

RICARDO EICHMANN – LARS-CHRISTIAN KOCH –  
FANG JIANJUN (HRSG.)

# Studien zur Musikarchäologie X

Klang – Objekt – Kultur – Geschichte  
Sound – Object – Culture – History

Vorträge des 9. Symposiums der Internationalen Studiengruppe Musikarchäologie  
im Ethnologischen Museum der Staatlichen Museen zu Berlin, 9.–12. September 2014

Papers from the 9<sup>th</sup> Symposium of the International Study Group on Music Archaeology  
at the Ethnological Museum, State Museums Berlin, 09–12 September, 2014

2016



Verlag Marie Leidorf GmbH · Rahden/Westf.

XII, 270 Seiten mit 109 Abbildungen und 16 Tabellen zzgl. 1 CD-ROM (mit Text- und Musikbeispielen)

EUROPEAN MUSIC ARCHAEOLOGY PROJECT



Kultur

Dieses Projekt wurde mit Unterstützung der Europäischen Kommission finanziert. Die Verantwortung für den Inhalt dieser Veröffentlichung trägt allein der Verfasser; die Kommission haftet nicht für die weitere Verwendung der darin enthaltenen Angaben.

### Bibliografische Information der Deutschen Nationalbibliothek

**Eichmann, Ricardo / Koch, Lars-Christian / Fang, Jianjun (Hrsg.):**

Studien zur Musikarchäologie X ; Vorträge des 9. Symposiums der Internationalen Studiengruppe Musikarchäologie im Ethnologischen Museum der Staatlichen Museen zu Berlin, 9.–12. September 2014.

[Red.: Orient-Abteilung des Deutschen Archäologischen Instituts].

Rahden/Westf.: Leidorf, 2016

(Orient-Archäologie ; Bd. 37)

ISBN 978-3-89646-667-9

Die Deutsche Nationalbibliothek verzeichnet diese Publikation in der Deutschen Nationalbibliografie. Detaillierte bibliografische Daten sind im Internet über <http://dnb.d-nb.de> abrufbar.

Gedruckt auf alterungsbeständigem Papier

Alle Rechte vorbehalten

© 2016



Verlag Marie Leidorf GmbH  
*Geschäftsführer:* Dr. Bert Wiegel  
Stellerloh 65 · D-32369 Rahden/Westf.  
Tel: +49/(0)5771/95 10-74  
Fax: +49/(0)5771/95 10-75  
E-Mail: [info@vml.de](mailto:info@vml.de)  
Internet: <http://www.vml.de>

ISBN 978-3-89646-667-9

ISSN 1434-162X

Kein Teil des Buches darf in irgendeiner Form (Druck, Fotokopie, CD-ROM, DVD, BLUERAY, Internet oder einem anderen Verfahren) ohne schriftliche Genehmigung des Verlages Marie Leidorf GmbH reproduziert werden oder unter Verwendung elektronischer Systeme verarbeitet, vervielfältigt oder verbreitet werden.

Umschlagentwurf: Susanne Kuprella, Berlin

Titelvignette: Dra' Abu el-Naga Mission Harp FN 1056 (nach Fig. 4 auf Seite 113 in diesem Band)

Redaktion: Dorothee Judith Arndt, Juliane Aurora Lange und Kristina Pfeiffer, Berlin

Bildredaktion: Michaela Jahn und Dorothee Judith Arndt, Berlin

Deutsches Archäologisches Institut, Orient-Abteilung, Podbielskiallee 69–71, D-14195 Berlin

[eMail: [orient@dainst.de](mailto:orient@dainst.de) – Homepage: <http://www.dainst.org>]

Satzerstellung, Layout und Bildbearbeitung: stm|media GmbH, Köthen

Druck und Produktion: druckhaus köthen GmbH & Co. KG, Köthen

# ‘Leading Notes’ in Ancient Near Eastern and Greek Music and Their Relation to Instrument Design

Stefan Hagel

## Zusammenfassung

*Eine Analyse antiker Musikdokumente sowohl in ugaritischer Keilschriftnotation aus der späten Bronzezeit als auch in griechischer Melodienotation aus den Jahrhunderten um die Zeitenwende beleuchtet belegte und mögliche ‚Leittonfunktionen‘ in melodischen beziehungsweise dichordharmonischen Schlussformeln. Ihre Verteilung und Funktion wird anhand der Instrumentaltechnik der kulturell bestimmenden Saiten- und Blasinstrumente (Leiern und Doppeloboen) diskutiert, wobei grundlegende Eigenheiten der antiken Musik von physischen Grundlagen und einfachen musikalischen Axiomen hergeleitet werden.*

In modern Western music, a leading note is usually understood as the note a semitone below a final which is perceived and typically used to ‘lead’ the melody towards this final. Such a leading note is naturally present as the seventh degree of major modes, but also employed in minor modes using a sharpened seventh degree (‘harmonic’ and ‘melodic’ minor scales). This usage of the term is evidently formed by Western hearing conventions, confounding the basic idea of a musical function with that of a particular interval size. In the present paper I shall employ the term in a more inclusive sense, as any note adjacent (within the *Gebrauchsskala*) to a focal note and typically preceding this focal note in melody – particularly in melodic closures.

This definition requires some clarifications. Firstly, the classification of ‘typically’ is exactly what needs to be established. Secondly, what is a ‘closure’? When working with a large corpus of melodies, one might concentrate exclusively on performance-final notes, which are largely unequivocal. But alas, the available pool of extant ancient notated music includes only a very limited number of preserved finishes, so that we need to evaluate performance-internal potential closures as well. These, however, may be either restful (as would normally be expected for performance ends) or suspensive.<sup>1</sup> By definition

the latter combine elements of closure with elements of non-closure, which makes their inclusion ambiguous. We will discuss the relevant examples below.

Despite the differences in sources and notation systems, I will once more draw comparisons between Greek and Near Eastern music. Though it is important to keep the temporal, geographical and cultural separation in mind, I think the two bodies of evidence may shed some light on each other exactly because they follow different approaches. Anyway, there is little doubt that Near Eastern music as reflected in the cuneiform sources and later ancient Greek music are in some way connected, through intimate contact in historical times no less than, plausibly, by continuing supra-regional characteristics of late Bronze Age musical culture, including heptatonism based on strings tuned in alternate fifths and fourths.<sup>2</sup>

## 1 The Near Eastern Evidence

Let us start with the earlier sources. The cuneiform musical texts build on the idea of what we may call ‘dichords’, combinations of two strings on a model instrument, which form an interval either of the fifth/fourth type (including a tritone or a diminished fifth in one place in the scale) or of the third/sixth type (each being a major or a minor sixth or third, depending on the tuning). Ten years ago I argued that the rudimentary musical notation on the well-known hymn tablets from Ras Šamra, which employs these dichords, is best understood as providing a basic intervallic harmonisation for a (non-notated) melody.<sup>3</sup> In this way it proved possible to make musical sense of statistical distributions as well as typical sequences and types of sequences. In

<sup>1</sup> Cf. the discussion in Cosgrove 2011, 167–181.

<sup>2</sup> Cf. Franklin 2006; Franklin 2011; Franklin 2015; for my doubts about lyres with as few as four strings cf. Hagel 2008.

