I argue that the Tiberian system of accents which annotate the text of the Hebrew Bible has a prosodic basis. Accentual representations are constructed in terms of units somewhat similar to the modern prosodic hierarchy, and they deviate from syntactic constituency in ways that are characteristic of prosodic representations. They are constrained by the effects of syntactic edges, geometric properties of prosodic phrases, principles for organizing phrases into higher-level constituents, and position in the phrase, associated with variations in tempo. It is shown that the Tiberian representation can best be understood by integrating results of phonological, phonetic, and psycholinguistic research on prosodic structure.*

INTRODUCTION

1. The Hebrew Bible text is annotated with a system of diacritic marks called accents. These accents, assigned to every word in the Bible, parse each verse in minute detail. The nature and purpose of this complex system of representation, developed in and around Tiberias over several generations up until the tenth century, has been much debated. Some scholars have suggested that it is intended to be a kind of syntactic representation, or else a system devised to indicate logical and semantic relations among words and phrases. I will argue that it is best viewed as providing a prosodic representation, designed to indicate the correct phrasing of the text. I will show that many characteristic properties of the Tiberian system of accents follow directly from basic principles of prosodic theory and are typical of the prosodic structure of other languages. Viewing the Tiberian accentuation from the perspective of prosodic theory also sheds light on elements of the system which have long appeared to be problematic. Conversely, the Tiberian system merits study, as it displays an extraordinary complexity and subtlety which may contribute to our understanding of prosodic representation in general.

The plan of this article is as follows. Section 2 is a brief introduction to the system of accents, its background, and its purpose. In §3 the accentual representation is considered in the light of recent proposals in prosodic theory,

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wherein it is hypothesized that syntactic structures are mapped into a hierarchy of prosodic levels which serve as the domain for rules of phrasal phonology. I show that there is a rough correspondence between the prosodic hierarchy and the various levels of the Tiberian system of representation, and that the latter can be fruitfully viewed in the context of prosodic theory. A brief survey of the phrasal phonology of Biblical Hebrew reveals that, with the exception of the intonational phrase, the Tiberian accents successfully encode the prosodic domains relevant to the phonology; this lends initial support to the hypothesis that they constitute a prosodic system.

This hypothesis is pursued in §§4–6, where we look at the relation between syntax and the constituents indicated by the accents, with a view to showing that the Tiberian phrasing departs from syntactic structure in ways characteristic of prosodic representation generally. We focus in turn on three aspects of Tiberian phrasing. The first, taken up in §4, concerns the ways in which words are combined into phrases. Certain typical deviations from syntactic constituency are shown to follow from principles for mapping syntax into prosodic structure which assign a central role to edges of designated categories as well as to geometrical properties of phrases, such as whether they branch or not. In §5 we turn to the higher-level organization of Tiberian phrases into larger phrases. In the Tiberian system, phonological phrases are nested in structures which are more highly articulated than those assumed in some versions of prosodic theory. Here we find affinities between Tiberian phrasing and the phrasing of modern languages, as observed in phonetic and psycholinguistic studies of pausing and the melodic contours of intonation. In §6 we consider a third major feature of Tiberian phrasing, namely its variability and sensitivity to context. This kind of variability has been noted to a limited extent in prosodic research in connection with changes in speaking rate. What is novel about the Biblical text is the systematic representation of tempo changes within each utterance, giving more weight to prominent phrases and moving more quickly over words in deeply embedded positions of the prosodic tree. It is also argued that the Tiberian representational system allows for an elegant account of these fine variations, which take the form of prosodic adjustment rules.

Section 7 is a short summary of the emerging picture of Tiberian Hebrew prosodic structure and implications for prosodic theory. It is proposed that prosodic structure must allow for a limited amount of recursion in the form of organizing phrases. These phrases have phonetic manifestations and influence the phonology indirectly through their effects on phrasing, but are invisible to phonological rules. The Discrete Stratum Hypothesis is posited to account for these results. It is shown that this theory preserves the advantages of the Strict Layer Hypothesis, which has been posited as a constraint on prosodic structure, while still allowing for the existence of organizing phrases.

In §8, the prosodic approach is applied to some particular problems in the system of accents. The first concerns branching asymmetries and a long-standing controversy concerning the relative value of repeated accents: it is suggested that previous treatments of this issue have not properly distinguished
between syntactic-semantic considerations and prosodic ones, and thus have not given a correct account of the prosodic value of the accents. The second concerns the lowest level of the hierarchy of accents: it is shown that the treatment of this level in the Tiberian system, puzzling from other viewpoints, can be readily understood in terms of general principles of prosodic representation. Section 9 considers the question of the status of the Tiberian transcription as linguistic data, and §10 is a brief conclusion.

THE TIBERIAN ACCENTS

2.1. BRIEF DESCRIPTION OF THE ACCENTS. The standard text of the Hebrew Bible developed in stages. The earliest layer consisted of a consonantal text, without indications for vowels or any prosodic or accentual information, or division into verses. More precisely, the writing system was mainly consonantal; the letters for the glides y, w, and h came to be used to represent long vowels in certain positions. This consonantal text was fixed around 200 B.C.E., and this is still the form of the text used in Torah scrolls.

Symbols for vowels, consonant diacritics, and accents began to be introduced in the 6th and 7th centuries C.E., presumably to preserve the correct pronunciation of the text. This activity was carried on for a number of generations by scholars known as MASORETES. Distinct but related traditions arose; the best-known, and the one which prevailed, was associated with a group working around Tiberias, and so is known as the TIBERIAN system. The work of the Tiberians began between 600 and 800, and reached its peak in the work of Aaron ben-Asher around 915. The oldest texts date from ca. 900.1

So as not to disturb the original consonantal text, the added symbols for vowels were represented by dots or lines written above and below the consonants. Points inside or next to consonants indicate a variety of phonological features, notably gemination and spirantization. The Masoretes also developed a complex system of accents; there are twenty-seven different accent symbols in the Tiberian notation.2 Each word in the text is assigned at least one of these accents. The accents can be divided into two classes, DISJUNCTIVE and CONJUNCTIVE. A word assigned a conjunctive accent is in the same phrase as the word which follows it. Rules of sentence phonology apply between words in the same phrase. A word assigned a disjunctive accent is final in its phrase, and does not undergo or trigger any phonological effects involving a following word.


