Iannis Xenakis and Sieve Theory

An Analysis of the Late Music (1984-1993)

A Dissertation
Presented in Fulfilment of the Requirements for the Degree of
Doctor of Philosophy

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by
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Volume 2 of 2: Figures and Appendices

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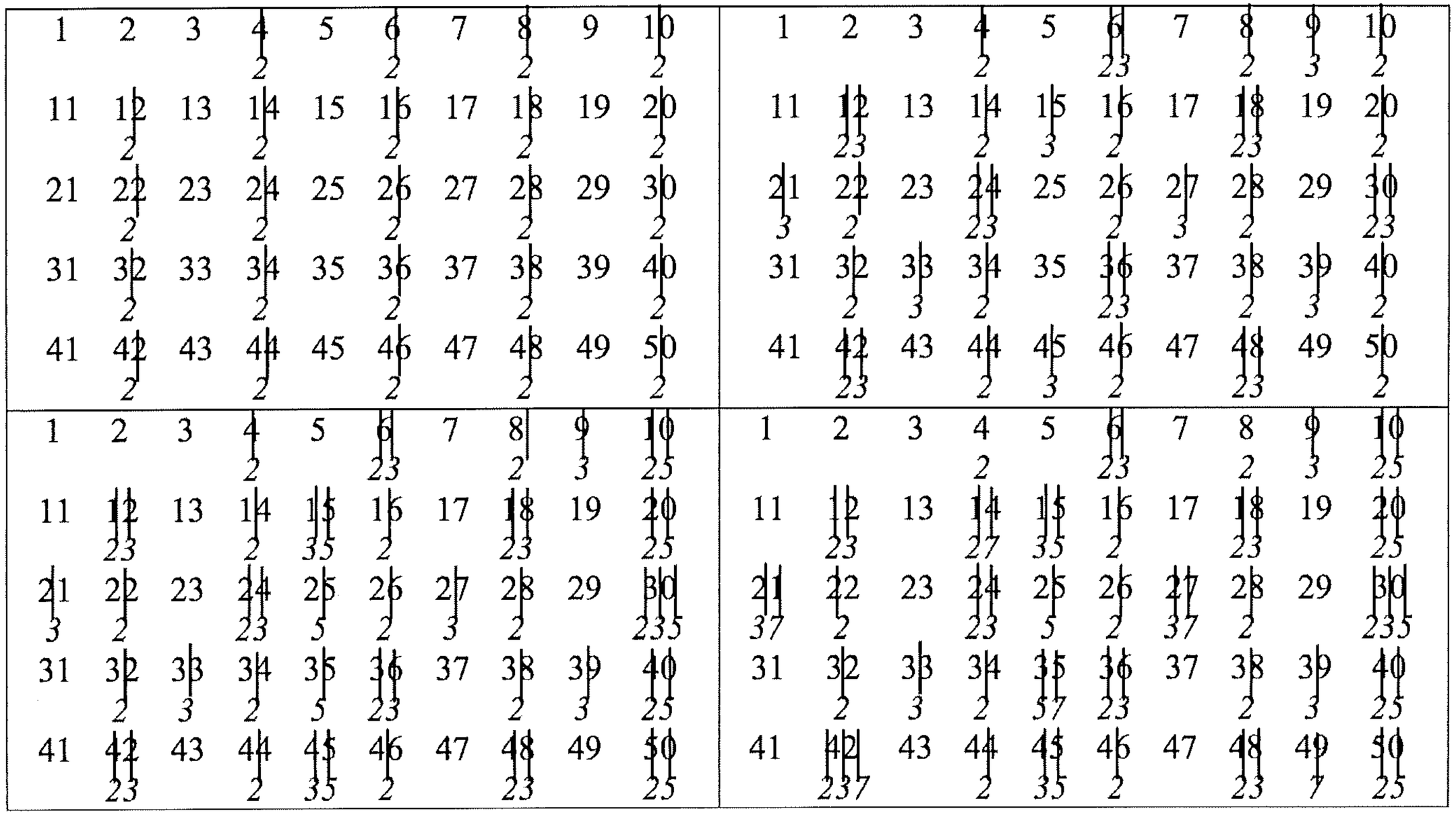


Figure 3.1: The Sieve of Eratosthenes, with $n = 50$.

4_i

3_j	0	1	2	3
0	0	9	6	3
1	4	1	10	7
2	8	5	2	11

Figure 3.2: Matrix for Moduli 4 and 3.

4_i

3_j	0	1	2	3
0	**0**	**9**	**6**	**3**
1	**4**	1	10	7
2	**8**	5	2	11

Figure 3.3: (3, 0) + (4, 0).

4_i

3j	0	1	2	3
0	**0**	**9**	6	3
1	**4**	1	10	**7**
2	8	**5**	**2**	**11**

Figure 3.4: Major Diatonic Scale.

12_j

5_i	0	1	2	3	4	5	6	7	8	9	10	11
0	0	25	50	15	40	5	30	55	20	45	10	35
1	36	1	26	51	16	41	6	31	56	21	46	11
2	12	37	2	27	52	17	42	7	32	57	22	47
3	48	13	38	3	28	53	18	43	8	33	58	23
4	24	49	14	39	4	29	54	19	44	9	34	59

Figure 3.5: Matrix for moduli 5 and 12.

4_i

3_j	0	1	2	3
0	**0**	**9**	**6**	**3**
1	4	1	10	**7**
2	8	5	2	**11**

Figure 3.6: (3, 0) + (4, 3).

4_i

3_j	0	1	2	3
0	**0**	**9**	**6**	**3**
1	4	**1**	10	7
2	8	**5**	2	11

Figure 3.7: (3, 0) + (4, 1).

4_i

3_j	0	1	2	3
0	**0**	**9**	**6**	**3**
1	**4**	**1**	10	7
2	**8**	5	2	**11**

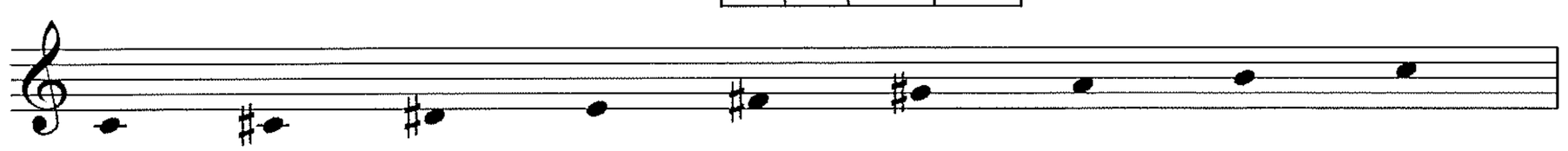


Figure 3.8: (3, 0) + (4, 0) + (3, 1)·(4, 1) + (3, 2)·(4, 2).

4_i

3_j	0	1	2	3
0	**0**	9	**6**	3
1	**4**	1	10	7
2	**8**	5	2	11

Figure 3.9: (4, 0) + (3, 0)·(4, 2).

4_i

3_j	0	1	2	3
0	**0**	**9**	6	**3**
1	4	1	**10**	**7**
2	8	**5**	**2**	11

Mode of D.

4_i

3_j	0	1	2	3
0	**0**	**9**	6	3
1	**4**	1	10	**7**
2	8	**5**	**2**	**11**

Major diatonic.

Figure 3.10: Matrices for the Mode of D and the Major Diatonic Scale.

4_i

3_j

	0	1	2	3
0	**0**	9	6	**3**
1	4	1	10	**7**
2	**8**	**5**	**2**	**11**

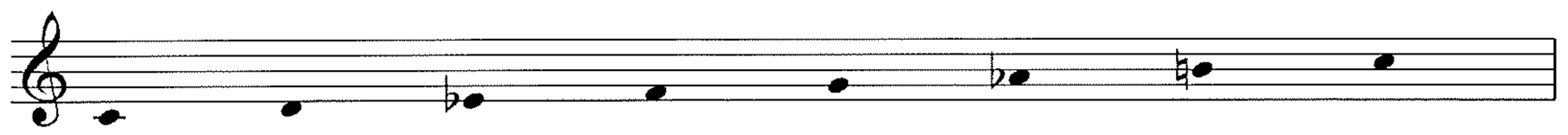
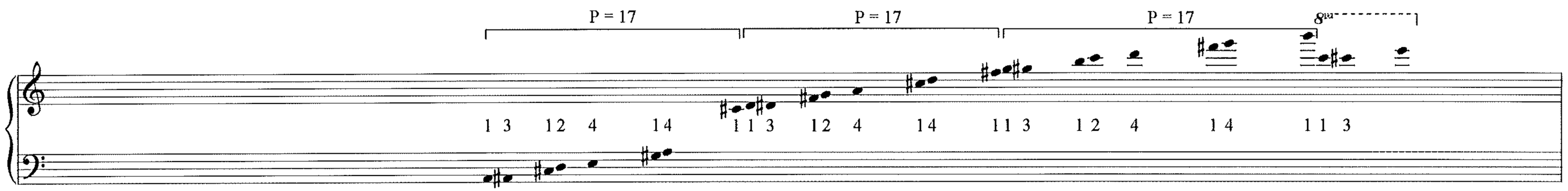


Figure 3.11: Harmonic minor.



3.12: Sieve of *Jonchaies*.

	Prime	Composite
Symmetric	palindromic structure prime period	palindromic structure composite period
	example: {0 2 5 6 9}, P = 11	example: major diatonic
Asymmetric	non-palindromic structure prime period	non-palindromic structure composite period
	example: *Jonchaies*	example: harmonic minor

Figure 3.13: Types of Sieves according to their Symmetry and Periodicity.

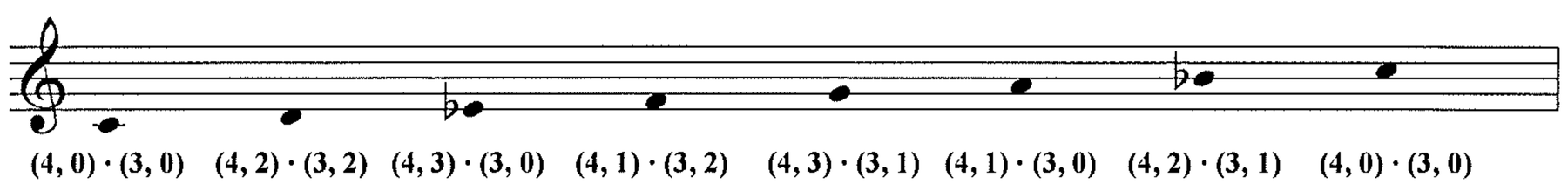


Figure 3.14: Cyclic Transposition of the Major Diatonic Scale, T_{+10}(mod12), that results in the Mode of D.

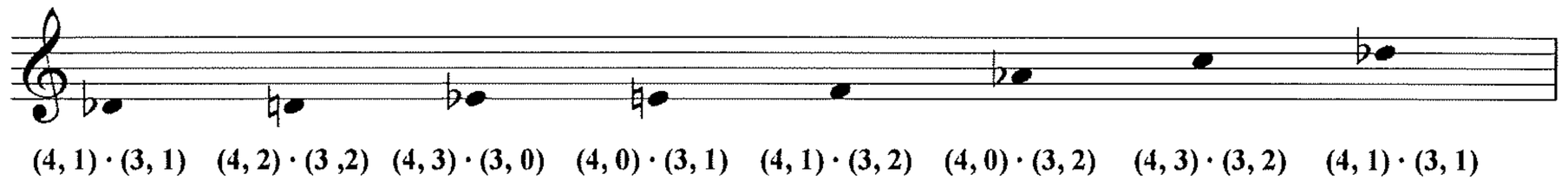


Figure 3.15: $r_2 = r_1 + r_2 + 1$

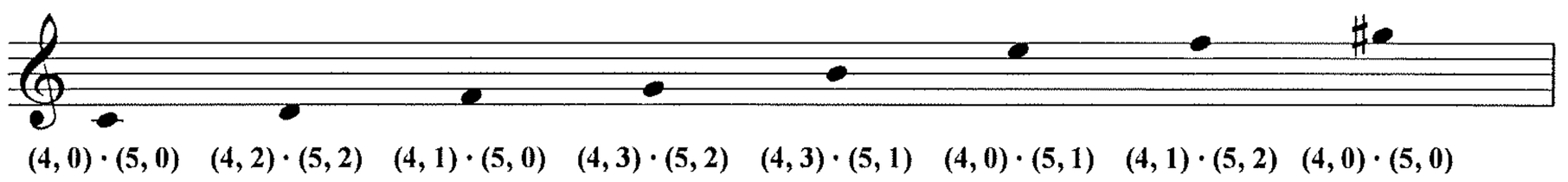


Figure 3.16: $m_2 = m_2 + 2$

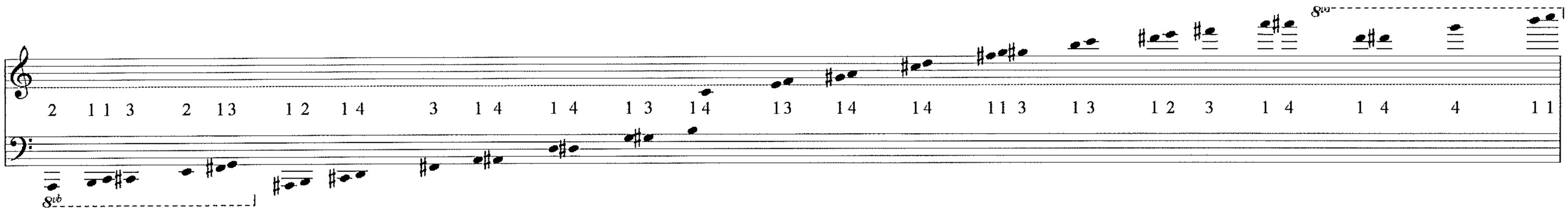


Figure 4.1: Sieve of *Nekuïa*.

11_j

8_i	0	1	2	3	4	5	6	7	8	9	10
0	**0**	56	**24**	80	**48**	**16**	**72**	40	8	64	32
1	33	1	**57**	**25**	81	49	**17**	**73**	41	**9**	65
2	**66**	**34**	**2**	**58**	26	**82**	50	18	74	42	**10**
3	11	**67**	**35**	**3**	**59**	27	83	51	19	75	**43**
4	**44**	12	68	36	**4**	60	28	84	**52**	20	76
5	**77**	45	**13**	**69**	37	5	61	**29**	85	**53**	**21**
6	22	**78**	46	**14**	70	**38**	6	**62**	**30**	**86**	54
7	55	23	79	**47**	15	71	**39**	**7**	**63**	31	**87**

Figure 4.2: Decomposed Matrix of the Sieve of *Nekuïa*.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	0	**2**	**3**	**4**	**7**	**9**	**10**	**13**	**14**	**16**	**17**	**21**	**24**	**25**	**29**	**30**	**34**	**35**	**38**	**39**	**43**
M, I, R	*2*	*1*	*1*	*3*	*2*	*1*	*3*	*1*	*2*	*1*	*4*	*3*	*1*	*4*	*1*	*4*	*1*	*3*	*1*	*4*	*1*
24, 0, 3	+												+								
14, 2, 6		+								+						+					
22, 3, 3			+											+							
31, 4, 2				+														+			
28, 7, 2					+													+			
29, 9, 2						+													+		
19, 10, 4							+								+						
25, 13, 2								+											+		
24, 14, 3									+										+		
26, 17, 2											+										+
23, 21, 2												+									
24, 10, 3							+										+				
30, 9, 2						+														+	
35, 17, 2											+										
29, 24, 2													+								
32, 25, 1														+							
30, 29, 1															+						
26, 21, 2												+									
30, 17, 2											+										
31, 16, 2										+											

Figure 5.1: Simplified Matrix of the sieve of *Nekuïa*.

	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
	44	**47**	**48**	**52**	**53**	**57**	**58**	**59**	**62**	**63**	**66**	**67**	**69**	**72**	**73**	**77**	**78**	**82**	**86**	**87**	**88**
M, I, R	*3*	*1*	*4*	*1*	*4*	*1*	*1*	*3*	*1*	*3*	*1*	*2*	*3*	*1*	*4*	*1*	*4*	*4*	*1*	*1*	
24, 0, 3			+											+							
14, 2, 6	+						+							+					+		
22, 3, 3		+											+								
31, 4, 2											+										
28, 7, 2										+											
29, 9, 2												+									
19, 10, 4			+									+							+		
25, 13, 2										+											+
24, 14, 3									+										+		
26, 17, 2													+								
23, 21, 2	+											+									
24, 10, 3							+											+			
30, 9, 2													+								
35, 17, 2				+																+	
29, 24, 2					+													+			
32, 25, 1						+															
30, 29, 1								+													
26, 21, 2		+													+						
30, 17, 2		+														+					
31, 16, 2		+															+				

Figure 5.1: Simplified Matrix of the sieve of *Nekuïa*, cont.

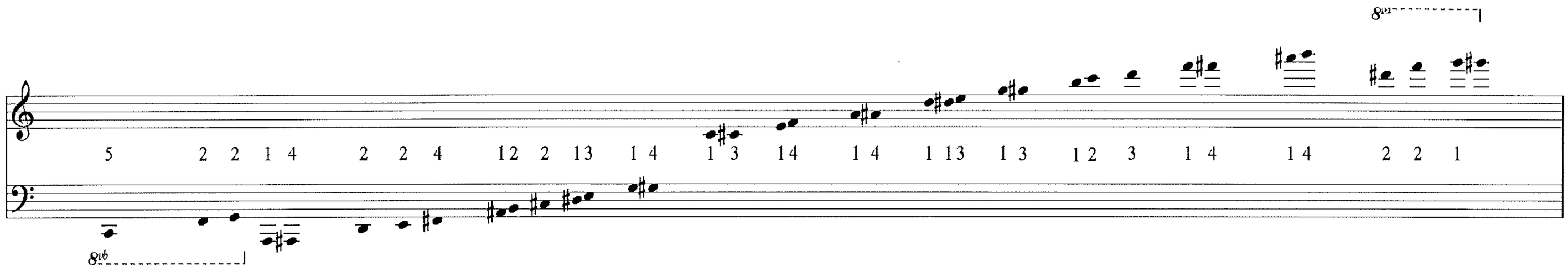


Figure 5.2: Sieve of *Akea*.

16_i

5_j	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	**0**	**65**	**50**	35	20	**5**	**70**	**55**	**40**	**25**	**10**	**75**	**60**	**45**	30	15
1	**16**	1	**66**	**51**	**36**	21	6	**71**	**56**	**41**	26	11	76	61	**46**	**31**
2	**32**	17	2	67	**52**	**37**	**22**	**7**	72	57	42	**27**	12	77	**62**	47
3	48	33	**18**	3	68	53	38	**23**	8	73	58	43	**28**	13	78	63
4	64	49	34	19	4	69	54	39	24	**9**	74	**59**	44	29	**14**	**79**

Figure 5.3: Decomposed matrix for the sieve of *Akea*.

Canonical Form	*M, I, R*	*Interval*
5	5, 40, 8	4th
$2 \cdot 7$	14, 9, 5 14, 52, 2	8^{ve} + tone
$3 \cdot 5$	15, 10, 4 15, 36, 2	8^{ve} + $m3^{rd}$
17	17, 28, 3	8^{ve} + 4th
$2 \cdot 3^2$	18, 5, 4	8^{ve} + tritone
19	19, 18, 3 19, 22, 3 19, 27, 2 19, 32, 2 19, 46, 1	8^{ve} + 5th
$2^2 \cdot 5$	20, 31, 2	8^{ve} + $m6^{th}$
23	23, 14, 2	8^{ve} + $M7^{th}$
$2^3 \cdot 3$	24, 7, 3	$2 \cdot 8^{ve}$
5^2	25, 0, 3 25, 16, 2	$2 \cdot 8^{ve}$ + semitone

Figure 5.4: Sketches of *Akea*, Simplified Formula of the Sieve.

Final Choice	*M, I, R*	*Points Covered*
1	25, 0, 3	**0 25 50 75**
2	18, 5, 4	**5 23 41 59 77**
3	24, 7, 3	**7 31 55 79**
4	14, 9, 5	**9** 23 **37 51 65** 79
5	15, 10, 4	**10** 25 **40** 55 **70**
6	23, 14, 2	**14** 37 **60**
7	25, 16, 2	**16** 41 **66**
8	19, 18, 3	**18** 37 **56** 75
9	19, 22, 3	**22** 41 60 79
(14, 9)	14, 23, 4	23 37 51 65 79
(15, 10)	15, 25, 3	25 40 55 70
10	19, 27, 2	**27 46** 65
11	17, 28, 3	**28 45 62** 79
12	20, 31, 2	**31** 51 **71**
13	19, 32, 2	**32** 51 70
14	15, 36, 2	**36** 51 66
(14, 9)	14, 37, 3	37 51 65 79
15	5, 40, 8	40 45 50 55 60 65 70 75 **80**
	15, 41, 2	41 56 71
(5, 40)	5, 45, 7	45 50 55 60 65 70 75 80
16	19, 46, 1	46 65
(5, 40)	5, 50, 6	50 55 60 65 70 75 80
(14, 9)	14, 51, 2	51 65 79
17	14, 52, 2	**52** 66 80
(5, 40)	5, 55, 5	55 60 65 70 75 80
	14, 56, 1	56 70
	6, 59, 3	59 65 71 77
(5, 40)	5, 60, 4	60 65 70 75 80
	9, 62, 2	62 71 80
(5, 40)	5, 65, 3	65 70 75 80
	9, 66, 1	66 75
(5, 40)	5, 70, 2	70 75 80
	4, 71, 2	71 75 79
	2, 75, 2	75 77 79
(2, 75)	2, 77, 1	77 79
(2, 75)	2, 79, 0	79
	2, 80, 0	80

Figure 5.5: Xenakis's Calculation of the Simplified Formula for the sieve of *Akea*.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	0	**5**	**7**	**9**	**10**	**14**	**16**	**18**	**22**	**23**	**25**	**27**	**28**	**31**	**32**	**36**	**37**	**40**	**41**	**45**
M, I, R	*5*	*2*	*2*	*1*	*4*	*2*	*2*	*4*	*1*	*2*	*2*	*1*	*3*	*1*	*4*	*1*	*3*	*1*	*4*	*1*
25, 0, 3	+										+									
18, 5, 4		+								+									+	
24, 7, 3			+											+						
14, 9, 5				+						+							+			
15, 10, 4					+						+							+		
23, 14, 2						+											+			
25, 16, 2							+												+	
19, 18, 3								+									+			
19, 22, 3									+										+	
19, 27, 2												+								
17, 28, 3													+							+
20, 31, 2														+						
19, 32, 2															+					
15, 36, 2																+				
5, 40, 8																		+		+
14, 52, 2																				

	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
	46	**50**	**51**	**52**	**55**	**56**	**59**	**60**	**62**	**65**	**66**	**70**	**71**	**75**	**77**	**79**	**80**
M, I, R	*4*	*1*	*1*	*3*	*1*	*3*	*1*	*2*	*3*	*1*	*4*	*1*	*4*	*2*	*2*	*1*	
25, 0, 3		+												+			
18, 5, 4							+								+		
24, 7, 3					+											+	
14, 9, 5			+							+						+	
15, 10, 4					+							+					
23, 14, 2								+									
25, 16, 2											+						
19, 18, 3						+								+			
19, 22, 3								+								+	
19, 27, 2	+									+							
17, 28, 3									+							+	
20, 31, 2			+										+				
19, 32, 2			+									+					
15, 36, 2			+								+						
5, 40, 8		+			+			+		+		+		+			+
14, 52, 2				+							+						+

Figure 5.6: Simplified Matrix of the Sieve of *Akea* from the Formula as found in the Pre-compositional Sketches.

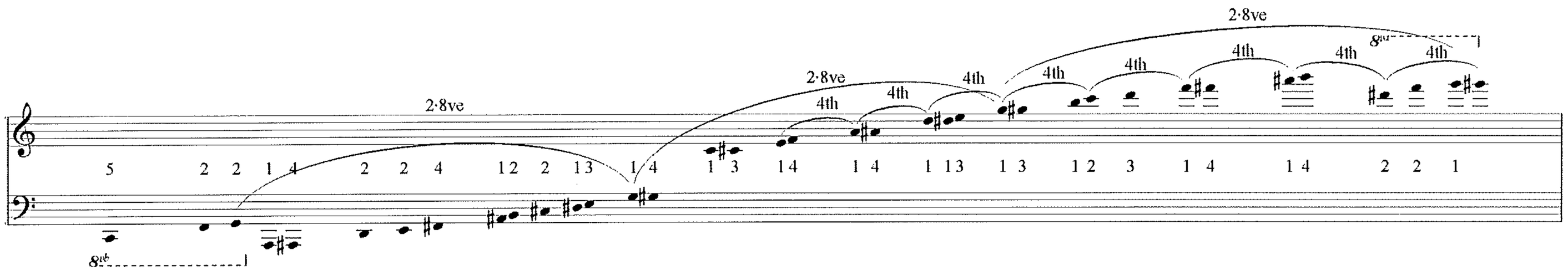


Figure 5.7: The Inner Periodicities of 2·8ve (24, 7, 3) and Perfect 4th (5, 40, 8) in the Sieve of *Akea*.

Modulus	*Interval*	*Canonical Form*	*Multiples of GCD*
5	4th	5	$1 \cdot 4^{th}$
15	8^{ve} + min 3rd	$3 \cdot 5$	$3 \cdot 4^{th}$
20	8^{ve} + min 6th	$2^2 \cdot 5$	$4 \cdot 4^{th}$
25	$2 \cdot 8^{ve}$ + semitone	5^2	$5 \cdot 4^{th}$

Figure 5.8: Moduli Congruent with the Perfect 4th in the Sieve of *Akea*.

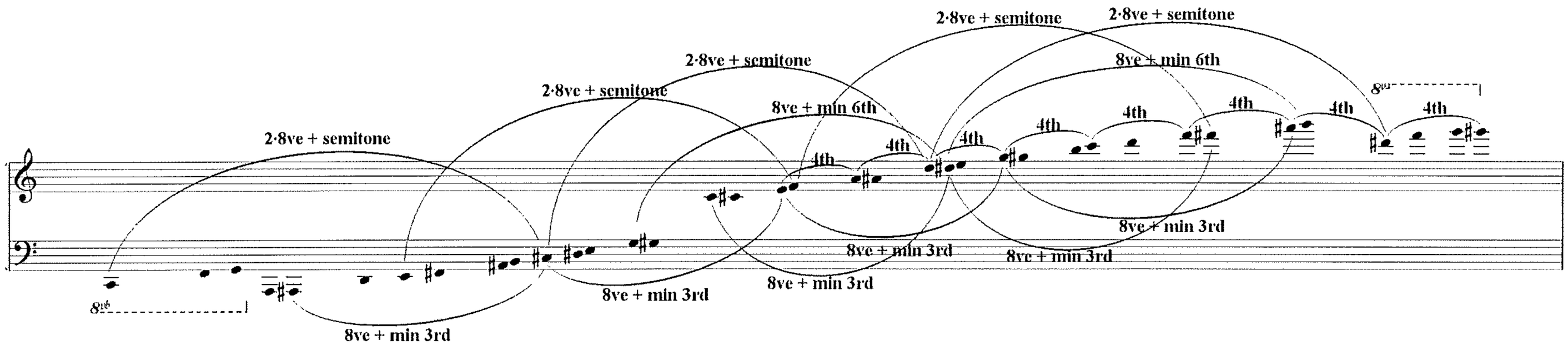


Figure 5.9: Sieve of *Akea* and its Moduli Congruent Modulo the Perfect 4th.

Canonical Form	*M, I, R*	*Interval*
$2 \cdot 7$	14, 9, 5	8^{ve} + tone
$3 \cdot 5$	15, 10, 4	8^{ve} + $m3^{rd}$
$2 \cdot 3^2$	18, 5, 4	8^{ve} + tritone
19	19, 18, 3	8^{ve} + 5th
$2^2 \cdot 5$	20, 5, 3	8^{ve} + $m6^{th}$
23	23, 14, 2	8^{ve} + $M7^{th}$
$2^3 \cdot 3$	24, 7, 3 24, 22, 2	$2 \cdot 8^{ve}$
5^2	25, 0, 3 25, 16, 2	$2 \cdot 8^{ve}$ + semitone
$2 \cdot 13$	26, 10, 2	$2 \cdot 8^{ve}$ + tone
3^3	27, 5, 2 27, 25, 2	$2 \cdot 8^{ve}$ + $m3^{rd}$
$2^2 \cdot 7$	28, 0, 2 28, 27, 1	$2 \cdot 8^{ve}$ + $M3^{rd}$
29	29, 22, 2	$2 \cdot 8^{ve}$ + 4th
31	31, 9, 2	$2 \cdot 8^{ve}$ + 5th

Figure 5.10: Simplified Formula of the Sieve of *Akea*, suggested by Program B.

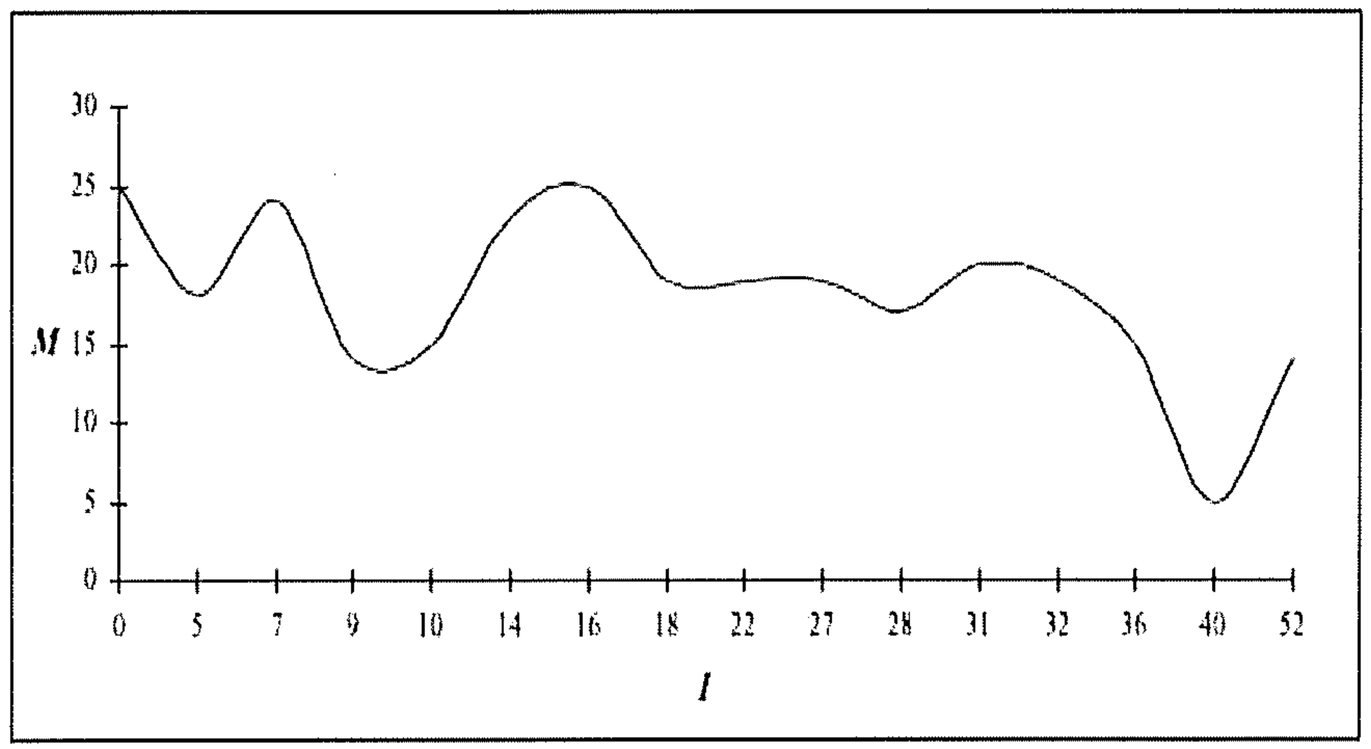
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	0	**5**	**7**	**9**	**10**	**14**	**16**	**18**	**22**	**23**	**25**	**27**	**28**	**31**	**32**	**36**	**37**	**40**	**41**	**45**
M, I, R	*5*	*2*	*2*	*1*	*4*	*2*	*2*	*4*	*1*	*2*	*2*	*1*	*3*	*1*	*4*	*1*	*3*	*1*	*4*	*1*
25, 0, 3	+										+									
18, 5, 4		+								+									+	
24, 7, 3			+											+						
14, 9, 5				+						+							+			
15, 10, 4					+						+							+		
23, 14, 2						+											+			
25, 16, 2							+												+	
19, 18, 3								+									+			
24, 22, 2									+											
28, 27, 1												+								
28, 0, 2	+												+							
27, 5, 2		+													+					
26, 10, 2					+											+				
20, 5, 3		+									+									+
27, 25, 2											+									
31, 9, 2				+														+		
29, 22, 2									+											

	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
	46	**50**	**51**	**52**	**55**	**56**	**59**	**60**	**62**	**65**	**66**	**70**	**71**	**75**	**77**	**79**	**80**
M, I, R	*4*	*1*	*1*	*3*	*1*	*3*	*1*	*2*	*3*	*1*	*4*	*1*	*4*	*2*	*2*	*1*	
25, 0, 3		+												+			
18, 5, 4							+								+		
24, 7, 3					+											+	
14, 9, 5			+							+						+	
15, 10, 4					+							+					
23, 14, 2								+									
25, 16, 2											+						
19, 18, 3						+								+			
24, 22, 2	+											+					
28, 27, 1					+												
28, 0, 2						+											
27, 5, 2							+										
26, 10, 2									+								
20, 5, 3										+							
27, 25, 2				+												+	
31, 9, 2													+				
29, 22, 2			+														+

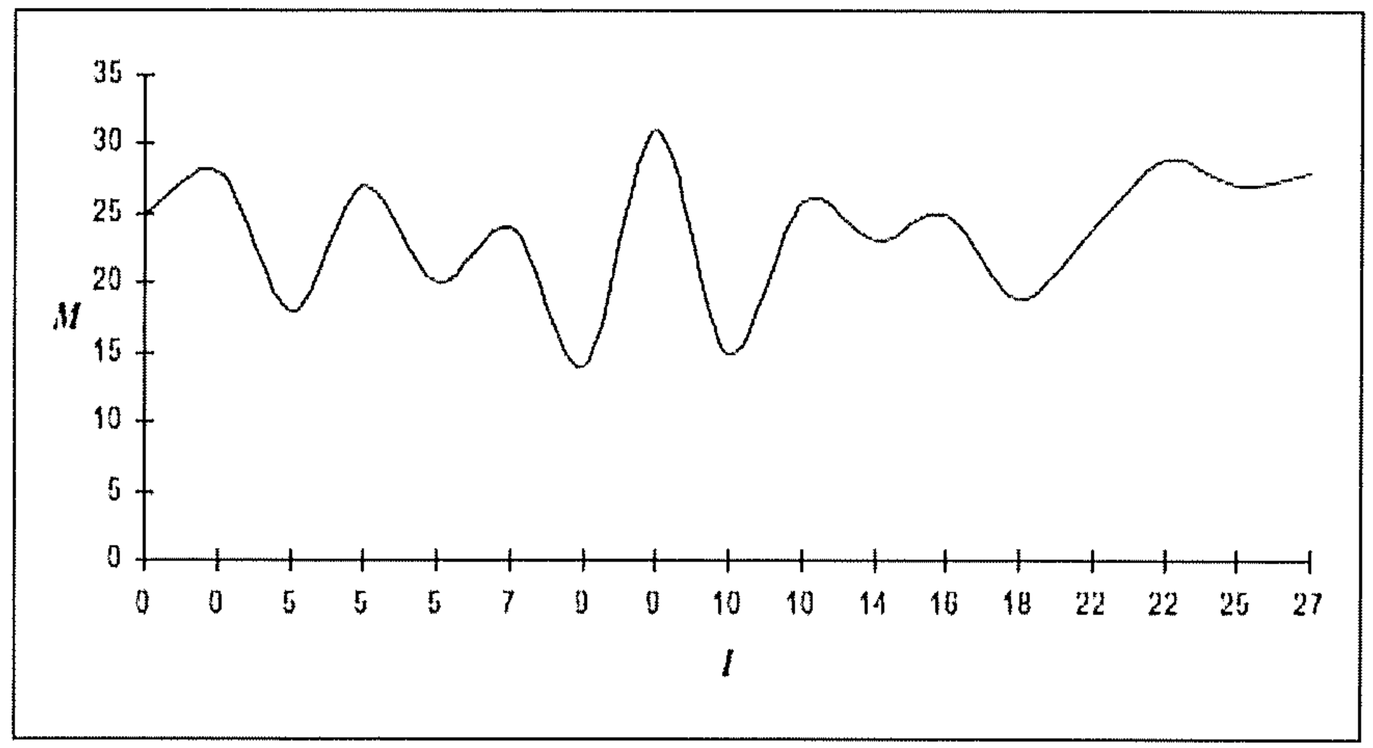
Figure 5.11: Simplified Matrix of the Sieve of *Akea*, from the Formula suggested by Program B.

	Point	1986	1990
1	**0**	**25, 0, 3**	**25, 0, 3** 28, 0, 2
2	**5**	**18, 5, 4**	**18, 5, 4** 27, 5, 2 20, 5, 3
3	**7**	**24, 7, 3**	**24, 7, 3**
4	**9**	**14, 9, 5**	**14, 9, 5** 31, 9, 2
5	**10**	**15, 10, 4**	**15, 10, 4** 26, 10, 2
6	**14**	**23, 14, 2**	**23, 14, 2**
7	**16**	**25, 16, 2**	**25, 16, 2**
8	**18**	**19, 18, 3**	**19, 18, 3**
9	**22**	**19, 22, 3**	**24, 22, 2** 29, 22, 2
10	**23**	18, 5, 4 14, 9, 5	18, 5, 4 14, 9, 5
11	**25**	25, 0, 3 15, 10, 4	25, 0, 3 15, 10, 4 20, 5, 3 27, 25, 2
12	**27**	**19, 27, 2**	**28, 27, 1**
13	**28**	**17, 28, 3**	**28, 0, 2**
14	**31**	24, 7, 3 **20, 31, 2**	24, 7, 3
15	**32**	**19, 32, 2**	**27, 5, 2**
16	**36**	**15, 36, 2**	**26, 10, 2**
17	**37**	14, 9, 5 23, 14, 2 19, 18, 3	14, 9, 5 23, 14, 2 19, 18, 3
18	**40**	15, 10, 4 **5, 40, 8**	15, 10, 4 31, 9, 2
19	**41**	18, 5, 4 25, 16, 2 19, 22, 3	18, 5, 4 25, 16, 2
20	**45**	17, 28, 3 5, 40, 8	**20, 5, 3**
21	**46**	19, 27, 2	24, 22, 2
22	**50**	25, 0, 3 5, 40, 8	25, 0, 3
23	**51**	14, 9, 5 20, 31, 2 19, 32, 2 15, 36, 2	14, 9, 5 29, 22, 2
24	**52**	**14, 52, 2**	**27, 25, 2**
25	**55**	24, 7, 3 15, 10, 4 5, 40, 8	24, 7, 3 15, 10, 4 28, 27, 1
26	**56**	19, 18, 3	19, 18, 3 28, 0, 2
27	**59**	18, 5, 4	18, 5, 4 27, 5, 2
28	**60**	23, 14, 2 19, 22, 3 5, 40, 8	23, 14, 2
29	**62**	17, 28, 3	26, 10, 2
30	**65**	14, 9, 5 19, 27, 2 5, 40, 8	14, 9, 5 20, 5, 3
31	**66**	25, 16, 2 15, 36, 2 14, 52, 2	25, 16, 2
32	**70**	15, 10, 4 19, 32, 2 5, 40, 8	15, 10, 4 24, 22, 2
33	**71**	20, 31, 2	**31, 9, 2**
34	**75**	25, 0, 3 19, 18, 3 5, 40, 8	25, 0, 3 19, 18, 3
35	**77**	18, 5, 4	18, 5, 4
36	**79**	24, 7, 3 14, 9, 5 19, 22, 3 17, 28, 3	24, 7, 3 14, 9, 5 27, 25, 2
37	**80**	5, 40, 8	**29, 22, 2**

Figure 5.12: The Sieve of *Akea* and the two versions of the Algorithm (1986 and 1990).



1986



1990

Figure 5.13: The size of *M* as *I* increases, in the Formulae of the Sieve of *Akea* by the two versions of the Algorithm.

Original	*Inversion*
14, 9, 5	14, 1, 5
15, 10, 4	15, 10, 4
18, 5, 4	18, 3, 4
19, 18, 3	19, 5, 3
20, 5, 3	20, 15, 3
23, 14, 2	23, 20, 2
24, 7, 3	24, 1, 3
24, 22, 2	24, 10, 2
25, 0, 3	25, 5, 3
25, 16, 2	25, 14, 2
26, 10, 2	26, 18, 2
27, 25, 2	27, 1, 2
27, 5, 2	27, 21, 2
28, 0, 2	28, 24, 2
28, 27, 1	28, 25, 1
29, 22, 2	29, 0, 2
31, 9, 2	31, 9, 2

Figure 5.14: The Simplified Formula of the Sieve of *Akea* and its Inversion.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
		0	**1**	**3**	**5**	**9**	**10**	**14**	**15**	**18**	**20**	**21**	**24**	**25**	**28**	**29**	**30**	**34**	**35**	**39**	**40**
	M, I, R	*1*	*2*	*2*	*4*	*1*	*4*	*1*	*3*	*2*	*1*	*3*	*1*	*3*	*1*	*1*	*4*	*1*	*4*	*1*	*3*
	25, 5, 3				+												+				
	18, 3, 4			+								+								+	
	24, 1, 3		+											+							
	14, 1, 5		+						+							+					
5	15, 10, 4						+							+							+
	23, 20, 2										+										
	25, 14, 2							+												+	
	19, 5, 3				+								+								
	24, 10, 2						+											+			
10	28, 25, 1													+							
	28, 24, 2												+								
	27, 21, 2											+									
	26, 18, 2									+											
	20, 15, 3								+										+		
15	27, 1, 2		+												+						
	31, 9, 2					+															+
	29, 0, 2	+														+					

		21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
		43	**44**	**48**	**49**	**52**	**53**	**55**	**57**	**58**	**62**	**64**	**66**	**70**	**71**	**73**	**75**	**80**
	M, I, R	*1*	*4*	*1*	*3*	*1*	*2*	*2*	*1*	*4*	*2*	*2*	*3*	*1*	*2*	*2*	*5*	
	25, 5, 3							+										+
	18, 3, 4								+								+	
	24, 1, 3				+											+		
	14, 1, 5	+							+						+			
5	15, 10, 4							+						+				
	23, 20, 2	+											+					
	25, 14, 2											+						
	19, 5, 3	+									+							
	24, 10, 2									+								
10	28, 25, 1						+											
	28, 24, 2					+												+
	27, 21, 2			+													+	
	26, 18, 2		+											+				
	20, 15, 3							+									+	
15	27, 1, 2							+										
	31, 9, 2														+			
	29, 0, 2									+								

Figure 5.15: Simplified Matrix of the Inversion of the Sieve of *Akea*.

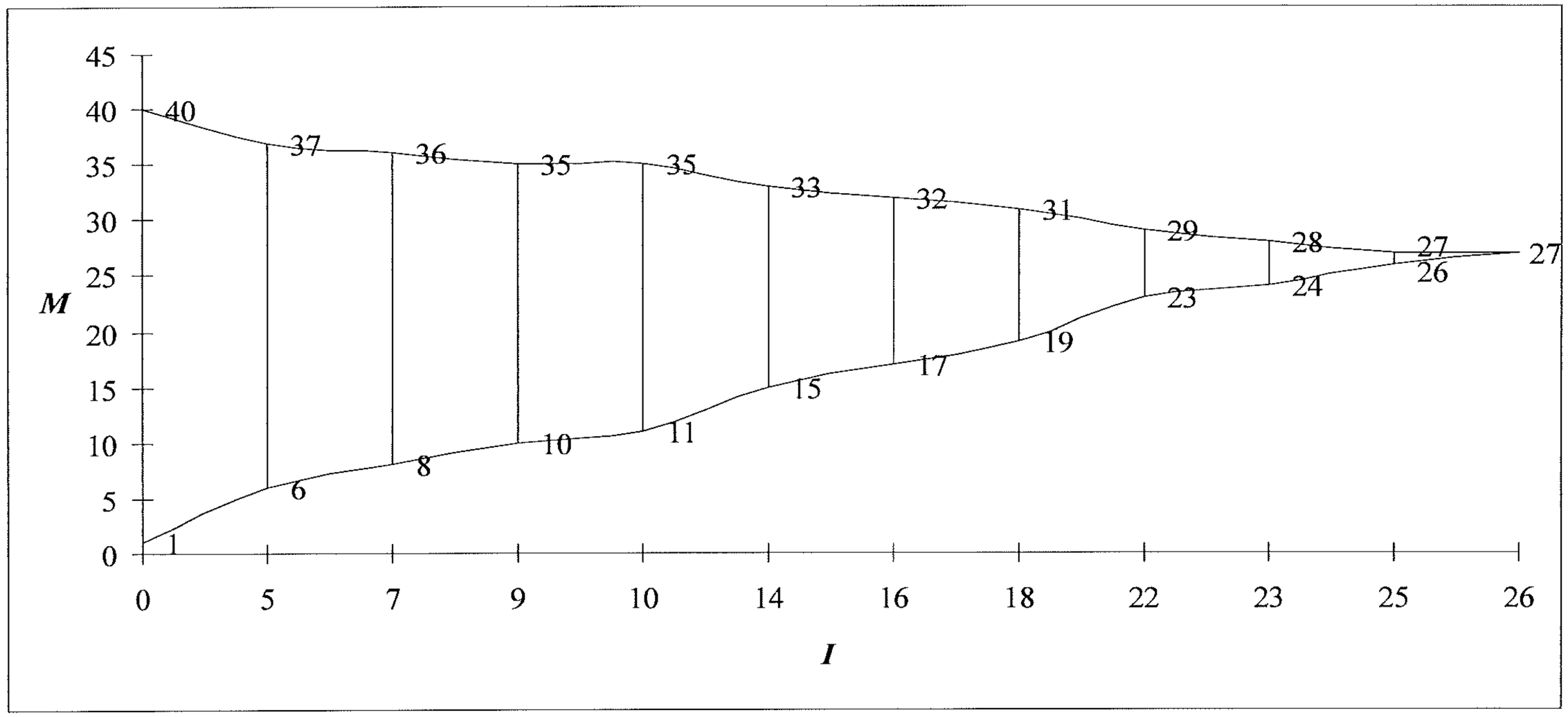


Figure 5.16: The Minimum and Maximum Values of *M*, according to the Condition of Inner Symmetry, as *I* Increases in the Sieve of *Akea*.

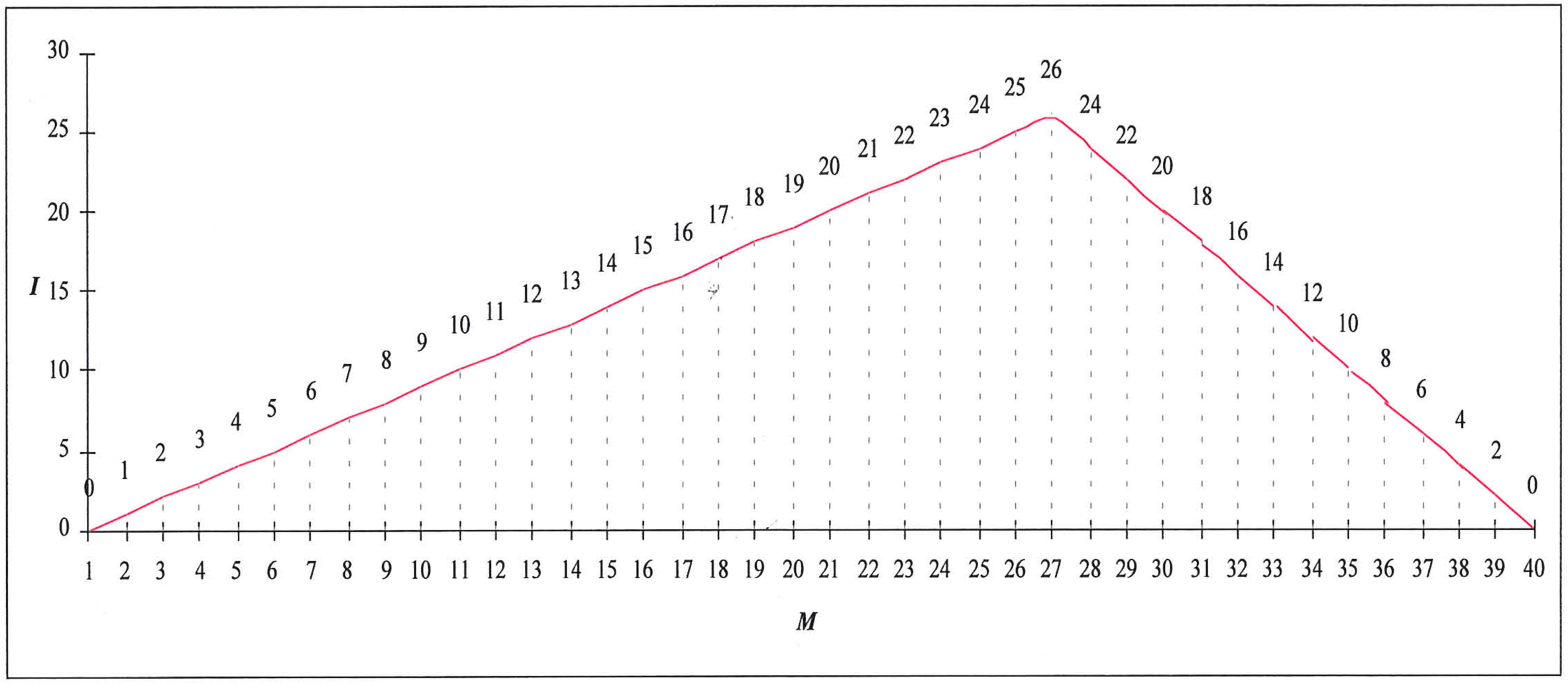


Figure 5.17: The Maximum Values of I as M Increases, when $n = 80$.

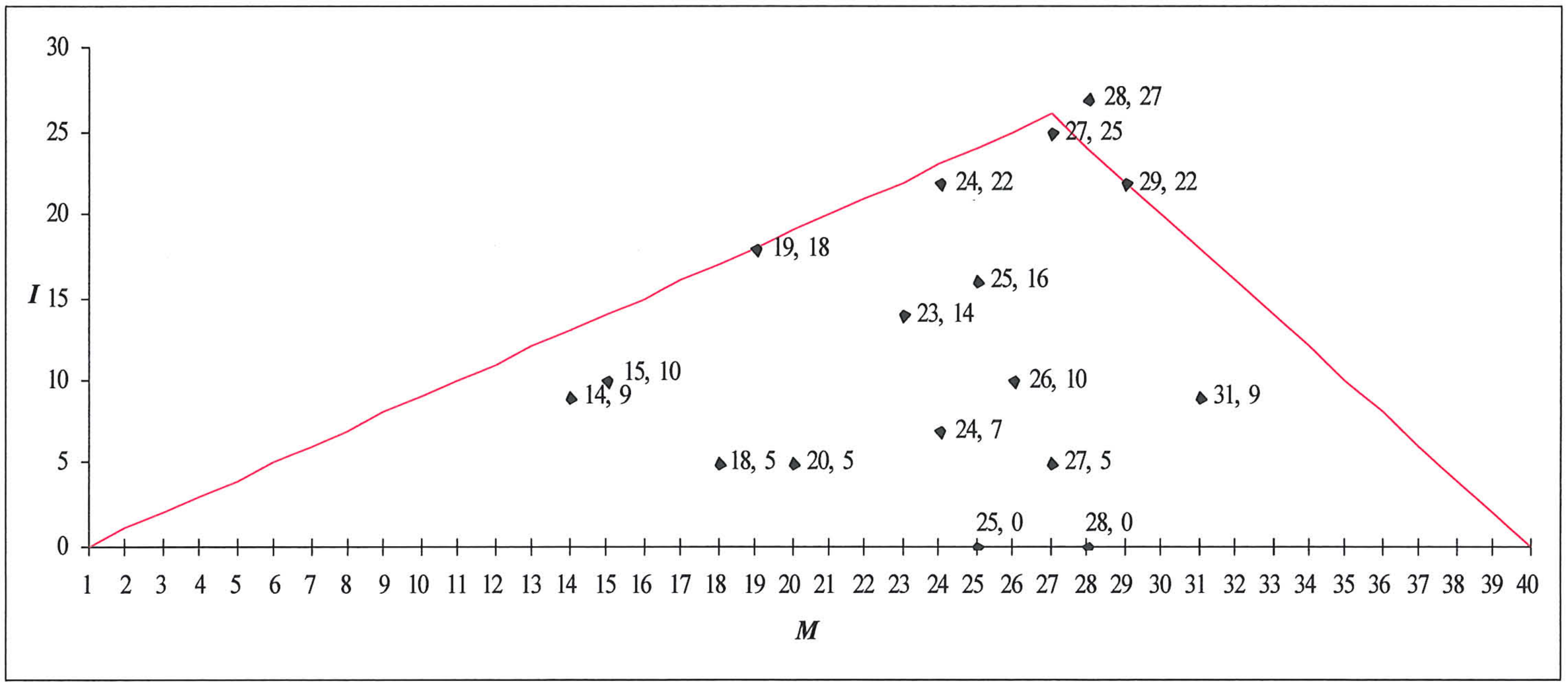


Figure 5.18: The Condition of Inner Symmetry and the Sieve of *Akea*.

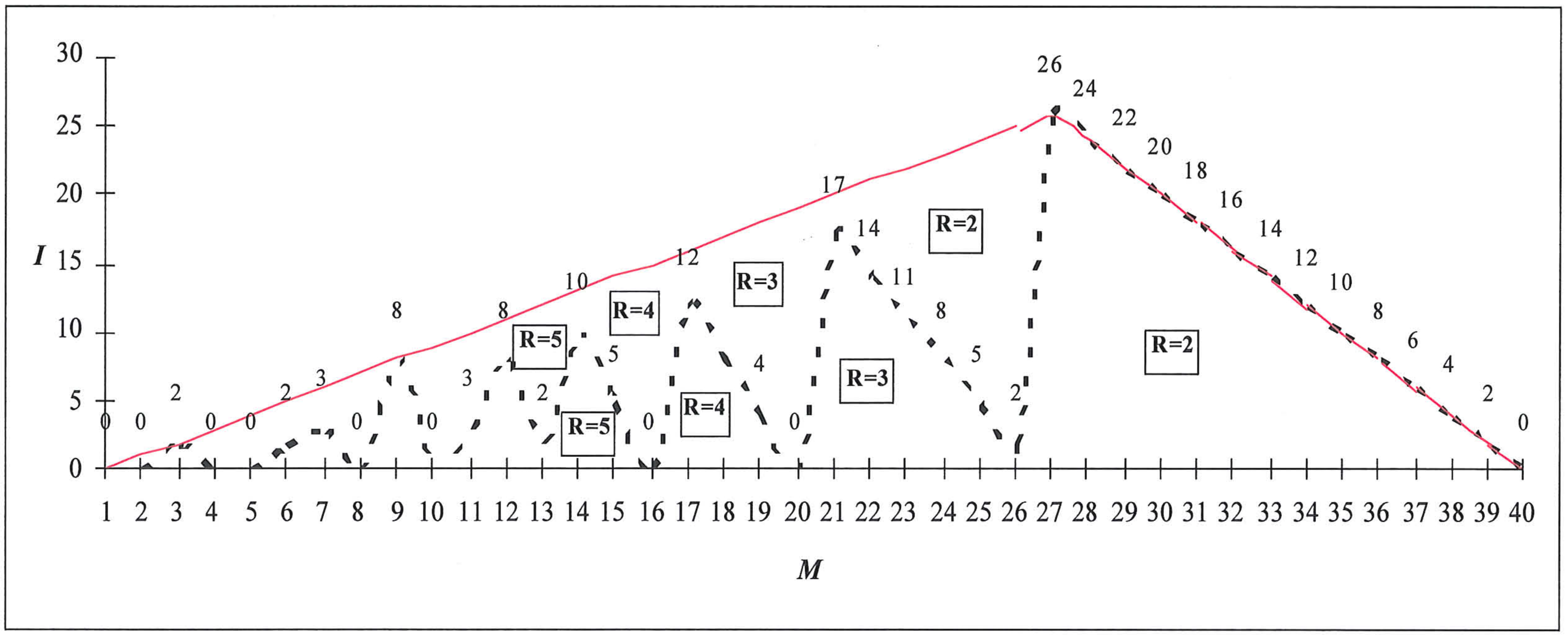


Figure 5.19: The values of R and $n(\mathrm{mod}M)$ as M increases, when $n = 80$.

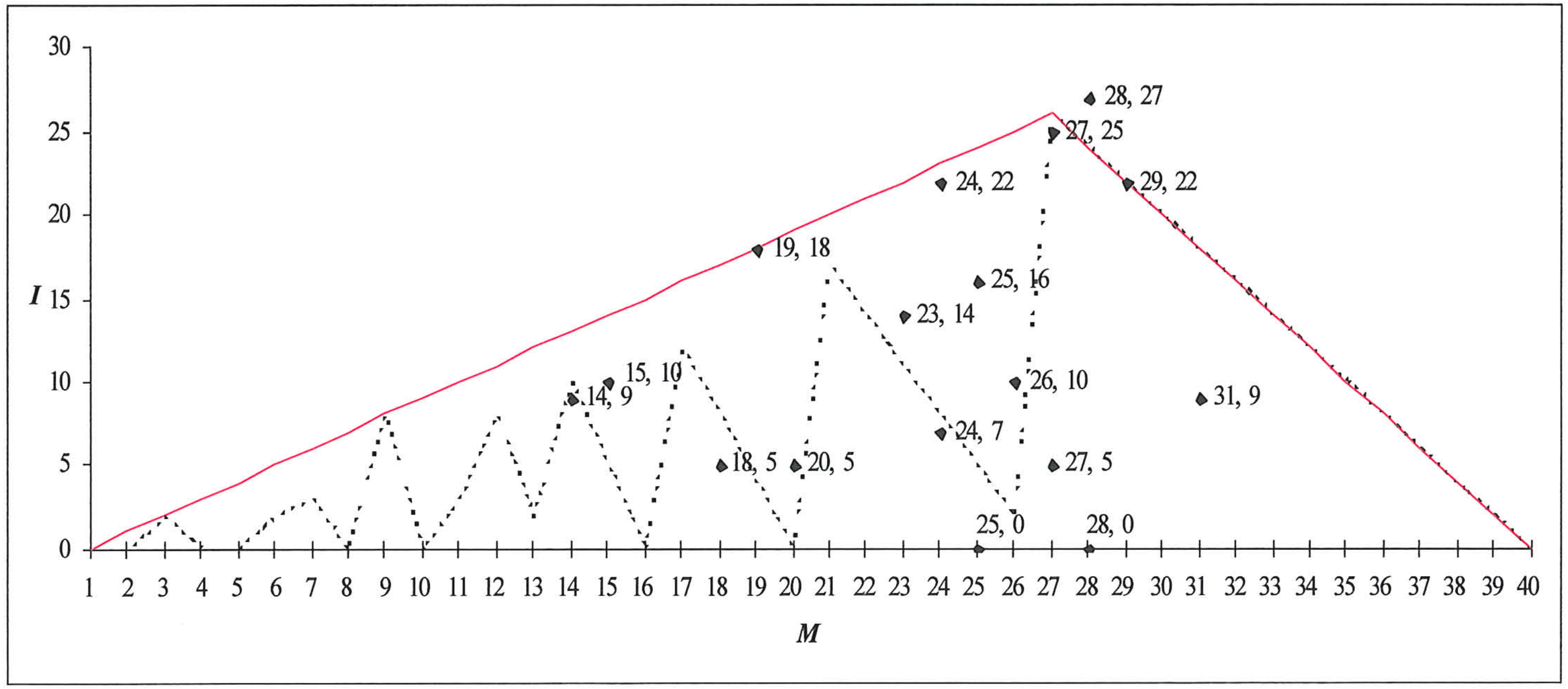


Figure 5.20: Inner Symmetry Chart for the Sieve of *Akea*.

