The Intonation Systems of Harry Partch

Petter Ekman

Iceland Academy of the Arts
Music Department
B.A. in Composition

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Petter Ekman
Tutor: Atli Ingólfsson

Summary of content

This essay is an introduction to the intonational world of Harry Partch (1901-1974). It is divided into three main sections. The first section, ”Exposition on Intonation” serves mainly is an introduction to the subject. The primary intention here is to give the reader the information needed to understand the following chapters. This includes basic physics of sound, the language of expressing intervals in ratios and a short overview on Partch’s philosophy and aesthetics. The second main section is called ”The Construction of Scales”. In this section, Partch’s methods for scale construction are discussed. The tonality diamonds are explained as well as the scales derived from them. The last section, ”Limitations of the System” is a comprehensive critique on Partch’s work. Here, I have used Partch’s own methods of analysis to criticize his own methods. Three subjects are discussed in this section. The first subject is an examination of Partch’s irrational handling of his scales, how he converts his 29-scale into a 43-tone scale. The second subject is Partch’s inexact classification of intervals. The third subject is modulation, a concept that Partch’s systems are unfamiliar to. To sum up, this essay is a guide to getting to know Harry Partch as well as a critical examination of him.

Introduction

The american composer Harry Partch's (1901-1974) manifesto-like treatise *Genesis of a Music* was first published in 1949. Partch, an autodidact and an outsider in the academic world, rejected in this volume the conventions of western music, asserting that our twelve-tone chromatic scale is hopelessly restricted as a material for music and that our equally tempered tuning is a corruption of true harmony. Harry Partch is probably most famous for two things: his system of intonation with his 43-tone scale, and his unique, handmade instruments. The music he wrote for this system and these instruments seems to be less widely known. I call attention to this since it is a sad fact, but this essay is not about Partch's music but about his intonation systems.

Genesis of a Music is a complicated work. I have done my best here to summarize its essential subjects in as few words as possible. This essay may hopefully serve as an introduction for readers not yet familiar with Partch's work. However, my main ambition is to present the critique on Partch in the last main section of the essay, ”Limitations of the System”.

Exposition on Intonation

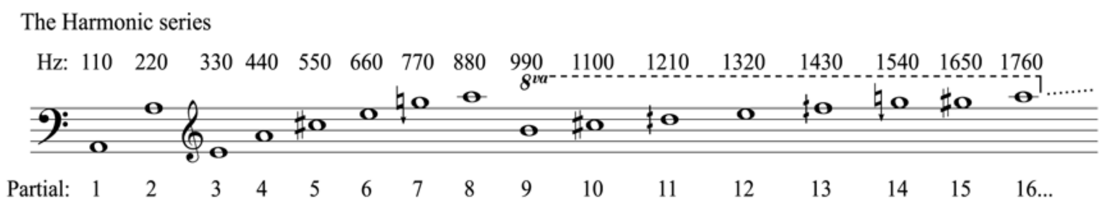
The Fundamentals of Sound

To understand Partch's ideas of harmony and tuning, one must understand some fundamental principles of sound and music. *The New Webster's Encyclopedic Dictionary of the English Language* describes sound as "mechanical vibrations transmitted through an elastic medium"[1]. What is called a *tone* or a *pitch* is an even vibration of constant speed. A fast vibration is heard as a high-pitched tone and a slow vibration is heard as a low-pitched tone. The velocity, or frequency, of the vibration is measured in cycles per second in the unit hertz (Hz)[2].

Except for people with the rather uncommon ability called absolute pitch, most humans cannot identify exact pitches. Nevertheless, the human ear, especially a trained one, has an extraordinary ability to determine pitches relatively. Even for people who do have absolute pitch, the *character* of a pitch is mainly relative, not absolute.

Partch meant that when two pitches are heard simultaneously the relationship between their frequencies decides how they sound together. Intervals where the relationship between the two frequencies can be expressed in a low-numbered ratio sound more consonant to our ears. The simpler the ratio, the more consonant the interval. Let us for example take the pitch A, which is 110 Hz. By multiplying the frequency by 2, 3, 4, 5, and so on, we get an infinite, constantly ascending series of pitches called the harmonic series.

