# Exposition of Monophony

## THE 11 DIATONIC INTERVALS

### The Overtone Series

It is not important whether one chooses to say that musical intervals have their source in the ratios of simple numbers, as did Pythagoras of Samos in the sixth century B. C., or that their source is in the overtone series, the phenomenon discovered by Marin Mersenne, French monk of the seventeenth century. The result is the same. Because a more graphic analysis is possible, intervals will be explained as having their source in ~~the~~ overtones ~~series~~. This work is called Exposition of Monophony in recognition of a single tone and its overtones ~~series~~.

Just intonation is any system of tuning with intervals exactly the same as the intervals of the overtone series. Therefore, the name Monophony might apply to any system of just intonation.

The tone of a string that makes one vibration in a certain length of time will be called fundamental, or 1. It is known that while the string is making one vibration it is also dividing itself in half, each half vibrating twice in the same length of time, creating the second overtone, or 2, the octave, the simplest and strongest of all intervals, 2/1; that it divides itself in three parts, each third vibrating three times in the same length of time, creating the third overtone, or 3; into four parts, creating the fourth overtone, or 4, the octave of 2, or the second octave of 1, and into five parts, creating the fifth overtone, or 5.

On the piano, if middle C is fundamental, the octave above is 2, the second G above 3, the second octave above 4, and the third E above 5.

The intervals of the pentatonic scale, one of the first used by man, have their genesis within 3. (They are expressed in the ratios 1-9/8-4/3-3/2-16/9-2/1).

or C-D-F-G-Bb-C. They may be seen in the ratios of the diatonic scales, explained immediately following.)

The intervals of the diatonic scales have their genesis within 5. The first of those intervals is the octave, 2/1, into which all the other intervals must be transposed to make them musically available. In a practical system of music the octave of a tone can have no identity; it is simply double the number of vibrations. A system is evolved for one octave, of which every other is a duplication.

The next interval is C to G, 2 to 3, or 3/2, the perfect fifth. It is transposed down an octave and is still C to G. The next is G to C, 3 to 4, or 4/3, which must be transposed within the 2/1, the distance of a perfect 12th, and becomes C to F, the same 4/3 relationship, thus creating the tone F. C to E, 4 to 5, or 5/4, transposed down two octaves within the 2/1, remains C to E. G to E, 3 to 5, or 5/3, transposed within the 2/1, down a perfect 12th, becomes C to A, the same 5/3 relationship, creating the tone A.

The odd-numbered of the overtone series are the only identities. The octave of G, 3, is G, 6. Then without drawing further from the series there is the interval E to G, 5 to 6, or 6/5, transposed to 1, the distance of an octave and a major 10th, giving the interval C to Eb, the same relationship. And there is also the interval E to C, 5 to 8, or 8/5 (8 is the octave of 4), which, transposed to 1, an octave and a major 10th, creates the interval C to Ab, the same relationship.

The words interval, ratio, relationship, tone, are practically synonymous in this exposition. A tone implies a ratio to its fundamental, and an interval is a ratio, or relationship.

To avoid confusion these simple intervals should be recognized by their ratios. Hereafter they will be used without translation to tempered scale nomenclature. The intervals are:

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|---|---|
| 2/1 -- octave | 5/4 -- major 3rd |
| 3/2 -- perfect 5th | 5/3 -- major 6th |
| 4/3 -- perfect 4th | 6/5 -- minor 3rd |
| | 8/5 -- minor 6th |

There are then left to discover only the major and minor 7ths and 2nds, occurring at the beginning and end of the scale. These are the result of ~~the addition of~~ two intervals within 5. The third of the string, which creates 3, divides into three parts, each part vibrating three times as fast as the third, or nine times as fast as 1, creating the 9th overtone, the fourth D above middle C in the series given before. One of the two possible new intervals is then C to D, 8 to 9, or 9/8, the major 2nd, which transposed down three 2/1s, is still C to D. Analyzed, it is the result of two 3/1s, or 3/2s--$\frac{3}{2}\times\frac{3}{2}=\frac{9}{4}$, or $\frac{9}{8}$.

It should be clearly understood that any ratio with a lower number less than half the larger is wider than a 2/1, and that doubling the lower is merely making the interval narrower by a 2/1. Doubling the upper widens the interval by a 2/1. Halving has the reverse effects.

The 9th overtone also allows the interval D to C, 9 to 16, or 16/9, the minor 7th. Analyzed, it is the result of two 4/3s--$\frac{4}{3}\times\frac{4}{3}=\frac{16}{9}$. Transposed within the 2/1, the distance of three 2/1s and a major 2nd, it becomes C to Bb, the same relationship.

The pentatonic scale is built from the intervals within 3, 1-4/3-3/2-2/1 (C-F-G-C), and the wide intervals 1-4/3 and 3/2-2/1 are divided by intervals that are the result of two intervals within 3, 9/8 and 16/9 (D and Bb).

The fifth of the string, which creates the 5th overtone, divides into three parts, each third vibrating three times as fast as the fifth or fifteen