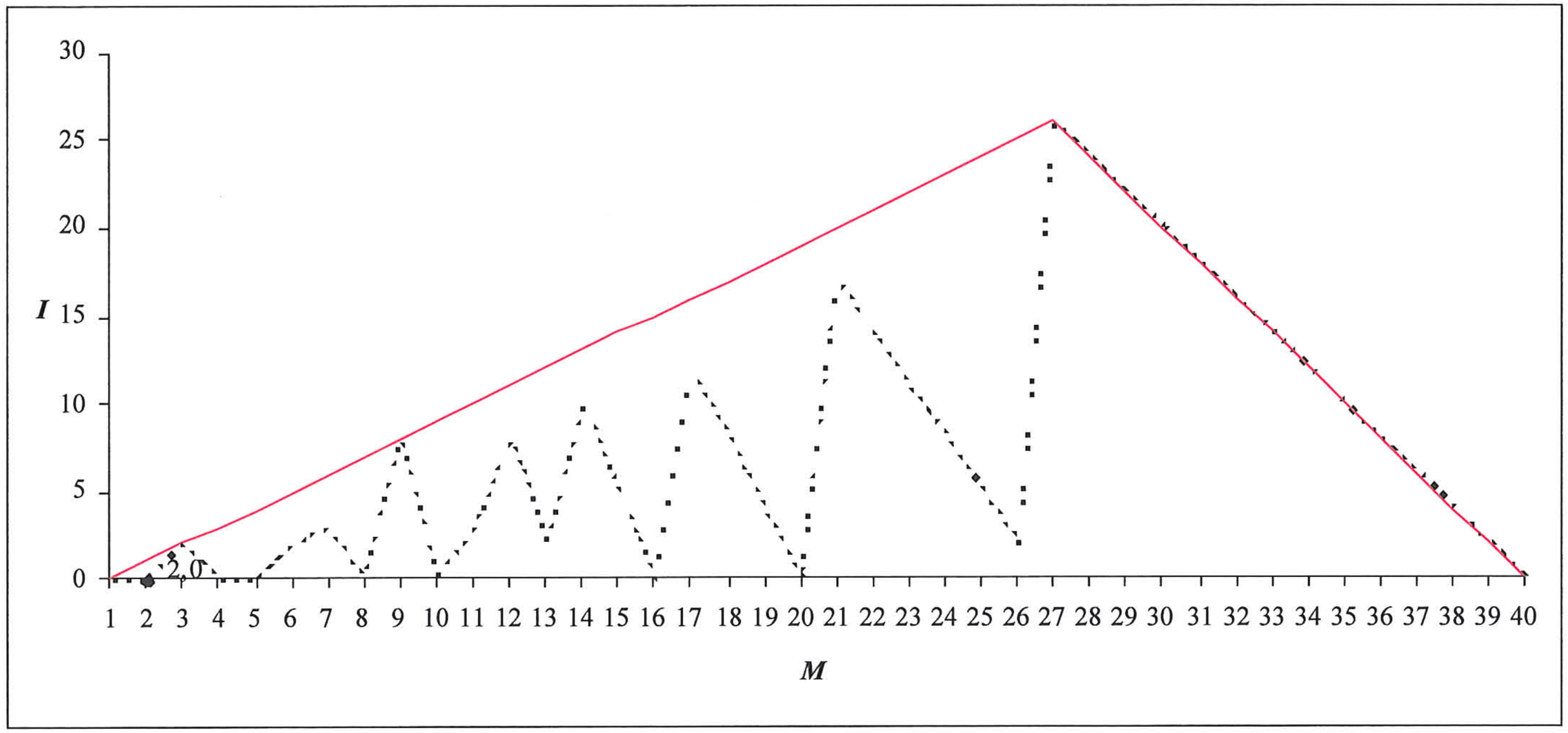


Figure 5.21: Inner Symmetry Chart for (2, 0), with $n = 80$.

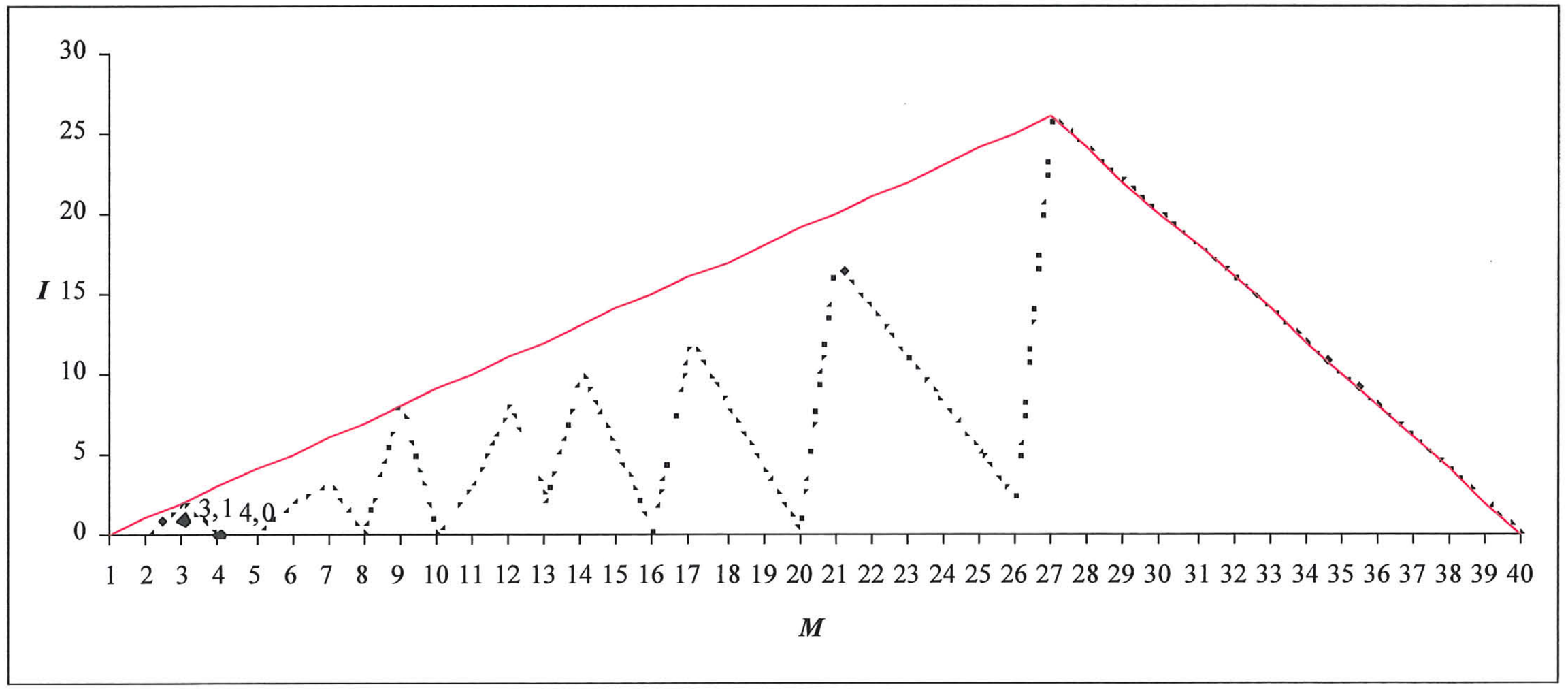


Figure 5.22: Inner Symmetry Chart for (3, 1) + (4, 0), with $n = 80$.

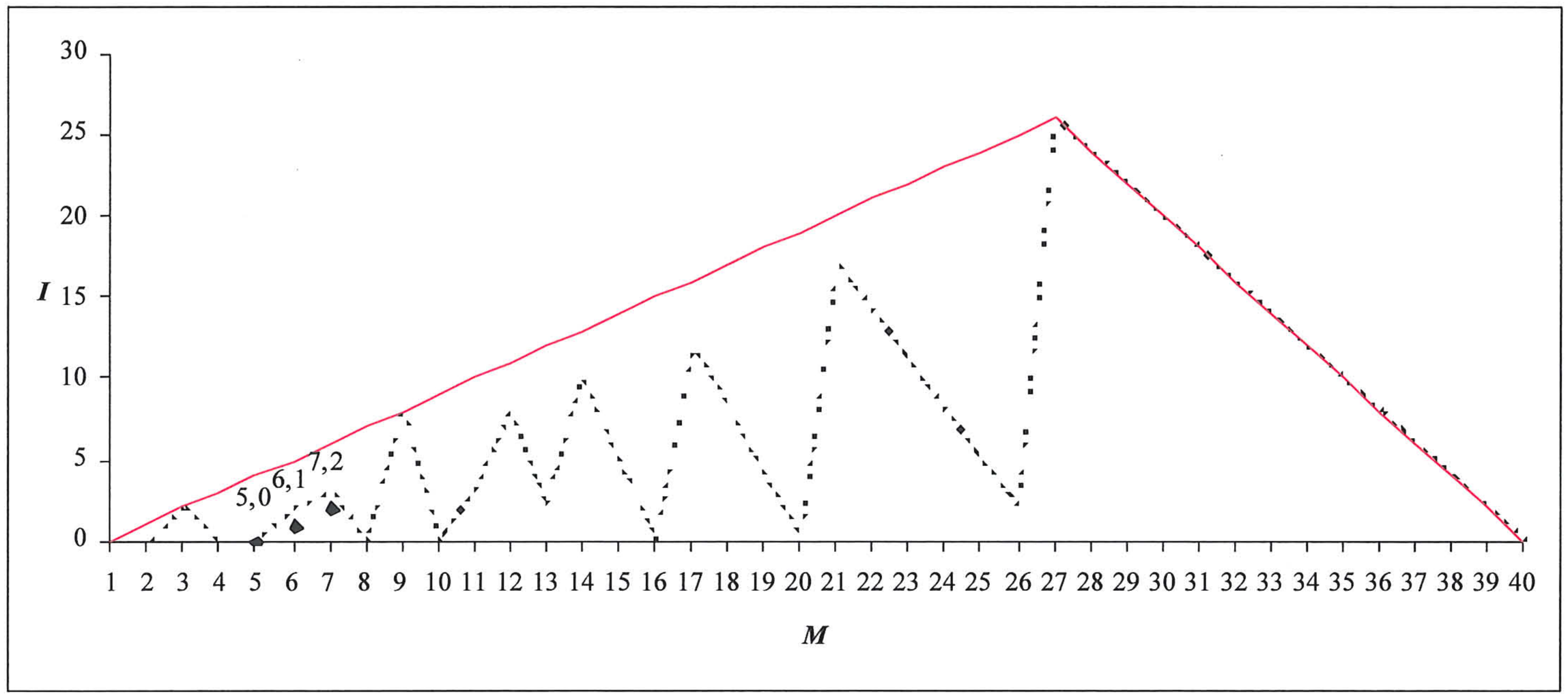


Figure 5.23: Inner Symmetry Chart for (5, 0) + (6, 1) + (7, 2), with $n = 80$.

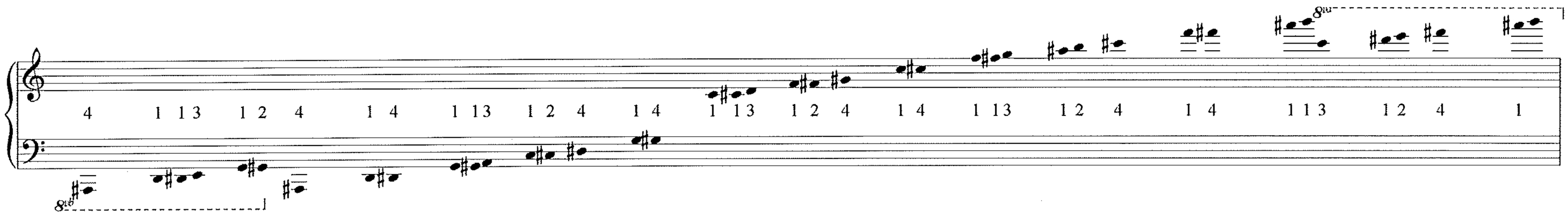


Figure 6.1: Sketches of *Palimpsest*, sieve of *Jonchaies* T_{-1}

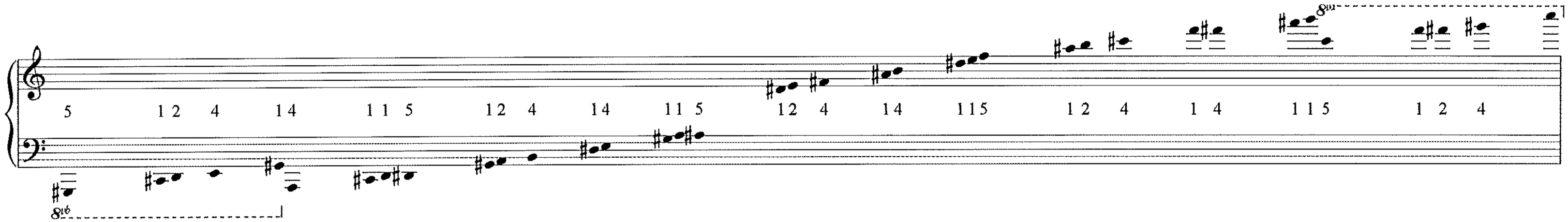


Figure 6.2: Sketches of *Palimpsest*, Sieve of *Jonchaies* T_{-7} and with perfect 4th instead of m3rd.

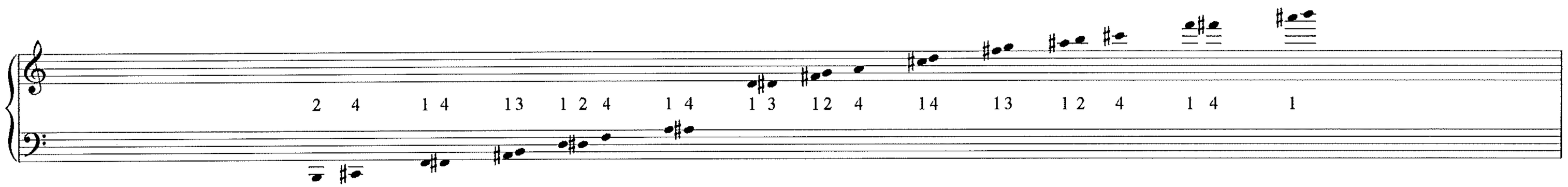


Figure 6.3: Sketches of *Palimpsest*, Sieve of *Jonchaies* T_{+1} and omitting the last element.

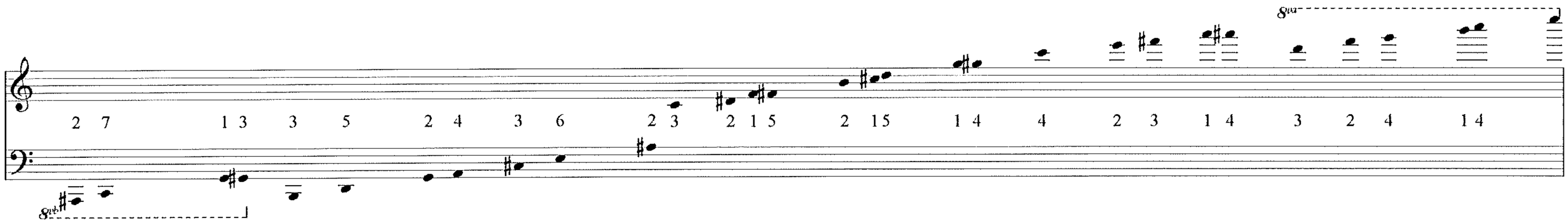


Figure 6.4: Original Sieve of *Mists*.

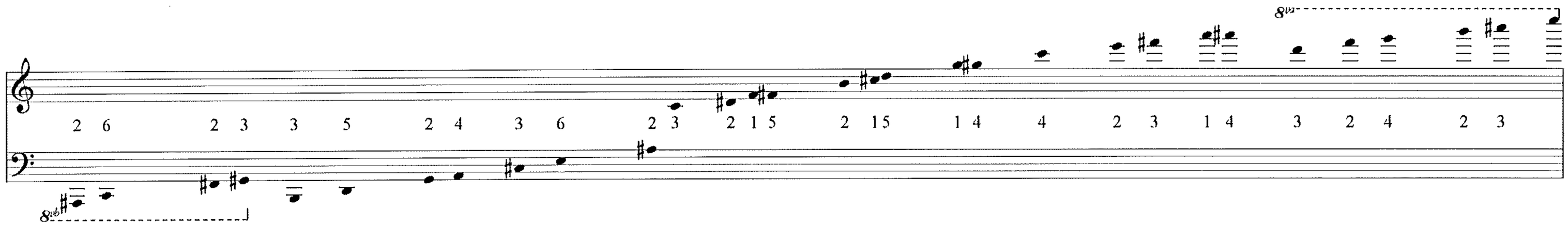


Figure 6.5: Final Version of the Sieve of *Mists*.

10_j

9_k	0	1	2	3	4	5	6	7	8	9
0	0	81	**72**	**63**	54	**45**	36	27	18	**9**
1	10	**1**	**82**	**73**	64	55	46	**37**	**28**	19
2	20	**11**	2	83	74	65	56	47	38	29
3	30	21	12	**3**	84	75	66	57	48	**39**
4	40	**31**	**22**	13	4	85	76	**67**	**58**	49
5	**50**	41	32	23	**14**	5	**86**	**77**	68	**59**
6	60	51	**42**	33	**24**	15	6	87	78	**69**
7	70	61	**52**	43	34	25	16	7	**88**	79
8	**80**	71	62	**53**	**44**	35	26	**17**	8	89

Figure 6.6: Decomposed Matrix for the Sieve of *Mists*.

5_j

2_i	0	1	2	3	4
0	0	6	2	8	4
1	5	1	7	3	9

Figure 6.7: Sub-matrix for the Sieve of *Mists*.

Canonical Form	*M, I, R*	*Interval*
5^2	25, 16, 2	2·8ve + semitone
$2^2 \cdot 7$	28, 10, 2 28, 16, 2 28, 23, 2	2·8ve + M3rd
29	29, 23, 2	2·8ve + 4th
$2 \cdot 3 \cdot 5$	30, 8, 2 30, 21, 2 30, 27, 2	2·8ve + tritone
2^5	32, 30, 1	2·8ve + m6th
$3 \cdot 11$	33, 10, 2	2·8ve + M6th
$5 \cdot 7$	35, 23, 1	2·8ve + M7th
$2^2 \cdot 3^2$	36, 0, 2 36, 13, 2	3·8ve
41	41, 8, 2 41, 30, 1	3·8ve + 4th
47	47, 2, 1	3·8ve + M7th

Figure 6.8: Simplified Formula of the Sieve of *Mists*.

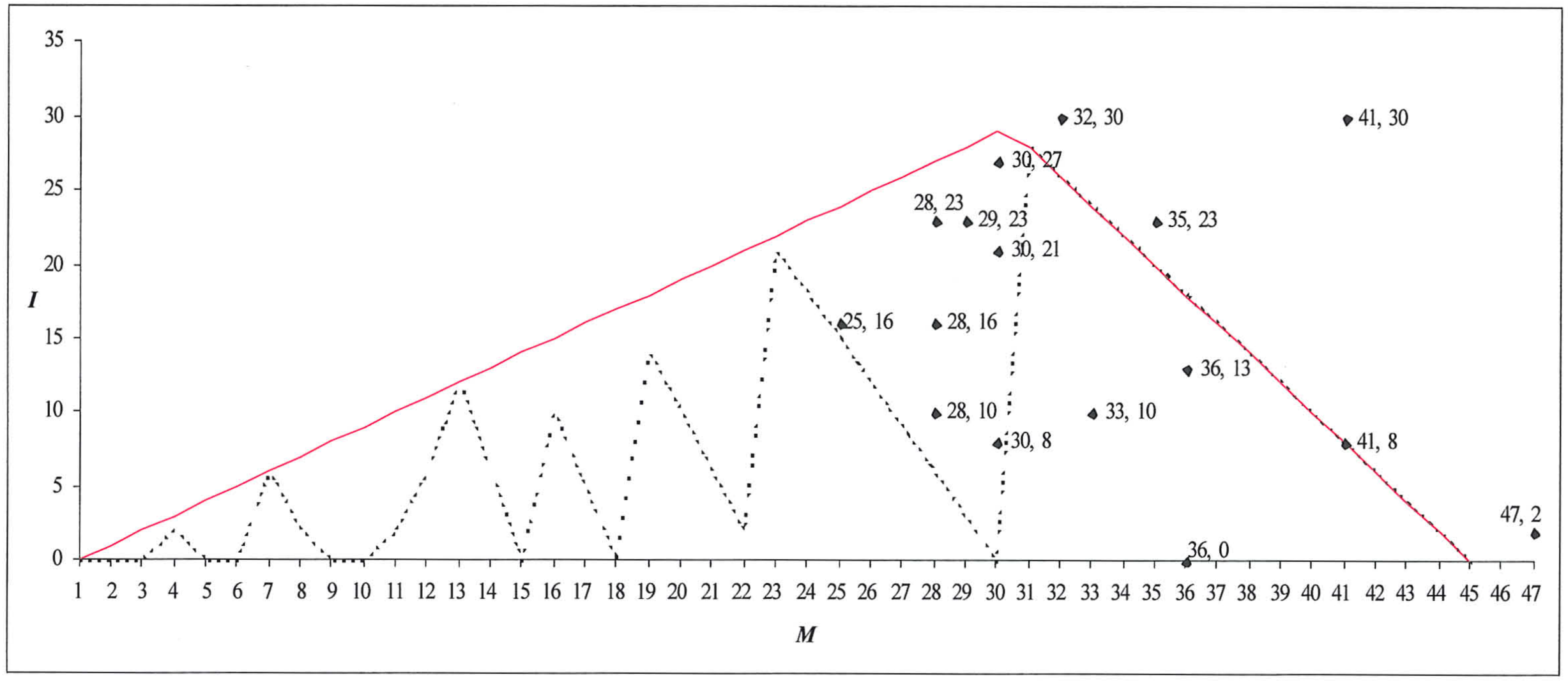


Figure 6.9: Inner Symmetry Chart for the Final Sieve of *Mists*.

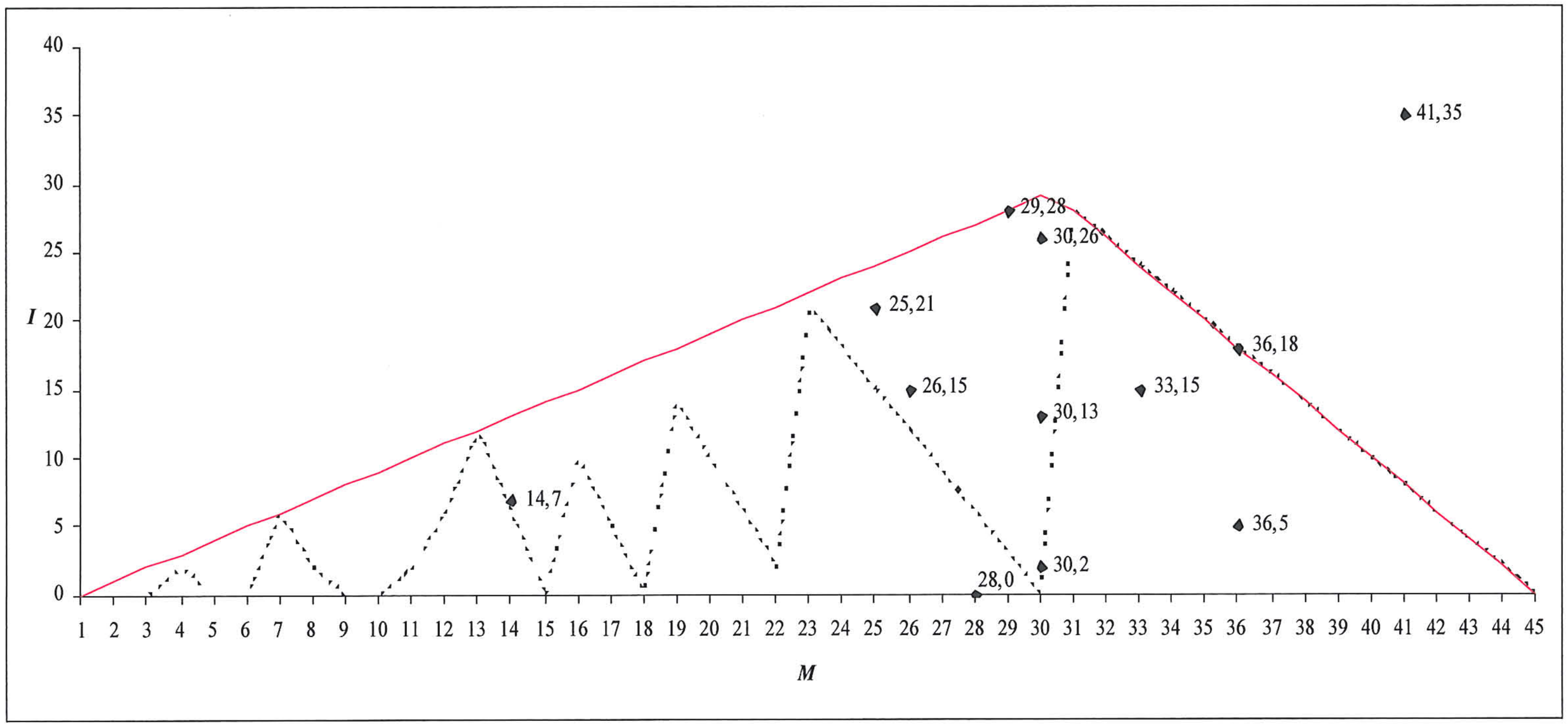


Figure 6.10: Sieve of *Mists*, T_7(mod90).

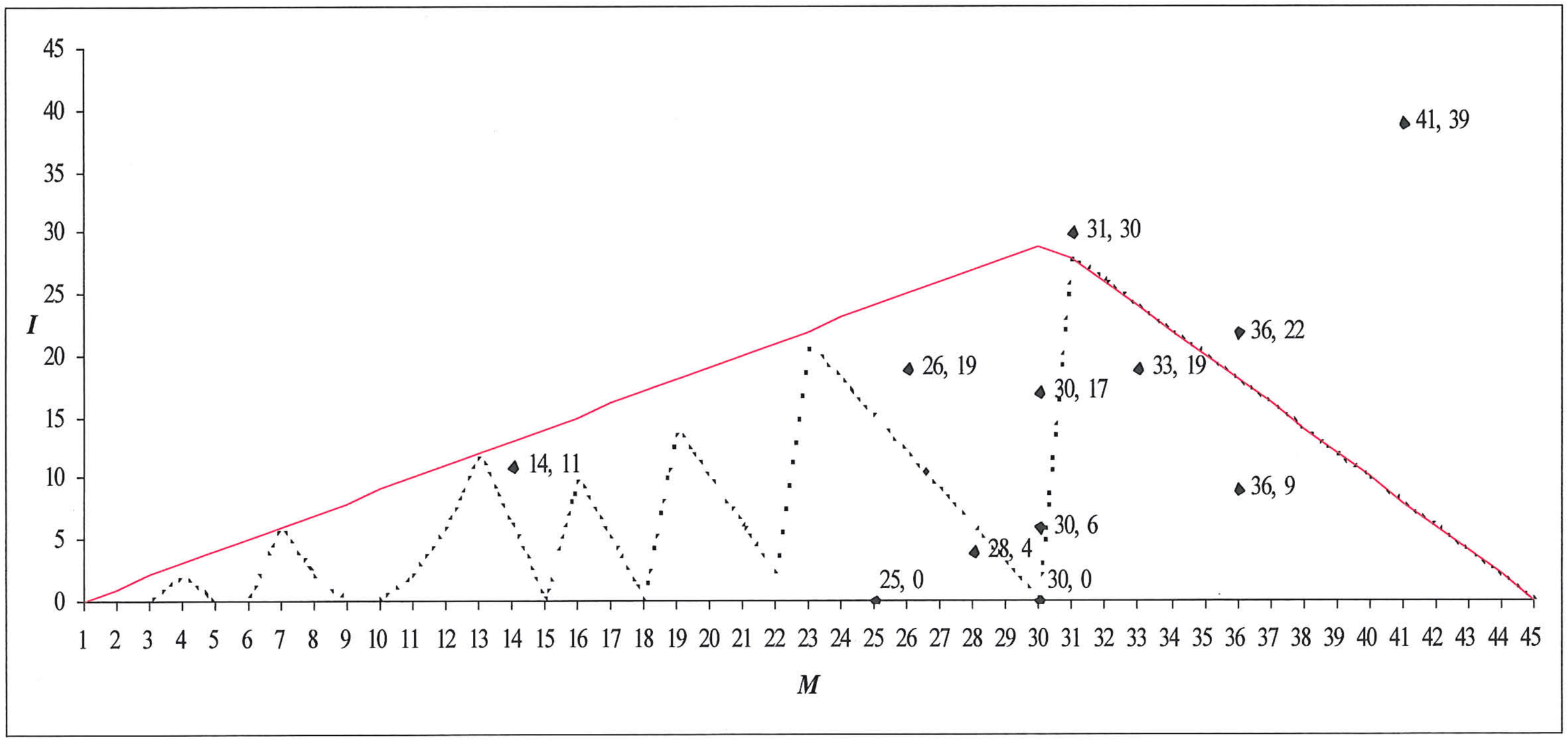


Figure 6.11: Sieve of *Mists*, T_8(mod90).

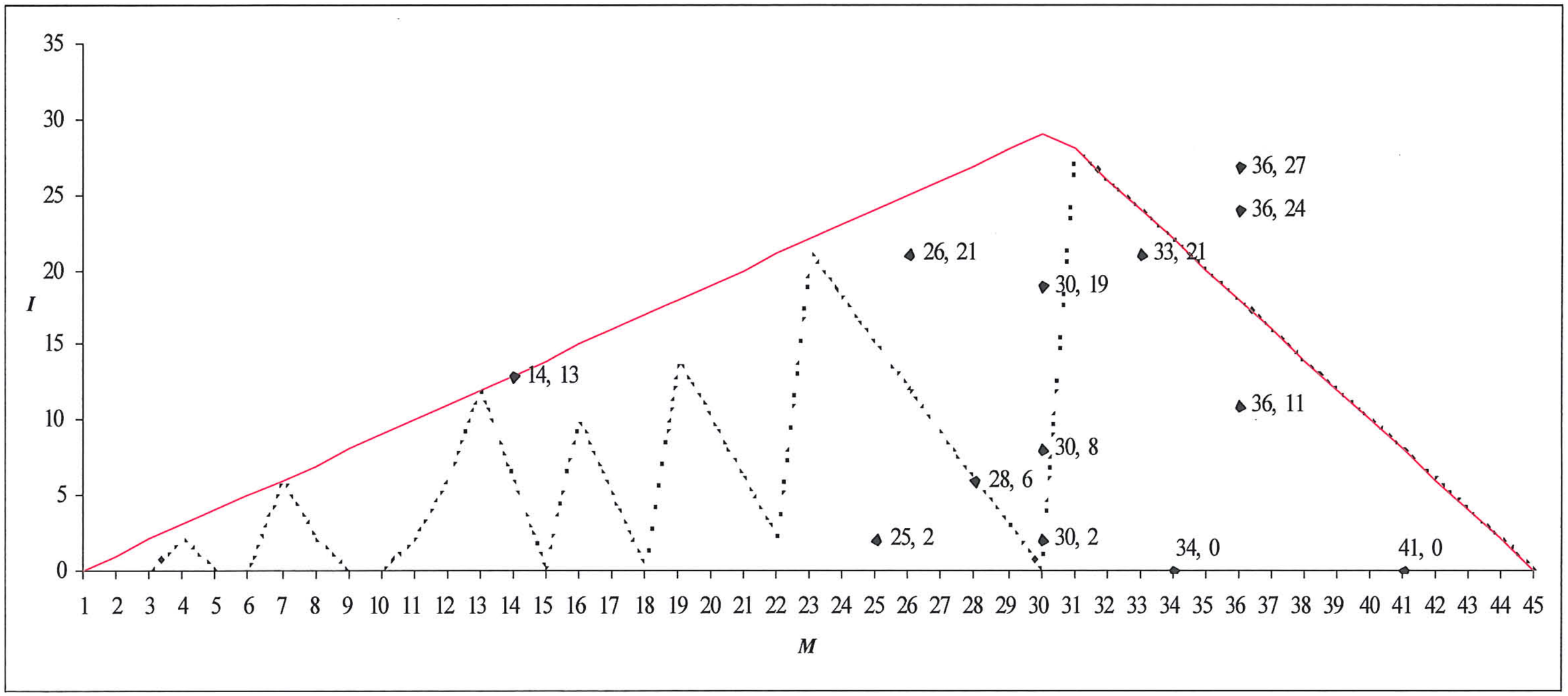


Figure 6.12: Sieve of *Mists*, T_{10}(mod90).

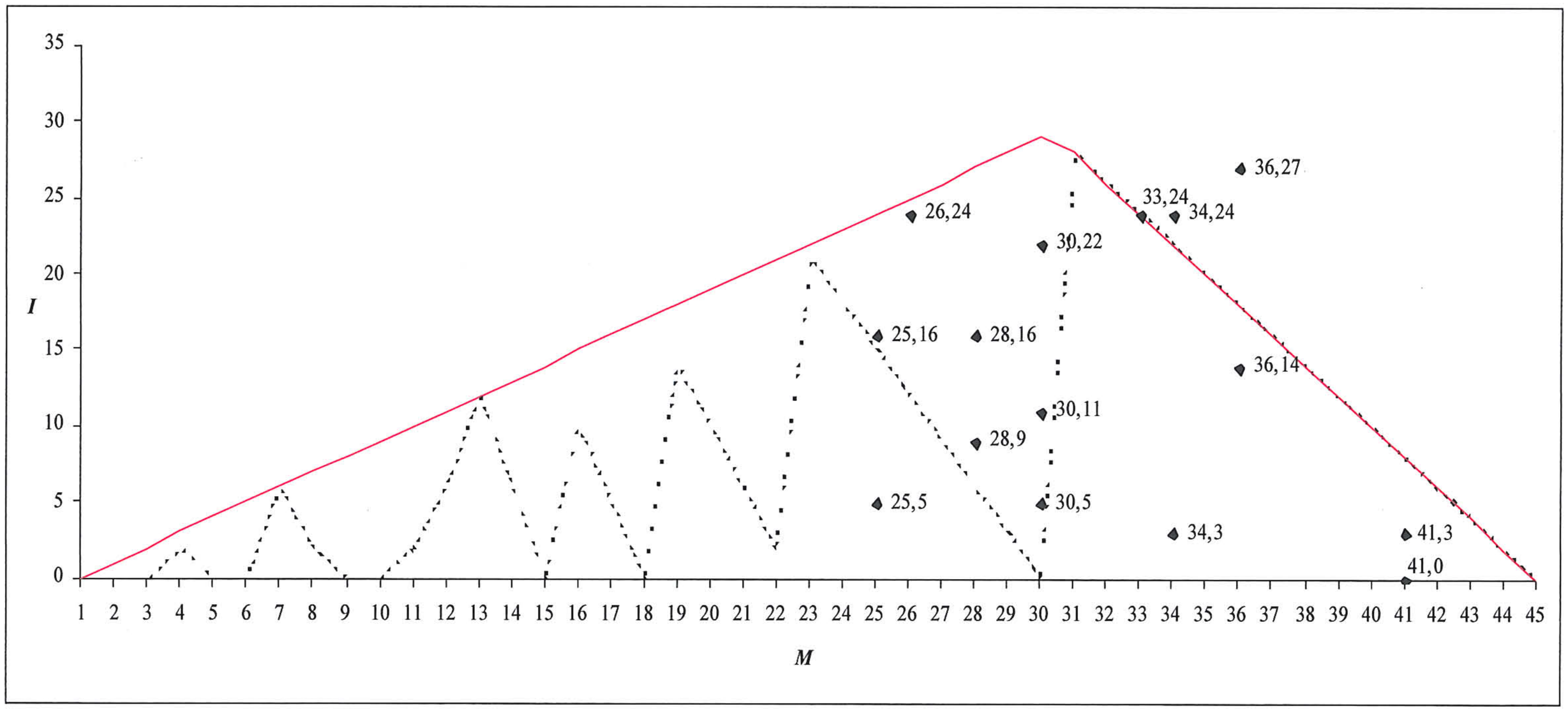


Figure 6.13: Sieve of *Mists*, T_{15}(mod90).

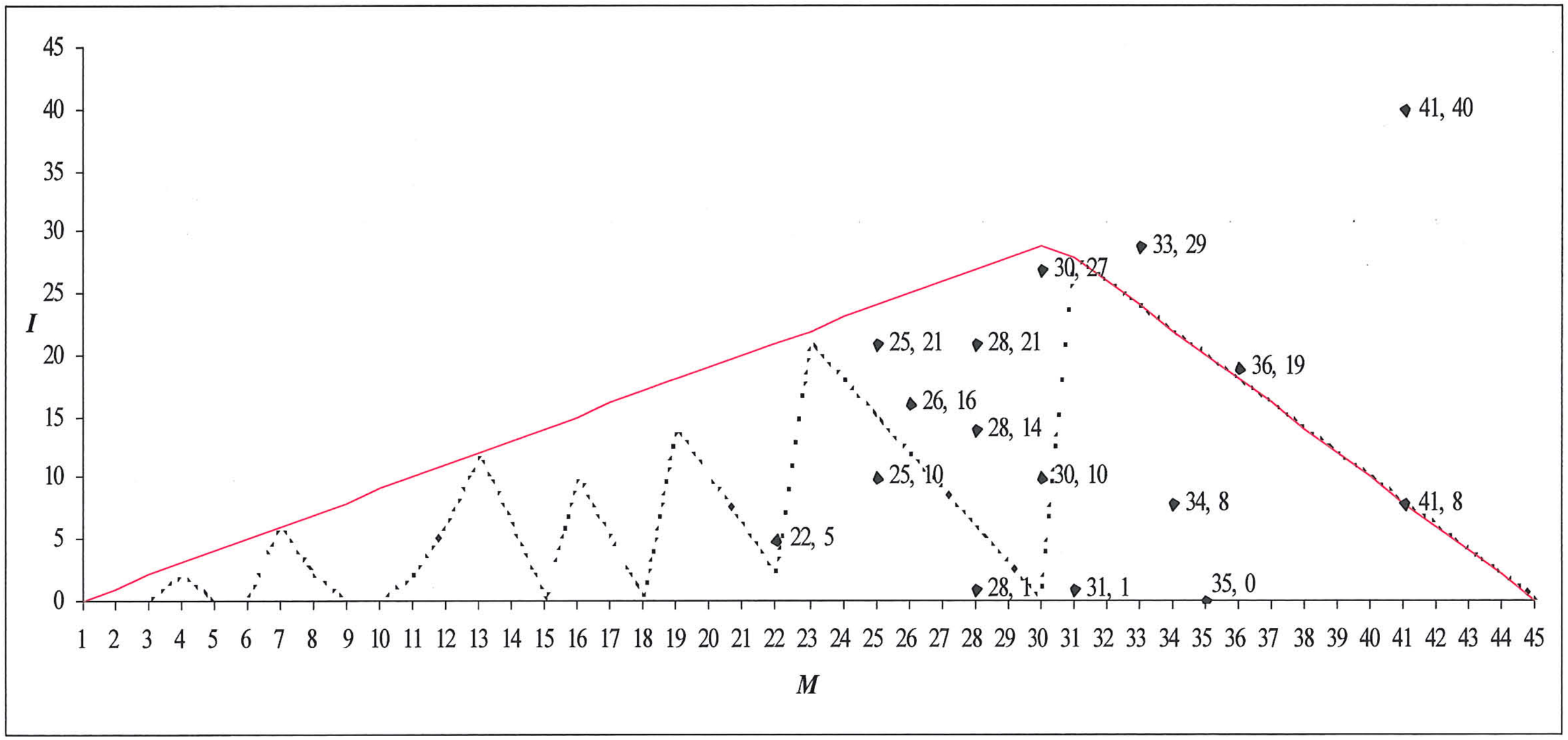


Figure 6.14: Sieve of *Mists*, T_{20}(mod90).

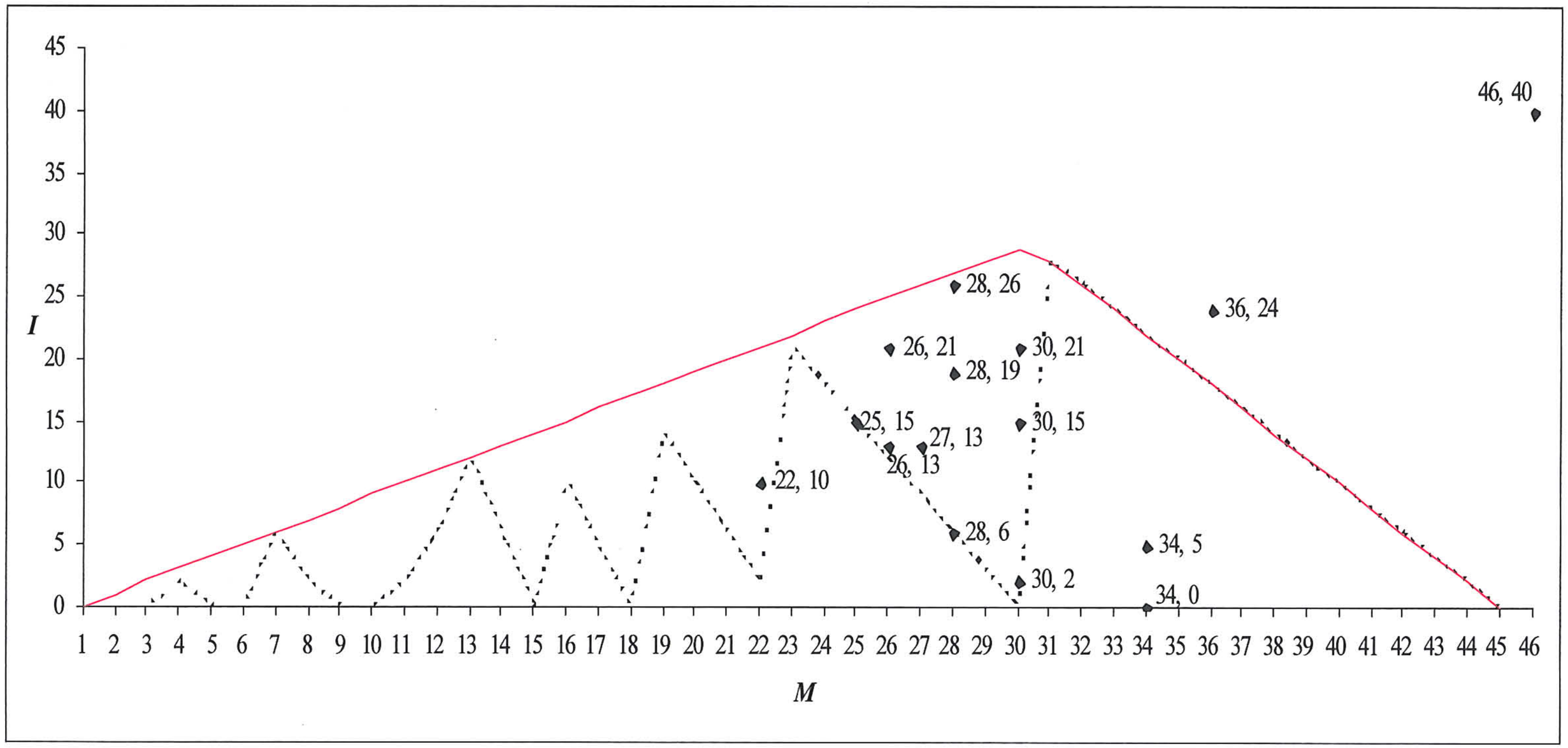


Figure 6.15: Sieve of *Mists*, T_{24}(mod90).

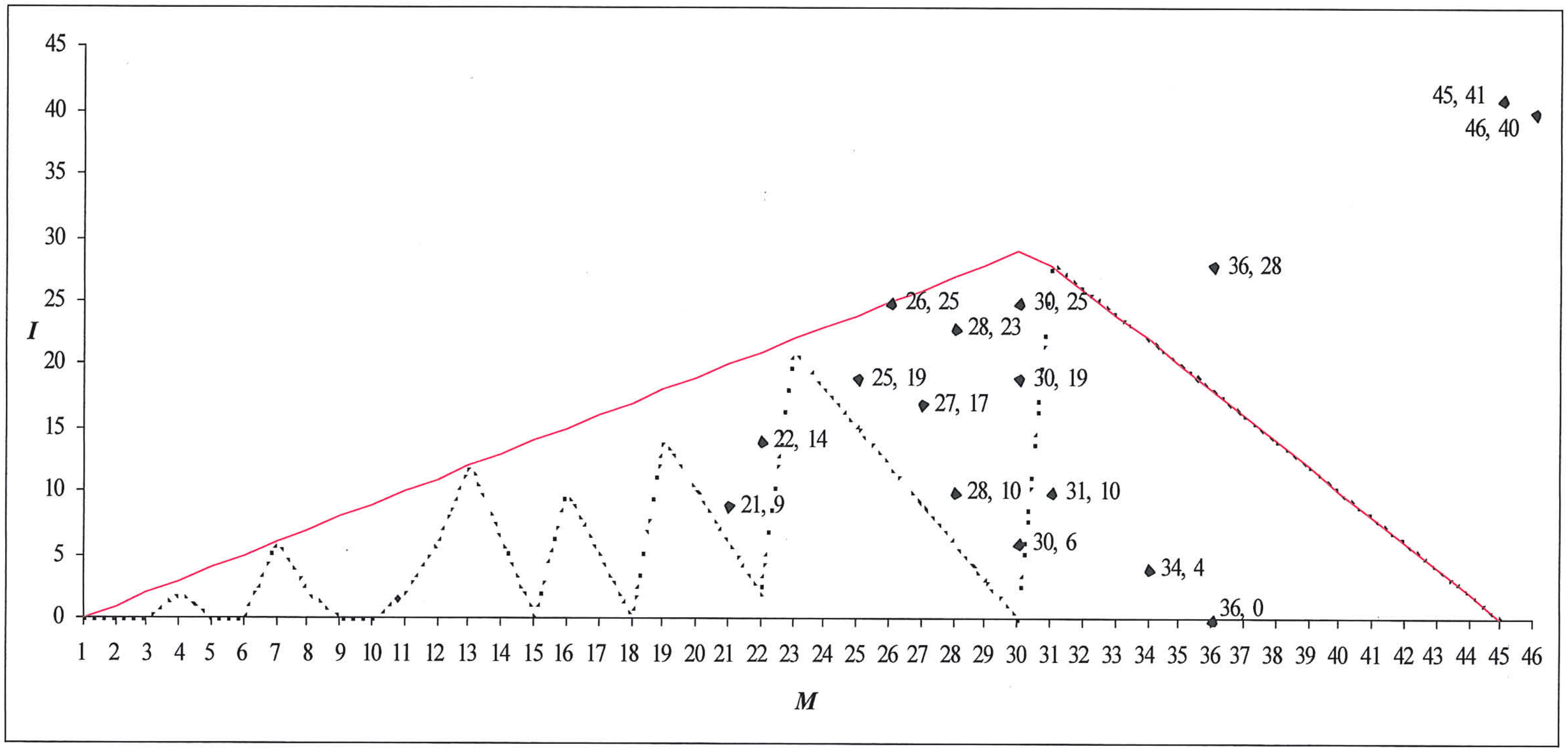


Figure 6.16: Sieve of *Mists*, T_{29}(mod90).

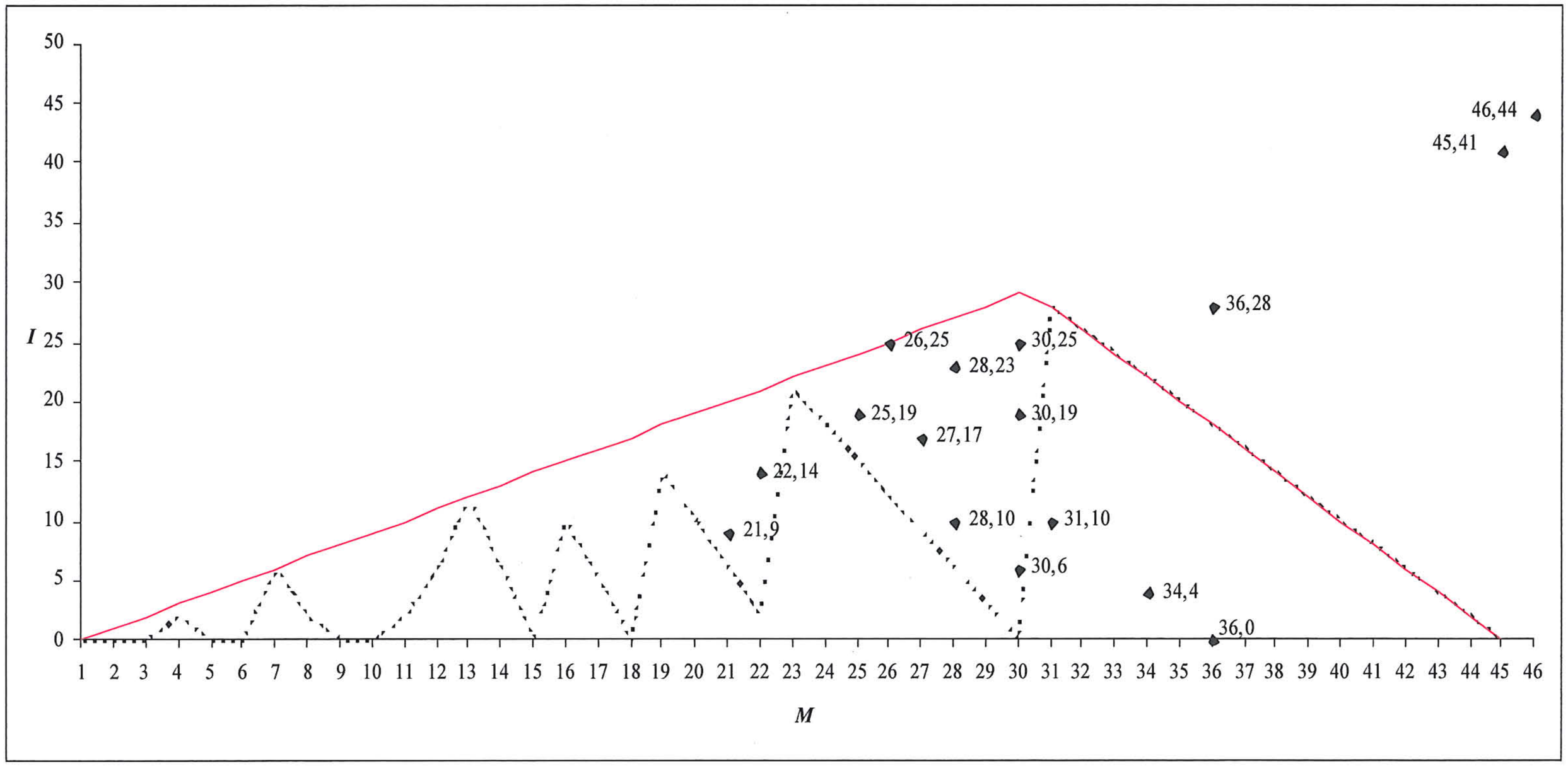


Figure 6.17: Sieve of *Mists*, T_{30}(mod90).

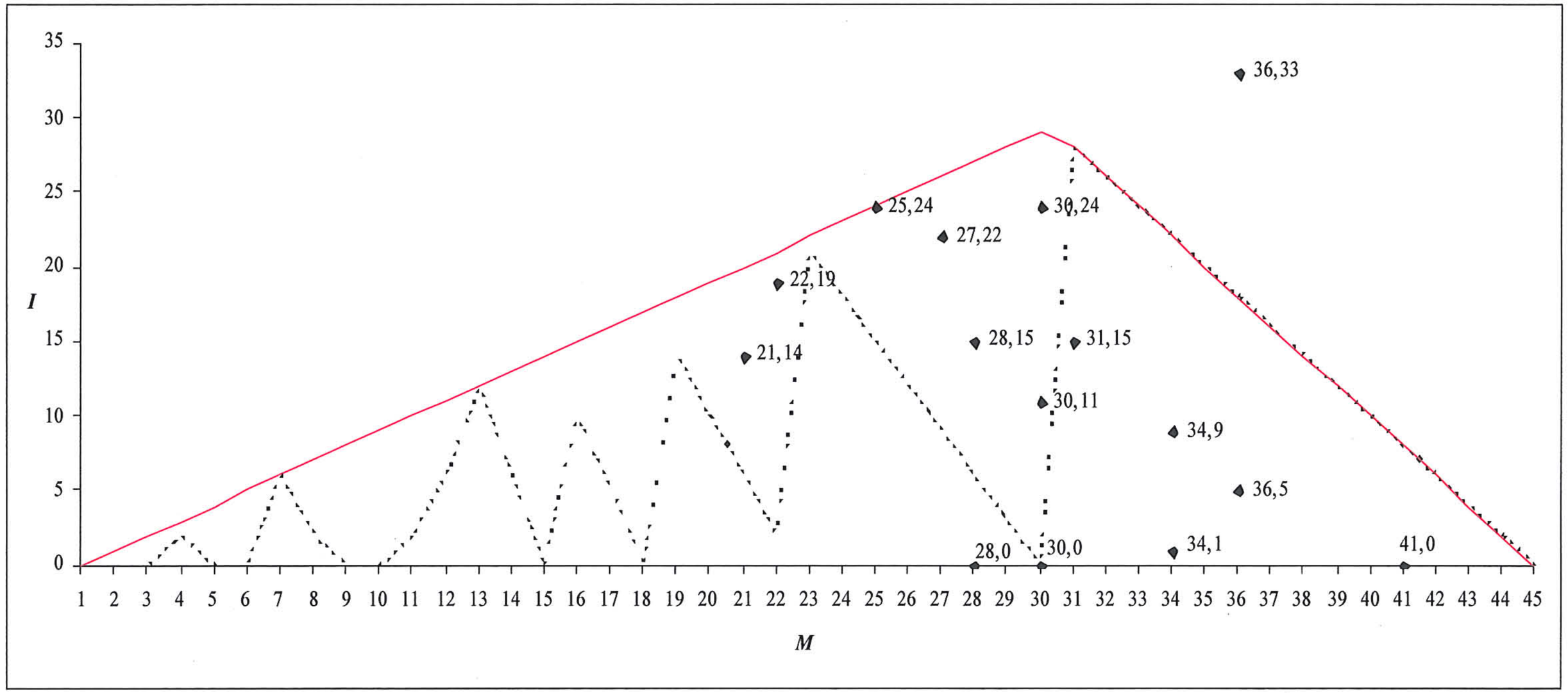


Figure 6.18: Sieve of *Mists*, T_{36}(mod90).

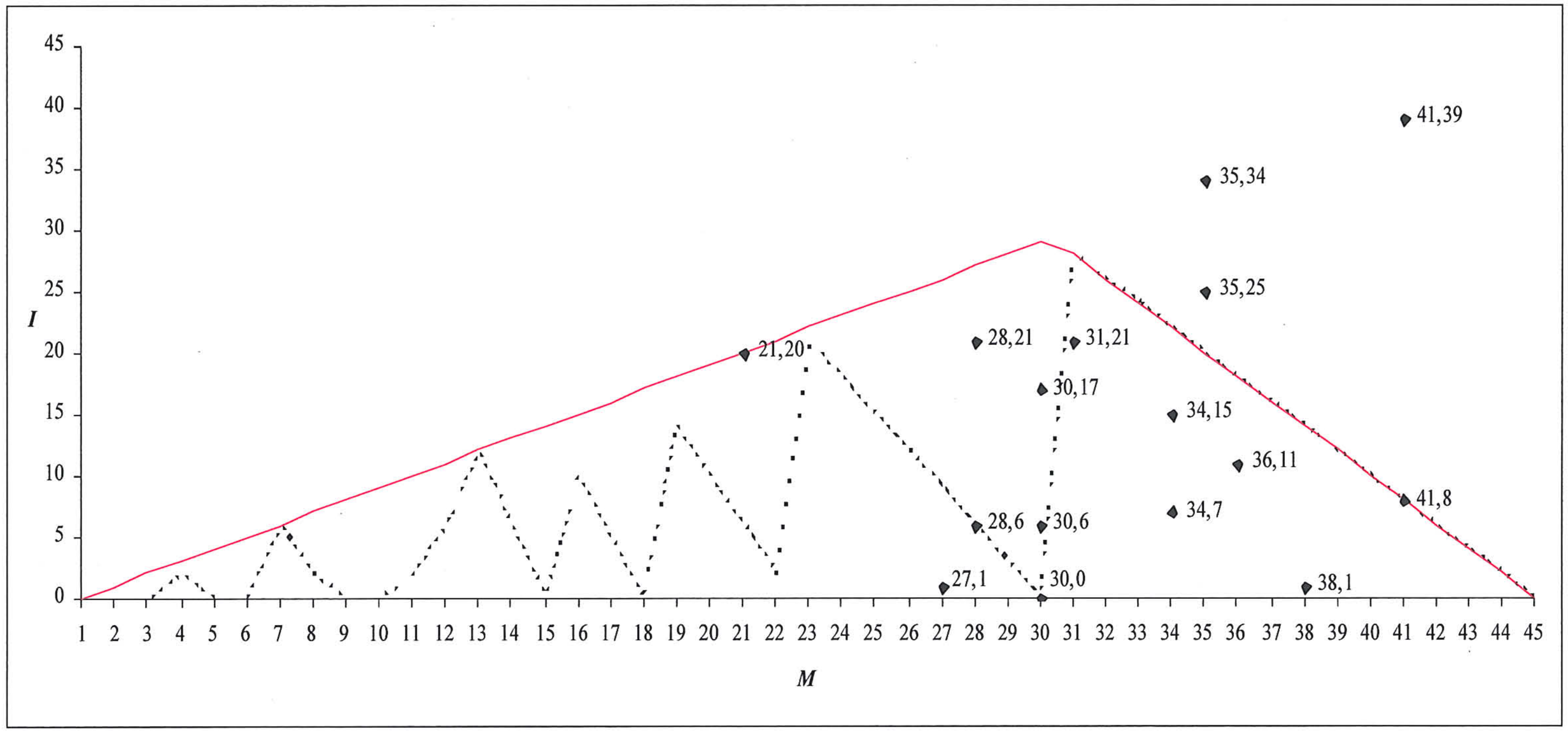


Figure 6.19: Sieve of *Mists*, T_{38}(mod90).

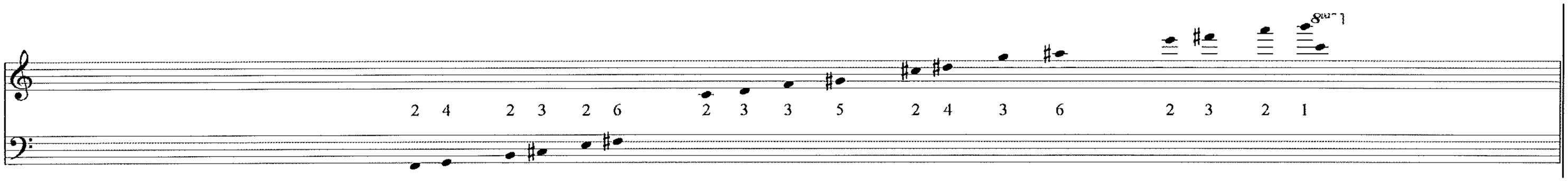


Figure 6.20: Sieve in the sketches of *Aïs* that was not finally used.