2 We will be concerned here with the twenty-one 'prose books' of the Hebrew Bible. The three 'poetical books'—Job, Proverbs, and Psalms—have a somewhat different system of accents.
To illustrate, consider the sample verse in 1.3 This verse has nine phonological words. Above each word is indicated the type of accent assigned it in the text; C represents a conjunctive accent, and the D (D0, D1, D2, ...) represent disjunctive accents:

(1) Sample verse with accents:

\[ \begin{align*}
\text{C} & \quad \text{D1} & \quad \text{C} & \quad \text{D0} \\
\text{sim'ũ} & \quad \text{dabar-yhwh} & \quad \text{qasînē} & \quad \text{sədōm} \\
\text{hear} & \quad \text{word-(of)Yhwh} & \quad \text{chieftains (of)Sodom} \\
\text{D2} & \quad \text{C} & \quad \text{D1} & \quad \text{C} & \quad \text{D0} \\
\text{ha?āzinũ} & \quad \text{tōrāt} & \quad \text{pēlōhēnũ} & \quad \text{s̱m ūm ūmōrā} \\
\text{give.ear.to} & \quad \text{instruction (of)our.God} & \quad \text{folk (of)Gomorrah} \\
\text{‘Hear the word of the Lord, You chieftains of Sodom;} & \quad \text{Give ear to our God’s instruction, You folk of Gomorrah.’ (Isa.} & \quad \text{1.10)}
\end{align*} \]

This verse can be represented schematically as in 2a. Words 1, 3, 6, and 8 have conjunctive accents, and so are part of the same phrase as the words which follow them, as shown in 2b. The other words have disjunctive accents, which end phrases. Disjunctive accents are themselves organized into four hierarchical levels, from D0 at the top to D3 at the bottom, and indicate the constituent organization of the phrases in 2b, as shown in 2c. A 0 level accent indicates a major break and is found on the last word of the verse, word 9, and on word 4, indicating that word 4 ends the first half of the verse. Words 2 and 7 have D1 accents, which indicate that they end a phrase that divides a D0 phrase. Finally, word 5 has a D2 accent, which divides a D1 phrase. As an aid in decoding the accentual notation, the main break in the verse is indicated by /1; higher numbers following a slash indicate increasingly subordinate divisions.

3 Hebrew examples are in accord with the Biblia Hebraica Stuttgartensia (Elliger & Rudolf 1977), which is based on the Leningrad codex (L), as well as with Breuer’s 1977 edition of the Bible based on the Aleppo codex (A). These manuscripts are considered the most reliable witnesses of the Tiberian tradition (Yeivin 1980). The English free glosses are from Tanakh (Jewish Publication Society 1985), with some adjustments, mainly of word order, to bring them closer to the Hebrew. In the word-for-word glosses, a hyphen corresponds to a hyphen in the Hebrew text; English words that correspond to a single Hebrew word are separated by a period. Spirantization is indicated by an underscore: p = [ɾ] or [ɾ], b = [v] or [β], t = [θ], d = [ð], k = [x], and g = [ɣ]. Stress is marked only where it is relevant to the discussion.

The transcription of the vowels is a fairly traditional one, such as can be found, for example, in Lambdin 1971, minus the phonologically irrelevant notation employed to distinguish long vowels supported by a mater lectionis (glide letter) in the text from those without one. The system of vowel quantity changed in the course of the history of Biblical Hebrew, and Lambdin suggests that the length contrasts indicated here are probably valid for an earlier stage of the language, but not for that of the time of the Masoretic texts. Khan 1987 surveys the evidence bearing on the state of the language around the time of the Tiberian texts, showing persuasively that by this time the quantitative contrasts in the vowel system had been restructured and were now dependent on syllable structure. These changes, however, do not affect my argument; the notation used here has the advantage of being closer to the system which was operative at the time that the accentual phrasings (as opposed to their notation) were established, and so provides for a more transparent account of phonological rules sensitive to prosodic domains, such as word-level phonology and the phonology of pausal forms. The abbreviations used in this article are ACC = accusative; ASP = aspect; m. = masculine; pl. = plural; sg. = singular.
The accentual representation of 2a can thus be converted into the tree representation in 2d.

(2) Conjunctive and disjunctive accents:
   a. Schematic verse: words (Wi) annotated with accent marks:
      \[
      \begin{array}{l}
      \text{C} \quad \text{D1} \quad \text{D0} \quad \text{D2} \quad \text{C} \quad \text{D1} \quad \text{D0} \\
      \text{W1} \quad \text{W2} \quad \text{W3} \quad \text{W4} \quad \text{W5} \quad \text{W6} \quad \text{W7} \quad \text{W8} \quad \text{W9}
      \end{array}
      \]
   b. Conjunctive accents indicate absence of phrase boundary:
      \[
      \begin{array}{l}
      \text{C} \quad \text{D1} \quad \text{C} \quad \text{D0} \quad \text{D2} \quad \text{C} \quad \text{D1} \quad \text{C} \quad \text{D0} \\
      (\text{W1} \quad \text{W2}) \quad (\text{W3} \quad \text{W4}) \quad (\text{W5}) \quad (\text{W6} \quad \text{W7}) \quad (\text{W8} \quad \text{W9})
      \end{array}
      \]
   c. Disjunctive accents indicate hierarchy and constituency:
      \[
      \begin{array}{l}
      \text{C} \quad \text{D1} \quad \text{C} \quad \text{D0} \quad \text{D2} \quad \text{C} \quad \text{D1} \quad \text{C} \quad \text{D0} \\
      (\text{W1} \quad \text{W2})/2 \quad (\text{W3} \quad \text{W4})/1 \quad (\text{W5})/3 \quad (\text{W6} \quad \text{W7})/2 \quad (\text{W8} \quad \text{W9})
      \end{array}
      \]
   d. Tree representation of 2c:
      \[
      \begin{array}{c}
      \text{A} \\
      \text{B} \quad \text{C} \\
      \text{E} \quad \text{F} \quad \text{G} \quad \text{H} \quad \text{I} \\
      \text{W1} \quad \text{W2} \quad \text{W3} \quad \text{W4} \quad \text{W5} \quad \text{W6} \quad \text{W7} \quad \text{W8} \quad \text{W9}
      \end{array}
      \]

In longer verses the process continues: phrases demarcated by an accent of level \(n\) may be divided by accents of level \(n + 1\). The accents run out at the D3 level; in very long verses where further divisions are required, D3 accents are used over again.\(^4\)

2.2. PURPOSE OF THE ACCENTS. What is the purpose of this elaborate system of accents? A number of answers have been given to this question. Since the accent marks are usually placed over or under the stressed syllable of a word, it has been suggested that one of the functions of the accents is to mark the position of main stress. This can hardly be their principal function, however, since some accents are placed not on the stressed syllable, but on the first or last letter of a word; moreover, an elaborate system of symbols is not needed just to mark the position of main stress, which is in any case largely predictable.

