Journey to the Heart of Music

Philip Perry

Example H
Gilles Binchois – Chanson
Adieu m'amour et ma Maistresse

MUTABLE NUMBER ANALYSIS

It is often the case that innovative forward looking aspects of style appear first in the secular repertoire, only later to be adopted by the more conservative and constrained official circles of the church and musical establishment. The Burgundian chanson of the first half and more of the fifteenth century was such a vanguard of harmonic practice, taking up the leadership of harmonic development from the great English composer John Dunstable and the sweeter strains of the Italian Ars Nova. These delicate accompanied songs of love, regret and loss, almost a late medieval gentle courtly careworn 'blues', contrast with the more robust and sometimes harsh polyphony of the mass, which still looked backward, to a degree, to the style of Machaut of the Notre Dame School. The court of the Duchy of Burgundy (at this time an independent country in all but name straddling northern and eastern France) provided a focus for a cosmopolitan group of musicians led by Guillaume Dufay (circa 1400-74) and the master of the chanson Gilles Binchois (circa 1400-60).

The harmonic language of the chanson is far from standard common practice. There is a tendency toward parallel motion between the parts, for example, the altus and tenor, measures 14 through 16. And the Landini cadences, with double leading notes (eg. B-F# resolving to C-G, measures 2 to 3) coupled with the lower part approaching the tonic by stepwise descent, lend the whole piece an antique flavour. Elements old are mixed with more familiar features, such as the full or perfect cadence at measures 7 to 8 – though still employing stepwise motion in the tenor part. One of the defining characteristics of tonal harmony (first identified by Rameau) is the freedom of the lowest voice to move by steps of fifths and fourths: this is mostly absent. Here the older practice of contrapuntal thought blends with newer intuitions of harmonic logic. A metrical tension is induced through the abundant use of off-beat accents to exploit the uncertainties of 6/4 time; while the many accented, non-harmonic, passing notes similarly obscure the harmonic definition in places. However significantly, the piece does finish with a full (V-I) cadence. Given such an amalgam of conflicting features, the path traced by the additions, subtractions and multiplicative exchanges shown below is not absolutely compelling. There are a number of sequences which might be drawn differently and in particular the long series of fifteen groups of eight, in measure 13, is as much bravado as analysis. It is not to be expected that an example from so early in the tonal era should 'compute' its mutable number digit sequences with the fluency and ease of a fully compliant common-practice harmonic study.

Notwithstanding its many ancient and tonally irregular features, a MOS analysis copes with all these aspects, though sometimes at the expense of quite extended aggregated and nested series. Like for example, the groups of fifteen and sixteen needed to encompass the semitonal exchange of fundamentals (B to C) at the cadences at measures 2 to 3, and 12 to 13. There are two interesting aspects to these antique cadences, when viewed through the prism of mutable numbers, 1) the underlying nested series which enfold the upper level aggregates, have a dominant-tonic (V-I) relationship, foreshadowing later practice and 2) the minor harmony of the penultimate chord (eg. B-minor chord in measure 2) forces the underlying nested series into contention as the chord's minor-third cannot be placed in the uppermost aggregated series. Minor chords are as least as old as major chords, they were there right at the dawn of the tonal era. The major and minor triads emerged together. This requires explanation. If the minor triad is taken to be a less basic object than the major, a compound entity with two fundamental frequencies, then would it not be natural for the minor harmony to emerge later in tonal music, as a permutation of the structural architecture, after the system had firmly established itself on the basis of fundamental major tonal exchanges? This is not how it happened: major and minor chords can be found together in almost all phrases no matter how early the period. An alternative scenario which might account for the early appearance of minor harmonies, is that the structure of the minor triad favored the development of a scheme of nested of harmonic relationships in human cognitive processes, and this in turn developed into mutable number processing: tonal harmony. That is, the minor triad was the catalyst for the evolution of tonal harmony (i.e. mutable number processing) and later, the ever present necessity for maintaining the separation of two or more harmonic series in a nesting-nested relationship – which provides the underlying structure for the operation of tonal exchanges (i.e. chord progressions).

In the analysis below the actual frequency, in hertz, of the nested fundamentals and conjunctions are shown at the top and bottom of the written out series (pitch standard – middle C 256Hz). These numbers delineate the precise relational path of the analysis. Pleasingly, although the piece strays from its initial pitch level as it computes the various modulation exchanges, it returns to the opening level in the final measures.

The analysis is formed upon the basis of the objective notes driving the system through the top level aggregated series. Thus the designation of fundamental harmonics (with capital Hs) of the lowest series representing the sense of a tonal center, the 'key' – here F major – are approximate and notional. (The values in hertz show the exact and ever shifting real position of the music, as an ideal physical system of mutable digit sequences.) Similarly, the 'stacked factor format' reading, below the staff, summarises the structure of nesting in the system (i.e. the mutable number digit sequence, topped by the decimal value and note-letter) using a fixed grid of the tonic harmonics for conjunctions and accounting for the flexing of the real system through adjustments to the value of the unit fundamental.