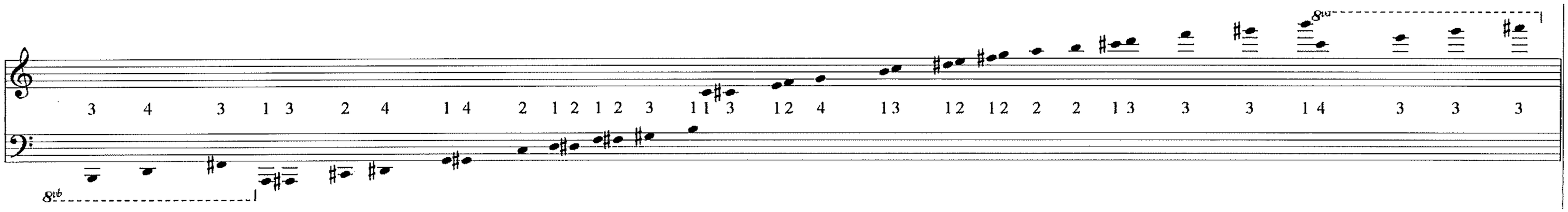


Figure 6.21: Original Sieve of *Aïs* (not finally used).

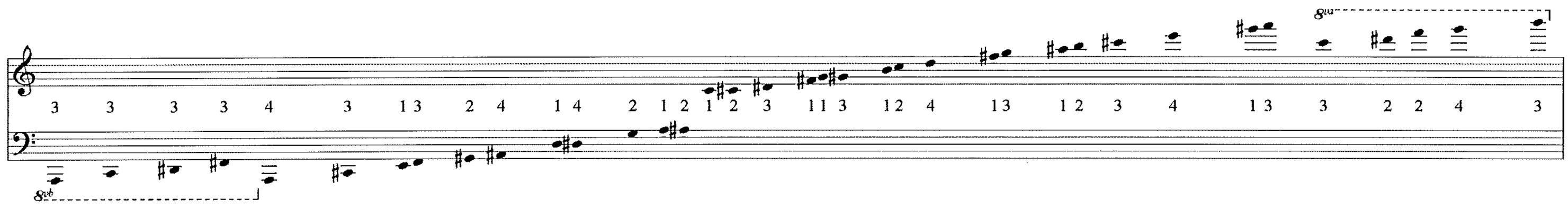


Figure 6.22: Sieve of *Aïs* (T_{+7} of the Original).

Canonical Form	*M, I, R*	*Interval*
3·7	21, 9, 3 21, 19, 3	8ve + M6th
2·11	22, 20, 3	8ve + m7th
2^3·3	24, 16, 2 24, 23, 2	2·8ve
5^2	25, 0, 3 25, 12, 2	2·8ve + semitone
2·13	26, 19, 2 26, 20, 2	2·8ve + tone
2^2·7	28, 6, 2	2·8ve + M3rd
29	29, 0, 2	2·8ve + 4th
2·3·5	30, 20, 2	2·8ve + tritone
31	31, 16, 2	2·8ve + 5th
2^5	32, 25, 1	2·8ve + m6th
3·11	33, 6, 2 33, 20, 2	2·8ve + M6th
2·17	34, 3, 2	2·8ve + m7th
2^2·3^2	36, 0, 2	3·8ve
37	37, 30, 1	3·8ve + semitone

Figure 6.23: Simplified Formula of the Final Sieve of *Aïs*.

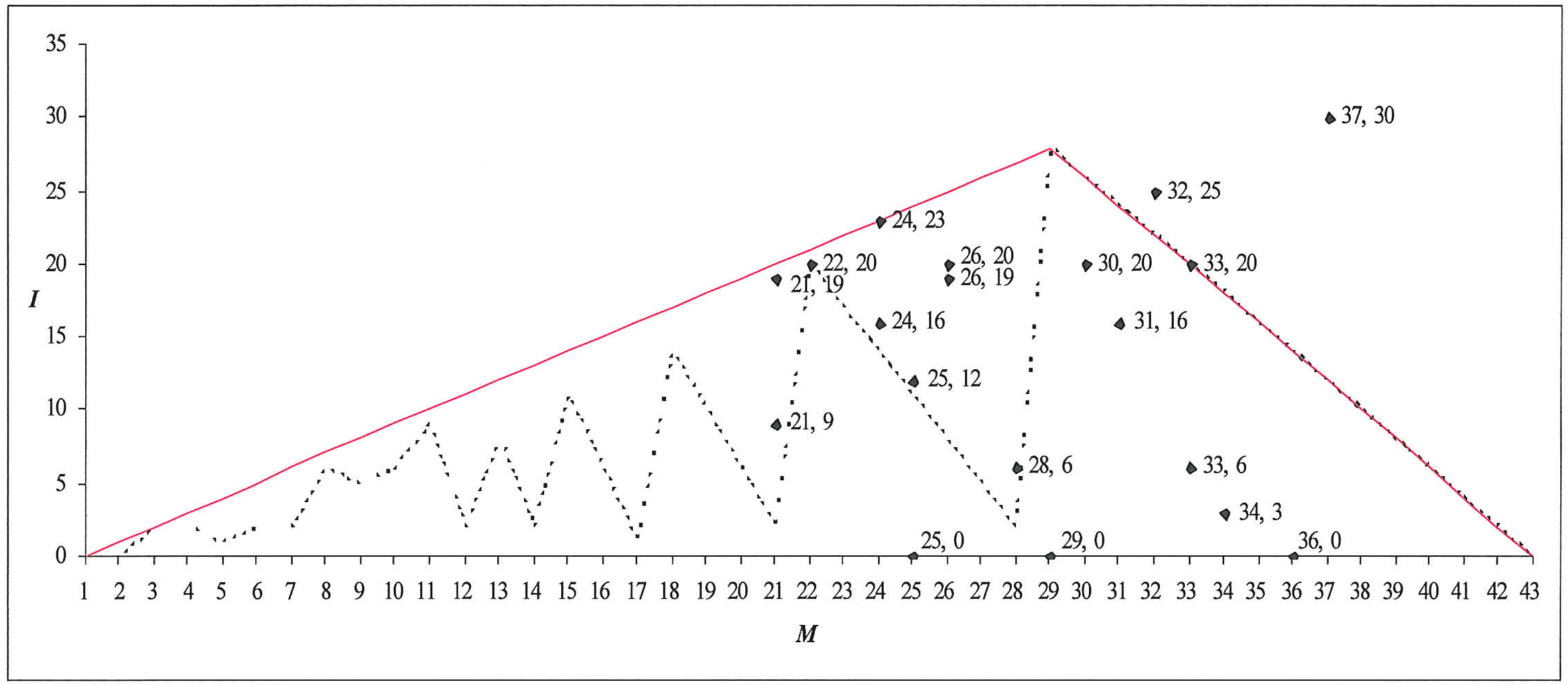


Figure 6.24: Inner Symmetry Chart for the Final Sieve of *Aïs*.

Canonical Form	*M, I, R*	*Interval*
3·7	21, 10, 3 21, 20, 3	8ve + M6th
2·11	22, 11, 3 22, 14, 3	8ve + m7th
23	23, 14, 3	8ve + M7th
5^2	25, 16, 2	2·8ve + semitone
2^2·7	28, 16, 2 28, 21, 2 28, 27, 2	2·8ve + M3rd
2·3·5	30, 0, 2 30, 3, 2 30, 28, 1	2·8ve + tritone
31	31, 7, 2 31, 11, 2 31, 25, 1	2·8ve + 5th
2^5	32, 16, 2	2·8ve + m6th
3·11	33, 20, 2	2·8ve + M6th

Figure 6.25: Simplified Formula of the Original Sieve of *Aïs*.

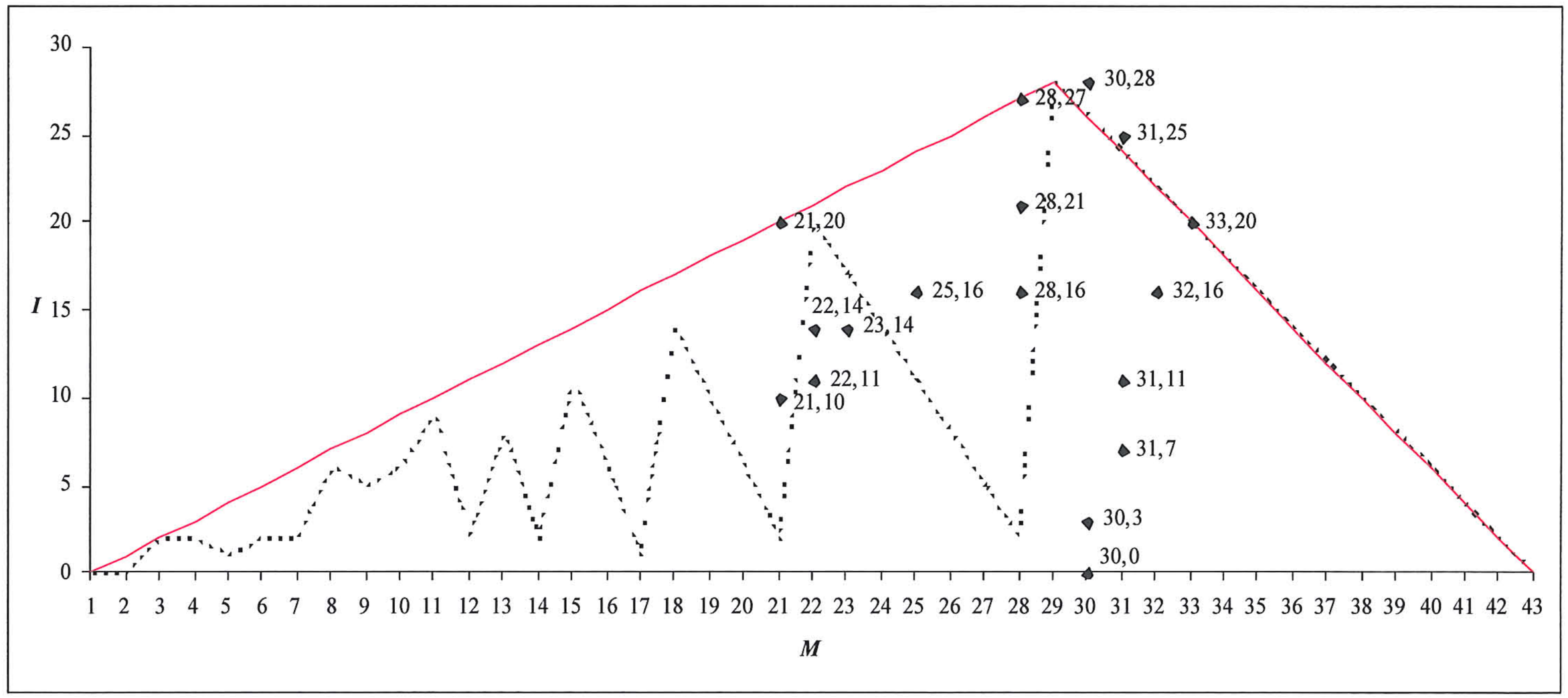


Figure 6.26: Inner Symmetry Chart for the original sieve of *Aïs*.

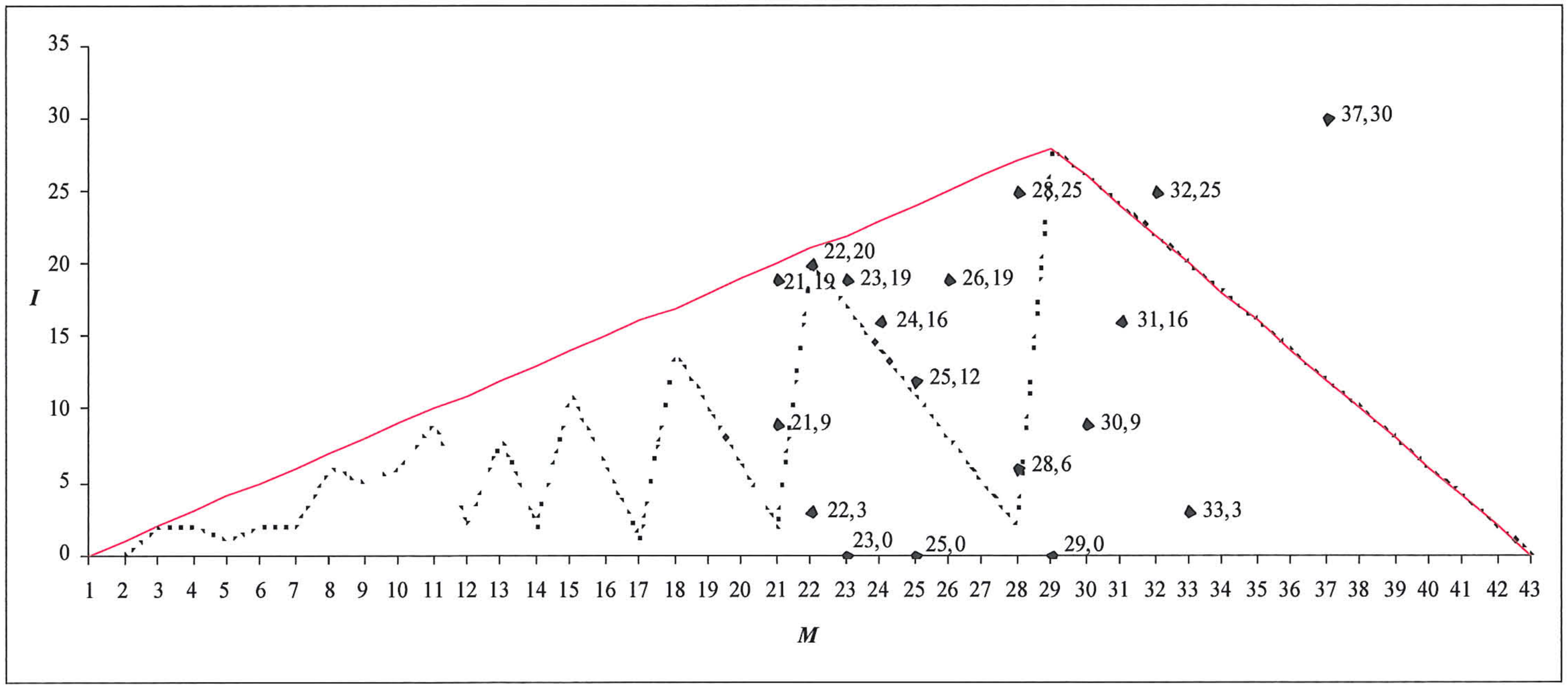


Figure 6.27: Inner Symmetry Chart of the T_7(mod86) Transposition of the original sieve of *Aïs*.

Canonical Form	*M, I, R*	*Interval*
2·7	14, 2, 6	8ve + tone
19	19, 10, 4	8ve + 5th
2·11	22, 3, 3	8ve + m7th
23	23, 21, 2	8ve + M7th
2^3·3	24, 0, 3 24, 14, 3 24, 10, 3	2·8ve
5^2	25, 13, 3	2·8ve + semitone
2·13	26, 17, 2 26, 21, 2	2·8ve + tone
2^2·7	28, 7, 2	2·8ve + M3rd
29	29, 9, 2 29, 24, 2	2·8ve + 4th
2·3·5	30, 9, 2 30, 17, 2 30, 29, 1	2·8ve + tritone
31	31, 4, 2 31, 16, 2	2·8ve + 5th
2^5	32, 25, 1	2·8ve + m6th
5·7	35, 17, 2	2·8ve + M7th

Figure 6.28: Simplified Formula of the Sieve of *Nekuïa*.

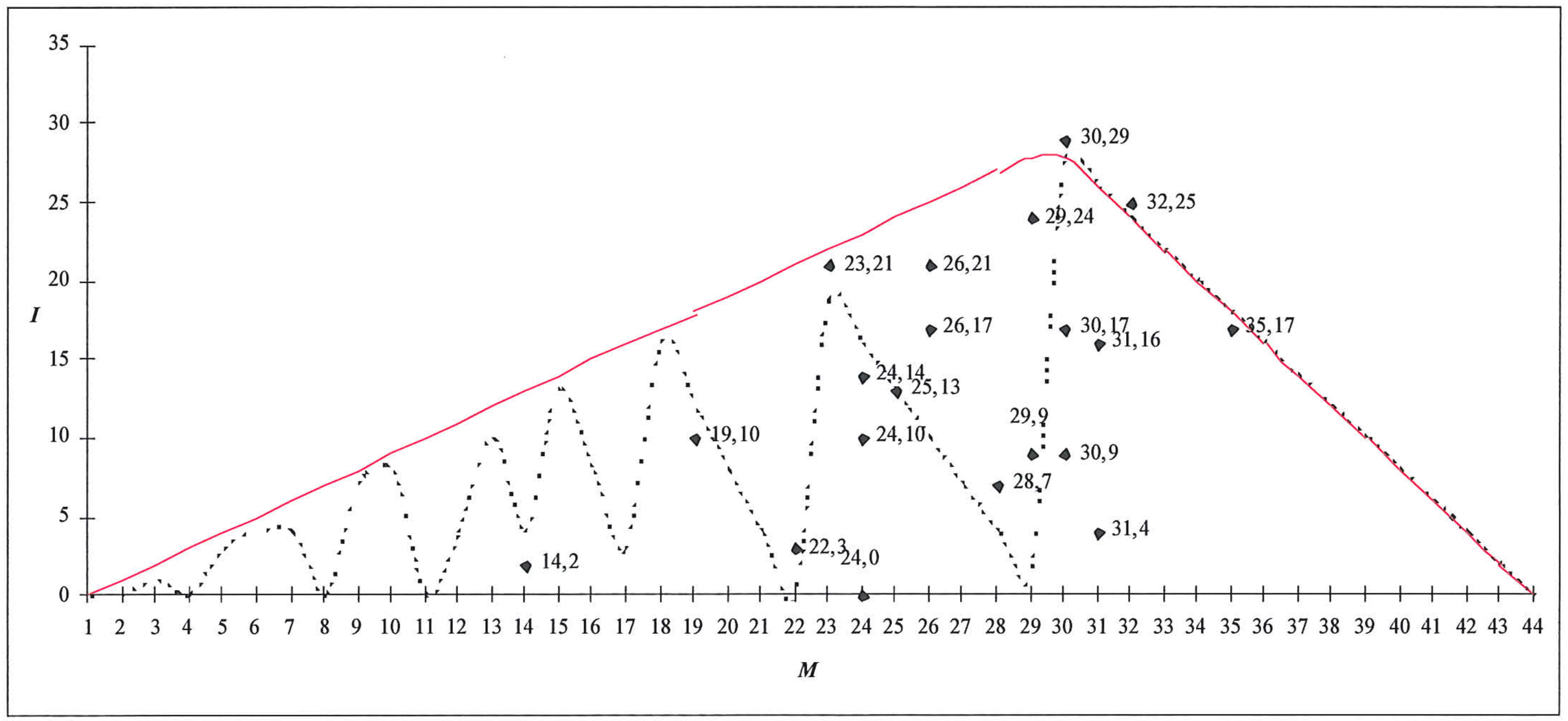


Figure 6.29: Inner Symmetry Chart for the Sieve of *Nekuïa*.

Cyclic Transposition	Effective Index mod88
$8_i + 11_j$	0
$8_i + 11_{j+8}$	8
$8_{i+1} + 11_j$	33
$8_i + 11_{j+7}$	40
$8_i + 11_{j+1}$	56
$8_{i+5} + 11_j$	77
$8_i + 11_{j+3}$	80

Figure 6.30: Cyclic Transpositions in *Nekuïa*.

Canonical Form	*M, I, R*	*Interval*
2·7	14, 8, 5	8ve + tone
19	19, 16, 3	8ve + 5th
2·11	22, 9, 3	8ve + m7th
23	23, 4, 3 23, 22, 2	8ve + M7th
$2^3 \cdot 3$	24, 6, 3 24, 16, 2 24, 20, 2	2·8ve
5^2	25, 15, 2 25, 19, 2	2·8ve + semitone
2·13	26, 23, 2	2·8ve + tone
3^3	27, 9, 2	2·8ve + m3rd
$2^2 \cdot 7$	28, 13, 2	2·8ve + M3rd
2·3·5	30, 5, 2 30, 19, 2 30, 23, 2	2·8ve + tritone
31	31, 10, 2 31, 22, 2 31, 27, 1	2·8ve + 5th
2^5	32, 27, 1	2·8ve + m6th
$2^2 \cdot 3^2$	36, 0, 2	3·8ve

T_8(mod88)

Canonical Form	*M, I, R*	*Interval*
3·5	15, 0, 5	8ve + m3rd
$2 \cdot 3^2$	18, 2, 4 18, 12, 4 18, 16, 4	8ve + tritone
$2^2 \cdot 5$	20, 15, 3	8ve + m6th
2·11	22, 12, 3	8ve + m7th
23	23, 6, 3 23, 10, 3	8ve + M7th
$2^3 \cdot 3$	24, 21, 2	2·8ve
5^2	25, 15, 2 25, 16, 2	2·8ve + semitone
3^3	27, 2, 3 27, 20, 2 27, 25, 2	2·8ve + m3rd
$2^2 \cdot 7$	28, 5, 2	2·8ve + M3rd
2·3·5	30, 1, 2	2·8ve + tritone
5·7	35, 9, 2	2·8ve + M7th

T_{33}(mod88)

Canonical Form	*M, I, R*	*Interval*
2·5	10, 4, 8	m7th
3·5	15, 4, 5 15, 9, 5	8ve + m3rd
$2 \cdot 3^2$	18, 11, 4	8ve + tritone
$2^2 \cdot 5$	20, 10, 3	8ve + m6th
2·11	22, 21, 3	8ve + m7th
23	23, 15, 3 23, 19, 3	8ve + M7th
5^2	25, 0, 3	2·8ve + semitone
2·13	26, 18, 2	2·8ve + tone
31	31, 25, 2	2·8ve + 5th
2^5	32, 25, 1	2·8ve + m6th
2·17	34, 10, 2 34, 19, 2	2·8ve + m7th
5·7	35, 5, 2	2·8ve + M7th

T_{40}(mod88)

Figure 6.31: Simplified Formulae of the Cyclic Transpositions of the Sieve of *Nekuïa*.

Canonical Form	*M, I, R*	*Interval*
19	19, 14, 3	8ve + 5th
$2^2 \cdot 5$	20, 4, 4 20, 18, 3	8ve + m6th
2·11	22, 13, 3	8ve + m7th
23	23, 10, 3	8ve + M7th
$2^3 \cdot 3$	24, 19, 2	2·8ve
5^2	25, 4, 3 25, 13, 3 25, 14, 2 25, 18, 2	2·8ve + semitone
2·13	26, 18, 2	2·8ve + tone
3^3	27, 25, 2	2·8ve + m3rd
$2^2 \cdot 7$	28, 0, 3 28, 5, 2	2·8ve + M3rd
29	29, 9, 2	2·8ve + 4th
2·3·5	30, 18, 2 30, 23, 2	2·8ve + tritone
31	31, 1, 2 31, 13, 2	2·8ve + 5th

T_{56}(mod88)

Canonical Form	*M, I, R*	*Interval*
19	19, 12, 4 19, 16, 3	8ve + 5th
23	23, 8, 3	8ve + M7th
$2^3 \cdot 3$	24, 1, 3 24, 16, 3 24, 21, 2	2·8ve
5^2	25, 0, 3	2·8ve + semitone
2·13	26, 4, 3	2·8ve + tone
$2^2 \cdot 7$	28, 17, 2 28, 22, 2 28, 26, 2	2·8ve + M3rd
29	29, 1, 3 29, 11, 2 29, 17, 2 29, 21, 2	2·8ve + 4th
2·3·5	30, 0, 2	2·8ve + tritone
31	31, 3, 2 31, 22, 2	2·8ve + 5th
2^5	32, 21, 2	2·8ve + m6th
3·11	33, 11, 2	2·8ve + M6th
5·7	35, 4, 2	2·8ve + M7th

T_{77}(mod88)

Canonical Form	*M, I, R*	*Interval*
2·7	14, 7, 5	8ve + tone
19	19, 1, 4 19, 16, 3	8ve + 5th
2·11	22, 16, 3	8ve + m7th
23	23, 12, 3	8ve + M7th
$2^3 \cdot 3$	24, 1, 3 24, 5, 3 24, 20, 2	2·8ve
5^2	25, 4, 3	2·8ve + semitone
2·13	26, 8, 3 26, 12, 2	2·8ve + tone
$2^2 \cdot 7$	28, 26, 2	2·8ve + M3rd
29	29, 15, 2 29, 21, 2 29, 25, 2	2·8ve + 4th
2·3·5	30, 0, 2	2·8ve + tritone
31	31, 7, 2 31, 26, 2	2·8ve + 5th
3·11	33, 15, 2	2·8ve + M6th
5·7	35, 8, 2	2·8ve + M7th

T_{80}(mod88)

Figure 6.31: Simplified Formulae of the Cyclic Transpositions of the Sieve of *Nekuïa*, cont.

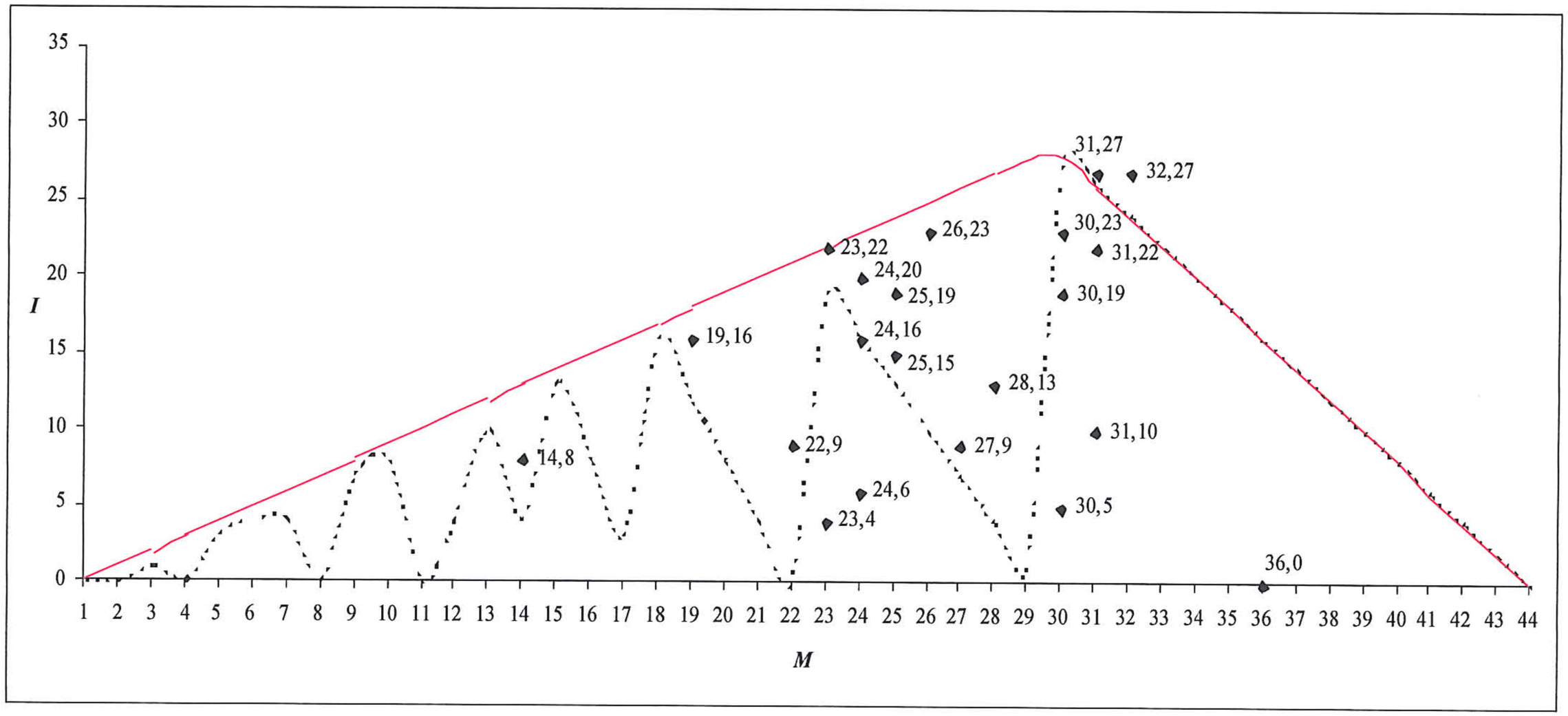


Figure 6.32: Sieve of *Nekuïa*, T_8(mod88).

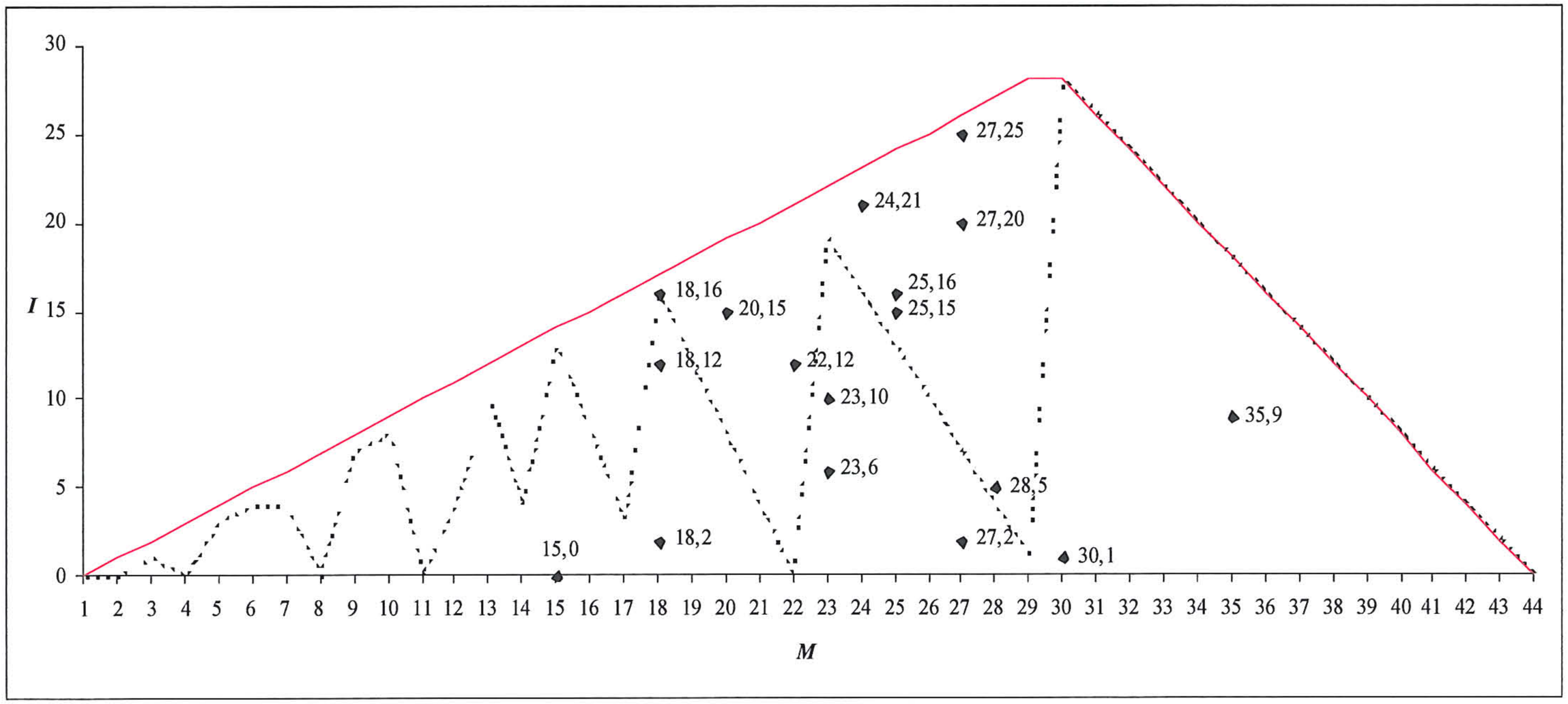


Figure 6.33: Sieve of *Nekuïa*, T_{33}(mod88).

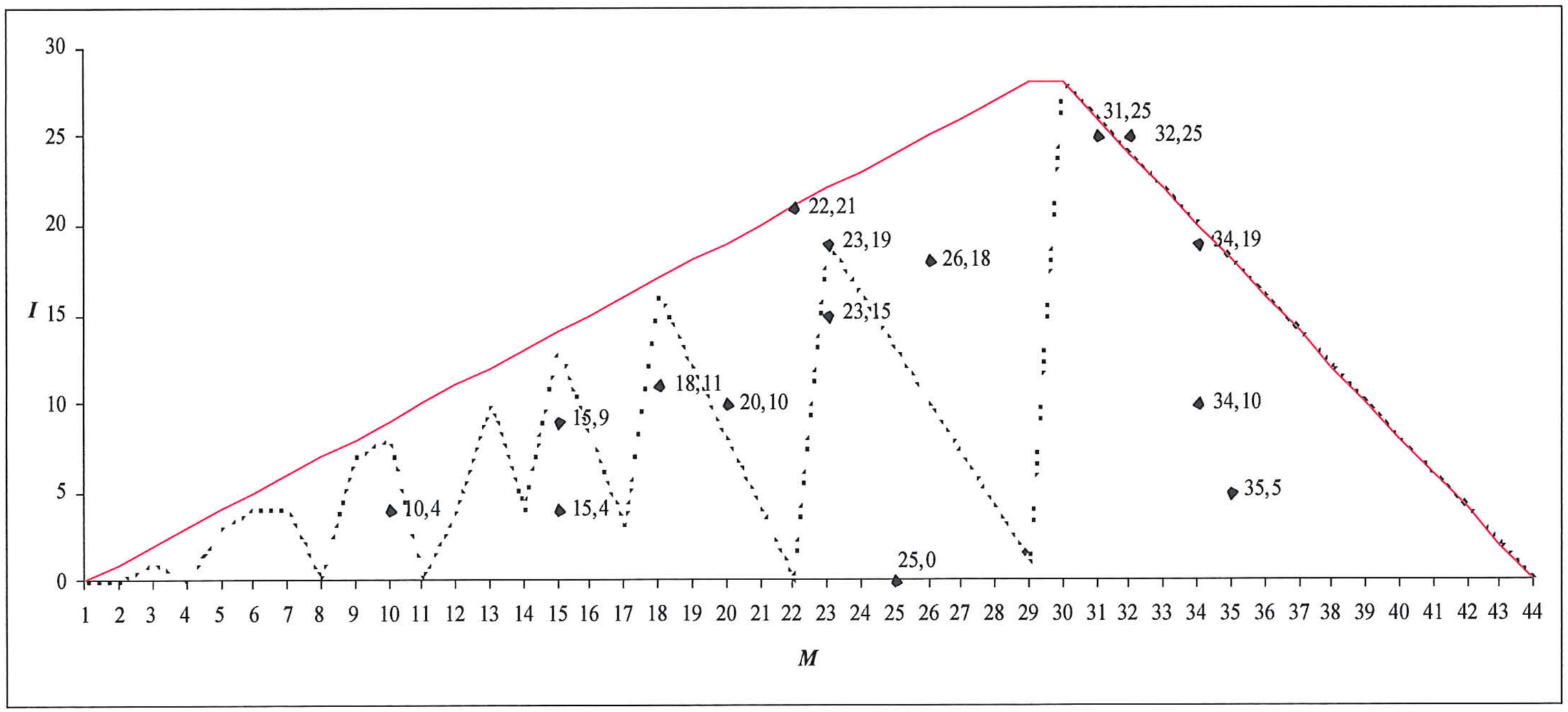


Figure 6.34: Sieve of *Nekuïa*, T_{40}(mod88).

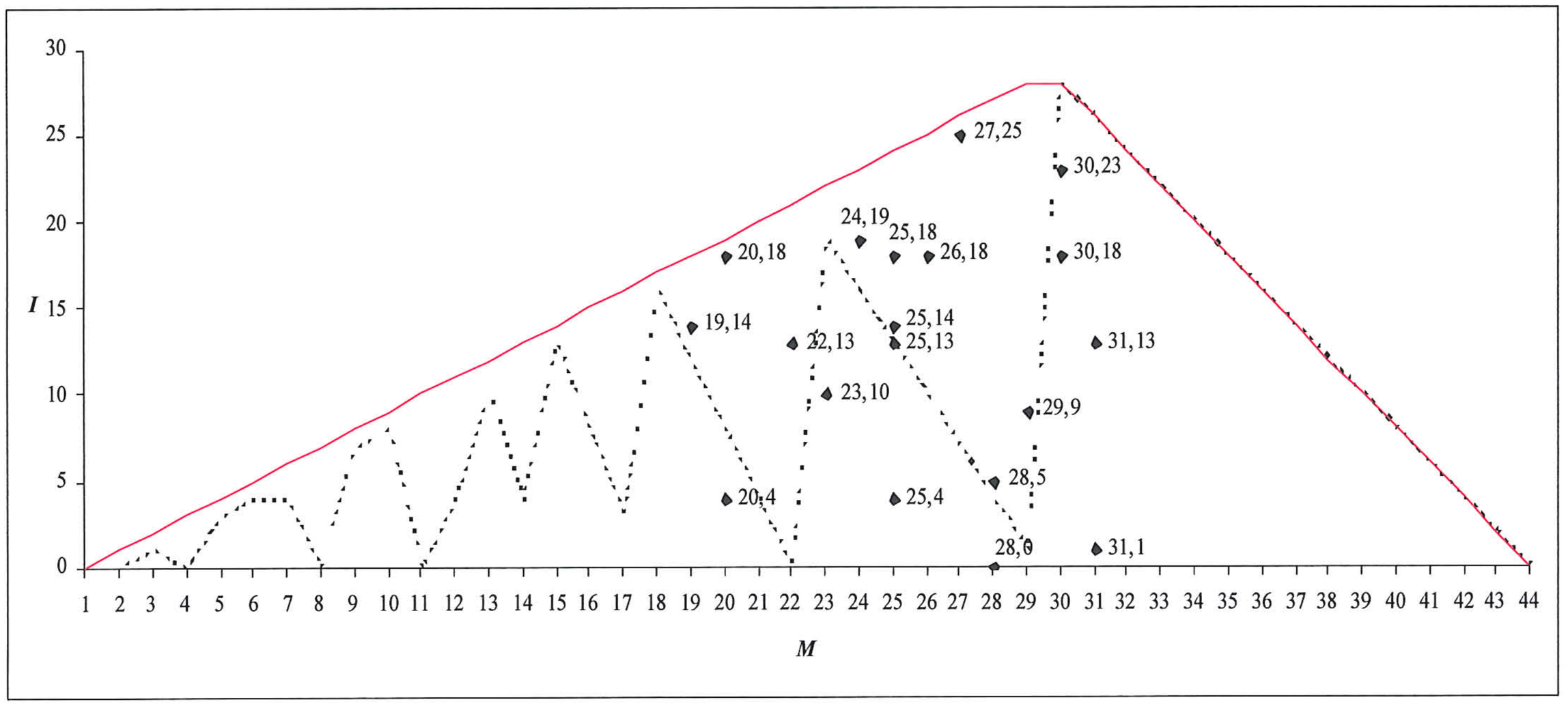


Figure 6.35: Sieve of *Nekuïa*, T_{56}(mod88).

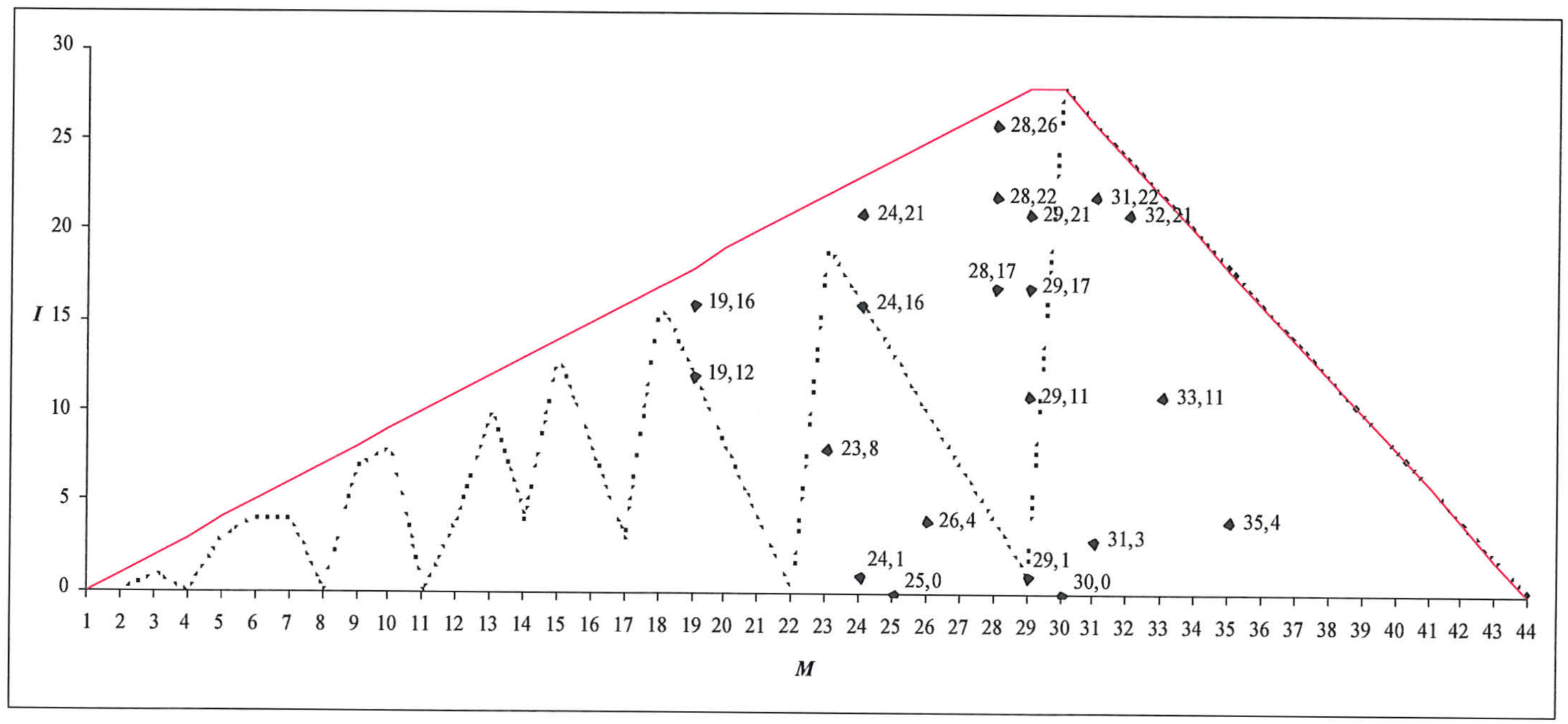


Figure 6.36: Sieve of *Nekuïa*, T_{77}(mod88).

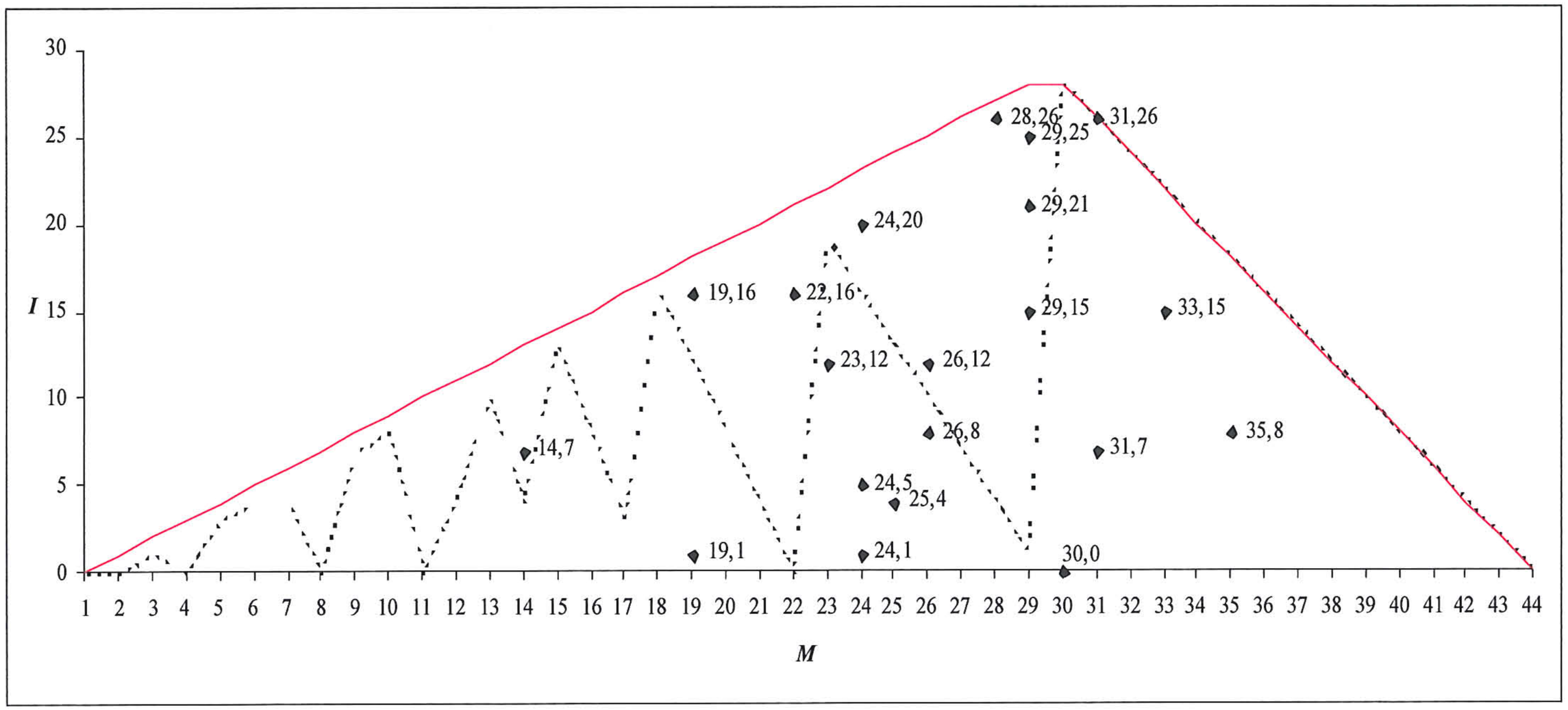


Figure 6.37: Sieve of *Nekuïa*, T_{80}(mod88).

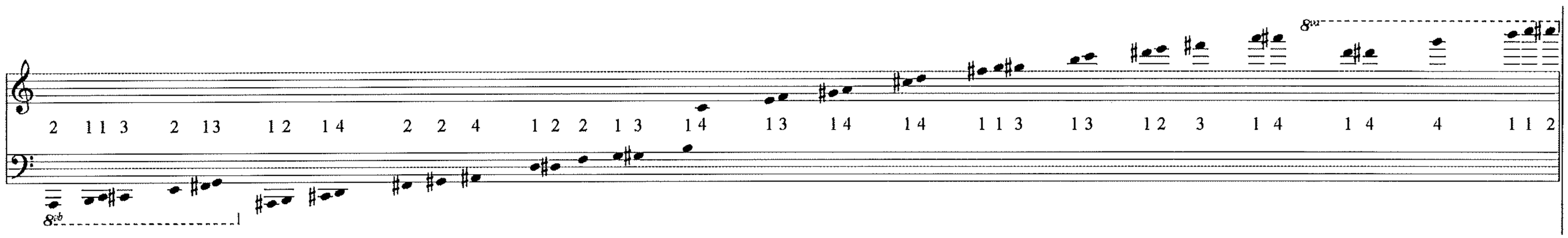


Figure 6.38: First Version of the Sieve of *Nekuïa*.

Canonical Form	*M, I, R*	*Interval*
2·7	14, 2, 6	8ve + tone
3·5	15, 2, 5	8ve + m3rd
19	19, 10, 4	8ve + 5th
2·11	22, 3, 3	8ve + m7th
23	23, 21, 2	8ve + M7th
$2^3 \cdot 3$	24, 10, 3 24, 14, 3	2·8ve
5^2	25, 7, 3 25, 13, 3 25, 23, 2	2·8ve + semitone
2·13	26, 17, 2	2·8ve + tone
29	29, 0, 3 29, 9, 2	2·8ve + 4th
2·3·5	30, 9, 2 30, 29, 1	2·8ve + tritone
31	31, 4, 2 31, 16, 2	2·8ve + 5th
5·7	35, 17, 2	2·8ve + M7th
$2^2 \cdot 3^2$	36, 17, 1	3·8ve

Figure 6.39: Simplified Formula of the First Version of the sieve of *Nekuïa*.

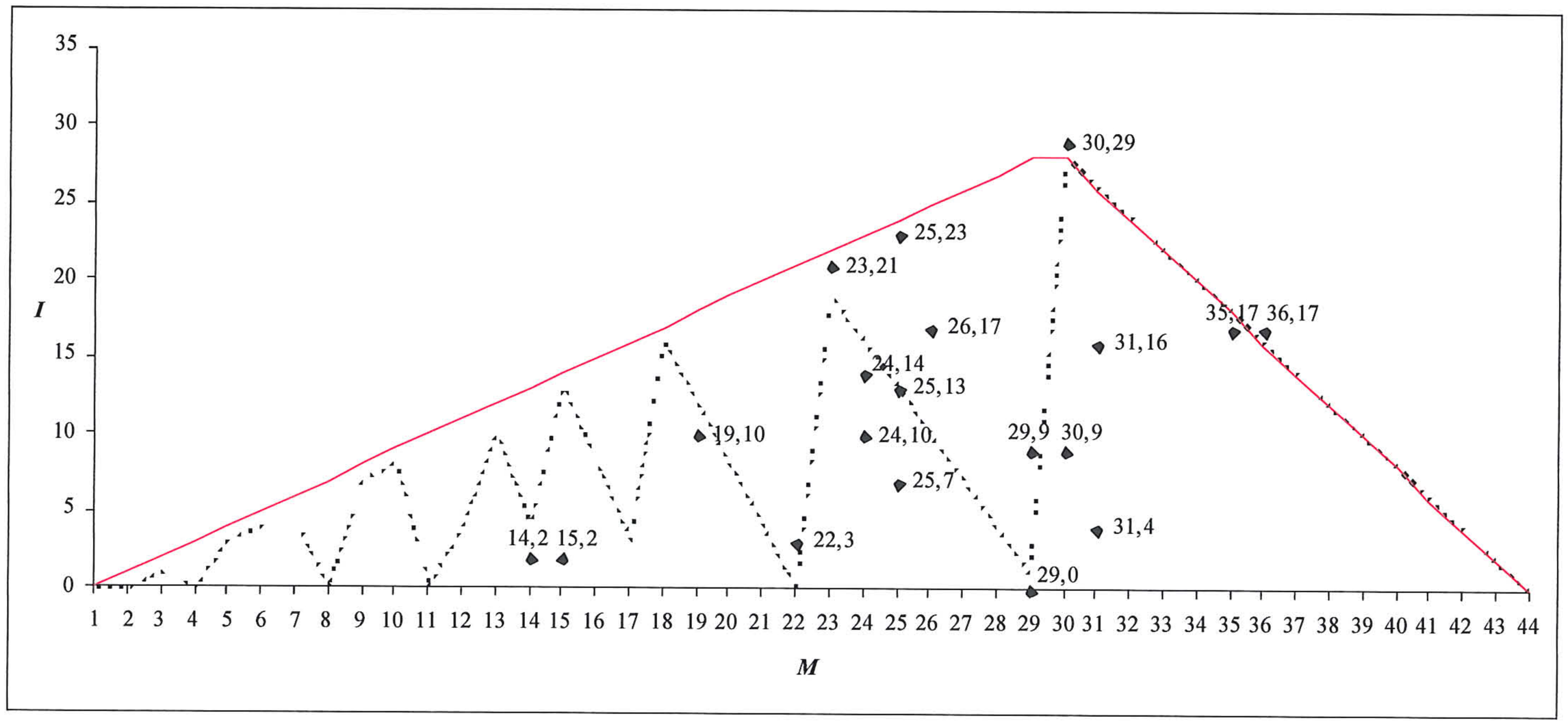


Figure 6.40: Inner Symmetry Chart of the First Version of the Sieve of *Nekuïa*.

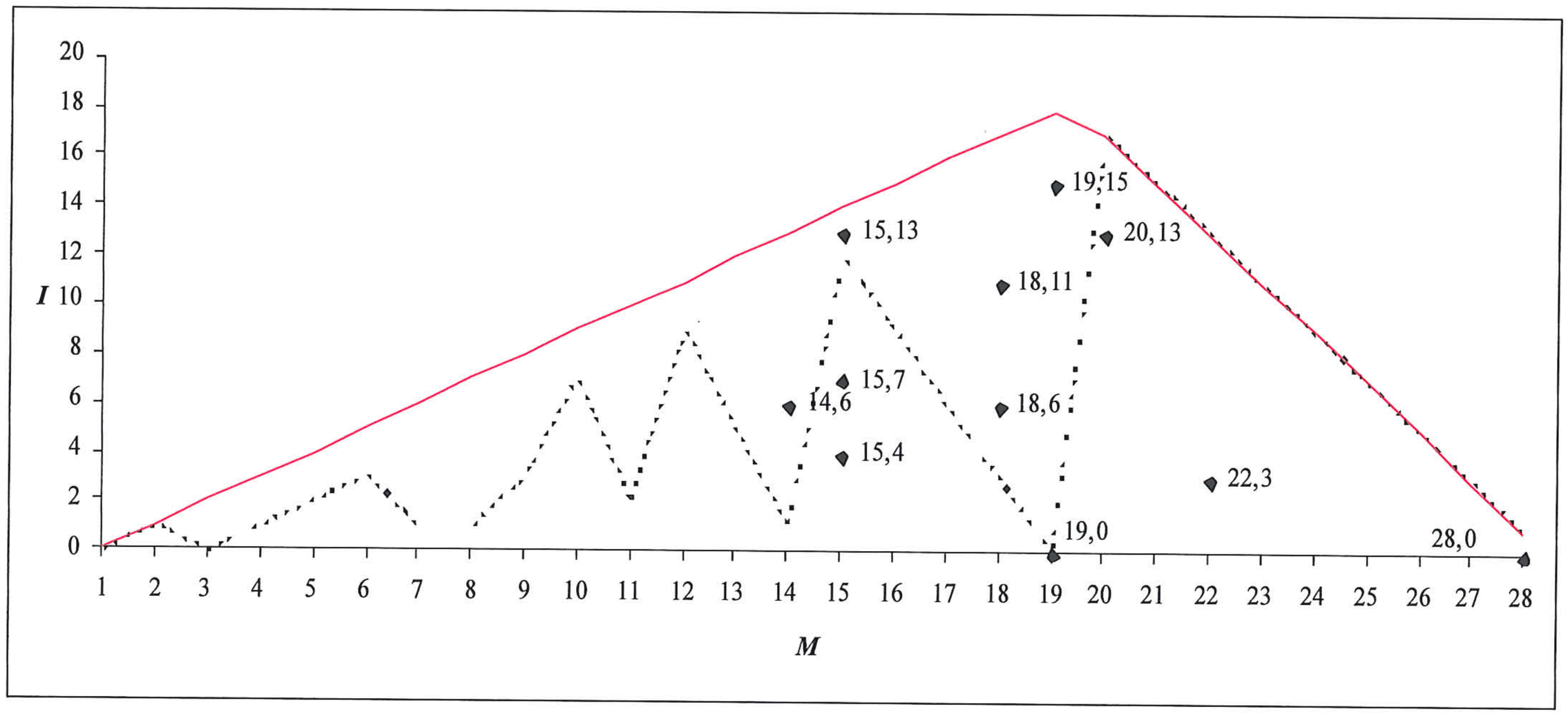
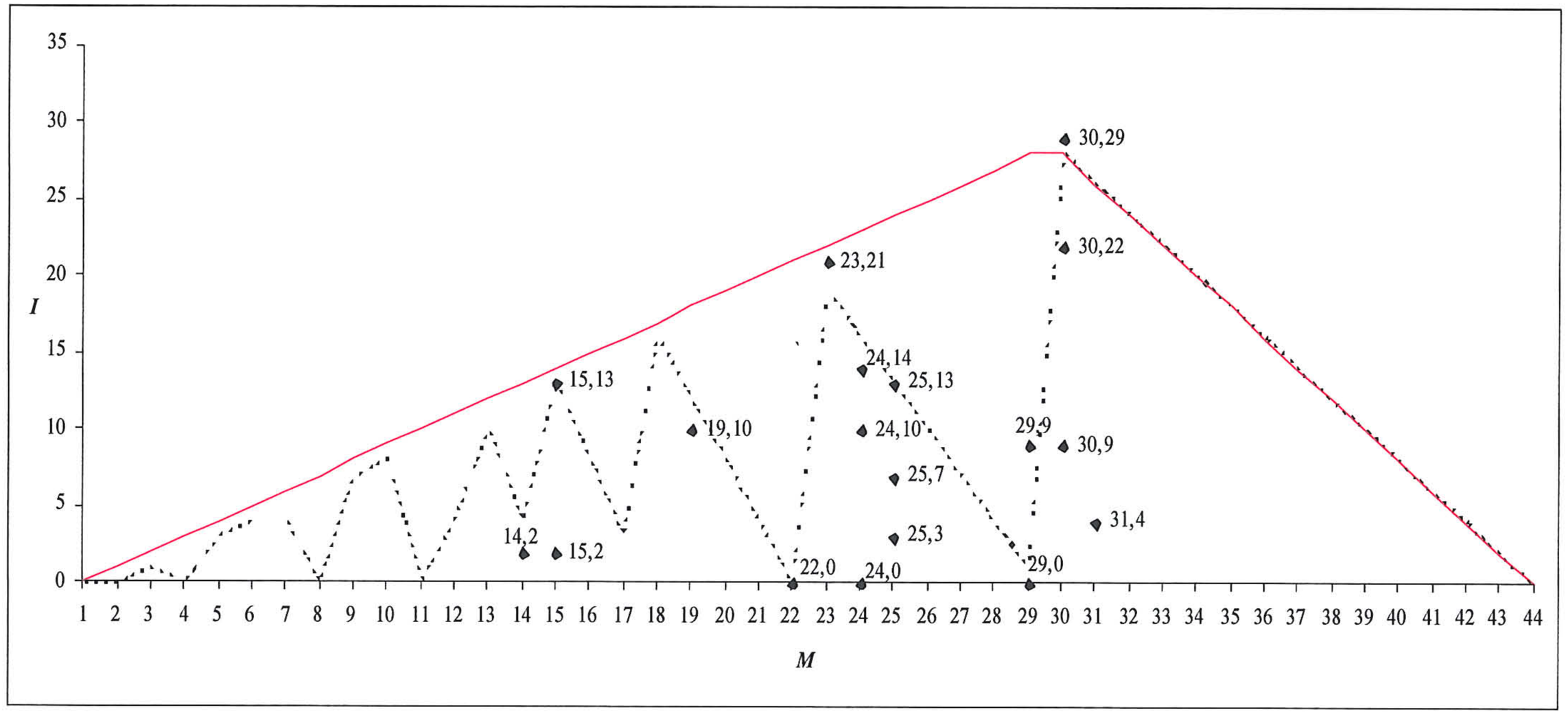


Figure 6.41: Inner Symmetry Chart of the sieve segment used in *Naama*.