A more important function of the accents is to indicate musical values for cantillation. The Biblical text is chanted, and each accent is associated with a series of notes; when strung together, they make up a tune. The tradition of reading the Bible with a tune is evidently very ancient, and the names of the

\(^4\) There are several accents at each disjunctive level, as well as nine conjunctive accents; this accounts for the discrepancy between the number of accents and the number of levels. The proliferation of accents lends musical variety to the cantillation. Also, since most disjunctive accents are preceded by their own special conjunctives and lower-level disjunctive accents, the accents serve as a guide to the reader as to where one is in the verse.
accents as well as their musical character predate the development of the written symbols for them (Dotan 1971:§1.3.3; Yeivin 1980:§190). Music for its own sake, however, was not a central preoccupation of the accentuators; it has often been observed in this connection that the conventional Hebrew term for the accents is \(\text{\`ta\text{\`a}mim} \) 'senses', a term which refers to their semantic rather than their musical value.

Therefore, the musical aspect of the accents has always been considered as secondary to their main purpose, which is to indicate the sense of the text; according to Gesenius (1910:§15.1), they serve as 'marks of punctuation to indicate the logical (syntactical) relation of words to their immediate surroundings, and thus to the whole sentence' (emphasis in original). Most commentators have stressed the semantic and logical functions of the accents. Thus, Yeivin (1980:§178) observes that, though the accentuation provides a guide to the syntax, it chiefly marks semantic units, which are not always identical with syntactic units. Breuer (1982) takes a similar view, citing cases where the accents follow the syntax as well as cases where they depart from syntax while still expressing logical relations between words. More recently, Aronoff (1985) has proposed that the accentuation is meant to correspond to a syntactic representation, though the syntactic theory behind it is quite different from any modern one.

The view I will be advocating here is distinct from both of these: by showing how words are to be grouped together, the accents serve as a guide to the proper phrasing of the text; that is, they comprise neither a semantic nor a syntactic representation, but a prosodic one. The distinction between the prosodic and the logico-syntactic approach is expressed well by Janis (1987:10): 'the Masoretes intended the accents to help convey the sense of the text, not abstractly but through utterance.'

Note that the three ways in which the accents can be said to convey the sense of the text correspond to three distinct linguistic levels—semantic, syntactic, and prosodic. In simple sentences the three levels are often isomorphic: the logical relations of the words to each other are conveyed by the syntax, and both are directly mirrored by the prosody. It is in the more complex cases that we will be able to distinguish between these representations. The claim that will be pursued here is that where these representations diverge, the system of accentuation reflects the prosody. Further, this prosodic orientation helps to account for some of the well-known 'failings' of the accents as markers of logical and syntactic relations.

2.3. THE ACCENTS AS A LINGUISTIC OBJECT. Because they do not always correspond well with semantic or syntactic structure, some students of the accents have been inclined to think of them as problematic linguistic objects. The rea-
sons have been eloquently stated by Aronoff (1985), whose reference point is the syntax. First, the unit which serves as the starting point for accentual analysis is the verse, itself a problematic unit which does not correspond to a well-defined syntactic constituent. While some verses consist of exactly one sentence, many verses contain both more and less than full sentences.

Second, it is unclear what sort of linguistic representation the accents are supposed to embody. Although this representation is somehow related to the syntax, accent symbols do not systematically correspond to syntactic nodes, and the structures indicated by the accents often deviate—sometimes quite eccentrically—from the syntax, by almost any theory of syntax.

Third, where the structures indicated by the accents depart from the syntax, the indicated phonology for the most part follows the accents. Consider again the verse in 1, which is divided into two parallel halves. Though the syntax of each half is the same, in the first half the words doḇar-yhwh are joined in the text by a hyphen known as maqqaf (or maqqef). The maqqaf indicates cliticization: words joined by maqqaf are treated as one prosodic word. Cliticization depends on a number of factors, such as word length and the type of disjunctive phrase which serves as its domain. For reasons we will not go into here, it applies in the first half of I but not in the second half. Since phrases normally consist of two (prosodic) words where possible, the verb simṢu is assigned to the same phrase as its object. In the second half of the verse there is no cliticization; since there are two prosodic words in the object phrase, the verb hafāẓinū is assigned to a separate phrase. The phonological consequence of this difference is evident in the initial consonant of the word following each verb: the d in ḏbar is spirantized because it follows a vowel in the same phrase, but not the t in ṭorat, since the preceding vowel is in a different phrase.6

Given the seeming arbitrariness of the verse and the imperfect degree to which accentual representations mirror syntax, Aronoff argues that the accentual system of Tiberian Hebrew is based on a (perhaps tacit) theory of syntactic analysis which is flawed in a number of ways. Moreover, since the phonology is faithful to this skewed analysis, he reasons that not just the accentuation system, but also the vocalism and other diacritic marks that accompany it, are to some degree artificial. He concludes that ‘the accents can therefore not be a record of actual recitation; rather, recitation must have come to be based on the accents...’ (1985:68). This conclusion is based on two central assumptions: that the accents are to be evaluated as a syntactic representation, and that rules of phrase phonology must be directly sensitive to syntactic structure.7

In the last few years, however, research in diverse areas has focused attention on a level of linguistic representation that has just the properties enumerated above, namely prosodic representation. A prosodic representation is based on

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6 There are many similar examples, including the near-minimal pair in Judges 1.1 and Judges 1.8 cited by Aronoff (1985:67ff.) and Rotenberg (1978).

7 This is not the place to enter into the textual and historical evidence bearing on the long-standing debate about the degree to which the Masoretes were innovators, harmonizing and syncretizing earlier traditions into an essentially new creation (Kahle 1959, 1961), as opposed to conservers and transcribers of a received tradition (see the citations in n.1). Our concern here is with internal arguments based on the plausibility and naturalness of the Tiberian system.
syntax and in some cases coincides with it; but it also often deviates from syntax in systematic ways. The starting point of prosodic analysis is a unit, the utterance, which is just as elusive as the verse, and in much the same way. Finally, where syntactic and prosodic representations diverge, phonology follows the prosodic structure. These considerations suggest that Tiberian accentuation might be better understood as a system of prosodic representation.