Figure 1



The harmonic series was not invented by Partch but is part of a fundamental acoustic principle that says that whenever a tone is produced, it will also produce multiplications of itself. These multiplications are called partials. The first partial can

1 *The New Webster's Dictionary of the English Language,* Random House Value Publishing, Inc., New York, 1997, p.631

2 The unit Hertz was not yet internationally accepted when *Genesis of a Music* was written, Partch used the equivalent unit cycles per second.

either be referred to as partial 1 or as the *fundamental*. When we have the harmonic series written down with numbered partials, we can use it to find pitch ratios expressed in conventional notation. Since the pitches c#'' and a' have the partial numbers 5 and 4 respectively, we know that their ratio is 5/4. Looking closer into the harmonic series, we find that the intervals produced by multiplication are constant. For example, the interval between partial 6 and 9 is the same, a perfect fifth, as the interval between partial 10 and 15, and partial 4 and 6. This is because 9/6 = 15/10 = 6/4. Here, the reader must be aware of the difference between the numbering of partials and the naming of intervals. "Partial 5" has nothing to do with the interval "fifth".

Partch asserts that intervals sound more consonant the simpler their ratio is, this is confirmed by the harmonic series. The first interval is the octave, 2/1, between the two first partials. Since an octave is a simple doubling or halving of a frequency, most theorists treat pitches separated by octaves as the same pitch. Partch was no exception, he always transposed his ratios to fit within the octave ("A system of music is determined for one 2/1; the system is then duplicated in every other 2/1[3]"). It means that any frequency or ratio number can be doubled or halved when needed without affecting its theoretical function.

Partial 3 gives, together with the octaves of the fundamental, the intervals perfect fifth, 3/2, and perfect fourth, 4/3. The six first partials form a major triad, and with partial 5 we can get the intervals major third, 5/4; minor third, 6/5; major sixth, 5/3 and minor sixth, 8/5. Including higher odd numbers results in a greater degree of dissonance (especially with prime numbers because they cannot be described through multiplication). At a certain point, the ear stops recognizing the relationships and the impression of consonance disappears.

Equal Temperament

Up to partial 5, our notation system works well. However, today we tune most keyboard instruments in 12-tone equal temperament, which does not produce exact harmonic ratios. 12-tone equal temperament (generally referred to simply as "equal temperament") means that the octave is divided into 12 proportionally equal parts.

3 Partch, Harry: *Genesis of a Music, Second Edition, Enlarged,* Da Capo Press, 1974, pp. 79

This division produces no pure low-numbered ratios except for the octave, it is the opposite of the harmonic series, where pure ratios are a result of multiplication. Equal temperament produces fair imitations of all ratios based on numbers of five and below. The tempered perfect fifth, for example, is quite pure, with a ratio of ca 2.9966/2, instead of the justly intoned 3/2. In other words, it is 2 cents flat. The tempered major third is a bit more out of tune with the ratio 5.0421/4 (14 cents sharp) instead of 5/4, and the tempered minor sixth is equally flat. The tempered minor third has the ratio 5.946/5 (16 cents flat) instead of 6/5. The tempered major sixth is equally sharp.

Equal temperament has it advantages. Through it, tempered major and minor triads are possible on all 12 degrees of its chromatic scale. This means that any of its pitches can assume the role as fundamental and that modulation is possible to all key signatures. In Partch’s time, equal temperament was seen by almost all theorists as the superior system of intonation. However, Partch disagreed. He saw the falsification of the ratios in equal temperament as an “egregious corruption”[4]. Moreover, he disliked the traditional western practice of producing tension through chromaticism and adding of unrelated dissonances, instead of using the more complex ratios of the harmonic series. Equal temperament lacks representation for many of the upper partials, especially partial 7 and 11, which differ 31 cents and 49 cents respectively from their closest tempered equivalent.

Historical Reflections

Partch seems to have had two reasons for his break from western tuning: he detested non-just intervals and aways strived to be original. His rhetoric is often direct and rather harsh, but is also sharply intellectual, alternating between dubious assertions (for example about equal temperament's total failure to produce anything truly musical) and long and clever expositions of his ideas from a historical perspective.

Genesis of a Music contains two extensive chapters on the history of music. The first chapter, *”From Emperor Chun to the Vacant Lot”*, is a comprehensive critique of the development of music and drama beginning in ancient China and Greece and

4 Partch: *Genesis of a Music* pp. 185

ending with the early modernists of the twentieth century. This chapter gives the reader a good picture of Partch's aesthetics. However, perhaps the most interesting chapter is *"A Thumbnail Sketch of the History of Intonation"*. Here Partch, from his own unique perspective, examines chronologically and thoroughly discoveries and developments in the history of musical science. Reading this chapter, one discovers that that Partch's archenemy is not equal temperament but its predecessor, the Pythagorean tuning. Named after its credited inventor, Pythagoras of Samos (second half of the sixth century BC [5]; he may have been preceded by Chinese theorists), the Pythagorean intonation is based on 3/2s (fifths) , ignoring all other low-numbered ratios.