At the bottom of each page the additions, subtractions and multiplications (i.e. modulation exchanges) of the nested and aggregated series are given. First, in black oblique type, the foreground top level aggregated series, which carry the majority of objective note and secondly, below in gray type, the additions, subtractions and exchanges of the background middle level nested series. The color scheme of black and gray is carried over into the ratios of the written-out series. Both the aggregated and nested series use a common conjunction for their computations, however, as often as not, these computations will be different. Which is to say the aggregated and nested series will at times move in parallel and at other times independently. In particular the aggregate groupings, marked by asterisks, can vary in their composition: breaking down into groups of two, three, four, five, etc., (depending on the divisibility of the nested series) and switch between alternative groupings, lending considerable flexibility to the range of mutable digit sequence exchanges. This is the heart of the mutable number analysis, the dance-like motions of the extended nested series and the aggregations able to form within them.

The lowest level fundamental series based on F 0.666...Hz is not shown, except in measure 1 and as capital Hn alternatives to the nested fundamentals (i.e. C-h1/H24). A Roman Numeral analysis is given between the tenor and contratenor staves.

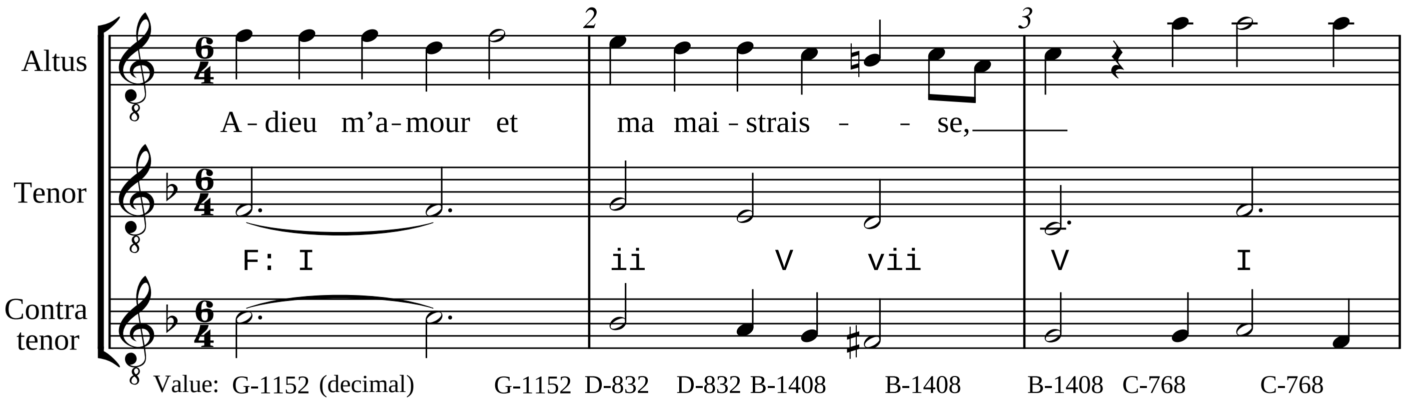
With regard to the metrical fluidity of the piece – with different voices move against each other in rhythmic groupings of two and three – the overall meter is perhaps best encapsulated as a mixture of 6/4 and 3/2 time. As illustrated in the figure below these two meters are held together by the conjunction of the predominant subdivision of the melodic line (quarternotes) and linked by a reversible primary sesquialtera 2:3 modulation exchange. In the formal language of mutable numbers this would be expessed as:

$$\text{MBN: } 3_2 0_1 = 2_3 0_1 \text{ (= Decimal 6)}$$

6/4 meter = (2 groups of 3) <——2:3——> (3 groups of 2) = 3/2 meter

```
eighthnote figuration:    h6                h4      :eighthnote figuration
   quarternote melody:    h3   conjunction  h2      :quarternote melody
   dotted quarternote:    h2                h1/H3   :halfnote pulse
dotted halfnote pulse:    h1/H2     2:3        H2   :dotted halfnote
       meter 6/4 time:       H1                H1   :meter 3/2 time
```

H.4 - CHANSON, G. BINCHOIS



Value:	G-1152 (decimal)	G-1152	D-832	D-832	B-1408	B-1408	B-1408	C-768	C-768
Mutable Digit Sequence	9	8	6	9	15	16	15	8	6
	4	5	5	4	4	5	4	4	4
	32 (Tonal Center F)	28	28	24	24	18	24	24	32
	1	1.029	0.990	0.962	0.978	0.978	0.978	1	1