<sup>3</sup> Hagel 2005a.

particular, I pointed to the fact that in several places dichords realised as thirds on the nine-stringed model instrument precede a fourth or fifth in such a way that one of the notes of the latter is located between those of the former. In other words, the third ‘closes in’ towards that note. Such sequences appear clearly favoured: there are no less than nine instances in the small corpus, while the calculation of a weighted expectation value shows that one would expect only 2.09, if the observed pool of dichords were randomly arranged. The chance of finding so many more actual instances purely by accident is less than 1 in 3000, so we may be virtually sure that the observed sequences had in fact a musical significance. Here we may be observing sequences indicating some kind of closure, since a priori one would expect that the more resonant intervals of the fifth/fourth type are more likely to correspond to restful positions in the performance than the third/sixth dichords. This appears to be confirmed by the numbers that accompany the dichords in the notation. Even though the musical interpretation of those numbers is not clear, it seems evident that higher numbers correspond to some sort of higher prominence (which might have been achieved, for instance, by repetition or duration).<sup>4</sup> Of course, large portions of a performance may employ non-restful harmonisation – in fact, this is perhaps what we would expect from a modern Western perspective – while the most restful events might occur only in a few places. This must caution us against interpreting mere sums of incidences or notated numbers as evidence for harmonic priority. On the other hand, we may very well expect that the most restful positions are prominent as well. Therefore, average notated numbers (totals of numbers found with a dichord divided by the number of occurrences) are probably the best guide to harmonic importance and may be associated with the idea of restfulness. An analysis of all the published Ras Šamra fragments corroborates this hypothesis: the average of the numbers accompanying fifth/fourth dichords is 2.08, as opposed to only 1.61 for the third/sixth dichords.<sup>5</sup> Moreover, the highest mean number is attributed to the fourth/fifth dichord *nīd qabli* (2.57),<sup>6</sup> which also holds the highest total of accompanying numbers, though it is by no means the most frequent one occurring: two third/sixth dichords are attested more often, and one just as often as *nīd qabli*.<sup>7</sup>

All this suggests a straightforward interpretation of the mentioned dichord successions where a third leads to a fifth/fourth: it is plausible that such combinations were favoured as a, if not *the* typical way of arriving at a restful position. This becomes even more likely considering that in four of the nine attested cases the target dichord is no other than *nīd qabli* – as we have seen, arguably the harmonic centre of the pieces’ mode.

How would such successions have worked in practice? A certain characteristic of harmonic movement observed in the fragments suggests, with an error probability of one in seven, an instrument of nine notes, exactly like the model instrument of cuneiform school musical lore.<sup>8</sup>

Certainly I do not want to suggest that no other notes but those of the notated dichords were played or sung – I would rather argue for a kind of variant heterophony based on the notated harmonic structure – but at least the notated dichords were of considerable significance, and it is likely that both of their notes were sounded together or in close proximity whenever they were notated (whether on a string instrument or a double pipe or across various instruments of a small orchestra). All in all I am confident that a contemplation of the abstract scheme presented by the notation may be a useful guide to what the Bronze Age musicians themselves considered as structurally important, if only because of all the elements present in performance, it was precisely the dichords that they singled out for noting down.

By definition, a dichord notation can only provide us with two potential leading notes, without telling us, which of these was in fact the one used by the singer(s) (who I am convinced did not perform multipart song any more than the Greeks did later, even where more than one vocalist was involved). With such a strong preference for instrumental leading notes, it is at least quite unlikely that the vocal melody did not employ any of the two but arrived at the final note by a larger intervallic jump of a third or more. In addition, having another melodic note would establish a regular triple harmonisation, as seems incompatible

<sup>4</sup> Hagel 2005a, 307–311.

<sup>5</sup> From this calculation, the few occurrences of the number sign for ‘10’ have been excluded, since this ‘number’ is almost certainly not to be taken literally (cf. Hagel 2005a, 309–310). If they are included, the means rise to 2.28 as opposed to 1.72, which similarly supports the present argument. Note that the figures presented here cannot be derived from the table in Hagel 2005a: there the total number of occurrences of each dichord in the tablets is counted, whether the associated numbers are preserved or not, while the calculation of means naturally evaluates only dichords whose accompanying number can be read.

<sup>6</sup> Followed by *qablītu*, another fifth/fourth dichord, with 2.27.





<sup>7</sup> It may be significant in this context that the hymns are, as far as we see, all in the tuning named, after the dichord, *nīd qabli*, but I am not convinced that this is much more than a coincidence: after all, in most of the tunings on the nine-stringed model instrument, *nīd qabli* is one of the ‘octave-enhanced’ dichords and therefore likely to gain modal prominence also in other tunings. Note that *qablītu* (above, no. 6) also falls within this category.

<sup>8</sup> Hagel 2005a, 320 with no. 88.

with all the ancient evidence. Therefore, it is on the one hand possible that there was a standard melodic choice corresponding to one note of the third/sixth dichord, the other being its standard harmonic counterpart. On the other hand, the voice may have been free to use one or the other. In the former case, melodic conventions would

have been independent and in a certain sense prior to harmonic conventions; in the latter, a harmonic conception might have been more fundamental. As long as no corresponding melodies are known, we cannot know.

Converted to stave notation, the discussed progressions include the following four:<sup>9</sup>

	<i>rebūtu</i> → <i>nīd qabli</i> : 2–7–(9) → 1–4–(8) [4 instances]
	<i>šalšatu</i> → <i>embūbu</i> : 1–6–(8) → 3–7 [3 instances]
	<i>šeru</i> → <i>išartu</i> : 5–7 → 2–6–(9) [1 instance]
	<i>titur qablītu</i> → <i>kitmu</i> : 2–4–(9) → 3–6 [1 instance]

It will be noticed that the much more frequent first two examples require doubling the nominal higher string at the lower octave, as is to be expected on a non-modulating nine-stringed instrument. This is confirmed by the 'retuning text' UET VII 74, where the ninth string is retuned together with the second.

It may be significant that the note towards which the thirds 'close in' is not randomly any of the two notes of the target dichord. In the first three instances, where the target dichord appears as a fifth, it is the lower note of that fifth, transcribed as *e*, *f* and *g* respectively. In the last case, where the target dichord can, within the ranges of the canonical nine notes, only appear as a fourth, it is the higher note of this fourth, *c'*. In the context of the system, which is generally based on functional invariance between notes an octave apart, the targeted notes are therefore functionally similar (just as in modern Western music *c* in a chord *c-e-g* is harmonically equivalent to *c'* in *g-c'-e'*). That the note to which the potential leading notes actually lead is functionally the bottom note of the fifth and not its top note (and conversely the top note of a fourth and not its bottom note) may naturally be understood on the basis of the fact that fifths formed from notes of similar sound form a less complex compound pitch spectrum than do fourths, other factors being equal. (Compare again the fact that a modern Western *g-c'-e'* chord is musically interpreted as a variant of *c-e-g*, meaning that the note conceived as basic is derived from a normalisation where it sits at the bottom of a fifth.)

The discussed set, therefore, appears to form a coherent, probably traditional class of harmonic progression. Even though it targets fifths/fourths dichords, of course not all of the instances would have marked some kind of closure. For reasons set out above, a restful character is quite likely for the first one, while the second, albeit significantly frequent, cannot have represented more than a transitory rest point, if perceived as a closure at all.<sup>10</sup> In the given tuning, it is interesting to see that the lowest note (*d*) was more likely to function as a leading note towards its higher neighbour than to receive modal focus itself. We need to bear this relation in mind.

Unfortunately, the ambiguity in determining an actual melodic leading note out of the two not only renders it impossible to assess the relation between leading notes above and below the final, but also makes it difficult to estimate the respective

<sup>9</sup> I equate the highest note of the system (string 1, *qudmum*) with modern *e'*, which has the enormous advantage of facilitating comparison with ancient Greek and Roman lyre tunings, which it makes the most sense to notate in the same way (cf. Hagel 2009). As Greek and Near Eastern lyres were historically connected in some way, and as the Greco-Roman lyre is pitched for accompanying male voices, there is also some probability that a similar notation might reflect a similar pitching. The ancient natural key, Lydian, which supports 'Dorian' tunings, thus corresponds to Near-Eastern *nīd qabli*. With this transcription, the actual Greek pitch would have been about three quarters of a tone above modern concert pitch. Cf. Shehata – Hagel 2012, Diagram 3.

<sup>10</sup> Cf. the low average accompanying number of *embūbu* (1.33).



importance of tones and semitones. However, we can state that all but one of the observed eight progressions involve a semitone besides a tone. A random selection of target notes in the octave, in contrast, would yield only four such progressions out of seven, the other three involving only tones (having a semitone both below and above is incompatible with a diatonic scale). Under this point of view, the sample is quite clearly not random – the chance to obtain such a large quantity of semitones in a random sample is only about 1 in 20.<sup>11</sup> This gives reason to propose the hypothesis that semitones may have played a role as leading notes in the few fragments of Bronze Age music we possess, although we cannot ascertain whether this extended to their melodic use or was only part of instrumental harmonisation. Most importantly, we must bear in mind that we are dealing here with fragments that were most probably all composed in the same mode or at least tuning – no general conclusions are warranted.