Partch extrapolates on the disadvantages of the Pythagorean view on the science of music. He illustrates the absurdity of the Pythagorean intervals, such as the major third. In the Pythagorean system, this interval is created by four fifths, equaling the ratio 81/64 when transposed into one octave. The just major third on the other hand, the one advocated by Partch, is made up by the ratio 5/4. If consonance is a consequence of low-numbered ratios, then 5/4 must be much more consonant than 81/64, but since only the fifth is accepted as a consonance in a Pythagorean system, 5/4 was rejected by Pythagorean theorists. In western music, intervals of 5 (thirds and sixths) were not widely accepted as consonances until about the age of the renaissance, and then only with the cautious caveat "incomplete".

Partch's Ideal

Partch believed that ratios should never be corrupted. He never allowed the purity of his ratios to be compromised in any of his works or theories. The system he called monophony proceeded from the idea of a single pitch functioning as root or fundamental of the key. He referred to this pitch with the ratio 1/1, indicating that it has a 1/1 relationship to itself. With this pitch established, he constructed a system of ratios around it. All these ratios are described with their function relative to the fundamental pitch. The second, "lower" number in Partch's ratios always refers to the fundamental pitch, and the first, "upper" number refers to the wanted pitch's relation to it. Consequently, 4/3 indicates a pitch that is in 4/3 relation with the fundamental.

As easily found in the harmonic series, this interval is a perfect fourth, which means that the pitch sought for is a perfect fourth above the fundamental.

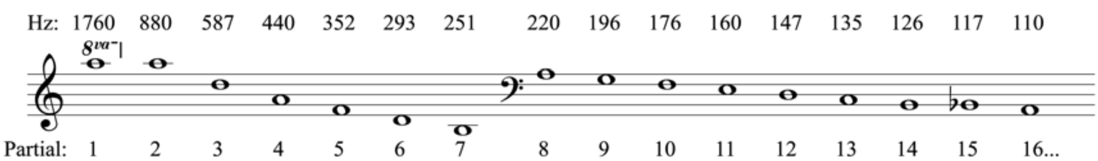
Despite Partch's desire for just intervals, he cared little for the harmonic series as a musical element. Instead, it was the intervals within it that he was looking for:

"... it is preferable to ignore partials as a source of musical materials. The ear is not impressed by partials as such. The faculty – the prime faculty – of the ear is the perception of small-number intervals, 2/1, 3/2, 4/3, etc., etc., and the ear cares not a whit whether these intervals are in or out of the overtone series."[6]

Many would disagree with this statement, but for Partch this conclusion was inevitable, since he needed to justify what he called *utonality.* The term utonality, derived from under-tonality, describes the sequence of ratios that appear when the harmonic series is put in a reversed order. It is the opposite of *otonality*, derived from over-tonality, which is the order of ratios found in the harmonic series. Unlike otonality, utonality is not a natural acoustic phenomenon, but is a theoretical construction. However, since the ratios of the utonality pattern are the same as those of the otonality pattern, Partch places utonality on an equal footing with otonality.

Figure 2

The Inverted harmonic series, "Utonality pattern"



The six first partials of the inverted harmonic series, the utonality series, form a minor triad instead of the major triad found in the regular harmonic series, or otonality pattern. This lead Partch to use otonality as an analogue to major in traditional harmony and utonality as an analogue to minor. He maintained this pseudo-major/minor polarization even in ratios without the traditional major/minor-defining number 5, the 3rd of a triad.

