G would form a "wolf." Rore seems deliberately to avoid "C chords," although measure 13 begins with such a chord from which the G is omitted. Measure 24 does however show a rare (for this piece) use of a full "C chord," and it is certain that here the default C+ would have been lowered to C so as to provide a pure compound third with the E♭+ introduced in voice 1. This would also remove the "wolf" that would have occurred with the G in voice 3. So even in such a simple piece there is evidence of the ever-present need to apply temporary changes to default pitches. Even though such a need is minimal in this movement, it demonstrates that a correct cognition and execution of the structure demands a high level of skill and proficiency on the part of the singer.

Roger Wibberley
Goldsmiths University of London,
Department of Music,
New Cross,
London SE14 6NW
r.wibberley@gold.ac.uk

Footnotes

1. Gioseffo Zarlino, *Le Istitutioni Harmoniche*, part 3, translated in Guy A. Marco and Claude V. Palisca *The Art of Counterpoint: Gioseffo Zarlino.* Part Three of 'Le Istitutioni Harmoniche', 1558 (New York, 1983). Full texts and graphics are available online at http://www.music.indiana.edu/smi/cinquecento.
Return to text

2. Though writing somewhat earlier, both Prosdocimus and Ugolino give very accurate specifications for the monochord positions of the notes of *musica ficta*. Equal weight is given to the power these *ficta* pitches must possess both in "perfecting the consonance" and in "coloring the dissonance." The pitch "F♯" therefore not only perfects the consonance with a lower B, but also colors the dissonance with a lower D. In this regard, the major third D-F♯ is described as a "colored dissonance." By this we must understand the "Pythagorean ditone" whose ratio is 81:64.
Return to text

3. This was first extensively discussed in Margaret Bent, "Diatonic *Ficta*," *Early Music History* 4 (1984), page 16. The version used here is the one proposed by Bent.
Return to text

4. I am now introducing a new method of notating comma inflection: each pitch is indicated by its letter name followed by a suffix consisting of an operand and a number. The notation "G" indicates the pitch of "Pythagorean G" (in any octave); while the notation "G-1" indicates "Pythagorean G lowered by a Syntonic comma." In other cases the notation "C+1" will indicate "Pythagorean C raised by a Syntonic comma," while the notation "E-2" will indicate "Pythagorean E lowered by two Syntonic commas." The purpose in using this notation is both analytic and functional. Not only does it enable each pitch to be understood in relation to the Pythagorean default against which it was deemed to exist in the world of JI, but it also instructs the computer program that generates the Audio files to provide exactly the correct pitch for the particular note employed. These pitches have been calibrated with mathematical precision, and when a comma analysis is undertaken, using this method of annotation, the results are given automatic and accurate playback through the computer program. A technical account of this process will be offered in a future article, together with a tool that will enable readers to generate accurate tuning through their own MIDI systems.
Return to text

5. Jonathan Walker, "Intonational Injustice: A Defense of Just Intonation in the Performance of Renaissance Polyphony," *Music Theory Online* 2.6 (1996), I.10.
Return to text

6. While, for example, B-flat/F forms a pure Pythagorean fifth, Walker's use of B-flat/F+ (in measure 48) injects an unacceptable and severe "wolf." The same combination occurs also in measures 49 and 51. In measure 49, Walker not only places an F+ against a B-flat, but also adds a D- in voices 1 and 2. While the use of D- creates a pure 5:4 third with the B-flat, the also-present F+ is wildly dissonant against both. While the combination of F/D- would have provided a pure 5:3 major sixth (being narrower by a Syntonic comma than its dissonant Pythagorean equivalent) the combination F+/D- actually prescribed narrows the interval by a further Syntonic comma creating thereby a double dissonance with the surrounding voices.
Return to text

7. No theorist even from the ancient world ever considered an interval as small as a comma (of any kind) to be melodic, and even Aristoxenus considered the smallest melodic interval to be the diesis.
Return to text

8. In order to perform according to Walker's prescription, the singers would need to engage in a game of "Deaf Man's Bluff." In this game, the singer of one voice would need to know in advance against which notes in another voice he should—in order to remain in tune with them—deliberately *avoid* singing in tune, because he will have been persuaded (in rehearsal) that the singer of the other voice will actually be intending to change the pitch of the note heard in such a way that if he *does* sing in tune against it he will then be "out of tune." All parties will also need to have been convinced that one (or more) of them was actively capable of singing a melodic Syntonic comma, and that the others were able to achieve the even more complex feat of *imagining in advance* what the effect of this will be so that they can then pitch their own notes accordingly in order to ensure that they all end up in tune. Since the last person to be considered during this entertainment is the *composer*, I would suggest that such anarchy has no connection whatsoever with the proper conceptual creation and execution of Syntonic tuning.
Return to text

9. I mean nothing more by this term than would reasonably be understood by a reader who can hear the sound of a major key and understand the ways in which it differs from that of a minor key.
Return to text

10. Hermann Zenck and Walter Gerstenberg, "Adrian Willaert, Opera Omnia," *Corpus Mensurabilis Musicae* vol. 3, 8.
Return to text

11. Willaert might even have felt some gratification that the music of other composers—especially when juxtaposed so closely in performance with his own—sounded less harmonious and more dissonant. Such differences would certainly have been noticed by informed listeners like Zarlino and Ganassi, both of whom remarked upon Willaert's uniqueness (the former noting his correction of "numerous errors" and the latter asserting his position as "the new Prometheus of celestial harmony").
Return to text

12. Such comma control shows that Willaert was aware throughout the composition of a new piece of exactly what, at any given moment, was the current "comma position" in relation to the base pitch. Careful comma analysis reveals that the base pitch will frequently but temporarily rise or fall by a comma during the unfolding of a composition, but that Willaert will generally hold this "comma drift" under tight control by taking appropriate evasive action to restore the pitch.
Return to text

13. I view these comma cross relations as "comma control points" and shall henceforward use this term to describe them. In this case the audible cross relation occurs between the new "F+1" in voice 1 and the previous "C" in voices 2 and 3. There is a perceptible "wolf," but it is absolutely indirect and the listener's awareness of its presence is only via a retrospective cognition of the previously-heard "C."
Return to text

14. In measure 7, beat 3, the "G+1" applied to voice 1 signals another audible "comma control point" by virtue of its juxtaposition with the previous pitch "D" in voice 3 against which there is another indirect "wolf."
Return to text

Copyright Statement

Prepared by Brent Yorgason, Managing Editor and Rebecca Flore and Tahirih Motazedian, Editorial Assistants