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A SURVEY OF TUNING AND TEMPERAMENT IN THE 18th CENTURY AND THE ATTITUDES REGARDING ITS IMPLEMENTATION

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Today's standardized tuning practices make a working knowledge of temperament unnecessary. The modern musician has heard of the Well-tempered Clavier and knows that the piano is tuned in equal temperament. Terms such as "Pythagorean", "just", or "meantone" tuning may be recognized from a history or theory class, but their definitions have probably become mixed and hazy through disuse. During the 18th Century, the period just prior to the adoption of equal temperament, a knowledge of the vocabulary and mechanics of tuning were essential to every accomplished musician. If an 18th-Century musician played several instruments he could easily encounter two or three different tuning systems in the course of a day's work. This paper will explain these various tuning systems and examine the attitudes of the musicians who used them and the relationship between the tunings systems and instrument construction and technique.

I

When two pitches with frequencies varying by simple whole number ratios of 2:1, 3:2, 4:3, and 5:4 are sounded together the resulting sound will be pure and without beats.[1] Since these ratios correspond respectively to the octave, fifth, fourth, and third of Western music, the laws of nature and man would appear to be in significant and advantageous harmony. When Pythagoras discovered this in the 6th century B. C., the natural order of nature seemed confirmed. Unfortunately for Pythagoras and all subsequent theorists, a flaw soon appeared in this nicely ordered scheme. The system works well for a single-note diatonic melody or melody with a tonic drone, but problems arise in polyphonic music of any complexity. Any attempt to play other than a tonic chord or to change the key center will quickly result in harsh and dissonant sounds, since all the ratios are related to the tonic. In order to have a system of small-integer, or "just", ratios that could be played without beats in different keys, a separate set of intervals would be needed for each step of the original scale. If the original scale had 12 pitches to the octave, the final result would have 132 separate pitches and some of these would be theoretically out of tune if used in a modulatory section. Obviously, perfect mathematical intonation is impossible in real music and a compromise must be sought. From among the many theories concerning the proper division of the octave, four have emerged as the most important to Western music. These are Pythagorian, just intonation, equal temperament, and meantone tuning.

[1]Arthur H. Benade, Horns, Strings & Harmony (Garden City, New York: Anchor Books, 1960), p. 77. Beats result when two tones of nearly the same pitch or with a common harmonic are sounded together. As the pulses of the slower frequency gradually fall behind the other, the amplitude of the sound is alternately cancelled and reinforced as the sound waves move in and out of phase. The beat pulse is the same as the difference in the two frequencies.

When discussing the various tunings and temperaments, we must consider the cents system associated with modern equal temperament. In this system the octave is divided into 1200 equal parts producing half-steps of 100 cents each. For example, the equal temperament fifth of seven half-steps would have a cents value of 700.

Pythagoras derived his system from the octave, 2:1, and the just fifth, 3:2, along with its inversion the fourth, 4:3. The just third was not considered in this system. One possible explanation is that the third was simply not an important interval to the Greeks, just as it was not considered a consonance during most of the Middle Ages. Another is that Pythagoras was as concerned with the philosophy of the system as with the actual music and a system based solely on two of the smallest whole integer ratios was too profound to be unnecessarily cluttered. A diatonic scale derived from this system has whole steps which are slightly larger than an equally tempered scale and half-steps which are 10 cents smaller. The Pythagorean third is 22 cents higher than a just third (5:4). The difference between the Pythagorean third and the just third is known as the Syntonic Comma. If the process of tuning by fifths is extended beyond twelve notes, Pythagorean sharps will be 24 cents higher than their enharmonic flats. This interval of 24 cents is known as the Ditonic Comma.[2] Since the difference of 2 cents between the syntonic and ditonic is at the threshold of perception, there is generally no need to make a distinction. A comma is usually considered 1/9 of a whole-tone.

Just intonation refers to any system having both pure fifths and pure major thirds. The ratio 5:4 is used for a just major third and

[2] J. Murray Barbour, Tuning and Temperament: A Historical Survey (East Lansing, Mich.: Michigan State College Press, 1951), p. ix.