9

MACROCOSMOS

GUITAR

Polyrhythms and Non-equivalents

ROGER PELL

Overview of Book 9

This book presents rhythmic and sonic reference material and methods for the distribution of these elements for musicians, sonic artisans and sound designers. The coupling of time and tone are the building materials that musicians interpret in performance. By expressive actions sound makes movement audible and this makes music a hearable and temporal art form.

These two concepts are realised as two sides of the same coin. The intention of book 9 therefore is to explain and explore time and tone and to amalgamate them in a functional way so as to present an aesthetic form.

This ninth book of the *Macrocosmos for Guitar* is divided into five sections. Part 1 discusses the fundamentals of rhythm, Part 2 evolves three levels of polyrhythmic development by the interference of two numbers between 2 and 9. Part 3 is the graphic representation of polyrhythms. Part 4 is a discourse on scales and documents the 224 non-equivalents within an octave. Part 5 presents variable velocities as a format for the distribution of duration for both sonic and rhythmic material.

The purpose of our inquiry into scales is to cultivate a wider sonic palette. Although some scales are more habitual than others, to not have access to the entire library would deny us the potential that we may find in the unfamiliar. It is to be noted that as scales can be perceived melodically, they may also be manipulated harmonically. Therefore all the chords available within a single octave are presented.

Our investigation into rhythm insinuates that motion precedes the element of sound, in other words to emit sound we must first have a moving part. Research on women who are pregnant indicates the fetus feels a mothers' beating heart. Time is more abstract and elusive for its components of duration, tempo, accent, pulse and coordination unfold the emotional effects of sonic motion; rhythm sequences the duration of sound.

Our discussion will be limited to a small but significant area of this rhythmic world with the intention to be more informed and to advance our concept of rhythm and hopefully to make the reader more rhythmically alert. This is achieved by explorations into the synchronistic actions of two individual integers that coexist simultaneously, i.e. polyrhythm. However when both are maintained over an extended period of time they may additionally be described as being the concurrence of different tempos.

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S 2T3n (st t st t), S 3T2n (st st t), S 2t4n (st st st st t).

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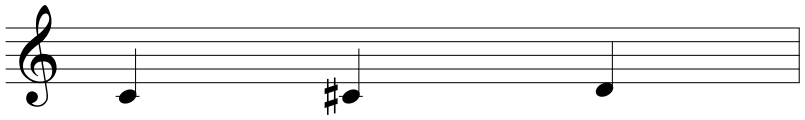
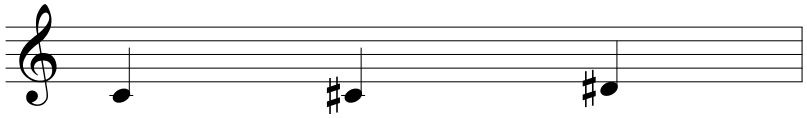
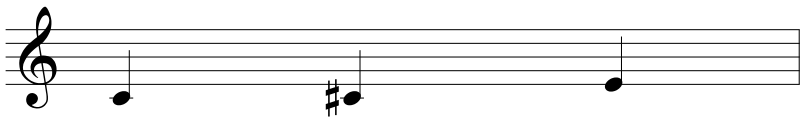
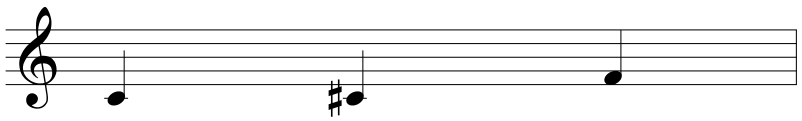
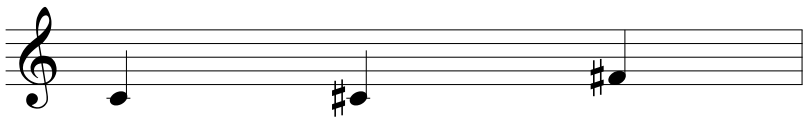
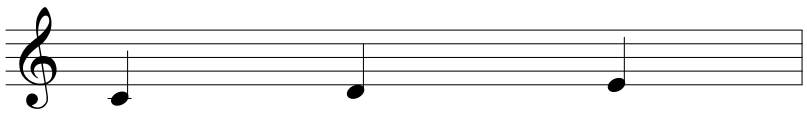
(12) 1.  [210000]