**Prosodic representation: The prosodic hierarchy**

3. It was observed in Chomsky & Halle 1968 that rules of phonology above the word level do not operate directly on surface syntactic structure; rather, the syntax is subject to various types of adjustments which convert it into a suitable input for the phonology. This adjusted syntactic structure is prosodic structure. A famous example of nonisomorphism between syntax and prosody is given in 3, where the phrasing (3b) cuts across major syntactic divisions (3a):

(3) Nonisomorphism between syntactic and prosodic structure:
   a. *This is [the cat [that chased [the rat [that stole the cheese]]]]*
   b. *(This is the cat) (that chased the rat) (that stole the cheese)*

Among phonologists, the main motivation for the development of a theory of prosodic structure has been to account for the operation of phonological rules. It has been observed that rules of sentence phonology may operate in a number of prosodic domains of different sizes. This observation has led to the positing of a series of prosodic levels organized in hierarchical fashion. As the theory has been developed by Selkirk (1978, 1984, 1986), Nespor & Vogel (1982, 1983, 1986), Hayes (1989), and others, this **prosodic hierarchy**, from the word level up, is commonly construed as in 4a.8 Surface syntactic structure consisting of units with syntactic labels is mapped into a prosodic structure whose constituents have labels drawn from the categories in 4a.

(4) The prosodic hierarchy:
   a. The modern hierarchy:  
      Utterance U  
      Intonational phrase I  
      Phonological phrase P  
      Phonological word W  
   b. The Tiberian hierarchy:  
      Biblical verse V  
      Disjunctive phrase Di, 0 ≤ i ≤ 3  
      Conjunctive phrase C  
      Phonological word W

It is evident that the Tiberian accents do not correspond to any system of syntactic node labels known to us: 1 above is a typical example of a discrepancy between syntax and accentual representations, and many more will be presented below. There are, however, interesting correspondences between the accents and the prosodic hierarchy in 4a. The various levels of the modern prosodic hierarchy can be put into a rough correspondence with the Tiberian hierarchy, as shown in 4b.

8 Following Hayes 1989 and Nespor & Vogel 1986, some writers include the clitic group as a unit of the prosodic hierarchy above the level of the word and below the phonological phrase. For our purposes, a clitic group, indicated in the Tiberian texts with maqqaf, counts as a phonological word, W. I also do not list prosodic categories below the word level, such as the foot and mora (or rime), as our main concern here is the word level and above.
Biblical Hebrew has a series of phonological rules which operate at various levels of the prosodic hierarchy. With one exception, these rules can be consistently assigned to distinct domains of the Tiberian representation. We will now review these rules, beginning with the level of the phonological word and working up from there.

3.1. The Phonological Word. A phonological word in the Tiberian Hebrew texts is any word surrounded by spaces. Such words may include grammatical and prosodic clitics. Grammatical clitics are morphemes that obligatorily cliticize onto their host; such clitics may never stand as independent words, and they will not concern us further. Of more relevance to the system of accents are prosodic clitics, potentially independent words which are cliticized in particular situations. Such clitics are joined to their hosts by maqqaf.

Phonological rules which are sensitive to whether or not a word is cliticized are stress and tone lengthening. A cliticized word has no main stress of its own, but participates with the word(s) to which it is cliticized in a single phonological word, with one main stress. Tone lengthening applies to a vowel which bears the peak stress in its prosodic word.9 In 5a the accusative particle 2et is an independent prosodic word; as such it carries a word-level stress and its vowel is long by virtue of tone lengthening. This particle, however, is more usually cliticized to a following word, as in 5b, in which case it loses its main stress and surfaces with a short vowel.

(5) Cliticization of the accusative particle:
   a. (2et) (qorbdin ha?am)
      ACC offering the.people ‘the people’s offering’ (Lev. 9.15)
      ACC-manner your.father ‘your father’s manner’ (Gen. 31.5)

The Tiberian system thus provides for a level of prosodic word which serves as the domain for rules of stress and tone lengthening.10

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9 There are some further conditions on this rule: it does not apply to the low vowel a when it is followed by two consonants, and it does not apply to verbs. See Prince 1975 for further discussion.

10 A complication arises in the case of the construction known as the construct, which refers to the close connection between a head noun (in construct state) and its following genitive (in absolute state, the same form that it has standing alone). Nouns in the construct state often differ in phonology from their absolute state counterparts. These differences derive from the fact that nouns in the construct are in close connection with the words that follow them (Prince 1975: §149), so that the main stress of the construct form is subordinate to that of the absolute form (Prince 1975). Thus, there is a sense in which words in the construct (or a construct chain, since the construction is recursive, as in the Hebrew equivalent of the word of the house of the captain of the guard) form a single prosodic word, even though they are not always treated as such by the system of accents (see Aronoff 1985:43–46 for discussion of the phrasing of construct chains by the accents). It is reasonable to suppose that construct phonology had its origin in prosodic phrasing: originally, a construct chain may have formed a prosodic unit similar to words joined by maqqaf. Over time, however, the construction became grammaticalized, so that the rules of main stress and tone lengthening developed morphological conditions in addition to purely phonological ones. This situation led to considerable variation: in some words tone lengthening applies according to the accents (to independent prosodic words only, even if in construct state); in others, it applies according to the syntax (to words in absolute state only, even if prosodically cliticized to a following word). The matter is complex and merits further discussion, but we cannot pursue it here.
3.2. THE CONJUNCTIVE PHRASE. Moving up the hierarchy, we can identify a constituent which we will call the conjunctive phrase, C. A word marked with a conjunctive accent is part of the same conjunctive phrase as the word which follows it; a word with a disjunctive accent ends such a phrase. The conjunctive phrase forms the domain for three rules of external sandhi: spirantization, gemination, and rhythmic stress shift. Similar processes are found in the sentence phonology of other languages—raddoppiamento sintattico in Italian, the rhythm rule in English, liaison in French, and so on. In these cases the relevant processes occur in the phonological phrase, P. Because it occupies the same place in the hierarchy, above the word level, we can identify the Tiberian conjunctive phrase with the phonological phrase of the modern hierarchy. The rules applying within the conjunctive phrase are briefly illustrated below.

3.2.1. SPIRANTIZATION. A nonemphatic nongeminate consonant is spirantized following a vowel, within words as well as across words that are in the same conjunctive phrase. For example, we saw in 1 above that the initial consonant in dabar, but not the one in tōrat, is spirantized by the word-final vowel that precedes it.