For the sake of comprehensiveness, an afterthought may be in place. Three of the dichord names appear to reference another dichord: besides *išartu* we find *titur išartu*, besides *qablītu*, *titur qablītu*, and *nīd qabli* may or may not be related to *qablītu*. If those terminological links reflected a genuine musical reality, typical harmonic progressions are certainly a plausible option, especially when taking into account the meaning of *titur*, which is generally translated as *bridge* or *causeway* (the meaning of *nīd* is less clear). To be sure, no such progressions between the members of these pairs are found in the Hurrian hymns; however, as these are younger by centuries than the establishment of the dichord names (and moreover not even in Akkadian language), the music for which the latter were coined may have been quite different. At any rate, here is a transcription of the pairs in question:

*titur išartu – išartu*

*titur qablītu – qablītu*

*nīd qabli – qablītu*

Obviously each of them involves one or two possible leading notes, but it is difficult to say much more. The two instances of *titur* work very differently – but that is a notorious problem that any

interpretation needs to face. After all, we cannot even assume that the direction implied in the transcription is valid. It is certainly the more likely for the *titur* cases, if (a big if) these indicate potential closures; about *nīd qabli*, not even that much can be said.

## 2 The Hellenistic Evidence

From the sad scraps of Near Eastern music we turn to the happier field of Greek musical scores (including the globalised Greek music of Roman imperial times), with dozens of readable melodies and melody fragments scattered over a period of about 600 years. Most of these are vocal music, which means they come with a text and often a recognisable metre, which in turn helps us greatly in determining potential locations of musical closure: we would expect it to occur not only at the end of the performance, but also at the end of individual sections and, to a lesser degree, of individual metrical periods or verses (where in turn suspensive closures are likely to play a greater role).

Similarly, it is often not too difficult to establish modal hierarchies between the notes of a piece, based on their frequency or repetition rate or their harmonic relation to other focal or final notes<sup>12</sup> – including the evaluation of non-suspensive internal breaks, where the danger of circularity is at least mitigated by taking the text and the metre into account as well.

Here is my list of extant closures, quoted from the edition by E. Pöhlmann and M. L. West (DAGM), with transcriptions following the new standard I have proposed,<sup>13</sup> comprising only closures where the final note is reached from one of its neighbours in the scale.

### 2.1 A) Falling Cadences

#### *DAGM 23: Seikilos Song*

At its very end the brief melody ventures below its previous range, terminating at a note a fourth and an octave respectively below the two melodic focal notes. Note that the final  $\Gamma \sim c^{+50}$  was a typical bass note on certain types of auloi: on such instruments, it is not possibly approached from below, there being no adjacent lower note.

<sup>11</sup>  $p=0.0503$ .

<sup>12</sup> For a discussion of tonal hierarchies in the fragments cf. West 1992a, 177–189. 283–326; Hagel 2009, 219–250. 256–326; Cosgrove 2011, 181–194; Hagel 2012.

<sup>13</sup> Pöhlmann – West 2001; Hagel 2009, 452–453.

$\begin{matrix} \text{C} & \bar{\text{C}} & \text{C} & \dot{\text{X}} & \bar{\text{I}} \\ \alpha & \pi & \alpha & \iota & \tau \epsilon \iota \end{matrix}$

a - pai - ti

DAGM 42: *Pap. Michigan 2958.3, 8, 9, 10*

Here dramatic dialogue is set to music; several extant verse ends can be determined.<sup>14</sup> The two in lines 8 and 10 end, via a step of a whole tone, on I, which is the central string (*mésē*) of the cithara and a traditional harmonic centre,<sup>15</sup> and which also seems a reasonable harmonic centre in the Hyperian mode, as can be gleaned from other fragments.<sup>16</sup>

$\begin{matrix} \text{I} & [ & ] & ? & \text{Z} & \dot{\text{I}} \\ \text{C} & \Omega & \text{T} & [ & ] & \text{H} \text{P} \text{I} \text{A} \end{matrix}$

sō - tē - rí - a

$\begin{matrix} ] & \text{Z} & \text{I} & \bar{\text{O}} \\ ] & \Lambda & \text{H} & \text{C} \end{matrix}$

l-ēs

Others, in line 3 and 9, stand out for terminating an emotional question in the high region of the voice:<sup>17</sup>

$\begin{matrix} \bar{\text{Z}} & \acute{\text{O}} & \text{O} & \text{O} & \text{O} & \bar{\text{A}} \\ \text{T} & \text{I} & \text{T} & \text{A} & \Delta & \text{E} & \Lambda & \text{E} & \text{G} & \text{E} & \text{I} & \text{C} \end{matrix}$

tá - de lé - geis

$\begin{matrix} ] & \text{A} & \bar{\text{A}} & \text{A} & \dot{\text{Z}} & \bar{\text{Z}} & \acute{\text{O}} \\ ] & \Gamma & \text{H} & \text{C} & \Delta & \text{E} & \text{Y} & \text{P} & \text{O} & \text{M} & \text{O} & \text{I} \end{matrix}$

deú - ró moi

DAGM 40: *Pap. Oslo 1413a.16*

Here also a verse end is discernible in stichic metre set to music (though it corresponds only to a weak grammatical break); the final note is here C, doubtless a traditional final by being the traditional lowest note (*hypátē*) of the early lyre. In accordance with the Lydian key (which establishes a 'Dorian' tuning), the penultimate note (*parhypátē* P) is a semitone above the final.

$\begin{matrix} \text{M} & \text{P} & \bar{\text{P}} & \text{C} \\ \delta & \epsilon & \text{o} & \mu & \text{o} & \upsilon \end{matrix}$

de ho-mū

DAGM 50: *Pap. Berlin 6870.12*

A clearly citharodic Paean once more ends on *hypátē* C. However, as the key is Hyperian, this time the adjacent higher note (*kbrōmatikē* O) is located a whole tone above it.

$\begin{matrix} \text{O} & \text{C} \\ \text{P} & \text{O} & \text{I} \end{matrix}$

l-poi

<sup>14</sup> I exclude the verse end in 13 (δ' αὖ μ' ἔτι), which falls in the middle of a grammatical phrase and is consequently marked by non-restful Z, a tone above I.  
<sup>15</sup> Cf. below n.31.  
<sup>16</sup> Cf. Hagel 2009, 302.  
<sup>17</sup> I include line 3 in accord with the verse division proposed by Pöhlmann and West; however, the preceding rest on the papyrus suggests a different division.

Similar figures are found at verse ends within the composition (ll. 7 and 10). Here, however, the impression of a final closure is neutralised because the two verses are linked by an additional short note that, though still sung to the last syllable of the previous verse, acts melodically as an introduction to the following:

DAGM 53: *Pap. Oxy. 3161 recto fr. 4.4*

A period end exhibits final and penultimate notes similar to the previous example; the key of this dramatic fragment cannot be established with confidence (also Hyperian, or rather Hypolydian?).

DAGM 38: *Pap. Oxy. 2436.ii.4*

A dramatic verse ends with what was almost certainly the lowest note on typical Roman-period citharas (*hyperypātē* Φ), in contrast to the foregoing items. However, there is no reason to regard this closure as anything but restful, since this final note chimes in with the modal framework found in the rest of the melody, which emphasises the notes a fourth and an octave above it – likely a typical way of employing the keys between which the piece modulates (Lydian and Hypolydian; the quoted passage is from a Hypolydian stretch).

DAGM 59: *Pap. Oxy. 1786.2 and 5*

A similar ending is twice exemplified in the famous Christian hymn from Oxyrhynchus, which almost certainly was also performed to the lyre. The mode is again Hypolydian.

## 2.2 B) Rising Cadences

DAGM 28: *Mesomedes, Hymn to Nemesis, 1*

Unfortunately, the last line of the hymn is lost (unless one considers the item to consist of two separate pieces). Even so, it may be instructive to contemplate its first verse, which is both textually self-contained and ends on the focal note of the hymn (which would also be the final note of the supposed first piece); cf. below DAGM 24 and 25. However, it seems that a rising sequence of three notes would not easily terminate a composition.



