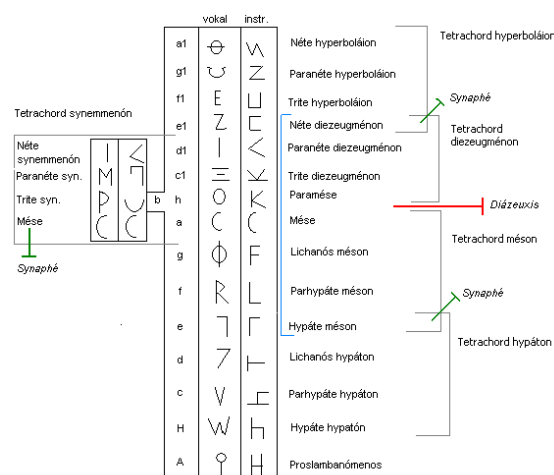


Musical system of ancient Greece

This article concerns itself with the music theory and musical intervals used since Ancient Greece (see also [musical tuning](#)). For a discussion of the cultural aspects and history of ancient Greek music, see [Music of ancient Greece](#).

The **musical system of ancient Greece** evolved over a period of more than 500 years from simple scales of tetrachords, or divisions of the perfect fourth, to *The Perfect Immutable System*, encompassing a span of fifteen pitch keys (see *tonoi* below) (Chalmers 1993, chapt. 6, p. 99)

Any discussion of ancient Greek music, theoretical, philosophical or aesthetic, is fraught with two problems: there are few examples of written music, and there are many, sometimes fragmentary theoretical and philosophical accounts. This article provides an overview that includes examples of different kinds of classification while also trying to show the broader form evolving from the simple tetrachord to system as a whole.



Depiction of the ancient Greek Tone system



The central octave of the ancient Greek system

1 *Systēma ametabolon*, an overview of the tone system

At about the turn of the 5th to 4th century BCE the tonal system, **systema teleion**, had been elaborated in its entirety. As an initial introduction to the principal names of the divisions of the system and the framing tetrachords, a depiction of notes and positional terms follows. Please note, this is an as yet not completely translated version of a German illustration, hence, *b* in the illustration is B \flat and *h*, B \natural .

Greek theorists conceived of scales from higher pitch to lower (the opposite of modern practice), and the largest intervals were always at the top of the tetrachord, with the smallest at the bottom. The 'characteristic interval' of a tetrachord is the largest one (or the 'tone' in the case of the 'tense/hard diatonic' genus). The image shows the descending two octaves of tones with corresponding modern note symbols and ancient Greek vocal, and instrumental, note symbols in the central columns. The modern note names are merely there for an orientation as to the intervals. They do not correspond to ancient Greek pitches or note names. The section delimited by a blue brace is the range of the central octave. The range is approximately what we today depict as follows:

The Greek note symbols originate from the work of Egert Pöhlmann (1970).

The **Greater Perfect System** (*systēma teleion meizon*) was composed of four stacked tetrachords called the (from bottom to top) Hypatôn, Mesôn, Diezeugmenôn and Hyperbolaiôn tetrachords (see the right hand side of the diagram). Each of these tetrachords contains the two fixed notes that bound it.

The octaves are each composed of two like tetrachords (1–1– $\frac{1}{2}$) connected by one common tone, the "*Synaphé*". At the position of the *Paramése*, which should be the connecting (*Synaphé*) tone, the continuation of the system encounters a boundary (at b-flat, *b*). To retain the logic of the internal divisions of the tetrachords (see below for more detail) such that *mésôn* not consist of three whole tone steps (b–a–g–f), an interstitial note, the *diázeuxis* ('dividing') was introduced between *Paramése* and *Mése*. The tetrachord *diezeugménôn* is the 'divided'. To bridge this inconsistency, the system allowed moving the *Néte* one step up permitting the construction of the *synemmenón* ('connecting') tetrachord (see the far left of the diagram).

The use of the synemmenón tetrachord effected a modulation of the system, hence the name *systema metabolon*,

the modulating system also the **Lesser Perfect System**. It was considered apart, built of three stacked tetrachords—the Hypatôn, Mesôn and Synêmmenôn. The first two of these are the same as the first two tetrachords of the Greater Perfect (right side diagram), with a third tetrachord placed above the Mesôn (left side diagram). When viewed together, with the Synêmmenôn tetrachord placed between the Mesôn and Diezeugmenôn tetrachords, they make up the **Immutable** (or Unmodulating) **System** (systêma ametabolon).