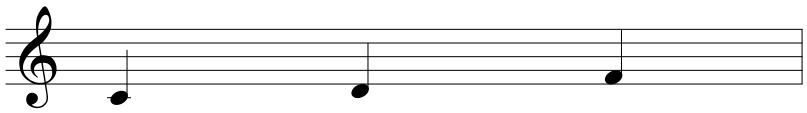
(13) 2.  [111000]

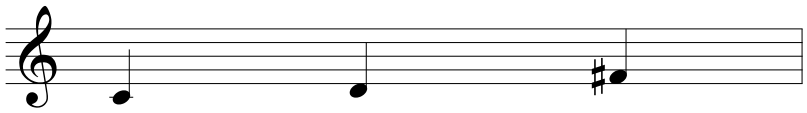
(14) 3.  [101100]

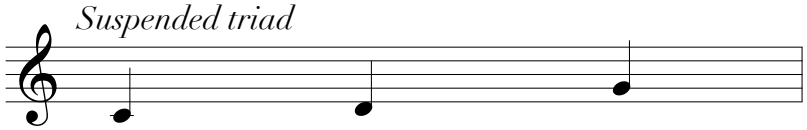
(15) 4.  [100110]

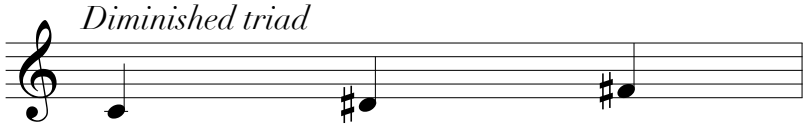
(16) 5.  [100011]

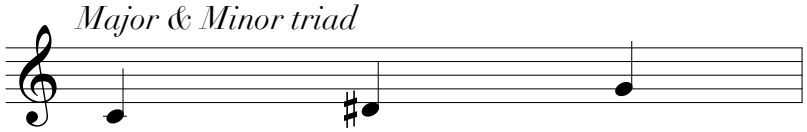
(24) 6.  [020100]

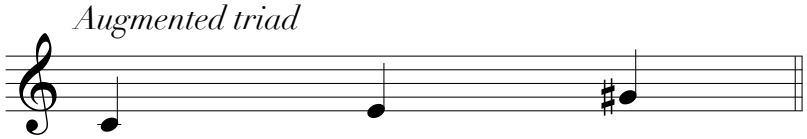
(25) 7.  [011010]

(26) 8.  [010101]

(27) 9. *Suspended triad*  [010020]

(36) 10. *Diminished triad*  [002001]

(37) 11. *Major & Minor triad*  [001110]

S 3T (48) 12. *Augmented triad*  3rd [000300]