Perhaps because conjunctive phrases typically consist of two words, it has been claimed that external sandhi in Biblical Hebrew is limited to words which are sole sisters in a phrase (cf. Rotenberg 1978, McCarthy 1981, Kaisse 1985). However, spirantization also applies within phrases of more than two words. Some examples are given in 6:

(6) Spirantization in phrases with more than two words:
   a. (lammā tāfāse kō) why you.deal thus ‘Why do you deal thus?’ (Ex. 5.15)
   b. (wayāhī kīšmōaʃ kol-malkē hāʾemōri) and.it.was when.heard all-kings (of)the.Amorites ‘When all the kings of the Amorites heard’ (Josh. 5.1)
   c. (hinne bāṭalṭā lōkā) behold you.rely to.you ‘for you rely’ (2 Ki. 18.21)
   d. (lō tāfāse-lōkā pesel wēkol-tāmūnā) not make.for.yourself sculptured.image and.all-likeness ‘You shall not make for yourself a sculptured image, or any likeness.’ (Ex. 20.4, ‘upper’ accentuation)\[11\]

3.2.2. EXTERNAL GEMINATION. Another phonological rule which applies within the domain of the conjunctive phrase is external gemination, whereby a word-initial consonant is geminated following a vowel-final word under a rather complex set of conditions (see Jouon 1947:$18$, Gesenius 1910:$20$.

\[11\] The Masoretic Text preserves two traditions of verse division for the Ten Commandments, dividing them into longer or shorter verses. Consequently, the Masoretes provided two sets of accents for these verses, commonly known as the ‘upper’ and ‘lower’ accentuations. In Breuer 1977 there is a maqqaf after the word lō.
TIBERIAN HEBREW SYSTEM OF ACCENTS

McCarthy 1981). An example is found in 6c above, where the l of ḫlakā is geminated. Here again the words in question do not have to be alone in the phrase. More examples are given in 7:

(7) External gemination:
   a. (ʔlm-lō ḥāgāṣtā bbāh)
      if-not you.have.delight in.her
      ‘should you no longer want her’ (Deut. 21.14)
   b. (Ŷōse ṣp̄rī)
      bear fruit ‘that bear fruit’ (Gen. 1.11)

3.2.3. THE RHYTHM RULE. A third phonological process whose domain is the conjunctive phrase is the rhythm rule (McCarthy 1979, Rappaport 1984, Revell 1987), by which a phrase-internal stress clash is alleviated, either by retraction of the main stress on the first word participating in the clash or by the joining of the two words by maqqaf, thereby deaccenting the first word.12 An example of stress retraction is found in 7b: Ŷōse for regular Ŷōsē (note that a syllable-initial schwa does not help to prevent the clash). Another example is given in 8; in this phrase we have two instances of clash reduction, illustrating the two strategies discussed above:

(8) Rhythm rule:
   (mōznē ṣēdeq ṣbnē ṣēdeq) → (mōznē ṣēdeq ṣbnē-ṣēdeq)
   balances honest weights honest
   ‘an honest balance, honest weights’ (Lev. 19.36)

3.3. THE INTONATIONAL PHRASE. Biblical Hebrew exhibits phonological processes which apply in a domain larger than the conjunctive phrase. At the ends of major breaks in a verse we usually find PAUSAL forms, which differ from CONTEXTUAL forms in a number of ways. Some examples are given in 9.

(9) Contextual and pausal forms:

<table>
<thead>
<tr>
<th>CONTEXTUAL</th>
<th>PAUSAL</th>
<th>GLOSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. kāṭāb</td>
<td>kāṭāb</td>
<td>‘he wrote’</td>
</tr>
<tr>
<td>b. máyîm</td>
<td>máyîm</td>
<td>‘water’</td>
</tr>
<tr>
<td>c. kāṭābā</td>
<td>kāṭābā</td>
<td>‘she wrote’</td>
</tr>
<tr>
<td>d. sūskā</td>
<td>sūsēkā</td>
<td>‘your horse’</td>
</tr>
<tr>
<td>e. ṭērēṣ</td>
<td>ṭāreṣ</td>
<td>‘land’</td>
</tr>
<tr>
<td>f. ṭēkā</td>
<td>ṭāk</td>
<td>‘to you (m.)’</td>
</tr>
</tbody>
</table>

Typical changes in pause include the lengthening of a stressed vowel if it is short, as in 9a–b. In other cases (9c–d), a vowel which is deleted in a contextual form appears in pause with stress. Exx. 9e–f illustrate other types of alternations, where qualitative vowel changes or deletion occur along with changes

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12 Cliticization may also entail stress retraction if certain conditions are met, for the cliticized word may be assigned a retracted secondary stress by the regular stress rules, so that the cliticized unit is treated as a single word; see Dresher 1981b. c. Revell (1987:81.15) cites one instance (Num. 23.23) where the rhythm rule applies across a disjunctive accent.
in stress or quantity. The central effects of pause appear to be connected with heightened stress or prominence associated with the end of a major phrase.\textsuperscript{13}

A successful prosodic theory would distinguish those phrases which end in pausal forms from those which do not. Most pausal forms in Hebrew are assigned D0 accents, and indeed, a special status is given to the topmost level of disjunctive accents: every verse, no matter how long or complex, is divided into at most two D0 phrases.\textsuperscript{14} Unlike every other level of the hierarchy of disjunctive accents, the D0 accents may not be employed recursively. These facts suggest that the domain demarcated by D0 accents—the half-verse—is intended to have a special status above an ordinary conjunctive phrase.

Pausal forms, however, are not consistently associated with D0 accents. The problem is that the Tiberians had only two D0 accents per verse; sometimes, though, especially in a long verse, there are more than two pausal forms. Revell \textsuperscript{1980} has observed that about 25\% of the pausal forms in the Book of Deuteronomy occur on lesser accents.\textsuperscript{15} Some examples of this phenomenon are given in 10 and 11, where pausal forms are underlined:

(10) Pausal forms with accents below D0—list:

\textit{But the seventh day is a sabbath of the Lord your God; D0 /1 you shall not do any work—you, your son or your daughter,] your male-slave or your female-slave,] your ox or your ass, or any of your cattle}... (Deut. 5.14)

(11) Pausal forms with accents below D0—major pause:

a. And it was \underline{slaughtered}.D0 /1 Moses dashed the blood against all sides of the altar. (Lev. 8.19)
b. And it was \underline{slaughtered}.D1 /2 Moses took some of its blood and put it on the ridge of Aaron’s right ear; D0 /1 and on the thumb of his right hand, and on the big toe of his right foot. (Lev. 8.23)
c. And it was \underline{slaughtered}.D2 /3 Moses took the blood and put some on each of the horns of the altar with his finger, D1 /2 cleansing the altar; D0 /1 then he poured out the blood at the base of the altar. Then he ... (Lev. 8.15)

\textsuperscript{13} For the phonology of pause, see Dresher \textsuperscript{1983} and Ehlich \textsuperscript{1980}, as well as the handbooks mentioned in n. 1. It should be reiterated that by the time of the final development of the Tiberian system the original quantitative changes described here had become mainly qualitative (Khan \textsuperscript{1987}); the best explanation for the origin of pausal phonology is nevertheless in terms of lengthening of vowels under high stress.

