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STRESS IN GREEK?

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0. Introduction

It is now ten years since the publication of Sidney Allen's *Accent and Rhythm*.[1] The book has become a classic, yet the controversy over its main thesis, that Greek had a "non-accentual stress," remains unresolved. The question is of central interest to classicists in general, who are naturally concerned to discover what the Greek language sounded like, and to students of Greek literature in particular: language is the artistic medium of an author, and a critical appreciation of the way in which an author handles his language is not possible without a secure knowledge on the part of the critic of the major characteristics of the language in question.

A number of scholars[2] over the last century have suggested that ancient Greek had a stress; the theory was first presented in a modern scientific form by Sidney Allen in 1966,[3] and received its definitive exposition in *Accent and Rhythm*. Reaction to the theory has been mixed. The concept of a stress in classical Greek offended against certain sensibilities and deeply held prejudices to such an extent that more than one major classical journal never published a review of *Accent and Rhythm*. Another reaction[4] was to dismiss the theory out of hand as wholly circular, a *petitio principii*.[5] There were also more positive opinions expressed, with

[1] W. Sidney Allen, *Accent and Rhythm* (Cambridge 1973).

[2] F. Hanssen, "Ueber den griechischen Wortiktus," *RhM* 37 (1882) 252; J. Hilberg, *Das Prinzip der Silbenwaegung und die daraus entspringenden Gesetze der Endsilben in der griechischen Poesie* (Vienna 1879); C. W. E. Miller, "The Pronunciation of Greek and Latin Prose," *TAPA* 53 (1922) 169; K. M. Zander, *Eurythmia vel compositio rythmica prosae antiquae I. Eurythmia Demosthenis* (Leipzig 1910).

[3] "Prosody and Prosodies in Greek," *TPS* 1966, 107.

[4] M. L. West, *Gnomon* 48 (1976) 1–8.

[5] A circular theory is not necessarily a bad theory: Einstein's theory of relativity was circular at the time it was proposed. It is the task of the critic to help in finding the independent evidence by which to confirm or disconfirm the hypothesis.

one review welcoming the theory in principle,[6] another feeling that "the hypothesis must be taken seriously, but it cannot be taken as proved."[7] In our view, recent discussion of the stress theory has failed to do justice to the presentation in *Accent and Rhythm*. The theory has been both accepted by its supporters without sufficient critical analysis and rejected by its opponents on insufficient grounds and without formal discussion of any workable alternative hypothesis. Attention was focused largely on the internal consistency of the hypothesis: reviewers simply sought to determine whether the theory worked as it stood by analyzing its formal aspects with little or no discussion of its substantive claims. To be in a position to evaluate the latter, we need to know:

1. what phonetic properties in any language could motivate the sort of data stress theory was designed to explain;

2. whether such properties could coexist with the suprasegmental properties we already know can be ascribed to ancient Greek;

3. whether any non-metrical evidence exists to provide independent confirmation of the hypothesis (over and above the obvious scholarly requirement that it explain the data with internal consistency);

4. whether the phonetic property identified can properly be termed "non-accentual stress" in the light of the various possible definitions of the terms "stress" and "accent."

Questions 1, 2 and 4 are questions of general phonological theory which can be answered only on the basis of a cross-linguistic survey of the relevant suprasegmental features: they cannot be answered from Greek alone, yet they must be confronted by the Greek linguist if he is to be in a position to explain a significant portion of his data.

1. The Stress Theory

Like any other theory involving metre, stress theory is based on a set of metrical premises combined with a set of linguistic premises. Let us begin with the metrical premises. Inherent in the podic structure of the stichic metres, according to stress theory, is a differentiation between strong and weak positions, which typically alternate throughout the line. The basic or underlying longum is the strong position. In addition to the primary quantitative requirements of the metrical pattern, there is, in stress theory, the additional requirement for the coincidence of stress with strong position and lack of stress with weak position. Sometimes this coincidence is the automatic consequence of the metrical structure,[8] in other cases it is ensured by subsidiary rules,

[6] D. M. Jones, *CR* 26 (1976) 225.

[7] L. P. E. Parker, *JHS* 97 (1977) 191.

[8] B. Newton, "Meter and Stress in Greek," *Phoenix* 23 (1969) 359.

generally bridges. The reader should note that stress location is hereby more highly constrained in the metre than is normal in some other familiar metrical systems that are partly or entirely stress based (such as Latin, English, Serbo-Croat deseterac, Estonian, Finnish). For instance, in English stress is permitted in weak positions and lack of stress in strong positions, and, in very general terms, what is avoided is a sequence that could be interpreted as reversing the strong-weak alternation of the metrical pattern.

The linguistic premises of stress theory consist of a set of rules for stress placement, which are summarized by Allen as follows:[9]

> *General*
> 1. A stress-matrix is constituted by (a) one heavy, or (b) two light syllables.
> 2. Words (or word-like sequences) longer than a matrix have internal contrasts of stress/non-stress.
>
> *Primary stress*
> 3. If the final syllable is heavy, it is stressed.
> 4. If the final syllable is light, the next preceding matrix is stressed.
>
> *Secondary stress*
> 5. A matrix preceding and separated from the primary stress is stressed.
>
> *Terminal stress*
> 6. In terminal (pre-pausal words), rules 3–5 are neutralized and the following substituted:
> (a) Rule 5 applies progressively from the primary stress of the preceding word;
> (b) Final š is stressed by this rule unless preceded by a matrix.

Rules 1–5 are typologically characteristic of the class of stress accent systems in which stress is phonologically predictable and occurs preferentially on heavy syllables in a basically alternating pattern. For instance, alternating stress is very typical of Uto-Aztecan languages. Rules like 6 seem not unnatural, and special prepausal rules are definitely found in stress accent systems: they are reported e.g. for Seneca,[10] Shiriana,[11] and Passamaquoddy.[12] The effect of these rules is exemplified by Table 1, in which stress is located on the indicated syllables of some common Greek word shapes.

[9] *Accent and Rhythm* 333–34.

[10] W. L. Chafe, *Seneca Morphology and Dictionary*, Smithsonian Contributions to Anthropology 4 (1967).

[11] E. Migliazza and J. E. Grimes, "Shiriana Phonology," *Anthropological Linguistics* 3.6 (1961) 31.

[12] T. Stowell, "Stress Systems of the World, Unite!," *Papers on Syllable Structure, Metrical Structure and Harmony Processes*, MIT Working Papers in Linguistics 1 (1982) 51.

		Regular stressing	Prepausal stressing
1. iamb-shaped word	φίλους	ŚS̄	(Ś#) ŚS̄
2. trochee-shaped word	ὄμμα	ŚS̆	(S#) ŚS̆
3. anapaest-shaped word	γονάτων	ŚS̆S̄	(Ś#) ŚS̆S̄, (S#) ŚS̆S̄
4. dactyl-shaped word	τύμπανα	ŚS̆S̆	(S#) ŚS̆Ś
5. spondee-shaped word	φεύγειν	ŚS̄	(S#) ŚS̄
6. tribrach-shaped word	φυγάδα	ŚS̆S̆	(Ś#) ŚS̆S̆, (Ś#)S̆S̆S̆ (?)
7. molossus-shaped word	ἀνθρώποις	S̄S̆S̄	(Ś#) S̄S̆S̄

Table 1: Application of stress rules to some common word shapes

As already noted, according to stress theory many bridges and similar rules governing the metrical location of various word shapes exist to ensure the occurrence of stress in the strong (longum) position and its absence in the weak position(s). Thus, when a spondee-shaped word ends with long third anceps in the trimeter, it violates Porson's bridge because (by Table 1, no. 5) there is a stress in anceps position and no stress in longum position, whereas the metre requires just the reverse. Similarly, in the hexameter, when a spondee-shaped word ends with contracted biceps, there is a stress in the biceps element and consequently no stress in the preceding longum element; again the metre demands the reverse stress pattern. Similarly, the stressing of the tribrach-shaped word ŚS̆S̆ (Table 1, no. 6) is invoked to explain the fact that, except at the beginning of the trimeter, such words are regularly located so that the first and second, rather than the second and third, syllables implement resolved longum.[13] In *Accent and Rhythm*, chapter 16b, the whole complex of rules for the location of different word shapes in Greek stichic metres is surveyed and explained in terms of the stress theory. A few indeterminacies remain, involving monosyllables, pyrrhic-shaped words, and tribrach-shaped words at the end of the pentameter. For instance, the stressing ŚS̆ required for κράτος at Soph. *Ajax* 443 seems difficult to reconcile with unstressed κράτος required at *Iliad* 1.509, etc. Such indeterminacies could be resolved if the theory had recourse to phonostylistic variation or to some limited degree of phrasal stressing, or both. Each assumption is linguistically quite unobjectionable (although each leaves the theory more open to the charge of being circular and *ad hoc*): for instance, in Sierra Miwok[14] a disyllabic word with light first syllable may have stress on either syllable or on neither syllable. More serious is the fact that stress theory is unable to explain the permissibility of anapaest substitution in the

[13] In some positions in the trimeter this is the automatic consequence of pre-existing factors, but it can be shown that in the second foot in Sophocles trochaic location of the tribrach-shaped word is far more frequent than would be expected on the basis of the distribution of its unresolved counterparts.

[14] L. S. Freeland, *Language of the Sierra Miwok*, IJAL Memoir 6 (1951).

comic trimeter. It is true that traditional theories cannot explain this phenomenon either. But for stress theory there seems to be a major contradiction: the premise that stress creates the matrix is incompatible with the premise that stress in breve/anceps positions is a violation of the metre.