I C P M  
βίου ροπά.

bí - ū rho - pá

DAGM 40: Pap. Oslo 1413a.18

Above, we encountered a weak verse-break on this papyrus, where the lower final was reached from above. Here, in an apparently stronger break, the traditional central note (*mésē* I), a fourth higher, is approached from below.

M I I Í  
ηργαζετο

ēr - gá - ze - to

DAGM 24: Invocation of the Muse

The end of this short piece is preserved; it moves from the later bottom note of the later lyre (*hyperypátē* Φ) to the older bottom note (*hypátē* C):

P M Φ C  
δονείτω.

do - nī - tō

The closure is already prefigured in the opening half-verse:

C Z Z Φ Φ Φ C C  
ἄειδε Μοῦσά μοι φίλη,

á - ī - de Mû - sá moi phi - lé

DAGM 25: Mesomedes, Invocation of Calliope and Apollo

Both the conclusion and its anticipation in the address in the first half-verse are paralleled in the second invocation from the same set of pieces transmitted in medieval manuscripts (they are all in the Lydian key):

C P M P C Φ C  
Καλλιόπεια σοφά,

Kal - li - ó - pī - a so - phá

I Φ C C  
πάρεστέ μοι.

pá - res - té moi

In contrast, the ends of the first two verses (which are hexameters) display no restful qualities, but appear to urge on to the brief final colon (a *lekythion*). Both end, after the traditional two melodic excursions that appear to have characterised hexametric performance from pre-Homeric times onward,<sup>18</sup> with a series of three rising notes. The first terminates on *hyperypátē* Φ, the note below *hypátē*, which in turn had been established as start and end note at the outset – consequently its neighbouring note is implicitly marked as non-final and therefore suspensive:

C C C C Γ R Φ  
προκαθαγέτιτερπνῶν

pro - ka - tha - gé - ti ter - pnōn

<sup>18</sup> Cf. Hagel 1994; Hagel 2004b.

The other terminates in the higher region on *mésē* l: here the suspensive character seems to be achieved by a combination of melodic rise and relatively high pitch:

I M P C M I  
Δήλιε Παϊάν

Déli - e Pai - án

DAGM 27: *Mesomedes, Hymn to Helios, 7, 23 and 25*

C is also the final in another hymn in the collection. Once more its modal status is already introduced in the opening, with the first verse sporting the now well-known finish on ΦC:

C C C C I C P C Φ Λ C  
Χιονοβλεφάρου πάτερ Ἄους,

khi - o - nob - le - phá - rū pá - ter A - ūs

The piece ends by combining the same option with that of approaching the final from above; quite unusually, an identical cadence is already found on the last verse but two. C appears first after a plunge down to Φ, but becomes the true final only after a melismatic excursion to the notes above it. The entailing resolution of the long penultimate position into three notes on a single syllable is exceptional in what remains of Mesomedes' compositions. Plausibly, it is introduced precisely for the melismatic effect, which does not so much extend the melody as lend weight to the final; consequently, I decided to discuss this instance among the other examples of ΦC rather than those (fewer) of PC.

I Φ C P M P C  
σύρμασι μόσχων·

súr - ma - si mós - khōn

I Φ C P M P C  
κόσμον ἑλίστων·

kós - mon he - lís - sōn

DAGM 39: *Pap. Oslo 1413a.8 and 14*

Twice periods end on the melodic focal note C preceded by Φ. In the first instance, this is part of a rising figure (in accord with the accentuation of the proper name Achilles, frequently found at verse end already in the Iliad), potentially indicating a lower degree of restfulness.

X X Φ C η  
αχιλλεύς

A - khil - leús

C O C Φ C η  
αοράτον

a - ó - ra - ton

DAGM 50: Pap. Berlin 6870.1

In the paean whose end was discussed above the tonality is once more introduced in the opening address, which both starts and ends with ΦC.

Φ C O Z O O Φ C  
 Π Α Ι Α Ν Ω Π Α Ι Α Ν

DAGM 51: Pap. Berlin 6870.13

The same papyrus also contains fragments of two instrumental pieces, presumably for *aulos*. One features period end (discernible by a prolonged note before a rest) on FC, which is the equivalent, in instrumental notation, of what we know from vocal notation as ΦC.

< < < E C F C η  
 < < < : < E C F C η

DAGM 53: Pap. Oxy. 3161 recto, fr.1.3 and 7

In another dramatic fragment, C thrice serves as a final. Only in a single instance is the preceding note also preserved; it is once more Φ:

O Φ C / η  
 θ ε ω

In another place, a rest indicates a break after Z, a frequent but otherwise not especially prominently used note. Too little is preserved of the context to determine the grammatical nature of the break:

υ ι ζ η  
 σ υ ν ε μ ο ι

### 3 Interpretation

Figure 1 sums up the presented evidence; it includes both certain and possible closures, differentiating them by the width of the arrows, while excluding cases which we could identify as almost certainly suspensive, especially where standing in contrast to one or more clearly restful examples in the same piece. Ascending and descending closures are about equally frequent (47% of the safer instances and 54% of all possible examples are ascending). However, semitone steps towards the final are very rare (6%/14%). They occur exclusively in falling endings, which is a corollary of the fact that ancient music seems never to grant final status to the functional notes *do* and *fa*.

As is to be expected, the bulk falls within the lower part of the usual gamut, according to a general linguistic and musical tendency of associating

pitch fall with utterance end.<sup>19</sup> But as has already become clear in our brief survey above, possible finals are by no means distributed randomly even in that region, nor are the ways they are reached in melody. Instead, the majority of cases (59%/61%) involve the same final, C.

### 4 Material Causes: Lyre

Above I have already described this note as the traditional bass note of the seven-stringed lyre, called *hypátē* ('topmost') according to its physical position on an instrument held tilted when playing. With such a limited resource as seven notes (excluding the fancy trick of eliciting overtones, which is hard-

<sup>19</sup> Cf. e.g. Devine – Stephens 1994, 435–452.

ly feasible in the usual manner of playing), the coincidence of melodic final and lowest available note on the instrument is all but natural. Even when the voice departed from the ambitus of the accompaniment, it was desirable to end on a common note.<sup>20</sup> However, our scores date from 200 to 800 years after the demise of the seven-stringed instrument in favour of lyres with nine, eleven and perhaps even more strings (whether the fifteen-stringed *lyra* mentioned by Ptolemy is an heir to the old lyres as regards playing technique and repertoire is questionable<sup>21</sup>). So it is no surprise that the scores do not reflect a state in which C would most typically have been preceded by its upper neighbour. Instead, this is true only for 30% (29%, counting the doubtful instances as well). In the majority of the discussed closures on C, it is preceded by  $\Phi$ , a whole tone below, and this cadence accounts for no less than 41% (43%) of our observed total. We know from the so-called *koinē hormasia* that this note was part of Roman-period tunings,<sup>22</sup> called *diápemptos*, ‘a fifth from [the central string]’, or *hyperypátē*, ‘beyond *hypátē*’, and it most probably was introduced as early as the fifth century BCE, when our sources mention instruments of nine and eleven strings.<sup>23</sup> Notably, in our best source for early modal scales the Dorian covers not only the ‘Dorian octave species’ down to C, but an entire ninth down to  $\Phi$  (cf. Fig. 1).<sup>24</sup> The association of the Dorian scale with a ninth is all the more noteworthy because, as far as we see, the whole given set of non-diatonic scales does not primarily belong in the context of lyres at all, but rather of auloi. Given the primacy of the Dorian (and its special association with the lyre) in Greek thought, it may be significant that one of the early modulating diagrams was expressly confined to twenty-eight quartertones (which is a ninth), that of all the reported early scales only the Dorian extends to such an ambitus, and that the system can be plausibly reconstructed as incorporating the other scales within the range of the Dorian.<sup>25</sup> All in all, there is reason to believe that in the early fourth century BCE the idea of a ‘Dorian ninth’ had already spread from lyre playing into the sphere of auletic scales.

At any rate, at least in Roman imperial times, when the greater part of the surviving scores were written, *hyperypátē*  $\Phi$  had been around long enough to attract modal prominence in certain kinds of music, so that it now appears as a final in its own right (not that the evidence would allow us to conclude, *ex silentio*, that this had not been the case much earlier). However, while *hypátē* C is more often reached from below, *hyperypátē*  $\Phi$  is only found in falling closures, as if the range of the extended cithara prescribed the melodic options, precluding notes outside it from becoming part of conventional melodic cadences.