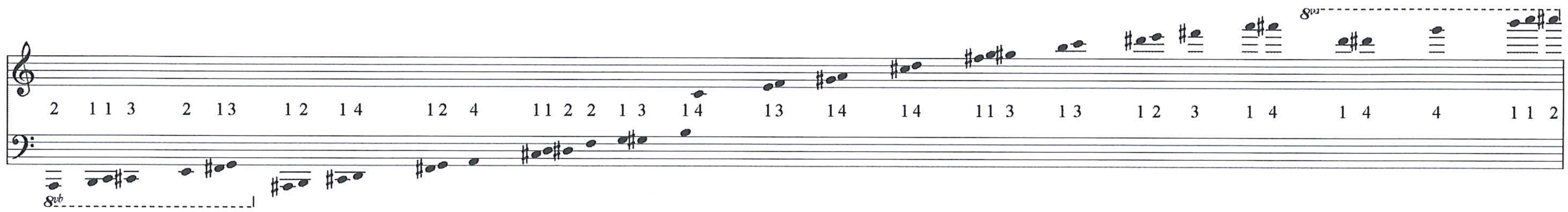
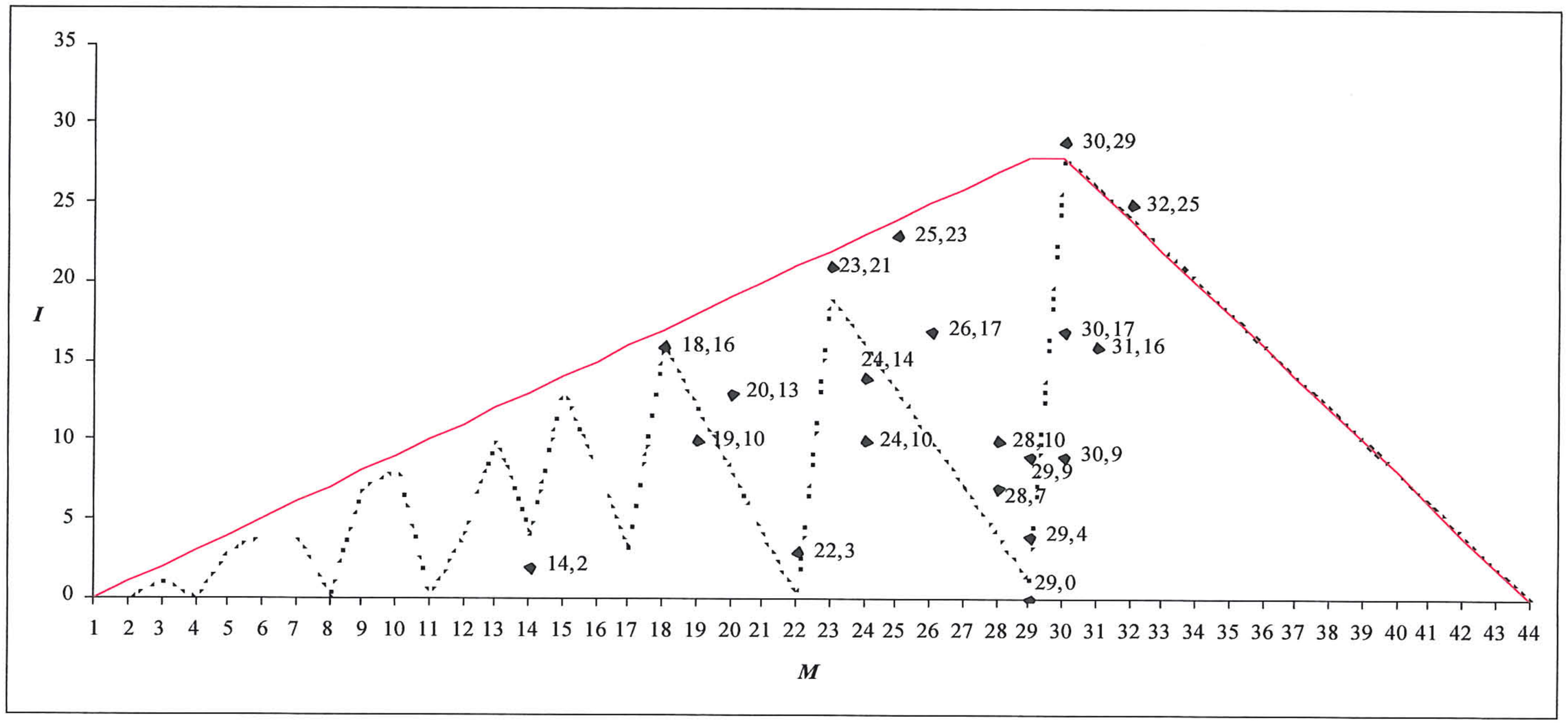


Figure 6.42: Second Version of the Sieve of *Nekuïa*.



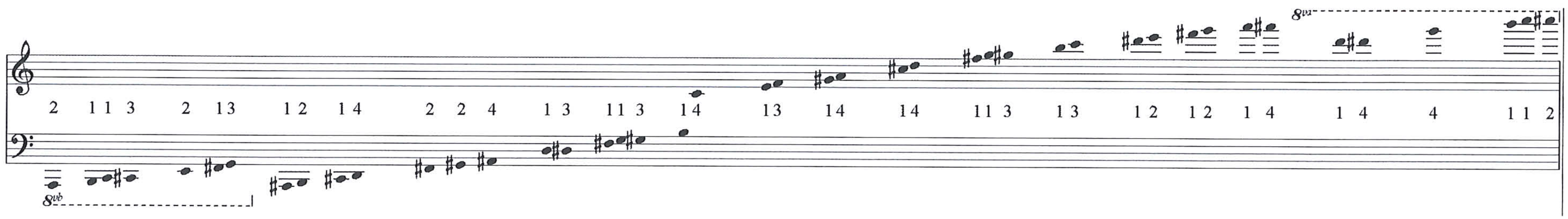


Figure 6.43: Third Version of the Sieve of *Nekuïa*.

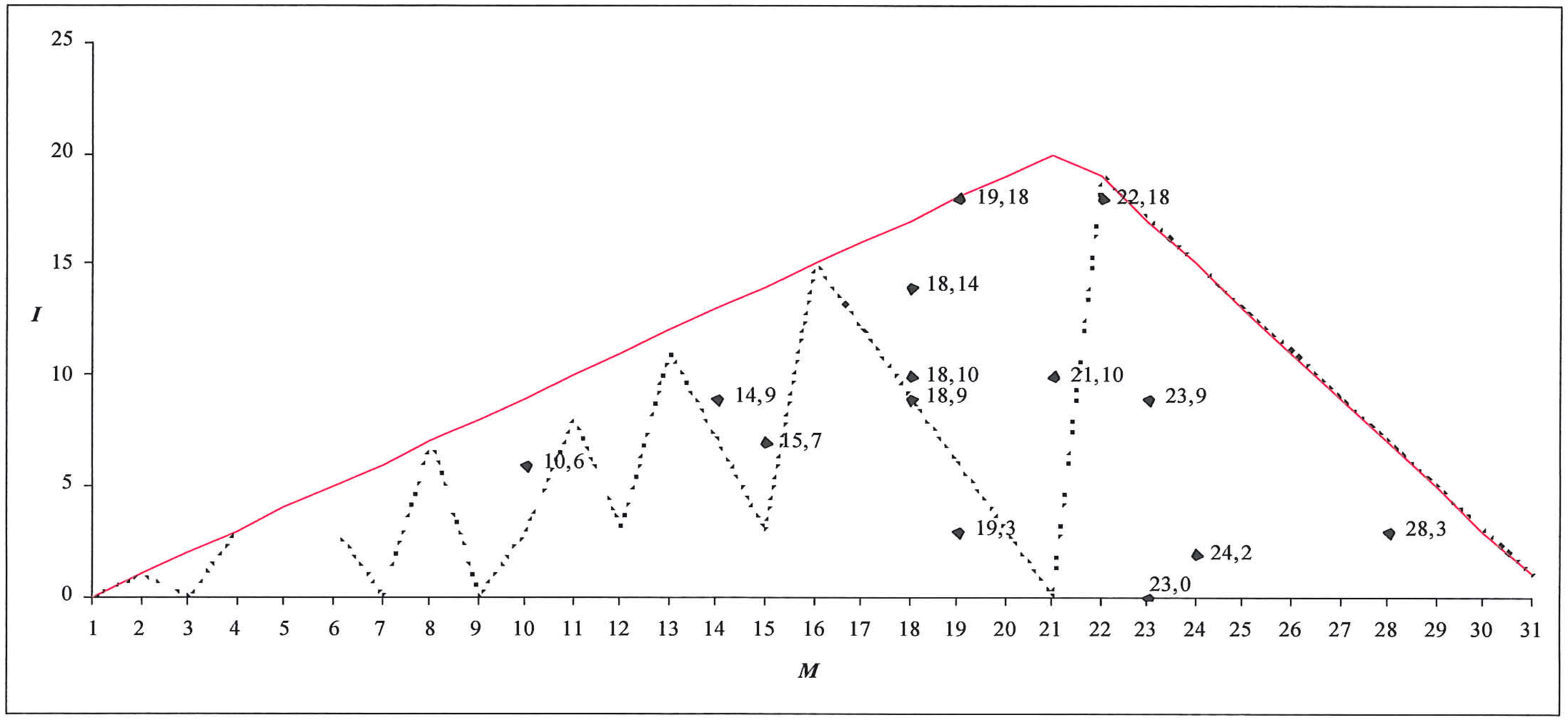
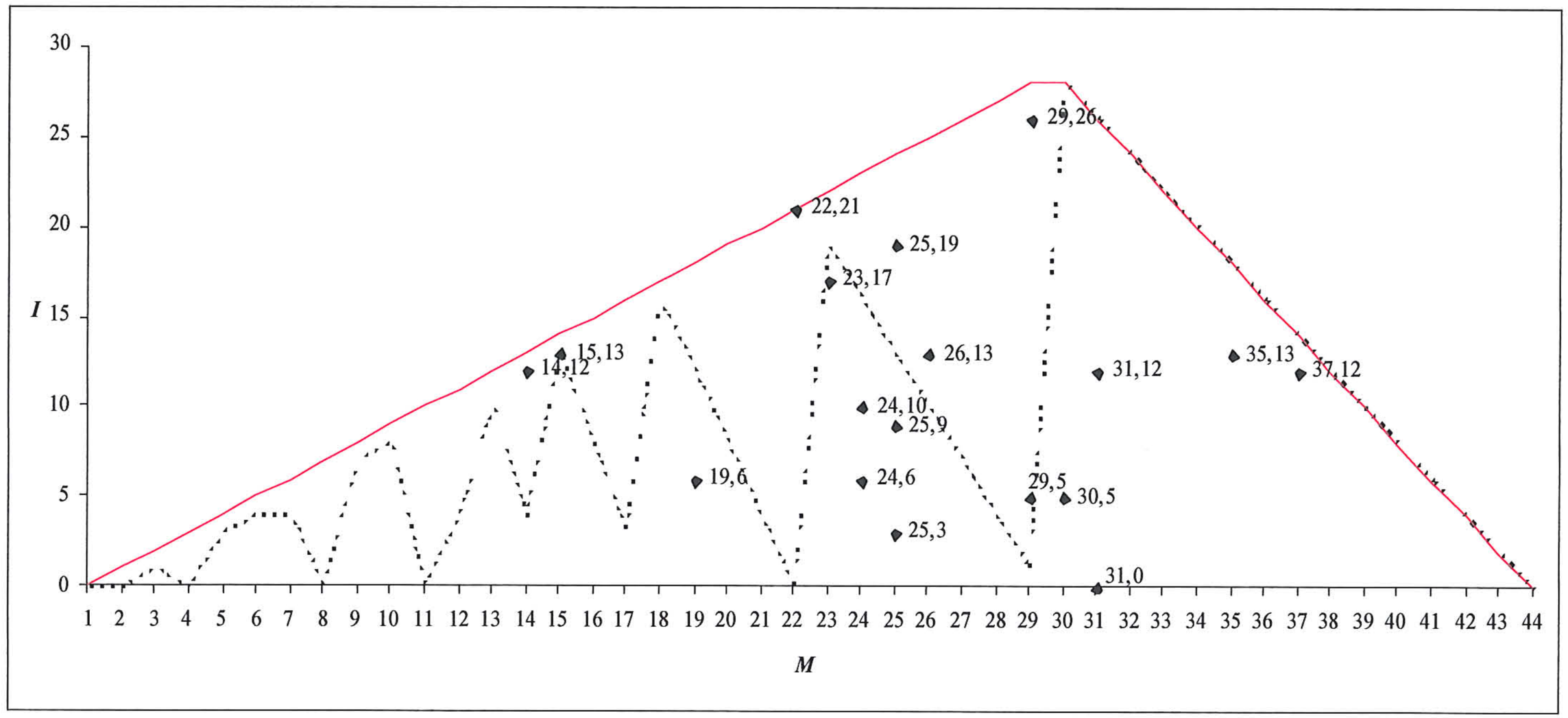


Figure 6.44: Inner Symmetry Chart of the segment of the sieve used in *A l'île de Gorée.*



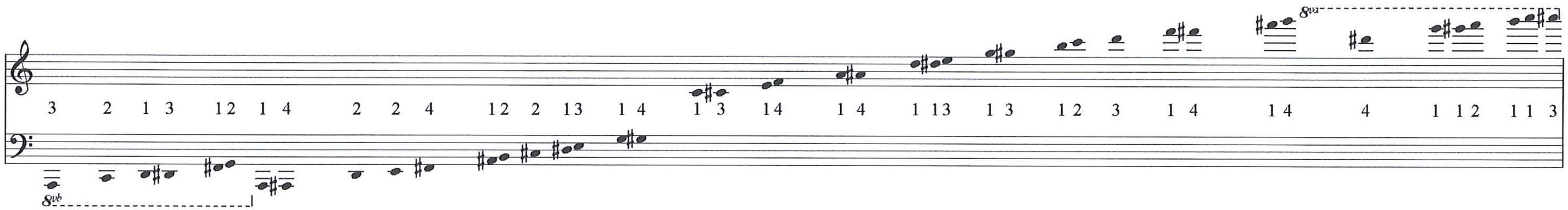


Figure 6.45: Fourth version of the sieve of *Nekuïa*.

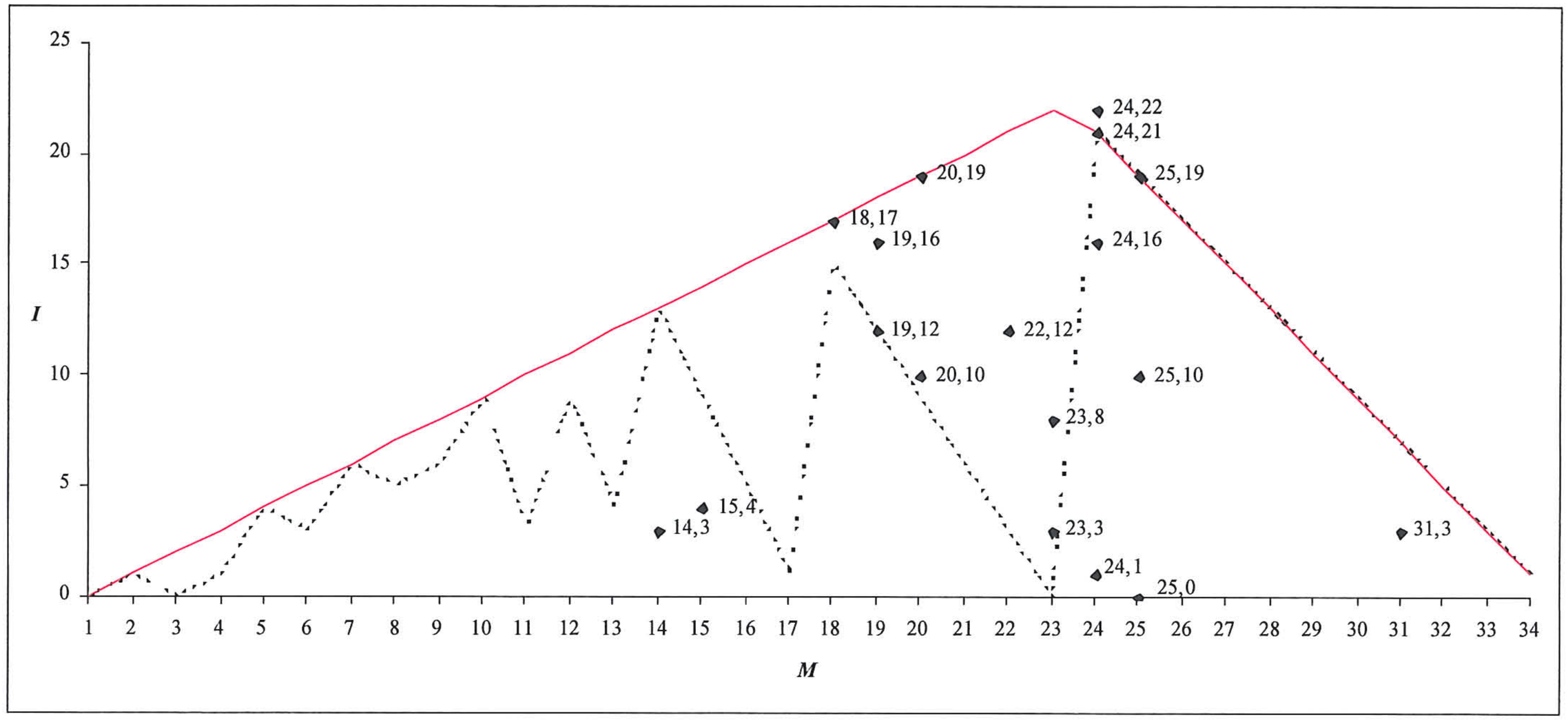
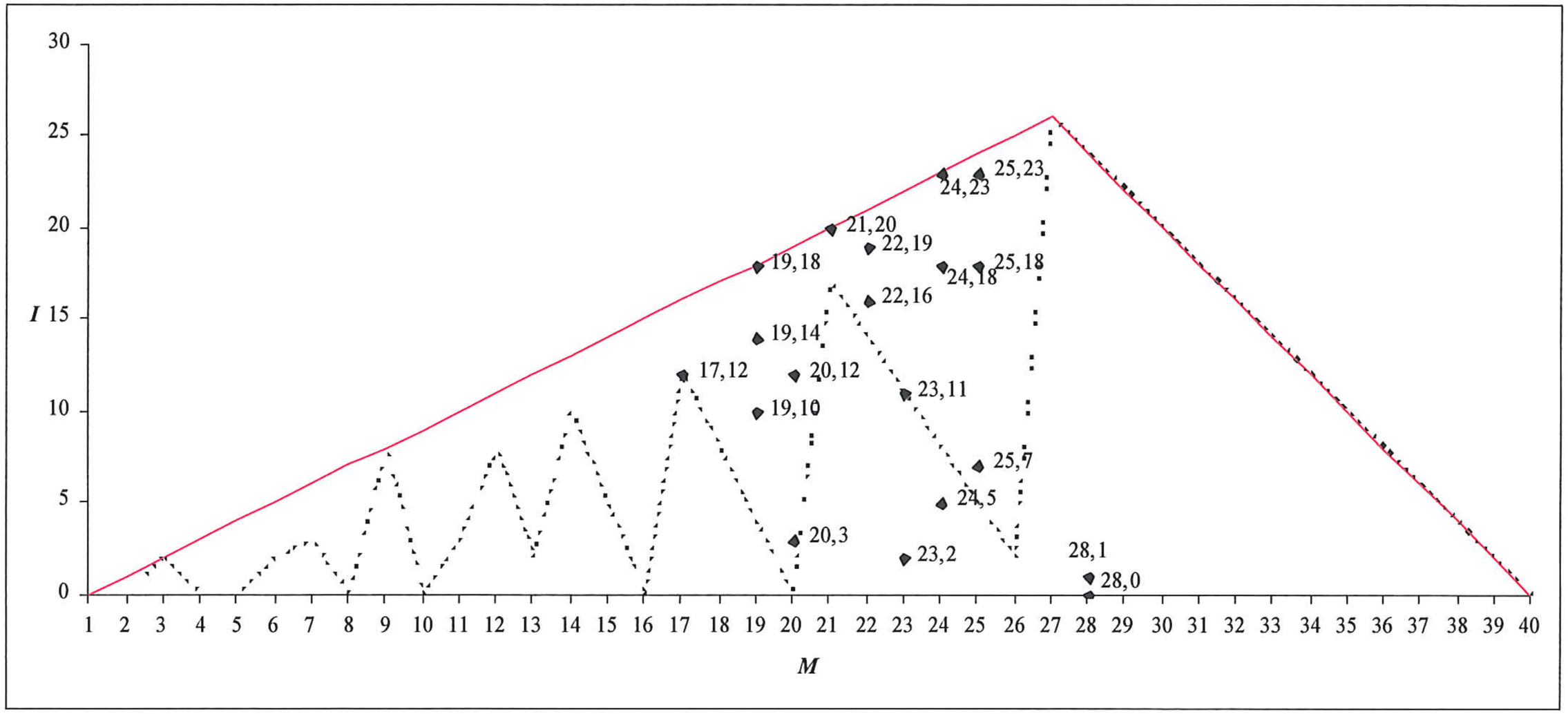


Figure 6.46: Inner Symmetry Chart for the Segment of the Sieve used in *Horos*.



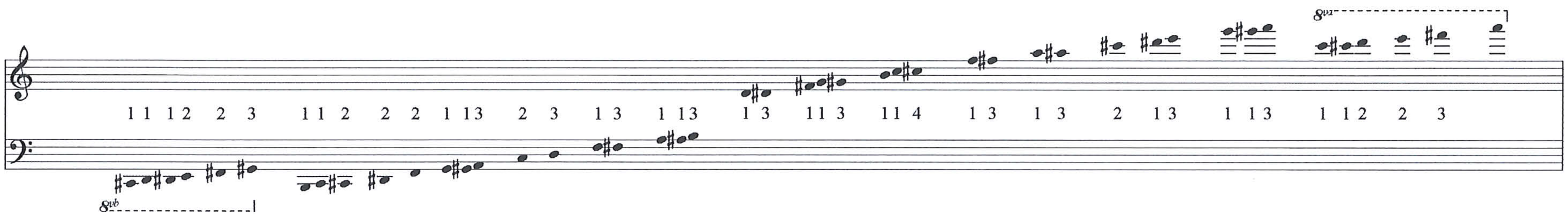
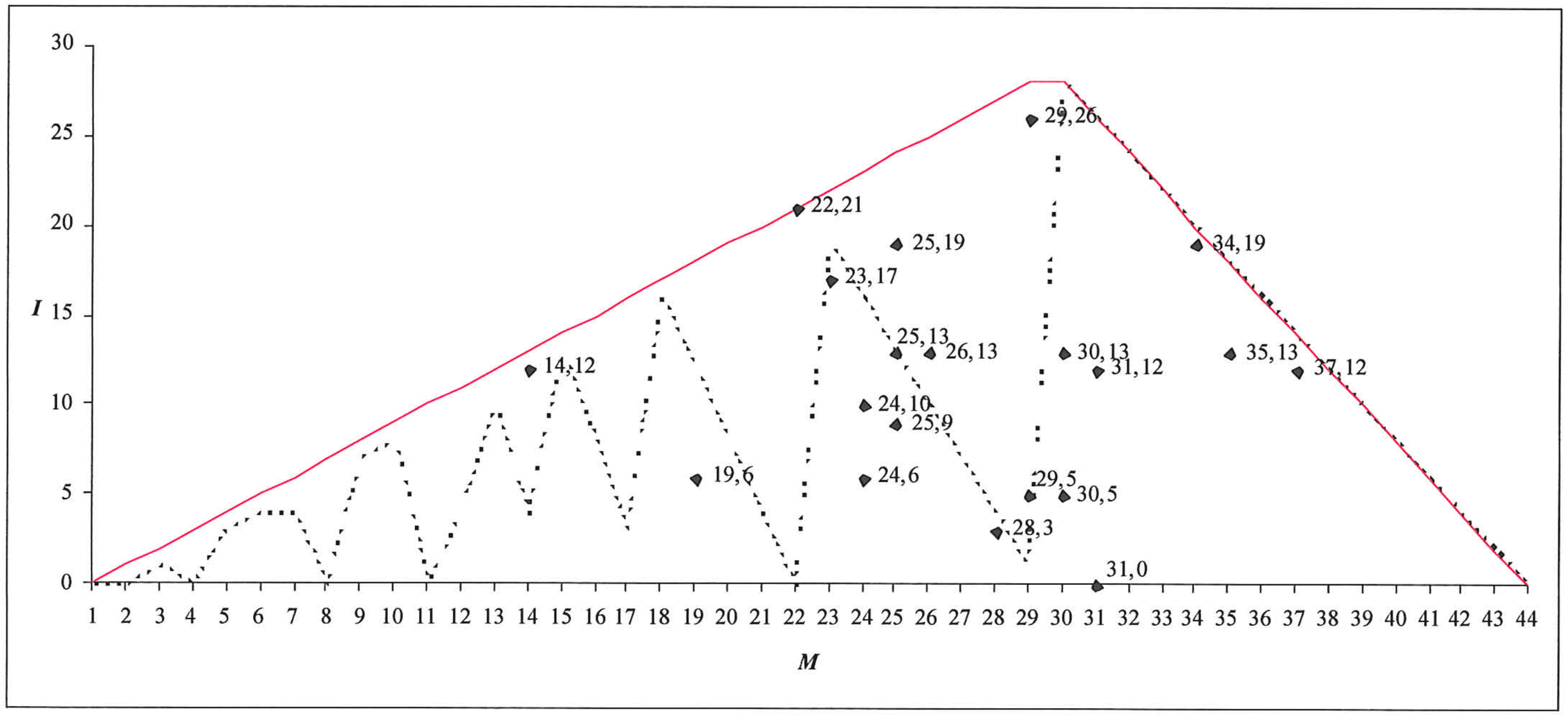


Figure 6.47: Complement of the Sieve of *Akea*.



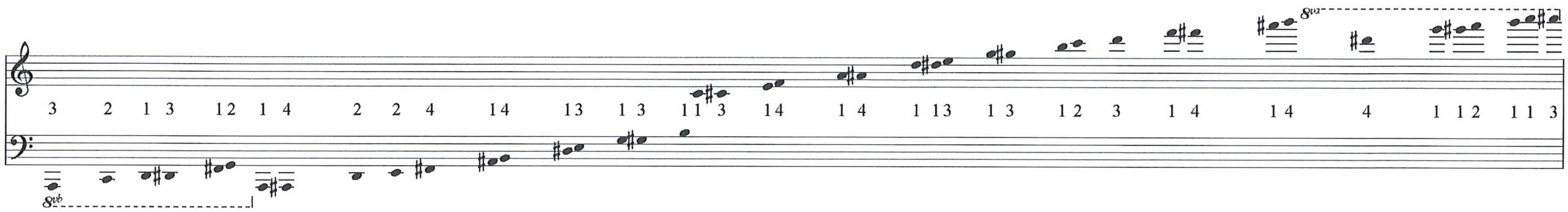


Figure 6.48: Fifth Version of the sieve of *Nekuïa*.

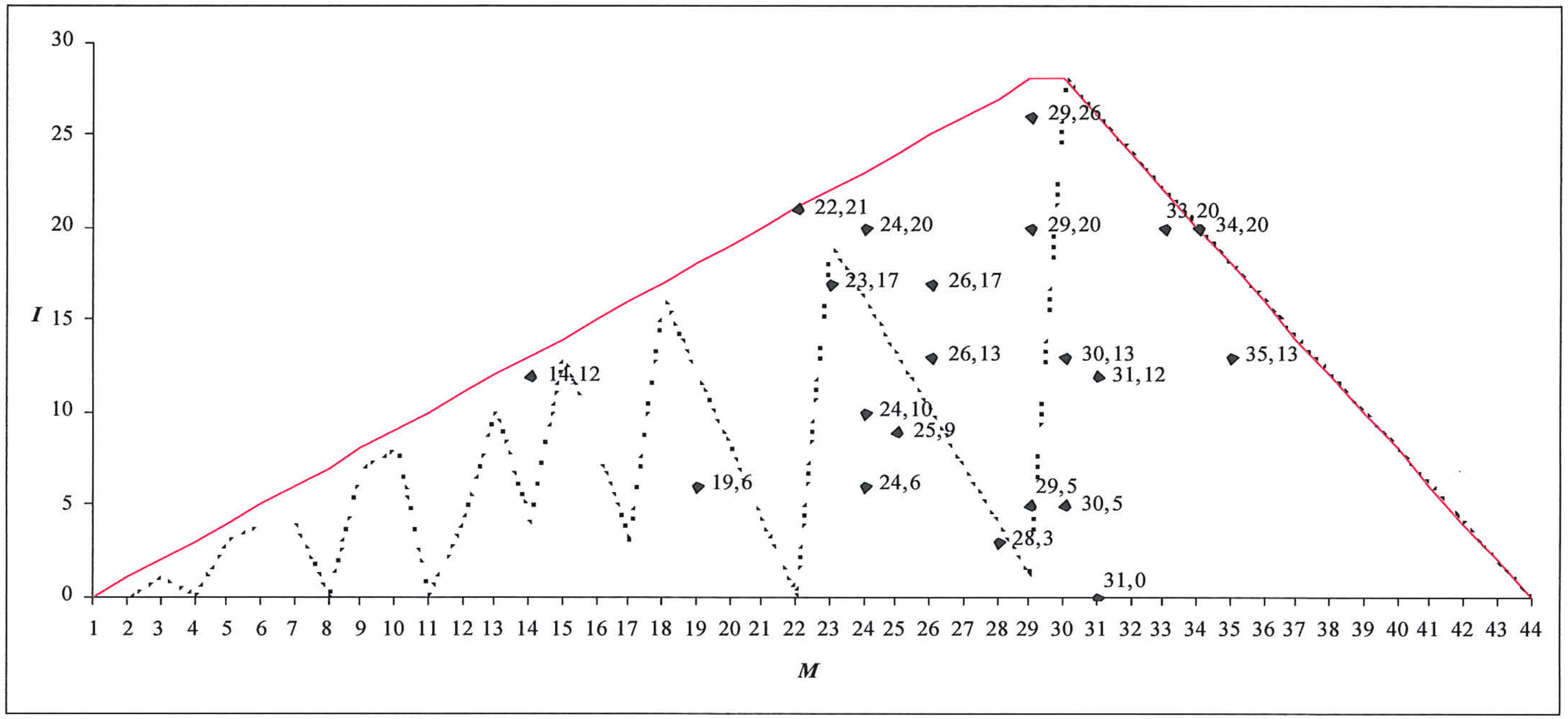
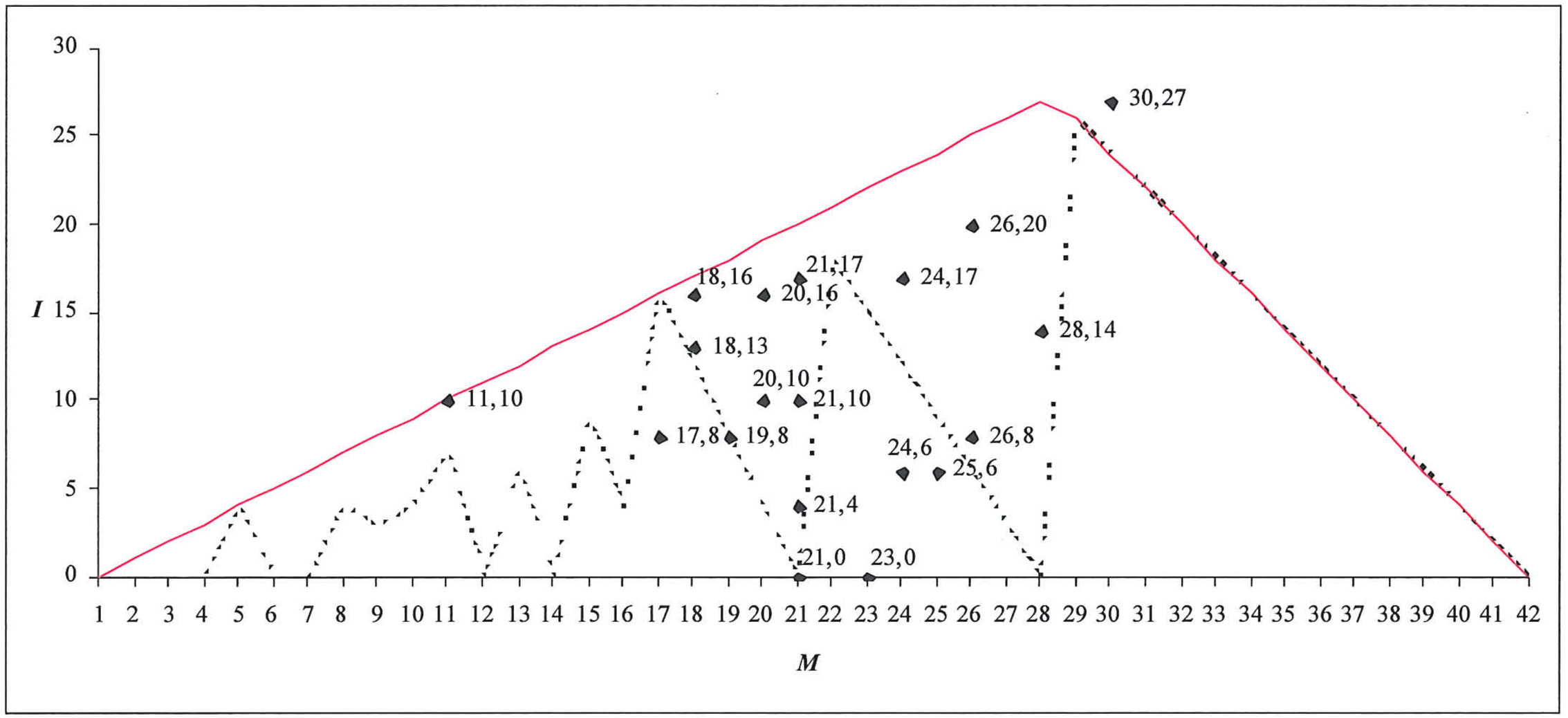


Figure 6.49: Inner Symmetry Chart for the T_{84}(mod88) Transposition of the sieve of *Nekuïa*.



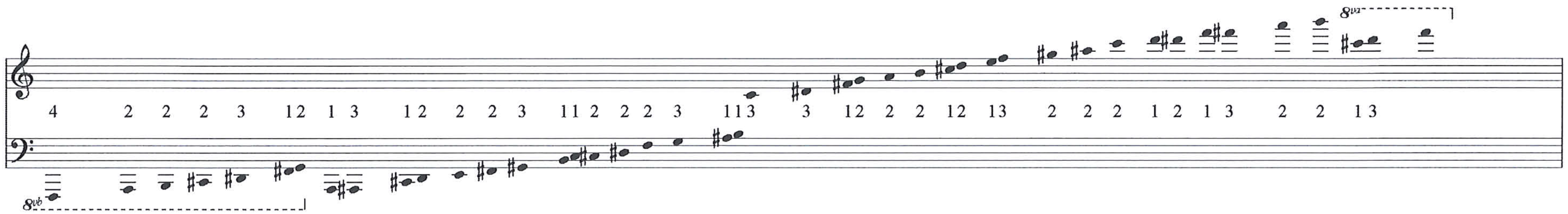
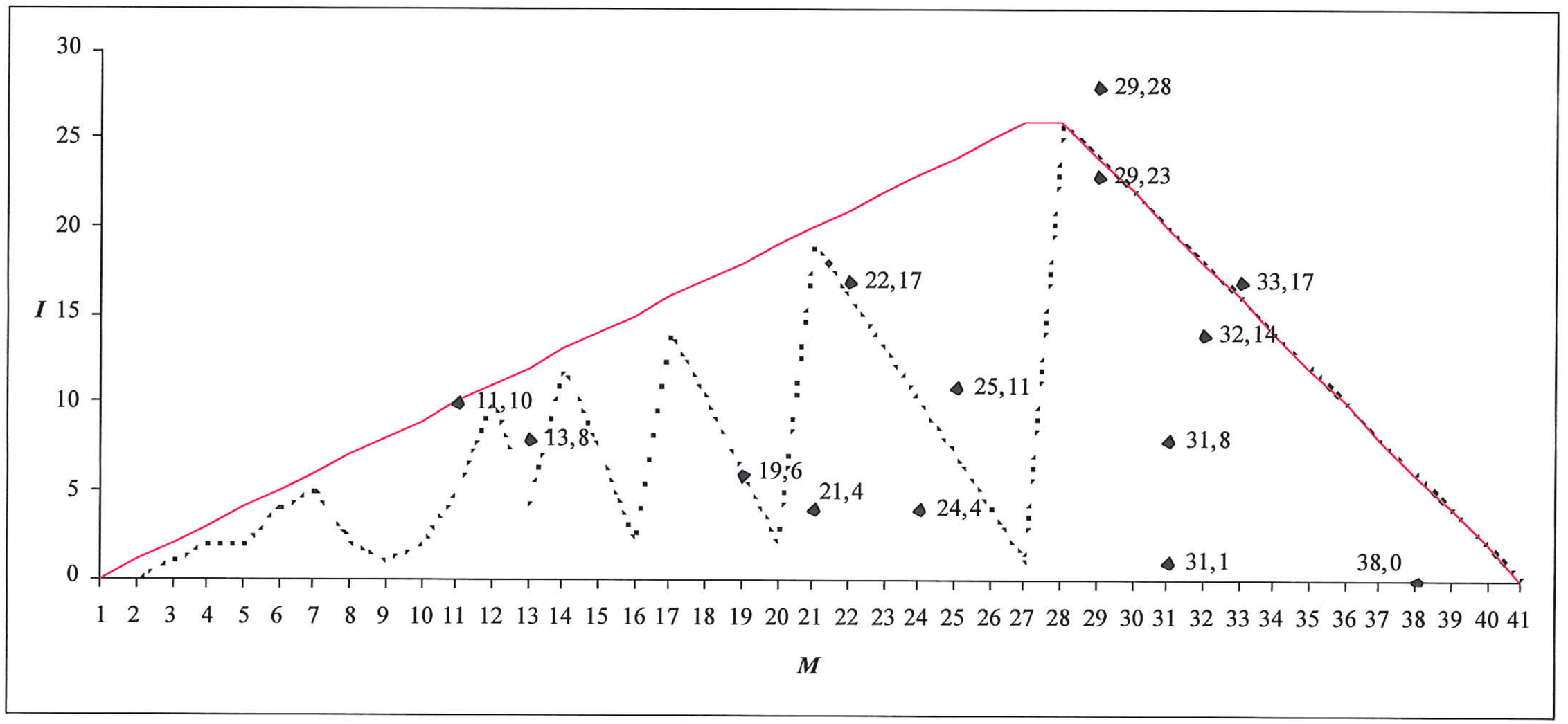


Figure 6.50: Opening Sieve of *Komboï*.



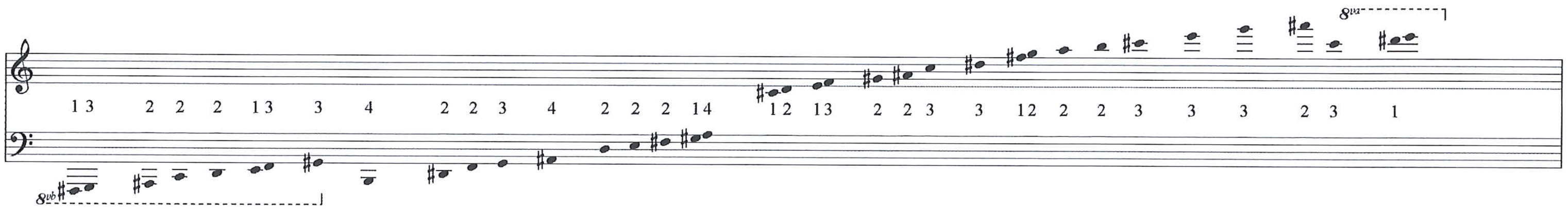


Figure 6.51: Sieve of *Komboï*.

α 2 1 4 3 3 2 3 2 3 3 2 3 2 1 2 3 2 3 3 2 3 2 3 1 4 5 4 2

β 4 1 4 1 4 1 4 1 4 1 4 1 4 1 4 1 4 1 4 1 4 1 4 1 4 1 4 1 4 1

γ 4 1 2 2 1 4 1 2 4 2 4 1 4 2 1 1 4 2 2 4 1 1 2 4 1 4 2 4 2 1 4 1 2

δ 3 2 1 1 2 1 1 3 3 1 2 1 1 1 2 3 1 3 2 1 1 2 1 3 1 3 1 2 3 1 1 1 3 3 2 2 1 3 1

δ' 3 2 1 1 2 1 1 3 3 1 2 1 1 1 2 3 1 3 2 1 1 2 1 3 1 3 1 2 1 2 3 1 1 1 3 2 2 1 3 1 3 1 1 2

Figure 6.52: Sieves in the Sketches of *Shaar* ($\alpha \rightarrow \delta$).

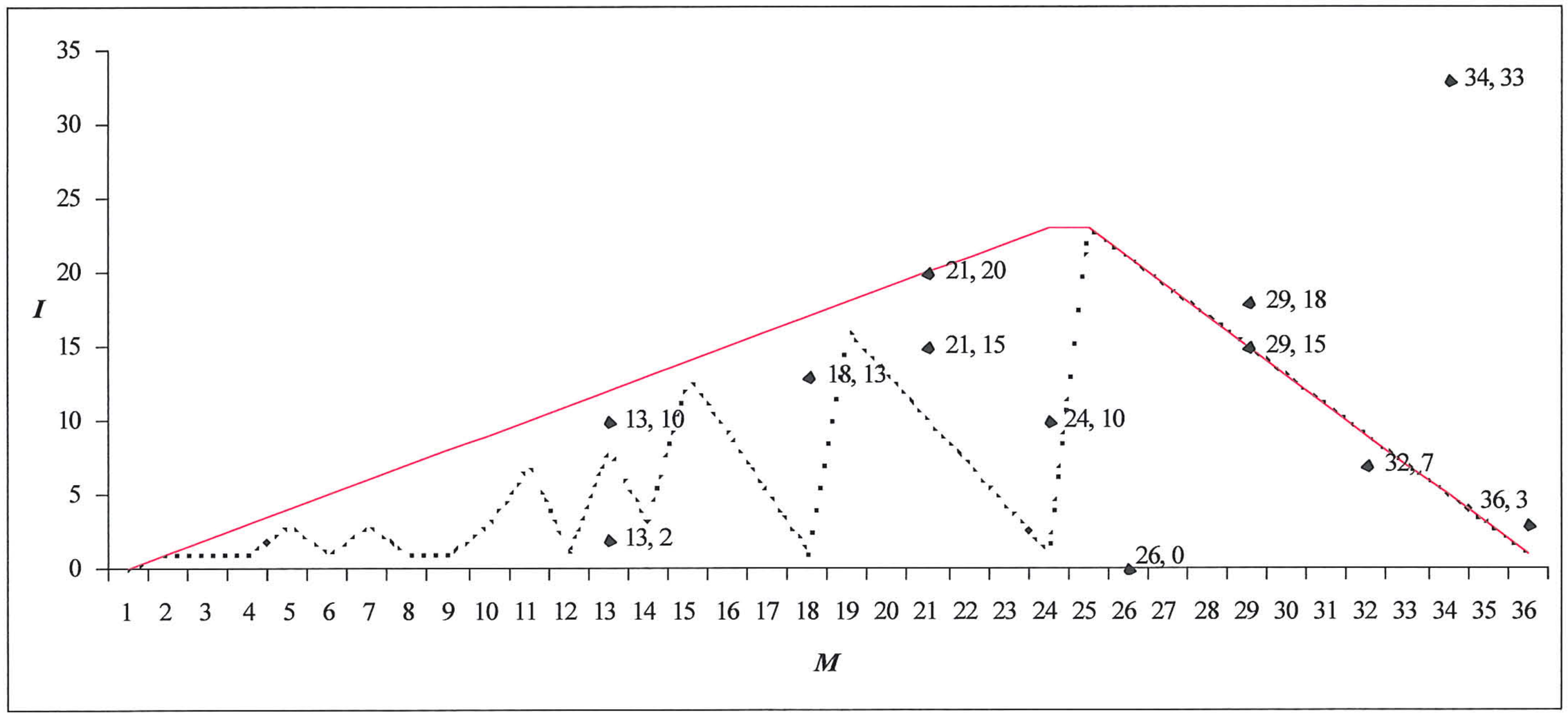


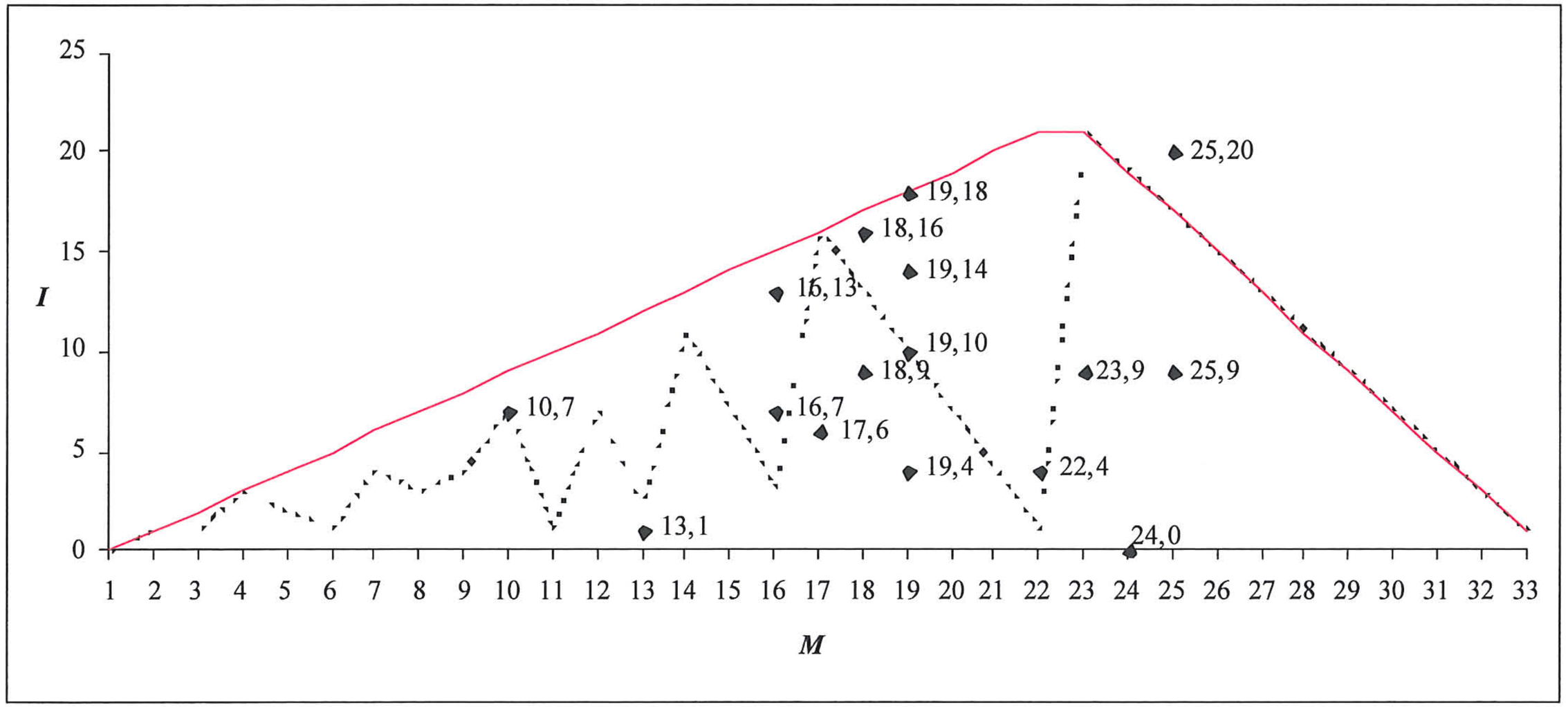
Figure 6.53: Inner Symmetry Chart for Sieve *α* of *Shaar*.

1	3	2	1	1	12	2	3	1	1
3	3	1	2	1	10	2	1	3	1
5	1	3	2	1	8	1	2	3	1
7	1	3	1	2	6	1	2	1	3
9	1	1	3	2	4	1	1	2	3
11	3	1	1	2	2	2	1	1	3

Figure 6.54: Intervallic Permutations in Sieve δ of *Shaar*.

1	4	1	2		12	2	1	4	
3	1	2	4		10	4	2	1	
5	4	2	1		8	1	2	4	
7	2	4	1		6	1	4	2	
9	1	4	2		4	2	4	1	
11	4	1	2		2	2	1	4	

Figure 6.55: Intervallic Permutations in Sieve γ of *Shaar*.



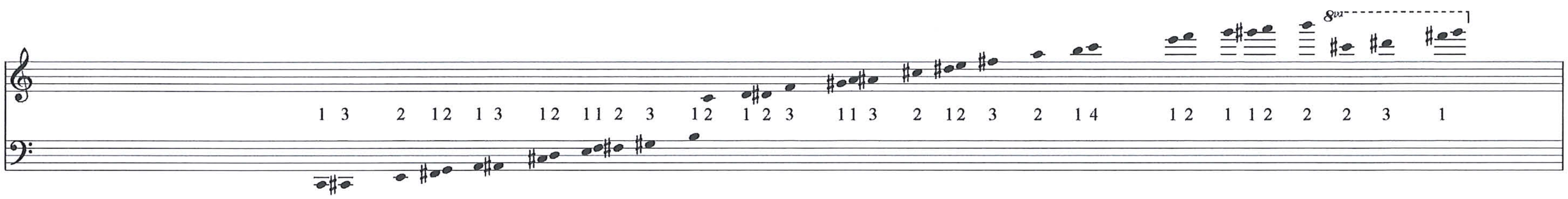
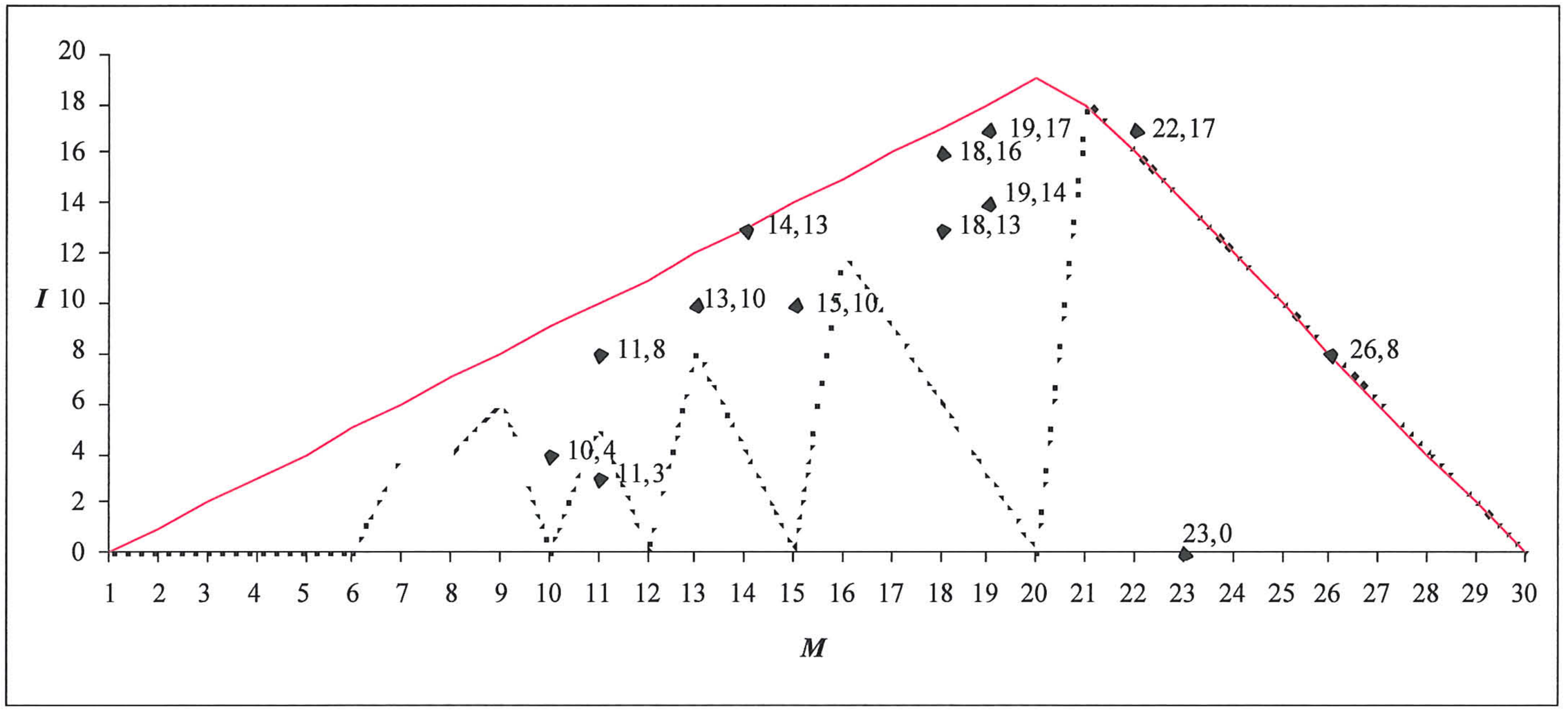


Figure 6.56: Sieve of *Tetras*.



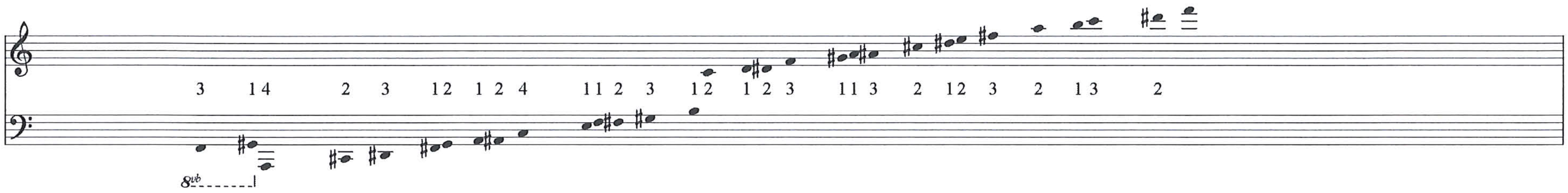


Figure 6.57: Opening Sieve of *Khal Perr*.

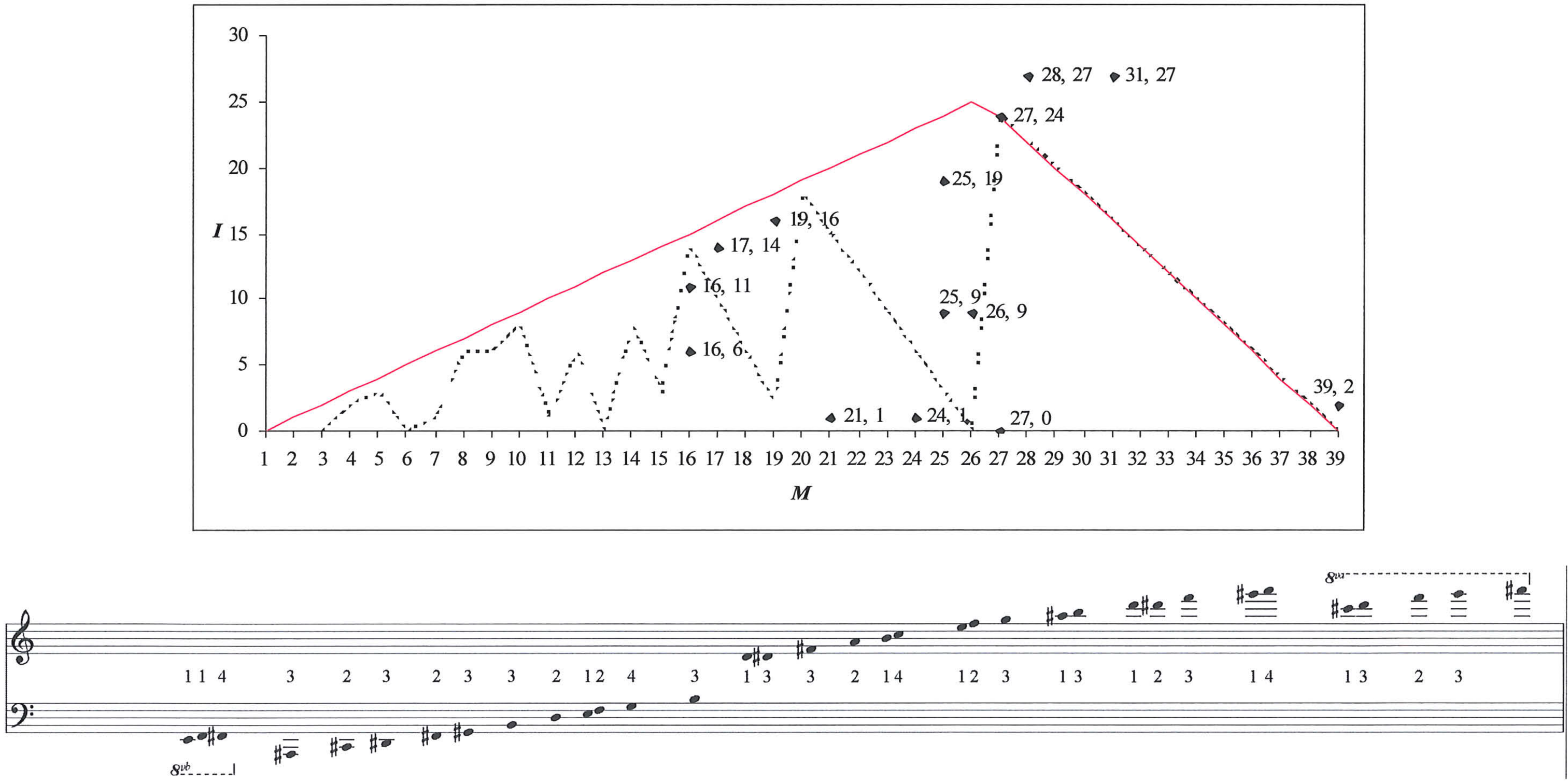


Figure 6.58: Sieve of *Lichens*.