The major problems with stress theory, as it is currently formulated, concern the metrical boundaries, in particular the caesura. The stress rules given in the column entitled "Regular stressing" in Table 1 would clearly produce regular stress conflict in the trimeter when a long anceps stands before the caesura (and before the diaeresis in the trochaic tetrameter). More often than not, there would be a reversal with lack of stress in the final longum of the first metron and full stress in the following long anceps. To avoid this situation, stress theory posits that the caesura, like line end, induces terminal stressing for the preceding word. Such an assumption, however, leads to quite serious inconsistency with other tenets of the theory. Consider the effect of terminal stressing at the caesura on hexameters having an initial spondaic word followed by a single (phonological) word before the caesura ($\bar{S}\bar{S}\#\bar{S}\{\underset{\check{S}\check{S}}{\bar{S}}\}\bar{S}(\check{S})$). This is quite a common pattern, occurring in fact in the well-known ἦμος δ' ἠριγένεια φάνη ῥοδοδάκτυλος ἠώς. If a word ends with the first foot, the remaining precaesural portion tends in over 70% of the instances according to Porter[15] to be occupied by a single phonological word, i.e. by a single word or a single conjunction of appositive(s) with headword. And spondaic words begin the hexameter in about one out of every ten lines;[16] in the case of a line-initial spondee-shaped word a stress conflict ($\bar{S}\acute{\bar{S}}\#$) is excused by stress theory on the metrical grounds that it is permitted in the first foot of the hexameter. However, terminal stressing of the precaesural word produces $\bar{S}\{\underset{\acute{S}\check{S}}{\acute{\bar{S}}}\}\bar{S}(\acute{\check{S}})$, which gives us not only lack of stress in strong position but also full stress in weak position. So terminal stressing at the caesura removes difficulties in the trimeter but creates them in the hexameter, and this constitutes an impasse from which we can find no escape short of permitting stress conflicts in the environment of the caesura (which was the position taken in an earlier presentation of stress theory)[17] or allowing more extensive recourse to phrasal stressing.

Stress theory will also need revision to account for some previously overlooked metrical data, namely for the constraint against words of the shape $\bar{S}\bar{S}\check{S}\check{S}$ at the end of the trimeter in the iambographers and words

[15] H. N. Porter, "The Early Greek Hexameter," *YCS* 12 (1951) 1.
[16] Allen (above, note 1) 292.
[17] Allen (above, note 3).

of the shape $\bar{S}\bar{S}\check{S}$ at the end of the hexameter.[18] According to the current formulation of the terminal stress rules, the first syllable of both word shapes would be unstressed after a final heavy syllable of the preceding word, which would allow them to stand in third anceps and fifth biceps respectively. In order to explain the metrical constraints on the location of these word shapes, it is necessary to assume that, at least in some styles of pronunciation, they had stressed first syllables. Note that this would result in contiguous stresses, which are not permitted in the current formulation of stress theory: $\acute{S}\acute{S}\check{S}\acute{S}$, $\acute{S}\acute{S}\check{S}$.

In this brief discussion of the formal aspects of stress theory, we have pointed out a number of contradictions and indeterminacies, at least some of which could probably be resolved by a further refinement of the theory. However, the major difficulties lie not so much in the internal consistency or descriptive adequacy of the theory as with its substantive phonological assumptions. If we are to make a serious attempt to evaluate these assumptions, we shall have to go beyond the comparatively abstract phonological concepts of stress and pitch accent to the more concrete acoustic parameters they must ultimately presuppose. It is only after deciding, on the basis of the available typological evidence, what prosodic properties are likely to have motivated the complex of metrical data in question, that we can return to the problem of whether stress is a suitable term for those properties and their function in Greek. It is well to remember, at all points in the discussion, that the metrical data can hardly be explained except in terms of some property of the Greek language: if we reject stress as an explanation, we automatically put ourselves in the position of having to find some other linguistic basis for the practice of the poets.

2. Stress Theory and the Greek Word Accent

The assumptions of stress theory can hardly be adequately evaluated except in the context of an overall account of word prosody in ancient Greek. It will be necessary to investigate, in both synchronic and diachronic terms, the substantive, functional, and formal relationship of the postulated non-accentual stress to the word accent. More specifically, we need to know what the substantive phonetic exponents of each are likely to be; what properties of each (e.g. culminativity, predictability) could point to accentual status; and to what extent the two constitute a unitary prosodic system, i.e. to what extent their location coincides and to what extent the factors governing their location form part of a unitary system or at least are comparable. Finally,

[18] A. M. Devine and L. D. Stephens, "Towards a New Theory of Greek Prosody: The Suprasyllabic Rules," *TAPA* 112 (1982) 33.

the diachronic aspect of the problems requires us to construct a relatively straightforward and natural account of the historical development from the ancient Greek to the modern Greek word prosodic system.

2.1. The pitch accent

There is no doubt that pitch was fundamental to the Greek word accent. The very terms applied to the accent, τόνος, τάσις, προσῳδία, are taken from the realm of pitch and singing. According to Aristoxenus (*Harm.* 1.18), λέγεται γὰρ δὴ καὶ λογῶδές τι μέλος, τὸ συγκείμενον ἐκ τῶν προσῳδιῶν τῶν ἐν τοῖς ὀνόμασιν. Whereas ancient descriptions (e.g., Plato, *Phaedr.* 268D, Aristotle *Rh.* 1403B) always specify the melodic character of the accent, they never refer to any feature of intensity, loudness, or added duration. From this *argumentum ex silentio* and the fact that the accent is irrelevant to classical versification and prose rhythm, it is generally assumed that the Greek accent was primarily or completely one of pitch. Some scholars, such as Schmitt,[19] however, suggest a weak dynamic character for the accent, and Szemerenyi has proposed that a number of forms have arisen by syncope of unaccented vowels at a time when "the musical accent cannot be doubted."[20]

Phonetically, the accent involved high pitch followed (except when final) by low pitch. Dionysius of Halicarnassus describes the circumflex as follows: αἱ μὲν κατὰ μίαν συλλαβὴν συνεφθαρμένον ἔχουσι τῷ ὀξεῖ τὸ βαρύ, ἃς δὴ περισπωμένας καλοῦμεν; and Choeroboscus recognizes the equivalence of the pitch pattern in the circumflex to that in the acute and post-acute syllables. The difference between the acute and the circumflex on long vowels is readily described if long vowels are analyzed into morae: the circumflex corresponds to high pitch on the first mora and low (or falling) pitch on the second, the acute to high pitch on the second mora with low pitch on the following vowel. Such an analysis is supported by the historical development whereby in final syllables V.V́ contracts to V̄, but V́.V to V̂, e.g. δαϝίς > δᾴς, but πάϝις > παῖς.

2.2 Limitation rules: the rules of vowel and syllable quantity

Culminativity, or the limitation of the occurrence of a feature to once per word, is a mark of accentual function. In Greek word prosody high pitch is a culminative feature. Except in combinations with enclitics it may occur only once per word, and even in such combinations imme-

[19] A. Schmitt, *Musikalischer Akzent und antike Metrik* (Münster 1953) 23ff.

[20] O. Szemerenyi, *Syncope in Greek and Indo-European and the Nature of the Indo-European Accent* (Napies 1964) 271.

diately successive high pitches are forbidden.[21] The stress of stress theory likewise would be culminative. According to the rules of stress theory given in section 1, the "primary" stress is the pivot relative to which the location of the "secondary" stress(es) is determined, and this pivot occurs only once per word. Primary stress would therefore be culminative at the word level. In a slightly extended sense, the posited secondary stress would also be culminative in the domain of the "stress-foot."

Outside of Aeolic (which has recessive accentuation),[22] neither the syllable on which the pitch accent falls nor the occurrence of the circumflex versus acute/grave on final syllables is predictable in purely phonological terms. There are, nevertheless, rules limiting the syllables and vocalic morae of penultimate long vowels on which the high pitch can occur. First there is a general limitation rule, valid for all dialects, fixing the antepenult as the leftmost syllable on which the accent can stand under any circumstances and restricting it to the acute if it does stand there. Accent recession is also constrained by the weight of the final syllable. Since the relevance of syllable weight, rather than simple vowel quantity, has often been ignored and since the computation of weight for final syllables differs from that of non-final syllables, it is necessary to review the evidence for constraints on recession. On the one hand, if the final vowel of the word is long (or a diphthong other than *-ai* or *-oi* not in the optative or locative terminations) the accent cannot stand before the penult. On the other hand, even if the final vowel is short, the accent cannot stand before the penult if the final syllable ends in two (or more) consonants. Although this last restriction was formulated by Goodwin[23] in his school grammar, given also by Smyth, and retained by Messing,[24] it has been overlooked by a number of more recent scholars. Steriade,[25] however, has shown that its validity is demonstrated by the failure of recession to the antepenult in regularly recessive compounds if they end in ξ or ψ, e.g. coordinate compounds such as πολύβοτρυς but πολυ-άνθραξ, regressively dependent compounds such as φιλόξενος, φίλελπις, but φιλοκόλαξ and prefix compounds such as πρόμαχος but προφύλαξ. This failure of recession cannot be attributed entirely to analogy with the oblique cases, since there are fully recessive compounds such as φίλελπις which are also one syllable longer in their oblique cases. The conclusion

[21] Homeric accentuations such as φύλλά τε are no exception, but merely show that the pitch movement could occur on a sonorant consonant; cf. the same phenomenon in Lithuanian, e.g. *vīlkas*.

[22] For exceptions see M. L. West, "On Lesbian Accentuation," *Glotta* 48 (1970) 194–98.

[23] W. W. Goodwin, *Greek Grammar* (Boston 1892) 26.

