

## Rough Summary of the Musarithmic Method in Gaspar Schott's Organum Mathematicum (1668)

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### Preface

This summary is based on the digital facsimile at ECHO and the work of Dr. H.J.Vollrath:

<http://echo.mpiwg-berlin.mpg.de/content>

<http://www.didaktik.mathematik.uni-wuerzburg.de/history/vollrath/>

### I. Composing Simple Counterpoint

There are four sets of tables for creating simple, note-against-note counterpoint. The table to be used is determined by the number of syllables in the verse which is being set, thus:

Meter	Syllables per line	Example
Euripedean (fig. 1a)	6/6/6/6	<i>Ave maris stella</i>
Anacreontic (fig. 1b)	7/7/7/7	<i>O felix ter quaterque</i>
Sapphic (fig. 2a)	11/11/11/5	<i>Iste Domini sacratus confessor</i>
Archilochic (fig. 2b)	8/8/8/8	<i>Veni Creator Spiritus</i>

An appropriate key must then be chosen (fig. 5). The keys that are applicable to each style are indicated at the top of each table (figs.1-4), e.g. *Toni I.II.III.IV*. The selection of the key should also depend on the theme of the words being set and their corresponding modal *ethos*:

Key/Tonus	Mood/Ethos
I	Pious, religious, modest
II	Happy, strolling, dancing
III	Tearful, mourning, sad
IV	Groaning, sad, funereal
V	Heroic, wandering, cheerful
VI	Warlike, rousing, glorious
VII	Somewhat sad, mournful, delightful (Espinoza describes it as “uniting pleasure and sadness”)
VIII	Cheerful, wandering, beautiful

NB: The keys marked minor (molle) have Bb in their key-signature. Some notes are also marked flat and sharp – these accidentals should be employed when the

succeeding note either descends by one step (so E-D becomes Eb-D) or if it rises by one step (F-G becomes F#-G).

An example of the setting of *Ave maris stella*, in the Euripidean meter and the Key II:

1. You should have some manuscript paper available with the staves set out for the four voices (Cantus, Alto, Tenor, Bass).
2. For the first line of the verse (e.g. *Ave maris stella*) consult the first of the tables relating to the Euripidean meter (fig. 1a)
3. Choose one of the six sets of tone-numbers. Each set consists of four rows, corresponding to the four voices. The numbers of Cantus, Alto and Tenor may be shuffled. In this example we choose the following set:

C: 3 4 5 4 2 3  
 A: 8 7 7 6 5 5  
 T: 5 4 3 8 7 8  
 B: 1 2 3 4 5 1

4. Choose a rhythmic scheme from the lower section of the table. There are two groups of schemes, for common (4/4) time and 3/2 time. Choose one row of rhythmic values: this will apply to all the voices. In this example the following scheme is chosen:

1/4.    1/8    1/4    1/4    1/2    1/2

Note that some rhythmic rows also have a rest preceding them, of either a half or quarter duration.

5. For each voice look up the tone-numbers on the table of the second key (fig. 5) to find what note to place. Set the note down with its corresponding rhythmic unit. So the example being discussed:

C: 3 4 5 4 2 3	B	C	D	C	A	#B (e.g. natural)
A: 8 7 7 6 5 5	G	F	F	bE	D	D
T: 5 4 3 8 7 8	D	C	B	G	#F	G
B: 1 2 3 4 5 1	G	A	B	C	D	G
	1/4.	1/8	1/4	1/4	1/2	1/2

may be notated thus:

**Cantus.**

**Altus.**

**Tenor.**

**Bassus.**

A ve ma ris fel la.

For the next line of the song, proceed to the second group of tone-numbers and rhythmic schemes (e.g. Stropha II) and so on.

## II. Composing Florid Counterpoint in Euripidean and Archilocheic meters

Schott provides two sets of tables for creating more intricate settings of Euripidean (figs. 4a & 4b) and Archilocheic (figs. 5a & 5b) verses. The technique is basically the same as the one detailed above. Briefly:

1. Select the group of tables appropriate to the meter (e.g. Euripidean = 6 syllables, Archilocheic = 7 syllables).
2. Choose a key.

