

## TABLE OF CONTENTS

	Page
LIST OF EXAMPLES .....	vi
LIST OF FIGURES .....	ix
Chapter	
1 Introduction .....	1
The Concept of the Physical Flute .....	1
Robert Morris Aitken, Canadian Flute Virtuoso .....	4
A Flute Lesson With Robert Aitken .....	6
The Purpose of this Paper .....	15
2 A Survey of Supporting Documentation .....	18
Breathing and Support .....	19
The Placement of the Vocal Tract .....	26
Lip Movements for Generating Register Changes .....	35
Summary .....	46
3 Physical Aspects of the Physical Flute .....	49
The Body and Breathing .....	49
The Vocal Tract and the Flutist .....	53
Measuring the effects of Opening the Jaws and Throat .....	60
The Physical Flute and Homogeneity of Sound .....	63

	The Physical Flute and the Vibrato .....	69
	The Physical Means of Changing Registers .....	71
	The Development of an Automatic Embouchure .....	78
	Summary .....	82
4	The Physical Flute and the Daily Exercise Routine .....	86
	Breathing and Support .....	86
	Opening the Throat .....	88
	The Tongue Position .....	89
	Training the Lips .....	91
	The Simple Resonance Exercise .....	97
	Abdominal Pulsing Exercises .....	101
	Harmonic Lip Exercises .....	110
	Developing the Embouchure through the Practice of Bugle Calls .....	121
	A Note About Dynamics .....	133
	A Note About the Daily Exercise Routine .....	134
	Notes About Vibrato .....	135
5	The Physical Flute and the Orchestral Excerpt Repertoire .....	141
	Mendelssohn, <i>Scherzo</i> from <i>A Midsummer Night's Dream</i> .....	142
	Saint-Saëns, <i>Volière</i> from <i>The Carnival of the Animals</i> .....	148
	Brahms, <i>Symphony No. 4, Allegro energico e passionato</i> .....	155
	Ludwig von Beethoven, <i>Leonore Overture No. 3</i> .....	157
	Ludwig von Beethoven, <i>Symphony No. 3, Finale</i> .....	160

Debussy, <i>Prelude to the Afternoon of a Faun</i> .....	162
Maurice Ravel, <i>Daphnis et Chloë</i> .....	165
Prokofiev, <i>Peter and the Wolf</i> .....	167
Prokofiev, <i>Classical Symphony, Finale</i> .....	171
Stravinsky, <i>Firebird Suite, Firebird Variation</i> .....	175
Bibliography .....	181

## LIST OF EXAMPLES

Chapter	Page
1 Introduction .....	1
Example 1.1. G <sub>6</sub> with harmonics .....	8
Example 1.2. Low G (G <sub>4</sub> ) to higher notes and back again .....	8
Example 1.3. Resonant G <sub>4</sub> .....	10
Example 1.4. Resonant low G slurred to resonant low F .....	10
Example 1.5. Resonant low G to low E .....	11
Example 1.6. Resonant low G to resonant low D .....	11
Example 1.7. Resonant low G to resonant low C .....	12
Example 1.8. The C <sub>4</sub> harmonic series from low C to high G .....	14
2 Survey of Literature .....	18
3 Physical Aspects of the Physical Flute .....	49
4 The Physical Flute and the Daily Exercise Routine .....	86
Example 4.1. Low register notes for long tone study .....	98
Example 4.2. A simple resonance building exercise .....	100
Example 4.3. Eighth-note abdominal pulsing exercise .....	102
Example 4.4. Eighth-note abdominal pulsing exercise with tongue .....	103
Example 4.5. Quarter-note abdominal pulsing exercise .....	104
Example 4.6. Quarter-note abdominal pulsing exercise with tongue .....	105
Example 4.7. Half-note abdominal pulsing exercise .....	107
Example 4.8. Half-note abdominal pulsing exercise with tongue .....	107
Example 4.9. Whole-note abdominal pulsing exercise .....	108
Example 4.10. Whole-note abdominal pulsing exercise with tongue .....	109
Example 4.11. Harmonic lip exercise with two partials .....	113
Example 4.12. Harmonic lip exercise with three partials .....	114
Example 4.13. Harmonic lip exercise with four partials .....	114
Example 4.14. Harmonic lip exercise with five partials .....	115
Example 4.15. Harmonic lip exercise with six partials .....	115
Example 4.16. Complete six-partial harmonic lip exercise .....	116

