

Reversing the Abstraction of Ancient Music Theory. The Case of the Genera

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ZUSAMMENFASSUNG

Die erst mit Aristoxenos wirklich fassbare antike Musiktheorie abstrahiert die Tonstrukturen der Musikpraxis zu einem umfassenden System ohne Bezug auf musikalische Genres oder instrumentale Grundlagen. Der vorliegende Beitrag befasst sich mit der Herausforderung, aus dem abstrakten System seine praktischen Ursprünge wieder zu ermitteln. Beispielhaft werden die sogenannten *géné* und ihre möglichen Bezüge zu Aulos und Kithara behandelt.

For us, ancient Greek music theory starts, more or less, with Aristoxenus in the late 4th century B.C. Books on music had been written earlier, purportedly as early as about 500. What remains from the intervening nearly two centuries are a few fragments preserved by later authors, occasional remarks in philosophical discussion or in comedy, and finally Aristoxenus' scathing comments on his predecessors' shortcomings. Yet it was during this time that all the conceptions formed which remain associated with ancient Greek music: theories of pitch and the nature of musical sound, consonance (*symphōnía*), modal scales (*harmoníai*), and ultimately their mutual relations as 'keys' (*tónoi*, *trópoi*). When Aristoxenus wrote, he was able to distil the different aspects of practical music making into a coherent and highly abstract scheme of pitch relations forming a comprehensive tonal system.

This is all very well for scholars concerned exclusively with the history of music theory. Those, however, who are also driven by a genuine interest in ancient music as such, and especially that of the classical era, are often on the verge of despair. The extreme degree of abstraction which Aristoxenus – quite rightly – regarded as the foundation of the science of *Harmonics*, deprives us of all the information regarding how the various possible scales (*systémata*) were related to musical

genres and, above all, to different instruments. What was played on the different kinds of aulos, how the *lýra* and the *kithára* were tuned, and which notes were confined to the vocal line, hardly ever comes into focus¹. The Pythagoreanizing strand does not contribute much explicit information either. Concerned mostly with musical structures insofar as they reflected ontological or cosmological principles, its exponents seldom referred to hard organological facts; when actual music conflicted with theory, they rather rejected the former as mistakenly guided by the ears, not by logical reasoning².

To approach questions of interest within music archaeology proper, an endeavour is therefore required to reverse, wherever possible, the process of abstraction which led to the Aristoxenian system, on the one hand, and to the Pythagoreanizing schemes, on the other. In my contribution to the last volume of this series I tried to show how information of a genuinely musical nature can or cannot be squeezed out of the apparent precision that ancient numbers for tetrachord tunings parade³. Now I am going to examine a more fundamental question: the origin of the so-called genera (*géné*).

¹ It must be emphasized that these remarks may not be extended to Aristoxenus' lost works, nor to the entire time span which we have come to call classical antiquity. For the 2nd century A.D. Ptolemy provides very detailed information on lyre tuning. Given the considerable amount of continuity in professional Greek music, such later data can, with the necessary caution, be projected backwards in time, especially where it elucidates early evidence.

² Cf. Ptolemaïs in Porphyry, *Comm. in Harm.* 23.24–31, Düring. To questions of larger tonal systems, Pythagoreanizing music theory does not contribute anyway, because the number-based description of musical structures was long confined to small or simple configurations such as the tetrachord (e.g. Archytas in Ptolemy, *Harmonics* 1.13, 30.3–31.18 Düring), the 'fixed notes' (cf. Hagel 2005), or non-modulating diatonic/chromatic.

³ Hagel 2006.

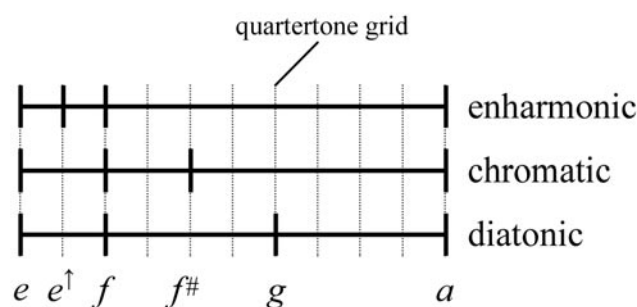


Diagram 1 The 'standard genera'.

From Aristoxenus on, any Greek – or, as far as he is concerned, any proper – musical scale is said to come in one of three flavours: diatonic, chromatic, or enharmonic. Although a mixture of these is possible, as well as modulation between them, they constitute basic scale forms clearly demarcated by perception. Within the infinite possibilities of dividing the fourth into three intervals constituting a well-formed scale fragment, each of such shades (*kbróai*) is perceived as belonging to one of the three categories, because it owns the particular character (*êthos*) of one and no other genus⁴. Regardless of the acknowledged infinity of shades, however, the entire ancient tradition (up until modern handbooks) adopts a set of 'standard' or 'quotation' forms of the genera⁵: a diatonic tetrachord consists of the sequence of semitone + tone + tone, a chromatic of semitone + semitone + 1½ tones, an enharmonic of quartertone + quartertone + ditone. Significantly, Aristoxenus himself employs these definitions whenever he is not dealing specifically with the question of tetrachord division, but rather with the rules governing larger musical structures.

These standard forms are obviously not Aristoxenus' invention. Their outstanding advantage is the commensurability of all their intervals on the basis of a quartertone (*díesis*, or, more exactly, "smallest enharmonic *díesis*", in Aristoxenian parlance): cf. Diagram 1 (as usual in the study of ancient Greek music, modern note names serve for orientation and indicate only relative pitch relations).

Now the *díesis* was already cited as the measure of musical scales by Aristotle. Interestingly, the relevant passages by no means deal with technicalities of music theory. The musical measure comes in as a means to explain conceptions of measurement and smallest units, side by side with everyday measures of length or weight⁶. Obviously Aristotle could rely on the fact that the reference to the *díesis* would be as clear to his hearers as would the foot or the mina. On the other hand, measures must be commensurable. We must there-

fore assume that not long before Aristoxenus the quartertone model was already widely current, in much the same form as the 'standard genera' presuppose.

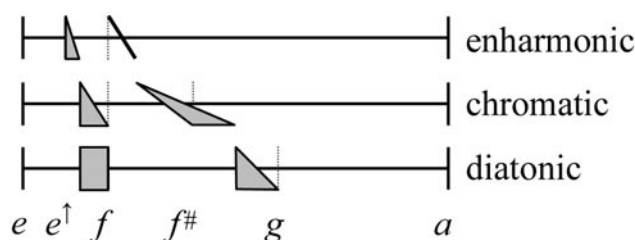
It is customary to quote a passage from Plato's *Republic* in this context, where a certain group of music theorists is ridiculed for its efforts on a stringed (experimental?) instrument: "inclining their ears as if hunting out a sound from next door, some of them assert that they can still just hear a sound in between, and that this is the smallest interval, by which measurement is to be made, while others take issue with them, saying that the notes sounded are already the same [...]"⁷. That the quartertone was eventually accepted as satisfying these conditions appears confirmed by a pas-

⁴ Cf. e.g. Aristoxenus, *Harmonics* 2.48, 60.15–61.2 Da Rios: ἰδίαν γὰρ δὴ κίνησιν ἕκαστον τῶν γενῶν κινεῖται πρὸς τὴν αἴσθησιν οὐ μὴ χρόμενον τετραχόρδου διαίρεσει ἀλλὰ πολλαῖς. ὥστ' εἶναι φανερόν, ὅτι κινουμένων τῶν μεγεθῶν συμβαίνει (διαμένειν) τὸ γένος, οὐ γὰρ ὁμοίως κινεῖται τῶν μεγεθῶν κινουμένων μέχρι τινός, ἀλλὰ διαμένει. "Each one of the genera moves in its particular kind of movement in regard to perception, employing not one tetrachord division but many. Thus it is evident that while the (interval) sizes move, the genus happens to remain constant, since up to a specific point it does not move similarly as the moving (interval) sizes, but remains constant."

⁵ Apart from musical treatises, cf. e.g. Proclus, *Comm. in Tim.* 3.191de, 2.168.14–20 Diehl (in spite of 'Pythagorean' reservations about semitones and quartertones), and the melodic intervals quoted in Dionysius of Halicarnassus, *De compositione verborum.* 11.63–64; Plutarch, as in no. 15 below; Sextus Empiricus, *Adversus mathematicos* 6.47 (standard intervals in spite of the enumeration of shades in 6.51).