In sum, it is clear that the ancient Greeks conceived of a unified system with the octave as the unifying structure (interval). The very last (deepest) tone no longer belongs to the system of tetrachords reflected in its name, the *Proslambanomenós*, the adjoined.

Below elaborates the mathematics that led to the logic of the system of tetrachords just described.

2 The Pythagoreans

Main article: Pythagorean interval

After the discovery of the fundamental intervals (octave, fourth and fifth), the first systematic divisions of the octave we know of were those of Pythagoras to whom was often attributed the discovery that the frequency of a vibrating string is inversely proportional to its length. Pythagoras construed the intervals arithmetically, allowing for 1:1 = Unison, 2:1 = Octave, 3:2 = Fifth, 4:3 = Fourth within the octave. Pythagoras's scale consists of a stack of perfect fifths, the ratio 3:2 (see also Pythagorean Interval and Pythagorean Tuning).

The earliest such description of a scale is found in Philolaus fr. B6. Philolaus recognizes that, if we go up the interval of a fourth from any given note, and then up the interval of a fifth, the final note is an octave above the first note. Thus, the octave is made up of a fourth and a fifth. ... Philolaus's scale thus consisted of the following intervals: 9:8, 9:8, 256:243 [these three intervals take us up a fourth], 9:8, 9:8, 9:8, 256:243 [these four intervals make up a fifth and complete the octave from our starting note]. This scale is known as the Pythagorean diatonic and is the scale that Plato adopted in the construction of the world soul in the *Timaeus* (36a-b). (Huffman 2011)

The next notable Pythagorean theorist we know of is Archytas, contemporary and friend of Plato, who explained the use of arithmetic, geometric and harmonic means in tuning musical instruments. Archytas is the first ancient Greek theorist to provide ratios for all 3 genera (Chalmers 1993, chapt. 6, p. 99). Archytas provided a

rigorous proof that the basic musical intervals cannot be divided in half, or in other words, that there is no mean proportional between numbers in super-particular ratio (octave 2:1, fourth 4:3, fifth 3:2, 9:8) (Huffman 2011; Barker 1984–89, 2:46–52). Euclid in his *The Division of the Canon* (*Katatomē kanonos*, the Latin *Sectio Canonis*) further developed Archytas's theory, elaborating the acoustics with reference to the frequency of vibrations (or movements) (Levin 1990,).

The three divisions of the tetrachords of Archytas were: the enharmonic 5:4, 36:35, and 28:27; the chromatic 32:27, 243:224, and 28:27; and the diatonic 9:8, 8:7, and 28:27 (Huffman 2011). The three tunings of Archytas appear to have corresponded to the actual musical practice of his day (Barker 1984–89, 2:46–52).

Tetrachords were classified in ancient Greek theory into genera depending on the position of the third note *lichanos* (the indicator) from the bottom of the lower tetrachord (in the upper tetrachord, referred to as the *paranete*). The interval between this note and the uppermost define the genus. A *lichanos* a minor third from the bottom and one whole (major second) from the top, genus diatonic. If the interval was a minor third, about one whole tone from the bottom, genus chromatic. If the interval was a major third with the 4/3 (or a semitone from the bottom), genus enharmonic (Chalmers 1993, chapt. 5, p. 47). In Archytas's case, only the *lichanos* varies.

More generally, depending on the positioning of the interposed tones in the tetrachords, three genera of all seven octave species can be recognized. The diatonic genus is composed of tones and semitones. The chromatic genus is composed of semitones and a minor third. The enharmonic genus consists of a major third and two quarter-tones or diesis (Cleonides 1965, 35–36). After the introduction of the Aristoxenos system (see below), the framing interval of the fourth is fixed, while the two internal (*lichanoi* and *parhypate*) pitches are movable. Within the basic forms the intervals of the chromatic and diatonic genera were varied further by three and two “shades” (*chroai*), respectively (Cleonides 1965, 39–40; Mathiesen 2001a, 6(iii)(e)).