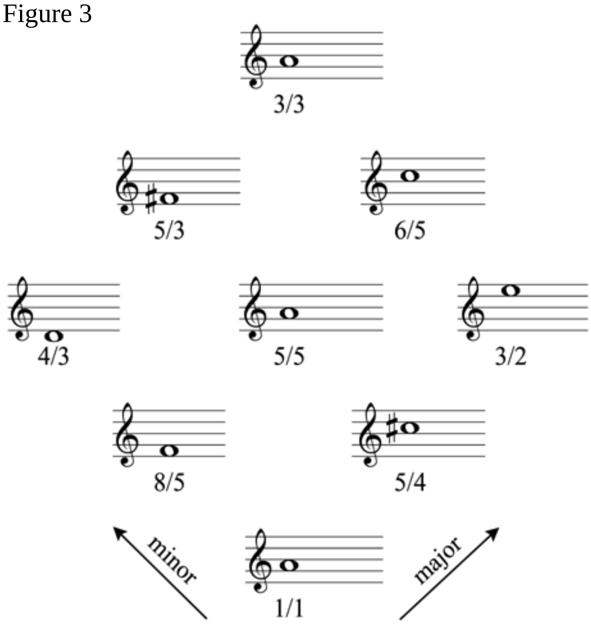
6 Partch: *Genesis of a Music* pp. 87

The Construction of Scales

The 5-limit

Partch found the best way to manifest his idea in the so called *tonality diamond*. The tonality diamond is a system of organizing and registering all pitches that can be derived from the ratios of a selection of numbers. One of the simplest examples is what Partch referred to as the 5-limit diamond.

Figure 3



The 5-limit diamond reproduces all ratios produced by numbers up to and including the number five.[7] It is arranged so that the numerator, henceforth called the “upper” number of the ratios, is decided by the pitch's diagonal lower-left to upper-right position in the diamond. The ratios in the lower-left row of the diamond thus have an upper number of 1 (or any of its octaves), the ratios in the diagonal middle row have an upper number of 5, and the ratios in the upper-right row have an upper number of 3. The denominator, henceforth called the “lower” number of the ratios is decided in the same way but by the pitch's diagonal lower-right to upper-left position. In the figure, the ratios have been translated into conventional notation, with the pitch a' serving as fundamental, or 1/1. The pitches of the vertical middle row are all the same as the fundamental. As mentioned above, the ratios make no distinction on octaves. In the figure, the pitches to the left of the vertical middle row have been written in a lower octave to elucidate the triadic relationships.

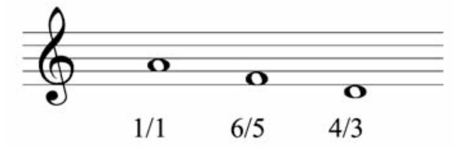
The diamond reveals a system where the pitches of all lower-left to upper-right diagonals form major triads, and where the pitches of all upper-left to lower-right diagonals form minor triads. The result is a major triad starting on every pitch of the

7 The term “limit” was employed by Partch to describe which ratios he included in his systems. Similarly, 7-limit means that all numbers up to and including seven are included.

minor triad of the lower-left diagonal row, and an inverted major triad, that is to say a minor triad, starting on every pitch of the lower-right diagonal row.

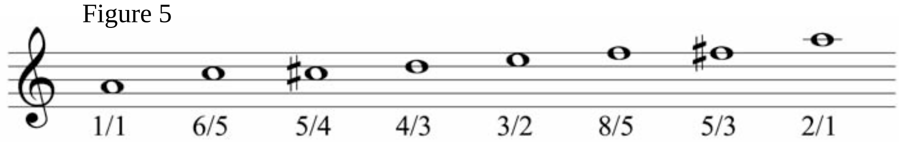
It is worth noting here that the location of a “root” in minor triads is controversial. Minor triads are inversions of major triads, as utonality is an inversion of otonality. The fundamental, the 1/1, is theoretically the root, but the the fifth between the 4/3 and the 1/1 creates a strong emphasis on the 4/3 as a root. This is illustrated in figure 4. However, the concept of a root is not necessary in tonality diamonds and Partch dismisses the paradox of roots as a matter of taste: “...the composer needs no greater authority than his fancy to put the “root” wherever he wants to put it”[8].

Figure 4



When the ratios are interpreted in a single octave and put in ascending order, a 7-tone non-diatonic scale results. With the 2/1 added it becomes symmetrical, the prime form equals the inversion. This is the natural and inevitable consequence of Partch’s equal treatment of otonality and utonality.