[24] H. Smyth, *Greek Grammar*, revised by G. Messing (Cambridge, Mass. 1956) 39.

[25] D. Steriade, "Degenerate Syllables and the Accentual System of Ancient Greek" (ms. 1979).

is inescapable: at the end of a word -V̆CC behaves just like -V̄(C) in preventing recession to the antepenult, and -V̆C behaves just like -V̆ in permitting it. Thus accent recession is sensitive to the weight of the final syllable, not merely to vowel length. The rule for computing the weight of final syllables discounts the last consonant. There is good typological support for phonological rules that discount the last consonant of a syllable at the ends of words but not word internally. For example, the stress rules of Cairene Arabic,[26] Moroccan Arabic,[27] Estonian,[28] and Nez Perce (Idaho)[29] all ignore word final consonants but not the final consonant of word internal syllables. Similarly, some rules governing vowel length in Menomini (Wisconsin)[30] classify final CV̆C as light but non-final CV̆C as heavy.

There is a second rule, the so-called final trochee rule, which does not apply to Doric. If the accent falls on a long vowel in the penult, it must be a circumflex if the final vowel is short or *-ai* or *-oi* not in the optative or locative: hence the alternations δῶρον ~ δώρων, λῦσαι ~ λύσαι.[31] The only exceptions arise when the final syllable was originally an enclitic (cf. ὥστε) or as the result of crasis. Unlike the limitation rule, the trochee rule is sensitive only to vowel length, not syllable quantity, e.g. πῖδαξ, ἦνοψ, like δῶρον.[32]

[26] J. McCarthy, *Formal Problems in Semitic Phonology and Morphology* (Diss. MIT 1979).

[27] R. S. Harrell, *A Short Reference Grammar of Moroccan Arabic* (Washington, D.C. 1962) 29.

[28] A. S. Prince, "A Metrical Theory of Estonian Quantity," *Linguistic Inquiry* 11 (1980) 530.

[29] See the observation of J. H. Crothers, s.v. Nez Perce in *Handbook of Phonological Data from a Sample of the World's Languages: a Report of the Stanford Phonology Archive*, vol. 1: *Phonetic Inventories*, compiled and edited by J. H. Crothers, J. P. Lorentz, D. Sherman, and M. M. Vihman (Department of Linguistics, Stanford Univ. 1979) 450.

[30] D. Pesetsky, "Menomini Quantity," *Papers on Syllable Structure, Metrical Structure and Harmony Processes*, ed. K. Safir, MIT Working Papers in Linguistics 1 (1979) 116ff.

[31] It is not necessary to posit a synchronic rule v̂ → v́/_V̄#. For the diachrony see note 32.

[32] The synchronic limitation and trochee rules correspond to historical sound changes. A Common Greek sound change retracted the free pitch accent of Proto-Indo-European: Skt. *bháramaṇas*, φερόμενος, Skt. *svādīyān*, ἡδίων. There is no reason to suppose that at this stage the retracted accent was anything other than an acute. The behaviour of original *-ai* and *-oi* like -V̆C can be explained on the assumption of a semivocalic final segment, [aj], [oj]. *-ai* and *-oi* of the optative were not originally final short diphthongs, but arose (*inter alia*) from the loss of *-t*, and thus provide a rough *terminus post quem* for the change. The behaviour of *-oi* of the locative may be analogical. Note that -ει of the thematic 3rd sg. act. has the same effect on retraction as the expected **-eti* would have had. The limitation rule ceased to be productive at least by the time of quantitative metathesis, πόλεως < πόληος, and was further obscured by analogical formations such as δύσερως. The trochee rule was a later sound change that did not affect Doric, e.g. παίδες, νᾶσος, (unless such forms are Doric innovations). This change was still productive after vowel contraction, e.g. ἑσταότες > *ἑστώτες > ἑστῶτες. Since it is possible that Greek did not have properispomenon

There are two sound changes concerning the accent for which syllable weight, and not merely vowel quantity, is relevant. According to Wheeler's Law[33] original oxytones become paroxytones if they have dactylic endings: S̄S̆V̆(C) > S̄S̆V̆(C), e.g. *ἀγκύλος* beside Skt. *aṅkurás*, as well as *ποικίλος* beside Skt. *peśalás*. Note that for Wheeler's Law too the final consonant is discounted in computing the weight of the final syllable. The second change is Vendryes' Law,[34] which applies only to Attic. Perispomena retract the accent to the antepenult if it is light: S̆ŜS > S̆SS, e.g. *βέβαιος* beside *ἀρχαῖος* as well as *σπουδαῖος*. There are apparently no cases in which either Wheeler's Law or Vendryes' Law has applied to words ending in final *ξ* or *ψ*.

A comparison of the rules of stress theory presented in section 1 with those constraining the pitch accent reveals three major differences. First, the location of the "non-accentual" stress is completely predictable in phonological terms, whereas that of the pitch accent is not. Second, the rules of stress theory are never sensitive to vowel quantity independently of syllable quantity: there is no counterpart to the trochee rule in stress theory. Third, stress location is computed for word shapes as they appear in the phonological phrase, whereas (aside from enclisis and the elision of oxytones) the location of the pitch accent is determined in the domain of the word regardless of its sandhi environment. Thus the stressing of words ending in -V̆C changes accordingly as the following word begins with a consonant or a vowel, but the pitch accent does not.

The "non-accentual" stress posited by stress theory has a distribution completely independent of the pitch accent. Every possible pattern of pitch accentuation can co-occur with each stress pattern. For example, (non-prepausally) the spondee-shaped word is stressed S̄S̄, but it can have any one of the four possible pitch accentuations, *φεύγειν*, *κῆρυξ*, *ψευδεῖς*, *πλευρὰς*. Similarly the three possible accent patterns of the tribrach-shaped word, *ἔλαβε*, *φυγάδα*, *ὑγιὲς*, are all stressed ŚS̀S. Nevertheless, there are statistical tendencies in the location of the posited stress relative to the circumflex, acute and grave.[35] In Table 2 we list six

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accentuation before the trochee rule and vowel contraction, there may never have been an actual historical retraction of the form V̂ → V̄/_V̄#. Consequently, the retraction could theoretically be formulated in terms of syllable weight (-V̆CC# = -V̄[C]#), whereas only vowel quantity was relevant for the later trochee rule.

[33] B. Wheeler, *Der griechische Nominalakzent* (Strasbourg 1885) 60f.

[34] J. Vendryes, *Traité d'accentuation grecque* (Paris 1929) 263. Vendryes' Law presents something of a paradox of rule ordering in synchronic phonology and of relative chronology (at least in a Neogrammarian framework). Even though it operates on the output of the trochee rule (*ἔγωγε* < **ἐγῶγε* < *ἐγώ* + *γε*) and the trochee rule operates on the output of vowel contraction, Vendryes' Law does not apply to properispomena that arise from vowel contraction (*ἐμοῦγε*).

[35] These tendencies are redundant, arising, *inter alia*, from the fact that circumflex syllables are always heavy and therefore potentially stressable, whereas the acute occurs

locations relative to the various types of pitch accent in column 1, and in column 2 we give the rate at which syllables in the specified locations would bear the posited stress. The data come from our counts of samples of Plato's *Republic*; prepausal words have been omitted, as have (the fairly rare) disyllabic matrices; secondary stress has been included in view of its important role in stress theory.[36] The circumflex and post-acute syllables more often than not coincide with the posited stress, while acute syllables more often than not coincide with absence of stress. The high rate of "stressing" of post-circumflex and post-post-acute syllables is explained by the fact that they are, of course, final, and final syllables are very frequently heavy.

Location relative to pitch accent	% of syllables in location bearing stress
Preceding any accent	33%
Post-circumflex or post-post-acute	81%
Acute	23%
Post-acute	65%
Circumflex	87%
Grave	65%

Table 2. Location of the posited stress relative to the pitch accent

2.3. The change from pitch to stress accentuation

The Modern Greek stress accent falls on the same syllable of the word as did the Ancient Greek circumflex, acute, or grave (with some readjustments due to paradigmatic analogy). This fact presents no problem for theories of Greek word prosody which do not posit a competing stress, but it is a *prima facie* difficulty for stress theory, since it must reconcile the development of stress in a location different from its posited "non-accentual" stress. On the other hand, stress theory would be strengthened if its "non-accentual" stress could be shown to have been an integral factor promoting the development of the Modern Greek stress, rather than an extraneous one simply suppressed by it.

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frequently on light syllables which are not stressable except in disyllabic matrices; the exclusion of the acute from final syllables which are frequently heavy and therefore stressed; and the fact that if the acute stands on a penultimate long vowel the final syllable will always be heavy and therefore stressed, whereas if the circumflex stands on the penult, the final syllable may be light so that the penult will be stressed.

[36] Our figures are extremely close to those provided by Allen ("Correlation of Tone and Stress in Ancient Greek," *To Honor Roman Jakobson* [The Hague 1967] 46–62) for the acute, post-acute, and circumflex only in relation to "primary" stress.