⁶ Aristotle, *Metaphysics* 1016b; 1053ab: (τὸ μέτρον) [...] ἐν μουσικῇ δίεσις, ὅτι ἐλάχιστον "(the measure) in music is the *díesis*, because it is smallest"; 1087b; *Analytica posteriora* 84b. On the alternative 'Pythagorean' meaning of '*díesis*', see below.

⁷ Plato, *Republic* 531ab: [...] παραβάλλοντες τὰ ὄτα, οἷον ἐκ γειτόνων φωνῆν θηρευόμενοι, οἱ μὲν φασιν εἶτι κατακούειν ἐν μέσῳ τινὰ ἤχην καὶ σμικρότατον εἶναι τοῦτο διάστημα ᾧ μετροῦτέον, οἱ δὲ ἀμφισβητοῦντες ὡς ὅμοιον ἤδη φθεγγόμενων [...] The translation follows Barker 1989.

Diagram 2 Aristoxenus' shades (*khróai*).

sage from Aristotle⁸. There, however, it seems that a sound-producing device capable of glissando is considered, such as the voice or the aulos. That it should not have been possible to discern an intermediate note (which would entail intervals of about an eighth of a tone⁹) in an experiment on a stringed instrument, probably devised exactly for such a purpose, is, at the least, surprising. For Aristoxenus it is clear that intervals smaller than the quartertone can be heard, although it is not possible to judge their size in comparison to any recognized interval¹⁰. Thus there is a remote possibility that Plato alludes to another school, which adopted the smaller *kómma* as the measure in music¹¹. In any case, Plato testifies to a general awareness of the question about whether there is a musical measure, and, if so, how it should be assessed. The date of these endeavours is ambiguous. The fictitious stage of the dialogue would demand reference to the later 5th century; but it is likely that Plato refers to later, perhaps almost contemporary approaches, which were of greater relevance for the fourth century public.

Aristoxenus himself acknowledges that substantial work on the three genera had been done before him, although not all questions had been addressed: “those who employed themselves with the instruments had a clear perception of each of the genera; yet the very point where the enharmonic becomes some sort of chromatic was never focussed upon by any of them”¹². Even so, one cannot but notice that Aristoxenus singles out one specific group of ‘organologists’, as if an analysis of all genera had not been undertaken by other schools of theorists. This is confirmed by other passages, in which *harmonikoí* are accused of not having treated anything but the enharmonic¹³.

To obtain a better understanding of the status quo before Aristoxenus, we must briefly describe his own system. As stated above, his standard shades are merely the most typical instances of an – in principle – infinite number of possible tetrachord tunings. Each of these is, however, associated with one definite genus, so that the definition of boundaries between them is necessary. The question of whether perception is actually precise

enough to adequately categorize the character of tunings close to these boundaries is never discussed. The possible shades can be read from Diagram 2: all note pairs lying at the same height

⁸ Aristotle, *De sensu* 446a: [...] καὶ ὁ ἐν τῇ διέσει φθόγγος λανθάνει, καίτοι συνεχοῦς ὄντος ἀκούει τοῦ μέλους παντός· τὸ δὲ διάστημα τὸ τοῦ μεταξὺ πρὸς τοὺς ἑσχάτους λανθάνει “the note within the *diesis* escapes notice, and yet one hears the entire melody as continuous: but the interval between the intermediate and the outer boundary notes escapes notice.”

⁹ Since the procedure was doubtlessly started by construing the ‘semitone’ by alternating fifths and fourths, the sought divisions of the enharmonic *diesis* would optimally amount to the fourth part of the *leímma*, or 23 cents.

¹⁰ Aristoxenus, *Harmonics* 1.14, Da Rios 1954, 19.16–20.1 (Aristotle, *Metaphysics* 1016b, is compatible with this position). It follows that intervals smaller than the *diesis* cannot be employed as a measure in practice. Thus, the *diesis* might have been adopted out of the insight that the continuous nature of pitch and of the auditory system precludes a smallest *physical* measure, while a purely *musical* measure (i.e., of scalar structures) was still arguable. This amounts to the compromise of a smallest measure defined by the nature of the human ear, but without resort to harmonic theory, while at the same time acknowledging the existence of (an infinity of) smaller intervals. The straightforward denial that intervals smaller than the *diesis* can be perceived at all is late (cf. Alexander of Aphrodisias, *Comm. in Metaph.* 609.13–15; 368.25–26; 799.19–20; for Alexander’s lack of musical expertise cf. his awkward definitions like ἔστι δὲ ἡ diesis ὁ λιαν σμικρότατος φθόγγος τῆς χορδῆς “the *diesis* is the very smallest note of the string”), and probably a misunderstanding of an era for which even enharmonic music was as strange as it is for us (cf. Damascius, *Life of Isidorus* fragm. 127, in Photius, *Bibliothēke* 344b: τοῦτο δὴ ἀπολωλὸς ἐκ τῆς ἡμετέρας αἰσθήσεως καὶ τὸ ἄλλο γένος τὸ ἐναρμόνιον προσαπόλεσεν “[the *diesis*], having vanished from our perception, has taken with it the third genus, the enharmonic”).

¹¹ Cf. the allegedly Philolaic system transmitted in Boethius, *De institutione musica* 3.5, Friedlein 1867, 276.15–277.18 = Philolaus A26 D.-K.; 3.8, Friedlein 1867, 278.11–16 = Philol., fragm. 6b; cf. especially. 277.4–18: [...] *unitatem loco commatis censet esse ponendam*. This system is dated to the fourth century by Huffman 1993, 364–374.

¹² Aristoxenus, *Harmonics* 2.35, Da Rios 1954, 44.15–22: ἀλλ’ οἱ γε διατρίβοντες περὶ τὰ ὄργανα διησθάνοντο μὲν ἐκείνου τῶν γενῶν, αὐτὸ μέντοι τὸ πότε ἄρχεται ἐξ ἁρμονίας χρῶμά τι γίνεσθαι, οὐδεὶς οὐδ’ ἐπέβλεψε πόποι’ αὐτῶν.

¹³ Aristoxenus, *Harmonics* 1.2, Da Rios 1954, 6.6–21; 2.35, Da Rios 1954, 44.12–14. On the term *harmonikoí*, cf. Barker 1978.

within the two grey regions (or, in the case of the higher enharmonic moving note, on the line) can together form an instance of the respective genus. These pairings are governed mainly by the rule that the lowest interval must not be larger than the second lowest. The boundary between the chromatic and the diatonic occurs where the sum of the two lower intervals becomes larger than the highest. In contrast, that between enharmonic and chromatic appears defined arbitrarily: if the sum of the two lower intervals together (called the *pyknón*) is smaller than two thirds of a tone, the division is enharmonic, otherwise it is chromatic. As a corollary, it will be noticed, the two intervals must apparently be equal if they are of the smallest chromatic form, but may be unequal if they form a wide variant of the enharmonic. Such details illuminate the artificial aspects of Aristoxenus' rigid definitions, if taken to their extremes. Even so, we may reasonably expect that they provided a sensible framework for the description of Greek music known in the fourth century.

With a view to his own definitions, we understand Aristoxenus' first criticism of the 'organologists' (quoted above) more clearly. "The very point where the enharmonic becomes some sort of chromatic" is the point two thirds of a tone above the lower boundary of the tetrachord. As this was not expressed before by anyone, the precise distinction is Aristoxenus' own invention. If we read further, it emerges that he was also the first to allow for an infinity of shades, and thus to define possible note positions not by points on, but by a span within, the pitch continuum¹⁴. The wording may be taken to imply that more than one shade per genus had already been described by the 'organologists'; but this is by no means certain¹⁵.

If we combine the standard definitions with Aristoxenus' shades, we can make a first attempt at translating the evidence into musically relevant structures: a regular diatonic of the Pythagorean type, sometimes 'softened' by lowering one or both of the adjustable notes in the tetrachord; a chromatic with the second highest note in the tetrachord about a tone above the lowest (with considerable variation in both directions) and an approximate bisection of the enclosed interval; finally an enharmonic consisting of small intervals whose sum was recognizably smaller than a tone.