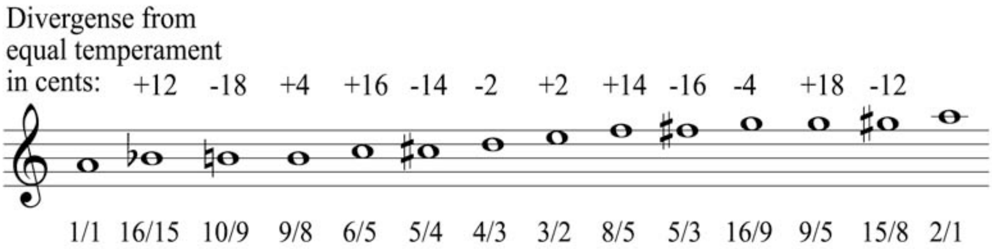
Figure 5



Partch's next step was an less rational decision. He disliked the big intervals between 1/1 and 6/5, and between 5/3 and 2/1, both equalling to 315.6 cents, and also the interval between 4/3 and 3/2 (equaling to 203.9 cents). So he decided to add new ratios outside the closed system of the diamond to fill up the gaps. Since all ratios of 5 and under were already exploited, Partch had to leave the 5-limit, and he did so by allowing multiplication of the numbers 3 and 5, thus allowing ratios of 9 (3*3) and 15 (3*5). The result was a diamond with 16 new ratios but since ten of them were only multiplications of ratios already found in the original diamond, only six new pitches. These ratios filled up the gaps at each end of the scale, resulting in a new scale with 13 degrees.

8 Partch: *Genesis of a Music* pp. 112

Figure 6



As illustrated by figure 6, this scale employs microtonal intervals indescribable by conventional notation. The ratios 9/8 and 10/9 are closely related to the tempered major 2nd and in diatonic harmony they are known from the interval sequence of the first three degrees of the just major scale (the first ratios of the just major scale are: 1/1; 9/8; 5/4, the interval between 9/8 and 5/4 equals 10/9 so that the interval sequence is 1/1; 9/8; 10/9). While both 9/8 and 10/9 are familiar to our ears as independent melodic intervals, the interval between the two pitches that are produced when the intervals are played from a common fundamental was unknown to us before. This interval has the ratio 81/80[9]. Though such a small interval would be called enharmonic in traditional western harmony, in Partch's music it has the status of a melodic interval.

While most composers would have settled with 13 pitch classes, for Partch this was only the beginning. Partch's thorough description of the 5-limit system is an exposition of the essential ideas of monophony. The 5-limit did not give him the microtonal possibilities he desired. By extending the system to all numbers up to and including 11, he increased the microtonal content.

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9 81/80 also equals the so called syntonic comma, which is the difference between the just (5/4, or 80/64) and the pythagorean (81/64) major thirds, about 22 cents.