The elaboration of the tetrachords was also accompanied by penta- and hexachords. As stated above, the union of tetra- and pentachords yields the octachord, or the complete heptatonic scale. However, there is sufficient evidence that two tetrachords were initially conjoined with an intermediary or shared note. The final evolution of the system did not end with the octave as such but with *Systema teleion* (above), a set of five tetrachords linked by conjunction and disjunction into arrays of tones spanning two octaves (Chalmers 1993, chapt. 6, p. 99).

After elaborating the *Systema teleion* in light of empirical studies of the division of the tetrachord (arithmetic, geometrical and harmonious means) and composition of *tonoilharmoniai*, we examine the most significant

individual system, that of *Aristoxenos*, which influenced much classification well into the Middle Ages.

The empirical research of scholars like Richard Crocker (1963) (also Crocker 1964 Crocker 1966), C. André Barbera (1977) and Barbera (1984), and John Chalmers (1990) has made it possible to look at the ancient Greek systems as a whole without regard to the tastes of any one ancient theorist. The primary genera they examine are those of Pythagoras (school), Archytas, Aristoxenos, and Ptolemy (including his versions of the Didymos and Eratosthenes genera) (Chalmers 1993, chapt. 5, pp. 48–51). The following reproduces tables from Chalmers show the common ancient *harmoniai*, the octave species (*tonoi*) in all genera and the system as a whole with all tones of the gamut.

3 The octave species in all genera

Main article: [Octave species](#)

The order of the octave species names in the following table are the traditional Greek, followed by later alternates, Greek and other. The species and notation are built around the E mode (Dorian).

Although the Dorian, Phrygian, and Lydian modes have distinctive tetrachordal forms, these forms were never named after their parent modes by any of the Greek theorists. In the chromatic and enharmonic genera the tonics of the species are transformed (Chalmers 1993, chapt. 6, p. 103)

3.1 Diatonic

3.2 Chromatic

3.3 Enharmonic

4 The oldest *harmoniai* in three genera

The - sign indicates a somewhat flattened version of the named note, the exact degree of flattening depending on the tuning involved. The (d) listed first for the Dorian is the *Proslambanómenos*, which was appended as it was, and falls out of the tetrachord scheme. These tables are a depiction of Aristides Quintilianus's enharmonic *harmoniai*, the diatonic of Henderson (1942) and John Chalmers (1936) chromatic versions. Chalmers, from whom they originate, states

In the enharmonic and chromatic forms of some of the *harmoniai*, it has been necessary

to use both a d and either a d \flat or d $\flat\flat$ because of the non-heptatonic nature of these scales. C and F are synonyms for d $\flat\flat$ a g $\flat\flat$. The appropriate tunings for these scales are those of Archytas (Mountford 1923) and Pythagoras. (Chalmers 1993, chapt. 6, p. 109)

The superficial resemblance of these octave species with the church modes is misleading. The conventional representation as a section (such as CDEF followed by DEFG) is incorrect. The species were re-tunings of the central octave such that the sequences of intervals (the cyclical modes divided by ratios defined by genus) corresponded to the notes of the Perfect Immutable System as depicted above (Chalmers 1993, chapt. 6, p. 106).

4.1 Dorian

4.2 Phrygian

4.3 Lydian

4.4 Mixolydian

4.5 Syntonolydian

4.6 Ionian (Iastian)

5 Classification of Aristoxenus

The nature of Aristoxenus's scales and genera deviated sharply from his predecessors. Aristoxenus introduced a radically different model for creating scales. Instead of using discrete ratios to place intervals, he used continuously variable quantities. Hence the structuring of his tetrachords and the resulting scales have other qualities of consonance (Chalmers 1993, chapt. 3, pp. 17–22). In contrast to Archytas who distinguished his genera only by moving the *lichanoi*, Aristoxenus varied both *lichanoi* and *parhypate* in considerable ranges (Chalmers 1993, chapt. 5, p. 48).