\textsuperscript{14} This statement needs to be further qualified. Some very short verses may have only one D0 accent, coming as always on the verse-final word; the half-verse in such cases is indicated by a D1 accent (see Dresher \textsuperscript{1981}:186). Conversely, the accent SEGOL, which appears in some long verses and which is usually classified as a D1, has some properties of a D0 accent, which could suggest a division of some long verses into three D0 phrases.

\textsuperscript{15} For the distribution of pausal forms in the texts and their relation to the accentual system, see Revell \textsuperscript{1980}, \textsuperscript{1981} and Ben-David \textsuperscript{1990}. Ben-David studies cases of contextual and pausal forms with unexpected accents (pausal forms with minor accents, contextual forms with major disjunctive accents) and shows that hitherto undetected patterns emerge if the words are divided into classes based on phonological characteristics (position of stress, nature of the contextual-pausal alternation, etc.). These patterns put at least some of the apparently anomalous cases into a new light.
The text in 10 is an example of a long verse, the second half of which contains a list. Since the main division of the verse occurs before the list, there are no D0 accents left except for the verse-final one. Therefore, although each grouping of two or three list items ends in a pausal form, the Tiberian system requires that they fall on lower-level accents. The result is that the accents are out of step with the required prosodic structure.

A similar dilemma arises in 11. Each verse begins with the same word wayyišḥāt ‘and it was slaughtered’, which in every case forms a major phrase on its own, as is shown by the fact that it is in pausal form, marked by the lengthened final vowel. In 11a this word receives a D0 accent because it ends the first half-verse. In the other two verses, however, the introductory formula is followed by more and more material, which pushes the main division point further and further to the right. Because of the relational nature of the accent system, and because the D0 accents are not recursive, the addition of material later in the verse affects the status of the verse-initial phrase, causing it to appear with increasingly subordinate accents.

What appears to be missing from the Tiberian system, then, is a consistent representation of a prosodic level that is greater than the conjunctive phrase but smaller than the verse or half-verse. In the modern prosodic hierarchy, this level is occupied by the intonational phrase, I. The intonational phrase I is commonly defined as the domain of an intonation contour; further, the ends of intonational phrases coincide with positions in which pauses may occur (Bierwisch 1966, Bing 1979, Nespor & Vogel 1986:Ch. 7). Unlike the D0 level of the Tiberian prosodic hierarchy, modern approaches place no limit on the number of I-phrases that may be in a U.

It has been noted that certain syntactic constructions usually form their own I-phrase. These include parenthetical expressions, nonrestrictive relative clauses, vocatives, lists, and other such expressions (see Selkirk 1978, 1984, Nespor & Vogel 1986, and the references therein):

(12) Syntactic constituents that usually delimit I-Phrases:
   a. Parenthetical expressions:
      
      [Lions]₁ [as you know]₁ [are dangerous]
   
   b. Nonrestrictive relative clauses:
      
      [My brother]₁ [who absolutely loves animals]₁ [just bought himself an exotic tropical bird]
   
   c. Lists:
      
      [They brought milk]₁ [eggs]₁ [bread]₁ [and cheese]

Since the parenthetical expression in 12a and the relative clause in 12b form I-phrases, the surrounding material must also be grouped into (at least) one I-phrase on each side.

I-phrase boundaries tend to occur, though not obligatorily, after subject noun phrases and at clause divisions. Constituents that do not ordinarily delimit I-phrases when they are short tend to be broken up as their length increases. In addition to these general tendencies, I-phrases may be shorter or longer at the discretion of the speaker, depending on factors such as speech rate and register, degree of emphasis, and other rhetorical considerations.
We can hypothesize, then, that pausal forms in Biblical Hebrew occur at the ends of intonational phrases. On the phonological side, they exhibit greater stress and vowel length—phonological characteristics which we might expect to find at the ends of intonational phrases.\(^\text{16}\) With respect to syntax, most pausal forms occur at the end of constructions which are typically associated with I-phrases: lists, or major breaks in an utterance. Put in traditional terms, pausal forms follow neither the syntax nor the accents; but it is not necessary to suppose on this account that they derive from a distinct reading tradition. The reason for the inconsistent matching of pausal forms with accents is that the Tiberian representation has no means of consistently marking this level of the prosodic hierarchy.

We can draw two conclusions from these facts. First, the evidence from pausal forms supports the view that there is no upper bound to the number of I-phrases in an utterance, and reveals a shortcoming in the Tiberian system. At the same time, the discrepancies constitute internal evidence for the reliability of the Tiberian transcription. Thus, Revell concludes (1980:177) that "the masoretic tradition did preserve the pausal forms faithfully even in these apparently anomalous cases, and the fact that the patterns which gave rise to them can still be recognized constitutes an important testimony to the antiquity and reliability of the masoretic tradition."\(^\text{17}\)

### 3.4. THE HIERARCHY OF DISJUNCTIVE PHRASES.

In the Tiberian system, conjunctive phrases are nested, and phrases at different levels of embedding are assigned accents of different types. Our sample verse in 1, for example, has five conjunctive phrases: two are assigned D0 accents, two are assigned D1 accents, and one has a D2 accent. From the point of view of the phonology, there is little significance to these labels; the rules discussed in §3.2 apply equally in each of these phrases. It is true that the higher levels of the disjunctive hierarchy are more likely to be associated with pausal phonology, but this is because a higher-level accent is more likely to end an intonational phrase; for reasons discussed above, the hierarchy of disjunctive accents does not adequately characterize the phonology of pause. There are thus no rules of the phonology that are sensitive to particular levels of the disjunctive hierarchy. For instance, there is no rule that applies only in a phrase ending in D1 or in D2. The rationale for the hierarchy of disjunctive accents and the nesting of phrases it represents, then, must lie elsewhere, an issue to which we will return in §§5 and 6.