So far we have discussed what became mainstream through Aristoxenus' outstanding authority. But there are also clear traces of substantially different views on the same matters. Firstly, the term *díesis* is curiously ambiguous. In texts that stand in the Pythagorean tradition it denotes not the quartertone but the semitone¹⁶. Secondly, the notation system, which in all probability originated in the fifth century, differentiates only between

two genera¹⁷. In the later tradition, it is held that the chromatic and the enharmonic are written with the same signs; but which was the original intention? The answer can be obtained from pitch equations inherent in the system. When the notation was employed for modulating music, notes from different keys (*tónoi*) were written with similar signs. The pitch relations established thus are clearly based on a quartertone enharmonic¹⁸. The enharmonic reading must therefore be regarded as the older, while its analogical chromatic interpretation appears to stem from a time when the enharmonic was becoming obsolete.

Obviously the canonical number of three genera is younger than the conception of the ancient notation¹⁹. Moreover, the lower movable notes (*parypátai*) of both the diatonic and the enharmonic are written with the same sign, while in the standard definition the higher enharmonic note falls on the same pitch with the lower diatonic (cf. Diagram 3). The standard definition obviously played no role here; since a quartertone as the lowest diatonic note is hardly credible, one has to reckon with a wider form of enharmonic, and perhaps a 'soft' variant of the diatonic. It will not have

¹⁴ Aristoxenus, *Harmonics* 2.35, Da Rios 1954, 44.18–22: οὔτε γὰρ κατὰ πᾶσαν χρόαν ἐκάστου τῶν γενῶν διησθάνοντο διὰ τὸ μῆτε πάσης μελοποιίας ἔμπειροι εἶναι μῆτε συνειθίσθαι περὶ τὰς τοιαύτας διαφορὰς ἀκριβολογεῖσθαι· οὐτ' αὐτὸ πως τοῦτο κατέμαθον ὅτι τόποι τινὲς ἦσαν τῶν κινουμένων φθόγγων ἐν ταῖς τῶν γενῶν διαφοραῖς. "For they did not understand each of the genera in all its shades, because they were not experienced with all kinds of composition, nor accustomed to making fine distinctions regarding differences of that kind. Nor did they grasp the point that there are certain ranges belonging to the notes that move in the changes between the genera".

¹⁵ Cf. also the non-Aristoxenian tradition behind Plutarch, *De E ap. Delph.* 389ef; *De defectu orac.* 436a, where melody is confined to the commensurable intervals of the standard definition. On the other hand, ps.-Plutarch, *On Music* 1145 B.C., clearly reflects a pre-Aristoxenian way of defining shades merely in terms of quartertones: the terms 'third size', 'fifth size', etc. for intervals consisting of three, five, etc. quartertones stem from a system which worked by a quartertone grid, such as the curious "archaic" notation in Aristides Quintilianus 1.7, Winnington-Ingram 1963, 12–13 (cf. Winnington-Ingram 1973; Chailley 1973; West 1992a, 42–46; West 1992, 263–265). Cf. further the non-Platonizing numerology related in Aristides Quintilianus 3.6, Winnington-Ingram 1963, 102. 22–29.

¹⁶ Philol. fragm. 6; Plut., *De animae procreatione in Timaeo* 1018e; Proclus, *Comm. in Tim.* 3.191e, 2.168.28–29 Diehls; Theon, *De utilitate mathematicae* 55.11–15 Hiller; 56.18–19; 91.8–92.16 (here: λείμμα διεσιαίου); Boethius, as in no. 11 above.

¹⁷ For an introduction to the ancient notation cf. West 1992, 254–263.

¹⁸ This regards the identification of diatonic and fixed notes with moving notes in the old Dorian-Phrygian-Lydian part of the system; e.g., Lydian *enarmónios* ΠΔ = Phrygian *diátonos* = Dorian *mésē*.

¹⁹ Cf. Rocconi 1998.

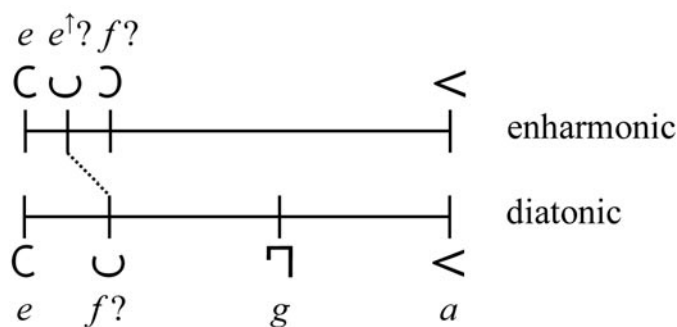


Diagram 3 The divergence between notation and standard genera.

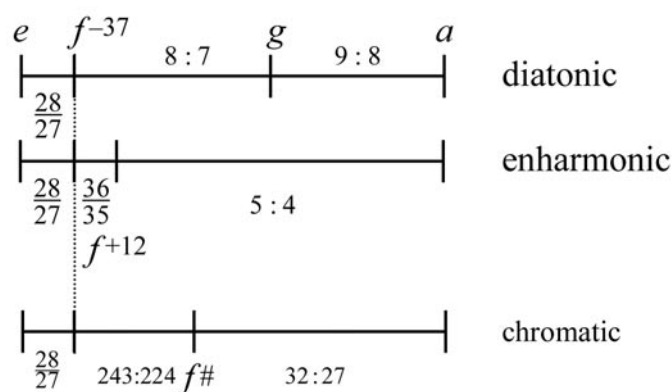


Diagram 4 Archytas' numeric divisions of the tetrachord.

escaped the reader's notice that this introduces a basic inconsistency directly into the notational system, since the interrelations between the old keys are governed by the standard definition very well. As I will explain in more detail in another publication, this inconsistency has historical roots: the introduction of modulating keys came at a later stage, and was (necessarily) based on the new commensurable paradigm.

The original approach of the notation is echoed in the mathematical tetrachord divisions of Archytas, the famous Pythagorean philosopher and friend of Plato (Diagram 4). He, too, equates the enharmonic and the diatonic *parypátē*, which results in a comparatively wide enharmonic – 22 cents wider than the *leîmma* of a Pythagorean diatonic – and a soft variant of the diatonic. The figures themselves are not to be taken at face value²⁰, but Archytas' independence from the standard definition is clear. Not being restricted by a fixed model, Archytas was able to develop a mathematically satisfying solution for the two genera. For the chromatic, he gave no figures; the corresponding tables in Ptolemy's *Harmonics* are derived from his remark that the difference between the higher chromatic and diatonic moving notes is the *leîmma*²¹. This adds an important

detail to our picture. Somehow Archytas was aware of the chromatic, but did not regard it as a structure on an equal footing with enharmonic and diatonic: once more we get the impression of a certain affinity between his view and the oldest stages of the notation. On the other hand, it stands out more clearly that not so long before Aristoxenus the idea of three genera was far from universal.

The assumption of a regular wide enharmonic in archaic Greek music would mitigate what is commonly regarded as its weirdest aspect (since, already in antiquity, some had doubted the possibility of musical quartertones²²). Yet it is not compatible with one of Aristoxenus' dearest claims, namely that the most noble enharmonic employs true ditones and hence quartertones, while every modification in the direction of the chromatic is a

²⁰ Cf. Hagel 2006, 285; 289–294. I am however no longer convinced of the Burkert/West interpretation of the 'Philoaic' microtonal system and take back the corresponding conclusions: Philolaus cannot serve as a witness for the standard genera in the fifth century.

²¹ Ptolemy, *Harmonics* 1.13, Düring 1930, 31.2–6 Düring; cf. No. 50 below.

²² [Plutarch], *On Music* 1145a (see below No. 59); cf. the commentary by Barker 1984, 245.

concession to an inerudite public²³. Even so, Aristoxenus reports that before him there were two views, positing as the higher enharmonic interval either a ditone or a smaller interval – but neither allowing for variation²⁴. It is tempting to recognize here the disagreement between the older view, exhibited in Archytas' division and the old notation, and the standard model. On the other hand, the difference is usually, and convincingly, explained as that between a 'Pythagorean' ditone of two major tones and a pure major third, in accordance with Archytas' figures²⁵. So we find ourselves confronted with a chronological conundrum: while Aristoxenus emphasizes the archaic nature of the ditonic variant, the external evidence indicates the opposite.