3. Choose a group of tone-numbers (e.g. from fig.5a or 6a). Note that the number of tone-numbers in some cases exceeds the number of syllables, allowing for the creation of melismatic passages.

4. Choose a group of rhythmic units (fig. 5b or 6b).

5. Our first line may look something like this:

C: 2 4 3 2 1 5 1 7 6 7	A	C	B	A	G	D	A	F	E #F
	1/1.	1/2.	1/2	1/2	1/4	1/4	1/1	1/4	1/2 1/1
A: 7 6 5 4 3 2 8 2	F	E	D	C	B	A	G	A	
	1/1.	1/2	1/2	1/2	1/1.	1/4	1/4	1/1	
T: 2 2 7 7 5 5	A	A	F	F	D	D			
	1/1.	1/2	1/2	1/2	2/1	1/1			
B: 5 2 3 7 1 5	D	A	B	F	G	D			
	1/1.	1/2	1/2	1/2	2/1	1/1			

Notated:

### III. Composition and simple counterpoint of a bass voice

A text of any length can be set using the tables in figure 6. The table shows groups of tone-numbers and rhythmic units divided into syllabic groups, and further subdivided depending on whether the penultimate syllable in the group is long or short.

An example of constructing a bass voice using the text *Laudate Dominum omnes Gentes*:

1. Choose an appropriate key.

2. The text is divided into syllabic groups – in this case six (*Laudate Dominum*) and four (*omnes Gentes*) syllables.

3. Since the penultimate syllable of *Laudate Dominum* is short a row of tone-numbers and a row of rhythmic units are chosen from the appropriate part of the table (e.g. the section *Sexsyllaba Pen: Brev:*):

5	3	1	5	5	1
1/1	1/2	1/2	1/2.	1/4	1/1

Likewise for *Omnes Gentes*:

8	4	5	1
1/1	1/2	1/1	1/1

4. Therefore, using the 6<sup>th</sup> key, the bass line would be:

Laudate Dominum						
5	3	1	5	5	1	
	C	A	F	C	C	F
	1/1	1/2	1/2	1/2	1/4	1/1
Omnes Gentes						
8	4	5	1			
	F	B	C	F		
	1/1	1/2	1/1	1/1		

5. To compose the counterpoint, the tables shown in figs.7a & 7b are used. For each note of the bass line consult the appropriate section. Above the bass staff are the staves for the rest of the voices. Each one has a selection of notes indicated which can be chosen to harmonise with the bass voice. The numbers indicate their relation to the bass note, e.g. a 3 indicates that note is a diatonic third above the bass. Choose a value for each voice. For each bass note, the numbers 3, 5 and 8 should be distributed between each of the three voices. The following should be noted:

Care should be taken not to have two consecutive 5s or 8s – if this is the case then swap intervals with the voice below.

The voices should also be kept close together, avoiding wide intervals (e.g. more than an octave between parts), since they sound more harmonious this way.

The final composition may look like this:

*Applicatorius*

*Exemplum Melothesia ope baculorum.*

Clavium. -f-

The image shows a musical score for a clavichord. On the left, there are five systems of musical notation, each consisting of a treble clef staff and a bass clef staff. The notes are labeled with letters: a, b, c, d, e, f, g. The first system has a dynamic marking '-f-'. Below the notation, there are five vertical lines, each with a diamond-shaped marker. These markers are placed at various intervals along the lines, corresponding to the notes in the notation above. At the bottom of the page, there are labels: C, A, F, CC, E, F, B, C, F, and s.VL.

C A F CC E F B C F s.VL

The figure displays four columns of musical notation for Euripidean strophes, labeled Strophae I, II, III, and IV. Each column contains a grid of numbers (5, 8, 3, 7) representing rhythmic values, a section titled 'Nota temporis' with vertical stems and dots, and a section titled 'Trijila' with horizontal lines and dots.