Conjunction:>
Objective Notes: ◯
Aggregates: *
Mid.C=256Hz

```
G-768.0(h36)*> 768Hz
F-682.6(h32)*
D#597.3(h28)*
C-512.0(h24)*
A-426.6(h20)*
G#405.3(h19)
G-384.0(h18)
F#362.6(h17)
F-341.3(h16)*
E-320.0(h15)
D#298.6(h14)
D-277.3(h13)
C-256.0(h12)*
B-234.6(h11)
A-213.3(h10)
G-192.0 (h9)
F-170.6 (h8)*
D#149.3 (h7)
C-128.0 (h6)
A-106.6 (h5)
F- 85.3 (h4)*R
C- 64.0 (h3)
F- 42.6 (h2)
F- 21.3 (h1/H32)
...............
F-  0.666Hz (H1)
```

```
G-h40*
- h35*
D-h30*> 576Hz
B-h25*
A#h24
- h23
A-h22
G#h21
G-h20*
F#h19
F-h18
E-h17
D#h16
D-h15*
C#h14
C-h13
A#h12
A-h11
G-h10*
F- h9
D# h8
C# h7
A# h6
G- h5*R
D# h4
A# h3
D# h2
D#h1/H28
(19.200Hz)
```

```
B-h60*> 960Hz
A#h56*
A-h52*
G-h48*
F#h44*
E-h40*
D-h36*
- h35
C-h32*
A#h28*
G-h24*
- h23
F#h22
F-h21
E-h20*
D#h19
D-h18
C#h17
C-h16*
B-h15
A#h14
A-h13
G-h12*
F#h11
E-h10
D- h9
C- h8*
A# h7
G- h6
E- h5
C- h4*R
G- h3
C- h2
C-h1/H24
(16.000Hz)
```

```
B-h80*>
- h75*
- h70*
- h65*
F#h60*
- h55*
D#h50*
- h45*
B-h40*
- h35*
F#h30*
D#h25*
D-h24
- h23
C#h22
C-h21
B-h20*
A#h19
A-h18
G#h17
G-h16
F#h15*
F-h14
E-h13
D-h12
C#h11
B-h10*
A- h9
G- h8
F- h7
D- h6
B- h5*R
G- h4
D- h3
G- h2
G-h1/H18
(12.000Hz)
```

```
B-h60*
A#h56*
A-h52*
G-h48*
F#h44*
E-h40*
D-h36*
C-h32*> 512Hz
A#h28*
G-h24*
- h23
F#h22
F-h21
E-h20*
D#h19
D-h18
C#h17
C-h16*
B-h15
A#h14
A-h13
G-h12*
F#h11
E-h10
D- h9
C- h8*
A# h7
G- h6
E- h5
C- h4*R
G- h3
C- h2
C-h1/H24
(16.000Hz)
```

```
C-h24*>
- h23
B-h22
A#h21
A-h20*
G#h19
G-h18
F#h17
F-h16*
E-h15
D#h14
D-h13
C-h12*
B-h11
A-h10
G- h9
F- h8*
D# h7
C- h6
A- h5
F- h4*R
C- h3
F- h2
F- h1/H32
(21.333Hz)
```

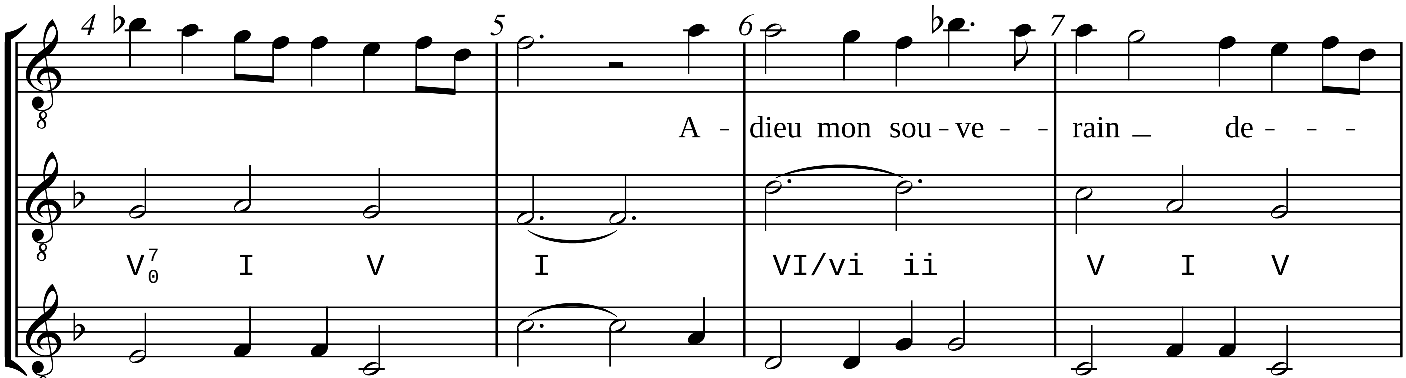
[Primary Sesquioctava Exchange]

Aggregated Series: (9 groups of 4) -----8:9----> (8 groups of 5)
(-2 grps of 5)
(6 groups of 5) 3:2 (9 groups of 4)
(+6 grps of 4)
(15 grps of 4) 16:15 (16 grps of 5) 15:16 (15 grps of 4)
(-7 grps of 4)
(8 grps of 4) -3:4-> (6 grps of 4)

[Quaternary Sesquinona Exchange]

