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TOWARDS A NEW THEORY OF GREEK PROSODY: THE SUPRASYLLABIC RULES

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For W. Sidney Allen
on the occasion of his sixty-fifth birthday

Introduction

Current theories of Greek prosody[1]—both those based exclusively on duration and those incorporating stress—are open to criticism on two counts. By ignoring a significant body of philological data from the trimeter and the hexameter, they fail to give an adequate description of certain basic facts of the distribution of prosodic properties in the Greek language. Also, they are not designed to provide a principled account of the prosodic variability that underlies different levels of metrical strictness in the same metre.

It is not practical, given the scope of the present discussion, for us to review the totality of data that constitute the explananda of a theory of Greek prosody. Rather, our concern here is to establish the absolutely essential theoretical postulates by analyzing a limited set of crucial and unambiguous cases, namely the three laws of the tetrasyllables (§1.1–3), pyrrhic-shaped words in the tragic trimeter (§2.1.1), and syntagmata at Porson's Bridge in satyric (§2.2).

[1] The term "prosody" is used with slightly different reference in metrics and in linguistics. In metrics, it refers to all of the phonological properties of a language that are relevant to versification. In linguistics, prosody commonly refers to the phonetic features of duration, pitch and intensity, and in the work of the British linguist Firth to all phonetic features (including, but not limited to the traditional suprasegmental features just enumerated) that are distributed over domains larger than single vowels and consonants. In this paper we use the term prosody as it is used in metrics. Greek prosody can be divided into syllabic prosody, which covers all the factors determining syllable weight, and suprasyllabic prosody, which covers the organization of the two classes of syllables into patterned sequences within the word and the phrase. The standard reference work on Greek prosody is the model discussion in Sidney Allen's *Accent and Rhythm* (Cambridge 1973).

1. The suprasyllabic prosody of syllables within the word

Our discussion will proceed from the following three observations:

1. In the strictest styles of the trimeter, long 3rd anceps is predominantly implemented by the second heavy syllable of molossus-shaped words [(Ŏ)S̄S̄S̄(Ŏ)], and, in particular, the first syllable of tetrasyllabic words of the shape S̄S̄ŎS̄ is avoided in 3rd anceps. Thus, in the strictest styles of the trimeter, a structure such as ἀνθρώπων ὁρᾷ (Sem. 7.15) is common at the end of the line, but a tetrasyllabic word such as μεμνημένος (Sem. 7.112) is not.

2. In the hexameter, contracted 5th biceps is predominantly implemented by the second heavy syllable of extended molossus- and dispondee-shaped words (S̄S̄S̄Ŏ, S̄S̄S̄S̄), and, in particular, trisyllabic words of the shape S̄S̄Ŏ, S̄S̄S̄ are strongly avoided. Thus, words such as ἐψεύσαντο (Call. *Hymn* 1.7), ἱππημολγῶν (*ib.* 3.252) occur not uncommonly at the end of the hexameter, but words such as ἄρκτοιο (Call. *Hymn* I.41), ἀνθρώπων (*Il.* 1.339, *Od.* 20.76) are relatively rare in line-final position.

3. In stricter styles of the trimeter, a 4th-paeon-shaped word is always located so that the resolution is implemented by the first and second syllables, rather than by the second and third syllables. Thus, a word such as γενομένων, which is located before the caesura at *Troad.* 504, cannot be so located in any extant play of Euripides earlier than the *Hercules Furens.*

Before any theoretical implications can be deduced from these philological observations, they must first be carefully analyzed and tested. It is necessary to control for the interacting effects of other independent metrical restrictions and of the statistical structure of the Greek language: otherwise, the possibility will remain that the philological observations are merely reflexes of pre-existing factors and not evidence for the rules of Greek prosody at all.

1.1. The first law of the tetrasyllables

It was Knox[2] who first suggested that special restrictions apply to the implementation of 3rd anceps by the first syllable of tetrasyllabic words in the trimeter (and tetrameter) of the iambographers. Table 1 gives the percentage of line-final tetrasyllabic words with heavy first syllable out of all line-final tetrasyllabic words in the trimeters of Solon, Semonides and Archilochus.[3] These figures present a strong *prima facie* indication that long

[2] A. D. Knox, "The Early Iambus," *Philologus* 8 (1932) 18–39. For an estimation of Knox's work (including his earlier papers) see A. M. Devine and L. D. Stephens, "Bridges in the Iambographers," *GRBS* 22 (1981) 305–21.

[3] Proper names are excluded. Instances in the Epodes and unassigned single trimeters of Archilochus are not counted. Stop + liquid/nasal was counted as heavy, but the two examples of ποιέω in Solon were assumed to have light first syllable: see M. L. West, *Studies in Greek Elegy and Iambus* (Berlin 1974) 79.

3rd anceps is avoided with line-final tetrasyllabic words. However, strictly speaking, taken by themselves they are meaningless until they have been subjected to careful testing so as to control for potentially interacting metrical and linguistic factors and to establish their statistical significance.

TABLE 1

Line-final tetrasyllabic words in the trimeter of the iambographers

	ŝŝšš	šŝšš	N
	%	%	
Solon	0.00	100.00	16
Semonides	15.69	84.31	51
Archilochus	16.66	83.33	24
	13.19	86.81	91

1.1.1. Test of prosodic significance

Our first objective is to discover whether words of the shape ŝŝšš in particular are constrained in this location, or whether their rarity is simply the result of a general preference for short 3rd anceps. The simplest proof of the prosodic significance of the figures in Table 1 is the demonstration that the first syllable of the tetrasyllabic word is behaving differently from medial syllables in 3rd anceps position (we already know from Porson's Bridge that final syllables behave differently from medial syllables). If it were the case that heavy initial syllables of tetrasyllabic words were no less frequent than heavy medial syllables in 3rd anceps position, then initial vs. medial position within the word would not be a relevant factor: it would simply be the case that long 3rd anceps was rare in longer words. This alternative interpretation represents the first metrical null hypothesis. In order to test this null hypothesis, we will calculate the relative frequency of molossus-shaped words as compared with that of cretic-shaped words when located with medial syllable in 3rd anceps position in the trimeter, and then compare the results with the percentages in Table 1. The data are presented in Table 2. If we look at the ratio column in Table 2, we see immediately that short anceps is not even ¾ as frequent as long anceps in the medial syllables of molossus/cretic-shaped words, whereas in the initial

TABLE 2

Initial and medial syllables in 3rd anceps in the iambographers

	š	š	Ratio	N
	%	%		
Initial in tetrasyllables	13.19	86.81	6.58	91
Medial in molossus/ cretic-shaped words	57.81	42.19	0.73	64

Odds ratio: 9.02

syllables of tetrasyllabic words short anceps is fully 6½ times as frequent as long anceps. If there were no difference between the two word shapes, the ratios would be identical and, consequently, the odds ratio (ratio of the ratios) would be 1: in fact it is about 9. This means that the odds of having a word-medial long 3rd anceps are 9 times those of having a word-initial long anceps in the four word shapes tested.

However, we still have to test the second metrical null hypothesis before we can be sure that a real difference between initial and medial syllables has been established. The molossus-shaped word can occur only with its central syllable in 3rd anceps, whereas tetrasyllables with initial heavy syllable can be located beginning in 1st as well as 3rd anceps. If long 3rd anceps were avoided but long 1st anceps were relatively unconstrained, it could be the case that tetrasyllabic words with heavy initial syllable would be preferentially located at the beginning of the line, whereas molossus-shaped words would continue to be used in long 3rd anceps since they had no alternative location. In that case, the figures in Table 2 would not reflect any real difference between initial and medial syllables, but would simply be a reflex of availability of alternative locations in the line not involving long 3rd anceps. The figures in Table 3 emphatically disconfirm the second metrical null hypothesis, since it turns out that, as compared with their treatment in tragedy, tetrasyllabic words with heavy initial syllables are avoided also at the beginning of the line in the iambographers.

TABLE 3

Line-initial tetrasyllabic words

	⏑̄⏑̄⏑⏑	⏑̆⏑̄⏑⏑	Ratio	N
	%	%		
Iambographers	21.14	78.86	0.26	14
Tragedy (*Helen*)	66.67	33.33	2.00	15

Odds ratio: 7.33; $\chi^2 = 5.992$

1.1.2. Test of linguistic significance

The results of the preceding section, taken *in vacuo*, are still, strictly speaking, meaningless. If it were a peculiarity of the Greek language that heavy syllables were far more frequent in the middle of trisyllabic words than at the beginning of tetrasyllabic words, then the figures in Tables 1, 2 and 3 would be an automatic reflex of quantitative properties of Greek phonological structure and would tell us nothing about the prosodic properties of the word shapes in question. It is possible to test this linguistic null hypothesis on the basis of samples from prose, but evident dangers are posed by the many possible lexical and phonological differences among dialects and among literary genres. A far simpler and more direct refutation of the linguistic null hypothesis is available: if it can be shown that the incidence of long 3rd anceps in initial syllables of tetrasyllabic

words varies significantly from one style of the trimeter to another, then it can safely be concluded that at least one of the two styles has a metrical constraint skewing the natural linguistic frequency distributions. To this end, we compare the figures in Table 2 with comparable data drawn from representative samples of the tragedians (Sophocles, *Oedipus Tyrannus*; Euripides, *Alcestis, Electra, Bacchae*). In the absence of any difference in constraint on the medial syllable of molossus/cretic-shaped words between tragedy and the iambographers, we would expect that the incidence of long 3rd anceps in such shapes be about the same in the two types of trimeter. Indeed, it emerges from Table 4 that the rate of long 3rd anceps in the trisyllabic shapes is almost identical in the iambographers and in tragedy, with an odds ratio (0.88) close to 1. The small observed difference is not statistically significant ($\chi^2 = 0.214$). On the other hand, Table 4 indicates

TABLE 4
Comparison of iambographers and tragedy

	Medial in molossus/cretic-shaped word			Initial in tetrasyllables		
	Š %	š %	Ratio	Š %	š %	Ratio
Iambographers	57.81	42.19	0.73	13.19	86.81	6.58
Tragedy	54.75	45.26	0.83	36.76	63.24	1.72
	Odds ratio: 0.88			Odds ratio: 3.82		

that the odds of getting a short 3rd anceps in the initial syllable of tetrasyllabic words are over 3½ times as great in the iambographers as they are in tragedy. The existence of a strong association between the rate of long anceps in tetrasyllables and the style of trimeter cannot be an automatic reflex of the phonological statistics of the language in both styles: there must be a metrical constraint in at least one style, and the only reasonable conclusion is that there is a constraint against long 3rd anceps in the 1st syllable of tetrasyllabic words in the iambographers.