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\(^{16}\) See Vaissière 1983 for a review of the literature on pausing and lengthening at the ends of phrases. To cite one study among many, Cooper & Paccia-Cooper (1980:46) observed cumulative phrase-final lengthening in English, with the greatest lengthening at the ends of major phrases.

\(^{17}\) Cf. Goshen-Gottstein (1963:94): "the work of the Masoretes ... is to be understood as the invention and perfection of an ever more refined graphic notation for an age-old oral tradition which endeavored to note down with the greatest possible exactness the smallest details of the customary liturgical way of reading the Bible." Similarly, Orlinsky (1966:xxxii): "All the Masoretes, from first to last, were essentially preservers and recorders of the pronunciation of Hebrew as they heard it."
3.5. The verse. The starting point for accentual analysis is the verse, V. No prosodic or phonological phenomena span more than one verse. Thus, V stands at the top of the Tiberian prosodic hierarchy. The division of the Biblical texts into verses is generally believed to have predated the development of the written form of the accentual system and the vocalization.\(^\text{18}\) A verse may comprise a sentence (13a,e) or, more rarely, a fragment of a sentence (13c,d); in the usual case, however, V contains something more than a sentence (13b,f).

(13) Some verses:

a. At the turn of the year, Ben-hadad mustered the Arameans and advanced on Aphek to fight Israel. (1 Ki. 20.26)

b. These are the names of the men who shall assist you: From Reuben, Elizur son of Shedeur. (Num. 1.5)

c. From Simeon, Shelumiel son of Zurishaddai. (Num. 1.6)

d. So Moses and Aaron took those men, who were designated by name, (Num. 1.17)

e. and on the first day of the second month they convoked the whole community, who were registered by the clans of their ancestral houses—the names of those aged twenty years and over being listed by head. (Num. 1.18)

f. And God said, ‘Let us make man in our image, after our likeness. They shall rule the fish of the sea, the birds of the sky, the cattle, the whole earth, and all the creeping things that creep on earth.’ (Gen. 1.26)

The variability of the verse recalls that of its counterpart at the topmost level of the modern prosodic hierarchy, the utterance, U. There is no precise definition of what may constitute a single U and what may not; a number of conditions are suggested by Nespor & Vogel (1986: Ch. 8). Most ordinary sentences can constitute a U, as can fragments of sentences, and even a sequence of separate sentences if they meet various pragmatic conditions, such as being logically connected. Some examples of possible utterances are given in 14.

(14) Some utterances:

a. John plays the trumpet, but Bill plays the clarinet.

b. The third from the right.

c. Turn up the heat. I’m freezing.

d. That’s a nice cat. Is it yours?

Nespor & Vogel, following Kahn 1980, observe that U is the domain of t-flapping, which may thus occur in 14c and 14d in the words heat and cat. By contrast, we do not expect flapping across two unrelated sentences like *Turn up the heat. I’m Frances*, which would not, under ordinary circumstances, be

\(^{18}\) Dotan (1971:$1.3.2$) observes that the tradition of division into verses is ancient, and was handed down orally for many generations. He adds, however, that this tradition also extended into the division of verses into parts, i.e. accentuation. So it is not clear that the tradition of division into verses developed entirely apart from the tradition(s) which culminated in the Tiberian system of accentuation.
grouped together as a U. In practice, U is usually taken as a given in most research on prosodic theory.

Thus, the utterance U has some of the characteristics of the verse V. There are no doubt ways in which the verse exceeds the usual parameters of variation we may expect to find in the utterance. Much of this greater variability may be due to the difference between writing and speech, as well as to the formal character of much Biblical writing. Nevertheless, the verse adheres to semantic and pragmatic constraints which are difficult to specify, but which appear to be similar in kind to those which govern the utterance. There appear to be no phonological processes in Tiberian Hebrew whose domain is only the verse.

**Mapping from Syntax to Phonological Phrases**

4. We have seen that the Tiberian accent system has two characteristic properties of prosodic structure: it has representations that are similar to syntax but yet distinct from it, and these representations define a series of prosodic levels which serve as the domains for phonological rules. In addition, the highest level of prosodic structure is a unit, the Biblical verse, which is not linguistically arbitrary, but plays the same role as the utterance in prosodic theory. Therefore, there is a certain prima facie plausibility to the idea that the Tiberian accents are to be interpreted in terms of prosodic representation.

The fact that the constituents indicated by the accents are not always syntactic does not in itself establish that they are prosodic; they might reflect something else, for example a special Tiberian theory of syntax, as proposed by Aronoff 1985. To support the claim that these representations are prosodic, we must show that they deviate from syntax in ways that are typical of prosodic representation. The derivation of Tiberian accentual representations is complex. Rather than tackle the system as a whole, I will proceed by stages, and show in turn how various aspects of the system can best be understood in the light of prosodic theory.

Since we have nothing more to say about the verse, which plays the role here of the utterance, and since the intonational phrase is not adequately represented in the Tiberian system, let us focus our attention on the conjunctive phrase, C, which we have identified with the phonological phrase, P. I will show that some of the ways in which C-phrases deviate from syntax can be attributed to the influence of two central determinants of prosodic structure—edges and geometry.

4.1. Edge-Based Mapping. Recent research in prosodic phonology has been influenced by the idea that there is a fixed correspondence between selected nodes of the syntactic tree and the various prosodic levels. One expression of this idea is the Designated Category Parameter (Hale & Selkirk 1987):

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19 See Cooper & Paccia-Cooper (1980:150–60) for further discussion of flapping across different types of boundaries.
(15) **The Designated Category Parameter:**
For each level $P_i$ of the prosodic hierarchy there is a single designated category $DC_i$ in the syntactic structure with respect to which phonological representation at level $P_i$ is defined.

Though it is stated in a general way, the relevance of the Designated Category Parameter to higher levels of prosodic structure is doubtful, and in practice it has been applied mainly to the formation of phonological phrases. Thus, in some languages the relevant syntactic category for defining the phonological phrase may be the maximal projection of a phrase or set of phrases $X$, henceforth called $X_{\text{max}}$; in others, it may be the head of $X$, $X_{\text{head}}$. Further conditions have been proposed as being relevant—whether or not the category is lexically governed, or whether it is an argument or an adjunct, or whether it is in focus.