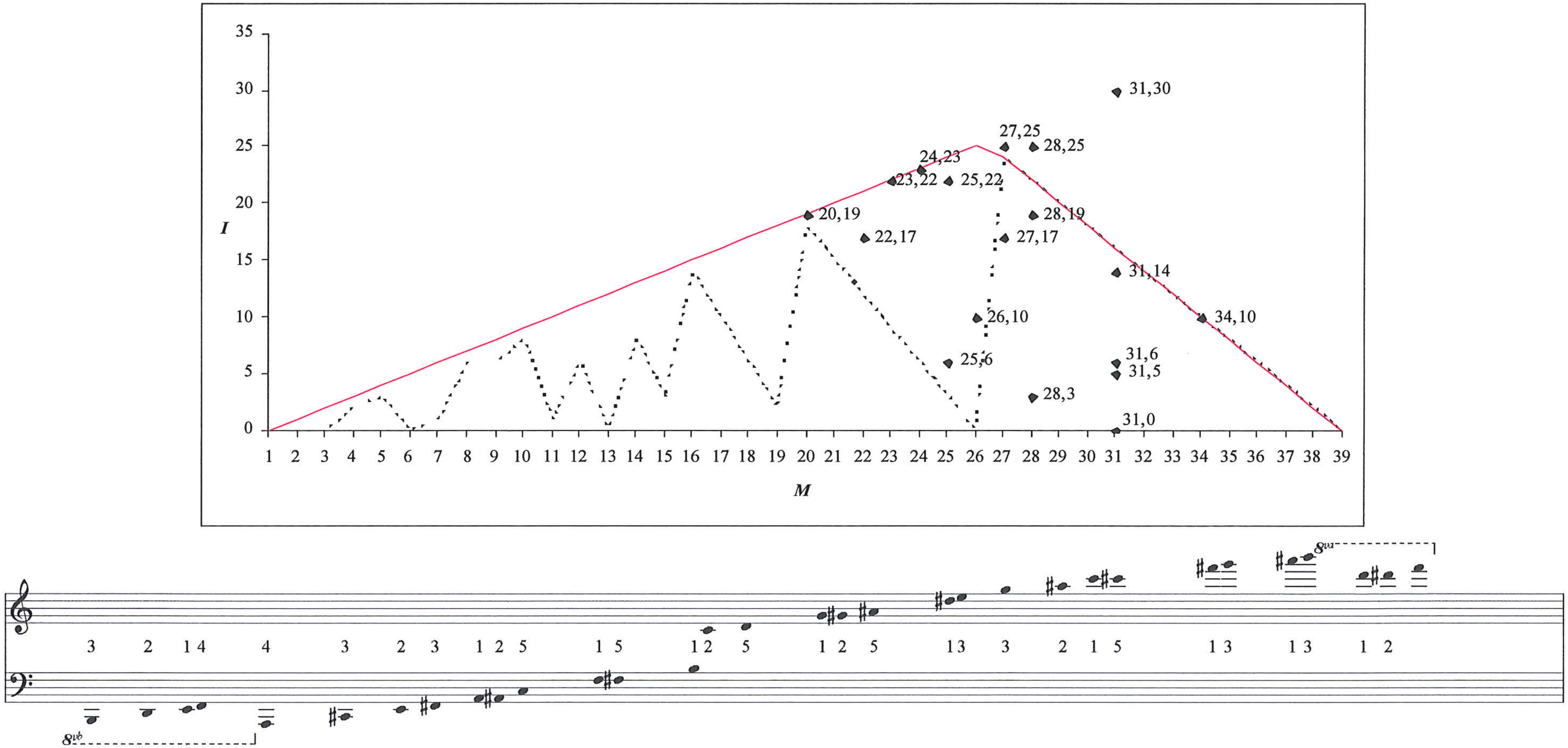
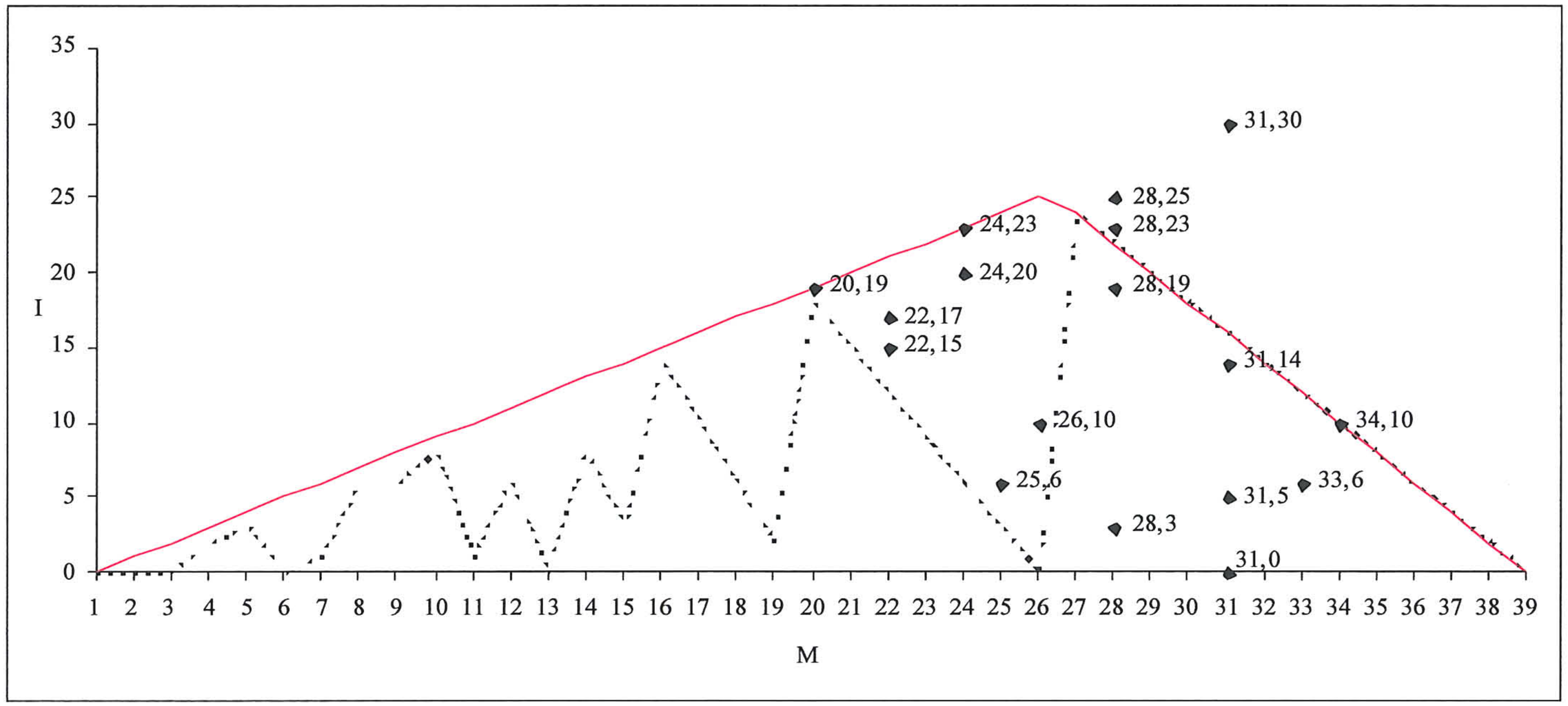


Figure 6.59: Sieve of *Thalleïn*.



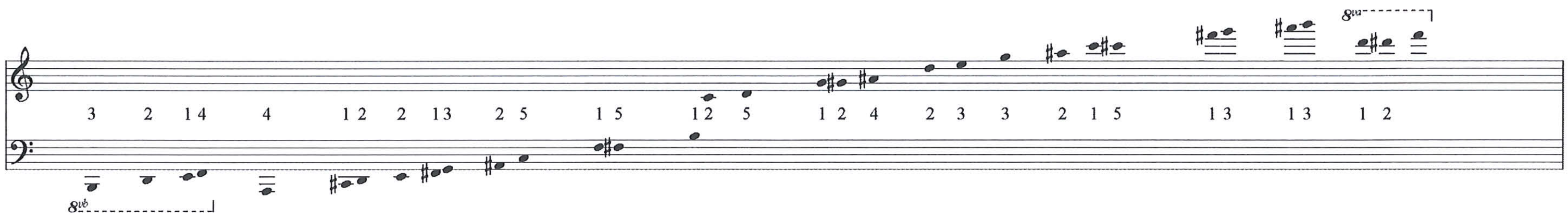


Figure 6.60: Sieve of *Thalleïn*, as it was used in *Alax*.

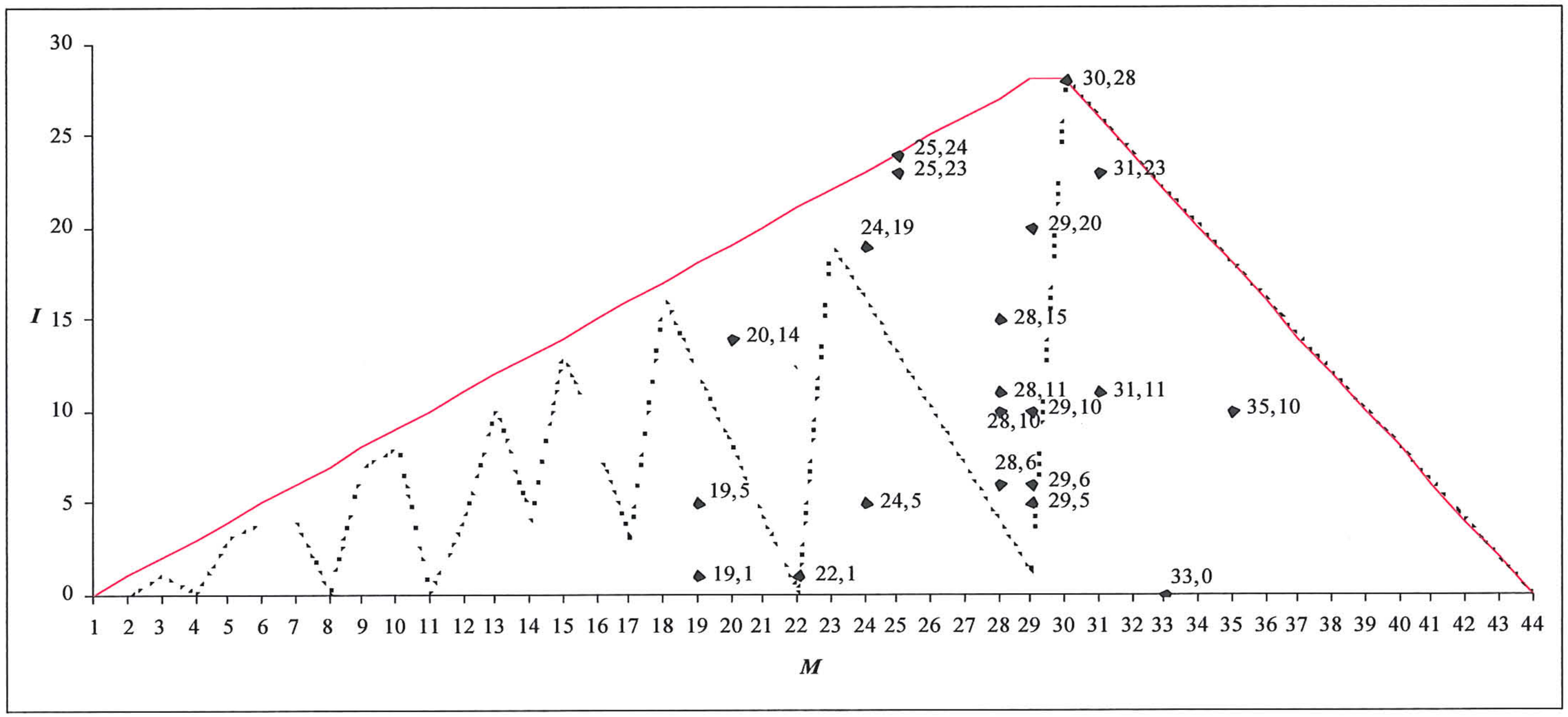
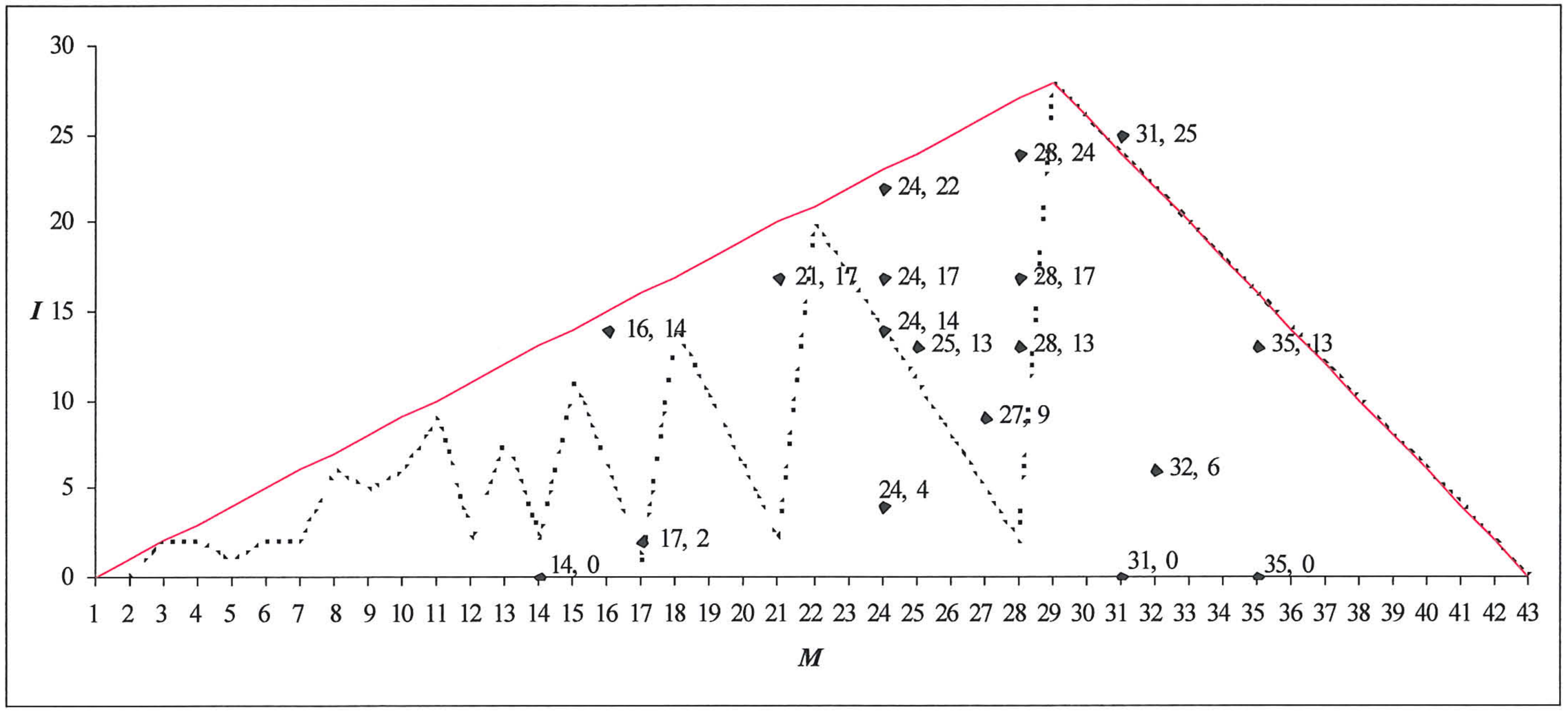


Figure 6.61: Inner Symmetry Chart of the T_{64}(mod88) Transposition of the sieve of *Nekuïa*.



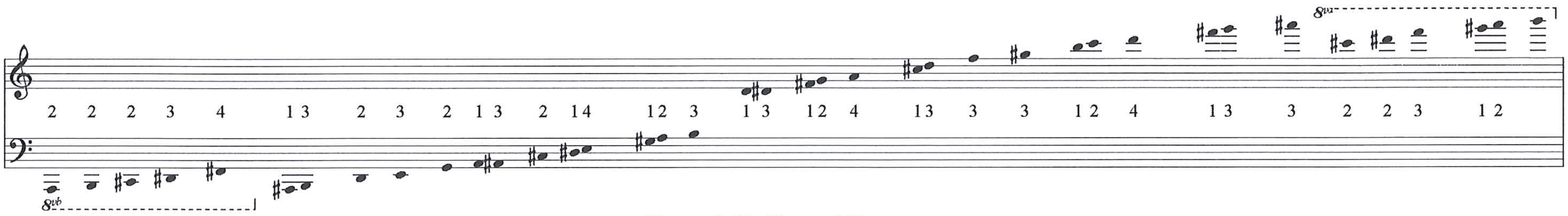
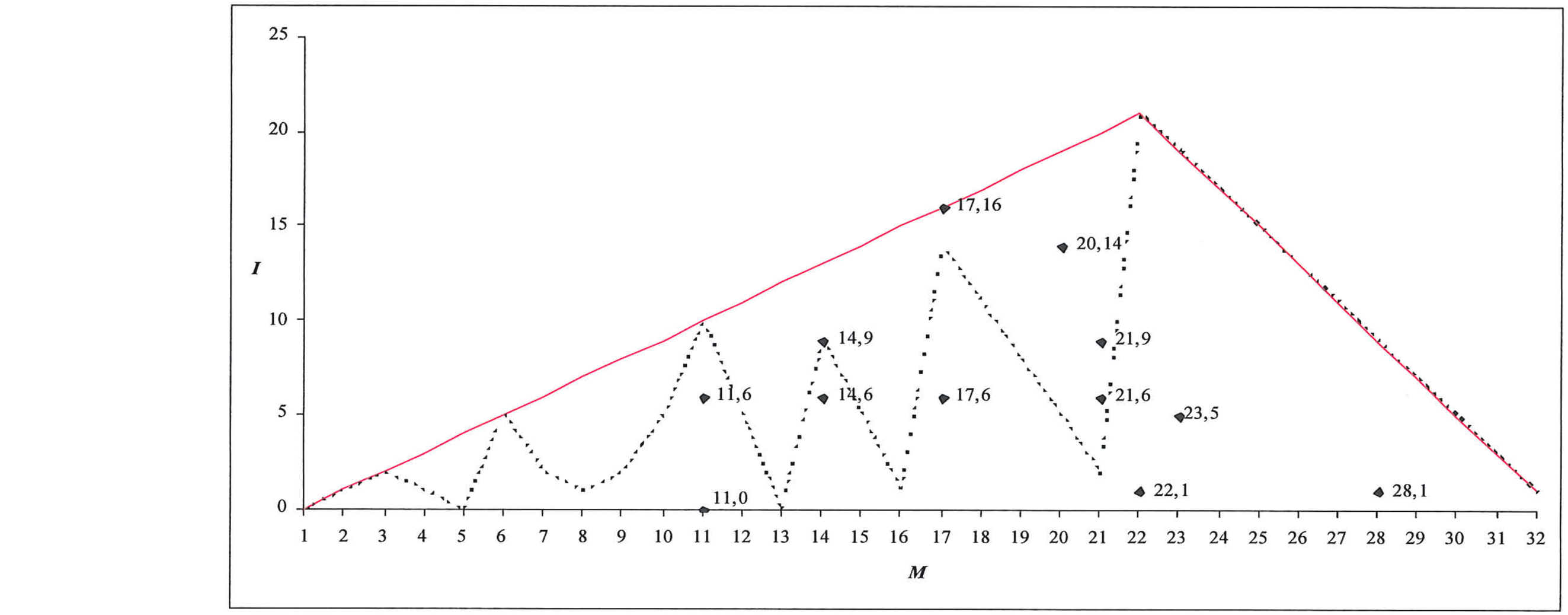


Figure 6.62: Sieve of *Keqrops*.



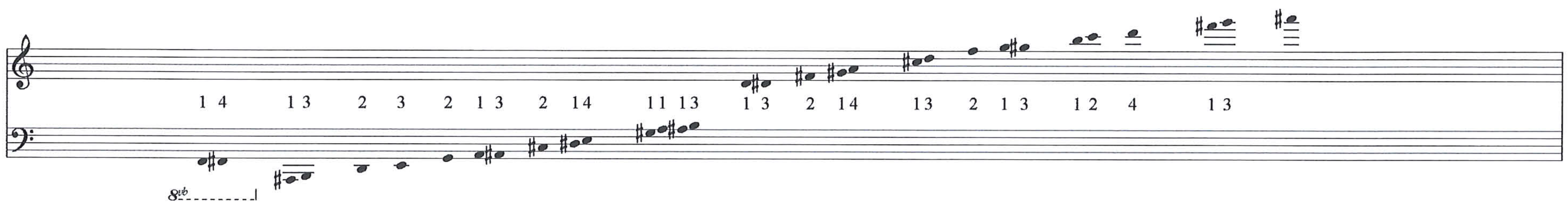
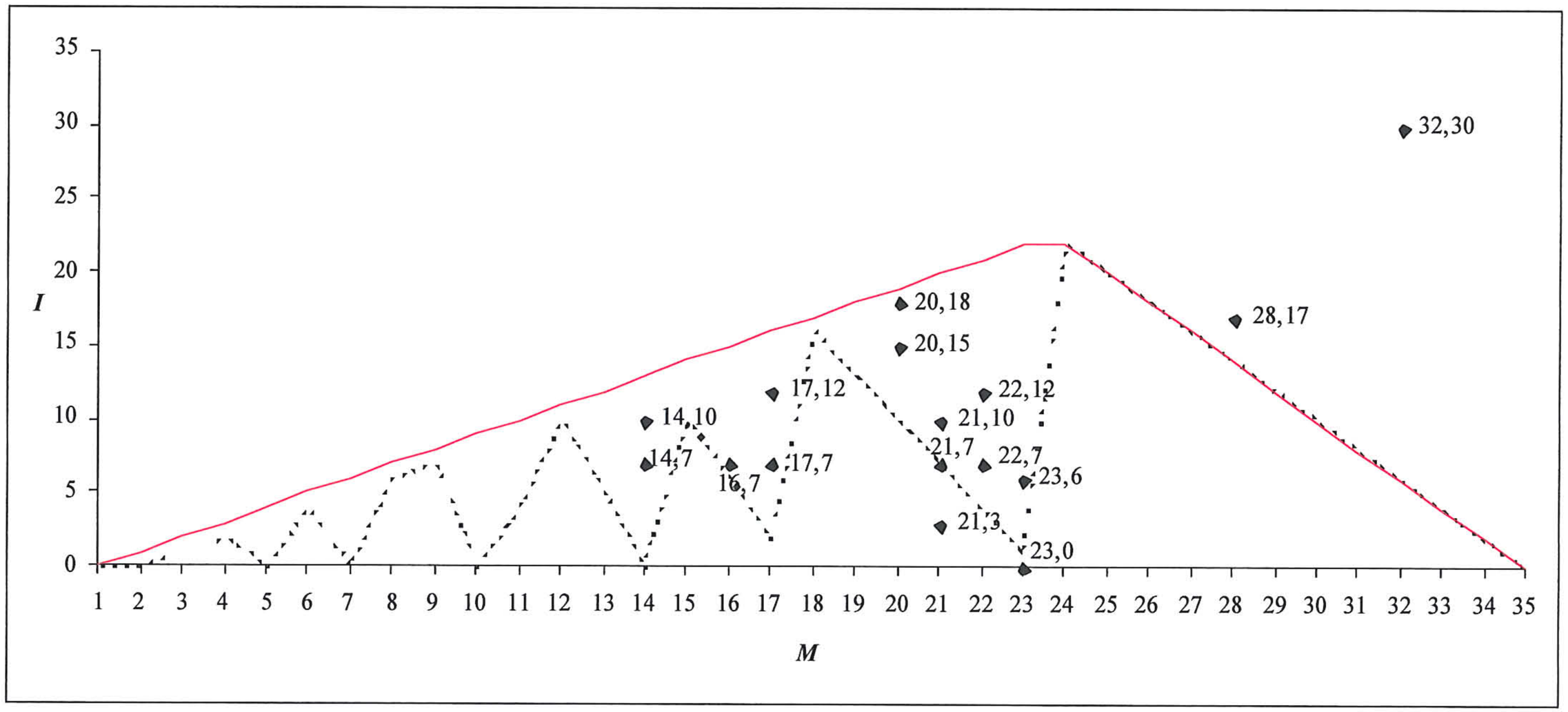


Figure 6.63: Version of the Sieve of *Keqrops* used in *A l'île de Gorée.*



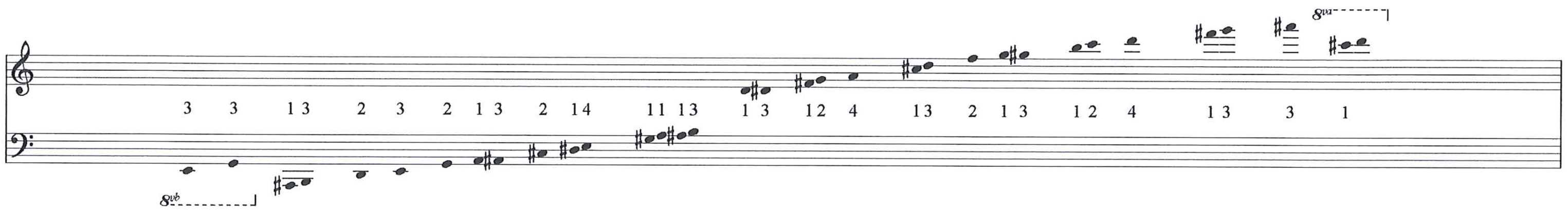
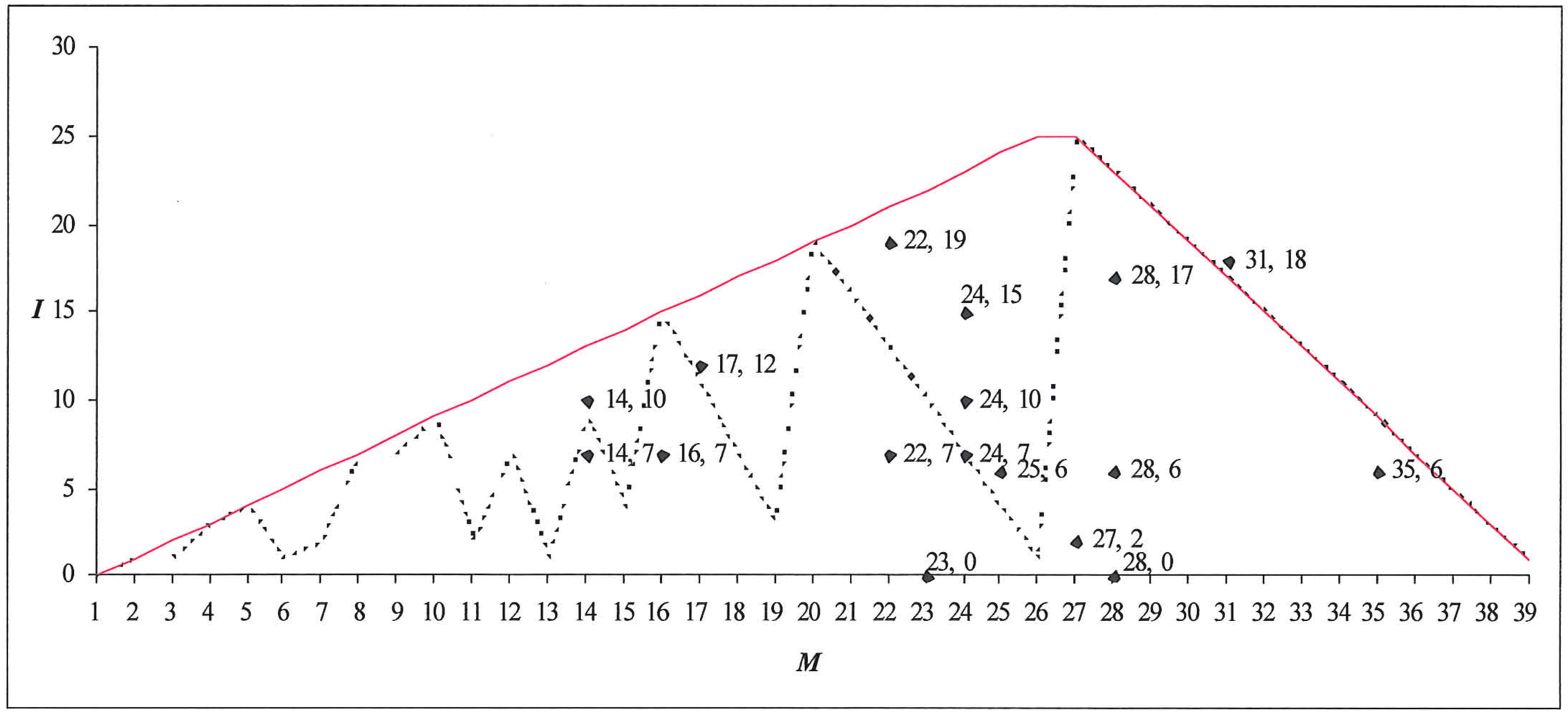


Figure 6.64: Version of the Sieve of *Keqrops* used in *Tuorakemsu*.



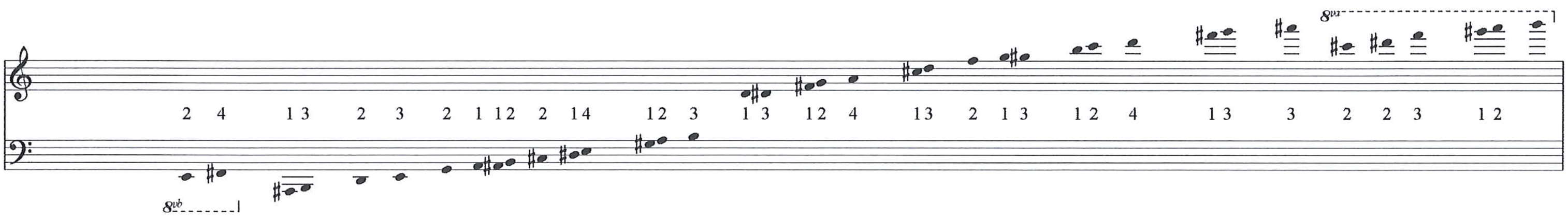
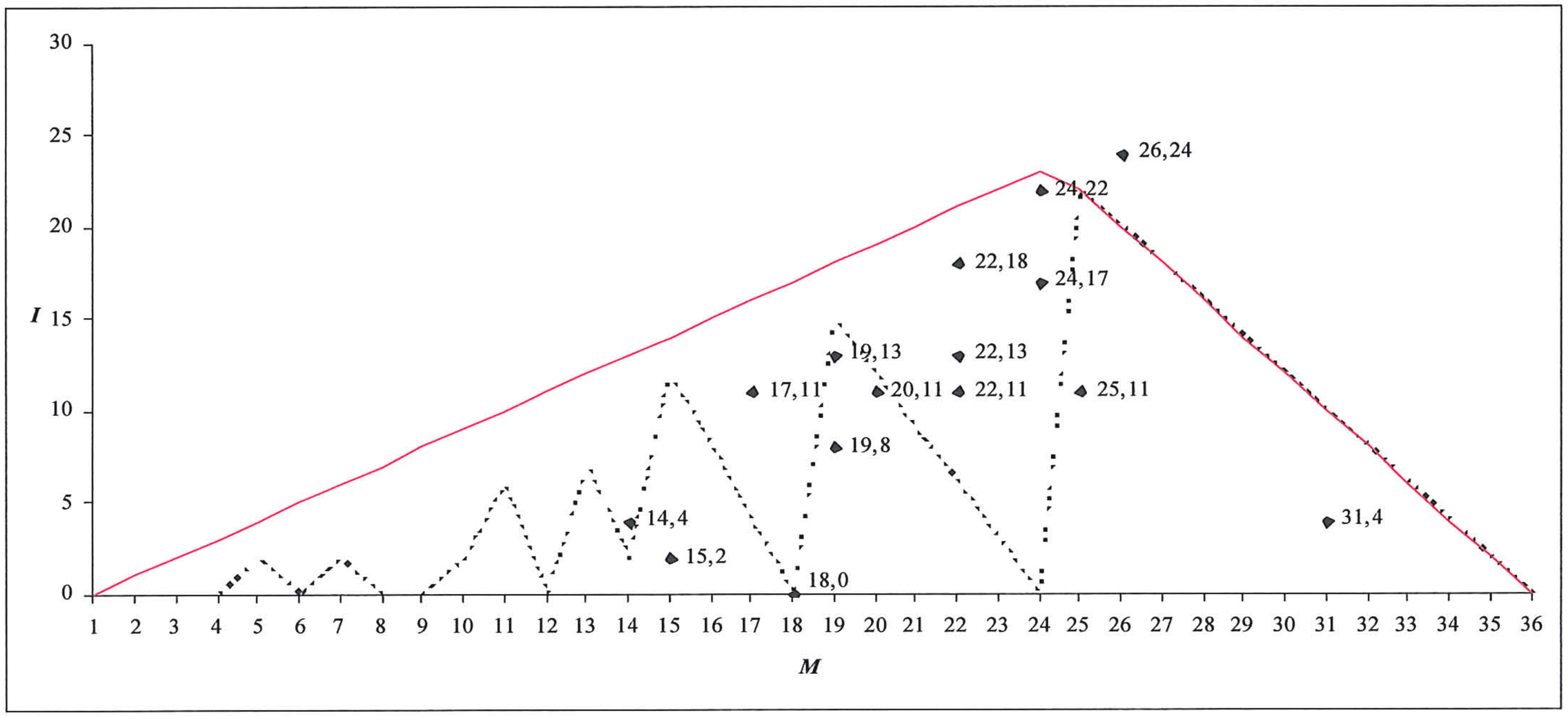


Figure 6.65: Version of the Sieve of *Keqrops* used in *Kyania*.



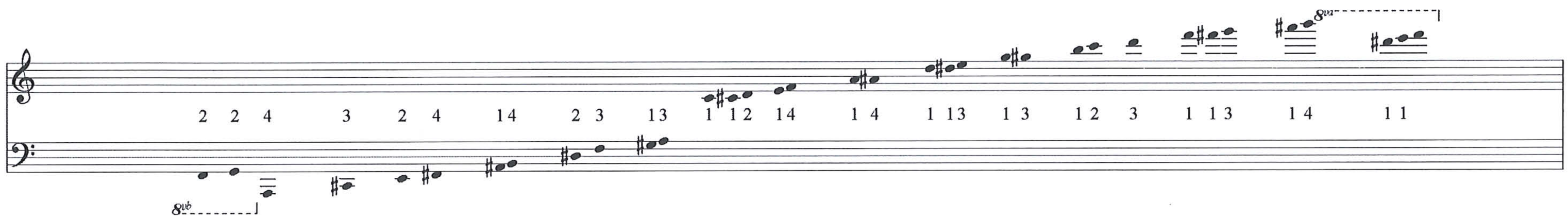
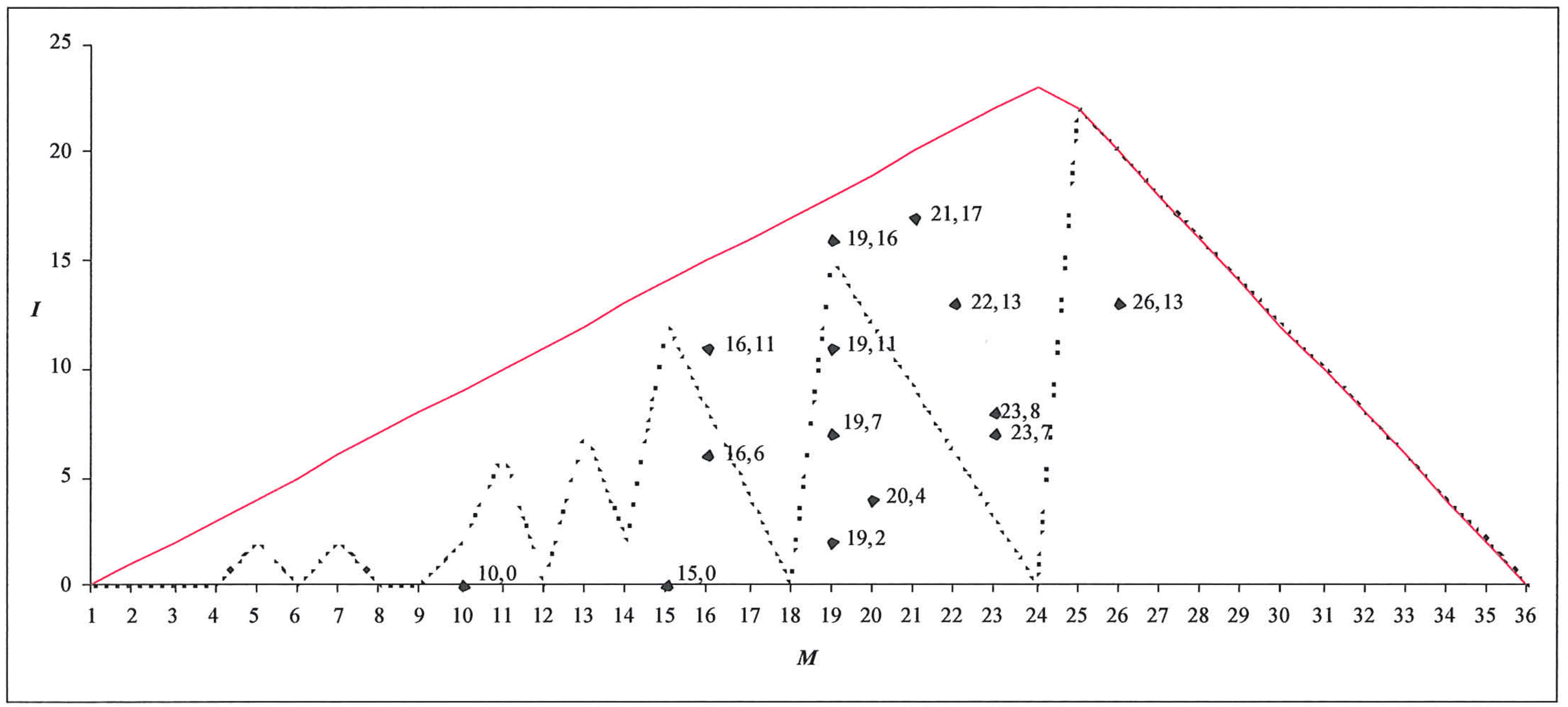


Figure 6.66: SWF.



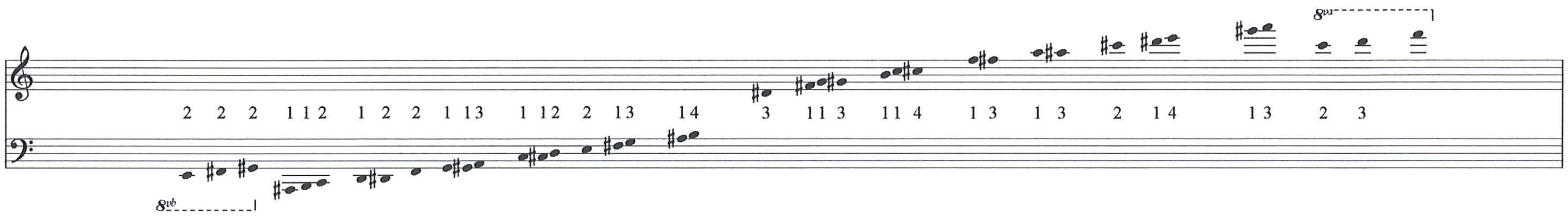
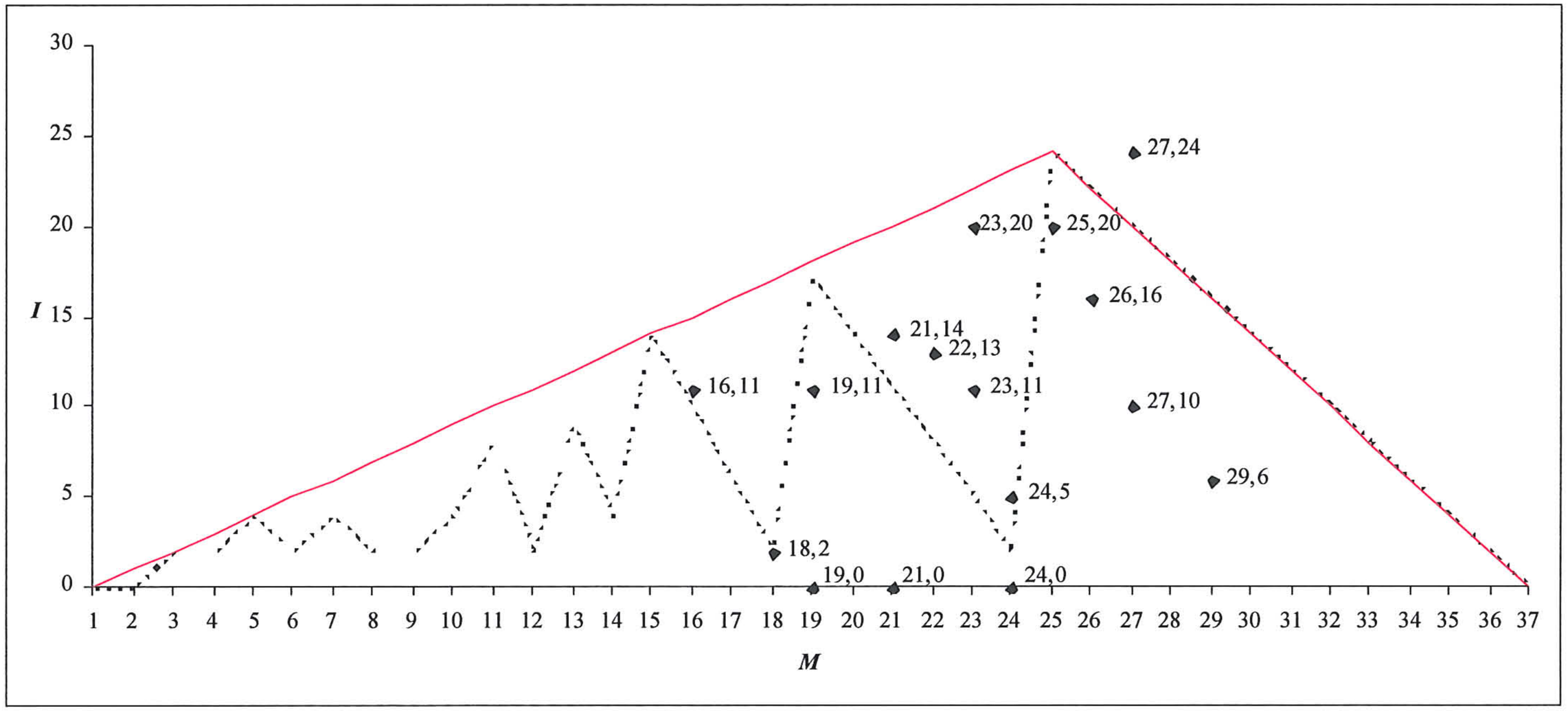


Figure 6.67: CSWF.



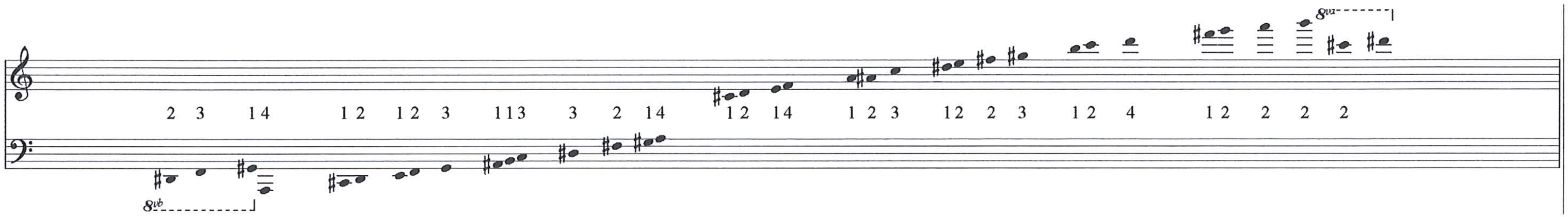
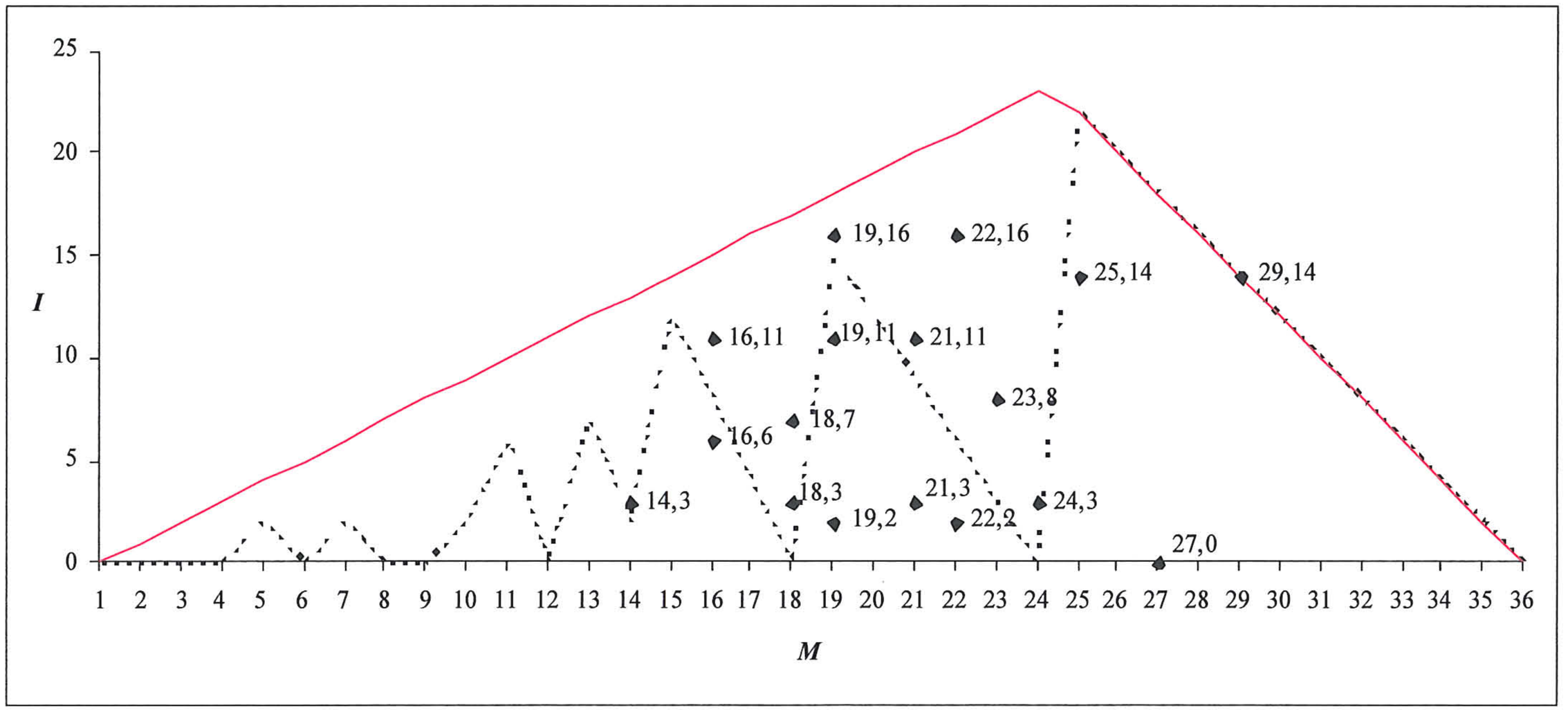


Figure 6.68: SWF'.



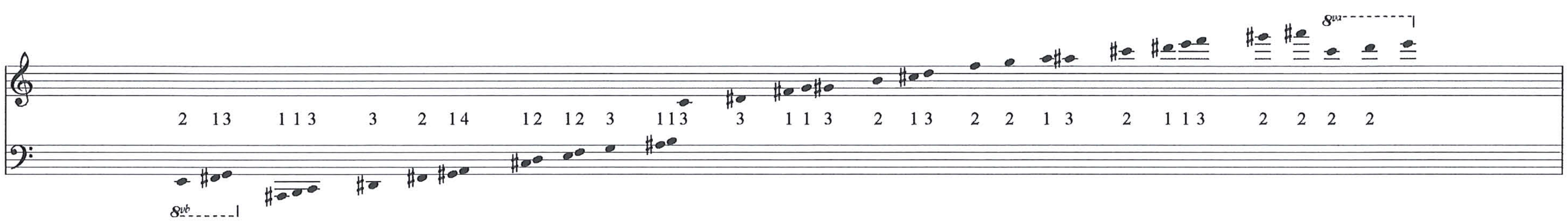
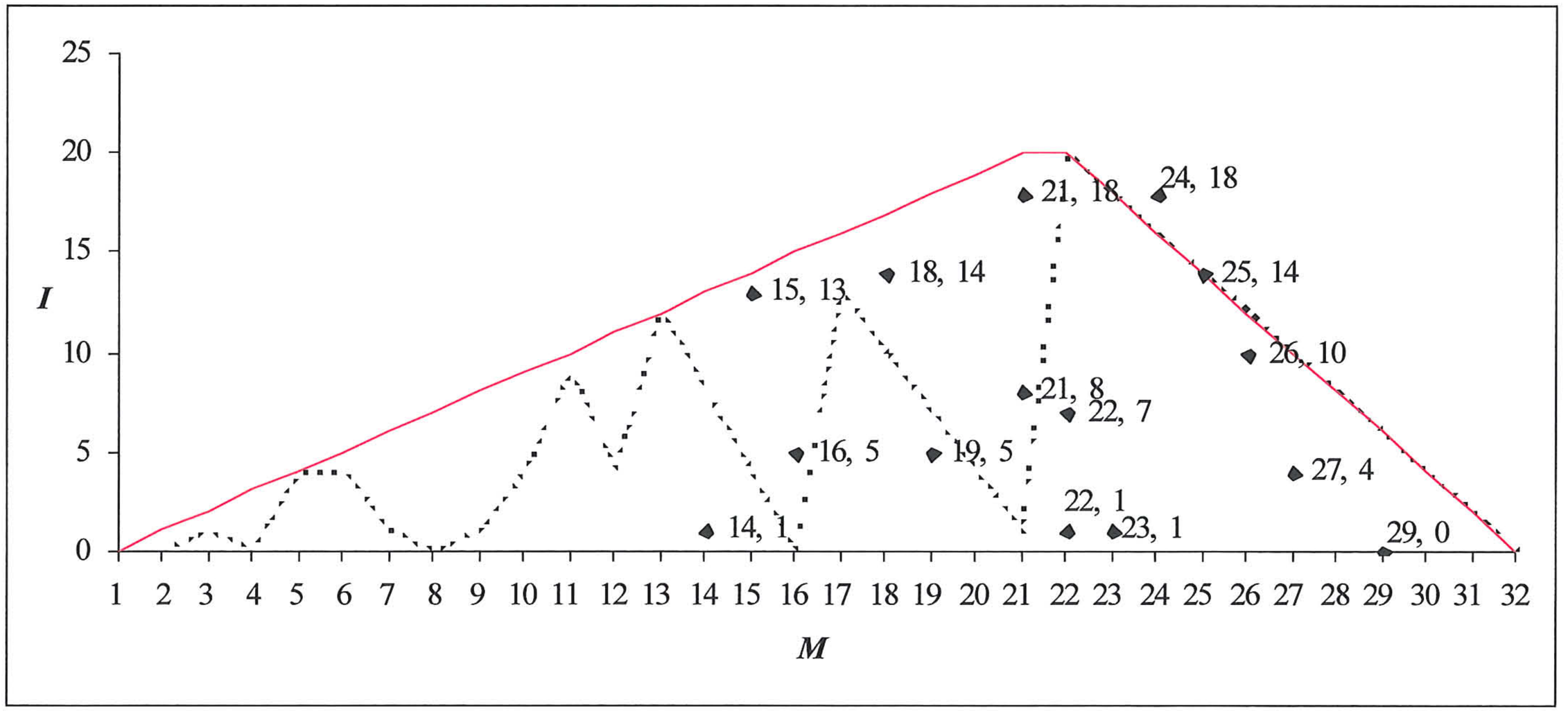


Figure 6.69: CSWF'.



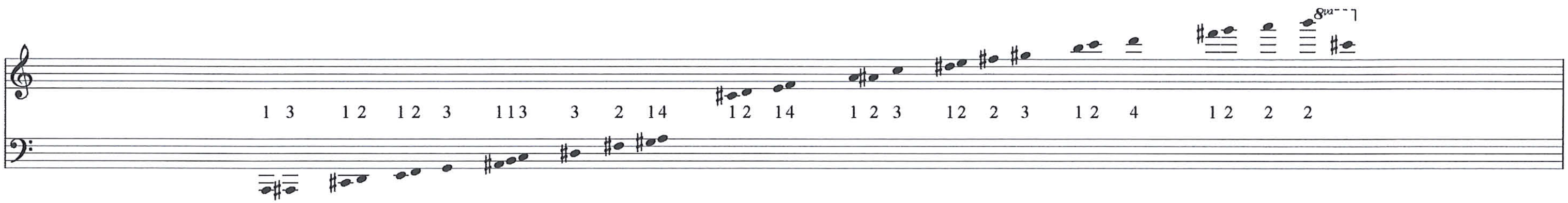
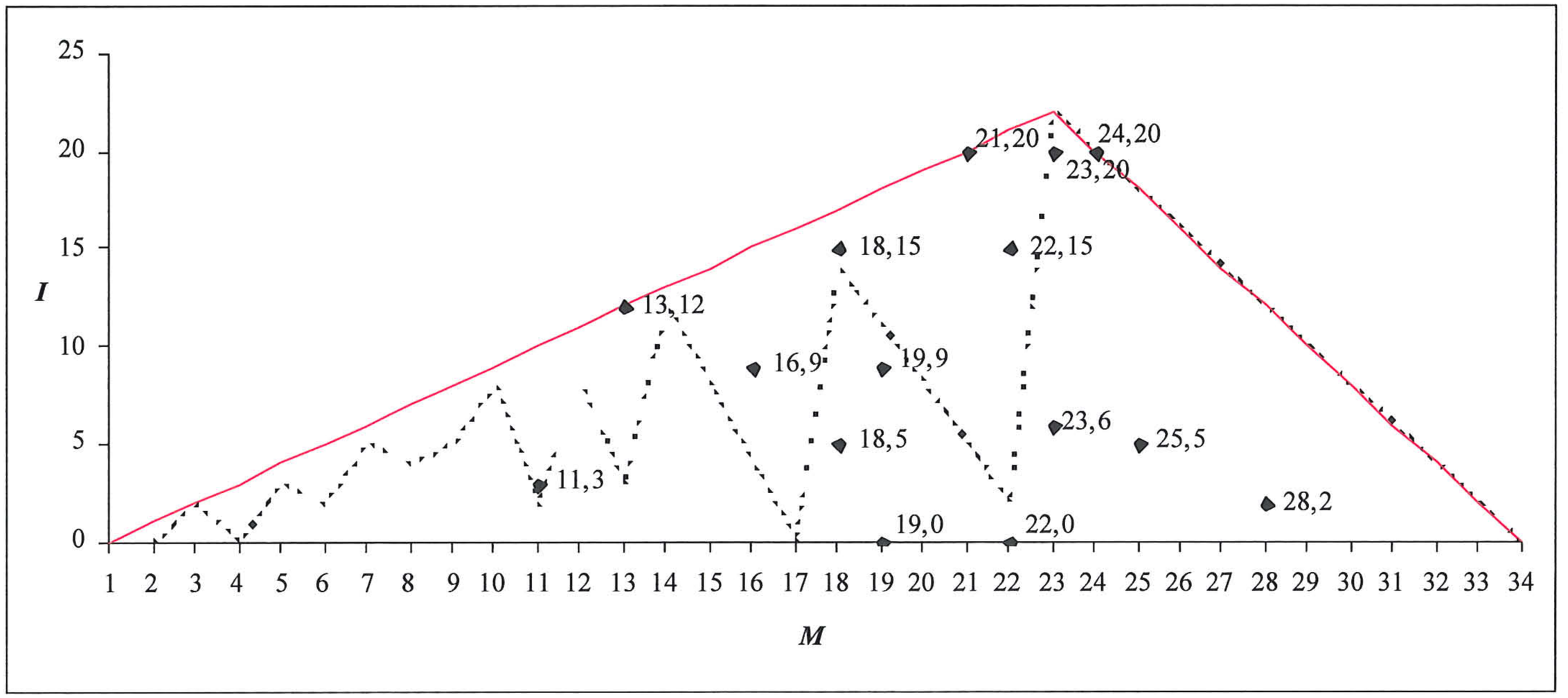


Figure 6.70: Sieve of *Krinoïdi*.



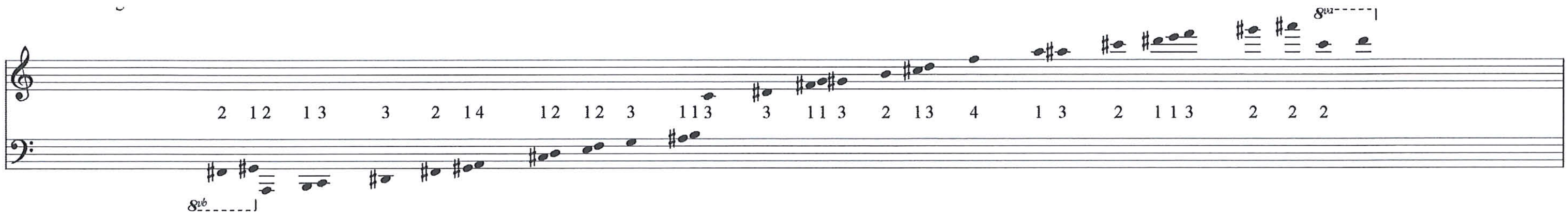
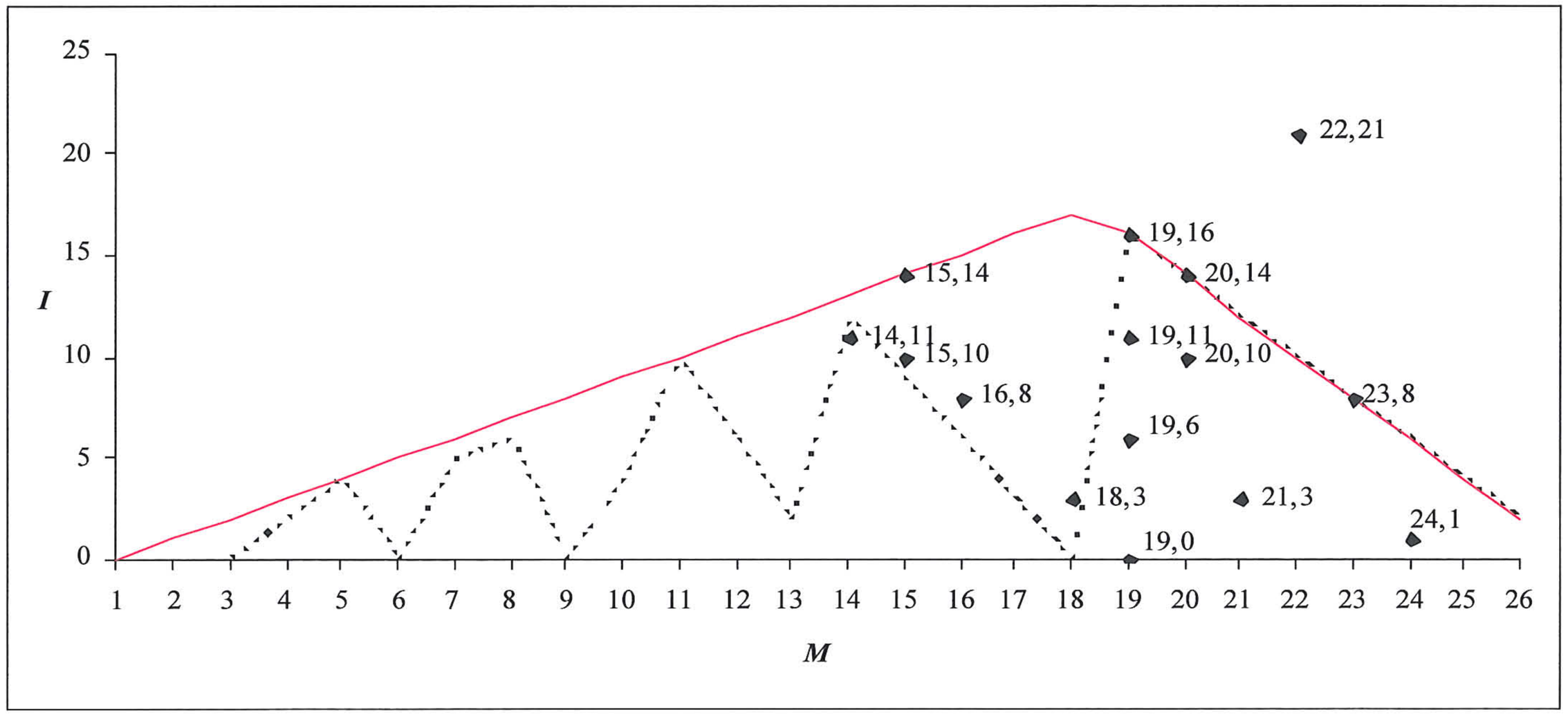


Figure 6.71: Complement of the Sieve of *Krinoïdi*.