The 11-limit

Figure 7

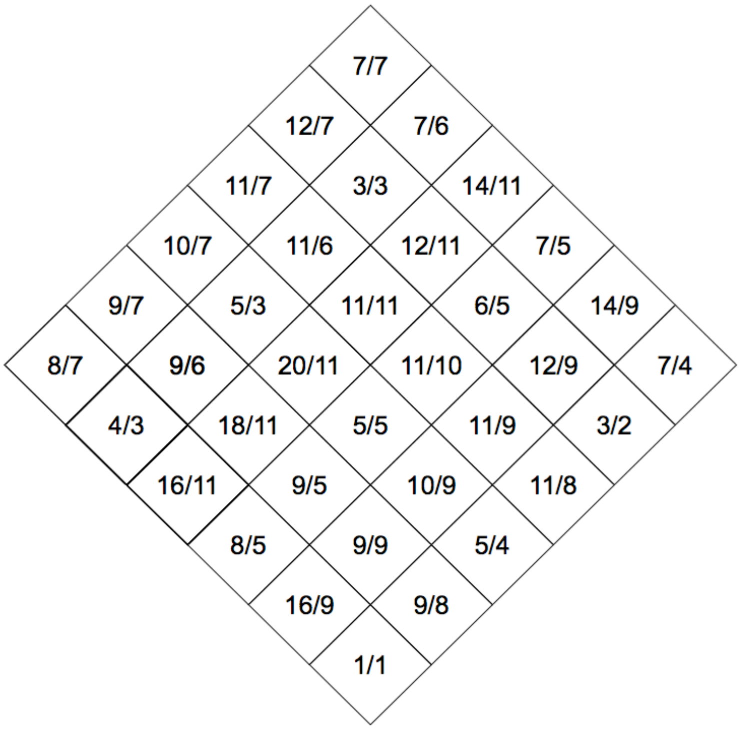


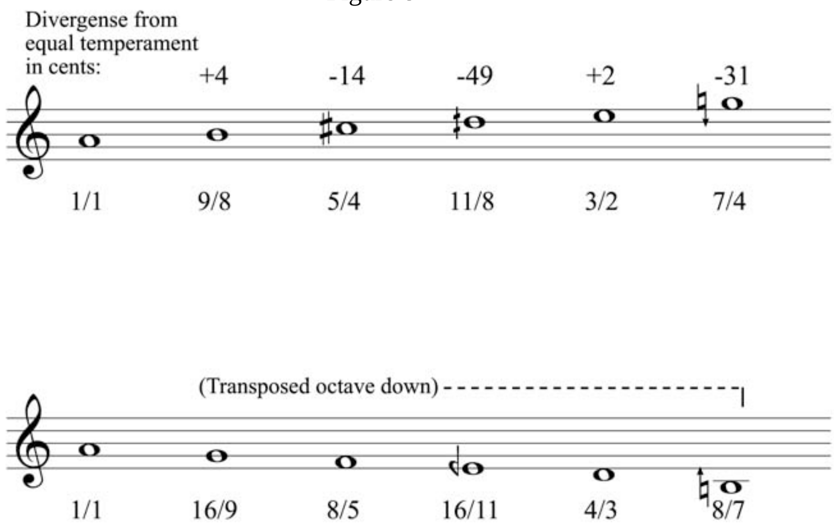
Figure 7 shows the 11-limit tonality diamond. It is organized in the same way as the 5-limit diamond but it is larger and more complex, since it employs more and higher numbers. The 1/1; 5/4; 3/2 sequence, of the lower right row of the 5-limit diamond is here expanded into the sequence 1/1; 9/8; 5/4; 11/8; 3/2; 7/4. What was once a major triad in the 5-limit system is now a hexachord (a group of six pitches). As with the 5-limit diamond, which was best understood as a development of triads, the 11-limit diamond is easiest to explain as a system of hexachords. The lower-right row is the otonality, or major[10], hexachord from 1/1. The lower-left row is the utonality, or minor, hexachord from 1/1. The other pitches of the system are derived from the hexachords in the same way as the pitches were derived from the triads of the 5-limit system: with a minor hexachord starting on every pitch of the major hexachord of 1/1, and a major hexachord starting on every pitch of the minor hexachord on 1/1. The diamond contains 36 ratios, but since some ratios have the same proportions, it contains “only” 29 separate pitches.

When the pitches of the diamond are put in ascending order into a scale, conventional notation is far from sufficient. The scale contains intervals as small as 121/120, or 14 cents, which is the interval found between 12/11 and 11/10, and between 20/11 and 11/6. It would be meaningless to try to describe such microtonality with a notation system designed for 12 tones and intervals never lesser than 100 cents. The hexachords of the lower-left and lower-right rows of the diamond can be notated

10 Even though the hexachords differ from diatonic scales, the terms major and minor can be adequately used to describe them since they contain either major or minor triads.

fairly accurately though, as long as one is aware of the deviation from equal temperament. From these original hexachords, it is easy to calculate the pitches of all ratios in the diamond.

Figure 8



Not even 29 pitches were enough for Partch. As in the 5-limit system, wide gaps occurred at the beginning and at the end of the scale, in this case in the intervals 1/1 to 12/11 and its counterpart 11/6 to 2/1, both equaling the ratio 12/11 or 150.6 cents. Again, Partch's solution was to allow the numbers of the ratios to be multiplied.

In the extended 5-limit scale, he simply allowed two new numbers, 9 and 15 and included them in his diamond. In that case it resulted in a more even scale. Such a process with the 11-limit diamond would have resulted in an immense number of pitches and would not have filled out the gaps as intended. Instead he located the largest gaps in his 29-tone scale and filled them out with ratios resulted from multiplication in order to craft a more even (if less coherent) scale. The largest gaps were (apart from those already mentioned) 7/6 to 6/5, 9/7 to 4/3, 4/3 to 11/8, and their counterparts 16/11 to 3/2, 3/2 to 14/9 and 5/3 to 12/7. All of these were in the range of 48 to 63 cents, or roughly a quartertone, apparently too large for Partch's taste. Partch filled the gaps with ratios handpicked to result in a scale as even as possible, the only caveat being that they should be multiples of numbers lower than 11. The result was a relatively even scale of 43 degrees where no successive intervals are smaller than 14.4 cents (121/120) or larger than 38.9 cents (45/44). Between these 43 tones, 340 intervals can be found.[11] Needless to say, space does not permit the complete scale's

[11] Partch: *Genesis of a Music* pp. 156

inclusion here.