For a long time before our first evidence for stress-based prose rhythm or versification,[37] one can observe the evolution of stricter regulation of the accent in a number of quantitative metres, particularly the growth of paroxytonesis.[38] For example, already in the pentameter of Anyte the rate of final oxytones and perispomena has been reduced to only 4.3%, a statistically significant reduction not only from the rate of 21.7% in Solon ($\chi^2 = 7.24$), but from the 16.8% in Callimachus ($\chi^2 = 5.02$). Paroxytonesis becomes regular also in the choliamb of Babrius, both miuric and normal paroemiacs, the trimeter, and the hexameter. While it continues even after the transition to a stress accent, it predates the development (at least in educated varieties of Greek) in the case of the pentameter, and probably the choliamb, and the miurics. The straightforward explanation[39] is an increasing preference for a fall of pitch on the final syllable of the verse. While granting that this preference could be explained as a "mechanical regularization of originally fortuitous tendencies"[40] stress theory proposes as an additional motive "an increase in the strength of the linguistic stress when, as in the majority of cases, it was associated with the *svarita* tone, of which the essential characteristic was its falling nature."[41] According to stress theory, the statistical correlation of its "non-accentual" stress with falling pitch (see Table 2) may have provided the crucial link in the transition from a pitch to a stress accent. In the case of the circumflex, the melodic high pitch + fall, encouraged by its statistical association with stress, is assumed to have developed a stress on the fall, S̈; the stress peak was then shifted back to coincide with the pitch peak, so that a pure stress accent remained, ś. In the case of the acute, the development posited by stress theory is more complex. Again encouraged by the statistical association with stress, the pitch fall on the following syllable is assumed to have developed a stress, śS̀ → śS̈. The pitch fall

[37] Accentually defined prose clausulae are found at least as early as Himerios and Themistios. While theoretically accentual clausulae might be melodic rather than stress-based, the "Vernachlässigung der Enklise" (P. Maas, review of H. Usener, *Der heilige Tychon*, *BZ* 17 [1908] 609–13) seen in forms such as μισοῦσά σε indicates a stress accent, since it is the change to a stress accent that causes the word accent and the enclitic accent to become contiguous; the accent on the syllable following the word accent was deleted (or shifted on disyllablic enclitic words) to avoid such contiguous stressing. Non-quantitative, accent-based versification is clearly demonstrable also by the fourth century A.D. in Gregory Nazianzen. See W. Meyer, "Anfang und Ursprung der lateinischen und griechischen rhythmischen Dichtung," *Gesammelte Abhandlungen* 2 (Berlin 1905) 45ff.

[38] See F. Hanssen, "Ein musikalisches Accentgesetz in der quantitirenden Poesie der Griechen," *RhM* 38 (1883) 222–44, and W. S. Allen (above, note 36).

[39] J. Wackernagel, review of J. Postgate, *A Short Guide to the Accentuation of Ancient Greek*, *IF* 43 (1925) Anz. 48ff.

[40] Allen (above, note 1) 268.

[41] Allen (above, note 36) 60.

would then be absorbed by the preceding syllable, bringing the stress with it, to give a structure similar to that of the circumflex, ś s̈ → s̃ (s). Again retraction of the stress peak to coincide with the pitch peak would give a pure stress accent.

The foregoing hypothesis requires that the circumflex accent be equipollent with the disyllabic combination of acute plus post-acute fall. Yet evidence from Babrius does not support such equipollence. Even if we retain the accentuations ἡμεῖς, ὑμεῖς (the most frequent candidates for final perispomena), rather than adopt, as most editors do, the well attested unemphatic accentuations ἧμεις, ὕμεις, there will still be a rate of at most 2.30% for perispomena among the disyllables at the end of the choliamb. Now Babrius also has a rate of only 3.38% for properispomena (for which there would be no warrant whether in terms of pitch or stress) among final disyllables. Comparison with Hipponax, Callimachus, and Herodas confirms that these low rates constitute a statistically significant avoidance of both perispomena and properispomena at the end of the choliamb. Thus the clearest philological evidence that has been offered in support of the hypothesis linking the posited stress and the development of the Modern Greek stress accent in fact is incompatible with the assumptions of that hypothesis.

3. Word Prosody in a Typological Perspective

The three suprasegmental features of sound (frequency, intensity, duration) are all manifestations in the medium of sound of general physical properties of many events of the world around us. Frequency expresses the rate of repetition of a regularly recurring event, and the frequency at which the vocal cords vibrate governs the pitch of a (voiced) vowel. Intensity expresses the amount of force, pressure, power or energy involved in an event, for instance the force of an explosion or the brightness of a light. The intensity of a vowel depends partly on the amplitude of the sound wave produced by the vibrating vocal cords: greater subglottal (lung) pressure at unchanged frequency results in the vocal cords travelling further in the same amount of time and consequently in a faster moving glottal airburst and thus a more intense acoustic signal. Duration, of course, is the measure of time taken by an event. Pitch and duration are fairly straightforward to measure experimentally, although care needs to be taken in designing the experiment to compose fully comparable frame sentences delivered in a natural speech context. The acoustic measurement of intensity is more controversial.

Considerable complication, not to say confusion, is caused by the interrelationship of the suprasegmental features of sound both at the level of their acoustic correlates and at the level of their linguistic function. For the former, note that intensity depends not only on amplitude but also on frequency. More energy is required to move an object further, and, equally obviously, more energy is required to move it the same distance twice as often; doubling the amplitude of a sound wave and doubling the frequency both have the effect of causing the air particles to travel twice as far in the same time, i.e. twice as fast. From the physiological point of view, greater subglottal air pressure results not only in greater amplitude but also (unless counteracted by laryngeal adjustments) in

higher pitch, since the vocal cords are driven at a faster rate. Conversely, when the vocal cords are tensed to produce higher pitch, greater air pressure is needed to overcome the additional impedance. Current research suggests that the contribution of variation in subglottal air pressure to pitch changes is less significant than that of vocal cord tension except in the case of pitch fall at the end of an intonation contour. An increase in subglottal air pressure produces a striking increase in intensity, but only a moderate rise in pitch. A recent study of the so-called "ballistic" syllables in Lalana Chinantec (Mexico)[42] contains some interesting suggestions on the degree to which intensity and tone can be independently controlled in a non-accentual application. At the linguistic level, what is termed stress in the literature can have phonetic exponents along any or all of the three major suprasegmental parameters: a stressed vowel may have higher pitch and/or greater intensity and/or greater duration. The one restriction in normal usage is that if higher pitch is not accompanied by significantly greater intensity or duration or both, the term pitch accent is often used in place of the term stress to indicate accentual prominence. Conversely all three suprasegmentals have a number of other important functions in addition to serving as exponents of stress. At the level of the sentence, they convey syntactic and attitudinal information and mark syntactic structure (the intonation contour and its durational and intensity correlates). Duration is also used to mark word boundary and more generally for the rhythmic production of speech; and in the so-called tone languages pitch is used systematically to differentiate lexical and grammatical items.

With these preliminary remarks, we are in a position to survey a number of languages, from various parts of the world, to see 1) whether stress and pitch can function together in any language in the way they are supposed to function in Greek according to stress theory, and 2) whether prosodic patterns comparable to those of Greek that stress theory is designed to explain can be identified in any other language in which pitch has a function comparable to that which it has in Greek.

3.1. Pitch and stress

The functions of pitch at the level of the word and the degree to which it is independent of other suprasegmental features can be viewed along a parameter ranging from non-accentual (morpholexical tone) through accentual (pure pitch accent) to accentual reinforced by duration and/or intensity (stress, or more precisely those types of stress of which pitch is a significant exponent). This parameter is represented in Figure 1. The categorical distinctions represented by the vertical lines should not be interpreted as indicating watertight compartments; the structures of a number of languages may be indeterminate in this regard or they may be diachronically transitional stages. In other instances, the linguist may have too limited a knowledge of the language to make a decisive categorization.

Morpholexical tone	Restricted tone	Pitch accent	Pitch differentiated stress	Stress
non-accentual		accentual	reinforced accentual	

Figure 1: Functions of pitch in the word

In tone languages, tonal distinctions are in principle a feature of every syllable, and in unrestricted systems, at least, tone does not exhibit patterns that

[42] R. L. Mugele, *Tone and Ballistic Syllable in Lalana Chinantec* (Diss. Texas 1982).

would be recognized as typically accentual. Some care is necessary in assessing reports of stress in tone languages: for instance, in Hausa (Nigeria), whereas one report gives a detailed description of stress,[43] another authority[44] states that what is perceived as word stress is mostly only the fall from high to low tone. Nevertheless, word stress is well attested in tone languages, e.g. Golin (New Guinea; stress on the last high tone in the word), Marinahua (Peru), Eastern Poploca (Mexico).[45] Certain differences of intensity and duration often characterize different tones. In general, vowels on low tones are longer than those on high tones, and vowels on rising tones are longer than those on falling tones, *ceteris paribus*. But such intrinsic differences do not interfere with word and phrase stress. For instance, in Chinese[46] stress tends to have the effect of exaggerating the pitch contour and increasing or decreasing the duration of the stressed vowel according to its tone, as well as affecting its intensity and formant characteristics. Stress does not universally result in higher pitch; rather it has the effect of emphasizing the tonal characteristics of a syllable. Thus in Tenango Otomi (Mexico), a low tone in a stressed syllable is slightly lower than in an unstressed syllable.[47] Needless to say, the fact that stress occurs in tone languages should not be cited as support for stress theory, since Greek is not a tone language.

In a number of tone languages, mostly African, the distributional freedom of the tones becomes restricted to a point at which the tones begin to show two common characteristics of accentual systems, namely predictability and culminativity. For instance, in Maasai (Kenya) the syllables of a word are, with the exception of certain polymorphemic words, variably mapped onto the fixed tonal patterns Low–High–Low or Low–High–"Downstepped." In Bambara (West Africa) the vast majority of native lexical items have either a level tone configuration with all high toned vowels or a rising configuration with one or more low toned vowels followed by one or more high toned vowels (apart from sandhi variants).[48] Thus the tonal configuration can be predicted if one knows which is the first high toned syllable in a word. According to one report, Bambara also has a word stress falling on the last high toned syllable, the exponents of which are extra-high tone, increased intensity and increased duration.[49] In Luganda (Uganda), the basic form of every word has at least one high toned syllable and no more than one fall from high to low pitch.[50] A stress has also been reported for Luganda, falling on the first syllable of the stem (rather than on the penultimate syllable, as in Southern Bantu languages such as Zulu [South Africa] and Shona [Zimbabwe]). Other languages show roughly parallel restrictions. In Mahas Nubian (Sudan) a word may have all high or all low tones; otherwise it

[43] R. C. Abraham, *A Modern Grammar of Spoken Hausa* (Government of Nigeria 1941).