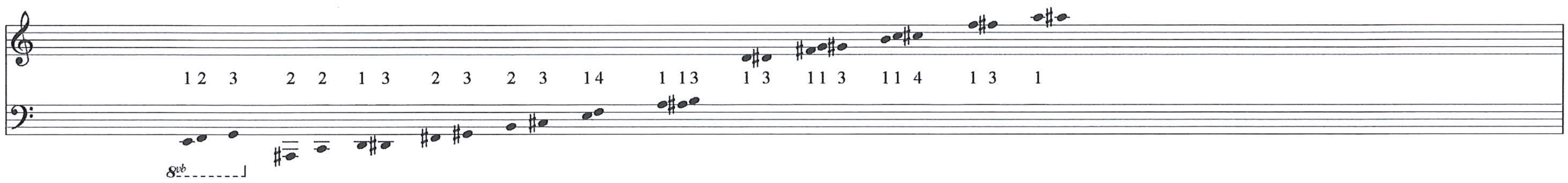


Figure 6.72: Sieve of *Kyania*.

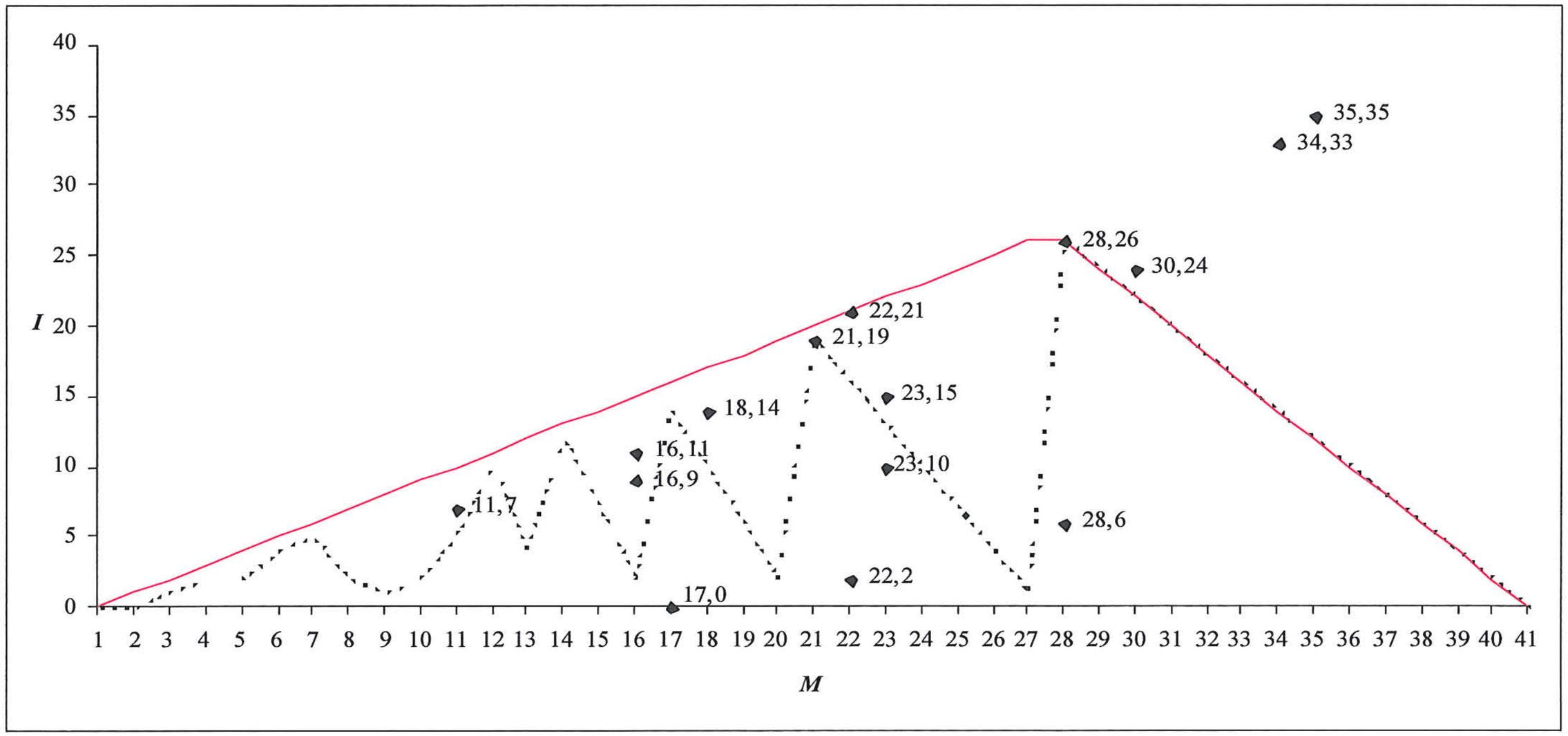
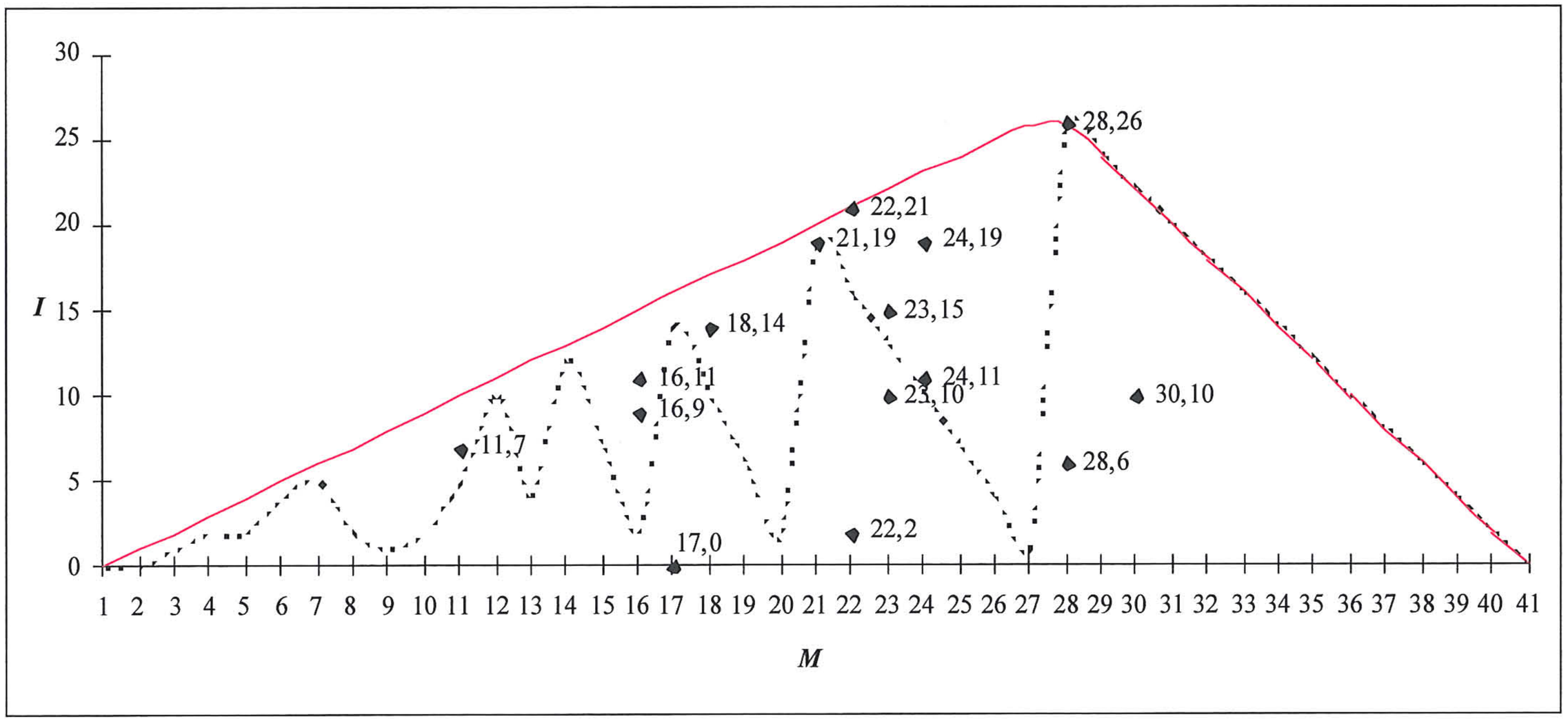


Figure 6.73: Sketches of *Echange*, Formula of ASK.



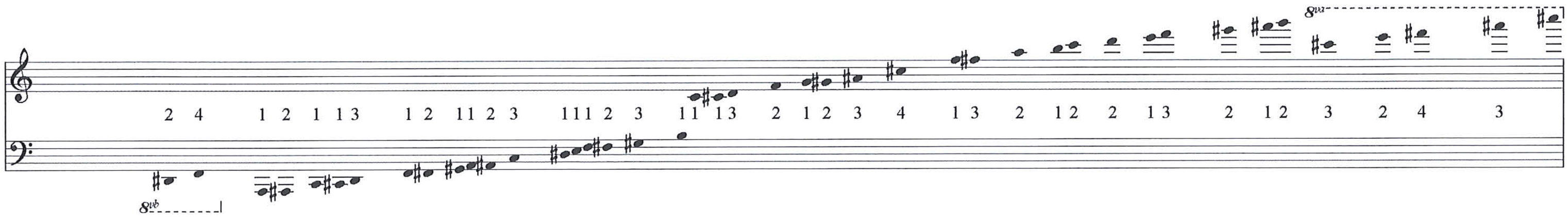
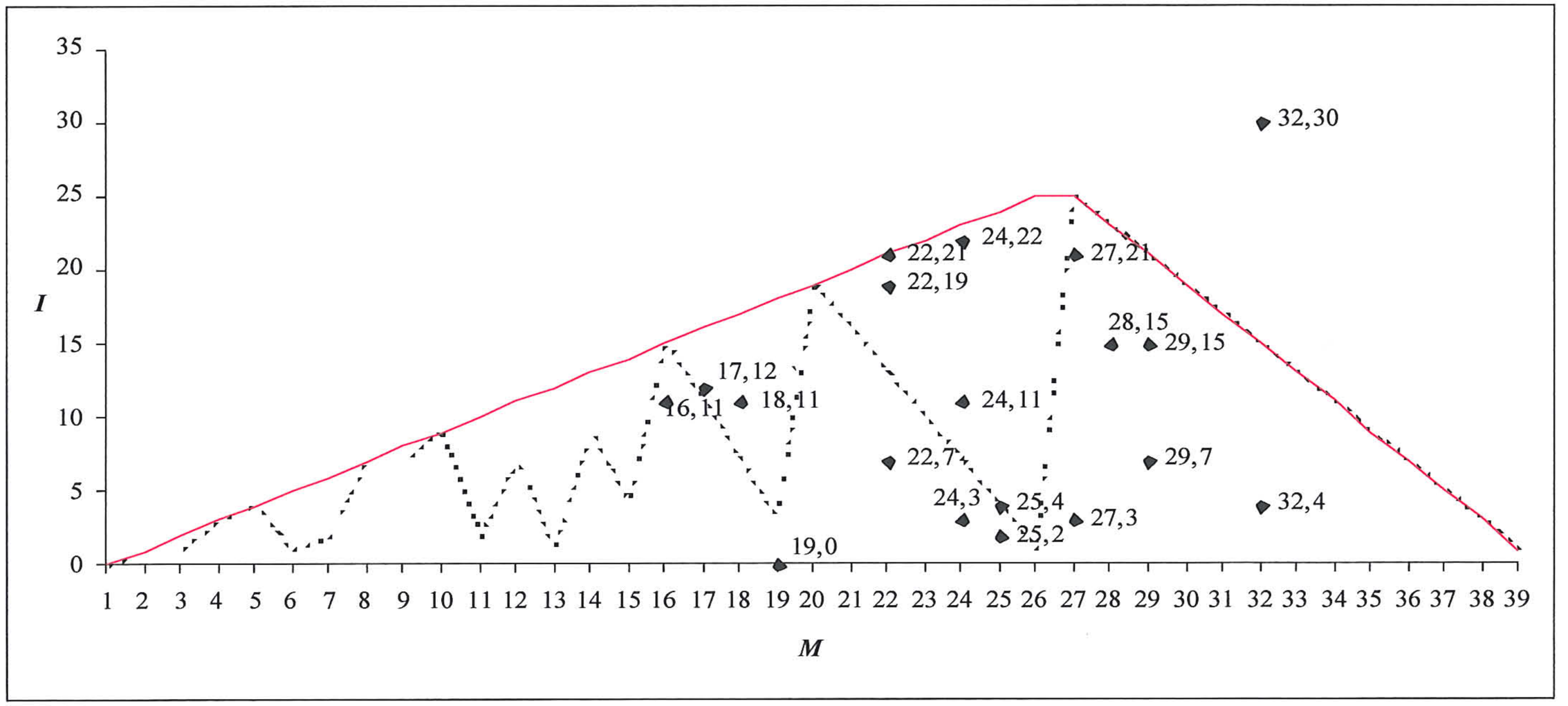


Figure 6.74: ASK.



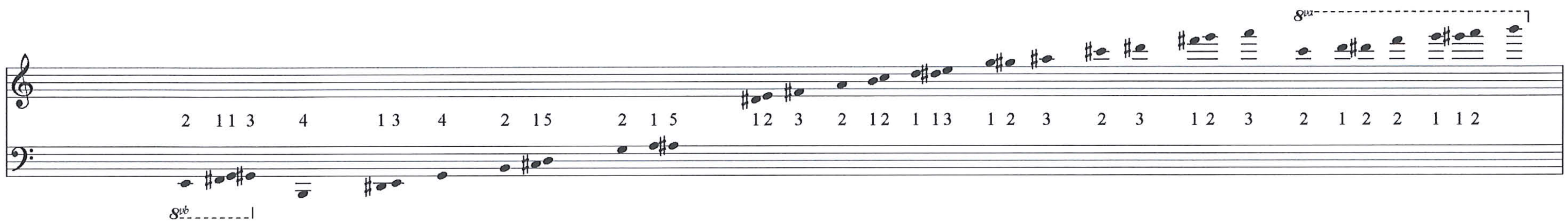
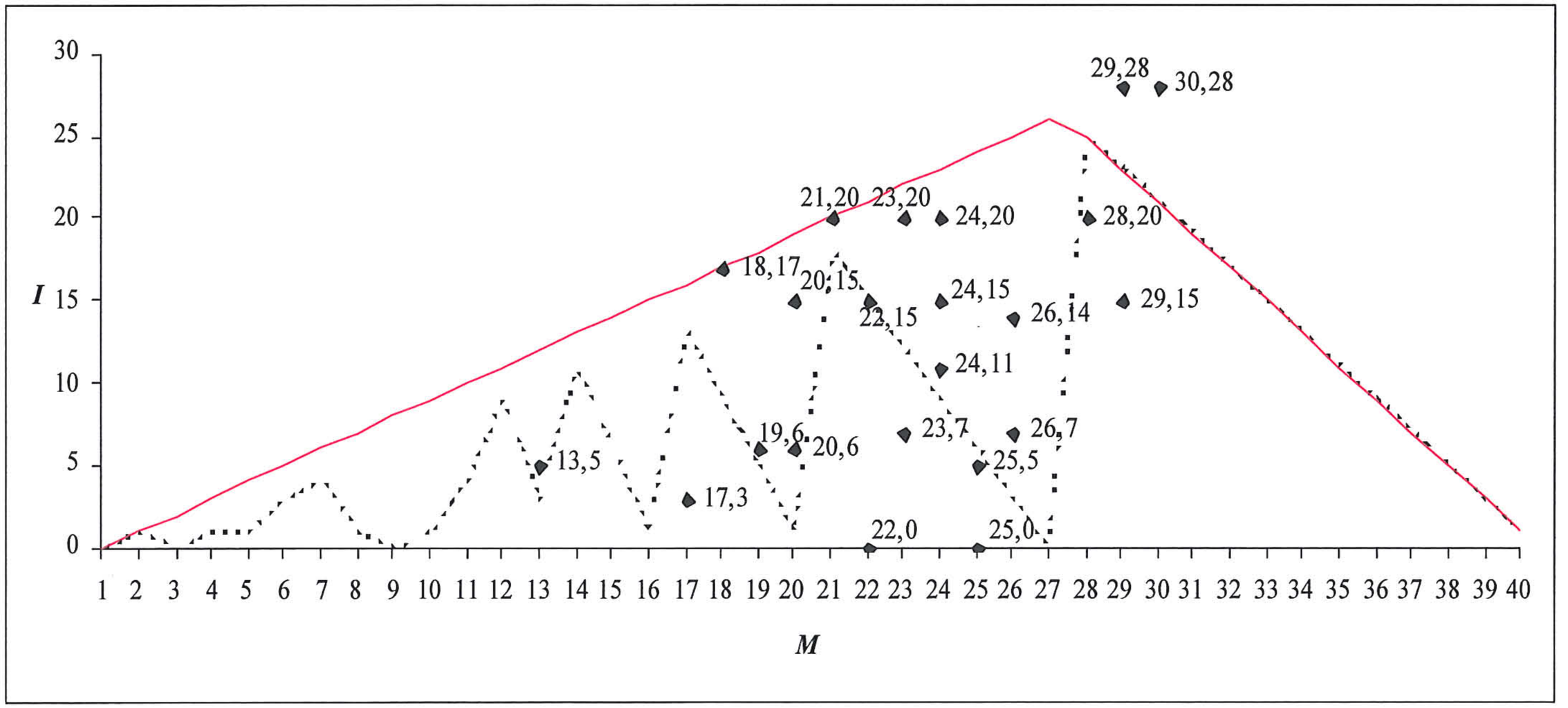


Figure 6.75: Complement of ASK.



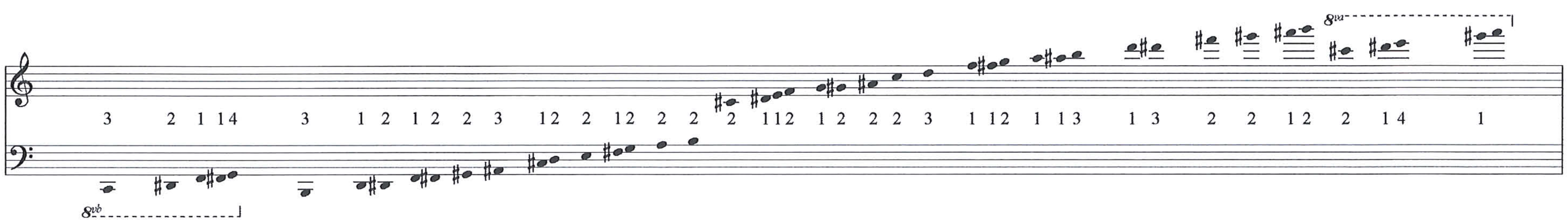
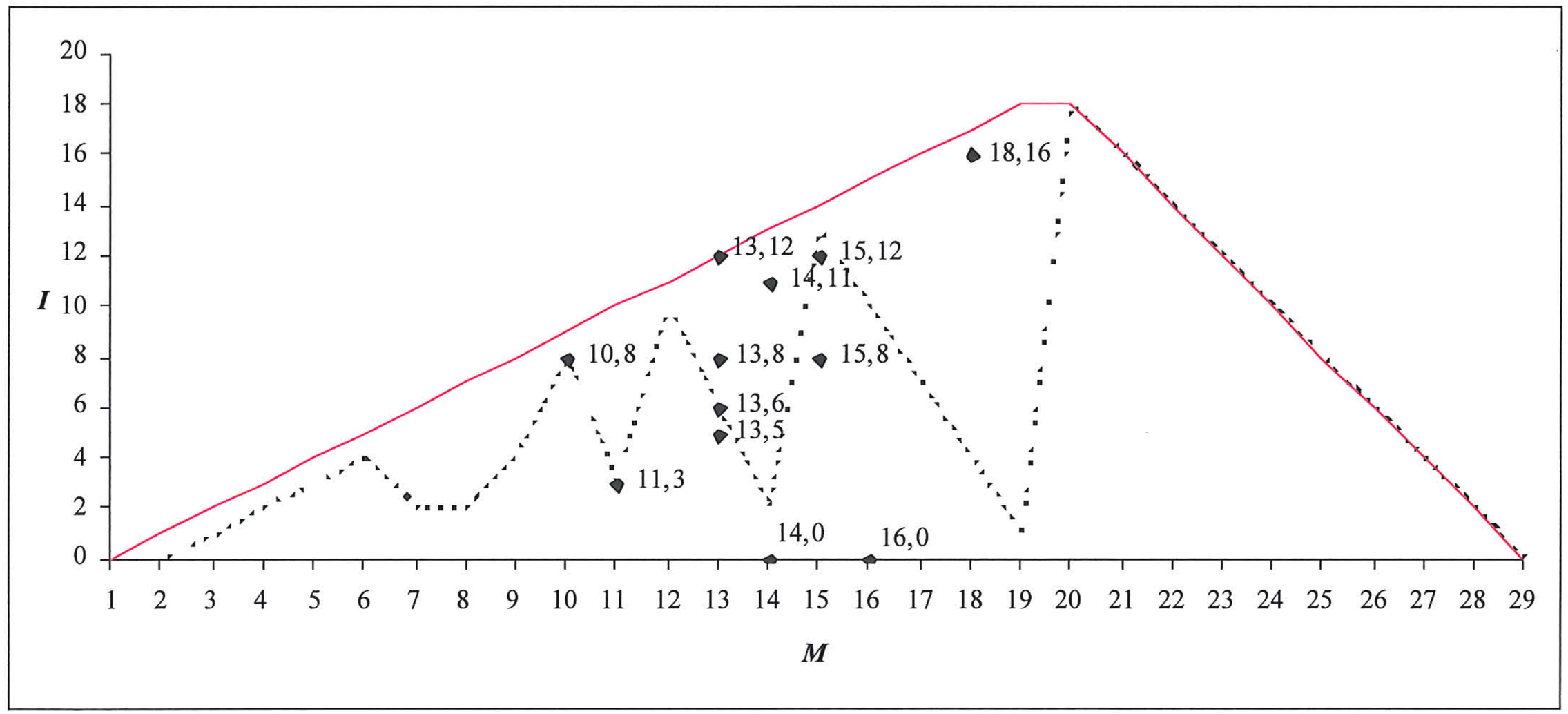


Figure 6.76: Sieve of *Epicycle*.



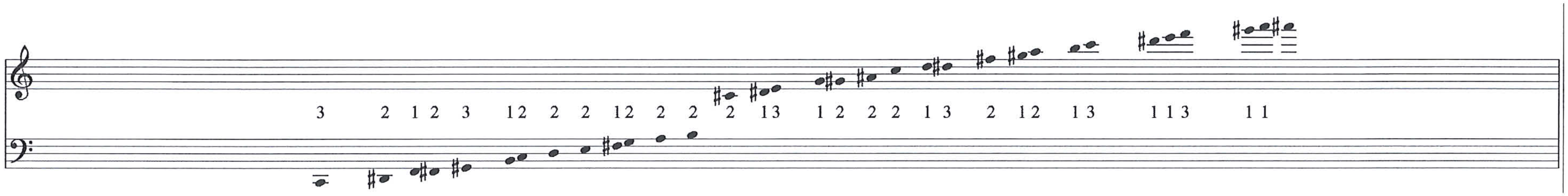
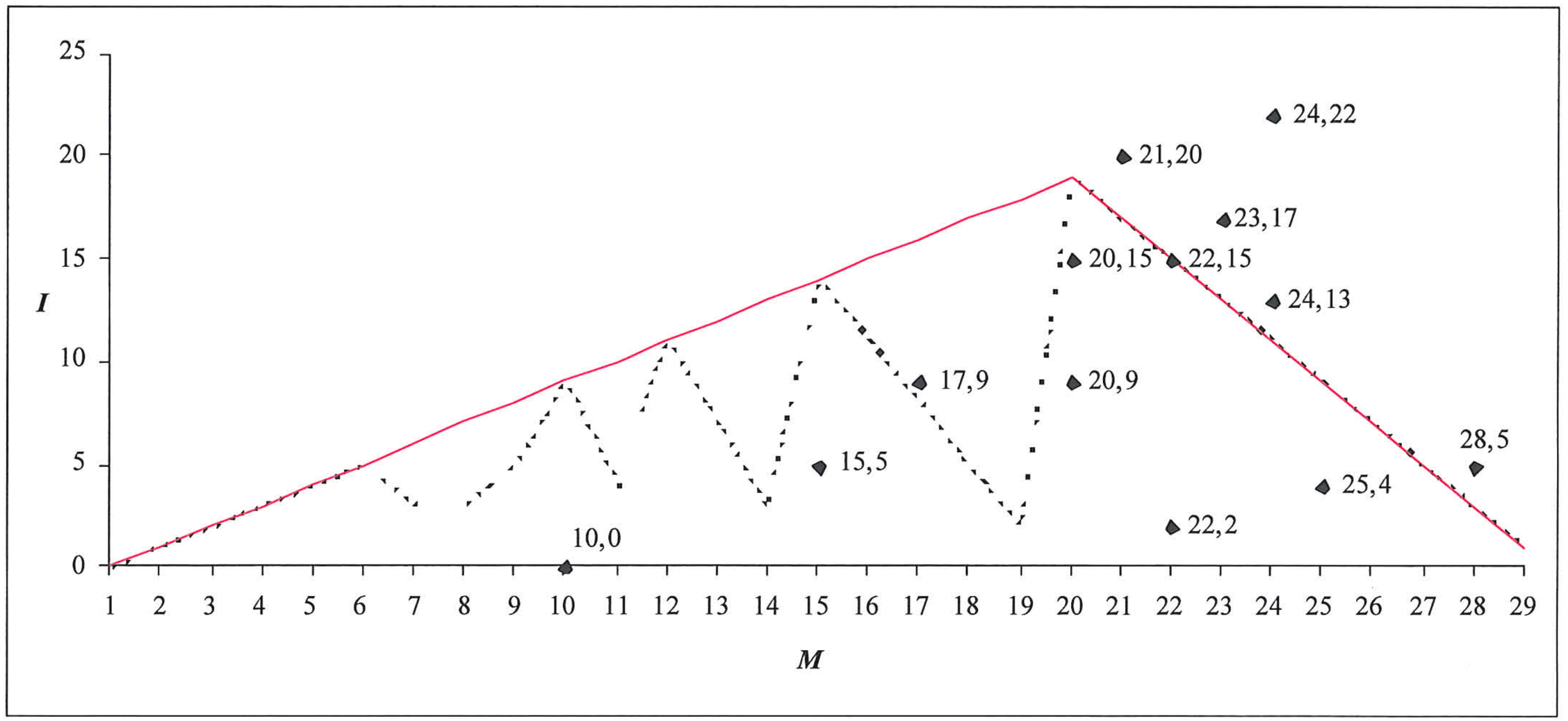


Figure 6.77: Sieve of *Epicycle* as used in *Tetora*.



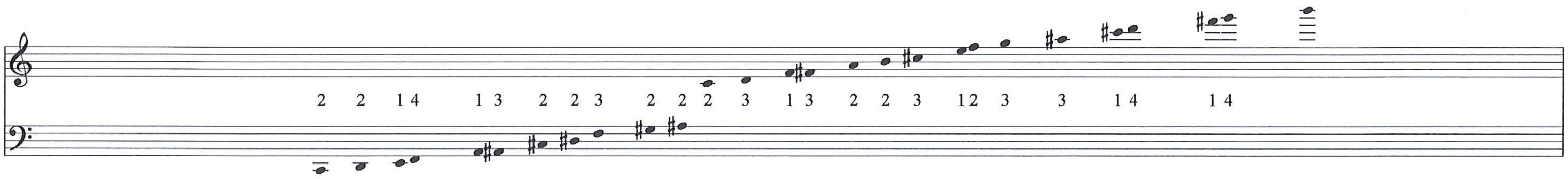
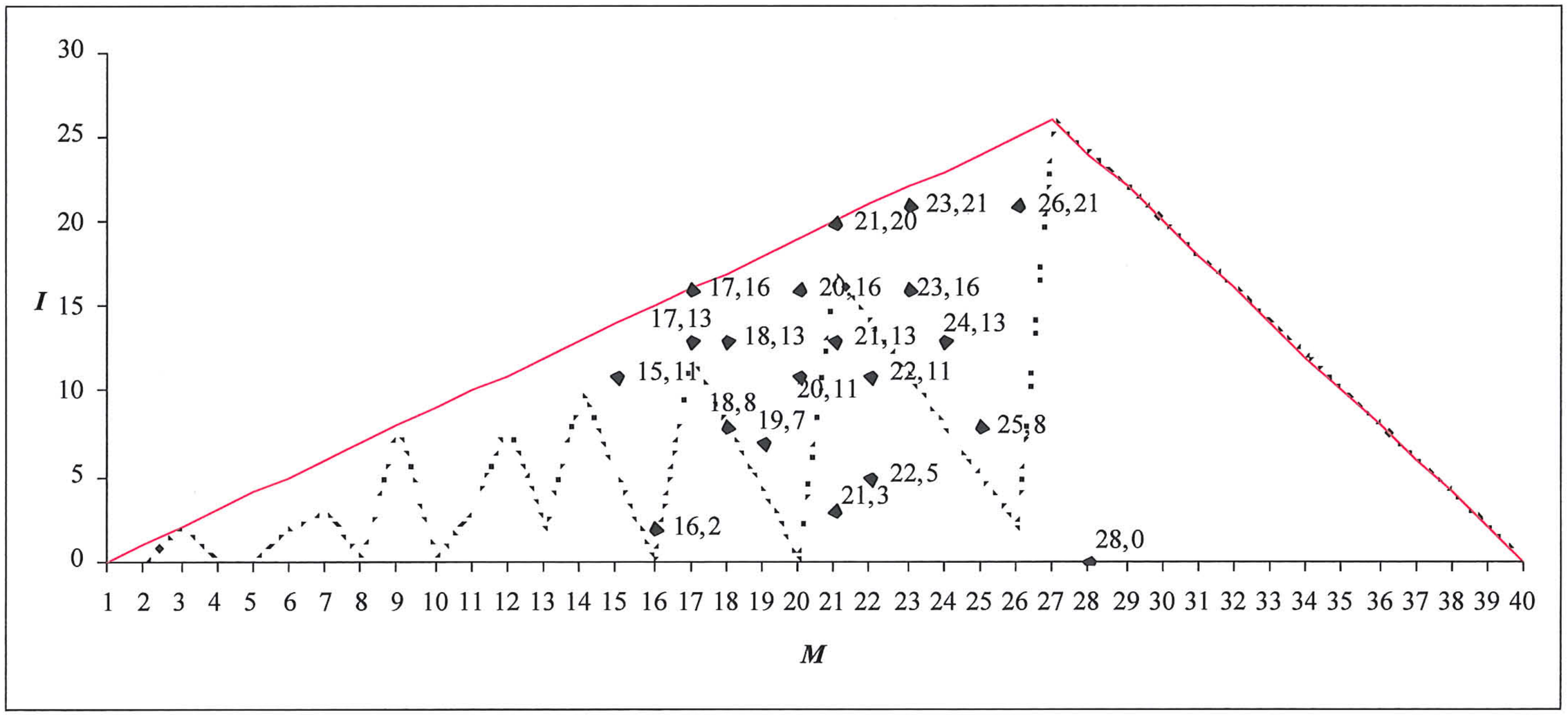


Figure 6.78: Complement of the Sieve of *Epicycle* as used in *Tetora*.



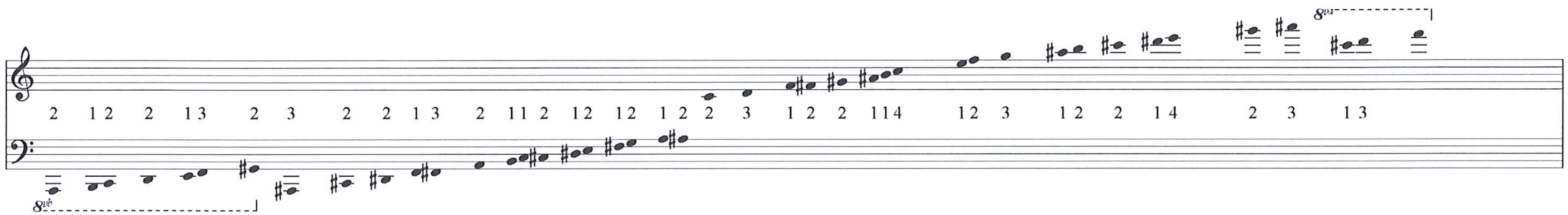


Figure 6.79: Sieve of *Paille in the Wind*.

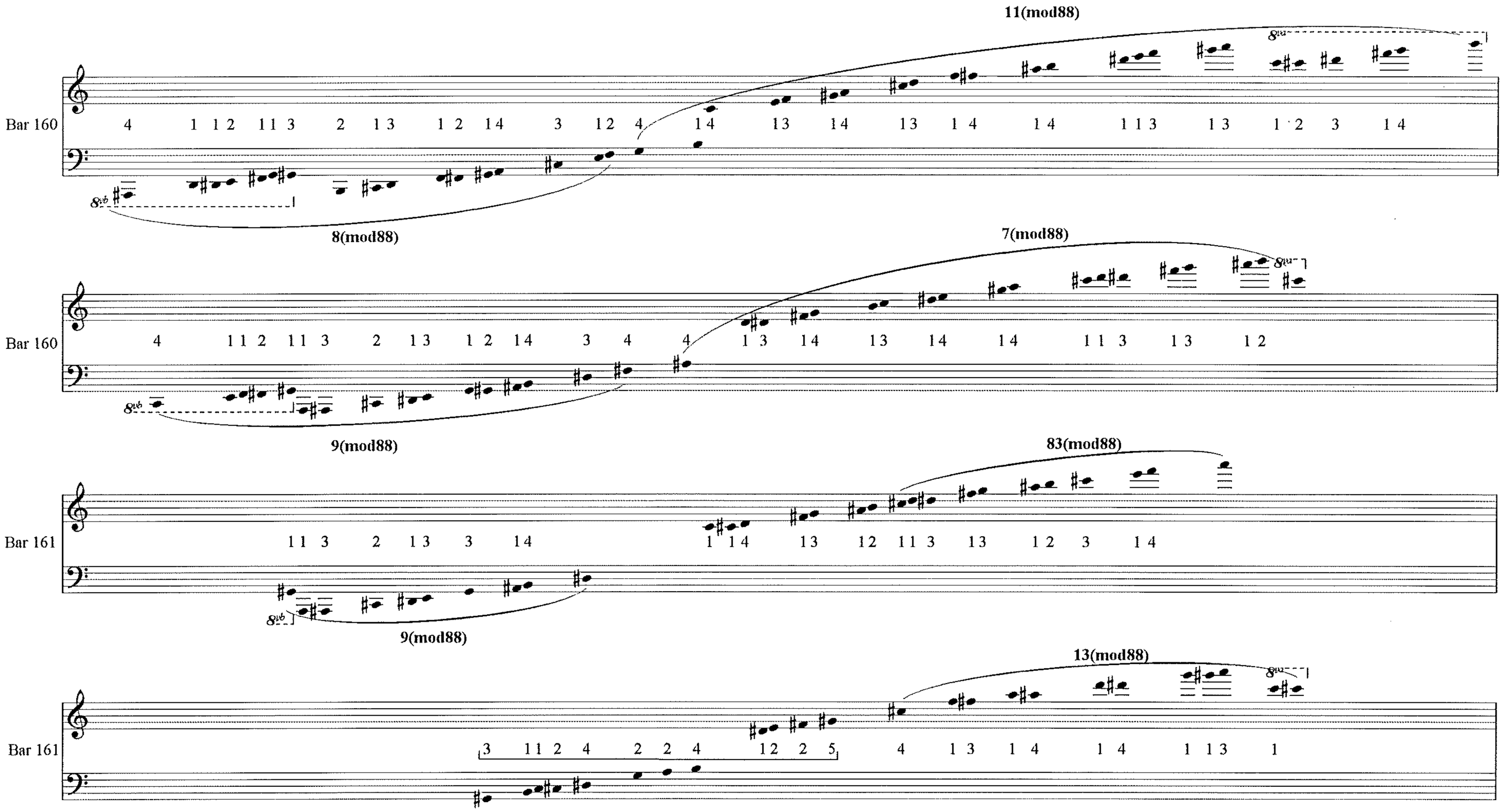


Figure 7.1: Sieves in the Final Section of *Keqrops* and Segments of the Sieve of *Nekuïa*.

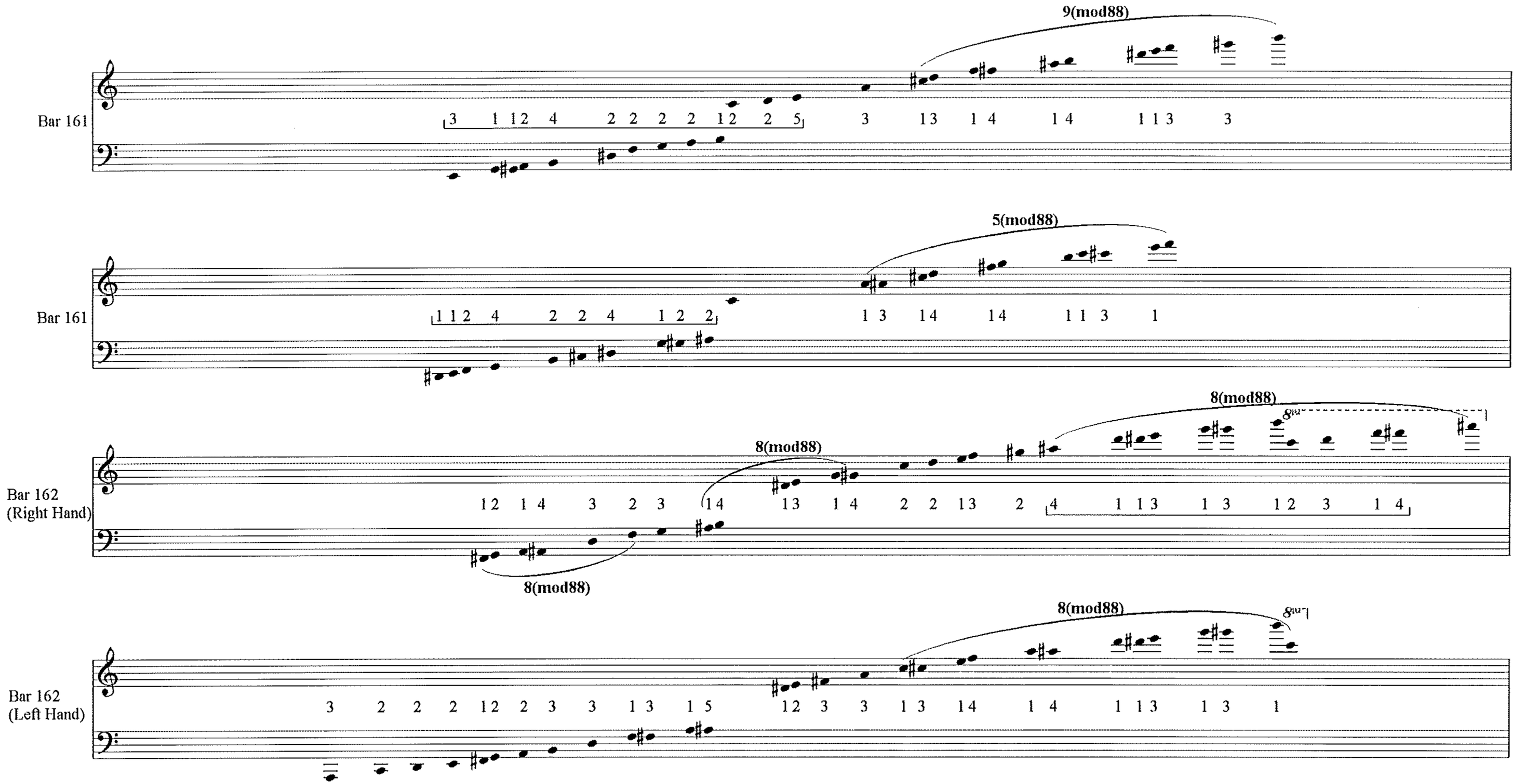


Figure 7.1: Sieves in the Final Section of *Keqrops* and Segments of the Sieve of *Nekuïa*, cont.

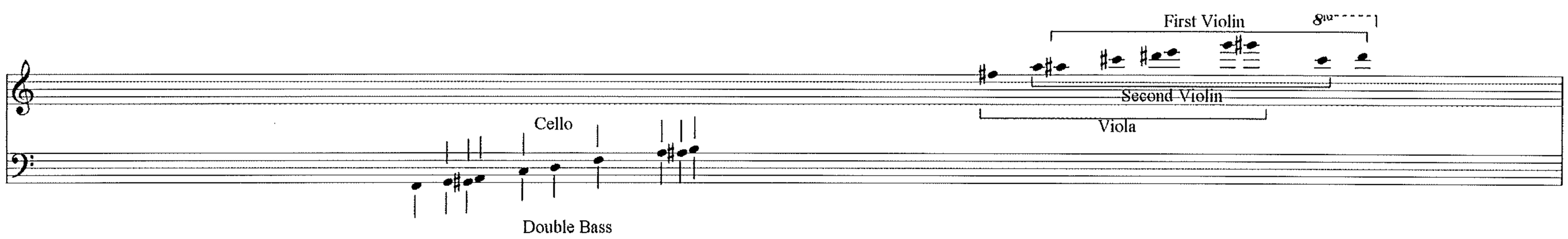


Figure 7.2: *Horos*, bars 47-50. Sieve Segments in the strings.

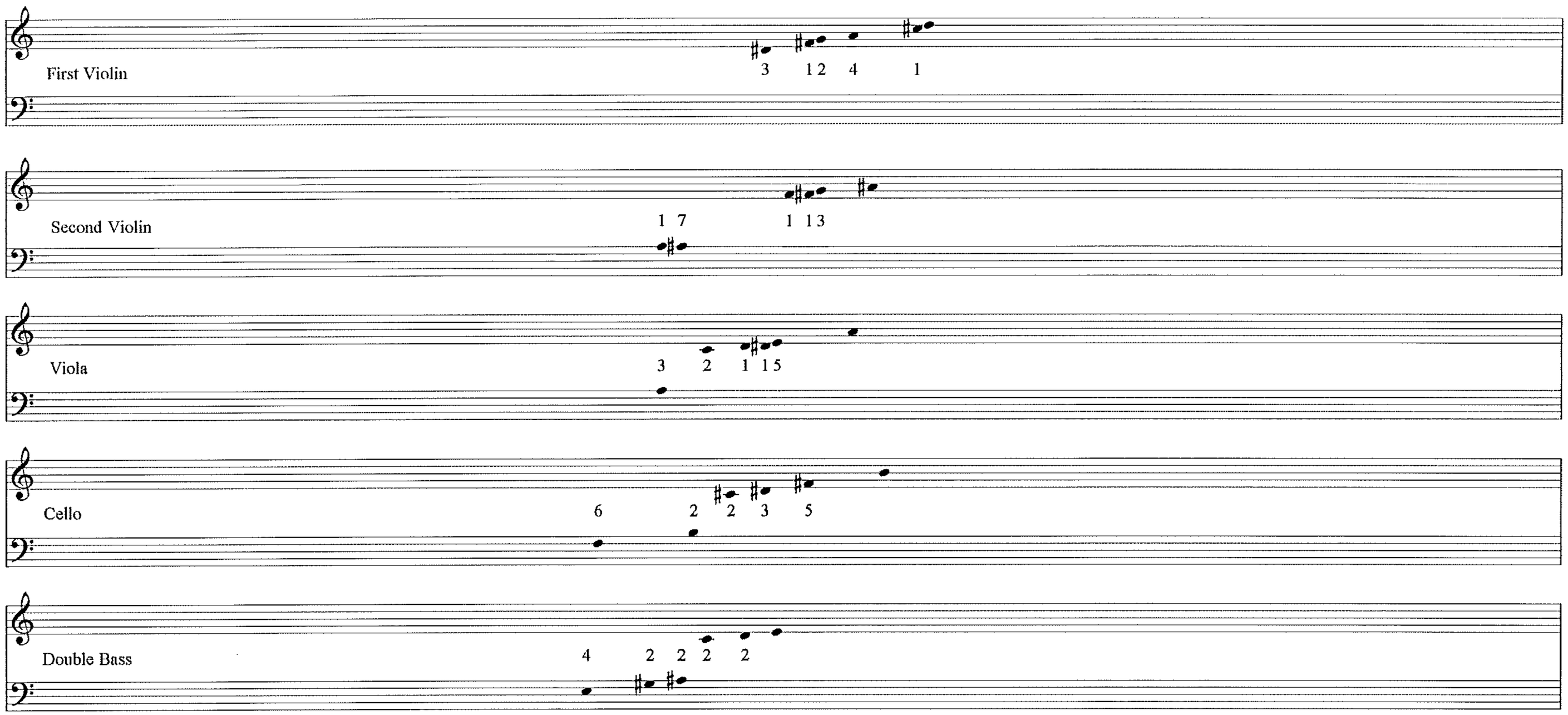


Figure 7.3: *Ata*, bars 68-70.

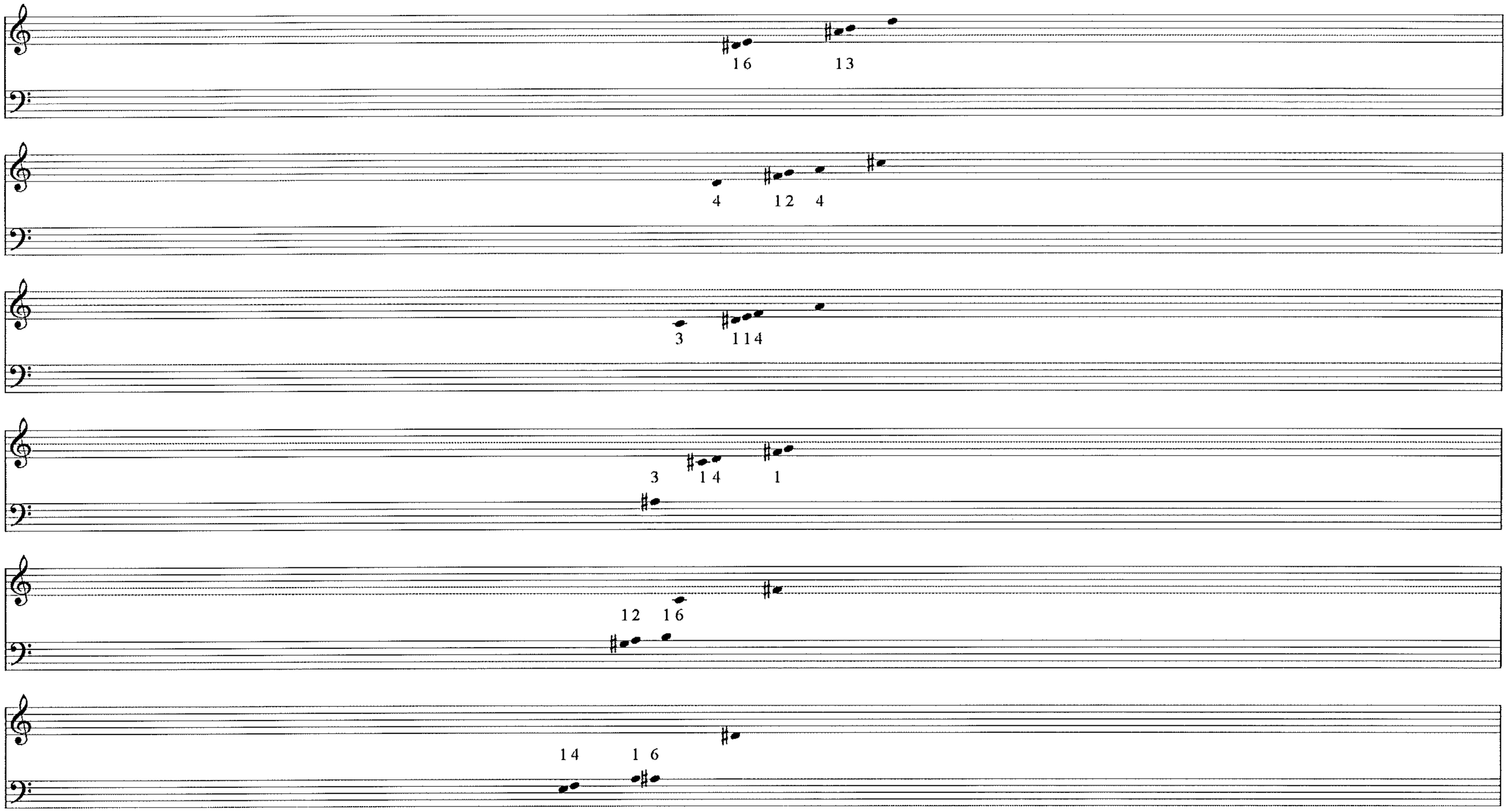


Figure 7.4: *Ata*, bars 68-70, Vertical Pentachords.

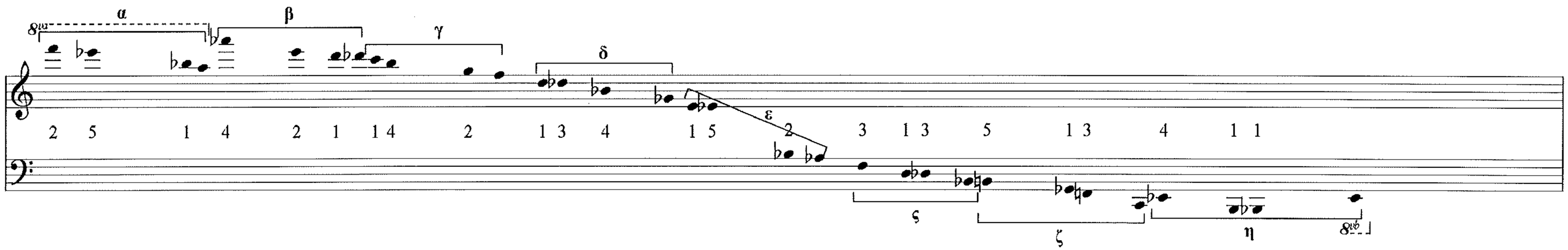


Figure 7.5: Sketches of *Keqrops*, Tetrachords of bars 126-137.

Bars:	126	127	128	129	130	131	132	133	134	135	136	137
Flute	γ	γ	γ	γ				β	β	β	β	β
Oboe		δ	δ	δ	γ			γ	γ	γ	γ	γ
Clarinet			ε		δ			β/γ	β/γ	β/γ	β/γ	β/γ
Bassoon				ζ	ζ ε	ζ	ζ	ζ				
Horn			δ	ζ	ζ	δ	δ	δ				
Trumpet			γ		δ	δ						
Trombone			ε			ε	ε	ε				
Violin I									α	α	α	α
Violin II									β	β	β	β

Figure 7.6: The Tetrachords of bars 126-137, as they are used in *Keqrops*.

Bars:	126								127								128											
Pitches:	**G**	**F**	**C**	**B**	**B**	**F**	**G**	**C**	**F**	**C**	**G**	**B**	**G**	**C**	**B**	**F**	**C**	**B**	**G**	**F**	**F**	**B**	**C**	**G**	**C**	**G**	**F**	**B**	**B**	**F**	**G**	**C**
Time-values	1	2	3	4	2	3	1	4	1	3	4	2	4	1	3	2	1	1	4	4	1	4	2	3	3	2	4	1	2	3	1	4

Bars:	129								130												131							
Pitches:	**G**	**F**	**C**	**B**	**B**	**G**	**C**	**F**	**C**	**F**	**B**	**G**	**F**	**B**	**C**	**G**	**C**	**B**	**G**	**F**	**G**	**C**	**B**	**F**	**B**	**F**	**G**	**C**
Time-values	1	2	3	4	4	2	1	3	2	4	1	3	1	4	2	3	1	2	3	4	4	1	3	2	2	4	1	3

Figure 7.7: Permutations of the Elements of Tetrachord γ in bars 126-131 of *Keqrops*.

Bars:	0-12	13-14	14-18	18-21
Piano:	**S**	**C**		**C**
Strings:	**C**	**C**	**S**	**S**

Figure 7.8: The Exchange of the Sieve and its Complement in the First Section of *Akea*.

RH

0	2	5	7	**10**	12	15	17	**20**	23	25	27	**30**	32	35	37	**39**	41	43	46	**49**	52	55	57
2	*3*	*2*	*3*	*2*	*3*	*2*	*3*	*3*	*2*	*2*	*3*	*2*	*3*	*2*	*2*	*2*	*2*	*3*	*3*	*3*	*3*	*2*	*2*

59	61	63	65	67	**69**	72	74	76	**79**	80	82	**85**	87	90	**92**	95	**98**	101	103	**105**	108	**110**	**112**
2	*2*	*2*	*2*	*2*	*3*	*2*	*2*	*3*	*1*	*2*	*3*	*2*	*3*	*2*	*3*	*3*	*3*	*2*	*2*	*3*	*2*	*2*	*2*

114	**117**	120	122	**124**	**127**	129	**131**	133	**136**	**139**	**142**
3	*3*	*2*	*2*	*3*	*2*	*2*	*2*	*3*	*3*	*3*	

LH

0	3	5	**8**	11	13	**16**	18	20	22	**(24)**	25	27	29	**31**	34	36	**38**	41	43	45	**46**	**(48)**	51
3	*2*	*3*	*3*	*2*	*3*	*2*	*2*	*2*	*2*	*1*	*2*	*2*	*2*	*3*	*2*	*2*	*3*	*2*	*2*	*1*	*2*	*3*	*3*

54	56	58	60	**62**	63	65	**67**	69	**71**	73	76	**(78)**	**79**	82	85	**87**	88	91	**94**	96	99	**102**	105
2	*2*	*2*	*2*	*1*	*2*	*2*	*2*	*2*	*2*	*3*	*1*	*1*	*3*	*3*	*2*	*1*	*2*	*3*	*2*	*3*	*3*	*3*	*2*

107	**109**	112	114	**117**	120	123	**125**	127	130	**132**	135	**138**	141	**143**
2	*3*	*2*	*3*	*3*	*3*	*2*	*2*	*3*	*2*	*3*	*3*	*3*	*2*	

Figure 7.9: *Akea*, bars 21-29, the Time-points of the Accented Dyads in the Piano.

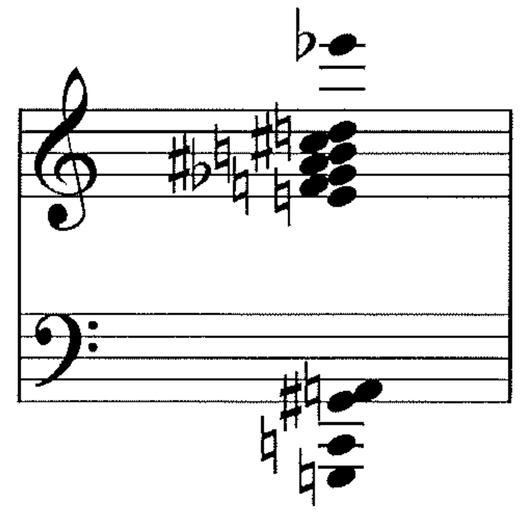


Figure 7.10: ***Akea*****, bar 36, Reiterated Chord.**

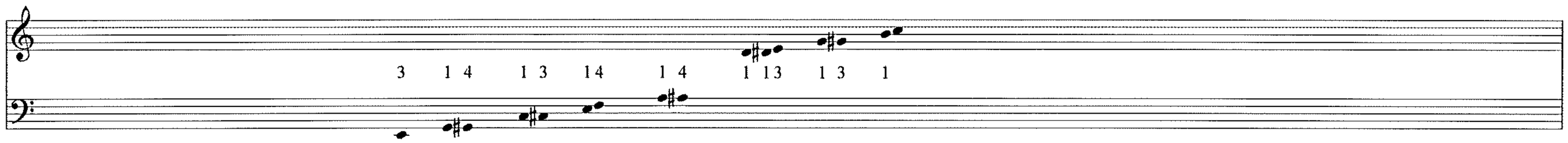


Figure 7.11: ***Akea*****, T_{-12} Segment of the Original Sieve for the Piano Sieve-Clusters in bars 48-50.**

Bars:	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59
Piano:				**S_{-12}**	**S_{-12}**	**C**	**?**	**?**	**?**	**C**	**C**		**C**	**C**	**S**
Strings:	**S**	**S**	**S**	**C_{-12}**	**C_{-12}**	**C_{-12}**	**C_{-12}**	**C_{-12}**	**S**	**S_{-12}**	**C_{-12}**	**S_{-12}**	**S**	**S**	**C**

Figure 7.12: The Sieve and its Octave Transpositions in the Middle Section of ***Akea*****.**

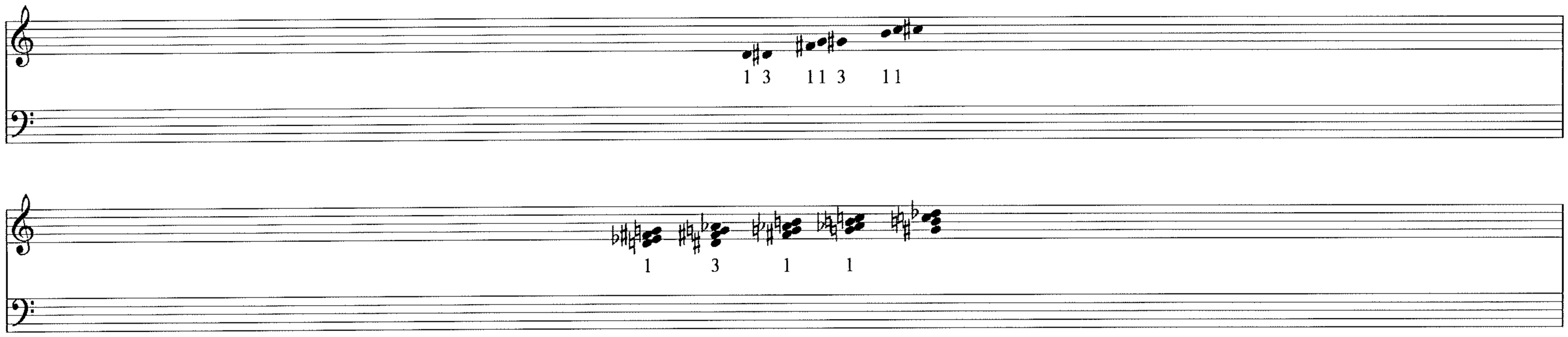


Figure 7.13: Sieve-Clusters from the Complement of the Sieve of *Akea*.

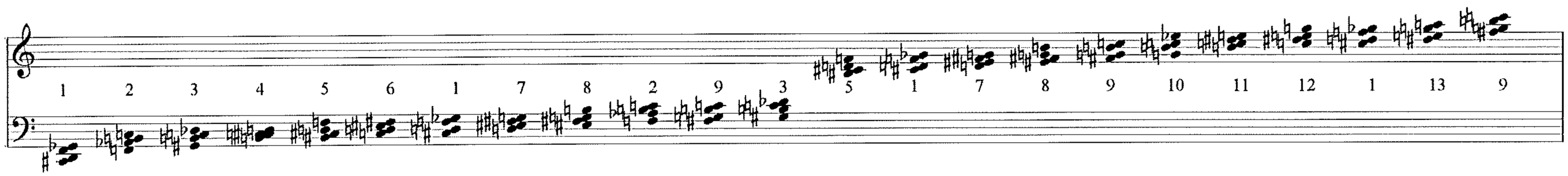


Figure 7.14: *Akea*, Sieve-Clusters of bars 71-78.

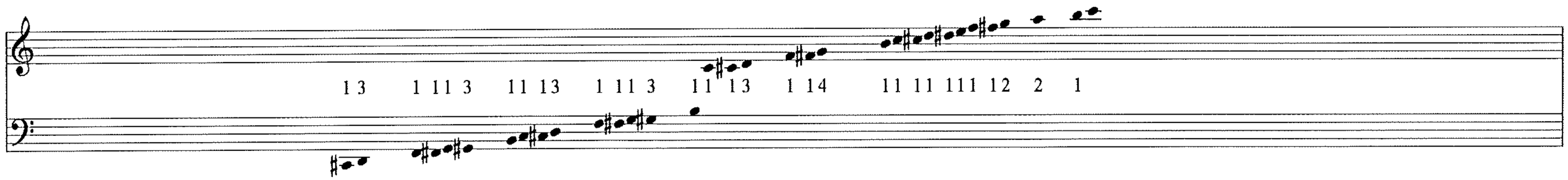


Figure 7.15: *Akea*, Pitch Content of bars 71-78.

