

CHAPTER 1

TONAL MODULATION WITH JUST INTONATION – IN THE MUSIC OF HARRY PARTCH

Background on Monophony

The Monophonic system of Harry Partch (commonly referred to as Monophony)¹ is a musical gamut of pitch resources that evolved over a period of years during Partch's early research into just intonation.² The description of Monophony as a *gamut* instead of a scale is not a frivolous distinction since a common misconception of Partch's music is that it is mostly based upon the free use of a 43-tone per octave microtonal chromatic scale, when a more appropriate conceptual metaphor, in my way of thinking, would be to describe it as a field of points in pitch class³ space that can be selectively chosen to map a desired melodic or harmonic structure. As Partch cautioned in his book *Genesis of a Music*, "music is not a fantasy of chromaticism. A scale is a source of materials, from which chords and melodies are drawn, and in which the scale as a scale appears only occasionally if at all."⁴

The defining feature of Monophony is that it is not based upon equal divisions of the octave like the common twelve-tone equal tempered chromatic scale, but rather its constituent tones all form whole number ratios with a single generative tone, the *Prime Unity*, or more specifically and preferably stated in ratio terms, $1/1$.⁵ Most of the familiar pitch intervals that occur in the twelve-tone equal tempered chromatic scale: the perfect fifth, perfect fourth, major third, minor sixth, minor third, major sixth, etc., also occur within Monophony. However, unlike their equal-tempered counterparts, the Monophonic intervals are perfectly in tune. A quick comparison of several of these intervals in Table 1.1 will be useful to illustrate the differences

between equal tempered intervals and their Monophonic equivalents via cents deviation.

Additionally, in Musical Example 1.1 a Virtual Chromelodeon I (using an electronic synthesizer instead of an acoustic reed organ) is used to perform the intervals in sequence beginning with each equal tempered interval followed by its closest Monophonic equivalent, for the purpose of providing an aural appreciation of the differences between equal tempered and Monophonic intervals.

Table 1.1 – Comparison of Equal Tempered and Monophonic Intervals

Equal Tempered Interval		Monophonic Interval		Cents Deviation
Interval Name	Interval In Cents	Ratio Name	Interval In Cents	
perfect fifth	700	3/2 (just perfect fifth)	702.0	$702.0 - 700 = -2.0$
perfect fourth	500	4/3 (just perfect fourth)	498.0	$500 - 498 = +2.0$
major third	400	5/4 (just major third)	386.3	$400 - 386.3 = +13.7$
minor sixth	800	8/5 (just minor sixth)	813.7	$813.7 - 800 = -13.7$
minor third	300	6/5 (just minor third)	315.6	$315.6 - 300 = +15.6$
major sixth	900	5/3 (just major sixth)	884.3	$900 - 884.3 = -15.6$

Musical Example 1.1 – Comparison of Equal Tempered and Monophonic Intervals (Performed on Virtual Chromelodeon I)

The musical notation displays two staves of intervals. The first staff shows three intervals: perfect fifth (ratio 3/2), perfect fourth (ratio 4/3), and major third (ratio 5/4). The second staff shows three intervals: minor sixth (ratio 8/5), minor third (ratio 6/5), and major sixth (ratio 5/3). Each interval is represented by a pair of notes on a five-line staff, with the ratio name and ratio value written above the notes.

In Table 1.1, the equal tempered intervals identified by their common musical names appear on the left, and their justly tuned Monophonic equivalents appear on the right. Cents (rounded off to the nearest tenth of a cent in the case of the Monophonic intervals) are used for both equal tempered intervals and Monophonic intervals as a unit of comparison.⁶ In the column for “Cents Deviation” the difference between the two versions is calculated. From this, one can see that the equal tempered perfect fifth is about two cents flatter than the Monophonic $3/2$ (or just perfect fifth), and conversely its complement the equal tempered perfect fourth is about two cents sharper than the Monophonic $4/3$ (or just perfect fourth). While these differences are not very striking, the intonation discrepancy of equal temperament becomes more pronounced in the case of thirds and sixths, for example when comparing the equal tempered major third with the Monophonic $5/4$ (or just major third), one notices that the equal tempered form is about fourteen cents sharper.⁷ This discrepancy accounts for why triads played on a piano tuned to twelve-tone equal temperament are never as well in tune as they can be when played on an instrument without fixed pitch, such as a violin or the human voice.