This 43-tone scale or *gamut,* was the one most often used by Partch and consequently the one most closely associated with him. However, it must not be forgotten that it was by no means the only one he used. Throughout his life he experimented with several systems, most of them based on the structure of diamonds. Experiments with 7-limit, 9-limit and even 13-limit systems, as well as different approaches to the 11-limit resulted in 37-, 39-, 41- and 55-tone gamuts to mention but a few.

Limitations of the System

The Problem With the Scale

Monophony is in most senses a logical system. We may assume that Partch's view on ratios is correct. Nothing refutes that the ratios between pitches determine what we experience as consonance and that low-numbered ratios equal a higher degree of consonance. The diamond organization is then a good way of finding the closest related pitches from a single fundamental. The main problem with monophony is not the system itself but Partch's inconsistent treatment of it.

Genesis of a Music relies on the assumption that music is a science. Inspired by ancient Greek as well as ancient Chinese philosophy, Partch believed that the origin of music is in the physics of sound. He speaks disdainfully about equal temperament and the western ”Golden age of music” as ”...the complete divorcement of the science of music from music theory...” and regarding the nature of this music as ”…the benevolent fraud of equally-tempered modulation...”[12].

Whether Partch's critique on equal temperament is justified or not will not be discussed further here. Instead, let us apply some of Partch's arguments against equal temperament to his own systems. No matter how hard he tried to be rational and to act scientifically, Partch remained an intuitive and emotional artist. In the construction of his systems, he pursued a rational selection of ratios, but only as long as it corresponded to his own ideals for a system of intonation. One of these ideals was the idea of a scale. The rational approach would be to accept the unevenness that is the result of strict treatment of the limits of the monophonic fabric, to limit the gamut to

[12] Partch: *Genesis of a Music* pp. 348

include only the ratios found in the diamond of the respective system. As we have see, Partch was prepared to expand his diamond (as in the extended 5-limit gamut) and even to add distantly related ratios wherever he considered them appropriate (as in the extended 11-limit) only to satisfy his desire for an even scale. He did not even bother to explain *why* the gaps of the initial gamuts needed to be filled; after asserting that the gaps were present, he proceeded to theoretically justify his decisions after the fact and without any further explanation[13]. Partch was convinced that scales were an essential part of music, and his conviction was so strong that he saw no reason to question this assumption or even to mention it in his theoretical work. This was despite the fact that his own system, the system he believed to be the closest to the physics of sound and the science of music, did not naturally result in scales. The logical conclusion may have been that scales are not implied by nature. Instead of strictly following his own concepts Partch reverted to an ideal not too far from that of Pythagoreanism and equal temperament. The modification of his systems into even scales was nothing but a symptom of the unscientific approach he despised.

The Classification of Intervals

Partch's classification of intervals is even more unscientific in approach. Partch asserted that the degree of consonance of an interval depended only on the largeness of the numbers involved in its ratio (”…the ear consciously or unconsciously classifies intervals according to their comparative consonance or comparative dissonance; this faculty stems directly from the comparative smallness or comparative largeness of the numbers of the vibrational ratio; and the faculty of the ear to bring definitive judgement to comparative consonance decreases as the numbers of the vibrational ratio increase.”). Whether this is completely true or not does not matter at the moment, what is interesting is Partch's inconsistency with this theory. For some reason, Partch found it appropriate to classify his intervals. After noting that the present classification system of perfect, major, minor, augmented and diminished intervals is ”fair so far as it goes”[14], he described his own system of classification. While the traditional interval classification was actually at least partly based on ratios

[13] Partch: *Genesis of a Music* pp. 113-114, 130-132

[14] Partch: *Genesis of a Music* pp. 156

rather than equal temperament (all the intervals of the 5-limit have names), Partch approached the intervals in a different way: by the largeness of the interval measured in distance between the pitches and not by their ratio.