**Stropha I:** Toni. I. II. III. IV. (Numbers: 5 5 3 2 3 3, 8 5 5 7 7 7, 3 2 3 4 5 5, 8 5 8 7 3 3, 5 5 5 5 5 5, 8 8 8 7 8 8, 3 3 3 2 3 3, 1 1 1 5 1 1, 8 2 3 6 5 5, 5 7 8 8 7 8, 3 4 8 4 2 3, 8 7 6 4 5 5, 8 2 3 2 1 7, 8 7 7 7 5 5, 5 5 5 4 3 2, 8 5 3 4 8 5, 3 2 3 4 5 5, 8 7 8 2 7 7, 5 5 5 2 3 3, 8 5 1 7 3 3, 3 4 5 4 2 3, 8 7 7 6 5 5, 5 4 3 8 7 8, 1 2 3 4 5 1)

**Stropha II:** Toni. I. II. III. IV. (Numbers: 5 4 3 2 4 2, 7 7 5 7 8 7, 3 2 3 5 8 5, 3 7 8 5 6 5, 3 3 3 3 2 2, 7 7 7 7 7 7, 5 5 5 5 4 4, 3 3 3 3 7 7, 7 6 7 3 2 2, 2 4 5 5 4 5, 7 8 5 8 6 7, 5 4 3 1 2 3, 3 2 3 5 4 5, 5 7 8 7 7 7, 3 4 8 3 2 8, 8 7 6 3 7 3, 3 2 3 5 8 3, 5 7 8 7 6 5, 3 4 8 7 4 7, 8 7 6 5 4 3, 3 2 3 5 2 3, 5 7 8 7 6 5, 3 4 8 3 4 7, 8 7 6 5 4 3)

**Stropha III:** Toni. I. II. III. IV. (Numbers: 5 5 4 3 2 3, 7 7 7 5 7 7, 3 3 2 3 4 5, 3 3 7 8 7 3, 2 2 2 2 8 7, 7 7 7 7 5 5, 4 4 4 4 3 2, 7 7 7 7 8 5, 7 2 3 5 4 5, 5 7 8 7 7 7, 3 4 8 3 2 3, 8 7 6 3 7 3, 5 4 5 4 3 2, 7 7 7 7 8 7, 3 2 3 4 5 5, 3 7 3 2 1 7, 5 4 6 5 4 5, 7 2 3 2 8 7, 5 7 3 5 8 2, 3 2 1 7 6 5, 5 4 6 5 4 5, 7 2 3 2 8 7, 5 7 3 5 8 2, 3 2 1 7 6 5)

**Stropha IV:** Toni. I. II. III. IV. (Numbers: 5 4 3 4 2 3, 7 7 5 6 5 5, 3 2 3 1 7 1, 3 7 8 4 5 1, 5 5 4 3 2 3, 7 7 6 5 5 5, 3 3 1 1 7 1, 3 3 4 1 5 1, 7 7 6 8 7 8, 5 5 4 3 5 5, 3 3 8 8 2 3, 3 3 4 6 5 1, 8 7 6 8 7 8, 6 5 4 5 5 5, 3 3 1 3 2 3, 6 3 4 1 5 1, 8 8 2 3 2 3, 6 5 7 8 7 8, 1 1 4 5 5 5, 4 3 2 1 5 1, 5 5 4 3 2 3, 7 7 6 5 5 5, 3 3 1 1 7 1, 3 3 4 1 5 1)