In Monophony, ratios serve a dual role as a precise description of the intervals between two distinct tones and as the names of specific pitches within the Monophonic fabric. Since the tones of Monophony are derived from the Prime Unity, or $1/1$, it holds true through the identity property of multiplication that any interval “added” to or “subtracted” from $1/1$ will result in a tone whose name is the same ratio as the interval it bears in relation to $1/1$.⁸ For example, the interval from “G” to “D” is a perfect fifth, or $3/2$ in ratio terms. Partch fixed his $1/1$ pitch as a “G” (for convenience this “G” was equivalent to the modern equal tempered “G” one and a half octaves below “middle C,” or more precisely 98 Hz). The interval $3/2$ when “added” to the tone

$1/1$ results in the Monophonic tone, $3/2$, a just perfect fifth higher than $1/1$. The tone $3/2$ is approximately equivalent to a “D,” or more accurately 147 Hz.

¹ In order to distinguish Partch’s term *Monophony*, which describes his unique system of just intonation including all of the principles it entails, and the traditional use of the word *monophonic*, used to describe a musical texture of one (or more) voices on a single line, the term Monophony will be capitalized when it refers to Partch’s system.

² David B. Doty defines *Just Intonation* as “any system of tuning in which all of the intervals can be represented by whole-number frequency ratios, *with a strongly implied preference for the simplest ratios compatible with a given musical purpose.*” (Doty, 1)

³ Aside from several isolated occurrences, the term “pitch class” will be substituted forthwith by the term “tone” in keeping with Partch’s nomenclature.

⁴ *Genesis*, 121

⁵ For the purpose of clarity, the convention used in this paper will be to print ratios referring to intervals in normal font, and ratios referring to specific tones in italics.

⁶ Alexander J. Ellis devised the *cent* as a unit of measurement for musical pitch within the twelve-tone equal tempered tuning system. In Ellis’s system there are 1200 cents per octave, and therefore 100 cents in a twelve-tone equal-tempered semitone. Cents are used in Table 1.1 to provide a familiar frame of reference for musicians used to thinking in terms of twelve-tone equal temperament.

⁷ Due to its evolution from Pythagorean tuning used in Western Europe during the Middle Ages, twelve-tone equal temperament bears a close resemblance to the twelve-tone Pythagorean chromatic scale, a scale built from successive just perfect fifths. In this scale, adjacent fourths and fifths are perfectly in tune, a fact that reflects their classification as consonances during the Middle Ages. On the other hand, thirds and sixths are relatively discordant, and bear a close resemblance to their twelve-tone equal tempered descendants. For example, the Pythagorean major third $81/64$ is equal to approximately 407.8 cents, and there is only a 7.8 cent difference between the Pythagorean major third and the twelve-tone equal tempered major third.

⁸ To calculate an ascending interval one must “add” the ratio of the interval to the ratio that describes the original pitch. The process for doing this is to multiply the numerator of the original pitch and the numerator of the interval, as well as the denominator of the original pitch and the denominator of the interval ($1/1 \times 3/2 = 3/2$; $3/2 \times 5/4 = 15/8$). To calculate a descending interval, one must “subtract” by multiplying the inverse of the descending interval with the original pitch ($1/1 \times 2/3 = 2/3 = 4/3$). In order to express the product ratio in simple form (within an octave, or more specifically, between $1/1$ and $2/1$) the numerator cannot be less than the denominator, nor can it be twice the denominator. If the denominator is less than the numerator, then double the numerator. If the numerator is more than twice the denominator then double the denominator.