1.1.3 Test of statistical significance

However, despite our careful control of metrical and linguistic factors, it still might be the case that the figures in Table 1 are meaningless, because the difference between the iambographers and tragedy is simply the result of random variation in samples taken from total text corpora with identical distributions. Whether or not this is in fact the case can be determined by the statistical procedure known as the χ^2-test. The value of the χ^2 obtained for the difference between tragedy and the iambographers for tetrasyllabic words is 17.498. In other words, the chance of a χ^2 value this large or larger being due to random fluctuation from one text to another is minuscule: 34,483:1 ($p = 0.000029$). A more immediate

and intuitive appreciation of this figure can be obtained in the following terms: it would be necessary for us to have almost 35 thousand times the extant number of trimeters of Archilochus, Semonides and Solon to be sure to find one single sample the size of the extant corpus having long 3rd anceps distributed in the initial syllable of tetrasyllabic words as infrequently as (or more infrequently than) in the extant corpus.

The rejection of all null hypotheses at each of the three levels confirms the first law of the tetrasyllables. There are two theoretically possible explanations of this law. Either, the tetrasyllable is disfavoured at the end of the line (for "rhythmic" reasons) and the constraint is increased by the added factor of long anceps; or there is a prosodic difference between the (more satisfactory) central syllable of the molossus-shaped word and the (less satisfactory) 1st syllable of the tetrasyllabic shape. The former explanation can be discarded, because there is no evidence for the avoidance of line-final tetrasyllabic words in general; on the contrary, they are one of the most common types of line end in the iambographers. Thus, the second explanation, which is of a purely prosodic order, must be correct. But, the only difference between the heavy syllable permitted in 3rd anceps (the central syllable of the molossus-shaped word) and the heavy syllable avoided in 3rd anceps (the first syllable of the tetrasyllabic shape) is the position of the syllable within the word. Thus the first law of the tetrasyllables is a law of suprasyllabic rather than syllabic prosody: it relates not to the definition of the classes of light and heavy syllables in terms of their constituents, but to the way even identical constituents of the same class differ according to their position within the word. The heavy syllable τη in the tetrasyllabic word τητωμένη (*Hel.* 274) is, we have just shown, distinguished by some property from the heavy syllable τη in the molossus-shaped word δύστηνοι (Sem. 1.12); since the syllables are segmentally identical, the position in the word must occasion the prosodic difference between them.

1.2. The second law of the tetrasyllables

The constraints on contracted 5th biceps in the hexameter were investigated in detail by Ludwich[4] over a century ago. A good number of word shapes that would yield contracted 5th biceps are excluded by the general constraint against final syllables in contracted biceps, and probably also by the avoidance of monosyllables at the end of the line. The word shapes that remain available after these exclusions are, apart from rare longer shapes, trisyllabic words of the shape S̄S̄S̆ and tetrasyllabic words of the shape S̄S̄S̄S̆. By the second law of the tetrasyllables, such tetrasyllabic words are comparatively free to occur at the end of the hexameter, while the trisyllabic shapes

[4] A. Ludwich, *De Hexametris Poetarum Graecorum Spondaicis* (Halle 1866) 8, 46 ff.

are strongly avoided.[5] Table 5 gives the proportions of single words beginning in 5th biceps and ending the line that are palimbacchiac-shaped (S̄S̄S̆) and extended anapaest-shaped (S̆S̆S̄S̆) in Callimachus.[6] These figures

TABLE 5
Occurrences in Callimachus of palimbacchiac- and extended anapaest-shaped words as a percentage of the sum of their occurrences

S̄S̄S̆	S̆S̆S̄S̆	N
%	%	
2.95	97.05	34

present a strong *prima facie* indication that contracted biceps is avoided with line-final words of the shape S̄S̄S̆. However, strictly speaking, taken by themselves, they are meaningless until they have been subjected to careful testing so as to control for potentially interacting metrical and linguistic factors and to establish their statistical significance.

1.2.1. Test of prosodic significance

Our first objective is to discover whether palimbacchiac-shaped words in particular are constrained at the end of the line, or whether their rarity is simply the result of a general preference for uncontracted 5th biceps. The simplest proof of the prosodic significance of the figures in Table 5 is the demonstration that the initial syllable of a palimbacchiac-shaped word is behaving differently from the second syllable of an extended molossus-shaped word (S̄S̄S̄S̆) at the end of the line. If it were the case that heavy initial syllables of palimbacchiac-shaped words were no less frequent than heavy second syllables of extended molossus-shaped words in 5th biceps, then initial *versus* medial location within the word would not be a relevant factor: it would simply be the case that contracted 5th biceps was rare in general. This alternative interpretation represents the metrical null hypothesis. In order to test this null hypothesis, we shall calculate the relative frequency of extended molossus-shaped words as compared with that of extended choriamb-shaped words (S̄S̆S̆S̄S̆) when located at the end of the line and then compare the results with the figures in Table 5. We are thus comparing two classes of word shapes, class A $\left\{\begin{matrix}\bar{S}\\ \breve{S}\bar{S}\end{matrix}\right\}$S̆S̆ and class B S̄$\left\{\begin{matrix}\bar{S}\\ \breve{S}\bar{S}\end{matrix}\right\}$S̆S̆. The data from Callimachus are presented in Table 6. If we look at the ratio column in Table 6, we see immediately that contracted 5th biceps is nearly one and three-quarter times as common as uncontracted 5th biceps with the medial syllable, whereas in the case of the initial

[5] Unlike the shapes S̄S̄S̆ and S̄S̄S̄S̆, the shapes S̄S̄S̄ and S̄S̄S̄S̄, with heavy final syllable, do not permit simple and direct statistical evaluation, as many complicating factors render their distributions in the line non-comparable.

[6] The data in Tables 5–8 are based on the figures given by E. O'Neill, "The localization of metrical word-types in the Greek hexameter," *YCS* 8 (1942) 103–78.

TABLE 6
Relative frequencies of contracted and uncontracted 5th biceps in word-shapes tested

	S̄	S̆S̆	Ratio
	%	%	
A. [ ]S̄S̆	2.95	97.05	0.03
B. S̄[ ]S̄S̆	63.38	36.62	1.73

Odds ratio: 57.11

syllable the proportions are strikingly reversed, *un*contracted 5th biceps being 33 times as common as contracted 5th biceps. If there were no difference between the shorter and the longer classes of word shape, the ratios would be identical, and, consequently, the odds ratio would be 1: in fact, it is 57.11. This means that the odds of having contracted 5th biceps with a word-medial syllable are over 57 times the odds of having contracted 5th biceps with the first syllable of the word in the word shapes tested. However, these results taken *in vacuo* are still, strictly speaking, meaningless. If it were a peculiarity of the Greek language that heavy syllables were far more frequent in word shapes of class B than in those of class A, then the figures in Tables 5 and 6 would be an automatic reflex of the statistical properties of Greek phonological structure and would tell us nothing about the prosodic properties of the heavy syllables in question. If it can be shown that the incidence of heavy syllables in class A words is significantly different when the two word shapes of class A are located elsewhere in the hexameter, then it can safely be concluded that there is a constraint on contracted 5th biceps skewing the natural linguistic frequency distributions of the word shapes of class A at the end of the line. Table 7 shows that in word shapes of class A the shape S̄S̆S̄ is

TABLE 7
Relative frequencies of contracted and uncontracted bicipitia in word shapes tested in line final and non-line final locations

	Word shapes of class A			Word shapes of class B		
	S̄S̆S̄	S̆S̄S̆S̄	Ratio	S̄S̆S̄	S̄S̆S̄S̆S̄	Ratio
	%	%		%	%	
end of line	2.95	97.05	0.03	63.38	36.62	1.73
elsewhere	46.31	53.69	0.86	74.25	25.75	2.88

Odds ratio: $\omega_A = 28.47$ Odds ratio: $\omega_B = 1.66$
Ratio of odds ratios: $\omega_A/\omega_B = 17.15$

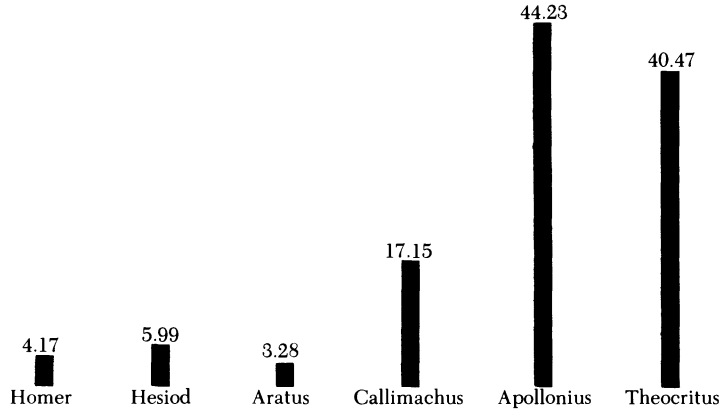
much more frequent relative to the shape S̆S̄S̆S̄S̆ when not located at the end of the line. This fact refutes the linguistic null hypothesis: the low frequency of heavy syllables in word shapes of class A implementing 5th biceps is not merely a consequence of a low overall frequency of heavy syllables in those

word shapes in the language of Callimachus' hexameters. Now, we know that there is a tendency to contract 5th biceps less often than other bicipitia; so we must also be sure that the difference just established for words of class A is not merely due to that tendency. This can be done by comparing the odds ratio for the left side of Table 7 (ω_A) with that for the right side (ω_B): the result is expressed as the ratio of the odds ratios (ω_A/ω_B) and shows that the odds against contracted 5th biceps in word shapes of class A is over 17 times as great as for class B. Less formally, the initial heavy syllable is avoided seventeen times as strongly as the medial heavy syllable in contracted 5th biceps in the word shapes tested.