[44] J. Greenberg, personal communication.

[45] E. V. Pike, "Word Stress and Sentence Stress in Various Tone Languages," *Proceedings of the Ninth International Congress of Phonetic Sciences* 2 (Copenhagen 1979) 410.

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

[47] R. C. Blight and E. V. Pike, "The Phonology of Tenango Otomi," *IJAL* 42 (1976) 51–57.

[48] K. Courtenay, "On the Nature of the Bambara Tone System," *SAL* 5 (1974) 303.

[49] C. Bird in N. Woo, *Prosody and Phonology* (Diss. MIT 1969) 16–17. For a discussion of the phonological and syntactic conditioning of this phenomenon and its interpretation as sentence stress see K. W. Mountford, *Bambara Declarative Sentence Intonation* (Diss. Indiana 1983) 113.

[50] J. Kalema, "Accent Modification Rules in Luganda," *SAL* 8 (1979) 127.

may contain no more than one tone shift, and it is always rising.[51] In Korku (a Munda language from India) only one tone shift per word is allowed, and it is always downward.[52] Tone is even further restricted in the Bantu language Safwa (Tanzania): in Safwa one and only one syllable in each word has high tone, the location of which is not predictable but has to be given in the lexicon and the morphology. It is reported that the high toned vowel also has greater intensity.[53]

Tone is particularly restricted in the Cushitic languages. In Iraqw (N. Tanzania), verbs are mostly mapped onto a rising contour with high tone on the final syllable, and nouns mostly onto a falling contour with tone fall on the penultimate syllable; there is only one tone shift in the word in both cases.[54] In Bilin (Eritrea), a word may lack any high toned syllables or have one or more contiguous high toned syllables; it may have a tone rise or tone fall or both, but not more than one of each.[55] In Beja (Sudan), Saho (Eritrea), and Somali, basic word forms may have only one high toned syllable.[56]

Some languages of New Guinea also have restricted tone or pitch accent systems. In Fasu, there is a distinction between high and low toned vowels, but it occurs only in stressed syllables. Conversely, the exponents of stress vary according to the tone of the stressed vowel (as in Chinese): on high toned vowels, stress is implemented by increased intensity, on low toned vowels by increased duration.[57] In Fore, most phrases are characterized by one of two rising-falling pitch contours, a gradual contour and an abrupt contour; the latter reaches a much higher peak than the former.[58] In Nimboran high tone can occur only once in the word, but its location is not predictable.[59]

All these restricted tone languages are of particular interest to the present discussion, since it is in this area that there is the best chance of finding a system in which accentual pitch coexists with an independent accentually patterned stress. No clear case has emerged, although, of course, the language descriptions are often very incomplete. In any event, it must be remembered that the mere fact that tone assignment can, in purely formalistic terms, be handled accentually at a certain level of phonological abstraction is not tantamount to the demonstration that the language in question has a surface pitch accent like ancient Greek. Contrast, for instance, the accentual analysis of tone in Kimatuumbi[60] with the pitch accent in Greek.

[51] H. Bell, "The Tone System of Mahas Nubian," *JAL* (1968) 26.

[52] N. H. Zide, "Korku Low Tone and the Proto-Korku-Kherwarian Vowel System," *Indo-Iranian Monographs* 5 (The Hague 1966) 214.

[53] J. Voorhoeve, "Safwa as a Restricted Tone System," *SAL* 4 (1973) 1.

[54] N. A. Tucker and M. A. Bryan, *Linguistic Analyses. The Non-Bantu Languages of North-Eastern Africa* (London 1966) 570.

[55] F. R. Palmer, "The Verb in Bilin," *BSOAS* 19 (1957) 131; id., "The Noun in Bilin," *BSOAS* 20 (1958) 376.

[56] R. A. Hudson, "Syllables, Moras, and Accents in Beja," *JL* 9 (1973) 53; W. E. Welmers, "Notes on the Structure of Saho," *Word* 8 (1952) 145; B. W. Andrzejewski, *The Declension of Somali Nouns* (London 1964).

[57] J. May and E. Loeweke, "The Phonological Hierarchy in Fasu," *Anthropological Linguistics* 7 (1965) 89.

[58] K. C. Pike and G. Scott, "Pitch Accent and Non-accented Phrases in Fore," *Zeitschrift für Phonetik* 16 (1963) 179.

[59] J. C. Anceaux, *The Nimboran Language: Phonology and Morphology* (The Hague 1965).

[60] D. Odden, "Separating Tone and Accent: The Case of Kimatuumbi," *Proceedings of the First West Coast Conference on Formal Linguistics* (Stanford 1982) 219.

Now that our survey has reached the central section of the parameter represented by Figure 1, let us skip to the far right and work back towards the central section again. English is an example of a language in which stress is very strongly marked, having all three suprasegmentals as its exponents: stressed vowels are longer, higher pitched, and more intense than unstressed vowels. The physiological manifestations of greater intensity and related stress phenomena are particularly clear under sentence stress, where they include increased respiratory activity, increased subglottal pressure, higher electromyographic signals, higher rates of articulator movement, closer approximation of articulators to vowel target positions. Phonologically the strength of English stress is evidenced by the abbreviation and centralization of the unstressed vowel system. There is some evidence that the durational attributes of English stress are learned by the child later than the pitch attributes, so that early English child language has something more like a (trochaically patterned) pitch accent.[61] Descriptions of stress in other languages (Georgian, Kota) sometimes note that stress is less strong than in English. In colloquial Meccan Arabic, stressed vowels have both higher pitch and greater duration than unstressed vowels.[62] In the case of long vowels durational differences between stressed and unstressed vowels are relatively great and pitch differences less significant, whereas for short vowels duration is exploited less and pitch more.

A number of languages, such as Serbo-Croat, Lithuanian, and Swedish (which are commonly said to have a "pitch accent"), differ from ordinary stress languages in that the pitch component of the stress is differentiated into two types: we refer to such languages as pitch differentiated stress languages. In Serbo-Croat, stressed vowels have approximately 50% greater duration than their unstressed counterparts as well as greater intensity and higher pitch.[63] In one type of long vowel accent, the pitch peak occurs early in the vowel, and the vowel of the following syllable has lower pitch. In the other type of long vowel accent, the pitch peak occurs late in the vowel, and the vowel of the following syllable has equally high or higher pitch. This dislocation of pitch from the other exponents of stress results from a historical change whereby, when the word accent was moved one syllable to the left, high pitch remained on the old accented syllable as well as being placed on the new accented syllable. (A parallel is provided by Onondaga [Iroquoian],[64] where a historical change produced a synchronic state in which the pitch peak is dislocated one syllable back from the syllable which has the intensity peak and which has vowel lengthening if it is open; there is a tendency to eliminate this dislocation in favour of unified penultimate stress.) In Swedish, accented vowels have greater duration and intensity than unaccented vowels, as well as higher pitch. The timing of the pitch peak relative to the accented syllable differentiates the two types of accent.[65] Since the intensity peak tends to occur in the middle of the vowel, at the point of maximum oral aperture, the pitch peak is dislocated therefrom when it occurs

[61] G. Allen and S. Hawkins, "The Development of Phonological Rhythm," *Syllables and Segments*, edd. A. Bell and J. Hooper (Amsterdam 1978) 173–85.

[62] D. Ohsiek, "Heavy Syllables and Stress," *Syllables and Segments* (above, note 61) 35.

[63] I. Lehiste and P. Ivić, "Interrelationship between Word Tone and Sentence Intonation in Serbocroatian," *Elements of Tone, Stress and Intonation*, ed. D. J. Napoli (Washington 1978) 100.

[64] W. L. Chafe, "Accent and Related Phenomena in the Five Nations Iroquois Languages," *Studies in Stress and Accent*, ed. L. M. Hyman (Los Angeles 1977) 173.

[65] E. Gårding, *The Scandinavian Word Accents* (Lund 1977).

early or late in the vowel. On the other hand, in whispered speech, a different strategy has to be adopted by the speaker, and the location of the intensity peak is the primary cue to distinguishing the two accents. There is considerable dialectal variation: in some dialects (Eastern Swedish) the pitch peak of the so-called accent 1 occurs so early that it can appear in the syllable preceding the accented syllable. In Lithuanian, stressed syllables have greater duration and intensity and higher pitch than unstressed syllables; the duration of short *i*/*u* in the first syllable of disyllabic words of the structure CV–TVC (where T is a stop consonant, either voiced or voiceless) was found to be ca. 80 msec. when the vowel was unaccented (e.g. *sukaĩs* "you turned") and ca. 140 msec. when accented (e.g. *sùkes* "having turned").[66] In Latvian (which, in any case, may be a type of tone language), accented vowels are on the average nearly a third longer than unaccented vowels.[67] Another type of pitch differentiated stress accent is found in Karok (California).[68] One syllable of each word is "stressed" (presumably has a louder and/or longer vowel nucleus; some degree of consonant lengthening is also associated with stress). Additionally there are three types of tone on stressed syllables: level high, falling high, and low (cf. Fasu above). The last occurs preferentially and the second only on long vowels. The tonal contours of pretonic and posttonic syllable sequences are predictable.