**Nota temporis:** Vertical stems with dots representing rhythmic notation.

**Trijila:** Horizontal lines with dots representing rhythmic notation.

Fig. 1a. Euripidean (6 syllables) – Simple Counterpoint





Archilochica. Stropha. I.	Archilochica. Stropha. II.	Archilochica. Stropha. III.	Archilochica. Stropha. IV.
Toni. V. VI. VIII.	Toni. V. VI. VIII.	Toni. V. VI. VIII.	Toni. V. VI. VIII.
5 5 5 4 3 2 2 1 8 2 8 8 8 7 7 8 3 2 3 6 5 5 5 5 8 5 3 4 1 5 5 1	5 4 3 1 4 3 3 4 8 8 7 6 8 8 8 8 5 6 5 3 6 5 5 6 8 4 5 6 4 1 1 4	3 2 3 4 3 2 2 3 8 7 8 2 8 7 7 8 5 5 5 6 5 5 5 5 1 5 3 2 3 5 5 1	5 4 4 3 2 2 2 3 8 8 2 8 8 7 7 8 3 6 6 5 6 5 5 5 1 4 2 3 4 5 5 1
3 2 4 3 3 2 2 3 8 7 2 8 8 7 7 8 5 5 6 5 5 5 5 5 1 5 2 3 1 5 5 1	3 3 2 3 5 5 4 5 8 8 7 8 2 8 8 2 5 5 5 5 5 6 6 7 8 8 5 8 7 6 6 5	3 2 2 2 1 2 2 2 8 7 7 6 5 6 6 7 5 5 5 4 5 4 4 5 5 5 5 2 8 2 2 5	8 8 4 3 3 2 2 3 5 6 2 8 8 7 7 8 3 4 6 5 5 5 5 5 1 4 2 3 1 5 5 1
3 3 2 8 8 7 7 8 8 8 6 5 6 5 5 5 5 5 4 3 2 2 2 3 1 1 2 3 4 5 5 1	5 5 5 8 7 6 6 7 8 8 5 6 2 2 2 2 3 3 2 3 5 4 4 5 8 8 7 6 5 2 2 5	5 5 4 4 3 2 2 2 8 7 8 2 8 6 6 7 3 2 6 5 5 4 4 5 2 5 6 7 8 2 2 5	3 2 8 8 4 5 5 5 8 6 5 6 6 7 7 8 5 4 3 8 8 2 2 3 1 2 3 4 6 5 5 1
8 8 8 8 3 2 2 3 5 6 5 6 5 5 5 5 3 3 3 8 8 7 7 8 8 6 3 4 1 5 5 1	3 3 2 2 8 2 2 2 8 8 7 6 5 6 6 7 5 5 5 4 5 4 4 5 1 1 5 2 3 2 2 5	1 1 2 4 3 4 4 3 5 5 5 6 7 8 8 8 3 3 2 8 5 6 6 5 8 8 7 6 5 4 4 1	3 2 8 8 8 7 7 8 8 6 5 6 3 5 5 5 5 4 3 8 8 2 2 3 1 2 3 4 6 5 5 1
3 4 3 8 4 3 3 4 8 8 7 6 8 8 8 8 5 6 5 3 6 5 5 6 8 4 5 6 4 1 1 4	3 2 4 3 3 2 2 3 8 7 2 8 8 7 7 8 5 5 6 5 5 5 5 5 1 5 2 3 1 5 5 1	3 8 8 2 3 2 2 3 5 6 5 6 8 7 7 8 8 8 8 4 5 5 5 5 1 4 3 2 1 5 5 1	5 5 4 3 2 2 2 3 3 3 2 8 8 7 7 8 8 8 6 5 6 5 5 5 1 1 2 3 4 5 5 1
3 2 4 3 3 2 2 3 8 7 2 8 8 7 7 8 5 5 6 5 5 5 5 5 1 5 2 3 1 5 5 1	3 3 2 3 5 5 4 5 8 8 7 8 2 8 8 2 5 5 5 5 5 6 6 7 8 8 5 8 7 6 6 5	3 5 4 4 3 2 2 2 7 2 8 2 8 6 6 7 5 7 6 5 5 4 4 5 8 5 6 7 8 2 2 5	3 1 8 8 8 7 7 8 8 6 5 6 3 5 5 5 5 4 3 8 8 2 2 3 1 2 3 4 6 5 5 1
Notæ temporis.	Notæ temporis.	Notæ temporis.	Notæ temporis.
Tripla	Tripla	Tripla	Tripla
$\frac{3}{2}$ 0 0 0 1 1 0 1 1 0 1 1 $\frac{1}{2}$ 0 0 0 0 1 1 0 1 1 $\frac{1}{2}$ 0 0 0 0 0 0 0	$\frac{3}{2}$ 0 0 0 1 1 0 1 1 0 1 1 $\frac{1}{2}$ 0 0 0 0 1 1 0 1 1 $\frac{1}{2}$ 0 0 0 0 0 0 0	$\frac{3}{2}$ 0 0 0 1 1 0 1 1 0 1 1 $\frac{1}{2}$ 0 0 0 0 1 1 0 1 1 $\frac{1}{2}$ 0 0 0 0 0 0 0	$\frac{3}{2}$ 0 0 0 1 1 0 1 1 0 1 1 $\frac{1}{2}$ 0 0 0 0 1 1 0 1 1 $\frac{1}{2}$ 0 0 0 0 0 0 0