The rejection of all three null hypotheses confirms the second law of the tetrasyllables. There is no difference between the heavy syllable permitted in 5th biceps (second syllable of an extended molossus-shaped word) and the heavy syllable avoided in 5th biceps (first syllable of a palimbacchiac-shaped word) other than that of their respective positions in the word: there must be a prosodic difference between the initial syllable of the one word shape and the medial syllable of the other.

This second law is further confirmed by a diachronic trend of increasing constraint against the trisyllabic type as one proceeds from Homer to the stricter Hellenistic poets (see Table 8). Such diachronic trends are, in general, clear indication of the reality of a metrical rule.

TABLE 8
Increasing constraint against line final palimbacchiac-shaped word as evidenced by ratios of odds ratios[7] (ω_A/ω_B) in hexameter poets



[7] The basis for the calculations is as in Table 7.

1.3. The third law of the tetrasyllables

It has often[8] been remarked that the 4th-paeon-shaped word (ŠŠŠS̄) is not, in the stricter styles of the tragic trimeter, located so that the second and third syllables implement the resolution. Before any conclusions of a prosodic nature can be drawn from this fact, it will be necessary for us to subject the data to a formal test controlling for non-prosodic factors (no such test is available from earlier discussions). Specifically, it will be necessary to demonstrate that the absence of 4th-paeon-shaped words from pre-caesural location in the earlier plays of Euripides is not merely due to a combination of the following four factors: (1) overall low rate of resolution; (2) particular avoidance of resolution of 2nd longum; (3) ready availability of alternative locations for 4th-paeon-shaped words; (4) relative frequencies of 4th-paeon-shaped words and other word shapes used in resolution in the language of Greek tragedy.

The most direct test is to compare the distribution of 4th-paeon-shaped words with that of tribrach-shaped words. Each word shape has two predominant locations in the line which could serve as alternatives to location before the penthemimeral caesura (whereas the anapaest-shaped word is a less suitable control word shape, having only one major alternative location). The test procedure is very simple. Table 9 presents the proportions of each word shape located before the penthemimeral caesural position and, respectively, elsewhere in the two earlier groups of plays as defined by Zieliński.[9] When it is realized that, in these plays, we

TABLE 9

Comparison of frequencies of 4th-paeon- and tribrach-shaped words located before penthemimeral caesural position

	Before penthemimeral caesural position	Elsewhere	N
	%	%	
4th-paeon word	0.00	100.00	140
tribrach word	8.17	91.83	257

$p = .000007$

would have expected a total of only eleven 4th-paeon-shaped words in this location, it becomes clear that this test is far from superfluous. Fortunately, the corpus on which it is based is extensive enough for us to determine that the exclusion of 4th-paeon-shaped words is real and not the result of

[8] In the 20th century by T. Zieliński, *Tragodumenon Libri Tres* (Cracow 1925) 148; E. Harrison, "Τριβραχυλογικά," *PCPhS* (1932) 4–5; J. Irigoin, "Lois et règles dans le trimètre iambique et le tétramètre trochaïque," *REG* 72 (1959) 67; A. M. Dale, *Euripides: Helen* (Oxford 1967) xxiv ff.; W. S. Allen, *Accent and Rhythm* (Cambridge 1973) 320.

[9] Zieliński's convenient classification is as follows: *Stilus severior* (E.S.): *Rhesus, Alcestis, Medea, Heraclidae, Hippolytus*; *Stilus semiseverus* (E.SS.): *Andromache, Hecuba, Supplices*; *Stilus liberrimus* (E.LM.): *Orestes, Bacchae, Iphigenia Aulidensis*; *Stilus liber* (E.L.): all other extant plays.

chance: we would need 1,142,586 early Euripidean plays (if each has the same average number of 4th-paeon-shaped words as in the sample) before we would expect to find a single group of eight plays in which 4th-paeon-shaped words were absent from pre-caesural location due purely to random statistical deviation from a distribution rate like that of the tribrach-shaped word before the penthemimeral caesural position.

There is no difference between the syllable sequence of the 4th-paeon-shaped word permitted as an implementation of resolution (S̃S̃S̃S̃) and that not permitted as an implementation of resolution in the stricter styles (S̃S̃S̃S̃) other than their respective locations in the word.

Word boundary, and *a fortiori* the caesura, unambiguously signal the end of a metrical element: but the Zielińskian *lex de solutione initiali* is not sufficient to explain the third law of the tetrasyllables. Just as in the Pāli and Prākrit *āryā*-metre, the word boundary required before a resolution precludes the possibility of the first syllable of the resolution being mistakenly grouped as a resolution with the preceding syllable. But, in the case of the 4th-paeon-shaped word in the trimeter, the preceding word boundary does not serve to indicate whether the second syllable of the word shape is grouped in resolution with the first or with the third syllable. Therefore, here again, there must be a prosodic difference between initial and medial syllable sequences in this word shape.

1.4 The word[10] level rules

As we have seen, the three laws of the tetrasyllables require that (non-final) syllables be differentiated not merely according to their segmental composition but also according to their position within the word. Consequently, a theory must be formulated to define the differentiating properties and to assign them in a coherent fashion to the relevant syllables. However, if this theory is to be more than merely an *ad hoc* descriptive mechanism to generate the correct philological output, it will have to be linguistically realistic; in the case of a dead language, for which direct evidence is unavailable, this means that it will have to be founded on a general typologically based understanding of suprasyllabic prosody.

There are three prosodic properties that are widely attested in the languages of the world: duration, intensity and pitch. Major pitch differences can be ruled out of our discussion, since the Greek pitch accent does not correlate with the data just analyzed, and a competing secondary pitch

[10] The distinction between word-level and phrase-level rules is obscured by the fact that some word shapes may not be liable to the prosodic rules discussed here except in the context of the phrase, and, for others, the so-called word-level rules may simply be the rules that apply most easily within the phrase. However, it is useful for the exposition to make the distinction, and it involves the claim that insofar as the prosodic rules apply to any word shapes uttered in isolation, they will be the so-called word-level rules.

pattern within the word would be typologically unlikely. Major systematic differences in intensity (which often correlate with durational and pitch differences) normally have accentual function, and languages do not seem to have independent and competing intensity and pitch accentual systems.[11] This leaves the traditionally assumed prosodic feature of duration: duration also has the *a priori* advantage of being the feature most immediately associated with syllable weight, which is, of course, the primary organizing feature of Greek metre.

Experimental evidence has shown that vowel durations can be manipulated in order for words to be fitted to a durational template. The work of Lindblom and Rapp,[12] Lindblom,[13] Nooteboom and Cohen,[14] Nooteboom,[15] Lyberg,[16] Lindblom

[11] J. H. Greenberg and D. Kaschube, "Word prosodic systems: a preliminary report," *Working Papers on Language Universals* 20 (1976) 1 ff. The co-occurrence of *lexical* tone (including simplified/restricted lexical tone systems) with accentual intensity and duration is, of course, well established.

It is not clear that "stress" is the most suitable term to describe the prosodic patterns evidenced by the laws of the tetrasyllables: although duration is often an important acoustic property of stress, the term "stress" is generally interpreted by linguists as additionally implying accentual function within the word and often significant differences in intensity. The evidence for the very strong claim that such durational patterns could not arise unless motivated by a stress is not conclusive. Cretic organization of molossic structures can occur in languages independently of a stress accent (see examples on p. 49). Moreover, the contiguous stresses that would have to be posited to explain the first law of the tetrasyllables imply a mora counting system, which is inconsistent with the system of syllable alternation required in a straightforward account of the molossic structures. As far as light syllables are concerned, the claim would be that two syllables cannot be programmed as a matrix unless the first of those two syllables is in some way suprasegmentally prominent. Such a claim would evidently need to be tested. The philological evidence from resolution does not seem to require such a claim. We have argued elsewhere ("Latin prosody and metre: brevis brevians," *CP* 75 [1980] 142–57) that the stress is not the causal factor of *brevis brevians* in Latin comedy, and it does not seem to be a necessary condition of simple resolution either (independent evidence for secondary stress in *règiónibus, proptèr amórem* is hard to find). A process comparable to resolution exists in the palimbacchiacs of the classical Somali *gabay* verse genre and it is not reported as limited to stressed syllables. In Prakrit *āryā*-metre, resolution is regularly formed by the first two light syllables of a word, but although the accent of Prakrit is much debated, it is not generally considered an initial stress language. Therefore, it remains possible that the matrix, like the heavy syllable, is a pre-existing prosodic unit on which stress is preferentially located, rather than a unit that can exist only when occasioned by stress. Such an assumption would also help to remove one of the major contradictions in stress theory: in the case of comic substitution (see note 41 below), the premise that stress creates the matrix is incompatible with the premise that stress in breve/anceps positions is a violation of the metre.

[12] B. E. F. Lindblom and K. Rapp, "Some temporal regularities of spoken Swedish," *Papers from the Institute of Linguistics* (University of Stockholm) 1973.

[13] B. E. F. Lindblom, "Some temporal regularities of spoken Swedish," *Auditory Analysis and Perception of Speech*, edd. G. Fant and M. A. A. Tatham (London 1975) 387.