Example 4.17. Complete five–partial harmonic lip exercise .....	117
Example 4.18. Complete four–partial harmonic lip exercise .....	118
Example 4.19. Complete three–partial harmonic lip exercise .....	119
Example 4.20. Half–note harmonic lip exercise .....	120
Example 4.21. Quarter–note harmonic lip exercise .....	121
Example 4.22. <i>Taps</i> in B .....	123
Example 4.23. <i>Taps</i> in C .....	123
Example 4.24. <i>Taps</i> in C# .....	124
Example 4.25. <i>Taps</i> in D .....	124
Example 4.26. <i>School</i> in B .....	125
Example 4.27. <i>School</i> in C .....	125
Example 4.28. <i>School</i> in C# .....	126
Example 4.29. <i>School</i> in D .....	126
Example 4.30. <i>School</i> in Eb .....	127
Example 4.31. <i>School</i> in E .....	127
Example 4.32. <i>School</i> in F .....	128
Example 4.33. <i>Reveille</i> in B .....	129
Example 4.34. <i>Reveille</i> in C .....	130
Example 4.35. <i>Reveille</i> in C# .....	131
Example 4.36. <i>Reveille</i> in D .....	132
Example 4.37. Simple dynamic exercise .....	134
Example 4.38. Pulsed note vibrato exercise at mm ♩ = 60 .....	139
5 The Physical Flute and the Orchestral Excerpt Repertoire .....	141
Example 5.1. Mendelssohn <i>Scherzo</i> , mm. 338-340 .....	143
Example 5.2. Mendelssohn <i>Scherzo</i> , mm. 338-340 .....	144
Example 5.3. Mendelssohn <i>Scherzo</i> , mm. 338-340 .....	144
Example 5.4. Mendelssohn <i>Scherzo</i> , mm. 338-340 .....	145
Example 5.5. Mendelssohn <i>Scherzo</i> , mm. 338-340 .....	146
Example 5.6. Mendelssohn <i>Scherzo</i> , mm. 338-340 .....	146
Example 5.7. Mendelssohn, <i>Scherzo</i> , mm. 338-385 .....	147
Example 5.8. Saint–Saëns, <i>Volière</i> , m. 3 .....	149
Example 5.9. Saint–Saëns, <i>Volière</i> , m. 3 .....	150
Example 5.10. Saint–Saëns, <i>Volière</i> , m. 3 .....	150
Example 5.11. Saint–Saëns, <i>Volière</i> , m. 3 .....	151
Example 5.12. Saint–Saëns, <i>Volière</i> , m. 3 .....	151
Example 5.13. Saint–Saëns, <i>Voliere</i> , m. 3 .....	152
Example 5.14. Saint–Saëns, <i>Voliere</i> , m. 3-31 .....	152
Example 5.15. Johannes Brahms, <i>Symphony No. 4</i> , <i>Allegro energico e passionato</i> , mm. 89–105 .....	156
Example 5.16. Ludwig von Beethoven, <i>Leonore Overture No. 3</i> , mm. 17-24 .....	158

Example 5.17. Ludwig von Beethoven, <i>Leonore Overture No. 3</i> , mm. 328-360 .....	159
Example 5.18. Ludwig von Beethoven, <i>Symphony no. 3, Finale</i> , mm. 173-200 .....	161
Example 5.19. Claude Debussy, <i>Prelude to the Afternoon of a Faun</i> , mm. 1-4 .....	163
Example 5.20. Claude Debussy, <i>Prelude to the Afternoon of a Faun</i> , mm. 21-30 .....	164
Example 5.21. Maurice Ravel, <i>Daphnis et Chloë, Suite No. 2</i> , mm. 171-195 .....	166
Example 5.22. Sergei Prokofiev, <i>Peter and the Wolf</i> , mm. 23-38 .....	168
Example 5.23. Sergei Prokofiev, <i>Peter and the Wolf</i> , mm. 580-590 .....	170
Example 5.24. Sergei Prokofiev, <i>Classical Symphony, Finale</i> , mm. 27-41 .....	172
Example 5.25. Sergei Prokofiev, <i>Classical Symphony, Finale</i> , mm. 155-169 .....	173
Example 5.26. Sergei Prokofiev, <i>Classical Symphony, Finale</i> , mm. 129-145 .....	174
Example 5.27. Sergei Prokofiev, <i>Classical Symphony, Finale</i> , mm. 215-224 .....	175
Example 5.28. Igor Stravinsky, <i>Firebird Suite (1919), Firebird</i> <i>Variation</i> , mm. 1-43 .....	176
Bibliography .....	181