Nested Series: (4 x nine) --------10:9-------> (4 x ten)
(-10 x one)
(6 x five) ----6:5----> (6 x six)
(+24 x one)
(20 x three) 4:3 (20 x four) -3:4-> (20 x three)
(-28 x one)
(8 x four) ---3:4--> (8 x three) 4:3->

H.5 - CHANSON, G. BINCHOIS



C-768	C-768	C-768	C-768	A-640	A-640	D-832	D-832	D-832	C-768	C-768	C-768
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
8	6	8	6	5	6	8	6	9	8	6	8
4	4	4	4	4	4	4	6	4	4	4	4
24	32	24	32	32	26	26	24	24	24	32	24
1	1	1	1	1	1.026	1	0.963	0.963	1	1	1

				(568.9Hz) D-h32*>	D-h36**>	D-h36*		
				C#h30	- h33*	C#h34	(505.7Hz)	
C-h32*> 512Hz	C-h24*>	C-h32*>	C-h24*	C-h28*	C-h32	C-h32*>	C-h24*>	C-h32*>
A#h28*	- h23	A#h28*	- h23	- h27	B-h30**	B-h30	- h23	A#h28*
G-h24*	B-h22	G-h24*	B-h22	B-h26	A#h28	A#h28*	B-h22	G-h24*
- h23	A#h21	- h23	A#h21	A#h25	- h27*	A-h26	A#h21	- h23
F#h22	A-h20*	F#h22	A-h20*>426.7Hz	A-h24*	A-h26	G#h25	A-h20*	F#h22
F-h21	G#h19	F-h21	G#h19	- h23	G#h25	G-h24*	G#h19	F-h21
E-h20*	G-h18	E-h20*	G-h18	G#h22	G-h24**	- h23	G-h18	E-h20*
D#h19	F#h17	D#h19	F#h17	G-h21	- h23	F#h22	F#h17	D#h19
D-h18	F-h16*	D-h18	F-h16*	F#h20*	F#h22	F-h21	F-h16*	D-h18
C#h17	E-h15	C#h17	E-h15	F-h19	F-h21*	E-h20*	E-h15	C#h17
C-h16*	D#h14	C-h16*	D#h14	E-h18	E-h20	D#h19	D#h14	C-h16*
B-h15	D-h13	B-h15	D-h13	D#h17	D#h19	D-h18	D-h13	B-h15
A#h14	C-h12*	A#h14	C-h12*	D-h16*	D-h18**	C#h17	C-h12*	A#h14
A-h13	B-h11	A-h13	B-h11	C#h15	C#h17	C-h16*	B-h11	A-h13
G-h12*	A-h10	G-h12*	A-h10	C-h14	C-h16	B-h15	A-h10	G-h12*
F#h11	G- h9	F#h11	G- h9	B-h13	B-h15*	A#h14	G- h9	F#h11
E-h10	F- h8*	E-h10	F- h8*	A-h12*	A#h14	A-h13	F- h8*	E-h10
D- h9	D# h7	D- h9	D# h7	G#h11	A-h13	G-h12*	D# h7	D- h9
C- h8*	C- h6	C- h8*	C- h6	F#h10	G-h12**	F#h11	C- h6	C- h8*
A# h7	A- h5	A# h7	A- h5	E- h9	F#h11	E-h10	A- h5	A# h7
G- h6	F- h4*R	G- h6	F- h4*R	D- h8*	E-h10	D- h9	F- h4*R	G- h6
E- h5	C- h3	E- h5	C- h3	C- h7	D- h9*	C- h8*	C- h3	E- h5
C- h4*R	F- h2	C- h4*R	F- h2	A- h6	C- h8	A# h7	F- h2	C- h4*R
G- h3	F- h1/H32	G- h3	F- h1/H32	F# h5	A# h7	G- h6	F- h1/H32	G- h3
C- h2	(21.333Hz)	C- h2	(21.333Hz)	D- h4*R	G- h6**R	E- h5	(21.069Hz)	C- h2
C-h1/H24		C-h1/H24		A- h3	E- h5	C- h4*R		C-h1/H24
(16.000Hz)		(16.000Hz)		D- h2	C- h4	G- h3		(15.802Hz)
				D- h1/H26	G- h3*	C- h2		
				(17.777Hz)	C- h2	C-h1/H24		
					C-h1/H24	(16.000Hz)		
					(15.802Hz)			

(8 grps of 4) 3:4 (6 grps of 4) 4:3 (8 grps of 4) 3:4 (6 grps of 4)

(-1 grp of 4)

(5 grps of 4) 6:5 (6 grps of 4)

(+2 grp of 4)

(8 grps of 4) 3:4 (6 grps of 6) 3:2 (9 grps of 4)

(-1 grp of 4)

(8 grps 4)3:4(6 grps 4)4:3(8 grps 4)

(8 x four) -3:4-> (3 x three) -4:3-> (8 x four) -3:4-> (8 x three)

(-4 x one)

(4 x five) -6:5-> (4 x six)