[14] S. G. Nooteboom and A. Cohen, "Anticipation in speech production and its implications for perception," *Structure and Process in Speech Production*, edd. A. Cohen and S. G. Nooteboom (Berlin 1975) 122.

and Lyberg and Holmgren[17] on Swedish and Dutch demonstrates the existence of a systematic pattern of regressive and progressive adjustment of syllable duration depending on the location of the syllable relative to the beginning and end of the word. For instance, it emerges that there is a consistent and predictable difference in duration (*ceteris paribus*) between the second and third syllable of a tetrasyllabic word in Dutch. One significant point demonstrated by such studies is that the word is an important phonological domain for these rules of suprasyllabic prosody. In Estonian,[18] longer words are divided into shorter foot-like subunits: thus the second syllable of a proceleusmatic-shaped word is pronounced longer than the first syllable; the final syllable of a proceleusmatic-shaped word is longer than both its first and its third syllable, whereas the final syllable of a tribrach-shaped word is actually shorter than its first syllable. Certain durational rules of suprasyllabic prosody can be independent of the word accent: in Japanese, which has a pitch accent and lengthening of final syllables,[19] although there is some evidence for increased duration in the accented mora, "accent is not a primary factor affecting segmental and moraic duration," according to the conclusions of Mitsuya and Sugito.[20]

When a sentence has been generated by the syntax, it is assigned a phonological representation on the basis of the lexical representation of the words and morphemes it contains. This phonological representation is initially very abstract and does not indicate how the syllables will be organized for the motor gestures involved in speech production. Abstract phonological representations are thus cast in terms of categorical properties such as syllable weight. At this abstract level, the durational component of the prosodic representation of a word consists of a sequence of heavy and light syllable weights, symbolized by the traditional *macron* and *breve*. The potential autonomy of this durational pattern from the consonants and vowels of the word is illustrated by the Bakwiri word game:[21] the serial reordering of syllables that constitutes the game affects

[15] S. G. Nooteboom, "The perceptual reality of some prosodic durations," *Journal of Phonetics* 1 (1973) 25.

[16] B. Lyberg, "Some observations on the timing of Swedish utterances," *Journal of Phonetics* 5 (1977) 49.

[17] B. Lindblom, B. Lyberg, K. Holmgren, *Durational Patterns of Swedish Phonology*, Indiana University Linguistics Club 1981.

[18] I. Lehiste, "Vowel quantity in word and utterance in Estonian," *Congressus Secundus Internationalis Finno-Ugristarum 1965* (1968) 293.

[19] T. S. Jinushi, *The Structure of Japanese*, Studies in Linguistics, Occasional Papers 11 (1967).

[20] F. Mitsuya and M. Sugito, "A study of the accentual effect on segmental and moraic duration in Japanese," *Ann. Bull. RILP* 12 (1978) 97. In a different experiment, Y. Homma found that in her dialect (Kyoto) the final vowel of disyllabic words was longer than the first irrespective of the accent ("An acoustic study of Japanese vowels," *The Study of Sounds* 16 [1973] 347–69).

[21] J. M. Hombert, "Speaking backwards in Bakwiri," *Studies in African Linguistics* 4 (1973) 227. Similarly in Tagalog and Hanunoo word games (Conklin, "Tagalog speech disguise," *Lang.* 33 [1956] 136–39; *id.*, "Linguistic play in cultural context," *Lang.* 35 [1959] 631–36).

the vowels and consonants but not the durational (or tonal) pattern of the word, so that a disyllabic word with trochaic vowel length pattern remains trochaic under syllable inversion and does not become iambic: *ẓ̌ēyà* "burn" ⟶ *yā́ẓè*, not **yàẓ̌ē*.

As a sentence is processed for pronunciation, the speaker performs a computation to assign sequences of syllables to higher level prosodic units or "contours."[22] In deliberate speech, these contours are generally assigned within the domain of the word, so that they tend not to span word boundaries; certain word shapes and long words of all shapes may be organized into more than one contour. On the other hand, in fluent speech, syllables are commonly mapped onto contours within the domain of the phrase, with the result that, in fluent speech, a contour may contain a word boundary. The foot-like phonological domains of Estonian are an example of the contour, as are, of course, the stress "feet" of English speech.[23] The contour provides the ontological basis for the unit known as the foot in the metrical systems of both languages.

Non-metrical, and therefore independent, evidence for the relevance of the contour in Greek is afforded by two rules of Greek phonology. The first rule, which has been much discussed by Kuryłowicz,[24] concerns the canonical structure of lexical words. A lexical word in Greek may not consist of a single light syllable: insofar as they exist in Greek, words consisting of a single light syllable only are all non-lexical (particles, pronouns, etc.). This fact suggests that a single light syllable by itself has insufficient phonological substance to constitute a complete contour and is consequently in some way non-autonomous as compared, e.g., to a single heavy syllable. A second insight is contributed by the comparative/superlative formation rule, according to which the short stem vowel -ο- is lengthened to -ω- after a light syllable but not after a heavy syllable: σοφο-τερος ⟶ σοφώτερος, but ὠμότερος, λεπτότερος, ἐλα-φρώτερος but ἐλαφ-ρότερος. This rule suggests that a contour should optimally contain a heavy syllable to provide it with a durational nucleus. In what follows the hypothesized durational nucleus will be indicated formally by the symbol +, and the non-nuclear, dependent syllables of the contour by

[22] The term "contour" is here used to indicate a phonological unit greater than the syllable, that serves as a domain for the timing of phonetic gestures. Linguists often use the term "foot" for this unit, but the latter would obviously lead to ambiguity in a work on metrics. The question of the physiological correlates of both the syllable and the contour requires further cross-linguistic experimental investigation.

[23] D. Abercrombie, "Syllable quantity and enclitics in English," *In Honour of Daniel Jones* (London 1964), ed. D. Abercrombie *et al.*, 216–22; I. Lehiste, "Rhythmic units and syntactic units in production and perception," *JASA* 54 (1973) 1228–34; *eadem*, "The role of temporal factors in the establishment of linguistic units and boundaries," *Phonologica 1972* ed. W. Dressler *et al.* (Munich 1975) 115–22.

[24] J. Kuryłowicz, "Latin and Germanic metre," *English and Germanic Studies* 2 (1949).

the symbol −. In the simplest situation, + is assigned to heavy syllables and − to light syllables. However, there are cases (commonly involving strings of identical syllable weights), in which this simple mapping procedure would result in contours either lacking a nucleus or without any dependent syllables. Such ill-formed contours can be normalized as the utterance is processed for pronunciation by additive or subtractive manipulation of syllable durations. An additive strategy is typical of slow and deliberate speech; a subtractive strategy is adopted to achieve the compaction that characterizes rapid and informal speech. The morphophonemic comparative rule can be interpreted as an extension of the additive processing of the 4th-paeon-shaped word to the point of categorical shift of vowel quantity. The laws of the tetrasyllables analyzed above receive a coherent interpretation as evidence for two subtractive rules used in the computation of +/− status designed to generate well formed contours. These two rules of suprasyllabic prosody are as follows:

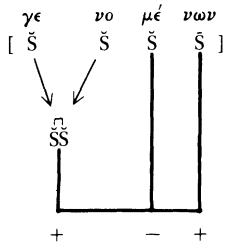
1. *Matrix formation.* + status may be assigned to a sequence of two light syllables in order to generate a nucleus for a contour. Two light syllables that have been mapped onto a + as a matrix may be assumed to lose autonomy and to have a resultant duration less than the sum of two unmatricized light syllables of the same segmental composition. It is the status of the light syllables as a matrix with + value that renders them a suitable implementation of the metrical *thesis* (*longum*). A + matrix cannot occur between two + units, since that would be inconsistent with the whole *raison d'être* of the matrix and with rule 2 below. + matrices are preferentially located so as to be separated from contiguous + units by a − unit: this is demonstrated by the third law of the tetrasyllables above, according to which the 4th-paeon-shaped word is preferentially organized as + − +. We shall refer to this as the principle of alternation. The rarity of tribrach-shaped words with matrix on the last two syllables (πατέρα) probably reflects the resistance of final syllables to processing by the matrix rule (they are even more resistant to processing by the subordination rule): we shall refer to this as the principle of finality. Lastly, the much stricter constraint against split resolution indicates that two light syllables belonging to different lexical words could not be processed as a matrix.

For the processual diagrams of the suprasyllabic rules we have chosen the simple comb model in preference to the currently popular (binarily branching, rooted) tree model.[25] The latter would have led us to make claims about the grouping of syllables into contours and about the hierarchical relationships between contours for which independent evidence is not available. Fig. 1 diagrams the prosodic organization of the 4th-paeon-shaped word generated by Matrix Formation at the word level. The

[25] For the tree model, see, e.g., M. Liberman and A. Prince, "On stress and linguistic rhythm," *Ling. Inq.* 8 (1977) 249–336.

baseline denotes the domain within which the suprasyllabic relations are computed: in fig. 1 it is coterminous with the word. Matrix assignment is

FIGURE 1

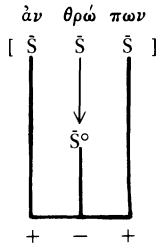


a prosodic rule of the Greek language. The metrical rule is that two light syllables cannot implement a resolution unless they can be processed as a matrix by the prosody of the language.