The pitch differentiated stress languages just surveyed are commonly cited as providing parallels for the Greek pitch accent. They clearly do provide parallels for a rising/falling accentual opposition; but the comparison cannot be carried any further unless one allows a significant element of stress in the Greek pitch accent, which most scholars are unwilling to do. In any case, the pitch differentiated stress languages do not in any sense constitute a parallel for the autonomous, non-accentual stress assumed for Greek by stress theory. In these languages, even when the pitch peak is dislocated from the stress to the extent of occurring in the preceding or following syllable, stress and pitch evidently correlate as two exponents of a single accentual prominence, and stress does not constitute an autonomous system patterned independently from pitch.

The only language having a pitch accent proper that has been investigated experimentally in adequate detail is Japanese.[69] Detailed acoustic analyses of the modern Korean pitch accent and of the pitch accents or restricted tone systems of Africa and New Guinea noted above are not, as far as we know, currently available. In the standard (Tokyo) dialect of Japanese, a word or minor phonological phrase may have at most one point at which pitch falls from high to low. In the traditional analysis, this point is specified diacritically by the accent mark. Words that do not have the pitch fall are thus unaccented. Note that both accented and unaccented words have high-tone syllables (although the high region of accented words is ca. 5 cps. higher than that of unaccented words), and that the class of unaccented words is not restricted to grammar function words as the class of clitics largely is in Greek. The remainder of the tonal pattern of the word is predictable. The first mora of the word is low, unless it is either itself accented or constitutes the first mora of a bimoraic sonorant sequence (long vowel, diphthong, etc.), in which case it is high. If an accented

[66] R. Ekblom, *Quantität und Intonation im Zentralen Hochlitauischen* (Uppsala 1925) 32ff.; V. Ambrazas et al., *Litovski Jazyk* in *Jazyki Narodov SSR*, ed. V. V. Vinogradov, 1 (1966) 50.

[67] R. Ekblom, *Die lettischen Akzentarten* (Uppsala 1933) 19.

[68] W. Bright, *The Karok Language*, UCPL 13 (1957).

[69] We are most grateful to our colleague William J. Poser, an expert in Japanese tonology, for his vital assistance with this section.

syllable is polymoraic, the pitch fall is always located from the first to the second mora: this means that Japanese cannot have a rising-falling/acute-circumflex type of accentual distinction. Morae standing between the first mora and the accented syllable (the final syllable in unaccented words) are all high in the Tokyo dialect. High tone may be considered to spread backwards from the accented syllable. In other dialects of Japanese, this is not the case. In the dialect of Nagoya, tone rises gradually to the high tone level of the accented syllable (as has been assumed for Greek; cf. also the mid tones in unaccented syllables in Korean). Some dialects also have rules for the location of high pitch that are typically accentual. In the dialect of Kagoshima, for instance, high pitch occurs once in each word, on either the penultimate or the final syllable.[70]

Accented vowels are not audibly longer than unaccented vowels. Some experimental studies[71] have found small increases in duration in the accented syllable, but the experiments are not very sophisticated, and the effects are marginal compared with those of position of the syllable in the phrase. This result also characterizes the experiment of Nishinuma,[72] according to which in the phrase initial tone sequences High-Low and Low-High, the first vowel has greater duration (and greater intensity) if it was High than if it was Low, but this effect was overridden by the fact that in both sequences the second vowel had greater duration (and greater intensity) than the first vowel, irrespective of the tone sequence. In sum, the role of duration as an exponent of the Japanese accent is still controversial: such effects as have been claimed are marginal both relative to other durational characteristics of the minor phrase and relative to the sort of durational increases associated with the accent in languages having a pitch differentiated stress such as Lithuanian, Serbo-Croat and Swedish. The marginal role of duration and intensity as exponents of the accent in Japanese requires us to distinguish it typologically from stress and from pitch differentiated stress: it is a pure pitch accent.

3.2. Durational rhythm

In many languages, the durational rhythm is centered on or coincides with the stress system. It is likely that in English there exists a rhythmic unit (let us call it the contour) consisting of the stressed syllable, which has the greatest duration *ceteris paribus*, plus any unstressed syllables associated with it; and that the durations of syllables are manipulated in such a way as to reduce the temporal differences between contours. This latter point is highly controversial, but seems indicated (provided the results are not due to artificial rhythmicization of repeated test sentences) by an experiment of Fowler,[73] according to which the stressed vowel of the name *Davis* was found to have 129 msec. duration in the sentence "Davis signed the paper" (disyllabic initial contour) and only 98 msec. in the sentence "Davis assigned the paper" (trisyllabic initial contour).

Other stress languages have contour based durational rhythmic systems that are unhitched from the stress in the sense that the syllable having the greatest

[70] J. D. McCawley, *The Accentual System of Standard Japanese* (Diss. MIT 1965).

[71] S. Hiki, Y. Kanamori, and J. Oizumi, "On the Duration of Phonemes in Running Speech," *Inst. Elec. Com. Tohoku* (Univ. Sendai); F. Mitsuya and M. Sugito, "A Study of the Accentual Effect on Segmental and Moraic Duration in Japanese," *Ann. Bull. RILP* 12 (1978) 97. For a study with negative results see M. Beckman, "Low-level Temporal Effects in a Japanese Corpus," ms. Bell Laboratories and Cornell Univ.

[72] Y. Nishinuma, *Un modèle d'analyse automatique de la prosodie* (Paris 1979) 163.

[73] C. A. Fowler, *Timing Control in Speech Production* (IULC 1977) 77.

duration is not necessarily the stressed syllable. In Estonian, the main word stress falls on the first syllable of the first contour in the word, secondary stress on the first syllable of subsequent contours. The exponents of stress in Estonian are higher pitch and greater intensity.[74] The Estonian rhythmic system involves the manipulation of the duration of contours in the direction of isochrony. At the level of phonological distribution, note that if the contour has only one syllable, then that syllable is overheavy; if the contour has three syllables, then the final syllable must be a light syllable. Lower level phonetic rules similarly modify duration, so that in disyllabic contours the duration of the vowel of the second syllable is inversely correlated with the weight of the first syllable. The vowel of the second syllable of the contour is shortest if the first syllable is overheavy, intermediate in duration if it is heavy, and longest if it is light. Thus in a proceleusmatic-shaped word šššš the unstressed second and fourth syllables are half again as long as the stressed first and third syllables. If the second syllable of a disyllabic contour is closed, the postvocalic consonant of the second syllable is lengthened after a light or heavy first syllable, but not after an overheavy first syllable. Similar phenomena are found in Southwestern Finnish:[75] in a proceleusmatic-shaped word, the vowels of the unstressed even-numbered syllables averaged 141% of the duration of the stressed odd-numbered syllables. These data are important, because they demonstrate that durational rhythm can have a considerable degree of independence from the accentual pattern, even in a stress accent language, at least in the sense that the stressed syllable will not automatically be longer than contiguous unstressed syllables.

Carib (Guiana)[76] is a language with a (mainly) pitch accent and a strongly marked rhythmic system. Monomorphemic words (and most polymorphemic words) of three to six syllables consist of a disyllabic or tetrasyllabic sequence of which the odd-numbered syllables must be heavy and the even-numbered syllables may not contain a long vowel; the sequence may optionally be preceded and followed by a syllable not containing a long vowel. The pitch accent is located on the second heavy syllable of the word or on the final syllable of the word if it has only one heavy syllable; the pitch accent is thus fairly independent of the rhythmic structure, since it can occur not only in the strong syllable of the "trochee" and "ditrochee" structures defined above, but also on the weak syllables provided they do not end in a short vowel. Highly marked iambic and/or trochaic durational rhythm is found in a number of stress languages: a particularly good example is afforded by Yuk (Western Eskimo),[77] a language in which if the strong syllable of the contour is light, vowel lengthening or consonant gemination takes place. The case of Carib shows that, synchronically, such a rhythmic system can exist independently of the word accent. Experimental data are now available from Japanese that show how a fully structured durational rhythmic system can function quite independently from the accent in a pure pitch accent language. The subjective impressions of speakers suggest that Japanese has a system of bimoraic contours with greater intensity or related features on the odd-numbered mora and greater duration on the even-numbered

[74] A. Eek, "Observations on the Duration of Some Word Structures: II," *Estonian Papers in Phonetics* (1975) 28.

[75] I. Lehiste, "Juncture," *Proc. 5th Int. Congress Phonetic Sciences Münster 1964* (Basel 1965) 172.

[76] B. J. Hoff, *The Carib Language* (The Hague 1968).

[77] O. Miyaoki, "On Syllable Modification and Quantity in Yuk Phonology," *IJAL* 37 (1971) 219–26.

mora. At the level of the word/minor phrase, intensity is reported to be greatest on the first syllable, and there is added duration on the final syllable. That the overall durations of the bimoraic contours are manipulated in the direction of isochrony is suggested by the results of experiments by Homma[78] and Port, Al-Ani, and Maeda,[79] both of which use bimoraic test words. For instance in Homma's experiment, although the first syllable of the bimoraic test word *gaga* had over 40% greater duration than the first syllable of the bimoraic test word *papa*, the overall duration of the two words was almost identical due to compensation in the second syllable.

The internal durational relations of the bimoraic contour were examined in a paper by Teranishi[80] which, in our opinion, provides the crucial typological evidence for an understanding of the Greek metrical data. In slow and deliberate speech, in a sequence of monomoraic syllables, every second mora (i.e. the final mora of each contour) is lengthened: in other words, an iambic durational pattern is imposed on pyrrhic/proceleusmatic structures. Contours are mapped counting from the beginning of the phrase; if this leaves a single syllable at the end of the phrase, this syllable constitutes a monomoraic contour. As speech tempo increases, the amount of lengthening applied to even-numbered morae decreases, so that in rapid speech contour structure is evanescent, speech rhythm becomes mora timed rather than contour timed, and the phonological phrase rather than the contour is the next unit of rhythmic organization above the syllable and the mora.