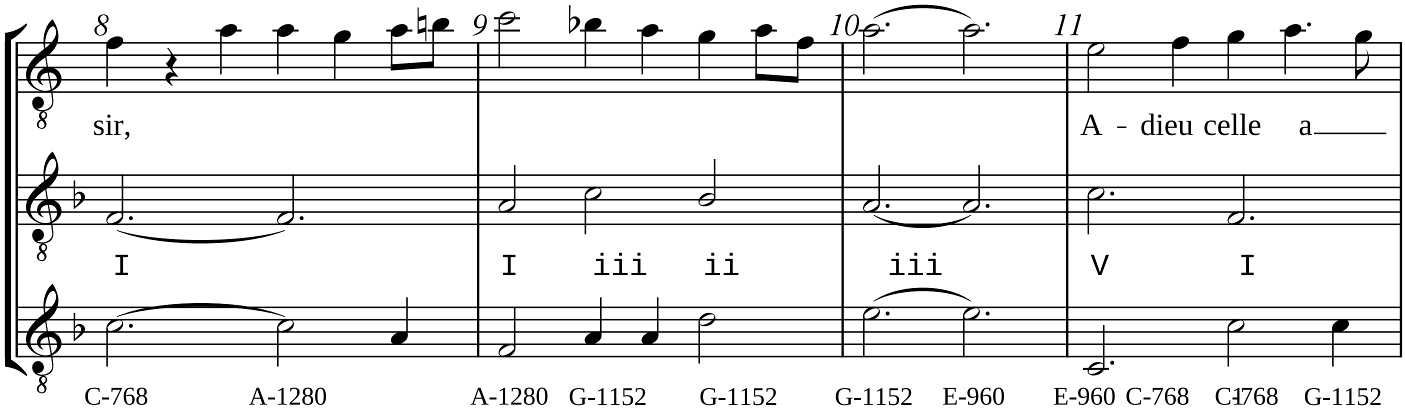
(+8 x one)

(4 x eight) -9:8-> (4 x nine)................

(-4 x one)

(8 x four) 3:4 (3 x three) 4:3 (8 x four)

H.6 - CHANSON, G. BINCHOIS



C-768	A-1280	A-1280	G-1152	G-1152	G-1152	E-960	E-960	C-768	C-768	G-1152
-----	-------	-------	-------	-------	-------	-----	-----	-----	-----	------
6	10	8	7	8	7	6	10	8	6	9
4	4	5	5	5	5	5	4	4	4	4
32	32	32	32	28	32	32	24	24	32	32
1	1	1	1.029	1.029	1.029	1	1	1		1

```
A-842.8(h40)*>   (842.8Hz)
G-758.5(h36)*
F-674.2(h32)*
D#589.9(h28)*
(505.7Hz) C-505.7(h24)*
A-421.3(h20)*
G#400.3(h19)
G-379.2(h18)
F#358.1(h17)
F-337.1(h16)*
E-316.0(h15)
D#294.9(h14)
D-273.9(h13)
C-252.8(h12)*
B-231.7(h11)
A-210.6(h10)
G-189.6(h9)
F-168.5 (h8)*
D#147.4 (h7)
C-126.4 (h6)
A-105.3 (h5)
F- 84.2 (h4)*R
C- 63.2 (h3)
F- 42.1 (h2)
F- 21.0 (h1/H32)
(21.070Hz)
```

```
A-h40*
G-h35*>
E-h30*
C#h25*
C-h24
- h23
B-h22
A#h21
A-h20*
G#h19
G-h18
F#h17
F-h16
E-h15*
D#h14
D-h13
C-h12
B-h11
A-h10*
G- h9
F- h8
D# h7
C- h6
A- h5*R
F- h4
C- h3
F- h2
F- h1/H32
(21.070Hz)
```

```
(737.4Hz)
G-h40*>
- h35*
D-h30*
B-h25*
A#h24
- h23
A-h22
G#h21
G-h20*
F#h19
F-h18
E-h17
D#h16
D-h15*
C#h14
C-h13
A#h12
A-h11
G-h10*
F- h9
D# h8
C# h7
A# h6
G- h5*R
D# h4
A# h3
D# h2
D# h1/H28
(18.436Hz)
```

```
G-h35*
E-h30*>632.1Hz
C#h25*
C-h24
- h23
B-h22
A#h21
A-h20*
G#h19
G-h18
F#h17
F-h16
E-h15*
D#h14
D-h13
C-h12
B-h11
A-h10*
G- h9
F- h8
D# h7
C- h6
A- h5*R
F- h4
C- h3
F- h2
F- h1/H32
(21.070Hz)
```