With fewer strings, a similar mechanism becomes less likely, because the voice would more often depart from the ambitus of the instrument anyway. Thus the archaic seven-stringed instrument with its restricted tonality may have been coupled with the vocal melody to a lesser degree, functioning a bit more as a rhythmical and harmonising instrument.<sup>26</sup> Consequently we may wonder whether a melodic closure on  $\Phi$ C may have been traditional even before the adoption of an extra  $\Phi$  string. Such an option may have been especially beneficial in non-strophic song, when the melody followed, to whatever degree, the contours of the Greek word accents and sentence intonation.<sup>27</sup> In particular, it would have allowed the archaic poets to combine a faithful melodic rendition of an end-accented word with a restful cadence on the bass note of their instrument. Since end-accented words at verse-end, including strong breaks such as between sentences or scenes, abound in Homeric poetry (key names such as *Akhilleús*, *Odysseús*, *Akhaioí* or *Zeús* most frequently appear in final position), this would have been a most powerful musical tool both for epic singers and for citharodes who adopted epic repertoire, furnishing it with more elaborate melodies.<sup>28</sup>

When strumming their lyres (which is the playing technique generally shown in the iconography), the Greeks must have sounded more than one note simultaneously; otherwise this technique does not make much sense.<sup>29</sup> There being no hint at

<sup>20</sup> Cf. ps.-Arist. *Probl.* 19.39. To be sure, in addition to the common note we must expect that at least another lyre string was struck; more below.

<sup>21</sup> Cf. Hagel 2009, 77–80.

<sup>22</sup> Hagel 2009, 122–132.

<sup>23</sup> West 1992a, 62–64; cf. Hagel 2009, 80–92.

<sup>24</sup> Aristid. *Quint.* 1.9, p.18–20 Winnington-Ingram; cf. Barker 1982, 183–4; Barker 1989, 419 n.112; Barker 2007, 45–48; Hagel 2009, 390–393. The notes, however, may have been added by the Roman-period writer who transmits the scales, which his sources probably specified merely as a list of intervals.

<sup>25</sup> Cf. Hagel 2000, 177–182; Hagel 2015, 371–385

<sup>26</sup> Cf. along these lines Aristoxenus contrasting contemporary (fourth-century BCE) focus on melody with an earlier predilection for rhythm: Ps.-Plut. *Mus.* 1138b.

<sup>27</sup> Such a correlation can be proven for the traditional technique of Homeric song down to at least the seventh century BCE (Hagel 1994; cf. West 1981; Danek 1989) and is well known from later scores from the second century BCE on (e.g. Devine – Stephens 1994; Cosgrove – Meyer 2006), so it would be surprising if the practice had not been used in the intermediate period as well.

<sup>28</sup> Cf. West 1981 and West 1986 on ps.-Plut. *Mus.* 1132b–f: καὶ γὰρ τὸν Τέρπανδρον ἔφη κιθαρωδικῶν ποιητὴν ὄντα νόμων κατὰ νόμον ἕκαστον τοῖς ἔπει τοῖς ἑαυτοῦ καὶ τοῖς Ὀμήρου μέλη περιτιθέντα ἄδειν ἐν τοῖς ἀγῶσιν “[Heraclides] also said that Terpander, being a composer of citharodic *nómoi*, in each single *nómos* adorned his own hexameters and those by Homer with melodies, singing them in the contests”.

<sup>29</sup> On lyre strumming cf. Lawson 2005.

ancient chords of more than two functional notes in the octave, we would a priori assume that the paradigm of ‘dichordal’ harmonisation extended to the Classical world as well, as we need to acknowledge for the inherently dichordal music of the *aulos* anyway. Speculating further, we might therefore wonder about the most plausible instrumental realisation of such a rising cadence. If the singer articulated what later became known as *hyperypátē* and notated as  $\Phi$ , the note one octave higher would have suggested itself as the most natural accompaniment. This note (U) was almost certainly present in most if not all early tunings.<sup>30</sup> In the cadence, the most plausible other note of the supposed dichord would have been the bass note’s higher neighbour (P or O), in the most typical instrumental way of arriving at the bass note. Expressed in Near Eastern string numbers, this combines to a dichord succession of 2–7–(9) → (1)–?–8. This matches the dichordal cadence we found favoured in the Hurrian hymns: 2–7–9 → 1–4–8. Would, once the ninth string had been added, a typical Greek dichordal cadence on the lyre have been identical with an Ugaritic-Hurrian one a thousand years earlier? If so, was it already part of a common inheritance dating from the Bronze Age? We cannot exclude the possibility, but as the facts underlying our speculation can all be explained merely by the layout and playing technique of the lyre, the factual parallels need not be anything more than the results of convergent evolution (granting a culture-crossing idea of intervallic harmony, as appears entailed by the common usage of double pipes). Moreover, in a Greek context, the most likely candidate for the second note in the final dichord, marked above as ‘?’, is not the Hurrian hymns’ string 4, but rather *mésē* I, corresponding to string 5.<sup>31</sup> Anyway, historic speculations apart, there can be no doubt that the nature of the typical cadences found in the ancient Greek musical documents was substantially influenced by the material substrate of lyre practice.

## 5 Material Causes: *Aulos*

However, it would be foolish to neglect the influence of the double-pipes, so omnipresent in Classical culture, on ancient hearing conventions. Here one might of course point to tonal characteristics that it shared with the lyre – so our most frequent final C is also the bass note of the Louvre *aulos*,<sup>32</sup> or on a pair of pipes from Pompeii, the treble note coincides with that of the cithara. But this would not explain much, as the pipes might have been modelled on the strings.

On the other hand, I believe that one traditional double-pipe design – more or less the only well-de-

fined type we can describe so far – may bear on our topic exactly in details that do not reflect characteristics of the lyre. This type of *aulos* is preserved in two specimens from Hellenistic Egypt, known as the ‘Louvre’ and the ‘Berlin’ *aulos*.<sup>33</sup> Their intricate connection with Greek theory is evinced by their bass notes being that of the model double octave, while that scale’s central note (‘functional *mésē*’) is the highest that is available on all pipes. The highest finger hole, on the other hand, is located an eleventh above the bass note, a relation that is almost certainly determined by the fact that the cylindrical pipes overblow to the twelfth: by overblowing, the scale is extended seamlessly (the Berlin *aulos* is specially suited for such a technique, and also sports speaker holes).

Now, from the basic choice of a bass note alone, several important modal constants can be derived – I will at present leave aside the question whether these historically result from the choice of the bass note, or whether, conversely, the bass note of theory was adopted with a view to traditional *aulos* design. As the bass note is a functional *la*, the non-overblown treble is a *re* (cf. Fig. 2). The highest note on the lower pipe is the octave of the bass note, once more *la*, but in a region that can be fingered in the primary playing position, at the top of both pipes, where it is possible to use all five fingers (the thumb hole is always second from the top). This may be motivated on the one hand by the need to have this note of the highest musical importance available on both pipes (it is the typical focal note of the musical documents dating from before the turn of the Christian era), and on the other perhaps also by the desire for a not too small difference between the ranges of the two hands, in order to maximise the overall playable range as well as the number of playable concords.<sup>34</sup> From the two top notes thus defined and the number of five fingers per hand, the ranges within a diatonic scale can be derived.<sup>35</sup>

<sup>30</sup> When speculating about the tuning of the seven-stringed lyre, later Greek sources either propose a sequence of two tetrachords, making the note in question the treble note, or a gapped octave, with what later was the third note from the top missing. This also leaves the note in question in place – forming a fourth with the central string, it seems to have been of particular importance.

<sup>31</sup> Cf. e.g. Winnington Ingram 1936, 4–9; West 1992a, 219; Hagel 2009, 117–122.

<sup>32</sup> Cf. Hagel 2004a; Hagel 2014.

<sup>33</sup> For the latter cf. Hagel 2010, and in general, Hagel 2009, 332–343. An argument for dating back an essentially similar instrument to the fourth century BCE is developed in Hagel 2005b.

<sup>34</sup> Note however that the playing ranges on preserved early *auloi* generally differ by only one finger hole, just as on the mentioned pair from Pompeii.