Graver conflicts are yet to be considered. In a famous passage, transmitted in the pseudo-Plutarchan dialogue *On Music*, Aristoxenus discusses the origins of the enharmonic²⁶. First he relates the story of its invention by the aulete Olympus as conceived by 'the *mousikoí*'; then he appends some comments of his own. Again, this is not the place for a detailed analysis, so I must confine myself to a few basic observations. The story runs as follows: Olympus played in the diatonic (*e-f-g-a-b*), left out the *likhanós* (*g*) and was delighted by the resulting character of the music. So he built up a larger scale (*sýstēma*) in that way: *e-f-a-b-c*. This is the scale of the *spondeíon* airs (a sort of traditional music used in cultic context). Aristoxenus adds that this form of scale is the lowest common denominator of all three genera, evidently arguing from the perspective of the standard definition. It was still heard played in this way. Typically, however, the semitone *e-f* had become divided to *e-e[†]-f*, and thus the true enharmonic was finally born. So far we can analyse the passage in terms of the standard definition, which Aristoxenus also applies wherever possible. But there is a serious complication. Aristoxenus refers to a possible misunderstanding of the scale as diatonic, because of the apparent sequence of two tone-like intervals above *a*. The higher one, he asserts, is however not a tone, but has the size of three quartertones. Thus our *a-b-c* becomes *a-b-c[†]* instead. Now such a sequence is not per se incompatible with diatonicism, since there were variant diatonic tunings with exactly such a three-quarter-tone interval (although not above another tone)²⁷. But it would amount to two 'tones' above another ditone (*f-a*), a structure that is impossible both in the diatonic and the enharmonic. The three-quarter-tone interval is cited with the technical term *spondeiasmós*, which shows that it was perceived as typical for *spondeíon* music. Thus, the higher 'semitone' is actually a quartertone too large. On top of this, Aristoxenus talks about the 'higher

spondeiasmós', which calls for the existence of a lower one, as well²⁸. This can only be the respective interval in the lower tetrachord, *e-f*²⁹. Indeed these two intervals are always treated as similar. Above all, the higher part of Olympus' scale is created analogically to the lower; this concept makes sense only if the particular characteristic interval is indeed identical in both³⁰.

The conclusion seems inevitable that at least the *spondeíon* the *mousikoí* referred to used a very wide variant of the enharmonic, to which quarter-tone-oriented theorists ascribed the size of three-quartertones. Aristoxenus, on the other hand, whenever talking not about interval sizes but

²³ Aristoxenus, *Harmonics* 1.23, Da Rios 1954, 29.12–30.8 (cf. Barker 1989, 141–142): the opposition is between (two kinds of) *arkhaiíkoí trópoi* and contemporary music.

²⁴ Aristoxenus, *Harmonics* 1.26, Da Rios 1954, 34.8–10; cf. 1.28, Da Rios 1954, 36.8–11; 2.49, Da Rios 1954, 61.7–13.

²⁵ Cf. Winnington-Ingram 1932, 200; Barker 1989, 50; Barker 2000, 122; Franklin 2005, 26–28; Hagel 2006, 284–285.

²⁶ [Plutarch], *On Music* 1134f–1135c. Cf. Winnington-Ingram 1928, with most of whose interpretation I agree in the following; Barker 1984, 215–218; 255–257. Further on the relations to the 'harmonic' aulos music described in [Plutarch], *On Music* 1137b–d, cf. Barker 1995, 50; Hagel 2004, 378.

²⁷ Aristoxenus' 'soft diatonic': *Harmonics* 2.51, Da Rios 1954, 64.8–11.

²⁸ Barker 1984, 255–256, interprets the expression '*syntonóteros spondeiasmós*' as the 'stretched' three-quarter-tone variant of a standard semitone *spondeiasmós*, which he regards as the typical *spondeíon* interval. Yet the semitone as such could not possibly be perceived as 'typical', since it was part of all melodies in all (standard) genera. The assumption that it was awarded a special name merely because it was not divided, inevitably presupposes firstly a common awareness of this fact, and secondly that the absence of a division was indeed characteristic for the *spondeíon*. Both these necessary hypotheses are contradicted by the text: the usual performance employed a divided 'semitone', and Aristoxenus found it necessary to point out carefully where one might detect the undivided variant (the wording, quoted in note 30 below, suggests that the unaware listener would hardly notice the difference, which is attributed more to the performer's intention than to the resulting sound).

²⁹ This does not affect the quoted argument about the two ditones, since the seven quartertones in *f[†]-a* can assume the scalar function of a ditone as well as could those in *a-c[†]*. That Aristoxenus consciously employs functional terminology and not exact interval sizes is illuminated by the expression ἐν τῇ τοῦ τονιαίου δυνάμει "in the function of a tone-like interval".

³⁰ Furthermore, Aristoxenus remarks on the performers using the more archaic style: ἀσύνθετον γὰρ βούλεται εἶναι καὶ τὸ ἐν ταῖς μέσαις ἡμιτόνιον "he intends that the semitone in the *mésai* [the lower tetrachord] is incomposite, as well". The word order strongly suggests that the opposition is 'the semitone in the higher tetrachord', whose melodic omission Aristoxenus treats as commonplace ([Plutarch], *On Music* 1137b; pace Barker 1984, 217, No. 88). Finally, the note intermediate between *b* and *c[†]* served as the consonant accompaniment to that between *e* and *f[†]* (*l.c.*), which also calls for identical structures at both places.

scalar relations, applied functional terminology, based on the standard definitions. Since he wrote for a public familiar with the *spondeion*, we cannot accuse him of deliberate fraud. But he probably tried to blur the picture a bit, guided by his own predilection for the tightest enharmonic possible and by the need to derive the standard enharmonic from the non-standard *spondeion*, following a traditional historical explanation.

To our surprise, the further our glances reach into the enharmonic past, the wider do the enharmonic intervals become. A three-quartertone *pyknón* is well beyond Aristoxenus' threshold for this genus; he classifies the respective division as the 'hemiotic chromatic'³¹.

Three-quartertone intervals also played an important role in another pre-Aristoxenian system: one of the early schemes of *tónoi* placed the different keys at distances of $\frac{3}{4}$ - $\frac{3}{4}$ -1- $\frac{3}{4}$ - $\frac{3}{4}$ tones³². Although its creators did not reveal their causes, they are clear to a specialist in the field such as Aristoxenus: the system is devised "with view to the boring of auloi". Again we encounter the awkward interval in the context of this instrument. Based on this passage and on the evaluation of a number of early aulos fragments that have come to light, M. L. West proposed a typical auletic tetrachord division of (approximately) $\frac{3}{4}$ - $\frac{3}{4}$ -1 tones³³. Actually this is the tetrachord Olympus would have started with in the story discussed above³⁴. Unfortunately, a satisfactory analysis of tonal structures in finds of early auloi is still missing. Even so, it is clear that their finger holes are neither equidistant, nor of sufficiently varied spacing to yield tones and semitones. On many of them, the extant length of the pipes rules out an hemiotic pentatonic interpretation. The existence of fourths is highly probable, given that the Greeks' own analysis of their scales was, as far as we know, always based on tetrachords. Thus the slightly unequal spacing yields to the interpretation that a fourth was indeed structured into (about) a tone and a remainder to be divided (about) equally. Such a conception provides a natural explanation for the three-quartertone intervals of aulos-based theory.

On the other hand, the corresponding instrument design can be understood out of physical constrictions. If one pipe is played with one hand, the maximal pitch range of the pipe is determined by the maximal finger span. That a large gamut is per se desirable is a natural assumption; but if the instrument is to play in the range of the male voice, even cruel spans of up to 14 cm cover not more than about a minor sixth. Extant instruments and vase paintings confirm that a large span between index and small finger was typical. Under such conditions, the nature of the hand exerts

restrictions on the possible positions of the intermediate holes, enforcing a rather uniform distribution. This is what we find in the artefacts.

It becomes clear that the *mousikoí* and Aristoxenus based their historical model on hard organological facts, besides their knowledge of traditional tunes. If West's reconstruction is accepted on the basis of the concurrent evidence, we can pose the question of how such 'early auletic tetrachords' relate to the tetrachord divisions of theory. On the aulos, pitches in addition to those from the finger holes can be produced mainly by partially covering the highest open one³⁵. Diagram 5 shows how this technique would have to be applied on a three-quartertone aulos in order to play the various shades described by Aristoxenus.