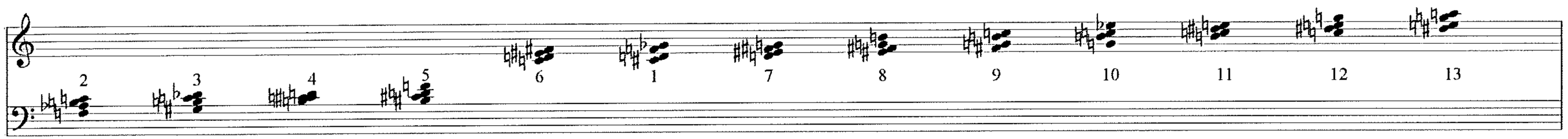


Figure 7.16: ***Akea*****, Sieve-Clusters of bars 71-78, after Octave Reduction.**

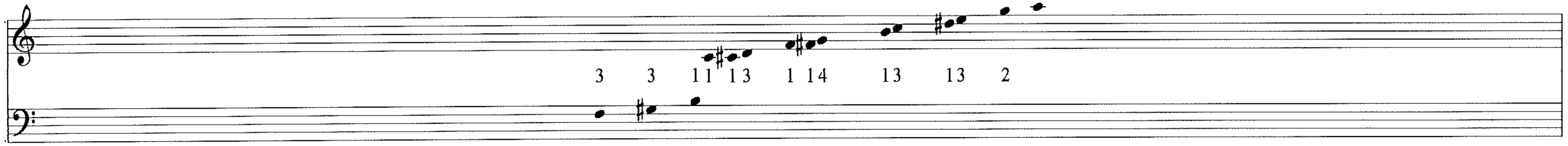


Figure 7.17: ***Akea*****, Pitch Content of the Sieve-Clusters of bars 71-78 (after Octave Reduction).**

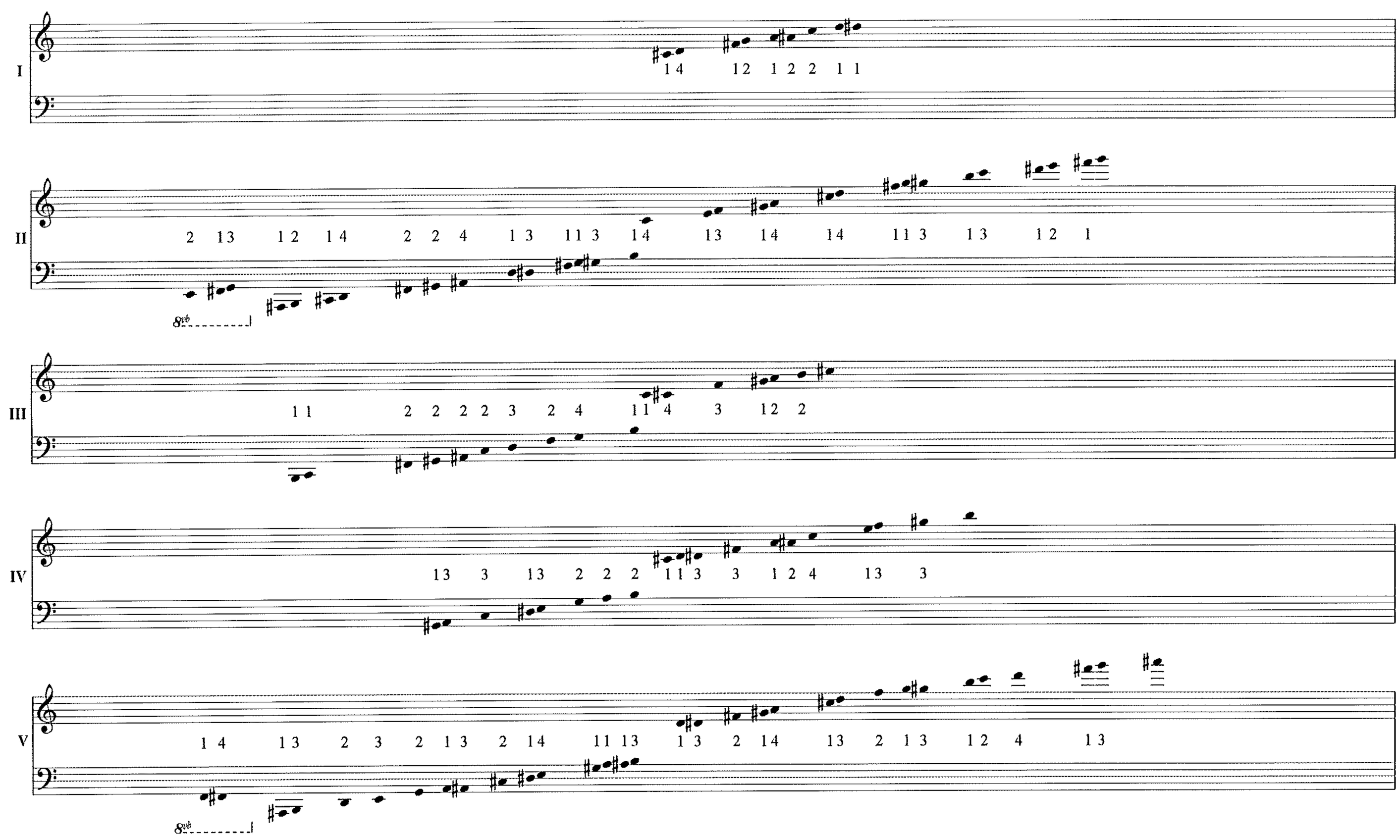


Figure 7.18: The Sieves of *À l'île de Gorée.*

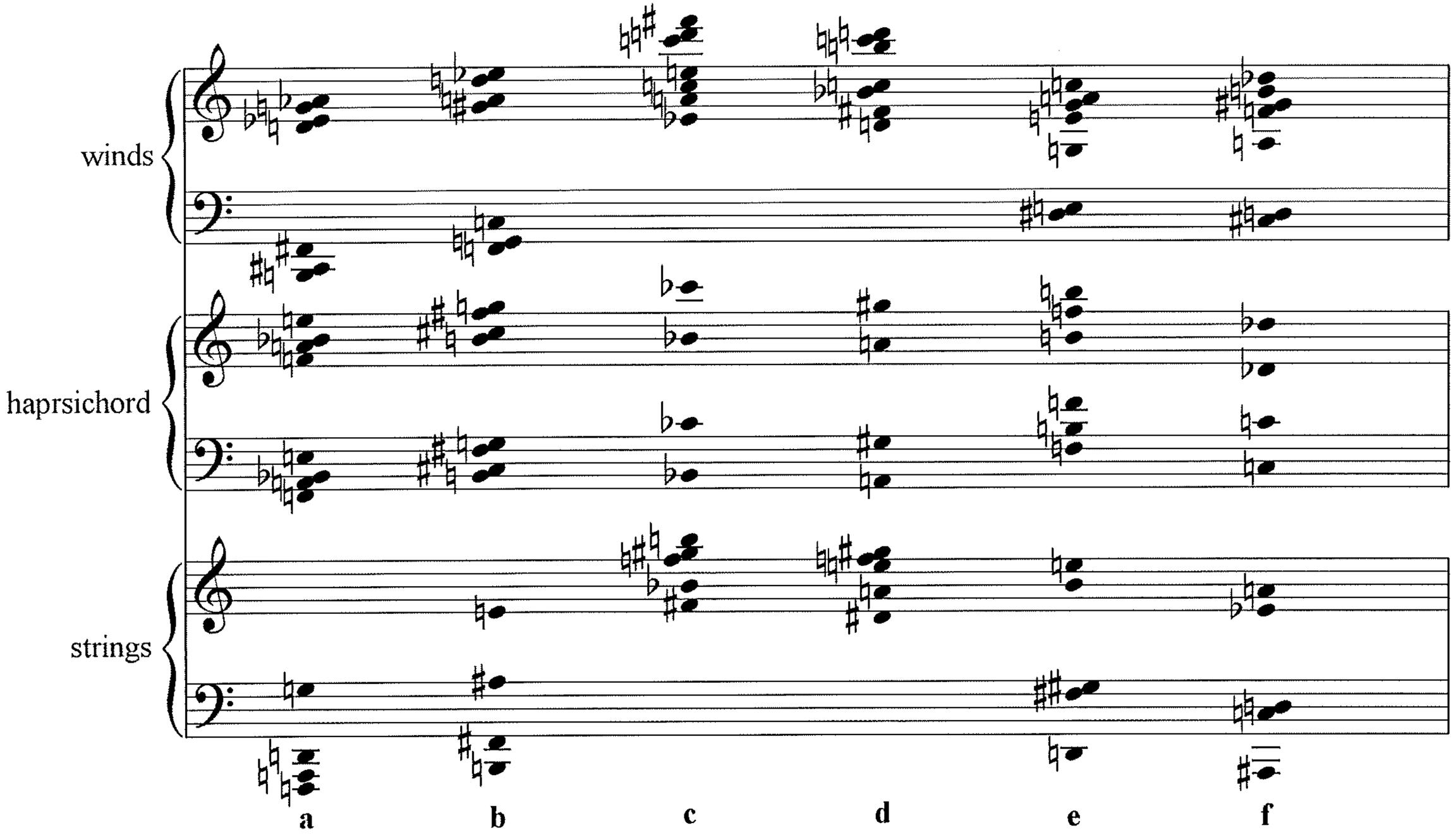
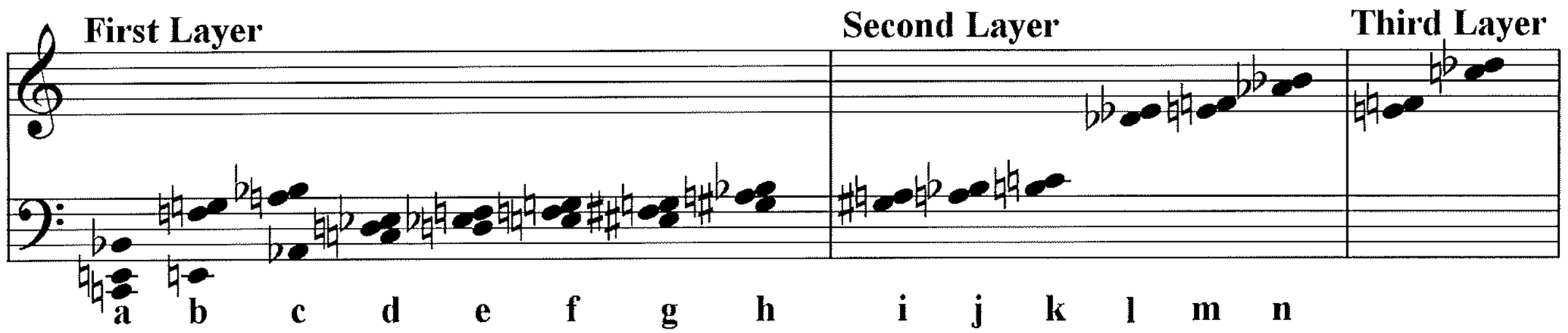


Figure 7.19: ***À l'île de Gorée*****, Chords of the Chord Sequence in bars 30-60.**



Bars	**f**	j	n	**l**	**c**	l	k	**c**	k	k	**b**	k	j	n	j	l	j	**a**	k	k	k	**a**	k	**d**	**d**	k	k	**d**	k	k	**g**	l	m	j	j	**a**	k	k
34-39	*2*	*3*	*3*	*2*	*2*	*2*	*2*	*2*	*2*	*3*	*2*	*3*	*2*	*3*	*2*	*2*	*2*	*3*	*2*	*2*	*2*	*3*	*2*	*2*	*2*	*3*	*2*	*2*	*2*	*3*	*3*	*3*	*3*	*2*	*2*	*3*	*2*	

Bars	k	**d**	k	**a**	**g**	l	j	m	**g**
40-41	*2*	*3*	*2*	*1*	*2*	*3*	*3*	*2*	

Bars	j	k	l	**g**	k	k	**e**	j	**a**	k	k	k	**e**	k	**e**	k	k	k
47-49	*6*	*3*	*2*	*5*	*2*	*2*	*3*	*2*	*3*	*2*	*2*	*2*	*2*	*2*	*3*	*2*	*2*	

Bars	**e**	k	k	k	**e**	k	**a**	k	k	**e**
51-53	*3*	*2*	*2*	*2*	*3*	*2*	*2*	*3*	*2*	

Figure 7.20: *À l'île de Gorée*, bars 34-53, Brass Chord Sequence.

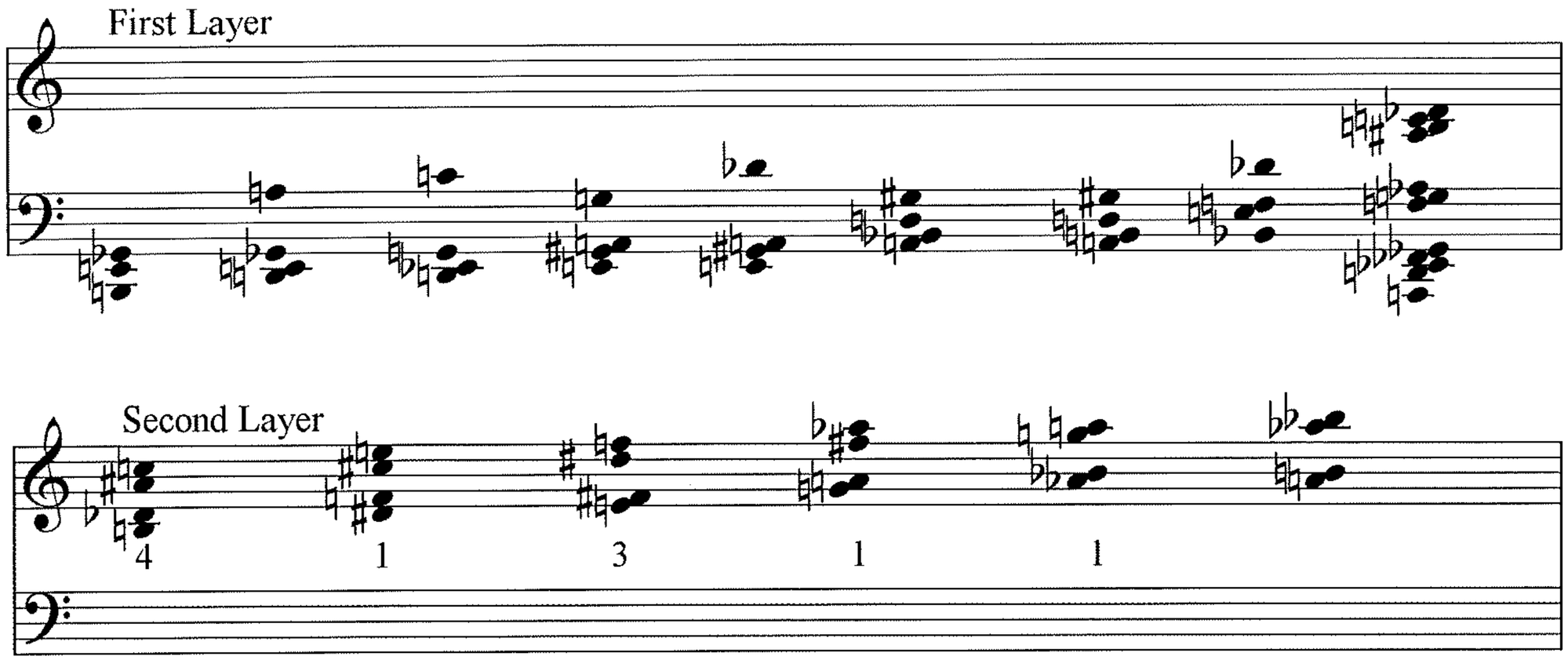


Figure 7.21: ***À l'île de Gorée*****, bars 63-80, The Chords of the First Two Layers in the Chord Sequence.**

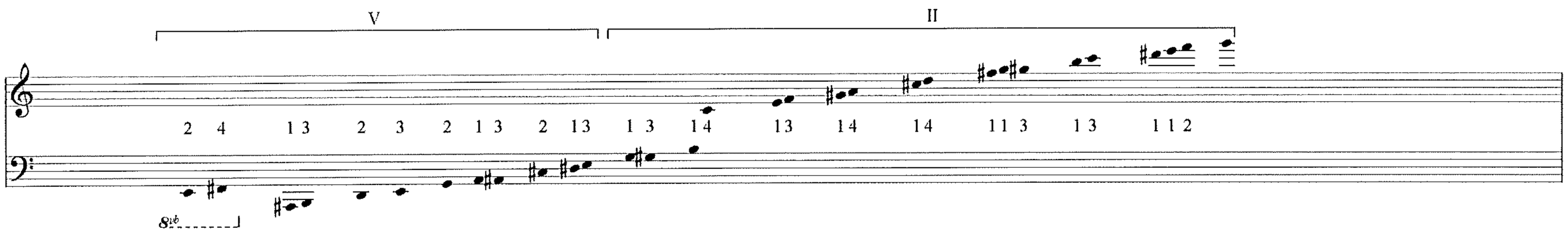


Figure 7.22: ***À l'île de Gorée*****, Sieve of bars 99-101.**

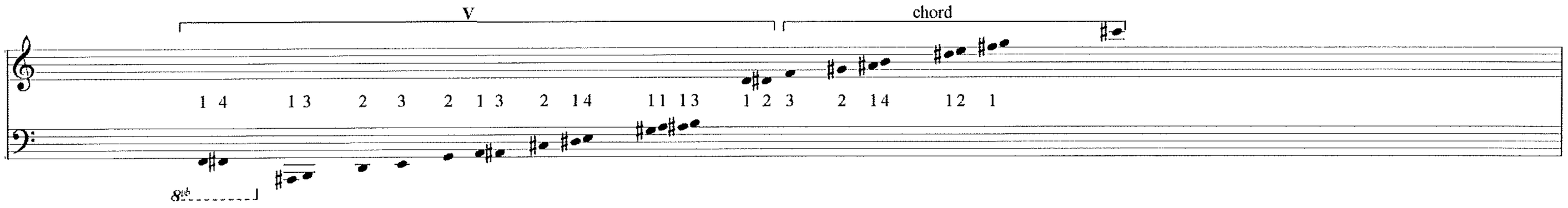


Figure 7.23: ***À l'île de Gorée*****, Harpsichord Sieve of bars 102-116.**

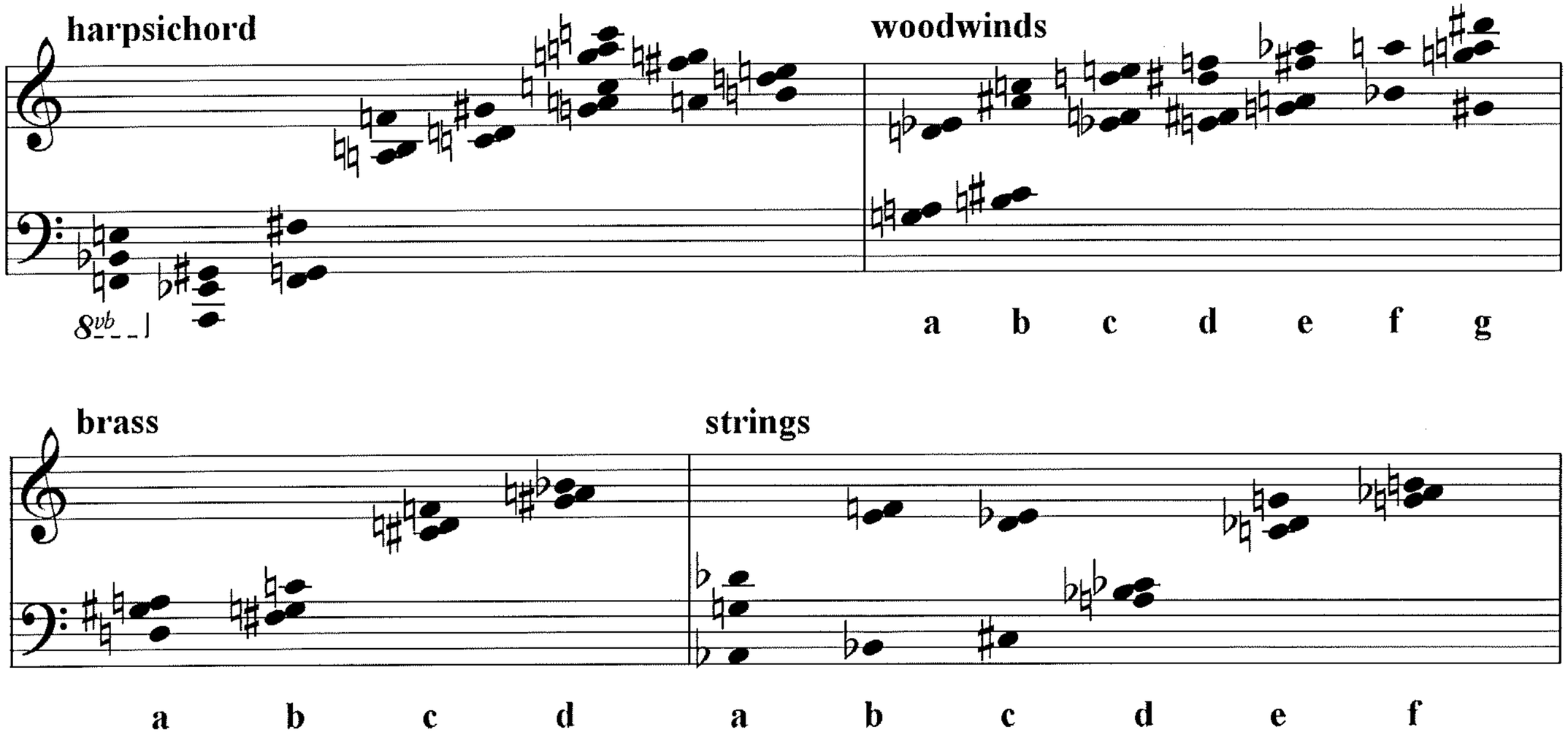


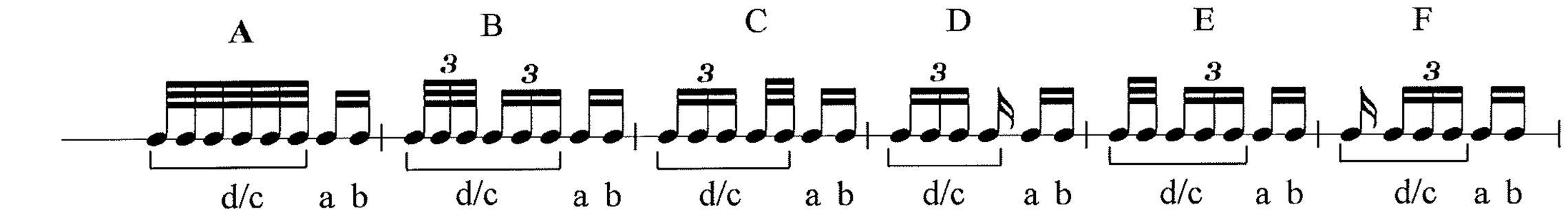
Figure 7.24: ***À l'île de Gorée*****, Chords of the Sequences in bars 127-137.**

Period	Accented Tetrachords					
1st	**a**	**b**	**f**	**e**	**c**	**f**
	3	*2*	*2*	*2*	*3*	
2nd	**a**	**f**	**c**	**e**	**c**	**d**
	2	*3*	*3*	*2*	*2*	
3rd	**a**	**c**	**d**	**f**	**b**	**f**
	2	*2*	*2*	*2*	*3*	*1*
4th	**a**	**c**	**e**	**d**	**f**	**c**
	2	*3*	*2*	*3*	*2*	
5th	**a**	**d**	**e**	**e**	**d**	**f**
	2	*2*	*3*	*3*	*2*	
6th	**a**	**e**	**e**	**f**	**b**	**c**
	2	*2*	*3*	*2*	*3*	
7th	**a**	**b**	**b**	**e**	**c**	**c**
	3	*2*	*3*	*2*	*2*	
8th	**a**	**c**	**e**	**d**	**f**	**c**
	2	*3*	*2*	*3*	*2*	
9th	**a**	**b**	**f**	**e**	**c**	**b**
	2	*3*	*2*	*2*	*3*	
10th	**a**	**e**	**e**	**f**	**b**	**c**
	2	*2*	*3*	*2*	*3*	
11th	**a**	**f**	**c**	**e**	**c**	**b**
	2	*3*	*3*	*2*	*2*	
12th	**a**	**b**	**b**	**e**	**c**	**c**
	3	*2*	*3*	*2*	*2*	

Figure 7.25: *À l'île de Gorée*, bars 127-137, The Accented Tetrachords in the Woodwinds' Chord Sequence.

Period	Trichords						
1st	**d**	**d**	**e**	**c**	**e**	**d**	**b**
	1	*2*	*3*	*3*	*2*	*2*	*2*
2nd	**b**	**b**	**f**	**e**	**f**	**f**	**a**
	1	*3*	*2*	*2*	*3*	*2*	*2*
3rd	**f**	**f**	**e**	**d**	**b**	**c**	**b**
	1	*3*	*2*	*3*	*2*	*2*	*2*
4th	**e**	**d**	**a**	**f**	**d**	**?**	**e**
	1	*3*	*2*	*2*	*2*	*3*	*2*
5th	**f**	**f**	**?**	**c**	**a**	**b**	**f**
	1	*2*	*2*	*3*	*2*	*3*	*2*
6th	**d**	**d**	**f**	**f**	**f**	**f**	**a**
	1	*2*	*3*	*3*	*3*	*2*	*1*
7th	**c**	**c**	**f**	**d**	**f**	**d**	**c**
	1	*2*	*2*	*3*	*2*	*3*	*2*
8th	**d**	**d**	**b**	**a**	**a**	**d**	**f**
	1	*3*	*3*	*2*	*3*	*2*	*1*
9th	**c**	**c**	**f**	**d**	**f**	**d**	**c**
	1	*2*	*2*	*3*	*2*	*3*	*2*
10th	**a**	**a**	**c**	**b**	**a**	**d**	**c**
	1	*3*	*2*	*2*	*2*	*3*	*2*
11th	**d**	**d**	**c**	**d**	**b**	**a**	**d**
	1	*3*	*3*	*2*	*3*	*2*	*1*
12th	**f**	**f**	**f**				
	1	*1*					

Figure 7.26: *À l'île de Gorée*, bars 127-137, The Trichords in the Strings' Chord Sequence.



Bar:	*127*			*128*				*129*				*130*				*131*				*132*				
Rhythmic Cell:	**A**	**B**	**B**	**A**	**C**	**A**	**C**	**A**	**D**	**B**	**C**	**B**	**A**	**C**	**A**	**A**	**D**	**B**	**C**	**E**	**F**	**A**	**E**	**C**
Bar:	*133*			*134*				*135*				*136*				*137*								
Rhythmic Cell:	**F**	**D**	**C**	**A**	**A**	**C**	**B**	**B**	**C**	**A**	**A**	**C**	**B**	**B**	**A**	**B**	**B**	**F**						

Figure 7.27: *À l'île de Gorée*, bars 127-137, The Trichords in the Brass' Chord Sequence.

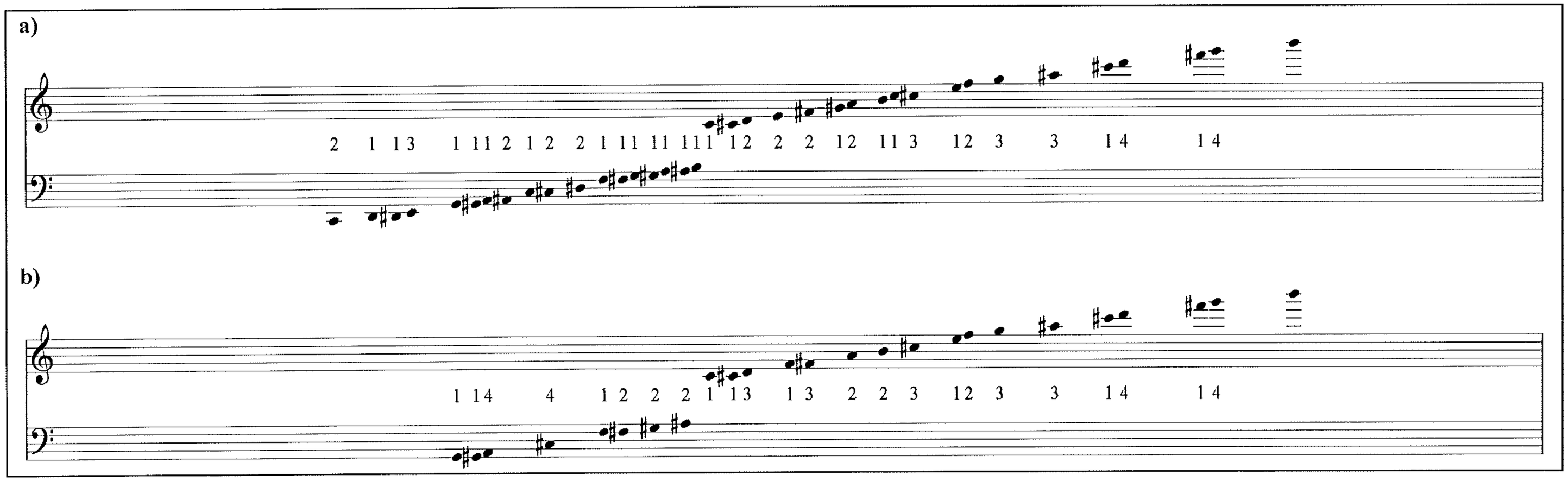


Figure 7.28: *Tetora*, pitch content and sieve of bars 27-30.

a) Chord Sequences and Transpositions:

Bars 21-24	**B**	**F**	**X**	**E**	**B**	**X**	**F**	**C**	**G**	**X**	**C**	**E**	**X**	**F**	**C**	**E**	**X**	**B**	**E**	**X**	**C**	**G**	**C**	**F**	**G**	**X**	**E**	**G**	**X**	**C**	**G**
(T_0)	*3*	*1*	*1*	*3*	*1*	*1*	*2*	*3*	*1*	*2*	*1*	*1*	*3*	*2*	*2*	*2*	*1*	*1*	*1*	*1*	*2*	*3*	*2*	*2*	*2*	*2*	*1*	*1*	*1*	*2*	
Bars 40-42	**F**	**C**	**ς**	**F**	**C**	**ς**	**E**	**F**	**C**	**ς**	**C**	**A**	**ς**	**E**	**E**	**F**	**ς**	**C**	**F**	**ς**	**E**	**F**	**E**	**F**	**C**	**ς**	**ε**				
(T_0)	*3*	*1*	*1*	*3*	*1*	*1*	*2*	*3*	*1*	*2*	*1*	*1*	*3*	*2*	*2*	*2*	*1*	*1*	*1*	*1*	*2*	*3*	*2*	*2*	*2*	*2*					
Bars 48-50	**ς**	**δ**	**ς**	**ς**	**δ**	**ς**	**ε**	**ς**	**δ**	**ε**	**δ**	**γ**	**ε**	**ε**	**ε**	**ς**	**ς**	**δ**	**ς**	**ε**	**ε**	**ς**	**ε**	**ς**	**δ**	**ς**					
(T_0)	*3*	*1*	*1*	*3*	*1*	*1*	*2*	*3*	*1*	*2*	*1*	*1*	*3*	*2*	*2*	*2*	*1*	*1*	*1*	*1*	*2*	*3*	*2*	*2*	*2*	*2*					

b) Chord Sequences and Substitutions:

40-42 → 48-50
F → ς
C → δ
E → ε
A → γ

Figure 7.29: ***Tetora*****, bars 21-24, 40-42, and 48-50, Chord Sequences.**

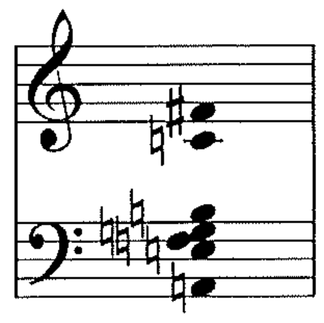


Figure 7.30: ***Tetora*****, bars 21-24, Low Heptachord (X).**

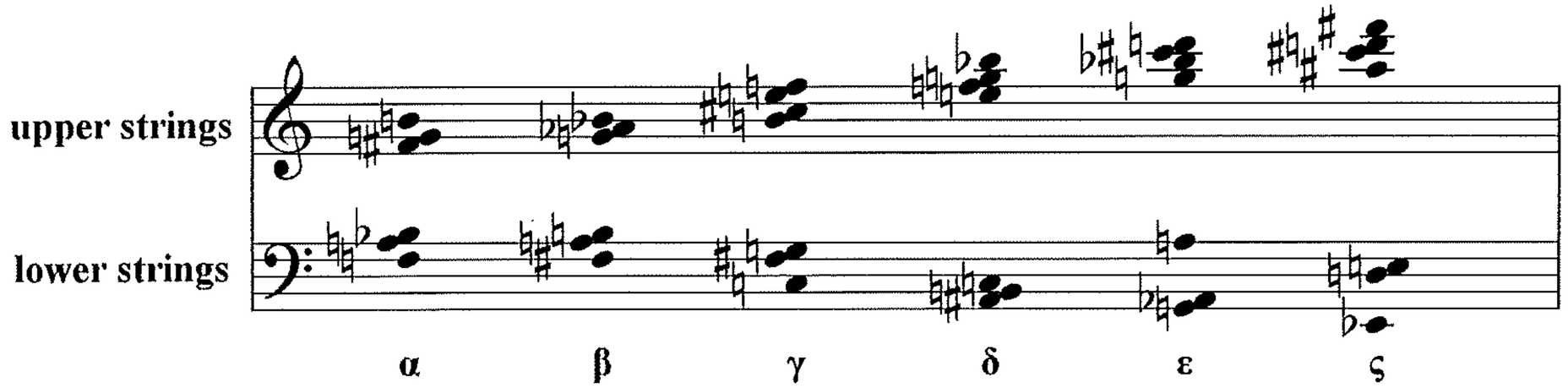


Figure 7.31: ***Tetora*****, Chords of bars 21-85.**

a) Chord Sequences and Transpositions:

Bars 59-62	ε	γ	ε	ε	γ	δ	δ	ε	γ		ς	γ	β	ε	δ	δ	ε	δ	γ	ε	ε	δ	ε	δ	ε	γ	ς		
(T_{-2})	*1*	*2*	*2*	*1*	*2*	*2*	*3*	*1*	*2*		*3*	*2*	*2*	*1*	*3*	*3*	*3*	*2*	*2*	*2*	*2*	*3*	*1*	*3*	*3*	*3*			
Bars 62-65	δ	ς	δ	δ	ς	ς	β	δ	ς		δ	ς	ε	ε	β	β	δ	ε	ς	δ	δ	β	δ	β	δ	ς	ς		
(T_{+3})	*2*	*3*	*3*	*2*	*3*	*3*	*1*	*2*	*3*		*1*	*3*	*3*	*2*	*1*	*1*	*1*	*3*	*3*	*3*	*3*	*1*	*2*	*1*	*1*	*1*			
Bars 65-68	α	ε	ς	α	ε	ε	γ	α	ε		δ	ε	ς	ς	γ	γ	α	ε	ε	α	ς	γ	α	γ	α	ε	δ		
(T_{-1})	*2*	*2*	*2*	*2*	*2*	*2*	*1*	*2*	*2*		*1*	*2*	*2*	*2*	*1*	*1*	*1*	*2*	*2*	*2*	*2*	*1*	*2*	*1*	*1*	*1*			
Bars 69-71	γ	β	ς	γ	β	ς	α	γ	β		ς	β	δ	ς	α	α	γ	ς	β	γ	ς	α	γ	α	γ	β	ς		
(T_{+1})	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*		*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*		
Bars 71-73	β	α	ε	β	α	ς	ς	β	α		ς	α	ε	ε	ς	ς	β	ς	α	β	ε	ς	β	ς	β	α	ε		
(T_{-3})	*2*	*1*	*2*	*1*	*2*	*1*	*2*	*1*	*2*		*1*	*2*	*1*	*2*	*1*	*2*	*1*	*2*	*1*	*2*	*2*	*2*	*1*	*2*	*1*	*2*			
Bars 73-74																	α	ε	ς	α	ς	β	α	β	α	ς	ς		
(T_{+2})																	1	2	1	2	1	3	1	2	1	2			
Bars 74-76	γ	γ	ε	γ	γ	ς	γ	γ	γ		δ	γ	γ	ε	γ	γ	γ	ς	γ	γ	δ	γ	γ	γ	γ	γ	ε		
(T_{+2})	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*		*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*		
Bars 83-85	α	ς	ς	α	ς	δ	β	α	ς	(α)	ε	ς	δ	ς	β	β	α	ε	ς	α	ς	β	α	β	α	ς	ς		
(T_{+4})	*3*	*1*	*2*	*1*	*3*	*1*	*2*	*1*	*2*	*1*	*1*	*2*	*1*	*2*	*1*	*3*	*1*	*2*	*1*	*2*	*1*	*3*	*1*	*2*	*1*	*2*			
Bars 83-85	[ς	ς	α	β	α	β	ς	α	ς	ε][1]	α	β	β	ς	δ	ς	ε	α	ς	α	β	δ	ς	α	ς	ς	α		
(T_{+4})	*[2*	*1*	*2*	*1*	*3*	*1*	*2*	*1*	*2*	*1]*	*3*	*1*	*2*	*1*	*2*	*1*	*1*	*2*	*1*	*2*	*1*	*3*	*1*	*2*	*1*	*3*			

b) Chord Sequences and Substitutions:

59-62		**62-5**		**65-8**		**69-71**		**71-3**		**73-4 (83-5)**		**74-6**
ε	→	δ	→	α	→	γ	→	β	→	α	→	γ
γ	→	ς	→	ε	→	β	→	α	→	ς	→	γ
δ	→	β	→	γ	→	α	→	ς	→	β	→	γ
β	→	ε	→	ς	→	δ	→	ε	→	δ	→	γ
1	→	2	—	2	→	1	—	1	—	1	—	1
2	→	3	→	2	→	1	→	2	→	3	→	1
3	→	1	—	1	—	1	—	1	→	2[2]	→	1

Figure 7.32: *Tetora*, bars 59-68, 69-76, and 83-85, Chord Sequences.

[1] Retrograde of bars 73-4.
[2] With an exception at the correspondence of the last chord of bar 72 with the second from the end of bar 83 (1 semiquaver instead of 2 or 3).

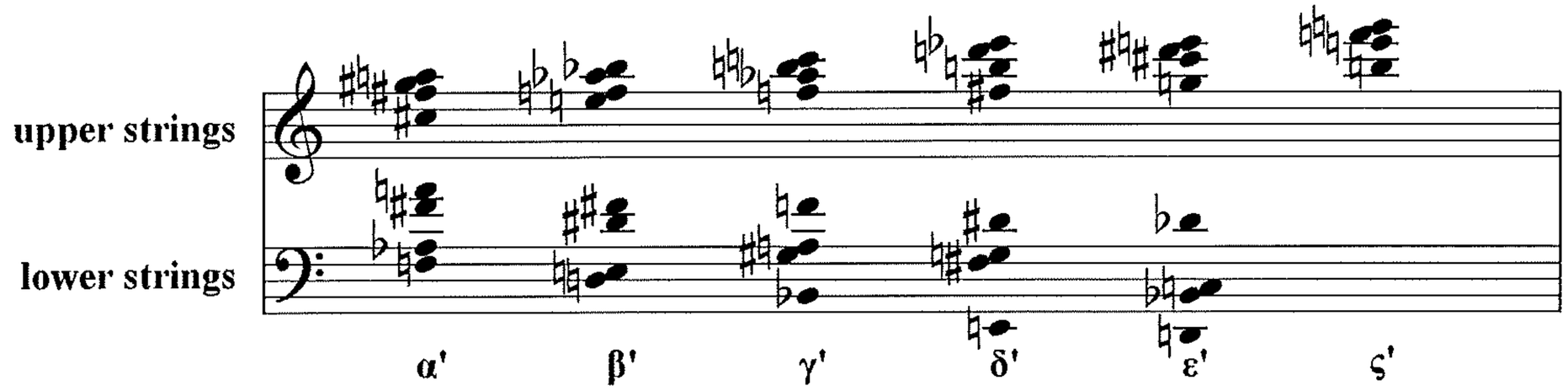


Figure 7.33: *Tetora*, chords of bars 115-137.

a) Chord Sequences and Transpositions:

Bars 115-116	**δ'**	**ε'**	**ε'**	**δ'**	**ε'**	**ε'**	**ς'**	**δ'**	**ε'**	**ε'**	**ε'**	**γ'**	**ε'**	**ς'**	**ς'**	**δ'**	**ε'**	**ε'**	**δ'**	**ε'**	**δ'**	**ς'**	**δ'**	**ε'**	**ε'**
(T_0)	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	
Bars 116-119	**ς'**	**β'**	**ε'**	**ς'**	**β'**	**δ'**	**δ'**	**ς'**	**β'**	**γ'**	**β'**	**α'**	**ε'**	**δ'**	**δ'**	**ς'**	**δ'**	**β'**	**ς'**	**ε'**	**δ'**	**ς'**	**δ'**	**ς'**	**β'**	**γ'**
(T_{+1})	*2*	*2*	*2*	*2*	*2*	*2*	*1*	*2*	*2*	*1*	*2*	*2*	*2*	*1*	*1*	*1*	*2*	*2*	*2*	*2*	*1*	*2*	*1*	*1*	*1*	
Bars 119-122	**γ'**	**α'**	**γ'**	**γ'**	**α'**	**ε'**	**ε'**	**γ'**	**α'**	**γ'**	**α'**	**β'**	**δ'**	**ε'**	**ε'**	**γ'**	**δ'**	**α'**	**γ'**	**γ'**	**(ε')**	**(γ')**		**(ε')**	**(γ')**	**(α')**
(T_{-1})	*2*	*3*	*3*	*3*	*3*	*3*	*1*	*2*	*3*	*1*	*3*	*3*	*2*	*1*	*1*	*1*	*3*	*3*	*3*							
Bars 122-125[3]	**α'**	**γ'**	**ε'**	**α'**	**γ'**	**ε'**	**β'**	**α'**	**γ'**	**δ'**	**γ'**	**δ'**	**δ'**	**β'**	**β'**	**α'**	**ε'**	**γ'**	**α'**	**δ'**		**α'**	**(δ')**	**β'**	**α'**	**γ'**	**ε'**
(T_{+3})	*3*	*1*	*1*	*3*	*1*	*1*	*2*	*3*	*1*	*2*	*1*	*1*	*3*	*2*	*2*	*2*	*1*	*1*	*1*	*2*		*1*	*(2)*	*1*	*2*	*2*	
Bars 125-128	**β'**	**δ'**	**δ'**	**β'**	**δ'**	**γ'**	**γ'**	**β'**	**δ'**	**ε'**	**δ'**	**ε'**	**δ'**	**γ'**	**γ'**	**β'**	**γ'**	**δ'**	**β'**	**δ'**	**(γ')**	**β'**		**γ'**	**β'**	**δ'**	**ε'**
(T_{-2})	*1*	*2*	*2*	*1*	*2*	*2*	*3*	*1*	*2*	*3*	*2*	*2*	*1*	*3*	*3*	*3*	*2*	*2*	*2*	*2*	*(3)*	*1*		*3*	*3*	*3*	

b) Chord Sequences and Substitutions:

115-116		**116-119**		**119-122**		**122-125**		**125-128**[4]
δ'	→	**ς'**	→	**γ'**	→	**α'**	→	**β'**
ε'	→	**β'**	→	**α'**	→	**γ'**	→	**δ'**
ς'	→	**δ'**	→	**ε'**	→	**β'**	→	**γ'**
γ'	→	**α'**	→	**β'**	→	**δ'**	→	**ε'**
1	→	2	—	2	→	3	→	1
1	→	2	→	3	→	1[5]	→	2
1	—	1	—	1	→	2	→	3

Figure 7.34: *Tetora*, bars 115-128, Chord Sequences.

[3] With one exception: in chord **α'** C6 has been substituted for D#6, where C4 is middle C.
[4] With some exception after the interruption of the normal evolution of the sequences (See the last six columns of part [a] of the table).
[5] With an exception at the correspondence of the last chord of bar 119 with the fourth of bar 122 (3 semiquavers instead of 2).

Bars 128-131:	ς'	γ'	α'	δ'	β'	β'	ς'	δ'	γ'	ε'	β'	α'	γ'	γ'	γ'	ε'	β'	ς'	β'	α'	ε'	γ'	δ'	ς'				
(T_0)	ε'	β'	γ'	β'	β'	α'	γ'	ε'	β'	γ'	β'	γ'	ε'	α'	β'	β'	ε'	ε'	ε'	δ'	β'	β'	ε'	γ'				
	3	*1*	*1*	*3*	*1*	*1*	*2*	*3*	*1*	*2*	*1*	*1*	*3*	*2*	*2*	*2*	*2*	*1*	*1*	*2*	*3*	*3*	*2*	*2*				
Bars 131-134:	ς'	α'	δ'	α'	γ'	γ'	ς'	δ'	ε'	γ'	γ'	ς'	β'	β'	ε'	δ'	ς'	ς'	β'	β'	ε'	α'	ς'	γ'	α'	β'	δ'	α'
(T_0)	β'	δ'	β'	γ'	α'	β'	β'	ε'	γ'	β'	α'	ε'	α'	β'	γ'	ε'	β'	γ'	α'	ε'	β'	δ'	β'	ε'	γ'	β'	β'	δ'
	3	*1*	*1*	*3*	*1*	*1*	*2*	*3*	*1*	*2*	*1*	*1*	*3*	*2*	*2*	*2*	*1*	*1*	*1*	*1*	*1*	*2*	*2*	*2*	*2*	*3*	*1*	*1*
Bars 134-137:	β'	ς'	α'	ε'	δ'	δ'	ε'	ς'	α'	ε'	ε'	γ'	β'	γ'	α'	β'	ε'	γ'	β'	α'	ε'	δ'	α'	ς'	β'	α'	ε'	
(T_0)	ε'	ε'	ε'	δ'	β'	ε'	δ'	γ'	γ'	δ'	β'	β'	ε'	ε'	ε'	ε'	γ'	β'	ε'	γ'	ε'	ε'	γ'	δ'	ε'	γ'	γ'	
	1	*2*	*2*	*2*	*3*	*2*	*1*	*1*	*1*	*1*	*1*	*2*	*2*	*2*	*3*	*1*	*1*	*2*	*1*	*3*	*2*	*1*	*1*	*3*	*1*	*1*	*3*	
Bars 134-137:	ε'	α'	β'	ς'	α'	δ'	ε'	α'	β'	γ'	ε'	β'	α'	γ'	β'	γ'	ε'	ε'	α'	ς'	ε'	δ'	δ'	ε'	α'	ς'	β'	
(T_0)	γ'	γ'	ε'	δ'	γ'	ε'	ε'	γ'	ε'	β'	γ'	ε'	ε'	ε'	ε'	ε'	β'	β'	δ'	γ'	γ'	δ'	ε'	β'	δ'	ε'	ε'	ε'
	3	*1*	*1*	*3*	*1*	*1*	*2*	*3*	*1*	*2*	*1*	*1*	*3*	*2*	*2*	*2*	*1*	*1*	*1*	*1*	*1*	*2*	*3*	*2*	*2*	*2*	*1*	

Figure 7.35: *Tetora*, bars 128-138, Chord Sequences.

transposition:	T_0	T_0	T_0	T_{-2}	T_{+3}	T_{-1}	T_{+1}	T_{-3}	T_{+2}	T_{+2}	T_{+4}	T_0	T_{+1}	T_{-1}	T_{+3}	T_{-2}	T_0	T_0	T_0
bars:	**21**	**40**	**48**	**59**	**62**	**65**	**69**	**71**	**73**	**74**	**83**	**115**	**116**	**119**	**122**	**125**	**128**	**131**	**134**
position:	**1st**	**1st**	**1st**	**2nd**	**3rd**									**3rd**	**1st**	**2nd**	**1st**	**1st**	**1st**
	3	3	3	1	2	2	1	1	1	1	1	1	2	2	3	1	3	3	3
	1	1	1	2	3	2	1	2	3	1	3	1	2	3	1	2	1	1	1
	2	2	2	3	1	1	1	1	2	1	2	1	1	1	2	3	2	2	2

Figure 7.36: Rotations of the Triangle in *Tetora*.

APPENDIX 1

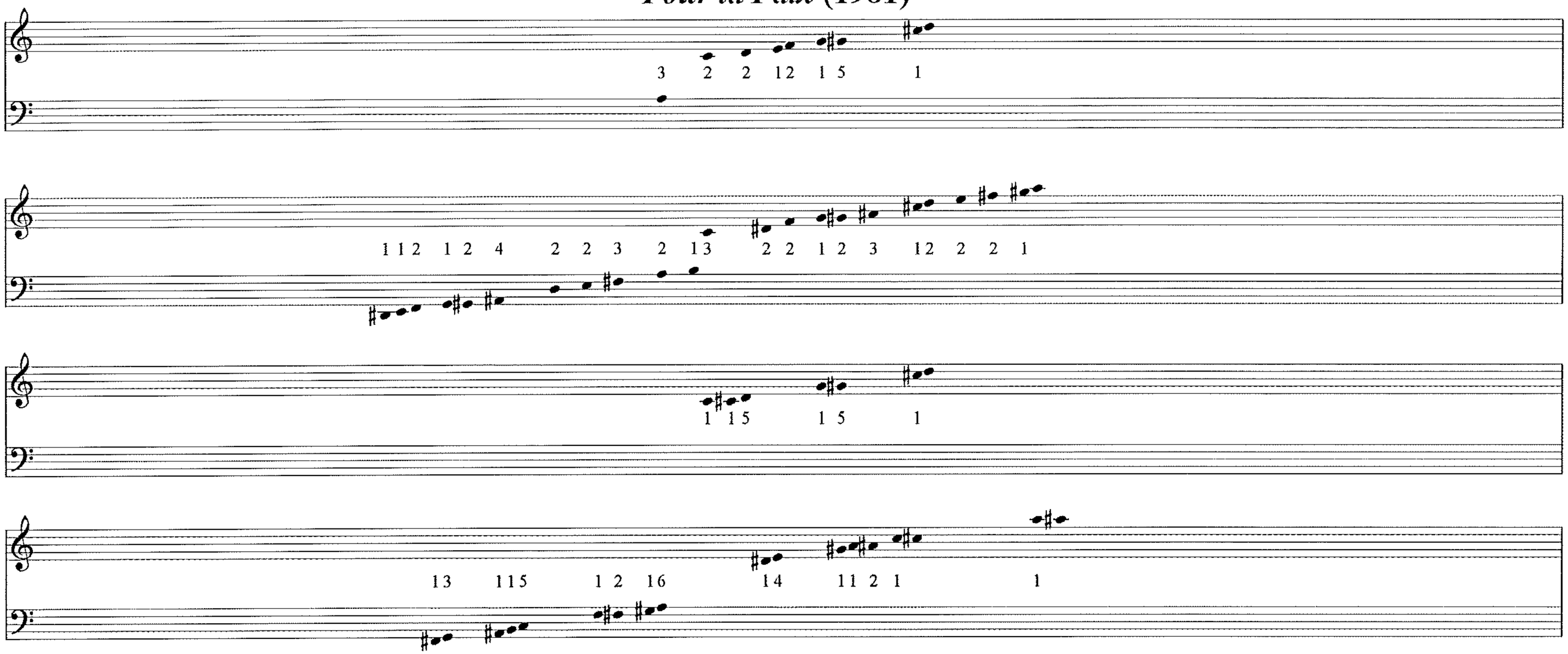
Prime Factorisation of the first 200 Integers, with Primes and Prime Powers shown in bold:

$1 = 1$	$21 = 3 \cdot 7$	$\mathbf{41 = 41}$	$\mathbf{61 = 61}$	$\mathbf{81 = 3^4}$	$\mathbf{101 = 101}$	$\mathbf{121 = 11^2}$	$141 = 3 \cdot 47$	$161 = 7 \cdot 23$	$\mathbf{181 = 181}$
$\mathbf{2 = 2}$	$22 = 2 \cdot 11$	$42 = 2 \cdot 3 \cdot 7$	$62 = 2 \cdot 31$	$82 = 2 \cdot 41$	$102 = 2 \cdot 3 \cdot 17$	$122 = 2 \cdot 61$	$142 = 2 \cdot 71$	$162 = 2 \cdot 3^4$	$182 = 2 \cdot 7 \cdot 13$
$\mathbf{3 = 3}$	$\mathbf{23 = 23}$	$\mathbf{43 = 43}$	$63 = 3^2 \cdot 7$	$\mathbf{83 = 83}$	$\mathbf{103 = 103}$	$123 = 3 \cdot 41$	$143 = 11 \cdot 13$	$\mathbf{163 = 163}$	$183 = 3 \cdot 61$
$4 = 2^2$	$24 = 2^3 \cdot 3$	$44 = 2^2 \cdot 11$	$\mathbf{64 = 2^6}$	$84 = 2^2 \cdot 3 \cdot 7$	$104 = 2^3 \cdot 13$	$124 = 2^2 \cdot 31$	$144 = 2^4 \cdot 3^2$	$164 = 2^2 \cdot 41$	$184 = 2^3 \cdot 23$
$\mathbf{5 = 5}$	$\mathbf{25 = 5^2}$	$45 = 3^2 \cdot 5$	$65 = 5 \cdot 13$	$85 = 5 \cdot 17$	$105 = 3 \cdot 5 \cdot 7$	$\mathbf{125 = 5^3}$	$145 = 5 \cdot 29$	$165 = 3 \cdot 5 \cdot 11$	$185 = 5 \cdot 37$
$6 = 2 \cdot 3$	$26 = 2 \cdot 13$	$46 = 2 \cdot 23$	$66 = 2 \cdot 3 \cdot 11$	$86 = 2 \cdot 43$	$106 = 2 \cdot 53$	$126 = 2 \cdot 3^2 \cdot 7$	$146 = 2 \cdot 73$	$166 = 2 \cdot 83$	$186 = 2 \cdot 3 \cdot 31$
$\mathbf{7 = 7}$	$\mathbf{27 = 3^3}$	$\mathbf{47 = 47}$	$\mathbf{67 = 67}$	$87 = 3 \cdot 29$	$\mathbf{107 = 107}$	$\mathbf{127 = 127}$	$147 = 3 \cdot 7^2$	$\mathbf{167 = 167}$	$187 = 11 \cdot 17$
$\mathbf{8 = 2^3}$	$28 = 2^2 \cdot 7$	$48 = 2^4 \cdot 3$	$68 = 2^2 \cdot 17$	$88 = 2^3 \cdot 11$	$108 = 2^2 \cdot 3^3$	$\mathbf{128 = 2^7}$	$148 = 2^2 \cdot 37$	$168 = 2^3 \cdot 3 \cdot 7$	$188 = 2^2 \cdot 47$
$\mathbf{9 = 3^2}$	$\mathbf{29 = 29}$	$\mathbf{49 = 7^2}$	$69 = 3 \cdot 23$	$\mathbf{89 = 89}$	$\mathbf{109 = 109}$	$129 = 3 \cdot 43$	$\mathbf{149 = 149}$	$\mathbf{169 = 13^2}$	$189 = 3^3 \cdot 7$
$10 = 2 \cdot 5$	$30 = 2 \cdot 3 \cdot 5$	$50 = 2 \cdot 5^2$	$70 = 2 \cdot 5 \cdot 7$	$90 = 2 \cdot 3^2 \cdot 5$	$110 = 2 \cdot 5 \cdot 11$	$130 = 2 \cdot 5 \cdot 13$	$150 = 2 \cdot 3 \cdot 5^2$	$170 = 2 \cdot 5 \cdot 17$	$190 = 2 \cdot 5 \cdot 19$
$\mathbf{11 = 11}$	$\mathbf{31 = 31}$	$51 = 3 \cdot 17$	$\mathbf{71 = 71}$	$91 = 7 \cdot 13$	$111 = 3 \cdot 37$	$\mathbf{131 = 131}$	$\mathbf{151 = 151}$	$171 = 3^2 \cdot 19$	$\mathbf{191 = 191}$
$12 = 2^2 \cdot 3$	$\mathbf{32 = 2^5}$	$52 = 2^2 \cdot 13$	$72 = 2^3 \cdot 3^2$	$92 = 2^2 \cdot 23$	$112 = 2^4 \cdot 7$	$132 = 2^2 \cdot 3 \cdot 11$	$152 = 2^3 \cdot 19$	$172 = 2^2 \cdot 43$	$192 = 2^6 \cdot 3$
$\mathbf{13 = 13}$	$33 = 3 \cdot 11$	$\mathbf{53 = 53}$	$\mathbf{73 = 73}$	$93 = 3 \cdot 31$	$\mathbf{113 = 113}$	$133 = 7 \cdot 19$	$153 = 3^2 \cdot 17$	$\mathbf{173 = 173}$	$\mathbf{193 = 193}$
$14 = 2 \cdot 7$	$34 = 2 \cdot 17$	$54 = 2 \cdot 3^3$	$74 = 2 \cdot 37$	$94 = 2 \cdot 47$	$114 = 2 \cdot 3 \cdot 19$	$134 = 2 \cdot 67$	$154 = 2 \cdot 7 \cdot 11$	$174 = 2 \cdot 3 \cdot 29$	$194 = 2 \cdot 97$
$15 = 3 \cdot 5$	$35 = 5 \cdot 7$	$55 = 5 \cdot 11$	$75 = 3 \cdot 5^2$	$95 = 5 \cdot 19$	$115 = 5 \cdot 23$	$135 = 3^3 \cdot 5$	$155 = 5 \cdot 31$	$175 = 5^2 \cdot 7$	$195 = 3 \cdot 5 \cdot 13$
$\mathbf{16 = 2^4}$	$36 = 2^2 \cdot 3^2$	$56 = 2^3 \cdot 7$	$76 = 2^2 \cdot 19$	$96 = 2^5 \cdot 3$	$116 = 2^2 \cdot 29$	$136 = 2^3 \cdot 17$	$156 = 2^2 \cdot 3 \cdot 13$	$176 = 2^4 \cdot 11$	$196 = 2^2 \cdot 7^2$
$\mathbf{17 = 17}$	$\mathbf{37 = 37}$	$57 = 3 \cdot 19$	$77 = 7 \cdot 11$	$\mathbf{97 = 97}$	$117 = 3^2 \cdot 13$	$\mathbf{137 = 137}$	$\mathbf{157 = 157}$	$177 = 3 \cdot 59$	$\mathbf{197 = 197}$
$18 = 2 \cdot 3^2$	$38 = 2 \cdot 19$	$58 = 2 \cdot 29$	$78 = 2 \cdot 3 \cdot 13$	$98 = 2 \cdot 7^2$	$118 = 2 \cdot 59$	$138 = 2 \cdot 3 \cdot 23$	$158 = 2 \cdot 79$	$178 = 2 \cdot 89$	$198 = 2 \cdot 3^2 \cdot 11$
$\mathbf{19 = 19}$	$39 = 3 \cdot 13$	$\mathbf{59 = 59}$	$\mathbf{79 = 79}$	$99 = 3^2 \cdot 11$	$119 = 7 \cdot 17$	$\mathbf{139 = 139}$	$159 = 3 \cdot 53$	$\mathbf{179 = 179}$	$\mathbf{199 = 199}$
$20 = 2^2 \cdot 5$	$40 = 2^3 \cdot 5$	$60 = 2^2 \cdot 3 \cdot 5$	$80 = 2^4 \cdot 5$	$100 = 2^2 \cdot 5^2$	$120 = 2^3 \cdot 3 \cdot 5$	$140 = 2^2 \cdot 5 \cdot 7$	$160 = 2^5 \cdot 5$	$180 = 2^2 \cdot 3^2 \cdot 5$	$200 = 2^3 \cdot 5^2$