<sup>35</sup> Within the typical pitch ranges of *auloi*, only heptatonic scales with comparatively evenly spaced notes come into question – which are essentially variants of diatonic.



five steps below high *re* we obtain *fa*, five steps below *la*, *do*. The lowest note of these stretches is played with all fingerholes above it closed, so its position is not literally fixed (and can be adjusted by means of plugs or a single turning sleeve on the Berlin *aulos*), but the notes in question are present on both surviving examples. Neither *fa* nor *do* stand in a consonant relation with any of the prominent notes so far established (nor do they play a prominent role in the surviving melodies), which excludes them as potential members of the primary modal framework. Instead, two other candidates stand out in the playable region. Firstly, the lower *re* stands at the distance of an octave from the top note, a fifth from the higher *la*, and (consequently) a fourth from the bass note. The playable triplet *re – la – re*, a fourth above a fifth, is naturally complemented by *sol*, a fourth above the lower and a fifth below the higher end of the same span. The resulting structure, an octave divided into two fourths separated by a tone, was described as the embodiment of *harmonía* from the fifth century BC on.<sup>36</sup> The concept may well have united lyre-based and *aulos*-based musical thought: while the earliest source for the concept appears to talk about the lyre as the model for *harmonía*, a movement in a well-known piece for *aulos* was also called *harmonía*,<sup>37</sup> a name that is difficult to understand (most pieces would have been ‘harmonious’ in a broad sense) unless it specifically emphasised the intervallic framework by which the term had come to be defined.

We may reckon that the most typical music played on instruments such as the Louvre and Berlin *auloi* evolved within this *harmonía*. Different ‘modes’ would have been available by variously stopping holes below or above the fingers, but none other would equally avail itself of the consonances built into the instrument while using all the fingers, including the thumbs.<sup>38</sup> With harmonic focal notes of *re* on the one hand and *sol* or *la* on the other, *re* would typically function as the final. Of course, on an *aulos* of this make a low final always comes with a higher accompanying note, as is entailed in the dichordal paradigm which we found in the Near Eastern system and have, somewhat hypothetically, applied to the Greek lyre as well. Anyway, the low final *re* is played with only the small finger lifted, as is *sol* on the higher pipe. The lowest notes on both pipes, in contrast, must perform a non-restive function, creating suspension which calls for resolution towards the primary modal axis. In other words, the lowest notes must be expected to function (also) as a kind of leading notes towards their higher neighbours (or, in the case of the higher pipe, perhaps also towards *la*, their higher neighbour but one). We may therefore imagine typical auletic cadences to have involved the lifting of one or both small fingers.

Whether we understand the basic choice in the design of this type of *aulos* as having *re* as the treble note or as having *la* as the bass note, it has become evident that from this basic choice an unbroken chain of musical and physical trivia quite necessarily leads to a configuration where focal notes, and especially a low final, may typically be reached from below via a step of a whole tone. In this way, traditional instrument design appears to be related to the fact that, as far as we currently see, ancient Hellenistic music knew leading notes below the final only as whole tones, in obvious contrast to later Western music.

Finally, we may try to tackle the question of harmonic chicken and egg. Was the selection of leading notes dictated by an instrument design that was motivated by entirely different ideas, or were, contrarily, the instruments designed to play music including a preconceived idea of whole-tone leading notes? The problem is not as intractable as it may seem, if we consider possible alternative *aulos* designs that would come with rising-semitone leading notes.

Some requirements for such pipe pairs have by now become obvious. Firstly, they need to span at least an octave in order to incorporate a *harmonía*-like structure not falling short of the musical capacity of the extant *auloi*. Secondly, in order to combine this with a lower leading note, their total range must exceed the octave by one step – a semitone step, in our imaginary case. Accordingly, the hands may overlap by no more than two fingers – with at least three additional fingerholes at the higher end on one pipe (for the following cf. Fig. 3). Since this is the maximum found on extant *auloi*, and many have a larger overlap,<sup>39</sup> we will not consider designs with an even larger difference in hand position. The treble note will therefore be an octave (nine minus one steps) above the low final. In order to have a

<sup>36</sup> Philolaus, fr. 6a = Nicom., *Ench.* 9, p.252.17–22, referring to lyre strings; Aristotle in ps.-Plut., 1139b–c (apparently quoting a source of Pythagorean hue). Explicit ancient awareness that *harmonía* was not simply homonymous with *dià pasón*, ‘octave (as an interval size)’, is shown in Porph., *In Ptol. Harm.* 1.5, p.96.21–23 Düring, with the important emendation by Raffa (2014): τῆ δὲ διὰ πασῶν – τῶ συστήματι, ὡς καὶ Θεόφραστος ἔφη – ἔθεντο ἁρμονίαν ‘to the concord of the octave – in the sense of a musical scale, as Theophrastus has also remarked – they gave the name *harmonía*’. The entire resonance of the term may have been something like “a set of notes, four of which, including the bounding ones, form a consonant skeleton of a well-divided octave, with the rest distributed in one of many meaningful ways within the larger gaps”.

<sup>37</sup> Cf. West 1992b, 33.

<sup>38</sup> A possible exception is the configuration with two finger holes below the higher hand closed, so that its bass note becomes *re*. Modally, this is but a variant of that discussed.

<sup>39</sup> This includes the hypothetical Dorian *spondeion* pipes I have proposed (Hagel 2009, 408–412).



leading note a semitone below the final, the final may be either *do* (resembling our major scale) or *fa*. The second option can be excluded as harmonically inferior to the observed design. Instead of a nice *harmonía* framework, its octave is divided as *fa – si – do – fa*, with a tritone and a diminished fifth in the places of the required lower fourth and upper fifth respectively.<sup>40</sup>

The major-scale option looks more promising at first glance, with a well-formed *harmonía* being constituted by the functional degrees *do – fa – sol – do*. However, the layout of its higher pipe is physically problematic for two reasons. I will start with the lesser: when there is only a semitone between the index hole at the top and the thumb hole, this results in a very small hole distance, especially in the highest region. Since each pipe is supported by one hand only, it is normally secured by the triangle formed by the index, thumb and some lower finger. The smaller the distance between the first two, the less stable the grip and the more wearying is it to uphold it for a longer period. Acting on a lever that is only half as long, the index finger needs to exert twice the force as on the extant pipes with whole tones at the top. The hand position becomes even worse when the thumb hole is opened. This is because the thumb, being the instrument’s only support, cannot be lifted from the hole, but must be rolled away from it. Since its joints only allow doing so in the upward direction, the tip of the thumb would basically end up right opposite the index finger, with the result that stability now depends on the fragile reed in the mouth of the player. All this is not necessarily detrimental, since the

reed must also counterbalance the pressure of the lower fingers whenever the index finger is lifted. Nevertheless, even after twenty-years experience with playing various kinds of *aulos*, my hands definitely do not like experimenting with such a modified position.

More importantly, a semitone below the treble hole is also detrimental to the overall span, because it is precisely the distance between thumb and index finger that adds a good deal to the total stretch of the hand. On the higher pipes of an *aulos* based on *do*, this potential is neglected, while at the same time putting additional demands on the other fingers, because all the remaining distances below the thumb are implemented by whole tones. The result is an even more strenuous fingering. The same problem applies, by the way, also to the alternative option based on *fa*, which we have excluded above on other grounds – only that there it affects both pipes. It is clear that no such twisted finger hole layout would possibly arise in an organological history that starts from putting holes in comfortable positions which are subsequently refined for better sound. On the other hand, it is almost as difficult to conceive a deliberate move towards such an unpractical design for musical reasons – especially as it is not clear at all what those reasons might be, when a comfortable fingering provides a perfectly consonant instrument.

In short, it seems that a musical culture in which double pipes play a central role is not easily compatible with our familiar leading notes of the rising-semitone type, and we may have succeeded in explaining fundamental choices of ancient music culture on the basis of instrumental physics, combined with a few well-grounded musical axioms.