Fig. 2b. Archilochic (8 syllable) – Simple Counterpoint

<i>Euripidea stylo florido.</i> Stropha.I.	<i>Euripidea stylo florido.</i> strophæ.II.	<i>Euripidea stylo florido.</i> Stropha.III.	<i>Euripidea stylo florido.</i> Stropha.IV.
Toni. I. II. III. IV. 2432151767 76543282 227755 523715	Toni. I. II. III. IV. 3217655 1765414323 553388 156341	Toni. I. II. III. IV. 12345545 5456767 328222 876525	Toni. I. II. III. IV. 32827171 175655 54384323 123451
73327171 556655 28844323 534451	823347 551765 3283323 876543	5565545 888787 334323282 884565	882323 6542555 21171171 432151
57728767 345755 82343212 173715	55543282 772221717 255555 557785	72111767 575645545 343322 371125	1171171 665455 442823 445651
8888221717 555555 333232 888785	823545 558777 328332823 876373	3333323 771777 553545 34556573	432175171 666655 843282322 445651
6671171 444555 882323 442151	82332222 516767 345545545 888725	3465545 771217 54323282 328765	444323 666555 12171171 445151
712323 5571171 234555 532151	888767 5565545 332222 884525	553545 171777 3283323 856373	5565414323 11176545 334888 884341

Fig. 3a. Euripidean (6 syllable) Verse – Florid Counterpoint (tone-numbers)

The figure displays four columns of musical notation, each representing a strophe (Stropha. I, II, III, IV). Each column is headed with a triangular banner containing the text "Nota temporis". The notation consists of six staves per column, with notes represented by stems and flags. The notes are arranged in a grid-like pattern, with some notes having flags that indicate specific rhythmic values. The notation is a form of Florid Counterpoint, where note lengths are indicated by the number of flags on the stem.

Fig. 3b. Euripidean Verse (6 syllable) – Florid Counterpoint (note-lengths)

<i>Archiloehica florido. Stropha.I. stylo</i>	<i>Archiloehica florido. Stropha.II. stylo</i>	<i>Archiloehica florido. Stropha.III. stylo</i>	<i>Archiloehica florido. Stropha.IV. stylo</i>
Toni.V.VI.VII.VIII.	Toni.V.VI.VII.VIII.	Toni.V.VI.VII.VIII.	Toni.V.VI.VII.VIII.
17233223	335545665	235545223222	7771234555
5567851171	88287227	71217766667	55568878
32455555	552321234545	5523212545445	33338323
154321551	11765225	5876521225	33366551
55543223	14432212	71217766667	112173332223
87888878	66665665	555545545545	56758888878
32365555	32282334	2323212223222	34435556555
15341551	64267662	58765521225	14231184551
3332321171	343214434	327176717671	72878687678
11171655	88768888	1654545555	555554555
55555432123	56536555	5421313223	3232383223
88853451	84564114	1456341551	3715341551
32433223	55587667	432122343434	56535432878
87211171	332362222	286666711167111	8878765555
55655555	555545445	6543445654556	3428887323
15234551	88765225	23456228412114	845634151
34345545	33554523223	343233321171	3278767878
11122117	8828765667	11711165555	8654545555
565223282	55232124545	56555543223	5428383223
84887665	117654321225	845111234551	1456341551
32443223	54321771	233211171	71223171
71121171	876567555	78864555	56655455
55655555	5432312323223	5554328323	2667882323
58678551	876567565434551	53146551	55443651

Fig. 4a. Archiloehic Verse (8 syllable) – front (tone-numbers)

The image displays four vertical columns of musical notation, each representing a strophe of an Archilochic Verse (8 syllable) – back (tone-numbers). Each column is labeled at the top with 'Stropha.I.', 'Stropha.II.', 'Stropha.III.', and 'Stropha.IV.' respectively. Above each column, the text 'Notæ temporis' is written diagonally. The notation consists of circles and vertical lines representing tones and syllables. The first column (Stropha.I.) has 12 rows of notation. The second column (Stropha.II.) has 12 rows. The third column (Stropha.III.) has 12 rows. The fourth column (Stropha.IV.) has 12 rows. The notation is organized into groups of four rows each, with a small gap between the groups. The circles represent tones, and the vertical lines represent syllables. The notation is arranged in a grid-like pattern, with each row containing a sequence of tones and syllables.