## LIST OF FIGURES

Chapter	Page
1 Introduction .....	1
2 Survey of Literature .....	18
3 Physical Aspects of the Physical Flute .....	49
Figure 3.1. The normal resting body position .....	50
Figure 3.2. The inhalation .....	51
Figure 3.3. The exhalation .....	53
Figure 3.4. Flutist with closed mouth .....	54
Figure 3.5. The flutist with a well–open jaw .....	55
Figure 3.6. Flutist set to play .....	56
Figure 3.7. The placement of the tongue .....	57
Figure 3.8. Flutist’s facial profile .....	58
Figure 3.9. The flutist with jaws and teeth apart .....	59
Figure 3.10. The flutist with the embouchure set .....	59
Figure 3.11. Frequency analysis of low G .....	61
Figure 3.12. Frequency analysis of low G .....	62
Figure 3.13. Spectral analysis of C <sub>5</sub> – C <sub>6</sub> chromatic scale .....	64
Figure 3.14. Spectral analysis of C <sub>5</sub> – C <sub>6</sub> chromatic scale .....	65
Figure 3.15. Spectral analysis of C <sub>4</sub> – C <sub>5</sub> chromatic scale .....	67
Figure 3.16. Spectral analysis of C <sub>6</sub> – C <sub>7</sub> chromatic scale .....	68
Figure 3.17. Frequency analysis of C# <sub>5</sub> .....	69
Figure 3.18. Frequency analysis of C# <sub>5</sub> .....	70
Figure 3.19. Flute head joint with straw .....	72
Figure 3.20. Flute head joint with straw .....	73
Figure 3.21. Flute head joint with straw .....	74
Figure 3.22. Flute head joint with lips .....	75
Figure 3.23. Lip opening and frequency analysis of G <sub>4</sub> .....	76
Figure 3.24. Lip opening and frequency analysis of G <sub>4</sub> .....	77
Figure 3.25. Frequency analysis of a low C (C <sub>4</sub> ) .....	78
Figure 3.26. Lip position for low C <sub>4</sub> .....	80
Figure 3.27. Lip position for harmonic C <sub>5</sub> .....	80

Figure 3.28. Lip position for harmonic $G_5$ .....	80
Figure 3.29. Lip position for harmonic $C_6$ .....	81
Figure 3.30. Lip position for harmonic $E_6$ .....	81
Figure 3.31. Lip position for harmonic $G_6$ .....	81
Figure 3.32. Comparison of lip positions for $C_4$ and $G_6$ .....	82
4 The Physical Flute and the Daily Exercise Routine .....	86
Figure 4.1. A simple breathing exercise .....	87
Figure 4.2. Profile of flutist showing closed and open throat .....	89
Figure 4.3. Diagram showing tongue placement .....	91
Figure 4.4. Front view of lips with jaws apart .....	93
Figure 4.5. Front view of open jaws and teeth .....	94
Figure 4.6. Front view teeth apart and lips closed .....	95
Figure 4.7. Exercise for developing the musculature around the lips .....	96
Figure 4.8. Exercise for developing the musculature around the lips .....	97
Figure 4.9. Lip position for low C and the next two partials .....	111
Figure 4.10. Lip positioning for low F and the next two partials .....	112
Figure 4.11. Frequency analyses of the apex and nadir of a vibrato pulse on $C\#_5$ .....	140
5 The Physical Flute and the Orchestral Excerpt Repertoire .....	141
Bibliography .....	181