<sup>40</sup> Similarly, Hellenistic music avoids lyre tunings that do not entail a complete four-note *harmonía*, as emerges from Ptolemy’s list of contemporary cithara *harmogai*, which cover only four out of the possible seven octave species (Dorian to Hypophrygian, ranging from the Lydian to the Iastian key), with a hint at the modulating inclusion of the next in the circle of fifth (*Iastiaiólía*). The other two would destroy the framework by retuning one of the two central strings. For the interpretation of Ptolemy’s tunings within the notation system, cf. Hagel 2009, 56–68.

## Ancient Sources

## ARISTIDIS QUINTILIANI

De Musica libri tres. Ed. by R. P. Winnington-Ingram (Leipzig 1963).

## NICOMACHUS

Encheiridion, in: C. v. Jan (ed.), *Musici scriptores* (Leipzig 1895).

## PORPHYRIUS

In Ptol. Harm.: Porphyrios Kommentar zur Harmonielehre des Ptolemaios. Ed. by I. Düring, Göteborg Högskolas Årsskrift 36/1 (Göteborg 1930).

Porphyry's Commentary on Ptolemy's Harmonics: A Greek Text and Annotated Translation (Cambridge 2015).

## PS.-ARISTOTELIAN PROBLEMS

in: C. v. Jan (ed.), *Musici scriptores* (Leipzig 1895).

## PS.-PLUTARCH

Mus.: Plutarchus, *Moralia* VI.3. Ed. by K. Ziegler (Leipzig 1964).

## Bibliography

## BARKER, A.

1982 Aristides Quintilianus and Constructions in Early Music Theory, *Classical Quarterly* 32, 184–197.

1989 Greek Musical Writings II. Harmonic and Acoustic Theory (Cambridge).

2007 The Science of Harmonics in Classical Greece (Cambridge).

## COSGROVE, CH.

2011 An Ancient Christian Hymn with Musical Notation. Papyrus Oxyrhynchus 1786 (Tübingen).

## COSGROVE, CH. – MEYER, M. C.

2006 Melody and Word Accent Relationships in Ancient Greek Musical Documents: The Pitch Height Rule, *Journal of Hellenic Studies* 126, 66–81.

## DANEK, G.

1989 ‚Singing Homer‘. Überlegungen zu Sprechintonation und Epengesang, *Wiener Humanistische Blätter* 31, 1–15.

## DEVINE, A. M. – STEPHENS, L. D.

1994 The Prosody of Greek Speech (New York/Oxford).

## FRANKLIN, J. C.

2006 Lyre Gods of the Bronze Age Musical Koine, *The Journal of Ancient Near Eastern Religions* 6, 39–70.

2011 s.v. Music, in: M. Finkelberg (ed.), *The Homer Encyclopedia* (Malden MA/Oxford).

2015 East Faces of Early Greek Music, <[https://www.academia.edu/12085713/East\\_Faces\\_of\\_Early\\_Greek\\_Music.\\_Conference\\_](https://www.academia.edu/12085713/East_Faces_of_Early_Greek_Music._Conference_)

[paper\\_APA\\_SCS\\_2015\\_MOISA\\_panel\\_>](#) (October 9, 2015).

## HAGEL, S.

1994 Zu den Konstituenten des griechischen Hexameters, *Wiener Studien* 107/108, 77–108.

2000 Modulation in altgriechischer Musik. Antike Melodien im Licht antiker Musiktheorie (Frankfurt/Main).

2004a Calculating auloi – The Louvre Aulos Scale, in: E. Hickmann – R. Eichmann (eds.), *Studien zur Musikarchäologie IV, Orient-Archäologie* 15 (Rahden/Westf.), 373–390.

2004b Caesura and Melody, in: F. Spaltenstein – O. Bianchi, *Autour de la césure*. Bern etc., 11–22.

2005a Is *nīd qabli* Dorian? Tuning and Modality in Greek and Hurrian Music, *Baghdader Mitteilungen* 36, 287–348.

2005b Twenty-four in Auloi: Aristotle, *Met.* 1093b, the Harmony of the Spheres, and the Formation of the Perfect System, in: S. Hagel – Ch. Harrauer (eds.), *Ancient Greek Music in Performance* (Vienna), 51–91.

2008 Die Sänger aus musikarchäologischer Perspektive, in: J. Latacz – T. Greub – P. Blome (eds.), *Homer. Der Mythos von Troia in Dichtung und Kunst* (München), 106–111.

2009 *Ancient Greek Music: A New Technical History* (Cambridge).

2010 Understanding the *Aulos* Berlin Egyptian Museum 12461/12462, in: R. Eichmann – E. Hickmann – L.-Ch. Koch (eds.), *Musical Perceptions – Past and Present: On Ethnographic Analogy in Music Archaeology*, *Studien zur Musikarchäologie VII, Orient-Archäologie* 25 (Rahden/Westf.), 67–87.

- 2012 Review of: Ch. Cosgrove, *An Ancient Christian Hymn with Musical Notation. Papyrus Oxrhynchus 1786: Text and Commentary*, *Studien und Texte zu Antike und Christentum* 65, Tübingen 2011, *Jahrbuch für Antike und Christentum* 55, 157–161.
- 2014 *Better Understanding the Louvre *Aulos**, in: R. Eichmann – J. J. Fang – L.-Ch. Koch (eds.), *Studien zur Musikarchäologie IX, Orient-Archäologie* 33 (Rahden/Westf.), 131–142.
- LAWSON, G.  
2005 *Ancient European Lyres: Excavated Finds and Experimental Performance Today*, in: S. Hagel – Ch. Harrauer (eds.), *Ancient Greek Music in Performance* (Vienna), 93–119.
- PÖHLMANN, E. – WEST, M. L.  
2001 *Documents of Ancient Greek Music: The Extant Melodies and Fragments* (Oxford).
- RAFFA, M.  
2014 *On the Text of Theophrastus fr. 717 Fortenbaugh*, *Classical Quarterly* 64, 409–410.
- SHEHATA, D. – HAGEL, S.  
2012 s.v. *Music: Ancient Near East*, in: *The Blackwell Encyclopedia of Ancient History* (Oxford), 4634–4636.
- WEST, M. L.  
1981 *The Singing of Homer and the Modes of Early Greek Music*, *Journal of Hellenic Studies* 101, 113–129.  
1986 *The Singing of Hexameters: Evidence from Epidauros*, *Zeitschrift für Papyrologie und Epigraphik* 63, 39–46.  
1992a *Ancient Greek Music* (Oxford).  
1992b *Analecta Musica*, *Zeitschrift für Papyrologie und Epigraphik* 92, 1–54.
- WINNINGTON-INGRAM, R. P.  
1936 *Mode in Ancient Greek Music* (Cambridge).