The phonological significance of the bimoraic contour in Japanese is evidenced by the role it plays in certain rules for the formation of hypocoristics, which have been studied in detail by Poser.[81] When the hypocoristic suffix *-tšaN* is added to a personal name, the name often appears as a modified stem. This stem typically consists of one or two bimoraic contours: polysyllabic names may be truncated, and monomoraic names (which are rare) may have their vowels lengthened. The product of these morphological processes is always a complete bimoraic contour, never a partial contour.

In Japanese verse, the different metres are defined by the number of morae in conjunctions of lines. The *haiku*, for instance, consists of a five mora line, a seven mora line, and a five mora line. The pitch accent is not relevant in Japanese verse, just as it is not relevant in Greek verse. One style of verse recitation involves an iambic rhythm: the line is divided into bimoraic feet with lengthening of the second mora, as long recognized in literary research. Each line is treated as composed of four bimoraic feet; the missing one or three morae in each line are filled in by pauses. It is evident that the foot of verse recitation is simply the contour of slow speech, and this is now confirmed by the experimental data of Teranishi, which evidence the same iambic organization in this style of verse recitation as in lento speech. Thus in lento speech the beginning of the prose sentence "Once upon a time there lived . . . " has the durational pattern

[78] Y. Homma, "Durational Relationship between Japanese Stops and Vowels," *JPh* 9 (1981) 273.

[79] R. F. Port, S. Al-Ani, and S. Maeda, "Temporal Compensation and Universal Phonetics," *Phonetica* 37 (1980) 235.

[80] R. Teranishi, "Two-moras-cluster as a Rhythm Unit in Spoken Japanese Sentence or Verse," ms. Dept. of Acoustic Design, Kyushu Institute of Design Research, Fukuoka, Japan.

[81] W. Poser, "Hypocoristic Formation in Japanese," *Proceedings of the Third West Coast Conference on Formal Linguistics*, ed. M. Westcoat (1984).

mŭka sī mŭka sī ārū tōkō rōnī

In this example the syllables of a bimoraic contour are written together and the syllable of a monomoraic contour separately; the *breve* indicates the duration of the first (unlengthened) mora of the bimoraic contour, the *macron* the prolongation of the second mora, and the tetraseme symbol (⏑) the double prolongation of the monomoraic contour. Similarly in verse recitation, the beginning of a sentence "Nearby an old castle in Komoro . . . " has the durational pattern

kŏmō rŏnā ru kŏzyō ŏnō hŏtō rī

4. Greek Word Prosody

4.1 Synchrony

We are finally in a position to confront the questions posed by the Greek data in the light of the above typological survey. The role of pitch in the word prosody of Greek belongs somewhere in the centre of the parameter represented by Figure 1. Ancient Greek is obviously not a simple stress language: apart from any other considerations, that possibility is precluded by the existence of the circumflex/acute distinction. Equally obviously, Greek is not a tone language: pitch has many highly accentual characteristics in Greek. It is culminative, in that, in citation forms, one syllable in the word has higher pitch than the others; its location in the word is partially predictable and is constrained according to rules involving computation from the end of the word and syllable weight and vowel length; high tone occurs on every word except for a small class of mostly non-lexicals. In the parameter of accentuality represented by Figure 1, pitch is more accentual in Greek than in standard Japanese.[82]

If we believe that in ancient Greek the accented vowel was not only higher pitched but also significantly louder and/or longer *ceteris paribus* than unaccented vowels, then the Greek accent was a pitch differentiated stress like that of Serbo-Croat or Lithuanian. In that case, the innovation of the Modern Greek accent[83] is limited to the elimination of the rising/falling distinction between acute and circumflex and the sharpening of the durational distinction between accented and unaccented vowels (note in particular the elimination of long vowels in unaccented syllables). If, on the other hand, we believe that in ancient Greek accented vowels were not significantly louder or longer *ceteris paribus*

[82] For Korean see discussion in S. R. Ramsey, *Accent and Morphology in Korean Dialects* (Diss. Yale 1975).

[83] According to a recent study of the acoustic exponents of the Modern Greek accent (A. Botinis, "Stress in Modern Greek: An Acoustic Study," *Working Papers of the Institute of Linguistics, Lund University* 22 [1982] 27), duration, intensity, and pitch all increase on the stressed syllable of the word, although the role of pitch is reduced in stressed syllables following the sentence stress due to the influence of the intonation contour.

than unaccented vowels, then the ancient Greek accent was a pure pitch accent comparable *mutatis mutandis* to that of Japanese. This latter view has the better chance of being correct. The descriptions of the pitch accent by ancient grammarians do not explicitly support the assumption of prosodic properties other than pitch as exponents of the accent (see section 2.1 above), and the various arguments that have over the years been proposed in favor of a "stress" component in the Greek word accent have not found general acceptance.[84] Moreover, the complex of metrical data that the stress hypothesis was designed to explain serves by its mere existence, irrespective of its precise interpretation, to limit the possible attributes of the pitch accent. The exponents of the word accent are less likely to include to any significant degree properties already involved in the prosodic patterning underlying the metrical evidence. The net effect of this is to move our view of the Greek accent towards the pure pitch type and away from the pitch differentiated stress type, which is in accordance with the traditional view.

The typological evidence cited in section 3.2 immediately suggests that the metrical data reflect a durational rhythmic patterning which is, as in Japanese, independent of the pitch accent. In our view, durational rhythm was achieved in Greek by the additive and subtractive manipulation of syllable durations in sequences of identical syllable weights. There are a number of interesting parallels between the Japanese data and our interpretation of the Greek evidence. In both languages, the existence of the contour is indicated by rules of a morphological/morphophonemic order: in Japanese the rules for the formation of hypocoristics, in Greek the rule for the formation of comparatives, whereby the stem vowel of certain adjectives is lengthened if it stands second in a string of three light syllables: σοφο-τερος → σοφώτερος.[85] In Japanese, the degree of durational modification and probably the domain in which it is applied vary significantly according to the rate of speech: in Greek, it is hardly possible to explain the differing degrees of metrical strictness among genres without the assumption that the rules for achieving durational rhythm varied according to phonostyle and rate of speech. Finally, the mere fact that the rhythm of one style of Japanese verse recitation was also characteristic of the rhythm of deliberate (prose) speech suggests that it is not unreasonable to ascribe metrical relevance to this sort of relatively low level durational rule and, conversely, to use this sort of Greek metrical data as evidence for the durational rhythms of everyday Greek speech.

[84] See H. Ehrlich, *Untersuchungen ueber die Natur der griechischen Betonung* (Berlin 1912) and notes 19 and 20 above.

[85] For further possible cases, see H. Hirt, *Handbuch der griechischen Laut- und Formenlehre* (Heidelberg 1912²) §138.

4.2 Diachrony

The later Greek loss of vowel length distinctions and the transition to a stress accent are the most striking developments in the restructuring of the rhythm of Greek speech from a rhythm independent of the word accent to a rhythm centered on the word accent. This restructuring could have developed quite naturally in either of two ways, depending on how the loss of quantity distinctions related to the transition from pitch to stress accentuation. If vowel quantity ceased to be phonologically relevant before the transition to stress accentuation, the restructuring was probably as follows: the disappearance of vowel quantity contrasts removed the phonological basis of the old rhythmical patterning, namely syllable weight. While it would have been perfectly possible for the old durational rhythmical patterns to survive implemented by lower level phonetic modifications, it would also now be possible for duration to be used to reinforce the prominence of the accented syllable. When pitch is reinforced by duration, it becomes stress. On the other hand, if a stress accent arose before the loss of quantity distinctions, the restructuring would probably have been a case of the phonologically culminative, high pitch, syllable attracting additional accentual exponents, such as increased duration. The old rhythmical patterning would have been in conflict with the tendency to lengthen accented syllables and shorten unaccented ones, so that it would have been eroded.

Spelling errors in inscriptions and papyri could provide evidence on which to decide between the two courses of development just outlined. To the extent that a speaker possesses a phonological distinction and is literate, he may be expected to represent that distinction insofar as his alphabet permits. Thus the qualitative change from close mid to high front vowel /ē̩/ > /ī/ motivated the replacement of the digraph ει by the letter ι. Since the digraph ει always corresponded to a long vowel (whether /ē̩/ or /ī/), the inverse use of the digraph for the letter ι would adequately represent the phonological distinction of vowel length only if it were used for /ī/ and not /ĭ/. In fact, the use of ει to represent /ĭ/ remained restricted, indicating that many speakers distinguished between /ī/ and /ĭ/. The ratio of the frequency of the spelling ει for /ī/ to that of the spelling ει for /ĭ/ in Attic inscriptions is 7 in the second century B.C. and 23.5 in the first,[86] whereas in the language the ratio of /ī/ to /ĭ/ was considerably less than 1. The hypothesis that stress developed before and conditioned the loss of vowel quantity distinctions leads to the prediction of several correlations between misspellings and accentuation that would not be expected on the converse hypothesis that quantity distinctions were lost before the development of stress. If there

[86] S. T. Teodorsson, *The Phonology of Attic in the Hellenistic Period*, Studia Graeca et Latina Gothoburgensia 40 (Uppsala 1978) 59–60.

was a tendency to lengthen accented vowels, spellings such as ει for /ĭ/, ω for ο (reflecting the qualitative change from open to close mid rounded vowel [ǭ] > [ǫ̣]), and η for ε (reflecting the qualitative change from open to close mid front vowel [ę̄] > [ę̣]) would be more likely in accented syllables. Conversely, if there was a tendency to shorten unaccented vowels, spellings such a ο for ω and ε for η would be more likely in unaccented syllables. If the abbreviation of unaccented vowels was great enough to lead to syncope, the omission of vowel letters in writing would be more likely in unaccented syllables. Of course, this last correlation could to some extent also be the result of the greater perceptual saliency given to a vowel by the pitch accent: even careless and poorly educated writers might pay more attention to the culminative peak of the word than to other syllables, whatever its phonetic exponents.