2. *Heavy syllable subordination.* − status may be assigned to a heavy syllable, in order to break down a sequence of contiguous contour nuclei.[26] A heavy syllable that has been subordinated may be assumed to undergo a reduction in its duration. The acceptability of the central syllable of the molossus-shaped word in 3rd anceps and of the extended molossus-shaped word in 5th biceps (see §1.1 and §1.2 above) indicates that a heavy syllable may be subordinated when it stands between two + units at the word level. It is its status as a − unit that allows the central heavy syllable of a molossus-shaped word to stand *in arsi* in anceps and biceps positions. The constraints against the first syllable of a tetrasyllabic word in 3rd anceps in the strictest styles of the trimeter (first law of the tetrasyllables) and against the first syllable of a palimbacchiac-shaped word in 5th biceps in the hexameter (second law of the tetrasyllables) indicate that subordination requires a preceding + unit as well as a following + unit within the domain of the rule (at the level we are here concerned with, this means within the word). Porson's Bridge and similar constraints indicate that subordination requires a following + unit as well as a preceding + within the domain of the rule. The higher degree of constraint associated with Porson's Bridge as against the first law of the tetrasyllables indicates the particular resistance of final heavy syllables to subordination, consonant with the principle of finality formulated above. Fig. 2 is a processual model of subordination as it applies to the molossus-shaped word. Fig. 2 illustrates that, with the prosodic subordination of its central syllable, the molossus-shaped word assumes cretic relation between its syllables, whereas the suprasyllabic organization of the tetrasyllabic shape ŠŠŠŠ could most closely be compared with a syncopated

[26] A sequence of two contiguous nuclei can occur word-medially in prose, as in a word of the shape ŠŠŠŠ (e.g., ἀκούουσι) and presumably phrase-medially.

FIGURE 2



trochaic structure. Subordination is a prosodic rule of the Greek language. The metrical rule is that, in general, a heavy syllable cannot stand in the arsis (i.e., implement anceps or biceps) unless it can be subordinated.

The molossus subordination rule is a very natural rule of suprasyllabic prosody, and is not restricted to durational alternation occasioned by stress patterns. In Slovak,[27] there is a well-known distributional rule whereby a long vowel (which includes certain diphthongs) may not stand in a syllable following another syllable containing a long vowel: this rule is the result of a historical change by which long vowels were shortened in this environment. In the Australian language Yidin^{y} (a very "metrical" language, in which most words consist of either one or more iambs, or one or more trochees),[28] not only do long vowel syllables not occur contiguous to one another, but they are always separated by just one short vowel syllable. In the New Guinea language Telefol, long vowels can occur in the initial and, more commonly, the final syllables of words of three syllables or more, but not in medial syllables. In English, the stress (and therefore *inter alia* the duration) of a syllable may be significantly reduced if it stands between two other stressed syllables within a phonological phrase: this is particularly well established in fixed phrases such as *bíg bàd wólf*.

2. Suprasyllabic prosody of Greek within the phrase

2.1 Light syllables

2.1.1. Pyrrhic-shaped words in resolution

Table 10 is a symmetrical implicational scaling representing the distribution of lexical pyrrhic-shaped words (e.g., *πόλιν Phoen.* 993), elided tribrach-shaped words (e.g., *πατέρ' Med.* 31), and appositive pyrrhic-shaped words (e.g., *περί Phoen.* 881) filling 2nd, 3rd, 4th and 5th resolved longum elements in the tragic trimeter; the figures give the rate per thousand trimeters. The term "lexical" is used here to refer to nouns, adjectives, non-appositive adverbs and verbs. Omitted are pyrrhic-shaped

[27] N. S. Trubetzkoy, *Principles of Phonology* (Berkeley 1969) 173, 223.

[28] R. M. W. Dixon, "Some phonological rules in Yidin^{y}," *Ling. Inq.* 8 (1977) 1.

TABLE 10
Lexical and appositive pyrrhic-shaped words implementing resolved 2nd, 3rd, 4th and 5th longa

longum	2			3			4			5		
	l.	e.	a.	l.	e.	a.	a.	e	l.	a.	e.	l.
Eur. S.	0	0	0	.45	.45	.23	0	.22	0	0	0	0
Soph.	0	0	0	.53	.53	1.99	0	0	0	0	0	0
Aesch.	0	0	0	.70	1.60	2.81	.47	0	0	.23	0	0
Eur. SS.	0	0	.71	2.84	1.42	4.62	.71	.36	0	0	0	0
Eur. L.	0	0	.81	13.28	3.80	5.15	1.76	.68	0	0	0	0
Eur. LM.	0	0	4.88	11.15	1.39	10.46	3.84	.35	0	.70	0	0

l. = lexical; e. = elided; a. = appositive

words followed by a postpositive and those that do not fall quite unambiguously into either the class of lexical items or the class of appositives (the excluded types are in the main grammatical function words, numerals, etc.). The less strict a metrical style, the lower it stands on the vertical axis. In any location in the line, the occurrence of any sub-class of pyrrhic-shaped word in a style implies its occurrence in that location in any less strict style (with a couple of exceptions). Also, in any location in the line, the occurrence of a lexical pyrrhic-shaped word implies the occurrence of an elided tribrach-shaped word, which in turn implies the occurrence of an appositive pyrrhic-shaped word. The central locations in the table are preferential locations for resolution in general and consequently for pyrrhic-shaped words in particular. What is significant is the distribution of the sub-classes of pyrrhic-shaped words within this overall pattern. In the two most marginal locations, both the lexical and the elided types are excluded in all styles and only the appositive type can occur, and even that is excluded in the stricter styles. In resolved 4th longum, lexicals are still excluded but the elided type begins to occur in less strict styles. Finally, it is only in the relatively unconstrained 3rd longum that lexicals can appear at all in non-lyric trimeters, and even there lexicals are less frequent than appositives in the stricter styles (the difference in Euripides' *severior* style is not statistically significant), although this relation becomes reversed in the less strict styles.

Thus, the following conclusions can be drawn from Table 10. (1) Pyrrhic-shaped words are excluded from locations in which we know resolution to be acceptable in certain other word shapes. (2) Appositive pyrrhic-shaped words have a property absent from lexical pyrrhic-shaped words, that renders them more acceptable in resolution. (3) Insofar as lexical pyrrhic-shaped words are used in resolution, either they have acquired this property or they are metrically imperfect.[29]

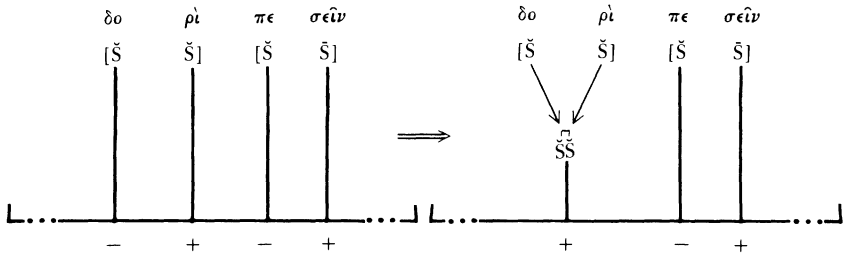
[29] See p. 61 below.

The reason for the high level of constraint on the use of pyrrhic-shaped words in resolution[30] is evidently that the resolution matrix includes the final syllable of the word. There is an inherent contradiction between the added duration that characterizes word-final syllables and the reduction in autonomy that is presupposed by the formation of a matrix. Since appositives are the least constrained sub-class of pyrrhic-shaped words, it is reasonable to assume that this contradiction was more easily resolved for appositive pyrrhic-shaped words than for lexicals. Now, the class of appositives consists of non-lexical words that are linked to an adjacent word in such a way that the phonological boundary between them is reduced. Phonological boundary reduction results in an approximation to word-internal phonology and entails, among other phonological processes, the reduction or elimination of word-final durational increment. Thus, the boundary weakening characteristic of appositives serves to reduce just that prosodic property that inhibits the formation of a matrix that can implement resolution. This surely must be the reason why, of all pyrrhic-shaped words, the appositives are the least constrained in resolution. According to (3) above, the most straightforward explanation for the permissibility of lexical pyrrhic-shaped words in resolution at all will be that they too undergo a degree of boundary reduction in certain (presumably less deliberate and formal) types of speech.[31] However, there is no reason to assume that lexical pyrrhic-shaped words lose all the phonological properties of independent words in rapid speech. Rather, the durational increment characterizing the final syllable of lexical pyrrhic-shaped words when uttered in isolation or prepausally (as, e.g., at the end of a stichos: *πεσόντος . . . . Ἑλλήνων δορί Hec.* 1112) may be supposed to have been reduced when those words are processed together with the following word(s) to form a phonological phrase, thus permitting the matrix formation rule to group even a final syllable into the matrix: [δόρι πεσεῖν Ἑλληνικῷ]$_{\text{verb phrase}}$ *Hec.* 5. This interpretation is confirmed by the fact that elided tribrach-shaped words stand intermediate between lexical and appositive pyrrhic-shaped words, as is particularly clear from the figures for resolved 4th longum in Table 10. (Elision is, of course, a phonological process that serves to integrate words within a phonological phrase.) Fig. 3 is a processual model of matrix formation as it affects the pyrrhic-shaped word in a syntagmatic domain (the values of the first and last nodes marked are not independent of the values of further nodes at the beginning and end of the domain).

[30] This high level of constraint is not merely an artefact of the availability of line-final position for pyrrhic-shaped words: see A. M. Devine and L. D. Stephens, "Rules for resolution: the Zielińskian canon," *TAPA* 110 (1980) 78.

[31] The reduction of phonological boundary marking between words is a universal trait of rapid speech.

FIGURE 3



2.1.2. Phrase level rules for light syllables

The crucial theoretical conclusion that emerges from the above analysis of the pyrrhic-shaped words in resolution is that a suprasyllabic prosody that is limited to the prosodic organization of syllables within the word (and appositive combinations) considered in isolation can account neither for the hierarchical relations between types of pyrrhic-shaped word nor for the fact that the lexical pyrrhic-shaped word can appear in resolution at all: that can only be done by a theory of prosody that encompasses also the prosodic organization of syllables within the phrase.