Figure 9

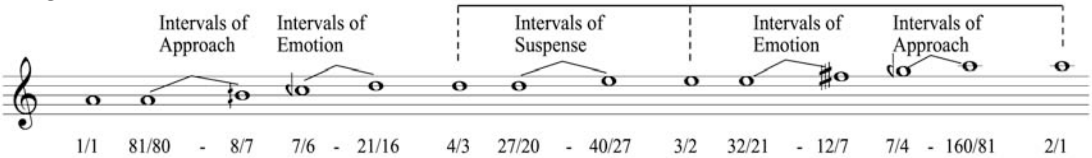


Figure 9, shows how Partch classified the ratios of the 11-limit gamut into four categories. The Intervals of Power were octaves, fifths and fourths; Intervals of Emotion were intervals with the approximate size of thirds and sixths; Intervals of Approach were approximate seconds and sevenths and Intervals of Suspense were all intervals between the fourth and the fifth. It is interesting how Partch contradicts himself by ignoring the largeness of the numbers within his ratios, for example by placing the fairly low-numbered 8/7 in the Intervals of Approach-category together with the high-numbered 81/80. The 32/27 is similarly placed in the Intervals of Emotion-category together with 5/4 and 6/5. A more logical classification would be based on the largeness of the numbers included in the ratios, which Partch also employs in a graph oddly named ”The One-Footed Bride”, not included here. This graph shows the relative consonance of the intervals based on their ratios. However, even though he has previously stated that the numbers of the ratios is the only factor that gives the intervals their qualities, which is also supported by the graph, he sticks to his classification of the intervals into categories. The reason for this is found when the ratios are transformed into audible pitches:

A good example is the ratio 14/11. It employs two relatively high primes, eleven and seven, and it should consequently be a relatively dissonant interval. Then we compare it with the ratio 10/9. This ratio employs lower numbers and should consequently be more consonant. However, 14/11 is likely to sound more consonant to our ears due to the narrowness of 10/9 and due to 14/11’s proximity to 5/4 (14/11 is 31.2 cents sharper than 5/4). Though Partch would probably blame this on our ”temperament-perverted ear[s]”[15] he seems not to have been immune to this influence himself. Another explanation would be that since the 14/11 is wider, it *is* actually

[15] Partch: *Genesis of a Music* pp. 115

more consonant than 10/9, which would mean that a great part of Partch's theories are incorrect. Yet another explanation would be that consonance is actually a subjective definition and nothing absolute, which would also contradict Partch's theories.

On the other hand, even if Partch did overestimate the importance of ratios this does not make his 43-tone gamut less practicable. Even if our ears do not accept intervals of higher numbers like eleven and nine as consonant, we do definitely hear the difference between correctly and incorrectly intoned intervals of three and five, and most likely also with intervals of seven. It is a fact that justly intoned triads are more pleasant than tempered triads. Also, it is obvious that a system of 43 pitches within an octave and 340 different intervals provides opportunities not found in a system of twelve pitches and twelve intervals.

Modulation

The two systems, monophony and equal temperament, are essentially different from each others. We think of equal temperament in terms of a closed circle, the circle of fifths, where all pitches are equal and where every pitch can accept any function of its fabric. The structure of monophony resembles more that of a tree, the ratios of monophony are developed from the fundamental pitch in the same way as the trunk of a tree fork into branches. As is evident with a tree, the trunk is constant. A branch cannot be reinterpreted as a trunk and in the same way, the fundamental of monophony is constant. This makes all modulation except for the simplest tonicization impracticable. An instrument tuned in the 43-tone gamut can play in one key only. Such a thing as a monophonic system of intonation where "all" keys are possible does not exist even in theory since every key has its own fabric of ratios and every one of these ratios will in turn give a new fabric of ratios if they are interpreted as fundamentals. The only solution would be to compensate the purity of the ratios and create some kind of temperament, but since Partch would never accept this, the system is infinite. Partch's dedicated an entire chapter called *The Question of Resolution* to modulation but failed to refute the fact that monophony is limited when it comes to modulation. Stubborn as he was, Partch refused to admit any disadvantages with his intonation system. Again, Partch did not accept what his system implied. He could have realized that modulation was not a natural part of monophony it but did so not.

Conclusion

My conclusion here is that in the in the adding of scale degrees, in the classification of intervals and in the attempts to justify modulation, we hear the voice of the artist and the musician Partch and not the scientist. Monophony was not given to Partch by nature but was invented by him to fit his musical ideals. However, monophony was built on a correct assertion, the assertion on the value of just intervals. Thanks to this, monophony gives a much better idea of the concept of consonance than equal temperament and pythagorean tuning have ever done.

As a scientific treatise, *Genesis of a Music* contains some inconsistency but its main theses are pioneering and brilliant. Partch could not follow his ideas in completely consistent way but on the other hand, it may have be this inconsistency that resulted in his unique and beautiful music. As an avant-garde artist he exposed the unexplored world of microtonality. More importantly though, he makes us question the foundations of our music, he makes us investigate what we would otherwise take for granted.

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