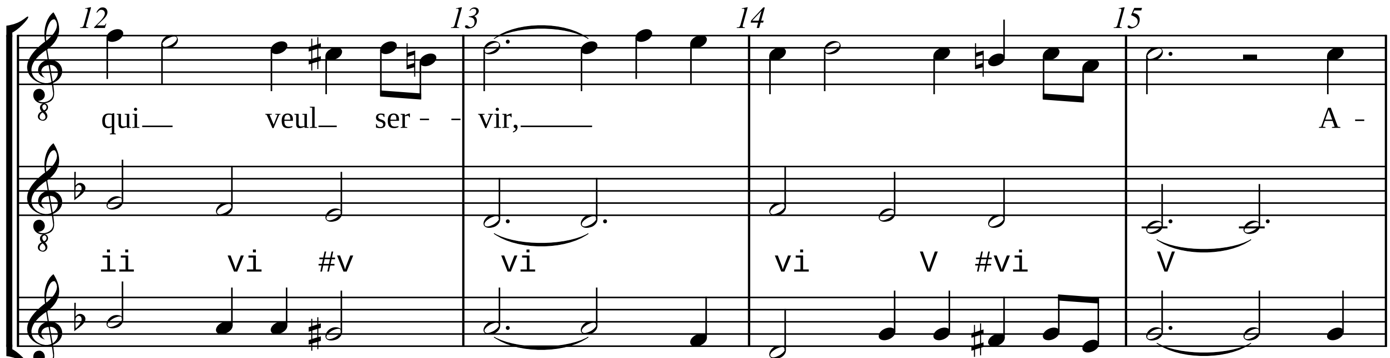
```
E-h40*
D-h36*
(505.7Hz) C-h32*>
A#h28*
G-h24*
- h23
F#h22
F-h21
E-h20*
D#h19
D-h18
C#h17
C-h16*
B-h15
A#h14
A-h13
G-h12*
F#h11
E-h10
D- h9
C- h8*
A# h7
G- h6
E- h5
C- h4*R
G- h3
C- h2
C-h1/H24
(15.802Hz)
```

```
G-h36*>758.5Hz
F-h32*
D#h28*
C-h24*
- h23
B-h22
A#h21
A-h20*
G#h19
G-h18
F#h17
F-h16*
E-h15
D#h14
D-h13
C-h12*
B-h11
A-h10
G- h9
F- h8*
D# h7
C- h6
A- h5
F- h4*R
C- h3
F- h2
F- h1/H32
(21.070Hz)
```

--3:4--> (6 groups of 4)
(+4 groups of 4)
(10 groups of 4) -------------4:5------------> (8 groups of 5)
(-1 group of 5)
(7 grps of 5) 8:7 (8 grps of 5) 7:8 (7 grps of 5)
(-1 group of 5)
(6 grps of 5) -5:3-> (10 grps of 4)
(-2 grps of 4)
(8 grps of 4) 3:4 (6 grps of 4)
(+3 grps of 4)
(9 grps of 4) 8:9

--3:4--> (8 x three)
(+16 x one)
(1 x forty) --------------------1:1------------------> (1 x forty)
(-5 x one)
(5 x seven) -8:7-> (5 x eight) -7:8-> (5 x seven)
(-5 x one)
(10 x three) -4:3-> (10 x four)
(-8 x one)
(8 x four) -3:4-> (6 x four)
(+12 x one)
(12 x three) 4:3

H.7 - CHANSON, G. BINCHOIS



G-1152	D-832	D-832	C#1600	C#1600	C#1600	C#1600	D-832	D-832	B-1408	B-1408	B-1408	G-1152
8	6	8	15	16	15	15	8	9	15	16	15	12
6	6	5	5	5	8	5	5	4	4	5	4	4
24	24	21	21	20	13	21	21	24	24	18	24	24
1	0.963	0.990	1.016	1	1.026	1.016	0.990	0.963	0.978	0.978	0.978	1