Previous studies of spelling errors have not provided data adequate for controlled statistical evaluation of the correlations defined above, and conflicting views are found in the literature.[87] Generally the method of investigation has been to compare the frequency of accentuation for misspellings of etymologically short vowels by long vowel letters with the frequency for misspellings of etymologically long vowels by short vowel letters. This method erroneously assumes equal probability of accentuation for the long and short vowels. Rather, one needs to compare the rate of accentuation in misspellings of a vowel with the rate in the correct spellings of the vowel. Since the latter evidence has not been made available, we have taken random samples from Plato and Xenophon in order to obtain estimates of the rates at which /ĭ/, ω, ο, η, ε, and all vowels in inter-consonantal environment (/C(#)__(#)C) bear an accent (including the grave). In Table 3 we compare these control rates (column 2) with the rates at which the six types of spelling errors listed in column 1 corresponded to accented vowels. The asterisk marks statistically significant differences. The accentuation rates of the misspellings are calculated from the material collected by Teodorsson[88] for Attic to 200 B.C. (column 3), Attic 199–1 B.C. (column 4), and Ptolemaic koinê (325–1, column 5). Table 3 must, of course, be regarded as a provisional analysis, since differences in vocabulary, redundancy of con-

[87] See *inter alios* P. Kretschmer, "Der Übergang von der musikalischen zur expiratorischen Betonung im Griechischen," *KZ* 30 (1890) 591–600; E. Mayser, *Grammatik der griechischen Papyri aus der Ptolemäerzeit* 1 (Leipzig 1906) 140–41; C. M. Knight, "The Change from the Ancient to the Modern Greek Accent," *The Journal of Philology* 35 (1919) 51–71; F. Gignac, *A Grammar of the Greek Papyri of the Roman and Byzantine Periods* (Milan n.d.) 1.211, 325; Teodorsson, *The Phonemic System of the Attic Dialect 400–340 B.C.*, Studia Graeca et Latina Gothoburgensia 32 (Lund 1974) 218, 294; id., (above, note 86) 80–82; id., *The Phonology of Ptolemaic Koine*, Studia Graeca et Latina Gothoburgensia 36 (Lund 1977) 232–33.

[88] Teodorsson (above, notes 86 and 87).

tent, use of particles, etc. could account for some of the differences observed. Nevertheless, there appears to be *prima facie* evidence for the existence of correlations between accentuation and some of the spelling errors.

Type of error	Prose sample	Attic −200 B.C.	Attic 199–1 B.C.	Ptolemaic koinê
	Percentage of etymological V accentuated in:			
Omission of V /C(#)_(#)C	42.55%	*30.00%	* 20.69%	n.a.
ει for /ĭ/	31.19%	*53.13%	*100%	30.38%
ο for ω	43.86%	42.62%	* 15.63%	*28.96%
ω for ο	38.22%	49.18%	57.14%	34.68%
ε for η	50.95%	52.31%	37.50%	44.48%
η for ε	37.74%	36.11%	35.71%	43.54%

Table 3

In Table 4 we list the type of spelling errors (column 1), the frequency relation (greater than >, less than <) between the rate of accentuation of the misspelled vowel (Acc(M)) and the average rate of the etymological vowel (Acc(E)) that would be expected if the misspellings were reflecting phonological developments conditioned by stress (column 2), and indicate (columns 3–5) whether the observed relation agrees (+) or disagrees (−) with the prediction. It will be seen that of the 17 observations 12, or 70.6%, agree with the predictions and, more importantly, that of the 6 statistically significant differences 100% agree with the predictions. These results lend some support to the view that a stress accent developed before the loss of quantity contrasts and conditioned that loss.[89]

[89] False quantities begin to appear with some frequency in Christian and popular verse during the third century A.D. At this date they may not be motivated by contextually limited phonological factors such as accentuation, but merely reflect imperfect mastery of an artificial literary register by speakers who have lost all traces of quantity distinctions in all environments. At any rate, A. Dihle's claim ("Die Anfänge der griechischen akzentuierenden Verskunst," *Hermes* 82 [1954] 182–99) that in the miuric, paroxytonetic paroemiacs of the Christian poem Pap. Amherst I 23 "nirgends steht als Hebung eine kurze nicht akzentuierte Silbe" is incorrect (cf. line 2.1). Our examination of false quantities in this poem, Heitsch 45.3 (normal paroemiacs), and the *Psalmos* of Methodius revealed no statistically significant correlation between accentuation and mistakes in quantity. An indication of changes in the old system of syllable weight might be seen considerably earlier in the chronological increase in preference, among quantitatively exact poets, for syllables long by nature (cv̄[c]) over syllables long by position (cv̆c) in certain locations in different metres. For example, the rate of cv̄(c) in the penultimate position of the choliamb increases from 58.3% in Hipponax, through 65.5% in Callimachus, 74.5% in Herodas, to 93.5% in Babrius. A similar increase from 59.8% to 97.3% takes place also in the final syllable of the choliamb. For the same phenomenon before the diaeresis of the pentameter see M. L. West, *Greek Metre* (Oxford 1982) 158, 181.

Type of error	Predicted relation	Agreement of prediction and observation in: Attic −200 B.C.	Attic 199–1 B.C.	Ptolemaic koinê
Omission of V /C(#)_(#)C	Acc(M) < Acc(E)	*+	*+	n.a.
ει for /ĭ/	Acc(M) > Acc(E)	*+	*+	−
ο for ω	Acc(M) < Acc(E)	+	*+	*+
ω for ο	Acc(M) > Acc(E)	+	+	−
ε for η	Acc(M) < Acc(E)	−	+	+
η for ε	Acc(M) > Acc(E)	−	−	+

R(+) = 70.67%
R(*+) = 100%

Table 4

4.3. The concept of non-accentual stress

We have answered the substantive questions about Greek word prosody raised in section 0 above; there remains the largely terminological question of whether the rhythmic system evidenced by the Greek metrical data can appropriately be termed a system of "non-accentual stress." It is our perception of general terminological practice that different terms are used for both pitch and duration according as they have, or do not have, accentual function. (The way they pattern tends to be correlated with their function, but pattern and function are theoretically distinct.) Pitch differences having an accentual function are referred to as "pitch accent" or (mostly when reinforced by intensity and/or duration) as "stress." Pitch differences having a lexical function are termed "tone," and those correlating with syntactic constituents as "intonation." Durational differences having accentual function are termed "stress"; non-accentual durational differences of the type described above are generally termed "rhythm." It seems unnecessary to refer to essentially rhythmic durational differences as "non-accentual stress," which is a bit like calling it "non-accentual accentual rhythm." Furthermore, when the term stress is used, it generally suggests more than simply rhythm:[90] use of the term stress to refer to a durational difference tends to imply that the durational difference is reinforced acoustically by significant differences of intensity and/or pitch, physiologically correlated with increased activity of the respiratory, laryngeal, and articulatory muscles (the details varying from language to language). We know the role played by pitch in Greek word prosody, and it

[90] It is worth remarking that a sort of sung emphatic stress is what underlies the "forceful enunciation" typical of some singers (e.g. the operatic tenor G. di Stefano): apart from some contribution from rubato, relative duration and pitch remain unchanged from one singer to another, so these effects are presumably due to increased amplitude (combined with modified articulations).

does not correlate with the rhythmic phenomena under consideration (see section 2). We do not know whether intensity played a role in the Greek word prosodic systems, and, if it did, how it patterned. In Modern Greek it has been found that stress involves *inter alia* increased acoustic intensity correlating with higher subglottal pressure (the latter measured by a newly suggested indirect method based on oral pressure during the articulation of stop consonants).[91] If in Classical Greek intensity peaks patterned in such a way that they reinforced the durational (rhythmic) pattern, then it would probably be justifiable to speak of a "non-accentual stress." However, there are problems with such an assumption. The typological evidence so far collected gives us *inter alia* instances of languages in which intensity is independent of both pitch and duration (Japanese), languages in which intensity is independent of duration and combines with pitch as an exponent of stress (Estonian, Komi),[92] and languages in which intensity combines with both pitch and duration as an exponent of stress (English). What is conspicuously lacking so far is a language in which duration reinforced by significant peaks of intensity does not constitute the main accent of the word. It may be that the combination of duration and intensity confers a strongly marked prominence to the syllable on which it occurs, thereby giving it accentual status. In that case a tone language may have accentual stress, but a pitch accent language may not have non-accentual stress. "Non-accentual stress" would then be a *contradictio in adiecto*, stress always being accentual in the domain of the word. On the other hand, durational rhythm may be linked to the word accent, as it is in English, or it may be in principle independent of it, as is the case in other languages including, we suggest, ancient Greek: not *Stress*, not *Accent*, but *Rhythm*.

[91] A. Botinis, "Stress in Modern Greek: A Physiological Study," *Working Papers of the Institue of Linguistics, Lund University* 22 (1982) 39–50.

[92] D. V. Bubrich, *Grammar of the Komi Language* (Leningrad 1949) 5.