Fig. 4b. Archilochic Verse (8 syllable) – back (tone-numbers)

Tonus I. Durus.		Tonus III. Mollis.		Tonus V. Mollis.		Tonus VII. Durus.	
<i>Pius. Religiosus modestus.</i>		<i>Lachrimosus. Querulus. moestus.</i>		<i>Heroicus. Vagus. Hilaris.</i>		<i>Subtristis. Querulus. Voluptuosus.</i>	
A	5	A	8	F	5	G	8
G	4	G	* 7	E	4	F	* 7
F	3	F	6	D	3	E	6
E	2	E	5	C	2	D	5
D	8.1	D	4	B	1.8	C	4
C	* 7	C	3	A	7	B	3
B	b 6	B	2	G	6	A	2
A	5	A	1.8	F	5	G	1.8
Mixtura Tonorum		Mixtura Tonorum		Mixtura Tonorum		Mixtura Tonorum	
III. VI.	VIII. VII. I.	VIII. IV.	VII. III.	V.	VI. V.	III. VIII.	IV. VII.
Tonus II. Mollis.		Tonus IV. Durus.		Tonus VI. Mollis.		Tonus VIII. Durus.	
<i>Lætus. Vagabundus. Triundiosus.</i>		<i>Gemebundus. Tristis. Funeralis.</i>		<i>Bellicus. Incitatus. Gloriosus.</i>		<i>Hilaris. Vagus. Amoens.</i>	
G	8.1	A	8	F	8	G	8
F	* 7	G	7	E	7	F	* 7
E	b 6	F	6	D	6	E	b 6
D	5	E	5	C	5	D	5
C	4	D	4	B	4	C	4
B	3	C	* 3	A	3	B	3
A	2	B	2	G	2	A	2
G	1.8	A	1.8	F	1.8	G	1.8
Mixtura Tonorum		Mixtura Tonorum		Mixtura Tonorum		Mixtura Tonorum	
V. IX.	VI. II.	VIII. VI.	VII. IV.	II.	V. VII.	III. VII.	IV. VIII.

Fig. 5. The Keys



The figure displays a musical score on the left and four corresponding composition tables (A, B, C, D) on the right. The score is written for four voices: Cantus molis, Altus, Tenor, and Bassus. Each voice part includes a staff with a treble clef, a common time signature (C), and a key signature of one flat (B-flat). The notes are labeled with letters (c, d, e, f, g, a, b) and some are marked with 'f' (forte) or 's' (soprano). The composition tables are organized into four columns, each labeled 'Baculus' at the top and 'A', 'B', 'C', or 'D' at the bottom. Each table contains a grid of notes (dots) and numbers (5, 3, 8) on a five-line staff, representing the composition scheme for each voice part.

Fig. 7a. Voice scheme and Bass Composition Tables (front)

The image displays a handwritten musical score and five corresponding composition tables. The score is organized into five systems, each with a vocal or instrumental part and a table of notes and fingerings.

- System 1: Applicatorius Clavium**
  - Notes: *c d e f*
  - Clef: *C*
  - Notes: *g a b*
  - Notes: *c d e f*
- System 2: Cantus durus**
  - Notes: *g a b*
  - Clef: *C*
  - Notes: *c d e f*
  - Notes: *g a b*
- System 3: Altus**
  - Notes: *f g a*
  - Clef: *C*
  - Notes: *c d e*
  - Notes: *f g a b*
- System 4: Tenor**
  - Notes: *d e f*
  - Clef: *C*
  - Notes: *a b c*
  - Notes: *d e f g*
- System 5: Bassus**
  - Notes: *g a b*
  - Clef: *C*
  - Notes: *c d e f*
  - Notes: *g a b*

The five tables, labeled *Baculus E*, *Baculus F*, *Baculus G*, and *Baculus A*, each contain five rows of notes and numbers (3, 5, 8) indicating fingerings or positions. The notes in the tables correspond to the notes in the score above them.

Fig. 7b. Voice scheme and Bass Composition Tables (back)