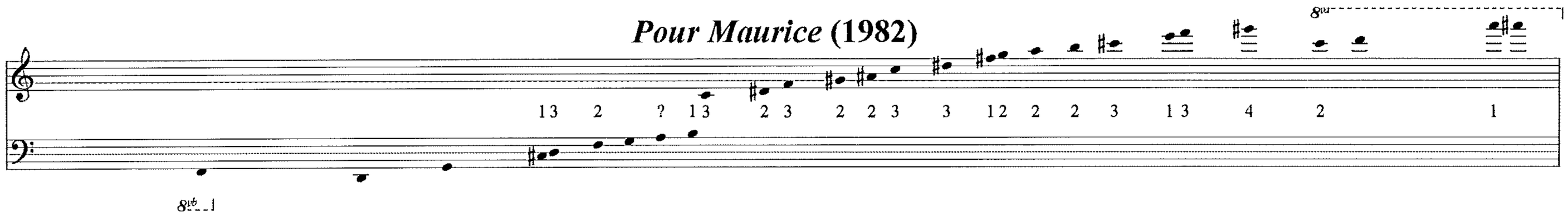
APPENDIX 2

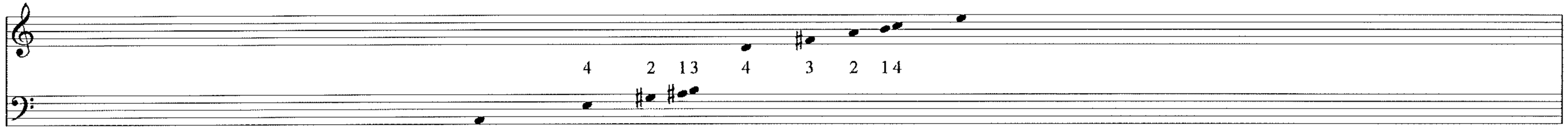
Sieve Listings

Pour la Paix (1981)

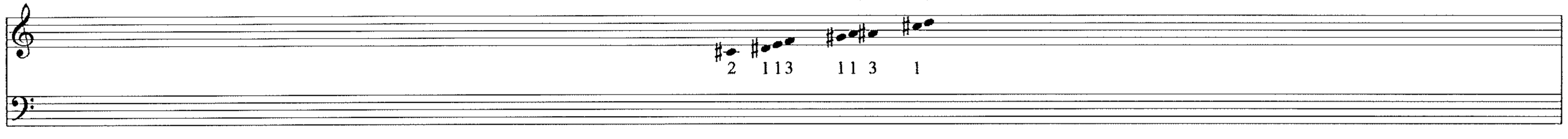


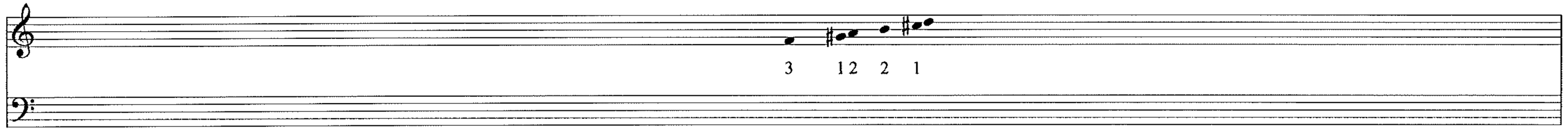
Pour Maurice (1982)



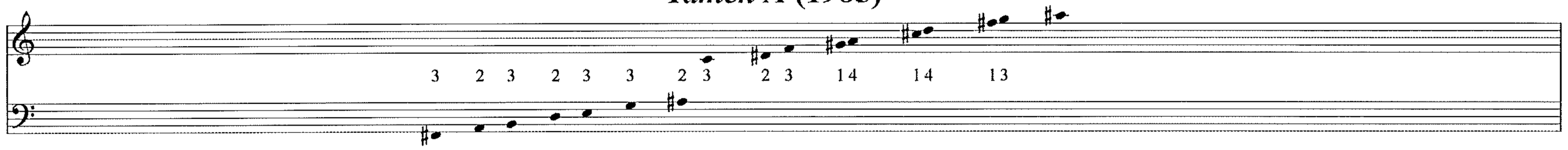


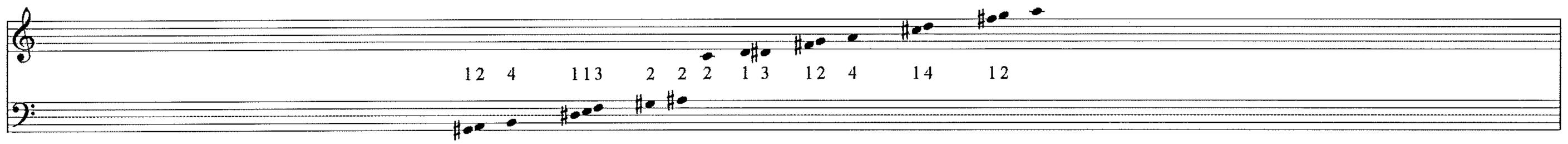
Chant des soleits (1983)



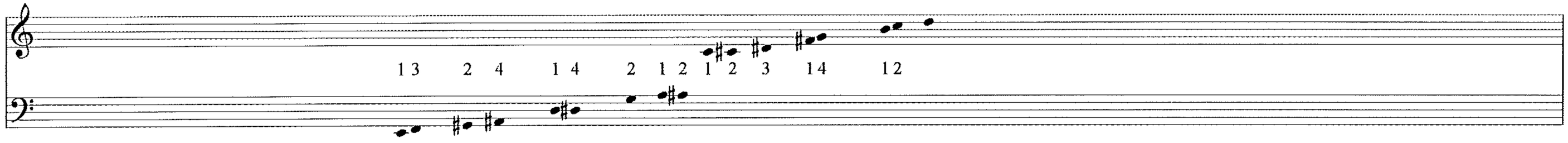


Idmen A (1985)

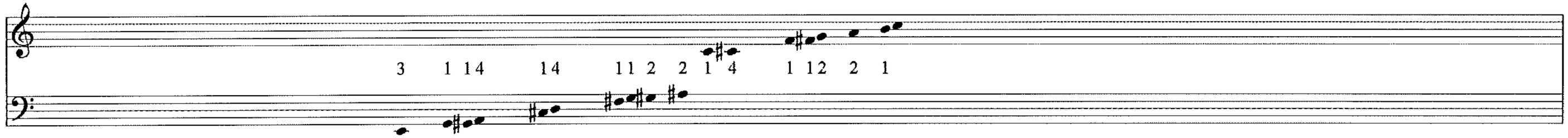




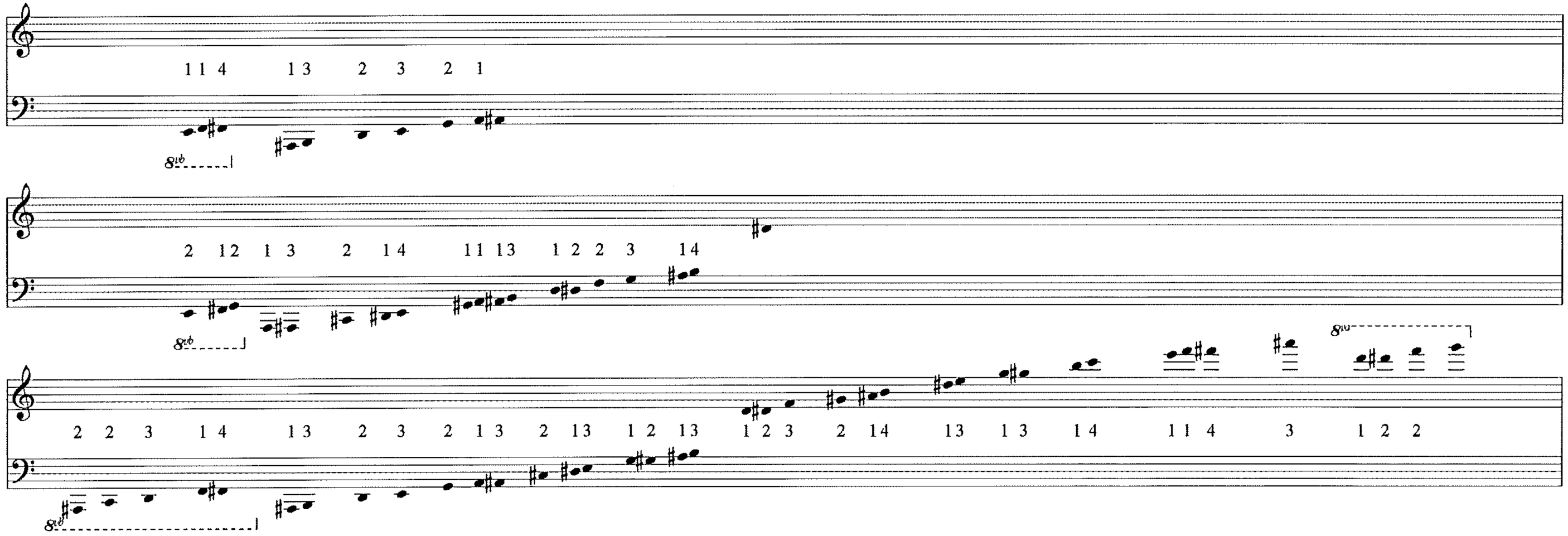
Alax (1985)

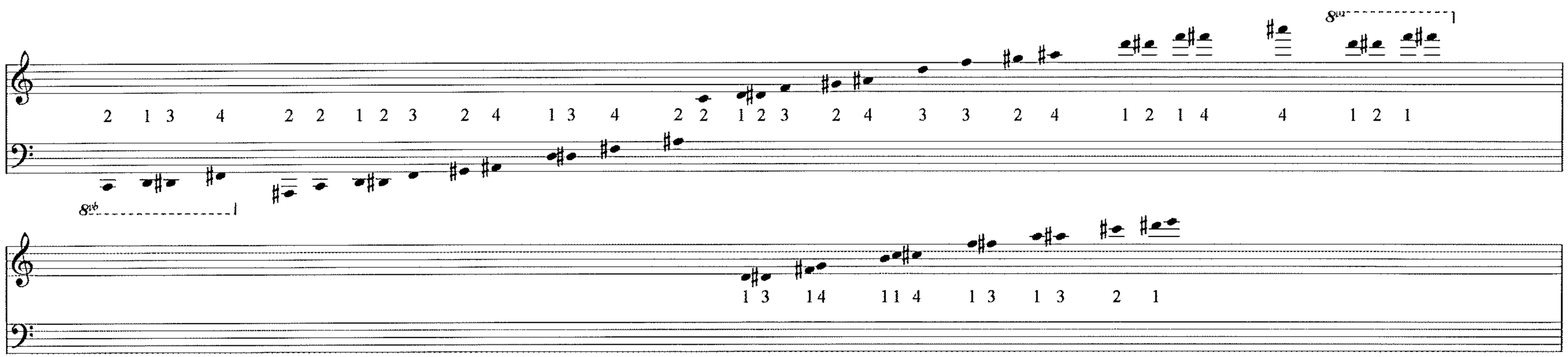


Keren (1986)

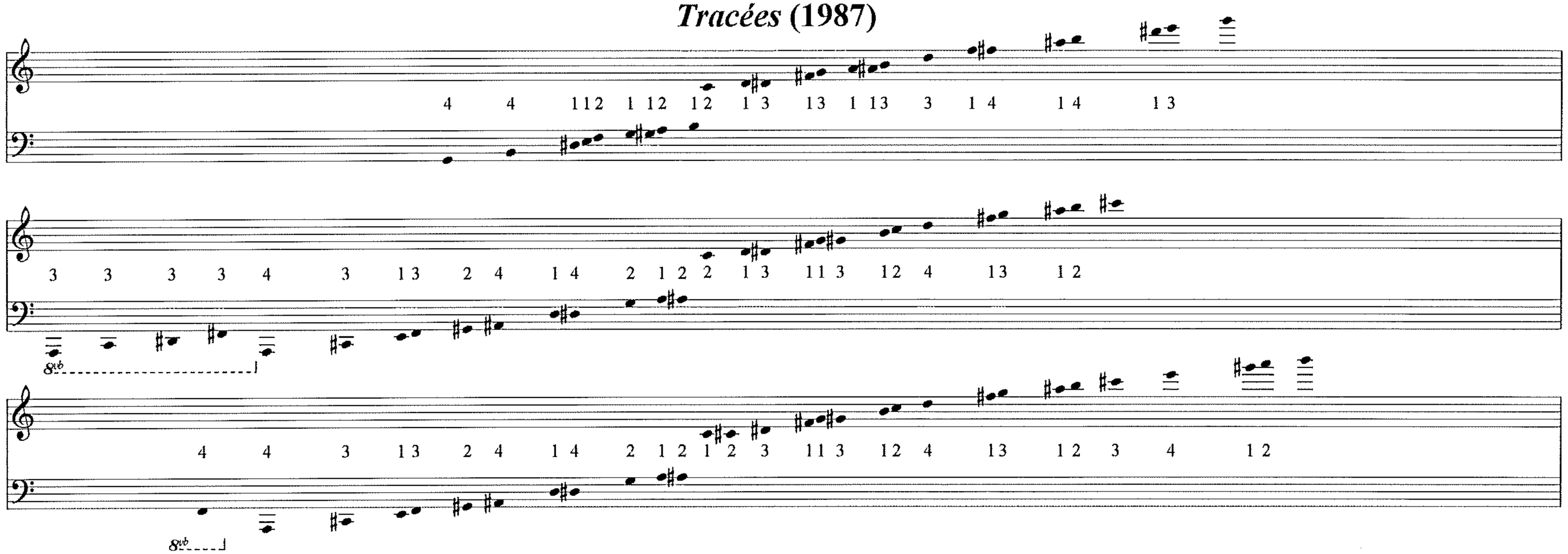


Jalons (1986)

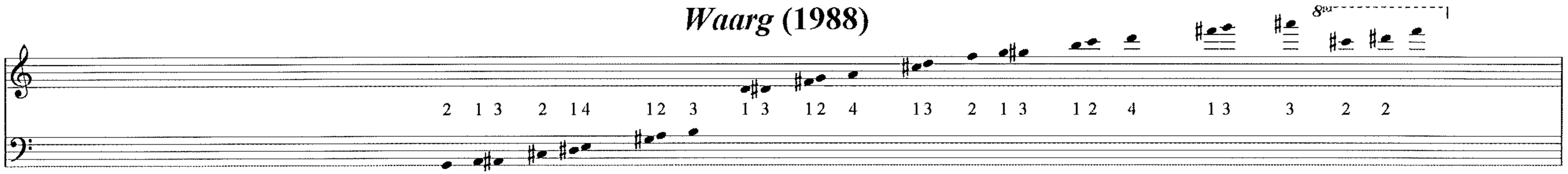




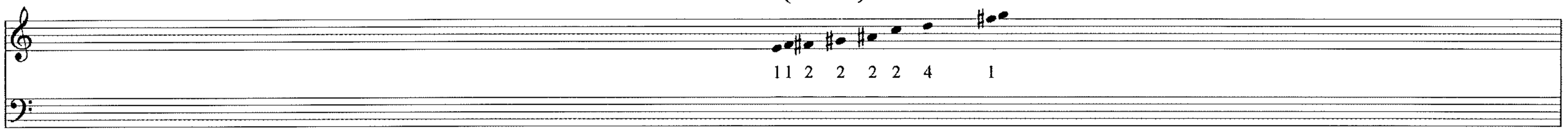
Tracées (1987)

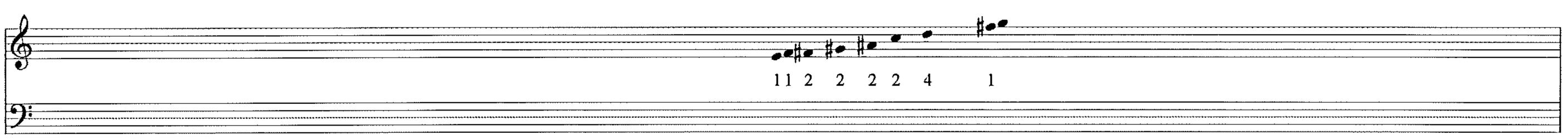


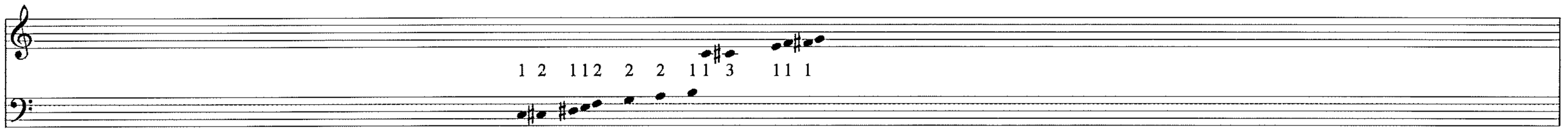
Waarg (1988)

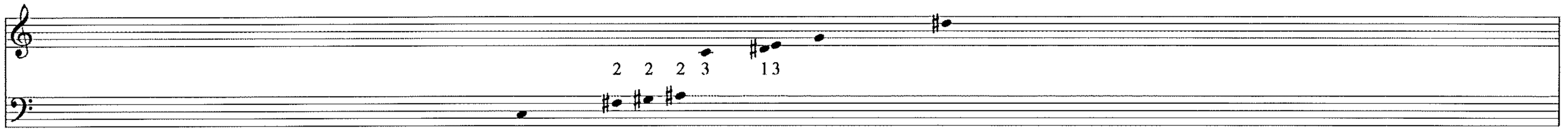


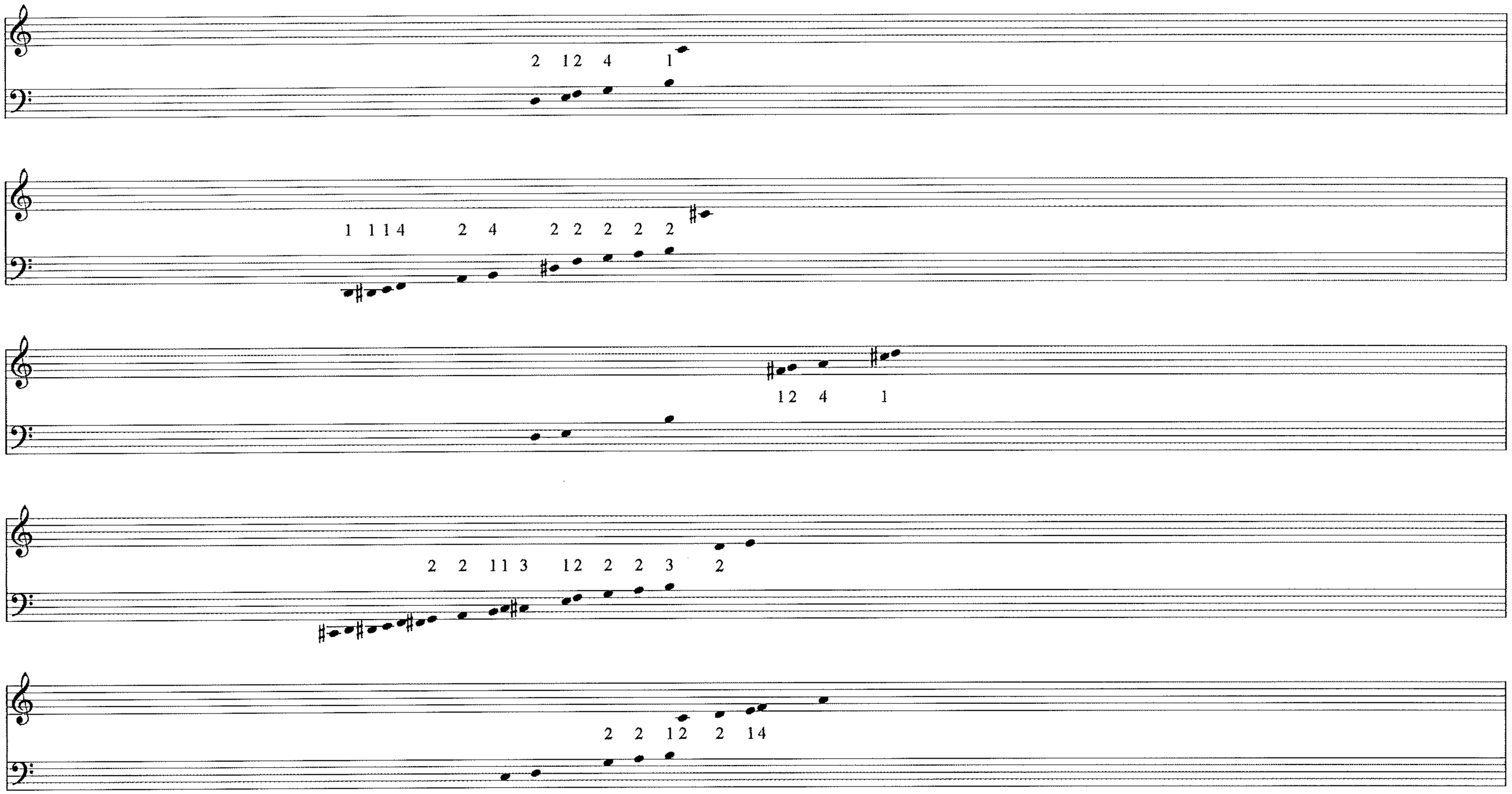
Tetora (1990)

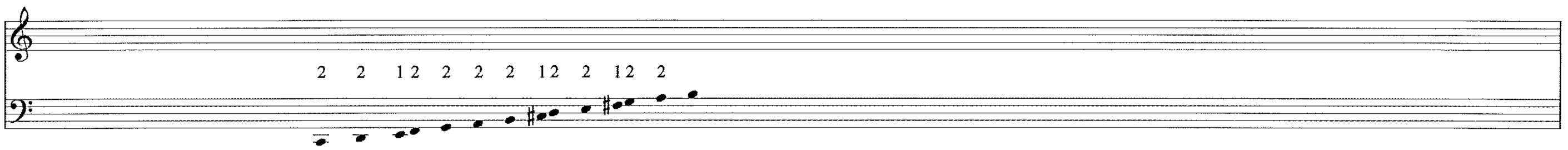




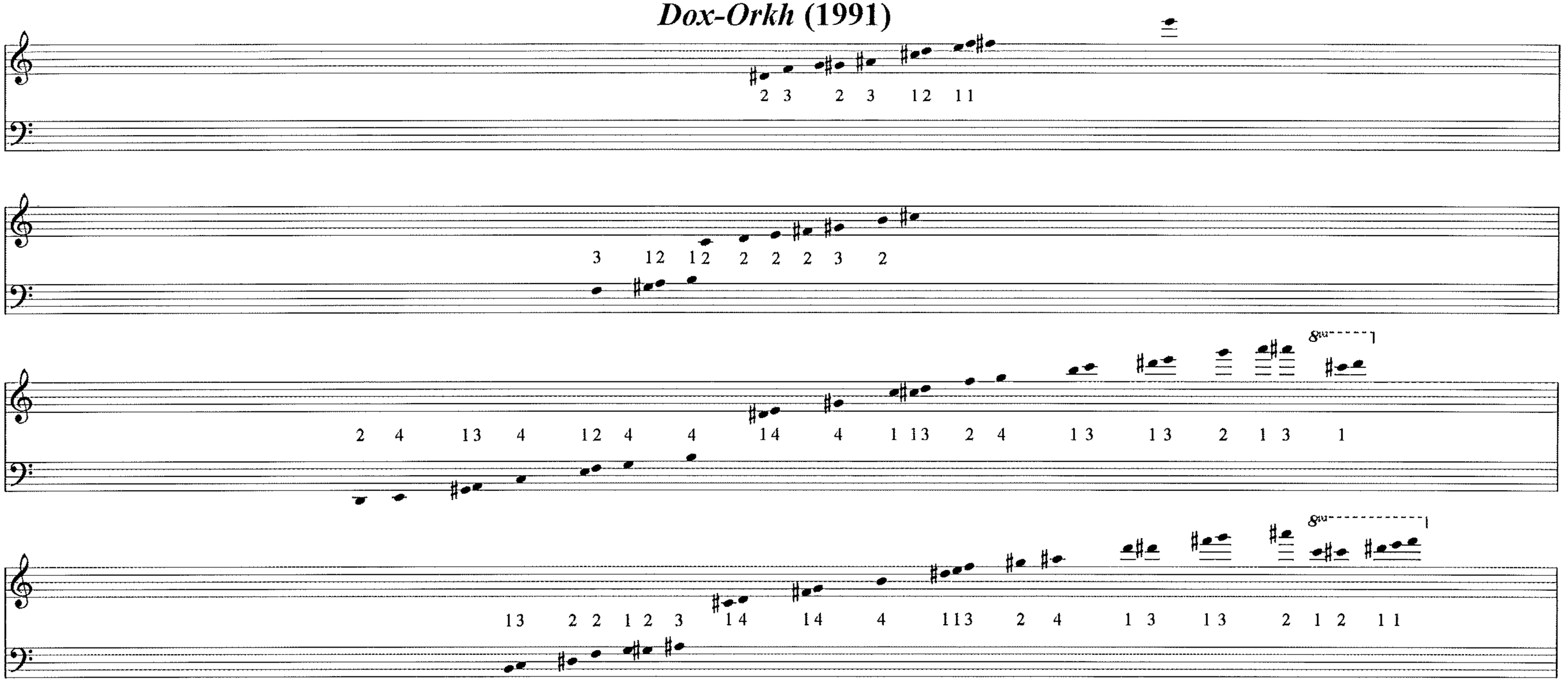


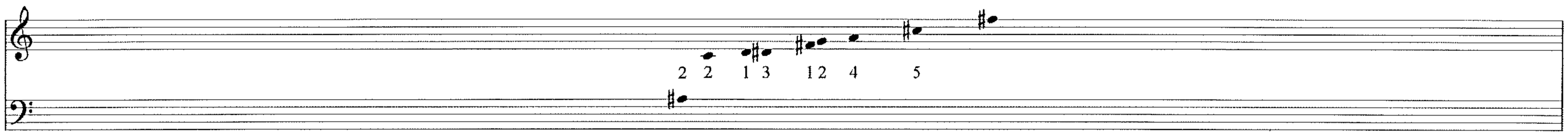



2 1 2 4 1
1 1 1 4 2 4 2 2 2 2 2
1 2 4 1
2 2 1 1 3 1 2 2 2 3 2
2 2 1 2 2 1 4

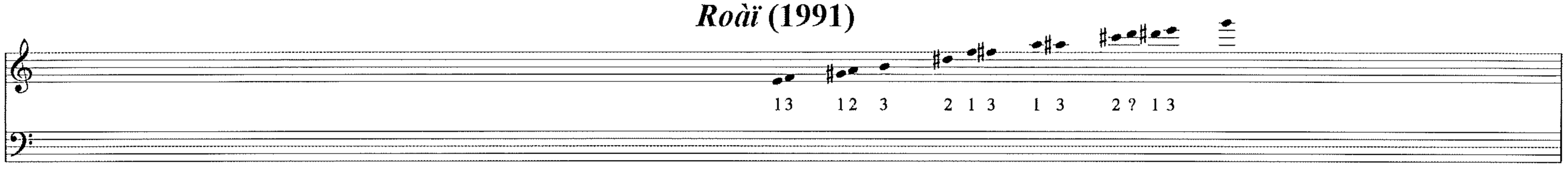


Dox-Orkh (1991)

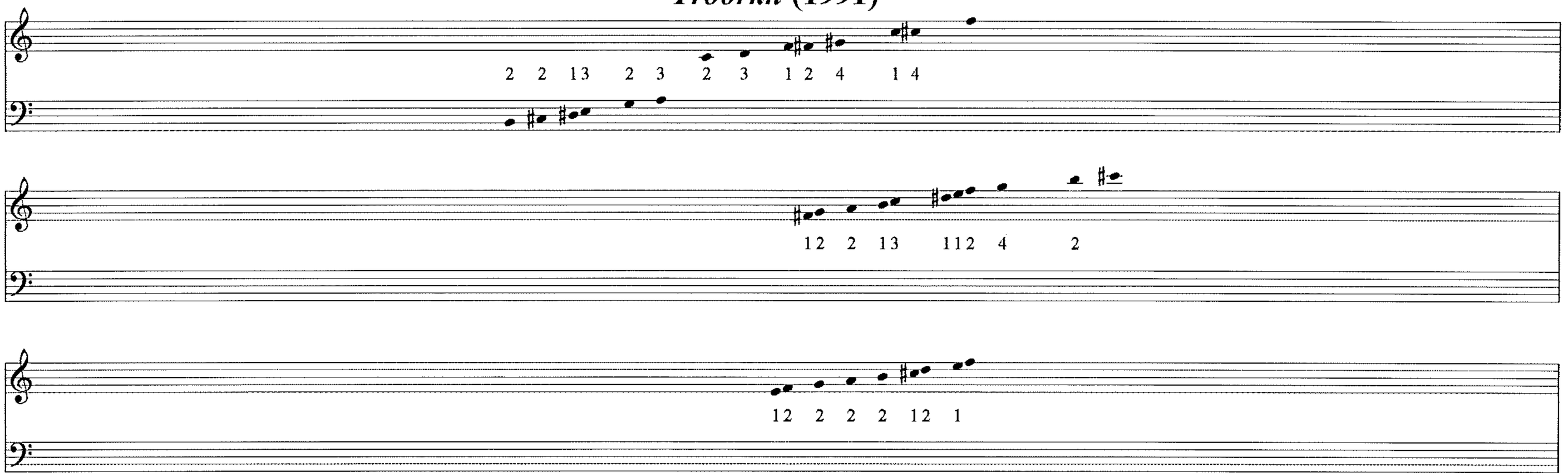




Roàï (1991)



Troorkh (1991)



APPENDIX 3

Full Scores and Score Excerpts

Note: Occasional marks on the scores are not related to the present analysis. They are performance notes and, unfortunately, could not be removed.

Keqrops (1896, for piano and orchestra)

Bars 121-141 & 160-165

21 (♩=36)

(pp)

5F:4 5F:6 ff

5F:4 p ff

5F:6 mf

(divisi) Legatissimo, pesant

3F:2 3F:2 3F:2

(sourd) Legatissimo, ferme mf

3F:2 3F:2

(sourd) Legatissimo, ferme mf

5F:4 5F:6 mf

pp

24

ff mf ff

ff mf ff

5F:7 7F:6

(ped) mf Ped dr. ½ (Ped)

VIOLONS: ff

3F:2 3F:2 3F:2 f

3F:2 3F:2 3F:2 ff p

127

non legato à 4

5F:8 f

à 4 ff pp

ff pp

pp f ff pp

pp ppp

5F:8 ff

(♩= 36)
non legato
legato sons fondus
legato
sound
leg.
(sonnent 8♮)

(♩ = 36)

bois, CORS : legato et ff

130

133

7F:5 7F:6 7F:6

7F:6 7F:6

5F:4

9F:7 9F:8 9F:7 7F:8 7F:8

7F:8 5F:3 7F:8 7F:8

7F:8 7F:8 (legato)

7F:8 7F:8 (legato) 5F:4

legato ff 7F:5

legato ff 9F:8

legato ff 5F:3

6F:4 3F:2 3F:2 3F:2 6F:4 6F:4 3F:2 3

3 3 3

fff 5F:9

fff 5F:9

(♩= 36)

133

136

ouverts

(mf)

(♩=36)

136

9F:8 7F:8 9F:8

31

139

PIANO

HRP

pesant (divisi)

139

142

Ped.

(ff)

Tutti: fff

160 ♩=240 MM

flat

stacc

163

Trem.

trem. serré

stacc

Tutti

♩ ~ 25 MM

163

Ralentir → suffisament →

166

ff

pédale intermittente

Retenez assez longue

suffisamment

Tutti: (ff) ——— mf

À l'île de Gorée (1896, for amplified harpsichord and ensemble)

Full Score

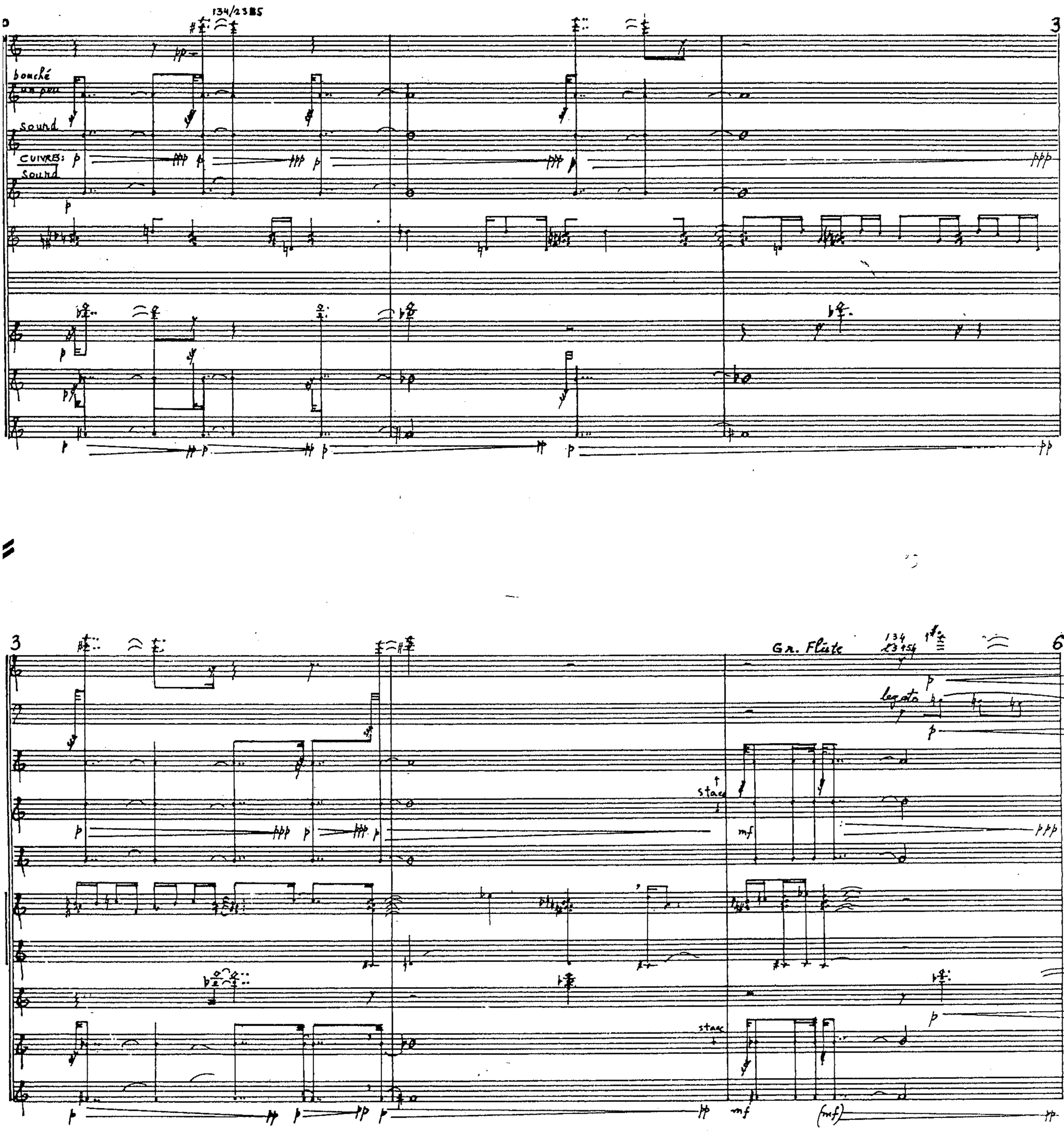
à l'île de Gorée

pour clavecin amplifié et orchestre

OUVRAGE PROTÉGÉ
PHOTOCOPIE INTERDITE
MÊME PARTIELLE
(Loi du 11 mars 1957)
constituerait CONTREFAÇON
(Code Pénal Art. 426)

Iannis XENAKIS

♩= 42 MM



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6 9

Fl
Hb
Cl
Fg
C
TP
TB
VI+VII
VA
VC
CB

Bois : sauf Fg
cuivres: mf
CORDES : sauf Co
(m/phon)
CORDES : pp

9 12

CLV

12 15

Fl
Hb
CLV
VI+VII
VA
VC

9F:7
4F:3 5F:4
9F:7
6F:5
CORDES : pp

15 18

Fg
C
TP
TB
CLV

sec
lid → sound
sourd straight
un peu bouché sec

9 21

pp pp pp mp 9F:8 9F:8 7F:5 9F:7 6F:5 9F:8 7F:5 6F:5 9F:7 7F:6 5F:4 6F:7 7F:5 4F:3 4F:3

4 24

6F:5 9F:7 4F:3 4F:3 7F:5 3F:2 3 3 7F:5 4F:3 9F:7 5F:4 9F:7 5F:4 6F:5 6F:5 7F:6 8F:7 9F:8

24 27

6F:5 7F:6 8F:7 9F:8 1F:1 9F:8 8F:7 7F:6 8F:7 7F:6 6F:5 5F:4 9F:7 1F:3 7F:5 3F:2 1/1 3F:2 7F:5

27

30

Fl
Hb
Cl
Fg
C
TP
TB
CLV

bois: très liés fff

C+TP+TB

mf

30

33

Fl
Hb
Cl
Fg
CUIVR
CLV

Bois : fff

C+TB

33

36

Fl
Hb
Cl
Fg
C
TP
TB
CLV
VI+
VII
VA
VC
CB

stacc

stacc

stacc

CORDES: pp

5

6

39

CUIVRES: mp

9

42

(+ idem Bb)

42 Tutti staccato 45

Fl
Hb
Cl
Fg
C
TP
TB
CLV
I+VII
VA
VC
CB

VENTS: f mp

CORES: f

mp f mp f mp

45 48

legato

ritard

SEMPRE STACCATO

Tutti: fff (fff)

7

51

tutti: stacc →

stacc.

tutti: fff

cuivres: (ppp)

7F:5 4F:3 5F:3 5F:3

5F:3 9F:7

9F:7 4E:3 5F:4

CORDES:

Tutti: ff

7

54

9F:7

7F:5

cuivres ff → 5F:3 5F:4

Tutti

Tutti: ff →

54

57

Fl
Hb
Cl
Fg
C
TP
TB
CLV
VI
VII
VA
VC
CB

9F:7 4F:3 1/1

7F:5 6F:5 1/1

9

6F:4 Y1→

5F:4 7F:6 Y1→

Pour les notes sans queues: 1) Attaquer les notes aux endroits géométriques précis par rapport à la battue régulière des doubles croches.
2) Tenir chaque note jusqu'à la suivante.

57

60

9F:7 7F:6 5F:3 5F:4

7F:5 5F:4 5F:3 3F:2 7F:6

6F:5 4F:3 5F:3 7F:5

K

;0

63

les accords secs partout

66

un peu bouché

(sourd)

(sourd)

5F: 6→

CORDES: ppp

66

69

Fl
Hb
Cl
Fg
C
Tp
Tb
Lv
Vl
Vll
VA
Vc
CB

(3 Bois: ♭)

(5F:6)

p

(CORDES: pp)

69

72

Fl
Hb
Cl
Fg
C
Tp
Tb
Lv
Vl
Vll
VA
Vc
CB

(5F:6)

p

CORDES: mp

72

75

(5F:6)

CORDES: mp

75

staccatissimo

78

vents:

(5F:6)

VI+VII. les cordes
en detache, sec

div

cordes: fff

p

fff

78 81

=1
Hb
Cl
bois: ff
Fg
C
TP
TB
cuivres (ff)
tFg
CLV
VI
VII
VA
VC
CB

81 84

CLV
VI
VII
VA
VC
CORDES
ppp

84 87

CLV
CORDES

87

90

Bois: pp

Fg+C+TB

mf

90

93

93

96

Fg

C

TB

96

99

Flt Hb+Cl

Fg

oscillations lentes et irrégulières de ± ½ ton

bois: (mp)

Bois: (fff)

99

Fl
Hb
Cl
Fg
C
TP
TB
VI
+VII
VA
VC
CB

Tutti: fff →

102

12 3/4 / 234

Bois: pp

CLV

lier au maximum.

4/4 > pp

VI
VII
VA
VC
CB

Presser en gardant la distance des doigts à la main gauche, jusqu'à la barre,

CORDES: mp

105

108

cuires: Aff>pp

a.norm

a.n

cordes: mp

108

111

Toujours, à chaque accord: Aff>pp

111

114

Fl
Hb
Cl
Fg
C
TP
TB
CLV
VI
VII
VA
VC
CB

Bois: mf

s.pont

114

117

Bois: mf

CORDES: pont.

arco, normal

CORDES: mp

117

120

Cuivres: f
et legatissimo

120

123

Bois: ff
et legatissimo

123

126

126 129

Fl +Hb
Cl +Fg
TP
C+ TB
CLV
VI+VII
VA+VC
CB

Fl
CL
Fg
C
TB
VI+VII
VA+VC
CB

Chasse-ma Bassi

CORDES: mf

129 132

Fl +Hb
Cl+ Fg
TP
C+ TB
CLV
VI+VII
VA+VC
CB

rallentir — progressivement

132 135

+Fl Hb
Cl+ Fg
TP
C+ TB
CLV
VI+VII
VA+VC
CB

Lent-

135

(p)

(mf)

(f)

138

5F:8

6F:7

7F:8

Assez lent

38

141

7F:3 5F:3 4F:3 6F:4

8F:7

7F:6

8F:7

144

141

9F:8

6F:4 6F:7 7F:5

144

5F:7

5F:7

5F:8 5F:8

Horos (1986, for orchestra)

Bars 46-51

w.w.

46

49

Fl
Hb
Cl
Fg
TP
TB
VI
VII
+Fg
VA
Vc
CB

(♩≅136)

sf :8

(Fl+Hb+Cl) bois (f) pp

5F:9

TR ALONE

TRP:

TR

1 2 3 4 1 2 3 4 1 2 3 4

only 1s.

others

ff

CORdes: ff

Fl-straight rhythm

49

52

Fl+Hb+Cl

4F:3

(GF:5)

(f) pp

TR ALONE

ff pp

(f) pp

390

Akea (1986, for piano and string quartet)

Full Score

AKÉA

POUR QUATUOR A CORDES ET PIANO

COMMANDE DE L'ETAT · AU FESTIVAL D'AUTOMNE A PARIS ET A SON DIRECTEUR MICHEL GUY.

les arpèges partent sur le temps et si contraires, arrivent en même temps. ils sont rapides.

I. XENAKIS

~12'

1986

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+8

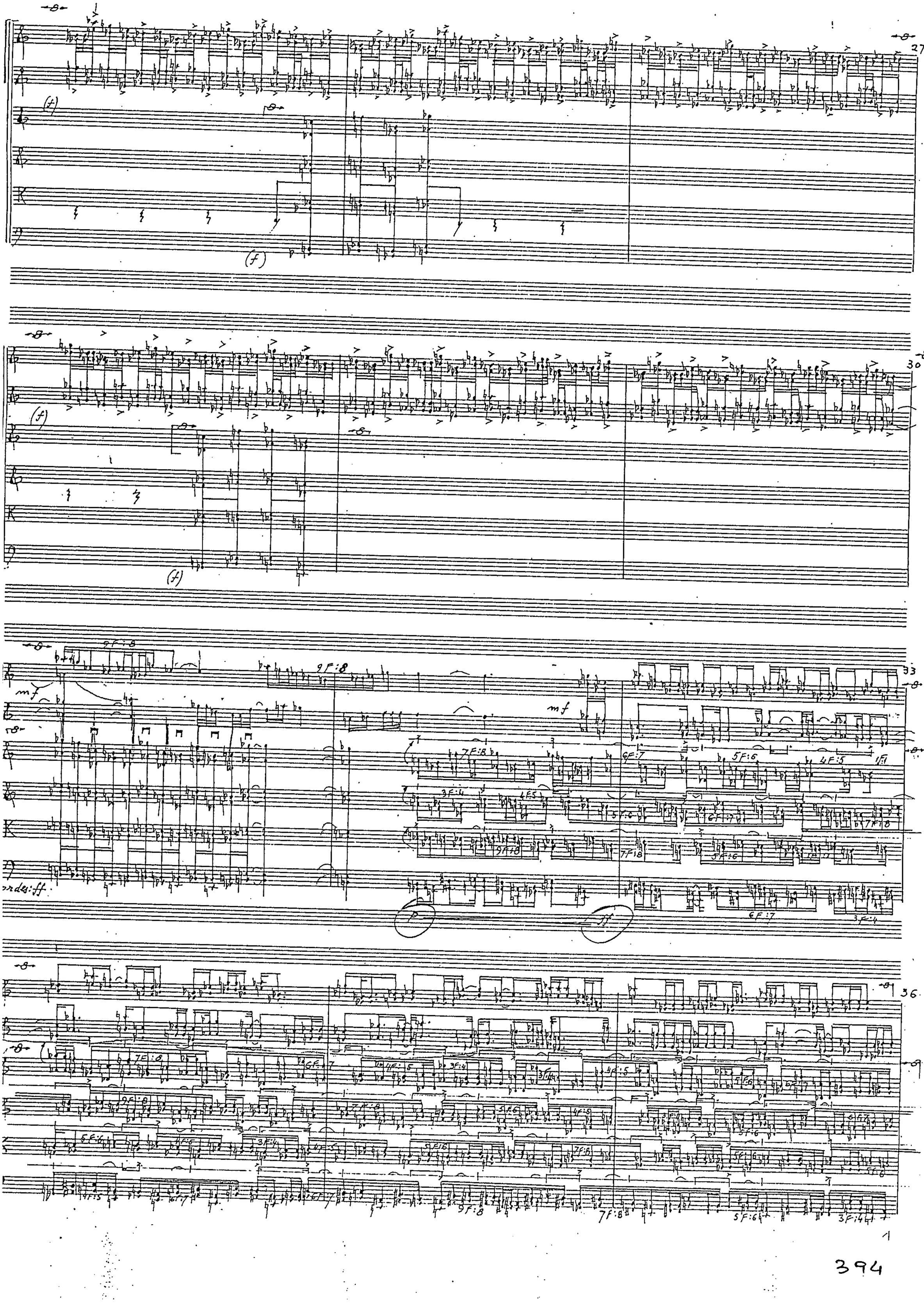
15

8

(21)

24

Cordes: f


27
30
33
36
(f)
mf
ff
9F:8
7F:8
5F:6
4F:5
3F:4
6F:7

1 2 3 4 5 6 On 4 5 6 2 9

39

ff

3:

42

pizzicati bowed clarinets

f

CORDES: f
ordin. tie
Tied

45

(T) eid

1 2 3 4 5 6 7 8

48

Cordes: p fff p

tutti: f fff

4

mf 7 ((T) Bb) mf (Flûx) flux legato (C) Bb) 8 (C) 51 5F:3 mf 3F:6 mf 3F:4 mf

54 2.8 f mf (T) 3F:2 7F:6 mf mf 3F:5 6F:7 7F:5

57 2.8 3F:6 ped Ped 1F:1 mf f 1F:1 60 (C) mf ped (T) mp (C) (T) 2

396

63

66

69

72

CORDES: ff

ped

(T)

Pont.

Mat

(mf)

75

9F:8

4F:3

(Divisi)

78

5F:3

1F:1

(fff)

81

Ped

Divisi

6F:5

1F:1

84

Ped

25 (♪=50)

(p)

Ped

avec chaleur pessimiste

Ped

sostenu

warm pessimism

(T)

(c)

(T)

(c)

87

90

Ped

ped

2 (5) 4 5 (6) 7 8

en assez long

92

mf

Ped

Ped

f

p

Ata (1987, for orchestra)

Bars 1-9 & 64-75

a t a

POUR ORCHESTRE

I. Xenakis

1987

DURÉE ~16 min.

COMMANDE DE LA SÜDWESTFUNK BADEN-BADEN
ET DE LA FONDATION CALOUSTE GULBENKIAN LISBONNE
DEDIÉ À JOSEF HÄUSLER et à LUIS PEREIRA LEAL

COMPOSITION DE L'ORCHESTRE : (4,4,4,4); (4,4,4); PERC; (CORDES 16, 14, 12, 10, 8)

Les mesures metronomiques sont approximatives. La notation est en hauteurs reelles sauf pour la contrebasse qui sonne 8 vaf

♩≃60 ♩≃50

1 (CSWF) 5F:3 5F:4 5F:3 5F:3 1F:1 3F:2 7F:5 7F:5 3F:2 1F:1

VI

VII (SWF) SWF

VA (CSWF)

VC (SWF)

La barre verticale signifie : prendre aussi toutes les notes chromatiques intermédiaires.

4 3 3 3 3 1F:1 5F:3 7F:5 7F:5 3 3 3 1F:1 7F:5

VI 5F:4 5F:4 5F:4 1F:1 5F:3 5F:3 5F:3 5F:3 5F:4 7F:5 7F:5

VII 7F:5 3 3 5F:4 5F:4 5F:4 5F:4 5F:4 5F:3 5F:3 5F:3

VA 5F:3 5F:3 3 3 5F:3 5F:4 5F:4 5F:3 7F:5 5F:4 5F:4 5F:4 5F:4

VC CSWF 1F:1 7F:5 7F:5 3 7F:5 7F:5 7F:5

CB fff

Flatt →

7

Fl

Hb

Cl Bois : fff

tr

VI

VII

VA

VC

CB

CORDES: (fff) p. fff

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(♩=72)

64

Fl
Hb
Cl
Fg
C
Tp
TB
Vl
Vll
VA
VC
CB

stacc

f

mf

stacc

(pizz)

Cordes: ff

67

Fl
Hb
Cl
Fg
C
Tp
TB
Perc

Bongo
Tumba

p

Vl
Vll
VA
VC
CB

Pizz

(Cordes ff)

70 (♩ ≅ 72)

Cl

Hb

Cl

Fg

C

Tp

TB

Pno

(mf)

f

V

VI

A

C

B

81

pizz

pizz

79

p

flatt sec

Echange (1989, for bass clarinet and ensemble)

Bars 1-9

ECHANGE

Pour Clarinette basse et ensemble instrumental — I. Xenakis 1989

dur. ≈ 14 min.

- Dédié à HARRY SPARNAAY : et à l'ASKO ensemble

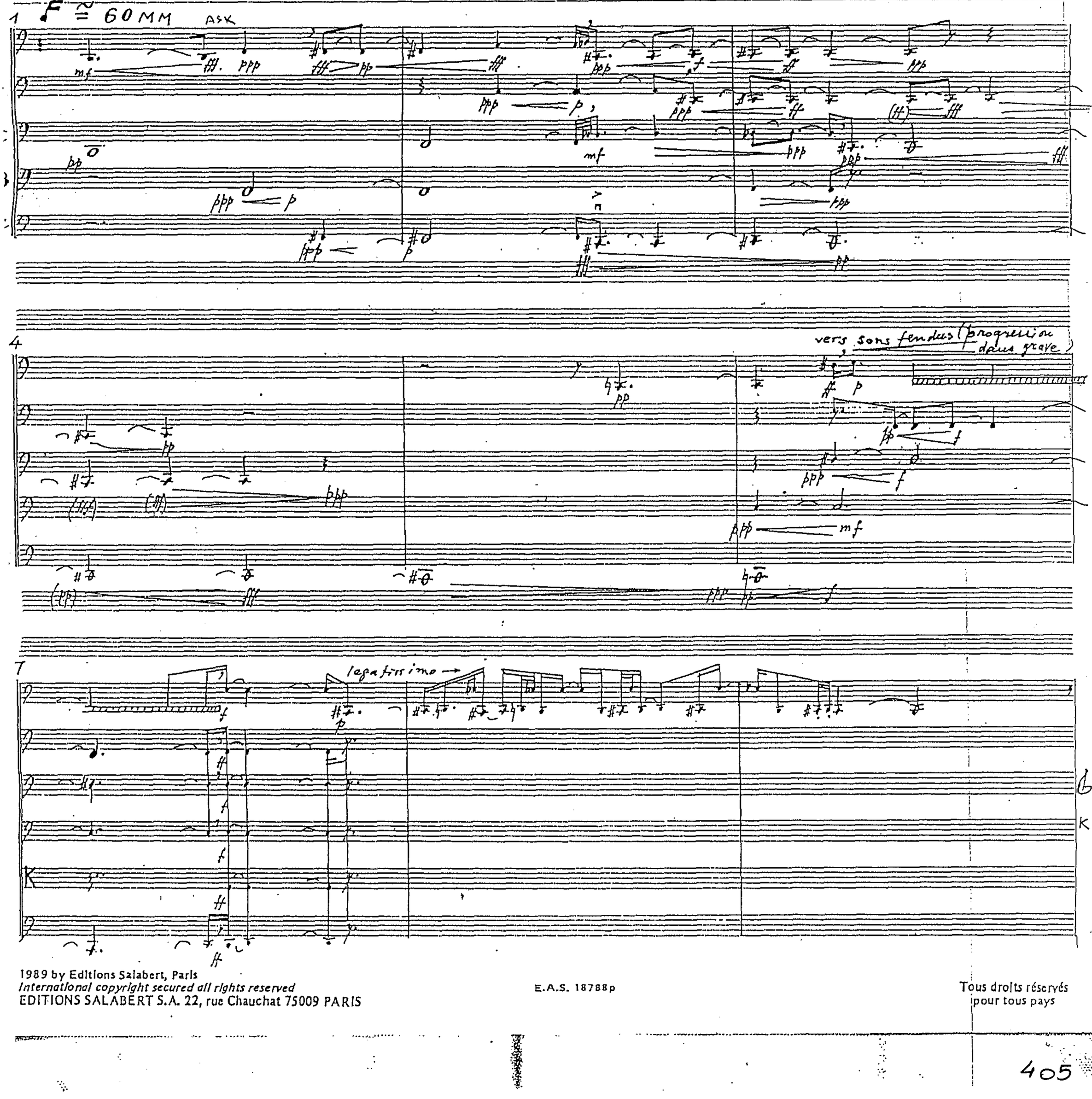
Commande de : "Stichting Amsterdams Fonds voor de Kunst" pour l'ensemble ASKO

Instrumentation : 1 clarinette Basse en soliste (+13 instr.)

1 Flûte, 1 Hautbois, 1 Clarinette en Sib, 1 Basson, 1 Cor en Fa, 1 Trompette en Ut,

1 Trombone ténor, 1 Tuba, 2 violons, 1 Alto, 1 violoncelle, 1 Contrebasse.

Notation en notes réelles sauf à la contrebasse qui sonne 8va. Pas de vibrato !



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Tetora (1990, for string quartet)

Full Score

T E T O R A

I. XENAKIS

Dur. ≈ 17'

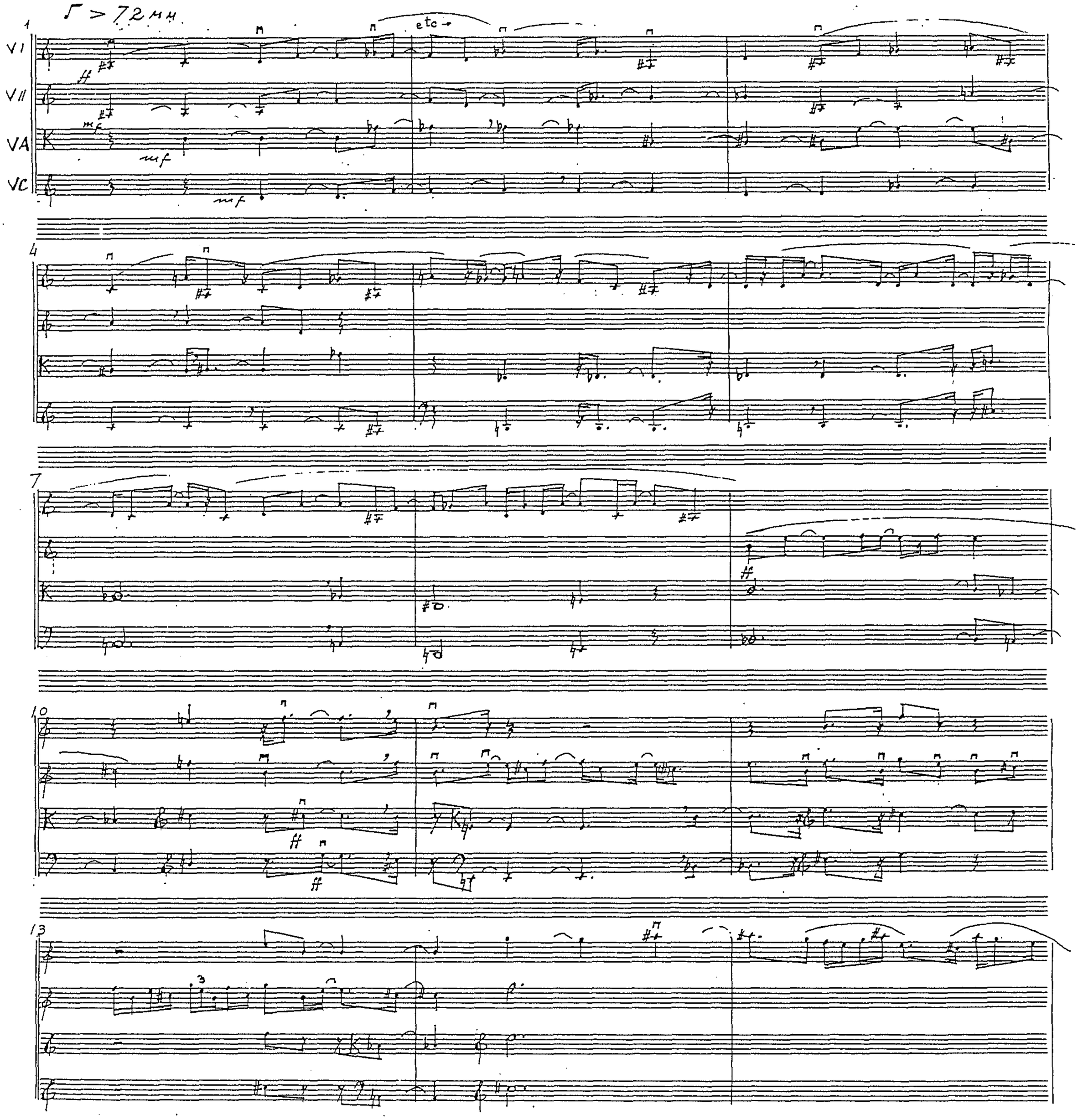
POUR QUATUOR A CORDES

1990

Commande du Dr. Wolfgang Becker de la WDR (COLOGNE) et des disques MONTAIGNE (Caisse des Dépôts et Consignations, PARIS), pour le Quatuor ARDITTI à l'initiative de M. Harry Vogt de la WDR.

le titre = 4 en Dorien.

♩ > 72 MM.



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E.A.S. 18968p

Tous droits réservés
pour tous pays

(♩.> 72 MM)

16

3

19

K

22

K

25

mf

mf

ff partout

28

mf

mp partout sauf VI

31

(pont)

(pont)

L. Tutti

(♩.> 72 MM)

34

37

s.pont

40

au talon

43

(sur talon)

au talon → Norm.

46

(sur talon)

49

legatissimo —

52 (♩ > 72)

55

tutti: fff

TTi: ff

sempre (= respecter les durées)

58

TTi pp →

TTi: fff →

61

64

legato →

67

tti pp →

mf

(♪ > 72)

70

tr

73

subi: p → cresc →

mf cresc →

76

mf

mf

mf

79

ff

mf

ff

mf

ff

mf

82

pp

pp

(bien lié)

85

(♩ = 72 ca.)

88

91

94

97

100

103

TTipp

80

cresc.

f cresc.

ff

106 ♩>72 F≧80 Long

109 mf 9f:8

112 ♩>50 9f:8 7f:6 7f:6 7f:6 7f:6

115 accel ♩>72

118

121

(♩=72)

124

127

♩=90

130

133

136

138