Allowing the rules of suprasyllabic prosody access to phrasal environments, rather than merely to words and appositive combinations, runs counter to the basic premises of practically every current theory of Greek prosody (although it has been suggested in earlier work).[32] Yet it can hardly be dismissed as an *ad hoc* device, invoked merely to make the prosodic rules generate the correct output. For we know, on independent evidence, that words are in fact integrated into higher level phonological units in Greek, and that, for a number of phonological processes, the *stichos* is the metrical counterpart of the phonological phrase.

Certain phonological processes of phrase formation can be identified on the basis of prose inscriptional spellings. Elision is by far the most frequent in syntactic phrases involving non-lexical words and especially appositives[33] (οὐδ' ὑφ' ἑνος, ὁποσ'ἀν, δ]εκ' ἀνδρασι, etc.) but can also occur across syntactic phrase boundary, as in the expression ἐκ τωv κατα ψηφισματ' ἀναλισκομενωv. Inscriptional spellings also attest assimilation of final consonants to the initial consonant of the following word: this is most frequent with appositives, but also occurs within noun phrases and

[32] See C. W. E. Miller, "The pronunciation of Greek and Latin prose," *TAPA* 53 (1922) 169–97.

[33] W. Lademann, *De Titulis Atticis* (Kirchhain 1915) 44 ff.; L. Threatte, *The Grammar of Attic Inscriptions* I (Berlin 1980) 418 ff.

more rarely elsewhere. According to Lademann,[34] for example, in the 4th century, of the 111 cases of the preposition ἐν before a word beginning with a labial stop, fully 82% show assimilation to ἐμ; the same assimilation across lexical boundary is far rarer but clearly documented: cf. τηv εἰσιουσαv/μ πρυταvειαv. Finally, avoidance of hiatus is a characteristic of major syntactic units in the orators. All these processes typically have the function of integrating words into larger phonological units.

In verse, it is the *stichos* that is the domain for such phonological processes of integration. Elision applies throughout the *stichos* (in the strictest style elision at the caesura and elision of lexical words are constrained), but not, with a few exceptions, from one *stichos* to the next. In many metres, hiatus is not permitted within the *stichos*, and when it occurs, it is the signal of the boundary between *stichoi*. Word final consonants are syllabified with a following word-initial vowel within the *stichos*: the weight of the final syllable of a word, and consequently the word shape itself, depends in part on the following word in the phrase. Similarly, in Estonian speech,[35] when words are combined into a phonological phrase, a final consonant before an initial vowel is resyllabified and pronounced like a medial intervocalic consonant. In short, the processes that effect the phonological integration of words into phonological phrases in prose are very comparable to those phonological processes that have the *stichos* as their domain in verse. This fact strongly suggests that the linguistic model for the *stichos* is the higher level phonological unit corresponding to the syntactic clause (or simple sentence) in normal speech tempo. Such an interpretation of the ontology of the *stichos* is consonant both with its general phonological length and with its relation to the syntactic units of the language. The vast majority of major syntactic boundaries are located at the end of the *stichos*. In a sample from Euripides' *Electra* (lines 1–111, 368–430), we found that of all cases of strong orthographic punctuation (full stop, question mark, colon), over 70% occurred at the end of the *stichos*. It is of course well-known that major syntactic boundaries[36] and even change of speaker can occur at almost any point within the *stichos*, sometimes with linguistically unnatural elision and resyllabification. But such artificial extensions from the linguistic model serve merely to confirm the interpretation of the *stichos* as a metrically defined phonological domain. Consequently, it is entirely reasonable to assume that the *stichos* could function as a domain for the rules of suprasyllabic prosody.

[34] Lademann 61 ff.

[35] I. Lehiste, *Consonant Quantity and Phonological Units in Estonian* (Bloomington 1966) 47.

[36] J. D. Denniston, "Pauses in the tragic senarius," *CQ* 30 (1936) 73–79.

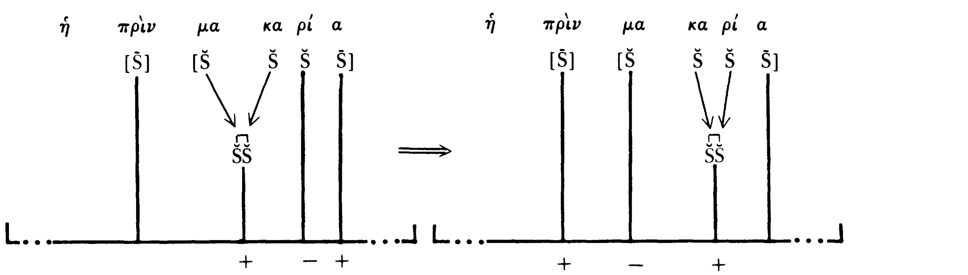
In general, one would expect that the phrase-level rules of suprasyllabic prosody should constitute an extension of the word-level rules, though subject to additional constraints varying according to the rate of speech. A clear example of this principle is afforded by the trochee-shortening rule in English (which, incidentally, is a rule of suprasyllabic prosody). In a phrase such as "to light matches . . . ," the vowel nucleus of the monosyllabic word *light* has considerable duration. The same vowel nucleus in the trochaic word *lighten* is noticeably shorter: this durational reduction is known as trochaic shortening. At conversational rates of speech, the domain of trochaic shortening is extended from the word to the phrase. Thus, it has been shown experimentally[37] that trochaic shortening applies not only to *lighten* in the sentence "The longshoremen must lighten inflammable cartons," but also to *light* before *an* in the sentence "The longshoremen must light an inflammable carton." (This sort of processing would not of course be possible in deliberate speech, where the word boundary after *light* would entail end of the contour.)

However, it must be realized that extension of the suprasyllabic rules to the domain of the phrase is subject to a finely structured hierarchy of constraints: if that were not the case, any sequence of syllables satisfying the syllable weight requirements of the *stichos* would scan, and there would be no philological evidence for the word-level rules discussed above, nor, indeed, for the well known constraints against split resolution etc. Thus prosodic rule 1 above can be extended to the domain of the phrase in such a way that a syllable of a contiguous word may provide the environment for matrix formation but may not itself become part of the matrix. The following hierarchy results. Matrix formation is easiest within the word and when neither syllable of the matrix is the final syllable of the word (as in the case of the 4th-paeon-shaped word discussed above: γένὸμένων). Matrix formation is more difficult when the second syllable of the matrix is the final syllable of the word, especially when followed by lexical word boundary, so that the matrix remains within a single word but the environment conditioning the matrix is at least in part provided by the next word in the phrase (as in the case of pyrrhic-shaped words just discussed). Matrix formation is not possible (even in the comparatively informal speech on which Aristophanes draws) when the first syllable of the matrix would be the final syllable of a word followed by a lexical boundary: in such cases, the lexical word boundary blocks the extension of the prosodic rule of matrix formation throughout the phrase, and the syllables contiguous to the word boundary remain durationally autonomous. Apparent exceptions such as ἀκούετέ # λεῷ (*Pax* 551 *et alibi*), τἄδικά # λέγων (*Nub.* 884) are clearly idiomatic expressions and consequently have reduced boundary.

[37] W. E. Cooper, S. G. Lapointe, and J. M. Paccia, "Syntactic blocking of phonological rules in speech production," *Journal of the Acoustical Society of America* 61 (1977) 1314–20.

In certain phrasal contexts, in the computation of the suprasyllabic prosody of a phrase, a conflict can arise between the location of the matrix according to the principles of finality and alternation within the domain of the word, and its location according to those same principles within the domain of the phrase. In more rapid and less formal speech, the word-level suprasyllabic prosody is progressively adjusted to and overridden by phrase-level prosodic organization. Phrasal organization accounts for the increasing acceptability of certain variant prosodic organizations in later Euripides and in Aristophanes. The prosody of the 4th-paeon-shaped word at the word level is, as argued above, S̄S̆S̆S̄: *γενομένων*. When this word shape is located within the phonological phrase after a word ending in a heavy syllable, alternation is violated in the domain of the phrase with respect to the preceding + unit. Nevertheless, 4th-paeon-shaped words are increasingly frequent before the caesura (i.e., with resolution implemented by the second and third syllables of the word) in later Euripides, and are common so located in Aristophanes.[38] Such location could be explained on the assumption that in colloquial speech the matrix was shifted onto the second and third syllables when this was necessary to produce alternation in the left hand environment.[39] This is diagrammed in fig. 4.

FIGURE 4



The light syllable at the end of the preceding word (− unit in the syntagmatic left hand environment) is crucial to the organization as a matrix of the first two syllables of the precaesural anapaest-shaped word: S̆S̆S̄, e.g., *τῶνδε γονάτων* (*Med.* 497). Likewise, it is the phrasally preceding light syllable that occasions the first two syllables of a word of the shape ionic a minore to be organized as a matrix and thus the following heavy syllable to be subordinated—the basic prosodic relations of the word are

[38] In cases such as *Lys.* 132 *παρατεμεῖν*, in which the word shape ends in 3rd anceps, the final heavy syllable may have been subordinated by rule 2 extended to phrasal environments: see note 45 below.

[39] It is not clear whether the left hand environment predominates over the right for establishing alternation, or whether the precaesural (phonologically phrase-final) position of the final heavy syllable confers on it a special status: see note 42 below.

thus overridden by its phrasal environment and the final result is a cretic structure: ⏜S̆S̆S̄°S̄, e.g., χειρὶ θέρα πεύειν (*Or.* 222). The more extensive processing required to organize the syllables of words of the shape ionic a minore into a cretic structure suitable for the metre accounts for it being a disfavoured word shape in the stricter styles of the trimeter.