	C#h75*>	C#h80*>	C#h120**>1066.7Hz	C#h75*			
	- h70*	- h75*	-----	- h70*	B-h60*>	B-h80*>948.1Hz	B-h60*
(758.5Hz)	- h65*	- h70*	C#h60*	- h65*	A#h56*	- h75*	A#h56*
G-h48**	A-h60*	- h65*	C-h56**	A-h60*	A-h52*	- h70*	A-h52*
- h45*	- h55*	G#h60*	B-h52*	- h55*	G-h48*	- h65*	G-h48*>758.5Hz
F-h42**	F#h50*	- h55*	A-h48**	F#h50*	F#h44*	F#h60*	F#h44*
- h39* (568.9Hz)	- h45*	F-h50*	G#h44*	- h45*	E-h40*	- h55*	E-h40*
D-h36**	D-h40*	- h45*	F#h40** (568.9Hz)	D-h40*>	D-h36*	D#h50*	D-h36*
- h33*	- h35*	C#h40*	E-h36*	- h35*	- h35	- h45*	C-h32*>
C-h32	A-h30*	- h35*	D-h32**	A-h30*	C-h32*	B-h40*	A#h28*
B-h30**	F#h25*	G#h30*	C#h30	F#h25*	A#h28*	- h35*	G-h24*
A#h28	F-h24	F-h25*	C-h28*	F-h24	G-h24*	F#h30*	- h23
- h27*	- h23	E-h24	- h27	- h23	- h23	D#h25*	F#h22
A-h26	E-h22	- h23	B-h26	E-h22	F#h22	D-h24	F-h21
G#h25	D#h21	D#h22	A#h25	D#h21	F-h21	- h23	E-h20*
G-h24**	D-h20*	D-h21	A-h24**	D-h20*	E-h20*	C#h22	D#h19
- h23	C#h19	C#h20*	- h23	C#h19	D#h19	C-h21	D-h18
F#h22	C-h18	C-h19	G#h22	C-h18	D-h18	B-h20*	C#h17
F-h21*	B-h17	B-h18	G-h21	B-h17	C#h17	A#h19	C-h16*
E-h20	A#h16	A#h17	F#h20*	A#h16	C-h16*	A-h18	B-h15
D#h19	A-h15*	A-h16	F-h19	A-h15*	B-h15	G#h17	A#h14
D-h18**	G#h14	G#h15*	E-h18	G#h14	A#h14	G-h16	A-h13
C#h17	G-h13	G-h14	D#h17	G-h13	A-h13	F#h15*	G-h12*
C-h16	F-h12	F#h13	D-h16**	F-h12	G-h12*	F-h14	F#h11
B-h15*	E-h11	E-h12	C#h15	E-h11	F#h11	E-h13	E-h10
A#h14	D-h10*	D#h11	C-h14	D-h10*	E-h10	D-h12	D- h9
A-h13	C- h9	C#h10*	B-h13	C- h9	D- h9	C#h11	C- h8*
G-h12**	A# h8	B- h9	A-h12*	A# h8	C- h8*	B-h10*	A# h7
F#h11	G# h7	A- h8	G#h11	G# h7	A# h7	A- h9	G- h6
E-h10	F- h6	G- h7	F#h10	F- h6	G- h6	G- h8	E- h5
D- h9*	D- h5*R	E- h6	E- h9	D- h5*R	E- h5	F- h7	C- h4*R
C- h8	A# h4	C# h5*R	D- h8**R	A# h4	C- h4*R	D- h6	G- h3
A# h7	F- h3	A- h4	C- h7	F- h3	G- h3	B- h5*R	C- h2
G- h6**R	A# h2	E- h3	A- h6	A# h2	C- h2	G- h4	C-h1/H24
E- h5	A# h1/H21	A- h2	F# h5	A# h1/H21	C-h1/H24	D- h3	(15.802Hz)
C- h4	(14.222Hz)	A- h1/H20	D- h4*	(14.222Hz)	(15.802Hz)	G- h2	
G- h3*		(13.333Hz)	A- h3			G- h1/H18	
C- h2			D- h2			(11.852Hz)	
C-h1/H24			D- h1/H13				
(15.802Hz)			(8.888Hz)				

--> (8 grps of 6)
(-2 grps of 6)
(6 grps of 6) 4:3 (8 grps of 5)
(+7 grps of 5)
(15 grps 5) 16:15 (16 grps 5) 15:16 (15 grps 8) -1:1-> (15 grps of 5)
(-7 grps of 5)
(8 grps of 5) 9:8 (9 grps of 4)
(+6 grps of 4)
(15 grps of 4)16:15 (16 grps of 5)15:16 (15 grps of 4)
(-3 grps of 4)
(12 grps of 4) ->

-> (12 x four)
(-12 x one)
(4 x nine) 10:9 (4 x ten)
(+35 x one)
(5 x fifteen) 16:15 (5 x sixteen)
(40 x two) -3:2-> (40 x three)
(15 x eight) -5:8-> (15 x five)
(-35 x one)
(4 x ten) -9:10-> (4 x nine)
(+24 x one)
(20 x three) 4:3 (20 x four) -3:4-> (20 x three)
(-12 x one)
(12 x four) -->

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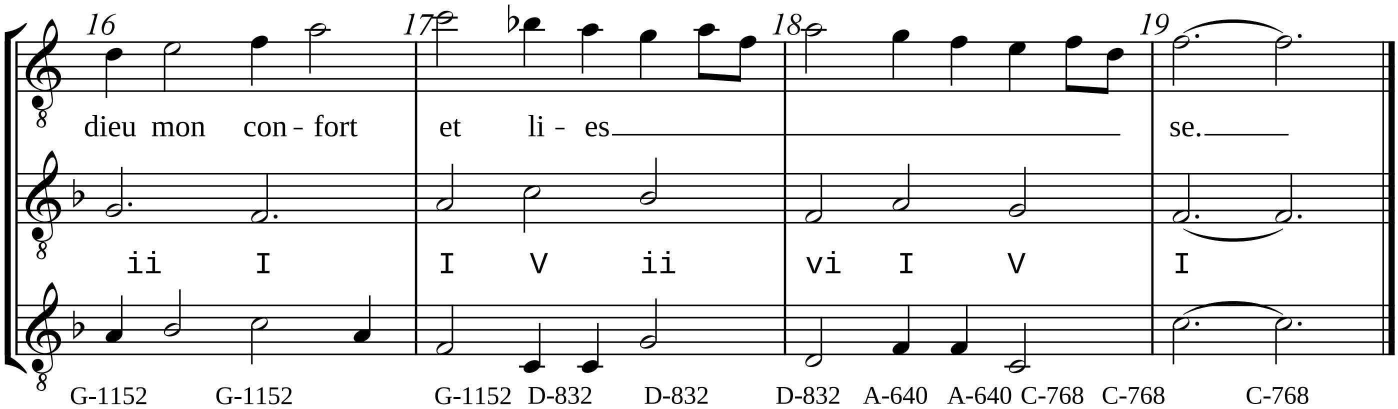