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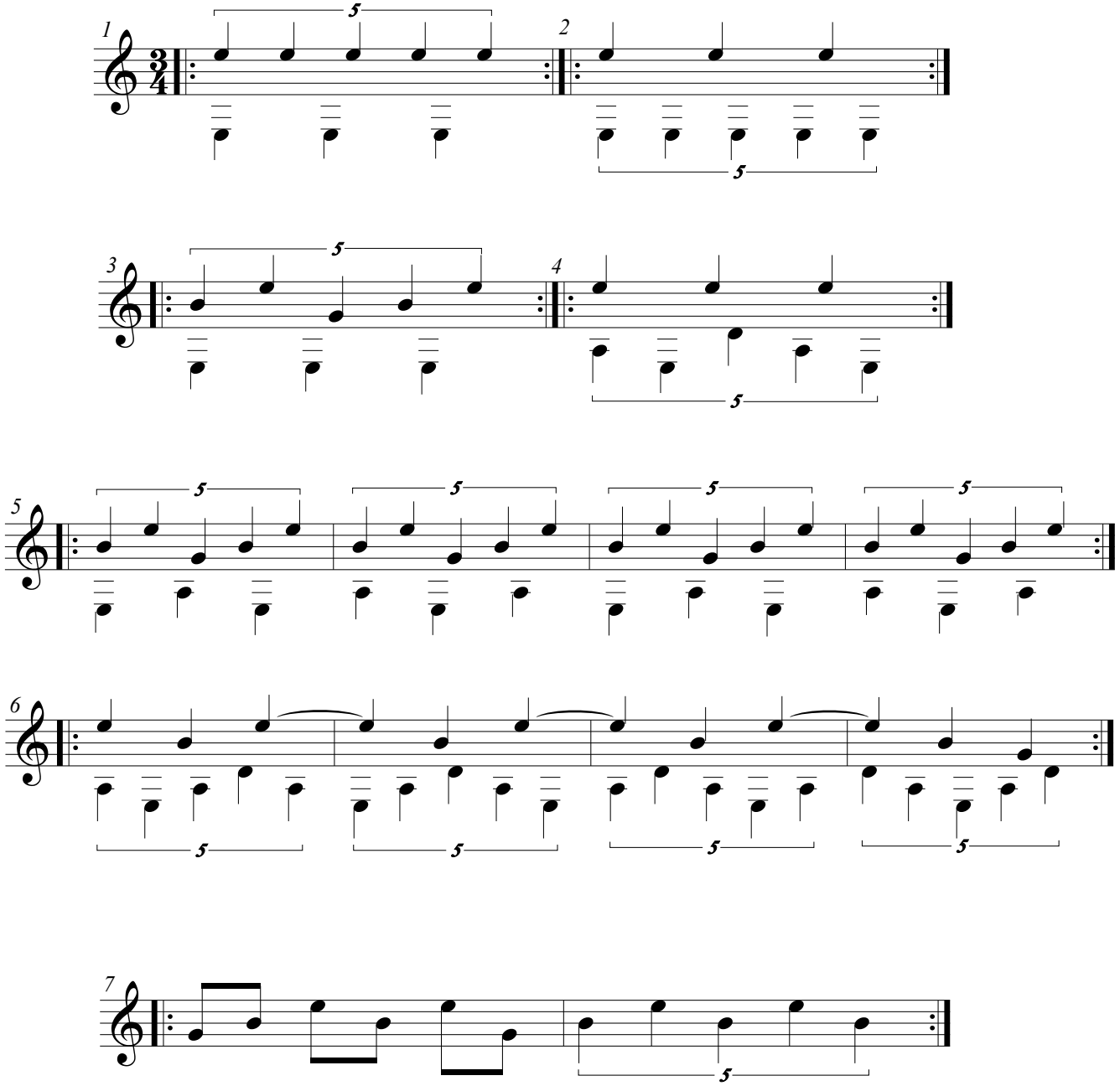

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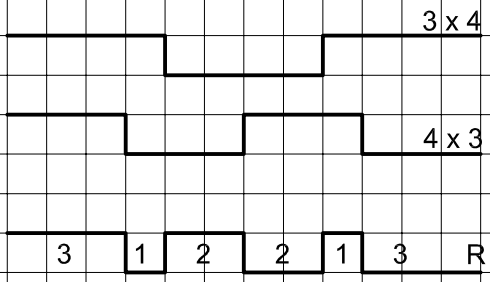