Most natural is of course the 'hemiotic chromatic', which corresponds entirely with the *spondeion* enharmonic. The 'soft chromatic' requires only a minimal adjustment of the upper note; any clear distinction between the lower ones, whose hypothetical positions are even closer to each other, is illusory with respect to any conceivable playing technique. Besides, it is likely that the *mousikoí* would still have analyzed such intervals in terms of a three-quartertone *pyknón*. Next in order is the 'tense diatonic'. It can employ the second highest finger hole in the tetrachord unaltered, but requires some flattening of the lower hole. In this latter respect, it differs from the 'diatonic' with open holes that seems envisaged in the story about Olympus. The two upper intervals of Aristoxenus' 'tense diatonic' are conceived as major tones, originating from alternating fifths and fourths³⁶, in accordance with the typical procedure of lyre (rough?) tuning. Very likely auletes had to reproduce this type of diatonic whenever playing together with lyres. For a 'soft diatonic', the note from the upper hole must be altered as well, or the hole might be drilled at a different

³¹ Aristoxenus, *Harmonics* 2.51, Da Rios 1954, 63.9–11.

³² Aristoxenus, *Harmonics* 2.37, Da Rios 1954, 47.6–13. For the analysis of the system, see Hagel 2000, 168–181.

³³ West 1992, 96–100. On the remains of 'early auloi' see Psaroudakēs 2002 and in this volume. I use this designation here (instead of e.g. 'primitive auloi') for instruments with no more than five finger holes (plus perhaps a vent hole) per pipe and no mechanism.

³⁴ The classification of this structure as a valid 'diatonic' is questionable in the light of all extant pre-Imperial ancient music theory (Ptolemy, however, admits the roughly similar division of 12:11 - 11:10 - 10:9 as diatonic: *Harmonics* 1.16, Düring 1930, 38.12–39.6). Aristoxenus passes over the implication in silence.

³⁵ Cross-fingering has almost no effect on pipes with such a large ratio of finger hole to main bore diameter as ancient auloi. Slight variations can be achieved by manipulating the mouthpieces, with decreasing effect on holes further down the pipe.

³⁶ E.g. Aristoxenus, *Harmonics* 1.21, Da Rios 1954, 27.14–16.

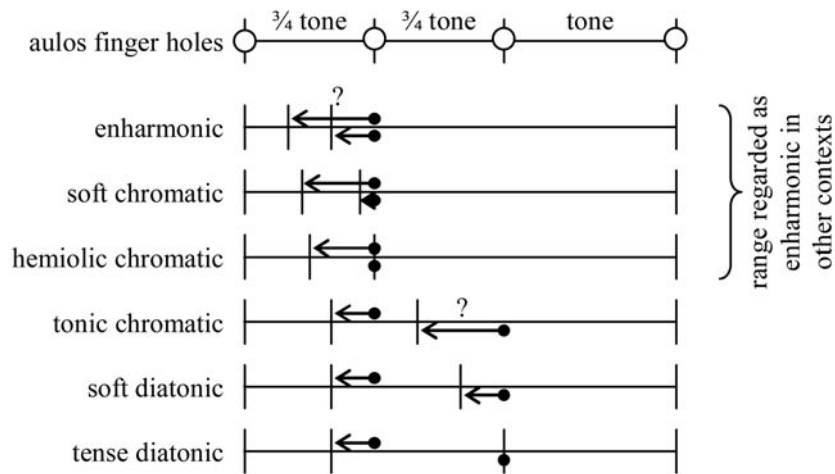


Diagram 5 Producing Aristoxenus' shades on a 'three-quartertone aulos'.

position from the outset. But we do not know whether 'soft' variants of the diatonic were associated with early auloi at all. There remain the standard enharmonic and chromatic (the 'tonic chromatic', in Aristoxenus nomenclature). These are actually the least comfortable to produce on an instrument of the posited design. None of their inner notes can be produced directly from an open hole. Worse still, both would entail lowering the pitch of a hole by no less than a semitone. This is not easily accomplished, and, as experience with contemporary folk instruments suggests and my experiments with various replicas and working models have confirmed, the necessary occlusion of a large proportion of the hole significantly decreases the sound quality. It must therefore be said that a 'three-quartertone aulos' is definitely not oriented towards a musical system built on the standard genera, and that the theoretical conception of the latter was certainly not motivated by this kind of instrument. Given the general absence of proper semitones on excavated early auloi, this conclusion seems warranted even if the hypothesis of auletic $\frac{3}{4}$ - $\frac{3}{4}$ -1 tetrachords is not entirely accepted.

While the archaic aulos featured a kind of diatonic and a kind of enharmonic, we do not find it associated with the chromatic. A combination of enharmonic and diatonic was also typical for the older notation, it stands behind Archytas' divisions, and it is said to have dominated the aulos-accompanied songs of classical tragedy in its Halcyon times³⁷. The chromatic, in contrast, was primarily associated with *kithára* music³⁸. Later sources generally emphasize its secondary status³⁹. Some of them derive the 'colour' metaphor from its intermediate position between the other two genera, just as colour is 'intermediate' between black and white. Such a view is clearly dependent

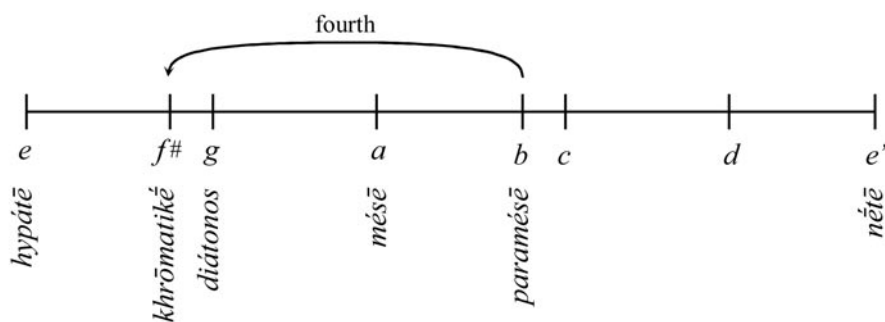
on Aristoxenian systematization and has no explanatory value. Others employ the idea of 'colour' as a modification, namely of the diatonic. The earliest references draw still another picture. Apart from the general loose metaphor of "well-coloured melodies" or "dance movements", current among musicians⁴⁰, in technical contexts

³⁷ Pap. Hibeh 13, ii.3-4 τῶν τραγωιδῶν [...] [τῶν διὰ πάλιντος εἰωθῶτων ἐφ' ἁρμονίας αἰδεῖν "the singers in tragedy who are altogether accustomed to singing in the enharmonic"; Aristoxenus, as in the following note; Psel-lus, *On Tragedy* 5: ἡ δὲ παλαιὰ τραγικὴ μελοποιία γένει μὲν τῷ ἑναρμονίῳ ἐχρήσατο ἀμυγῆ καὶ μικτῷ ἐξ ἁρμονίας καὶ διατόνου. "The old tragic music employed the enharmonic genus unmixed as well as one mixed of enharmonic and diatonic."

³⁸ Aristoxenus in [Plutarch], *On Music* 1137de: τῷ γὰρ χρωματικῷ γένει καὶ τῷ (ποικίλῳ Lasserre) ὀυθμῷ τραγωδία μὲν οὐδέπω καὶ τήμερον κέχρηται, κithára δέ, πολλαῖς γενεαῖς πρεσβυτέρα τραγωδίας οὔσα, ἐξ ἀρχῆς ἐχρήσατο. "Tragedy makes no use of the chromatic genus and the (manifold) rhythm even today, while the *kithára*, being many generations older than tragedy, employed it from the beginning." Cf. Philochorus, in Athenaeus, *Deip-nosophists* 638a, on the citharist Lysander: χρώματά τε εὐχρῶα πρῶτος ἐκithάρησε "he was the first to play well-coloured colours on the *kithára*" (cf. Barker 1982).

³⁹ The passages are conveniently collected in Rocconi 2004. Although I follow her conclusions in general, it appears that Archytas' reference to the chromatic precludes its derivation from tuning variants as well as its definition as a genus only by Aristoxenus. The recent extended study on the chromatic by Roch 2001 is marred by many translation errors, misunderstandings, and ignorance of much of the relevant literature. To comment only on one point relevant to the present subject, I find a model hard to accept that regards the reduction of a scale fragment *e-f-g-a* to *e-f-a* (Olympus' pre-enharmonic) as a logical imitation of *e-g-a* (from a supposed pentatonic lyre, 245-246).

⁴⁰ Plato, *Laws* 655a. Cf. Philochorus, as in no. 38 above, where the vague adjective is combined with the more technical *khrómata*. Plato himself employs the metaphor of music 'colouring' the text: *Laws* 669c; *Republic* 601b.