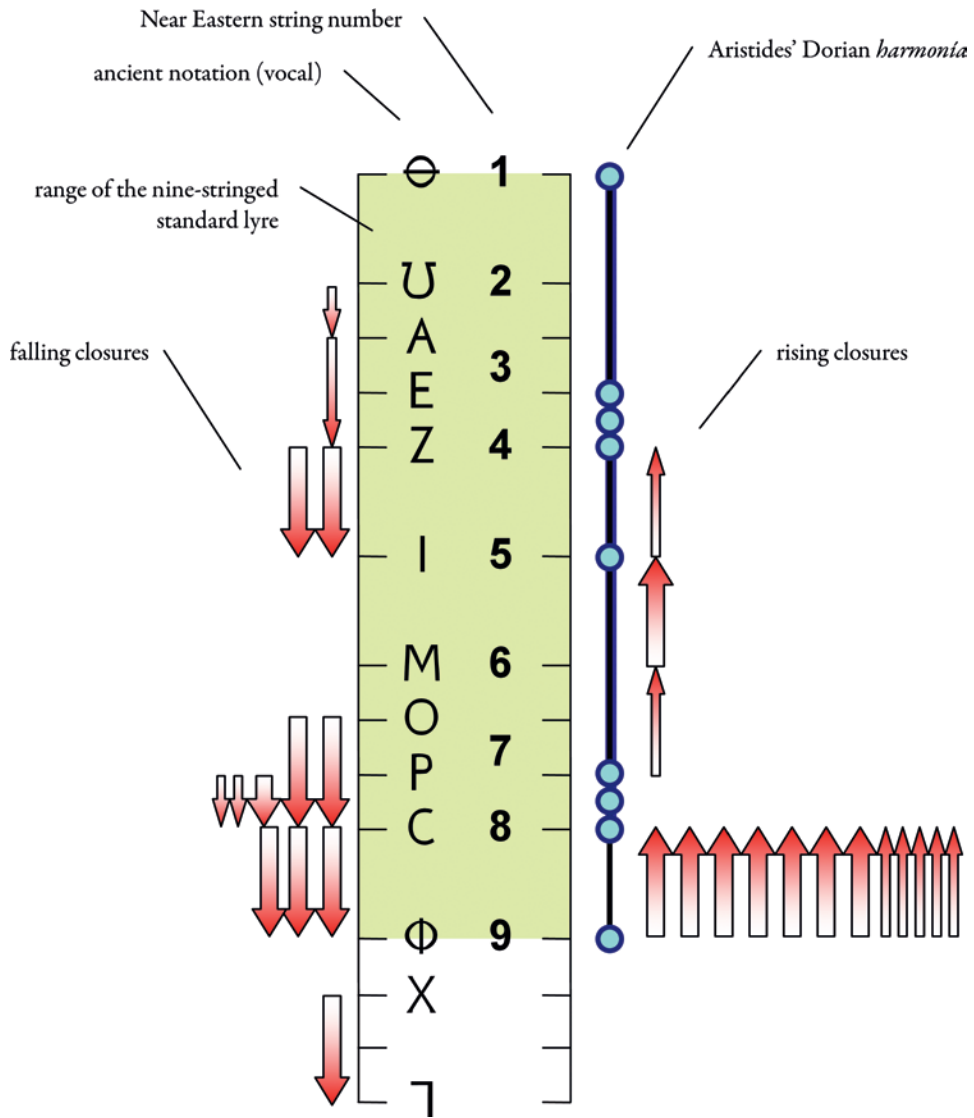


Fig. 1 Summary of closures found in ancient Greek musical scores (made by Stefan Hagel).

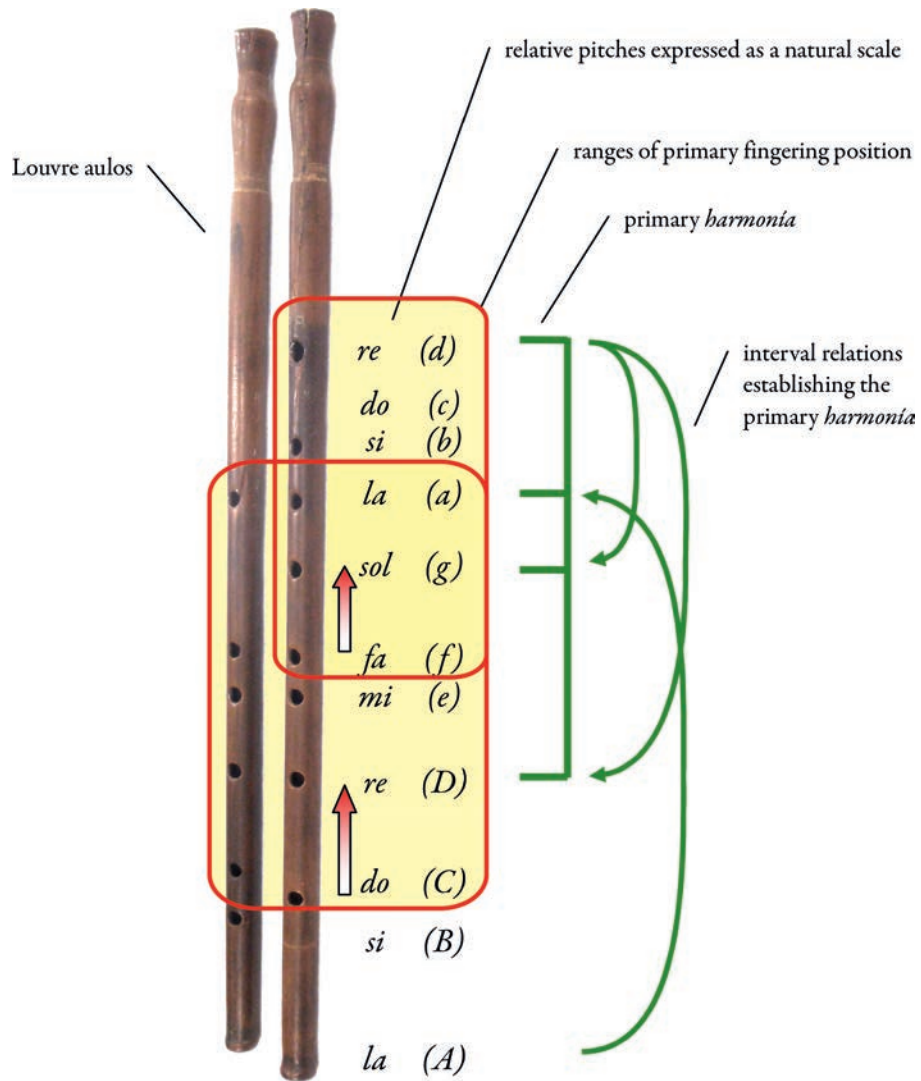


Fig. 2 Modal concepts entailed by traditional *aulos* design (made by Stefan Hagel).

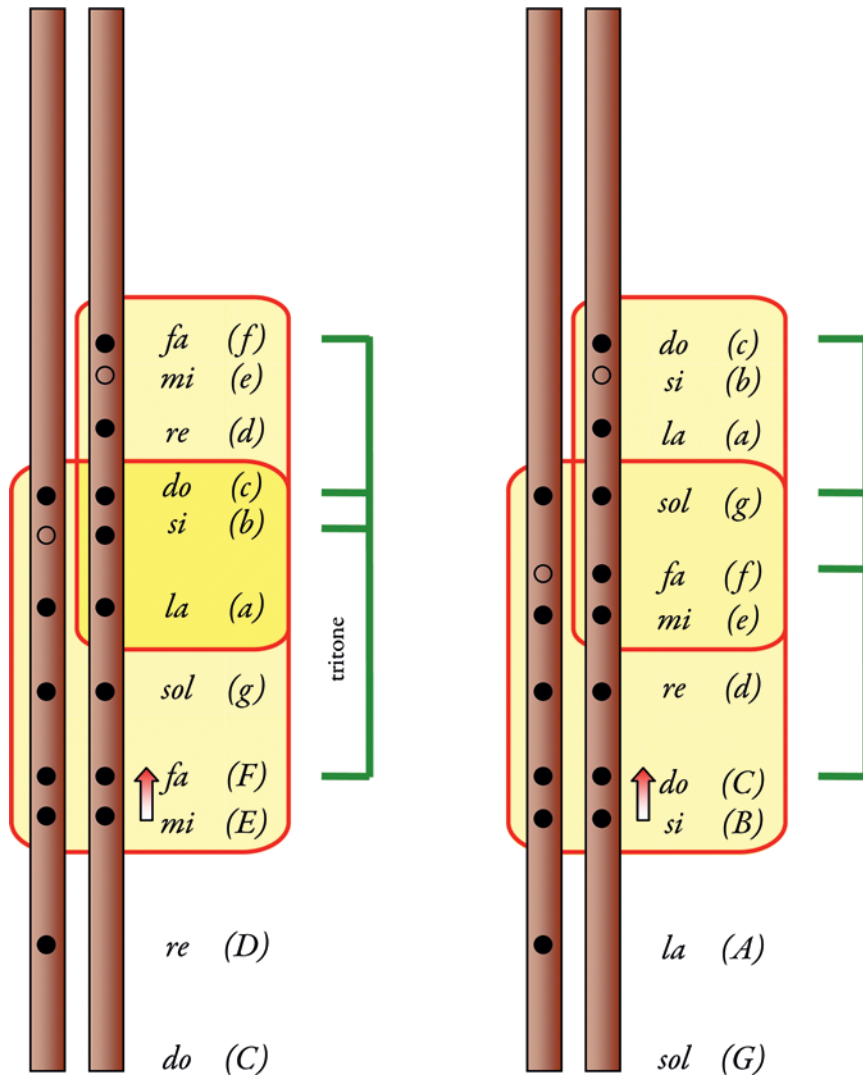


Fig. 3 Hypothetical double-pipe designs for rising semitone leading notes (made by Stefan Hagel).