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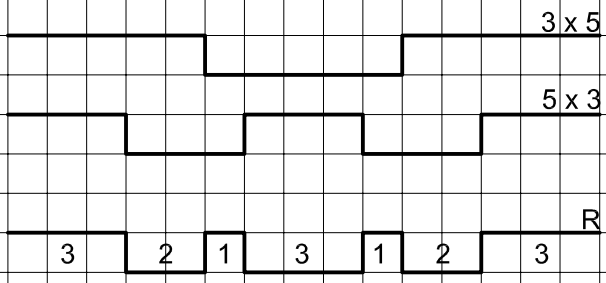

Nonequivalents

At some stage in a musician's life the statistician deep within surfaces and starts collecting, documenting and studying scales. It is almost unavoidable for they are so fundamental to the structural elements of music. We recognise that scales are sonic moods and that when manipulated carefully can represent enculturation along with the graduation of human emotion.

By having 12 notes in our alphabet we may intuitively imagine a closed system exists. However in doing some quick mathematics we realise the vast number of scales that actually exist. To place them into some manageable format certainly becomes an absorbing enterprise, for there are 479,001,600 permutations of 12 notes, with each note capable of having an intimate relationship with any one of eleven degrees in relation to its tonic.

The significance of a non-equivalent is that it becomes representative of multitudes of descendants, allowing our initial number to be greatly diminished. For instance all major scales and their modes can be reduced to only one code, or one scale called a non-equivalent. When this reduction process is applied to all groups of notes in one octave of the chromatic scale we end up with a far more manageable system of just 224 scales, all of which are documented in the following pages.

A non-equivalent is a group of notes that can be named by the number of semitones separating the first note from the others i.e. EFG = (13), E to F is one semitone and from E to G is 3 semitones. The scales' code (SC) is therefore (13) which is distinguished by curved brackets and can be transposed by starting on any one of the eleven other notes of the chromatic scale, BCD etc. It can also be subjected to expansion by inversion i.e. rearranging the sequence of its notes. This is achieved by circular permutation 1 x 2 x 3 = 6 inversions.

i	E	F	G
ii	E	G	F
iii	F	G	E
iv	F	E	G
v	G	E	F
vi	G	F	E

Therefore the transposition plus the inversions for (13) total 12 x 6 = 72, these then will be considered equivalents of the initial scale's code.

Distribution of Durations

From the interference of numbers we derive a source material called the resultant which may be interpreted as a series of durations. These fundamental elements can be subjected to permutation and accordingly distributed to develop a rhythmic aesthetic that structurally conveys a desired form of artistic communication.

As mentioned before botanical growth suggests a summation series which was first discovered by Fibonacci in the C13 and serves as one of many methods for the distribution of parts. To give one example 1.2.3.5.8.13.21.34.55. etc. Initially these growth rates express a process of expansion, however as with polyrhythms their resultants have a precise retrograde organically built into all of them. This principle of contraction accounts for the reciprocation of numbers, 55.34.21.13.8.5.3.2.1. If these two geometric inversions are subjected to permutation they thematically manipulate their data, inventing vast systems for the distribution of duration. Here are some other examples of variable velocities that could be used to propagate information, indeed the list is infinite.

i	Natural harmonic	1 2 3 4			
ii	Arithmetic + 2.	1 3 5 7 9			
iii	Geometric x 2.	1 2 4 8 16			
iv	Power.	*i*	3 9 27 81	*ii*	2 4 8 32 256
v	Prime No.	1 3 5 7 11 13 17			
vi	Summation.	*i*	1 2 3 5 8 13	*ii*	1 3 4 7 11 18
		iii	1 4 5 9 14 23	*iv*	1 2 3 6 11 20 37

The action of permutation is to create a development or arrangement or an assemblage of parts that explores the potential of pattern making from any given *source material* (SM).

To take the first three digits from the natural harmonic example 1. 2. 3 and subject them to *circular permutation* (CP) we discover three variations or inversions, i.e. 123. 231. 312.

These elements can be further extended by *general permutation* (GP) which reveals 1 x 2 x 3 x = 6, i.e 123. 132. 231. 213. 312. 312.