The Greek scales in the Aristoxenian tradition were (Barbera 1984, 240; Mathiesen 2001a, 6(iii)(d)):

- Mixolydian: *hypate hypaton–paramese* (b–b')
- Lydian: *parhypate hypaton–trite diezeugmenon* (c'–c'')
- Phrygian: *lichanos hypaton–paranete diezeugmenon* (d'–d'')
- Dorian: *hypate meson–nete diezeugmenon* (e'–e'')
- Hypolydian: *parhypate meson–trite hyperbolaion* (f'–f'')

- Hypophrygian: *lichanos meson–paranete hyperbolaion* (g'–g'')
- Common, Locrian, or Hypodorian: *mese–nete hyperbolaion* or *proslambanomenos–mese* (a'–a'' or a–a')

These names are derived from Ancient Greek subgroups (Dorians), one small region in central Greece (Locris), and certain neighboring (non-Greek) peoples from Asia Minor (Lydia, Phrygia). The association of these ethnic names with the octave species appears to precede Aristoxenus, who criticized their application to the *tonoi* by the earlier theorists whom he called the Harmonicists (Mathiesen 2001a, 6(iii)(d)).

5.1 Aristoxenus's *tonoi*

The term *tonos* (pl. *tonoi*) was used in four senses: “as note, interval, region of the voice, and pitch. We use it of the region of the voice whenever we speak of Dorian, or Phrygian, or Lydian, or any of the other tones” (Cleonides 1965, 44) Cleonides attributes thirteen *tonoi* to Aristoxenus, which represent a progressive transposition of the entire system (or scale) by semitone over the range of an octave between the Hypodorian and the Hypermixolydian (Mathiesen 2001a, 6(iii)(e)). Aristoxenus's transpositional *tonoi*, according to Cleonides (1965, 44) were named analogously to the octave species, supplemented with new terms to raise the number of degrees from seven to thirteen. However, according to the interpretation of at least two modern authorities, in these transpositional *tonoi* the Hypodorian is the lowest, and the Mixolydian next-to-highest—the reverse of the case of the octave species (Mathiesen 2001a, 6(iii)(e); Solomon 1984,), with nominal base pitches as follows (descending order):

6 Ptolemy and the Alexandrians

In marked contrast to his predecessors, Ptolemy's scales employed a division of the *pyknon* in the ratio of 1:2, melodic, in place of equal divisions (Chalmers 1993, chapt. 2, p. 10). Ptolemy, in his *Harmonics*, ii.3–11, construed the *tonoi* differently, presenting all seven octave species within a fixed octave, through chromatic inflection of the scale degrees (comparable to the modern conception of building all seven modal scales on a single tonic). In Ptolemy's system, therefore there are only seven *tonoi* (Mathiesen 2001a, 6(iii)(e); Mathiesen 2001c). Ptolemy preserved Archytas's tunings in his *Harmonics* as well as transmitting the tunings of Eratosthenes and Didymos and providing his own ratios and scales (Chalmers 1993, chapt. 6, p. 99).

7 *Harmoniai*

In music theory the Greek word *harmonia* can signify the enharmonic genus of tetrachord, the seven octave species, or a style of music associated with one of the ethnic types or the *tonoi* named by them (Mathiesen 2001b).

Particularly in the earliest surviving writings, *harmonia* is regarded not as a scale, but as the epitome of the stylised singing of a particular district or people or occupation (Winnington-Ingram 1936, 3). When the late 6th-century poet Lasus of Hermione referred to the Aeolian *harmonia*, for example, he was more likely thinking of a melodic style characteristic of Greeks speaking the Aeolic dialect than of a scale pattern (Anderson and Mathiesen 2001).

In the *Republic*, Plato uses the term inclusively to encompass a particular type of scale, range and register, characteristic rhythmic pattern, textual subject, etc. (Mathiesen 2001a, 6(iii)(e)).