Similar variability is found with the prosody of the tribrach-shaped word. Matrix formation is most likely when the tribrach-shaped word stands between a light syllable and a heavy syllable in the phrase, so that the matrix is located on the first two syllables of the word. When it stands after a pause, the left hand environment is neutralized and the location of the matrix depends solely on the right hand environment. However, the principle of finality predicts that, under these conditions, location of the matrix on the last two syllables (iambic organization: πατέρα) should be inhibited relative to location on the first two syllables (trochaic organization: πάτερα): and indeed, there is a striking difference in the frequencies of the tribrach-shaped word at the beginning of the trimeter (where it is ⏜S̆S̆S̆) and at the beginning of the tetrameter (where it is ⏜S̆S̆S̆) relative to its frequency after the caesura and diaeresis respectively (where it is S̆S̆S̆ in both cases). In the tetrameter it has approximately the same frequency at the beginning of each hemistich, whereas in the trimeter it is five times as common after the caesura as at the beginning of the line. Iambic organization of the tribrach-shaped word in metrical environments other than line-initial is strongly resisted in the trimeter, and the majority of instances have an adjacent appositive (πατέρα σόν Eur. *El.* 970, καὶ χάριτας *Or.* 244),[40] which of course indicates prosodic integration. This type is relatively more frequent in satyric: forty per cent of all examples in Euripides of a tribrach-shaped word ending in 4th longum are in the *Cyclops*. Finally, in Aristophanes, iambic organization of the tribrach-shaped word is sometimes, though rarely, found without adjacent appositives, indicating the further extension of phrasal organization (ἑτέρος *Eq.* 134, πάρεχε *Ran.* 663).[41]

[40] καὶ χάριτας is a syntagmatic 1st-paeon-shaped word. Words of this shape are preferentially organized with the matrix on the final two syllables by Aeschylus (τυμβοχόα *Sept.* 1022, νηφάλια *Eum.* 107), but on the two medial syllables by Euripides (αὐτόματον *I.T.* 1166, γυμνάσια *Phoen.* 368).

[41] In tragedy, a light syllable matrix may not implement the breve element except in the case of proper names, whereas in comedy such implementations are very common. Indeed, in Aristophanes a matrix in position 3 (substitution in 1st breve, e.g., Φίλων ἀδικεῖς *Nub.* 25) is 1¼ times as common as a matrix in position 4 (resolution in 2nd longum, e.g., ὦ Λάμαχ' ἀδικεῖς *Pax* 473). Between two unsubordinated heavy syllables (or postpausally before an unsubordinated heavy syllable) two non-final light syllables are subject to a grouping process analogous to rule 1 with the distinction that in this case the matrix is prosodically non-prominent. This phenomenon represents a further stage in the compaction of phonological substance conditioned by increasingly rapid rate of delivery. Consequently, we have the following correlation with genre. Two light syllables between unsubordinated heavy syllables

2.2. *Heavy syllables*

Table 11 is a stair-step implicational scaling representing the distribution of heavy syllables from different environments at long 3rd anceps in the major styles of the trimeter. • indicates relatively unconstrained occurrence, o indicates either a high level of constraint or complete exclusion. The less strict a metrical style, the lower it stands on the vertical axis. In any one style, the occurrence of a heavy syllable in an environment to the left on the horizontal axis implies its occurrence in all environments further to the right. The far right hand column of Table 11 shows that the

TABLE 11
Types of heavy syllables in long 3rd anceps

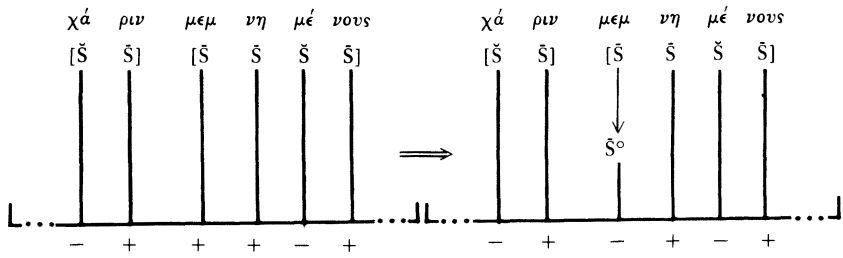
	Final S̄ before Lexical #	Final S̄ before Non-lexical #	Final S̄ before Appositive #	1st S̄ of S̄S̆S̆S̆	2nd S̄ of S̄S̆S̆
Iambographers	o	o	o	o	•
Tragedy (strict)	o	o	o	•	•
Tragedy	o	o	•	•	•
Satyric	o	•	•	•	•
Comedy	•	•	•	•	•

central heavy syllable in the molossus-shaped word is permitted in 3rd anceps in all styles of the trimeter included in the table. The reason for its permissibility lies in its having been subordinated by prosodic rule 2 above, according to which S̄S̆S̄ ⟶ S̄S̆°S̄. Tetrasyllabic words of the shape S̄S̆S̆S̆ occur freely in tragedy but not in the iambographers. Therefore, either the tetrasyllables have, in the language of tragedy, a property rendering initial syllables acceptable in long 3rd anceps that they do not have, for the most part, in the language of the iambographers, or tragedy ignores what for the iambographers was a prosodic violation of the metre. On the former assumption, the initial syllable of the tetrasyllable must have become more like the medial syllable of the molossus-shaped word. It would do so if the environment of prosodic rule 2 (subordination) were extended to *phrasal* contexts, so that a final heavy syllable of the preceding word could function as the first syllable of the molossus sequence to which the subordination rule applies:[42] see fig. 5.

remain autonomous in the hexameter, and this fact reflects that metre's character as σεμνὸς ἄλλα λεκτικῆς ἁρμονίας δεόμενος (Arist. *Rhet.* 3.8). On the other hand, two non-final light syllables between unsubordinated heavy syllables function as the equivalent of a single light syllable by "substitution" in the comic trimeter, and this fact reflects that metre's character as more informal even than the tragic trimeter, which is τῷ λόγῳ ὁμοιότατον (*Rhet.* 3.1).

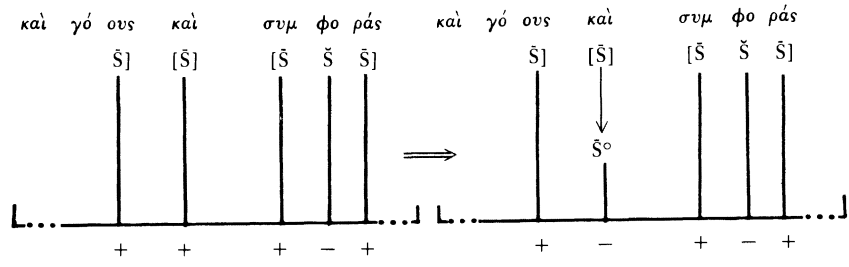
[42] The spondee-shaped word does not provide the environment for rule 2, subordination, to apply at the word level. Therefore, to the extent that the first syllable is subordinated, it will be due to extension of rule 2 to the domain of the phrase when a final heavy syllable precedes. This hypothesis seems consistent with the statistics for the location of the spondee-shaped word in the hexameter. It is well known that the spondee-shaped word is avoided

FIGURE 5 (Eur. *Suppl.* 1169)



Prepositives are the most common sub-class of appositives to appear at Porson's Bridge. They are increasingly common in long 3rd anceps in the less strict styles of tragedy, but do not occur at all in the iambographers and are extremely rare in the strictest styles of the tragic trimeter in that position (see the central column in Table 11).[43] It would appear that the word boundary reduction that is typical of appositives entailed prosodic processes rendering the prepositive in this environment prosodically comparable to the initial syllable of the tetrasyllables and thus, ultimately, to the central syllable of the molossus-shaped word. For instance, reduction of the boundary after *καί* at *Or.* 677 *καὶ συμφορᾶς* permits rule 2 to subordinate the heavy syllable of the prepositive between the final heavy syllable of the preceding word and the initial heavy syllable of the cretic: see fig. 6.

FIGURE 6



ending in bicipitia (other than the first), reflecting the fact that, by the principle of finality, its second syllable strongly resists subordination. However, it has not been properly appreciated that the spondee-shaped word is far more frequent at the end of the line (and consequently less frequent ending in line-internal longa) than would arise by chance: in Homer nearly a third of all spondee-shaped words are line-final, in Callimachus nearly a half. Preference for line-final location could reflect the fact that the first syllable of the spondee-shaped word does not require phrase-level subordination in this position in the line. The interpretation of the status of any final heavy syllable (including that of the spondee-shaped word) at the end of the hexameter and before the caesura in the trimeter remains a difficult and disputed problem: the major decision is between + status with special metrical conditions, and − status of postnuclear heavy syllables in phrase-final position. A similar indeterminacy between linguistic and metrically based explanations is presented by line-initial spondee-shaped words in the hexameter and trimeter.

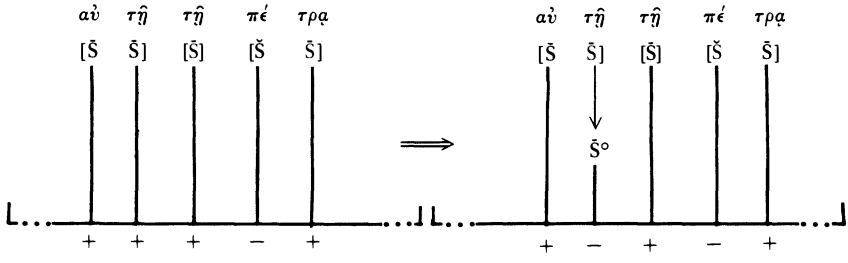
[43] For further details see our "A new aspect of the evolution of the trimeter in Euripides," *TAPA* 111 (1981) 43–64.