Diagram 6 Ptolemy's *trítai*.

khrōmata are connected with modulation as characteristics of a complex style gaining ground at the end of the fifth century⁴¹. While the evolved idea of a chromatic ‘genus’, connected with the static image of a scale, is designated by the singular *khrōma*⁴², the plural in the texts obviously refers to recurring features within the temporal unfolding of a melody, analogously to modulations⁴³. Such ‘colourings’ were judged adversely when transferred to inappropriate genres (e.g., to tragedy instead of citharody) or applied in an inappropriate, perhaps too exuberant, way⁴⁴.

In the search for the origins of the chromatic, Aristoxenus set us on the track of *kitthára* music. There we need not search long for its traces, although the most explicit sources are only Roman Imperial. In the 2nd century, when, judging from the extant score fragments, true chromatic music was almost extinct, citharodes still employed the name *khrōmatikē* for a certain string on their instrument⁴⁵. Its pitch (conveniently transcribed as *f#*) was a major tone above the bottommost note of the tunings’ main octave (*hypátē*, *e*), and tuned by two consecutive pure fourths down from the topmost note (*nētē*, *e'*). For an example, see Diagram 6; there it becomes at once apparent that the string had maintained its designation as ‘the chromatic one’ in a scalar environment that had nothing to do with a chromatic tetrachord⁴⁶.

It follows that the name must be much older, stemming from a time when the string still fulfilled a truly chromatic function. How it did so becomes obvious from its opposition to the next higher string, *diátonos*. Both obtain their original meaning only if we add the lower moving note near the bottom of the scale, *parhypátē* (*f*; see Diagram 7)⁴⁷. Thus, the lower fourth of the octave can assume either a chromatic (*e-f-f#-a*) or a diatonic shape (*e-f-g-a*), between which modulation is possible; the distinctive notes are called after the genus they establish⁴⁸.

Nevertheless, it is crucial that the *khrōmatikē* stands not at some random interval, but a major

tone above *hypátē* (*e*). Only thus can it fulfil a second modulating function, providing the transition to the neighbouring key (*tónos*). Only this later function survived into the Roman era. But which, if the question is meaningful at all, was original?

Here we must turn back to Archytas, our first certain source dealing with the pitch of this note. He gave no figures for a chromatic division as

⁴¹ Antiphanes in Athenaeus, *Deipnosophists* 643d, on Philoxenus (ca. 400 B.C.): τὰ μέλη μεταβολαῖς καὶ χρώμασιν ὡς εὖ κέχραται “how well his melodies are blended with modulations and *khrōmata*”; Aristoxenus in [Plutarch], *On Music* 1137–1138: ἀπεσχισμένους χρώματός τε καὶ μεταβολῆς καὶ πολυχορδίας “abstaining from *khrōma*, modulation and multiplicity of notes”.

⁴² The earliest instance is probably Pap. Hibeh 13, i.16.

⁴³ Antiphanes, as in No. 41 above; Philochorus, as in No. 38 above; cf. also Plut. as in the following note.

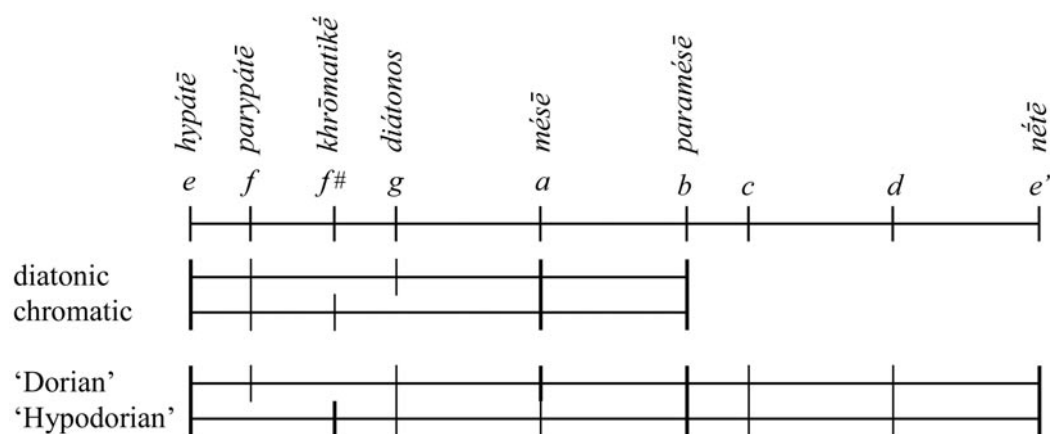
⁴⁴ Aristotle, *Politics* 1342a: τῶν ἁρμονιῶν παρεχβάσεις εἰσι καὶ τῶν μελῶν τὰ σύντονα καὶ παρακεχρωσμένα: for the public of low taste there are “inappropriate digressions from the modes (*harmoniai*) and the tense and inappropriately coloured melodies”. The pejorative aspect is expressed by the preposition *para-*; cf. Plut., *Quaestiones convivivales*. 645d: τὰς μὲν ἐν τοῖς μέλεσι παρακχρώσεις.

⁴⁵ Ptolemy, *Harmonics* 2.1, Düring 1930, 43.10–11; *Koinē hormasia* (Pöhlmann 1970, No. 6): the latter consists of a table apparently copied from a manual with close affinities to lyre practice; in a future publication I shall argue for its value as a source.

⁴⁶ In Ptolemy’s cithara tunings the *khrōmatikē* functions only as a fixed note (in functional terminology, as *paramésē* in *trítai* and as *hypátē mesôn* in *hypértropa*; to this we may add *paramésē* in *trópoi* and *mésē* in *iastiaiólia*); a true chromatic tetrachord appears only in the high part of *trópoi*.

⁴⁷ While the intervals of Diagram 6 are drawn in Ptolemy’s favourite diatonic with a small semitone, Diagram 7 uses the ‘Pythagorean’ tuning. Actual professional tunings from the late 5th century B.C. on employed more than the printed set of nine strings; but cf. the highly plausible reconstruction of the eleven-stringed *kitthára* in West 1992a, 26–27, of which the printed notes are a subset.

⁴⁸ The habit of distinguishing only the names of the upper ‘moving’ note according to the genus, so natural in lyre tuning, was sometimes extended by theorists to the enharmonic, although in such a comprehensive overview the lower moving note would require such a distinction, as well. It is important in that context that the note names are derived from lyre strings.

Diagram 7 The modulating *kithára* tuning behind the string names.

such, and those which modern commentators, following Ptolemy, derived are entirely different from his beautiful diatonic and enharmonic ratios. Had the famous Pythagorean treated the chromatic as a genus in the same right as the two others, he would have found little difficulty in establishing a more satisfying numeric solution⁴⁹. But all he remarked upon was that the distinctive chromatic note lies a *leímma* below the diatonic⁵⁰. Since the latter resided in its typical position one major tone below the upper boundary note in Archytas' system also, it follows that the *khrōmatikē* was perceived as occupying the symmetric position a tone above the lower boundary note, exactly as in the Roman Imperial sources so many centuries later⁵¹. We conclude that for Archytas in the early fourth century, the modulating major tone was more important than a 'chromatic division'; or at least that its tuning on the lyre 'by consonance' was so obvious that it would not have done to suggest a different mathematical solution. On top of this, Archytas seems to have been focussing on the auletic paradigm⁵², which further explains why he mentioned a feature of *kithára* music only in passing.

The same major-tone *khrōmatikē* underlies not only Archytas' divisions and the standard definition, which originated in about the same period, but within entirely different conceptional frameworks; but it also underlies a continuing strand of 'Platonizing' Pythagoreanism. Its orientation towards the division of the cosmic soul in Plato's *Timaeus*, carried out in detail in the pseudographic 'Timaeus Locrus', must not obscure the fact that Plato mentions only the diatonic division (without the particulars of its application), while the 'Timaeus Locrus' also introduces chromatic structures, explicitly discussing their two unequal forms of semitone⁵³. This 'Pythagorean' diatonic-chromatic interval pattern was also transferred to

the model scale of music theory and became a widely recognized standard⁵⁴. Thus we have at least three independent pre-Aristoxenian schemes that are unanimous in attributing a major tone to the chromatic *pyknón*, in compliance with Ptolemy's *kithára*: the standard genera, Archytas, and the 'Timaeus' tradition. It seems safe to acknowledge this unusual conformity as a common refer-

⁴⁹ Tannery 1915, 71, No.1, points to the possible division 28:27 – 15:14 – 6:5.