G-1152	G-1152	G-1152	D-832	D-832	D-832	A-640	A-640	C-768	C-768	C-768
12	9	12	9	6	8	6	5	6	8	6
4	4	4	4	5	5	5	4	4	4	4
24	32	24	24	28	21	21	32	32	24	32
1	1	1	0.963	0.990	0.990	1.016	1	1	1	1

```
G-h48*>
F#h44*
E-h40*
D-h36*
C-h32*>
A#h28*
G-h24*
- h23
F#h22
F-h21
E-h20*
D#h19
D-h18
C#h17
C-h16*
B-h15
A#h14
A-h13
G-h12*
F#h11
E-h10
D- h9
C- h8*
A# h7
G- h6
E- h5
C- h4*R
G- h3
C- h2
C-h1/H24
(15.802Hz)
```

```
G-h36*> 758.5Hz
F-h32*
D#h28*
C-h24*
A#h21
A-h20*
G#h19
G-h18
F#h17
F-h16*
E-h15
D#h14
D-h13
C-h12*
B-h11
A-h10
G- h9
F- h8*
D# h7
C- h6
A- h5
F- h4*R
C- h3
F- h2
F- h1/H32
(21.070Hz)
```

```
G-h48*
F#h44*
E-h40*
D-h36*>
C-h32*
A#h28*
G-h24*
- h23
F#h22
F-h21
E-h20*
D#h19
D-h18
C#h17
C-h16*
B-h15
A#h14
A-h13
G-h12*
F#h11
E-h10
D- h9
C- h8*
A# h7
G- h6
E- h5
C- h4*R
G- h3
C- h2
C-h1/H24
(15.802Hz)
```

```
(568.9Hz)
D-h30*>
B-h25*
A#h24(426.7Hz)
- h23
A-h22
G#h21
G-h20*
F#h19
F-h18
E-h17
D#h16
D-h15*
C#h14
C-h13
A#h12
A-h11
G-h10*
F- h9
D# h8
C# h7
A# h6
G- h5*R
D# h4
A# h3
D# h2
D# h1/H28
(18.963Hz)
```

```
D-h40*
- h35*
A-h30*>
F#h25*
F-h24
- h23
E-h22
D#h21
D-h20*
C#h19
C-h18
B-h17
A#h16
A-h15*
G#h14
G-h13
F-h12
E-h11
D-h10*
C- h9
A# h8
G# h7
F- h6
D- h5*R
A# h4
F- h3
A# h2
A# h1/H21
(14.222Hz)
```

```
(512.0Hz)
C-h24*>
- h23
B-h22
A#h21
A-h20*
G#h19
G-h18
F#h17
F-h16*
E-h15
D#h14
D-h13
C-h12*
B-h11
A-h10
G- h9
F- h8*
D# h7
C- h6
A- h5
F- h4*R
C- h3
F- h2
F- h1/H32
(21.333Hz)
```

```
C-h32*>
A#h28*
G-h24*
- h23
F#h22
F-h21
E-h20*
D#h19
D-h18
C#h17
C-h16*
B-h15
A#h14
A-h13
G-h12*
F#h11
E-h10
D- h9
C- h8*
A# h7
G- h6
E- h5
C- h4*R
G- h3
C- h2
C-h1/H24
(16.000Hz)
```

```
C-h24*
- h23
B-h22
A#h21
A-h20*>
G#h19
G-h18
F#h17
F-h16*
E-h15
D#h14
D-h13
C-h12*
B-h11
A-h10
G- h9
F- h8*
D# h7
C- h6
A- h5
F- h4*R
C- h3
F- h2
F- h1/H32
(21.333Hz)
```

--> (12 grps of 4) -3:4-> (9 grps of 4) --4:3--> (12 groups of 4)
(-3 group of 4)
(9 grps of 4) 2:3 (6 grps of 5) 4:3 (8 grps of 5)
(-2 grps of 5)
(6 grps of 5) 5:6 (5 grps of 4)
(+1 group of 4)
(6 grps of 4) 4:3 (8 grps of 4) 3:4 (6 grps of 4)

--> (12 x four) ---3:4--> (12 x three) ------4:3----> (12 x four)
(-12 x one)
(6 x six) 5:6 (6 x five)
(10 x three) 4:3 (10 x four)
(-10 x one)
(10 x three) 2:3 (10 x two)
(+4 x one)
(8 x three) 4:3 (8 x four) -3:4-> (8 x three)