The philosophical writings of Plato and Aristotle (c. 350 BCE) include sections that describe the effect of different *harmoniai* on mood and character formation. For example, Aristotle in the *Politics* (viii:1340a:40–1340b:5):

But melodies themselves do contain imitations of character. This is perfectly clear, for the *harmoniai* have quite distinct natures from one another, so that those who hear them are differently affected and do not respond in the same way to each. To some, such as the one called Mixolydian, they respond with more grief and anxiety, to others, such as the relaxed *harmoniai*, with more mellowness of mind, and to one another with a special degree of moderation and firmness, Dorian being apparently the only one of the *harmoniai* to have this effect, while Phrygian creates ecstatic excitement. These points have been well expressed by those who have thought deeply about this kind of education; for they cull the evidence for what they say from the facts themselves. (Barker 1984–89, 1:175–76)

In *The Republic* Plato describes the music a person listens to as molding the person's character. Aristotle remarks:

From what has been said it is evident what an influence music has over the disposition of the mind, and how variously it can fascinate it—and if it can do this, most certainly it is what youth ought to be instructed in. (Jowett 1937, ; Aristotle 1912, book 8, chapter 5)

8 Ethos

The word ethos in this context means “moral character”, and Greek ethos theory concerns the ways music can convey, foster, and even generate ethical states (Anderson and Mathiesen 2001).

9 Melos

Cleonides describes “melic” composition, “the employment of the materials subject to harmonic practice with due regard to the requirements of each of the subjects under consideration” (Cleonides 1965, 35)—which, together with the scales, *tonoi*, and *harmoniai* resemble elements found in medieval modal theory (Mathiesen 2001a, 6(iii)). According to Aristides Quintilianus (*On Music*, i.12), melic composition is subdivided into three classes: dithyrambic, nomic, and tragic. These parallel his three classes of rhythmic composition: systaltic, diastaltic and hesychastic. Each of these broad classes of melic composition may contain various subclasses, such as erotic, comic and panegyric, and any composition might be elevating (diastaltic), depressing (systaltic), or soothing (hesychastic) (Mathiesen 2001a, 4).

The classification of the *requirements* we have from Proclus *Useful Knowledge* as preserved by Photios:

- for the gods—hymn, prosodion, paeon, dithyramb, nomos, adonidia, iobakchos, and hyporcheme;
- for humans—encomion, epinikion, skolon, erotica, epithalamia, hymenaios, sillos, threnos, and epikedeion;
- for the gods and humans—partheneion, daphnephorika, tripodophorika, oschophorika, and eutika

According to Mathiesen:

Such pieces of music were called melos, which in its perfect form (teleion melos) comprised not only the melody and the text (including its elements of rhythm and diction) but also stylized dance movement. Melic and rhythmic composition (respectively, melopoiia and rhuthmopoiia) were the processes of selecting and applying the various components of melos and rhythm to create a complete work. (Mathiesen 1999, 25)

10 Unicode

Main article: Ancient Greek Musical Notation (Unicode block)

Music symbols of ancient Greece were added to the Unicode Standard in March, 2005 with the release of version 4.1.

The Unicode block for the musical system of ancient Greece, called Ancient Greek Musical Notation, is U+1D200–U+1D24F:

11 See also

- Alypius (music writer), which we have from Meibom (1652) -> Karl von Jan (1895) (Mathiesen 2001d).

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13 Further reading

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14 External links

- Elsie Hamilton, [booklet on the modes of ancient Greece](#), with detailed examples of the construction of Aulos (reed pipe instruments) and monochord, which might help reconstruct the intervals and modes of the Greeks
- Nikolaos Ioannidis musician, composer, has attempted to reconstruct ancient Greek music from a combination of the ancient texts (to be performed) and his knowledge of Greek music.
- A relatively concise overview of ancient Greek musical culture and philosophy (archive from 9 October 2011).
- A mid-19th century, 1902 edition, Henry S. Macran, *The Harmonics of Aristoxenus*. The Barbera translation cited above is more up to date.
- Joe Monzo (2004). [Analysis of Aristoxenus](#). Full of interesting and insightful mathematical analysis. There are some original hypotheses outlined.
- Robert Erickson, American composer and academic, [Analysis of Archytas](#), something of a complement to the above Aristoxenus but, dealing with the earlier and arithmetically precise Archytas. An incidental note. Erickson is keen to demonstrate that Archytas tuning system not only corresponds with Platos Harmonia, but also with the practice of musicians. Erickson mentions the ease of tuning with the Lyre.

- Austrian Academy of Sciences examples of instruments and compositions
- Ensemble Kérylos, a music group led by scholar Annie Bélis, dedicated to the recreation of ancient Greek and Roman music and playing scores written on inscriptions and papyri.

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15.1 Text

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