⁵⁰ Unfortunately, Ptolemy translated Archytas account into his own terminology: φησὶ γὰρ λόγον ἔχειν τὸν ἐν τῷ χρωματικῷ δευτέρον ἀπὸ τοῦ ὀξυτάτου πρὸς τὸν ὀμοιον τὸν ἐν τῷ διατονικῷ τὸν τῶν σνς' πρὸς τὰ σμγ' (*Harmonics* 1.13, Düring 1930, 31.4–6) "he says that the second highest in the chromatic has a ratio of 256:243 to the respective in the diatonic".

⁵¹ Archytas' slightly complicated way of putting it seems to be borne out of an interest in the specific question about the difference between *khrōmatikē* and *diátonos*. No extra calculation was required, by the way, since the value for the remainder (*leímma*) after two tones are subtracted from a fourth was known from the 'Pythagorean' diatonic (the knowledge of whose calculation is presupposed in Plato, *Timaeus* 36ab).

⁵² Besides the parallels to the aulos-based notation, it must be significant that in his treatment of the physics of sound Archytas refers to the aulos first of all instruments, but never to strings (fragm. 1 D.-K.). Cf. Athenaeus, *Deipnosophists* 184e: καὶ τῶν Πυθαγορικῶν δὲ πολλοὶ τὴν αὐλητικὴν ἤσκησαν, ὡς Εὐφράνωρ τε καὶ Ἀρχύτας Φιλόλαός τε ἄλλοι τε οὐκ ὀλίγοι. ὁ δ' Εὐφράνωρ καὶ σύγγραμμα περὶ αὐλῶν κατέλιπεν ὁμοίως δὲ καὶ ὁ Ἀρχύτας "many of the Pythagoreans practised the art of the aulos, Euphranor, for instance, and Archytas, and Philolaus, and quite a number of others. Euphranor even left an essay on auloi; and Archytas did the same".

⁵³ 'Timaeus Locrus' 213.8; 12 (*díesis*); 213.7; 11 (*apotomé*); 213.2–15 (*leímma*); 211.6–12 ('major' and 'minor semitone': read μεῖζον ἀμιτόνιο(ν) in 6). Note also that the chromatic and the diatonic are curiously united in Pap. Hibeh 13, i.17–ii.4.

⁵⁴ Thrasyllus in Theon, *De utilitate mathematicae* 91–93; Gaudentius 15–16, 343–344 Jan; Anecd. Studemund, 3–7; 14–19 (cf. Hagel 2006a).

ence to the practice of lyre tuning. One would be led to suspect a connection of the chromatic with the art of the lyre even without the explicit textual evidence, since only the ‘tuning by concordance’ of a stringed instrument gives rise to such a definite conception of pitch, while the protean nature of aulos notes would have allowed for divergent interpretations.

On balance, the *khrōmatiké* seems to have been a constant of *kithára* practice at least from the late 5th century B.C. until the 2nd century A.D. Nothing suggests that – of its specific double modulating function – the genus was primary. More plausible appears an evolution from the modulation between adjacent keys (*e-f-g-a-b* and *e-f#-g-a-b*) to the free employment of the modulating string together with the old *parypátē*, as well⁵⁵. The instrument design with its row of indiscriminate strings facilitates such an evolution, which we need not imagine as a slow shift. The effects gained by interspersing modulating notes in traditional melodic patterns explain the notion of ‘coloured melodies’ very well⁵⁶. Eventually the specific combination *e-f-f#-a* was singled out as a ‘chromatic’ genus in its own right. The way was probably led by the analogous patterns of the (wide) auletic enharmonic and (perhaps) ‘soft’ variants of the diatonic, which had shaped the musical perception towards a system as later formulated by Aristoxenus.

Before we can sum up our conclusions, we have to tackle two still unsolved problems: the double nature of *díesis* as a semitone and a quarter-tone, and the discrepancy between the apparent lack of semitones on early auloi and Aristoxenus’ insistence on a quarter-tone enharmonic in accordance with the standard genera definition. For the latter, I can only propose a possible answer. We know that the modulating avant-garde music from around 400 flourished also in aulos-accompanied genres, especially in the dithyramb. This had become possible through the invention of a mechanism that allowed having many more than five finger holes per pipe: currently unused ones were closed by metal collars that could be operated during performance. Much as in modern Western music, modulation followed primarily the circle of fifths, so that it became necessary to employ instrumental scales built of tones and ultimately semitones⁵⁷. The mechanism, which called for different playing skills, delivered professional aulos music from the old physical constraints discussed above. As a corollary, the tonality of the aulos and the lyre could coalesce into the standard definitions⁵⁸. This process started in the second half of the 5th century, and must have been more or less complete in the first half of the fourth. As a consequence, the semitone-chromatic became the natur-

al auletic scale alongside the diatonic; indeed what we have from Hellenistic music is dominated by these two genera. If the enharmonic was performed on the new professional instruments in the old way, namely by dividing the lower diatonic interval, the result was quartertones. In this stage we must accordingly search for the origins of the standard definition. The new paradigm was not yet adopted by Archytas of Tarentum’s scalar mathematics; but it must have determined the elevated musical culture of the Greek centres during Aristoxenus’ childhood and youth. I regard it as probable that Aristoxenus’ ‘enharmonic acculturation’ in such an environment is responsible for his favour for its harshest form. But it was a transient stage. When he wrote, the enharmonic was almost obsolete, practiced only rarely and then mostly in a ‘near-chromatic’ shape⁵⁹. If the present recon-

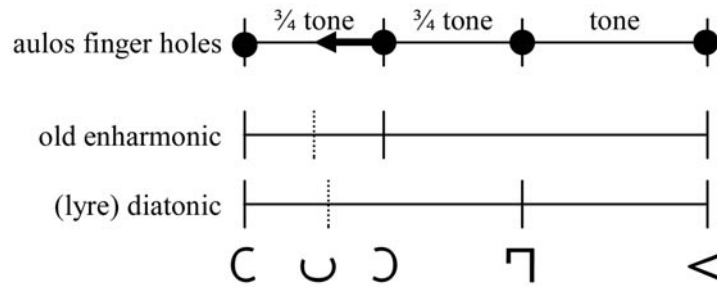
⁵⁵ Cf. Abert 1924, 37; Vogel 1963b, 124–125 (“bildete sich aus der Vermischung zweier Einstimmungen ein neuartiges Tetrachord, dem ein eigenes Ethos zuerkannt wurde”): a similar development was possible in the higher range with the inclusion of the modulating tetrachords *diezeugménōn* and *synēmménōn*.

⁵⁶ In this context we can understand the (abridged or corrupted) sentence interpolated in Aristides Quintilianus 2.19, Winnington-Ingram 1963, 92.24–25 W.-I.: *χρωματικὸν δὲ καλεῖται παρὰ τὸ χρώζειν αὐτὸ τὰ λοιπὰ διαστήματα, μὴ δεῖσθαι δὲ τινος ἐκείνων* “chromatic it is called because it colours the rest of the intervals, but does not need any of them”. If conceived from the viewpoint of modulation, the higher chromatic movable note (*f#*) is provided by the neighbouring key, while the lower semitone (producing the *f*) is common to the enharmonic and the diatonic in the standard definition. Thus, a chromatic structure can be distilled from simple modulation in both other genera, precisely because the chromatic does not require an interval specific to only one of these. It ensues that here, too, the ‘colouristic’ effect of *f#* is secondary to modulation.

⁵⁷ We have fragmentary examples of such instruments from the Hellenistic period (e.g. Bodley 1946; Литвинский 1999) and largely complete specimens from Roman times (the Pompeii pipes, cf. Howard 1893).

⁵⁸ Cf. the two old *tónoi* systems mentioned by Aristoxenus, one built on the old three-quartertones, the other on the standard definition (Hagel, as in No. 32 above).