The rules for which heavy syllables can stand in 3rd anceps in satyric differ from those for tragedy in two ways. First, the relative frequency of appositive boundaries is significantly greater than in even the least strict of the Euripidean tragedies. Second, as we have argued in greater detail elsewhere,[44] the syntagms involved also include some that are unambiguously phrasal (as opposed to the monosyllabic appositives that account for the vast majority of the tragic instances). The following examples are unlike anything found in tragedy (with the possible exception of *O.C.* 664):

Cycl. 210	τάχα τις ὑμῶν τῷ ξύλῳ
681	ποτέρας τῆς χερός
682	πρὸς αὐτῇ τῇ πέτρᾳ
Ichn. 333	αὐτῇ τῇ κλο[πῇ]

These examples share the characteristic structure of non-lexical polysyllabic word followed by a form of the article. One can conclude that in the language on which satyric is based, such syntactic structures were organized as a phonological unit within the domain of which the subordination rule could apply. The final heavy syllable of a polysyllabic non-lexical word is subordinated before articular noun phrases and so is permitted to stand in long 3rd anceps (see fig. 7), whereas the final heavy

FIGURE 7



syllable of a lexical word is excluded from this position in comparable syntactic contexts, since it remains unsubordinated. This evidence from satyric has the same crucial implications for the second rule of suprasyllabic prosody (subordination) as the evidence of the pyrrhic-shaped words had for the first rule (matrix formation). It demonstrates unequivocally that a suprasyllabic prosody that is limited to the prosodic organization of syllables within the word (and appositive combinations) considered in isolation can neither account for the above examples from satyric in a substantive manner nor even write a rule to generate the permitted structures without reference to their syntactic context: that can only be

[44] "Semantics, syntax and phonological organization in Greek: Aspects of the theory of metrical bridges," *CP* 78 (1983).

done by a theory of prosody that encompasses also the prosodic organization of syllables within the phrase.[45]

Phrase level organization of prosodic features is a well documented cross-linguistic process. It is familiar to us from the English rhythm rule known as "iambic reversal." According to this rule, although we say *thìrtéen* with iambic stressing in isolation, in the phrase *thirteen men* we generally say *thírtèen mén* with trochaic stressing to maximize the alternation: similarly *àchromátic* but *áchromàtic léns*. Comparable rules are found in German (*Grósvàter* but *Úrgròssváter*), Masoretic Hebrew,[46] Polish[47] and Chinese.[48] The situation in Lithuanian[49] is worth reporting in some detail, since it illustrates the same sort of hierarchical organization revealed by the Greek metrical evidence. Monosyllabic prepositions are always unaccented when the following word has the accent on its first syllable: *ant stãlo* "on the table." When the following word has the accent on its third syllable, monosyllabic prepositions are accented: *sù ugnimì* "with fire." When the following word has the accent on its second syllable, a preceding monosyllabic preposition may be accented or, more usually, unaccented: *be vertẽs/bè vertẽs* "without value." This accent alternation rule is extended to the domain of larger syntactic structures, so that a word final accent can be retracted onto the penultimate syllable before a word with the initial accent: *naujàs kélnes* "new trousers" (acc. pl.) ⟶ *naũjas kélnes*. It is instructive that accent retraction is obligatory when the vowel of the final syllable of the first word is short and optional when it is long. An example of phonological vowel length rather than stress varying according to phrasal context is provided by Fijian,[50] where the aspect particle is *sǎ* if it can be grouped with the first syllable of the following word and *sā* if it cannot. The stress location rules of Modern Standard Chinese serve not only to illustrate the principle of alternation, but also the principle of finality and the prosodic effect of varying speech tempo and style. In an experiment,[51] a speaker was induced to pronounce the sentence *tā zǒulù zǒu de màn* "he walks slowly" at various phonostyles. In deliberate speech, the utterance consisted of two cretically stressed segments with a slight pause between the contiguous stresses: ŚSŚ#ŚSŚ; this structure was progressively compacted at faster

[45] The interpretation of the further relaxations in comedy is more ambiguous. It is certainly possible to assume that in rapid speech the final syllables of lexical words could be subordinated by rule 2 within any phrase and that, consequently, the subordination rule applied within the domain of the *stichos* without linguistic restrictions in comedy. Alternatively, it could be assumed that the metrical requirements of *anceps* were simply less stringent in comedy. The fact that punctuation and even change of speaker can occur at long 3rd anceps is not decisive evidence: elision can apply across change of speaker, despite the evident linguistic absurdity (e.g., Menander *Sam.* 196, 285, 662, *Dysc.* 102, 129, 512, etc.), and even an anapaest may be so divided (*Nub.* 849, *Eccl.* 1011).

[46] M. Liberman and A. Prince (see note 25 above).

[47] G. Dogil, *Autosegmental Account of Phonological Emphasis* (Edmonton 1979).

[48] P. Kratochvil, *The Chinese Language Today* (London 1968) 122.

[49] A. Senn, *Handbuch der litauischen Sprache* I (Heidelberg 1966) 76.

[50] A. J. Schütz, "Fijian prosody I: syllables and groups," *Working Papers in Linguistics* (University of Hawaii) 8 (1976) 75.

[51] Kratochvil (above, note 48) note 41, 123.

rates of speech passing through the intermediate stages ŚSSŚSŚ (elimination of pause and of contiguous stresses within the resulting phonological phrase) and ŚSSSSŚ, to end up as SSSSSŚ with only the final syllable stressed.

For any metrical function—we are here concerned with the implementation of resolution, long anceps and contracted biceps—each different word shape in its various syntactic contexts can be ranked according to its suitability to that metrical function. A list of such rankings constitutes a hierarchy ranging from the most preferred to the most avoided usages. Since this is a hierarchy of linguistic entities and structures, the motivation for the different rankings can only be linguistic (otherwise, it would be quite arbitrary). In theory, this linguistic motivation could be of two types. It has been our assumption all along that the hierarchy was one of phonostylistically graded pronunciations. The example just given from Chinese shows how language can generate a phonostylistically graded hierarchy of alternative prosodic organizations of one and the same syntactic structure. Linguistic structures are preferred in a metrical function if their basic phonostylistic pronunciations are appropriate to that function. Linguistic structures are avoided in a metrical function to the extent that the function is fulfilled by phonostylistically more marginal pronunciations. Linguistic structures are never or only exceptionally used in a metrical function when no pronunciations exist that are suitable to that function, as applies in the case of split resolution, for instance. The second way in which the linguistic hierarchy could be motivated does not assume actual pronunciations directly predicated on the metrical function for all sections of the hierarchy. At least part of the hierarchy is explained in terms of potential rather than actual pronunciations, i.e., on the basis of the distance between the optimal fulfillment of the metrical function and the pronunciation of the structure in question. On this approach, the criterion for ranking would be as follows: if a syllable of a word shape were pronounced with application of the relevant prosodic rule, how far would it diverge from actually occurring pronunciations? In the case of the matrix formation and subordination, most potentially ambiguous applications involve boundary weakening: cf. for the former rule the types *πέρι, καὶ χάριτας, ἀκούετε λέω*, and for the latter rule the types *καὶ συμφοράς, πρὸς αὐτῇ τῇ πέτρᾳ* at Porson's Bridge. Since boundary weakening characteristically involves the application of word-internal phonetic processes to an enlarged domain, it is quite likely, if not absolutely demonstrable, that the hierarchy revealed by the metrical data does reflect actual pronunciations, and that, consequently, the first of the two possible interpretations discussed is that more likely to be correct in most instances.[52]

[52] The problem just discussed and related metatheoretical questions are more fully analyzed in our paper "Semantics, syntax . . ." (above, note 44).

3. *Conclusion*

We have argued that specific restrictions on the location of certain phonological and syntactic structures in the hexameter and the trimeter cannot be accounted for in a theory of prosody without the following four postulates:

(i) Over and above the basic distinction of syllable weight, the syllables in a word exhibit a patterned organization of relative differentiation and grouping (which does not globally exclude contiguous prominent syllables). This organization, of which the long recognized special status of final syllables is merely a component, is generated by the rules of suprasyllabic prosody.

(ii) Of the various rules of suprasyllabic prosody, there are two that organize sequences of syllables of the same weight into typologically expected alternating structures compatible with metrical requirements: the first rule groups light syllables into a matrix and the second rule subordinates a heavy syllable relative to contiguous prosodically prominent units.

(iii) Both these prosodic rules can be progressively extended from the domain of the word to the domain of the phrase according to certain well defined and again typologically predictable levels of constraint.

(iv) The degree to which the rules of suprasyllabic prosody can be extended beyond their optimal syntactic and phonological environments depends on the formality and rate of delivery of the utterance, and is consequently correlated with the style and genre of the literary text that furnishes the philological evidence.

The formulation of these postulates permits us to identify the major differences between currently accepted prosodic theories and the theory we have proposed in this paper. Postulate (i) is incompatible both with the purely binary distinction of traditional durationalist theories between the last syllable of the word and all other syllables, and with the proscription of contiguous stressed syllables that is a foundation of current stress theory. The phonological rules of postulate (ii) (like the rules of stress theory) are basic strategies determined by the dynamics of speech production; current durationalist theories are mostly oriented towards low-level or surface phonetic differences. Unlike the rules of stress theory, which operate with uniform stress assignment, these rules organize syllable sequences by additive or subtractive manipulation of syllable durations. Postulate (iii) is incompatible with the overall framework of both durationalist and stress theories, in which the domain of the rules of suprasyllabic prosody is almost exclusively the word and appositive combinations. Postulate (iv) provides a linguistic mechanism to account for differences between metrical styles, as a partial alternative to the currently favoured approach which, since it operates with a monolithic language structure, must continually have recourse to distinctions between strict and careless versification.

The above analysis and evaluation of certain philological data, specifically selected for their bearing on the axiomatic basis of suprasyllabic prosody, has forced us to positions largely at variance with the currently accepted premises of Greek prosodic theory. In particular, we have argued that syllables may be prosodically prominent even when they are not final and even when they are contiguous to another prominent syllable; and that suprasyllabic prosody extends beyond the level of the word to the domain of the phrase. Nevertheless, we share with a number of other theories, and particularly with stress theory, the basic metatheoretical tenet that the study of Greek metrics belongs neither in its nature nor in its methods exclusively to the areas of textual criticism and literary aesthetics, being both a source of valuable evidence for Greek linguistics and, conversely, properly founded on the study of language in general and of the Greek language in particular.