⁵⁹ Aristoxenus in [Plutarch], *On Music* 1145a: *Οἱ δὲ νῦν τὸ μὲν κάλλιστον τῶν γενῶν, ὅπερ μάλιστα διὰ σεμνότητα παρὰ τοῖς ἀρχαίοις ἐσπουδάζετο, παντελῶς παρητήσαντο, ὥστε μὴδὲ τὴν τυχοῦσαν ἀντίληψιν τῶν ἑναρμονίων διαστημάτων τοῖς πολλοῖς ὑπάρχειν. οὕτως δ’ ἀργῶς διάκεινται καὶ ἠαθύμως, ὥστε μὴδ’ ἔμφασιν νομίζειν παρέχειν καθόλου τῶν ὑπὸ τὴν αἴσθησιν πιπτόντων τὴν ἑναρμόνιον δίεσιν, ἐξορίζειν δ’ αὐτὴν ἐκ τῶν μελωδημάτων, πεφλυαρημένοι τε τοὺς δόξαντας τι περὶ τούτου καὶ τῷ γένει τούτῳ κεχρημένους* “Our contemporaries have entirely deprecated the most beautiful of the genera, that which was most appreciated by the ancients because of its dignity, so that the majority has no longer the slightest apprehension of the enharmonic intervals. They are so idle and careless that they think the enharmonic *díesis* does not give the impression of something falling within the realm of perception at all, but exclude it from the melodic lines and make a fool of those who attribute the issue some significance and make use of this

Diagram 8 The old auletic *diesis*.

struction is appropriate, the reasons for this rapid decline of a formerly prevailing musical form are not hard to conjecture: the quartertones were a more or less artificial substitution for the old auletic *pykná*. In spite of being supported by newly developed theoretical models, the quartertone enharmonic would not last as a living musical form⁶⁰. Aristoxenus, however, was bound to keep it, because only the standard genera fitted the semitone grid of a complete modulating diagram⁶¹. Probably he felt justified in doing so by the musical experience of his youth, when professional performers played ‘classical’ music on auloi that adhered, by and large, to the semitone paradigm.

The case of the *diesis* is less doubtful. According to the accepted interpretation, the term derives from the procedure of half-stopping a finger hole, i.e. ‘letting through’ a certain quantity of air (or sound). It is therefore of auletic origin, and could not designate an interval of ascertainable size. On a three-quartertone aulos, the player would bisect the enharmonic *pyknón* by this technique, resulting in a theoretical division of 75-75-350 cents. When playing together with a lyre in ‘Pythagorean’ tuning, the pitch of the lower hole had also to be lowered by a certain amount, from the about 150 cents of the three-quartertone interval to the 90 cents of the *leîmma*. The difference between the half-stopped notes achieved in both procedures is therefore a theoretical 15 cents. Under realistic conditions, this is tantamount to nothing, and there can hardly be any doubt that the musicians neither made nor noted any difference between the two contexts of half-stopping (cf. Diagram 8). The notation testifies to this fact by designating the two functions with the same sign. Archytas adopted the same concept.

Originally, then, the term *diesis* was applicable to ‘the’ small interval. When Pythagoreans began to investigate the structures of the tetrachord, they took over the auletic term for the small interval in the diatonic – either because there was as yet no conception of a ‘semitone’ or because one became aware almost at once that this designation was misleading. Ancient sources attribute the diatonic

‘*diesis*’ to Philolaus, together with the notion of the *apotomé* as its larger counterpart⁶². The harmonicist tradition, on the other hand, concentrated on the enharmonic. Consequently the *diesis* became here the quartertone, and thus the ‘measure’ of the tonal space, once the standard definitions of the genera were created. Aristoxenus inherited this usage, but still conveys the awareness that the term *diesis* is properly applied to more than one type of ‘small interval’. Thus, his quartertone is properly called the ‘smallest enharmonic *diesis*’, while there is also a ‘smallest chromatic *diesis*’; larger *diéseis* are thus implicitly acknowledged.

genus”; *Harmonics* 1.23, Da Rios 1954, 29.2–8: [...] οἱ μὲν γὰρ τῇ νῦν κατεχούσῃ μελποοῖα συνήθεις μόνον ὄντες εἰκότως τὴν δίτονον λιχανὸν ἐξορίζουσι· συντονωτέρας γὰρ χρῶνται σχεδὸν οἱ πλείστοι τῶν νῦν. τούτου δ’ αἴτιον τὸ βούλεσθαι γλυκαίνειν αἰεὶ· σημεῖον δ’ ὅτι τούτου στοχάζουσι, μάλιστα μὲν γὰρ καὶ πλείστον χρόνον ἐν τῷ χρώματι διατρίβουσιν, ὅταν δ’ ἀφίκωνται ποτε εἰς τὴν ἁρμονίαν, ἐγγὺς τοῦ χρώματος προσάγουσι συνεπισπωμένου τοῦ μέλους “those who are accustomed merely to the currently prevailing music rightly exclude the ditone *likhanós*; for nowadays practically the majority employs higher ones. The reason for this is the pursuit of sweetness throughout. That this is their objective is shown by the fact that above all and for the most time they employ themselves with the chromatic, and when they eventually arrive at the enharmonic, they drive it close to the chromatic, the melody being dragged along.”

⁶⁰ Whether the ‘nearly-chromatic’ rendition of enharmonic melodies (see the preceding note) was a modern ‘deterioration’, as Aristoxenus seems to imply, rather than the continuation of the older intervallic form is questionable. How it would be played on a semitone aulos depends on how large we assume the difference actually was. If the hypothesis of a pure major fourth instead of a ditone is embraced, the variation of 22 cents would hardly be effected by partially opening a finger hole. Personally I doubt that such a small melodic difference could be ascertained by listening to the reed instrument with its intrinsic resonances and easily shifting pitches being played in practice. On the other hand, if the half-stopping technique was employed for wide enharmonic ‘shades’ of any kind, it is understandable that this genus was no longer favoured by performers.

⁶¹ On Aristoxenus’ *diágramma polýtropon* see Hagel 2000, 182–188.

⁶² Cf. footnote 11 above.

We have arrived at a fairly consistent picture of the evolution of the genera within their organological context. In archaic times, it seems, aulos and lyre music were more separated than later. Although both took part in a diatonic musical metalanguage and were thus able to perform together, each instrument type also developed its idioms, in accordance with its capabilities⁶³. The *kithára* expanded its characteristic tuning in alternating fifths and fourths from heptatony into the first steps of modulation, employing the resulting note also for the purpose of ‘colouring’ the melodies. The aulos, on the other hand, with its fixed set of finger holes, achieved a greater potential by producing intermediate notes – interestingly, at that place where a similar playing technique was required for performing together with the lyre. The tonality of the two instruments was able to coalesce when a new generation of modulating auloi replaced old patterns, dictated by physical constraints, with the semitone-generating paradigm of modulation. Contemporary theory reflected this shift by describing the tonal space within a quartertone grid, blending the semitones of the circle of fifths with the revered microtonality of classical music⁶⁴. The abstraction of three genera from their original organological connotations was virtually complete at this time. It was left to Aristoxenus to fine-tune this system, re-introducing intervallic variants purportedly found in performance. The boundary he posits between the enharmonic and the chromatic, however, seems unhistorical: his chromatic conquers much of an area that had formerly been (and was perhaps still by many) associated with the enharmonic. This is at least partially due to his personal predilections; but it also testifies to the firm establishment of the chromatic as a proper genus beyond doubt, abstracted from its original context and susceptible to intervallic variation.

I conclude with an open question: how old is the chromatic in the art of the *kithára*? If it is accepted that its name and the older testimonies cannot refer to pure chromatic scales, the ‘colouring’ of a melody apparently requires an additional string. This would put its invention in the fifth century. On the other hand, Aristoxenus holds that it was part of citharody “from the beginning”⁶⁵, many generations before tragedies were played, which points back to (semi)legendary figures such as Orpheus or at least Terpander in the seventh century. What shall we make of this contradiction? Is it conceivable that lyres with more than the canonical seven strings had been around for centuries, contrary to the general assumption built on ancient testimonies as well as the iconographic evidence? It is certainly worth noting that the only positive Near Eastern evidence we have, the Hurrian hymns from the 14th century B.C., very probably presuppose a nine-stringed instrument, and several of them apparently one of ten strings⁶⁶. Moreover, the latter pieces favour a modulating interpretation with alternation between *f* and *f*#, at exactly the same position of the scale as the Greek *khrōmatiké*. It might be tempting to draw a line over the centuries to the musical innovation brought by Terpander from the Eastern colonies – but currently this can be no more than speculation⁶⁷.

⁶³ Cf. Franklin forthcoming; on the diatonic as the basis of heptatony cf. also Franklin 2002.

⁶⁴ Cf. Franklin 2005, 22.

⁶⁵ Cf. footnote 38 above.

⁶⁶ For a bibliography on the Hurrian hymns and their musical analysis see Hagel 2005a. The conclusions reached there for a possible relation between Near Eastern and Greek music would have to be modified if an archaic modulating *khrōmatiké* is accepted.

⁶⁷ On possible Near Eastern connections cf. Franklin 2002a and most recently Franklin 2006; Franklin 2006a.

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