Selkirk 1986, building on proposals of Clements 1978 for Ewe and of Chen 1987 for Xiamen tone sandhi, proposes that prosodic domains are demarcated by either the left or the right end of the syntactic constituents selected in 15—so that each language requires setting what Hale & Selkirk (1987) call the End Parameter:

(16) **The End Parameter:**
Only one end (Right or Left) of the designated category $DC_i$ is relevant in the formation of a prosodic constituent $P_i$; a $P_i$ extends from one instance of the appropriate end of $DC_i$ to the next.

For example, consider how the syntactic structure in 17 is mapped into phrases in two different dialects of Chinese. In Shanghai (Selkirk & Shen 1990), a phrase boundary is placed at the left end of a maximal projection, in this case VP, PP, and NP. By contrast, Xiamen phonological phrases are delimited by the right ends of maximal projections (Chen 1987). As a result, a preposition is phrased together with its object in Xiamen, but not in Shanghai.

(17) Parameter settings for P-phrases in Shanghai and Xiamen:

a. Shanghai: $X_{\text{max}}^\text{left}$

b. Xiamen: $X_{\text{max}}^\text{right}$

P-phrases delimited by $X_{\text{max}}^\text{left}$ are what Selkirk 1986 calls ‘large P-phrases’; when $X_{\text{head}}$ is selected, the result is a ‘small P-phrase’. French liaison, for
example, is sensitive to small phrases delimited by the right edge of $X^{\text{head}}$. Although the two Chinese dialects in 17 have similar syntax but opposite settings of the End Parameter, Nespor & Vogel (1986) suggest that P-phrase formation tends to follow the direction of syntactic branching in a language. Thus, small P-phrases join a head to its specifiers on the nonrecursive side, whereas large P-phrases include also complements on the recursive side of the head.20

Biblical Hebrew has a right-recursive syntax, with specifiers on the left of the head and complements on the right; therefore, we expect that phrases will be delimited by the right edges of designated syntactic categories. This appears to be generally true, though it is not easy to determine what the designated categories are. For Hebrew exhibits big P-phrases and small P-phrases, and various other sizes also, depending on geometry and position in the prosodic tree. Abstracting away from these complicating factors for the time being, we can observe the effects of mapping to the right edge of $X^{\text{max}}$ in some typical situations, including cases where the phrasing indicated by the accents cuts across syntactic constituents.

We observe first that prepositions, complementizers, and other minor-class lexical items typically pattern with the following word, as in the phrases in 18. The phrasings in 18 are consistent with setting the End Parameter to the right edge of $X^{\text{max}}$, just as in Xiamen. Consequently, in 18a the PP, which consists of a single prosodic word, forms a phrase together with the preceding complementizer (cutting across a syntactic boundary), leaving the verb to form another phrase. In 18b a phrase boundary again occurs between the PP and the V (with cliticization of the preposition to the following noun).

(18) Syntax and phrasing: $X^{\text{max}}$ right:


```
(18) Syntax and phrasing: X^{max} right:

   S'  
     |   
     S   
       |   
       PP  VP  
        |   |   |   
       Co P NP V  
                   |   |   |   |   
         (ki mimmemnā) (luqqāḥta)D0 (wā?el-Sēpār) (tāsūḥ)D0  
       for from.it you.were.taken and.to-dust you.shall.return  

When a verb or noun has a coordinate complement immediately to its right, the phrasing may keep the members of the complement together, as we would

20 Condoravdi 1990 suggests that both small and large P-phrases exist in Greek, each being the domain of phonological rules.
expect if phrasing is sensitive to syntactic constituency. An example of phrasing of this kind is shown in 19a.

(19) Phrasing of X [Y and-Z], X governs [Y and-Z]:
   a. (yōḏʕē) (tōḇ wārāʕ)
      knowers (of) good and evil (Gen. 3.5)
   b. (kabbēd ṣet-ʔābikā) (wāʔet-ʔimmekā)
      Honor acc-your.father and acc-your.mother (Deut. 5.16)\textsuperscript{21}

In 19a, the phrase ‘good and evil’ is kept together by the accents. As Janis (1987:120) points out, the bond between the two elements of the coordinate is particularly strong, since the text is concerned with knowledge of good and evil together (i.e. good-and-evil as a single concept), not knowledge of good plus knowledge of evil. In cases where the members of the coordinate phrase are less tightly conjoined semantically, the phrasing is more likely to group the first member of the compound with the preceding governor, as in 19b. This type of phrasing is consistent with putting a phrase boundary at the right edge of \( X^\text{max} \): the first such edge in 19 coincides with the end of the first NP of the complement.

It is significant that this type of regrouping is never reported to occur in structures where the coordinate phrase precedes its governor, as for example in a structure of the form [NP and-NP] \( V \), as shown in 20a:\textsuperscript{22}

(20) Phrasing of [Y and-Z] X, X governs [Y and-Z]:
   a. (ki-ḥemʔā ūdbaš) (yōkēl)
      for-curds and honey shall eat
      ‘For (everyone) ... shall eat curds and honey’ (Isa. 7.22)
   b. *(ki-ḥemʔā) (ūdbaš yōkēl)

These structures are not parsed by the accents as in 20b, because there is no source for such a phrasing. It is not compatible with the syntax; and unlike 19b, putting a phrase boundary at the right edge of every \( X^\text{max} \) here would create not two phrases but three. Hence, the asymmetry in phrasing between coördinates governed from the left and those governed from the right follows from a general principle for deriving prosodic representations that has been observed in many languages.

4.2. GEOMETRIC EFFECTS. We have noted that it is generally assumed that there is a certain fluidity and variability in the formation of utterances and intonational phrases, where not only syntax, but a variety of rhetorical, se-

\textsuperscript{21} This is verse 5.15 in Breuer 1977.

\textsuperscript{22} Breuer (1982:363) claims that there are cases where a coordinate structure is split so that the last part or parts are phrased with a following governor; but all the examples he cites involve higher-level grouping of conjunctive phrases, not the formation of conjunctive phrases themselves. A typical example is given in (i). We will consider the formation of higher-level phrases in §§5 and 6. The only example he lists that involves C-phrase formation is the one in (ii), which does not contain a coordinate structure, but the emphatic repetition of the same word:

(i) ((Their flocks and their herds) (and their asses)) /1 ((and that which was inside the town) (and that which was outside)) (they seized) (Gen. 34.28)

(ii) ((A ruin, a ruin) (a ruin I will make it)) (Ezek. 21.32)
mantic, and performance factors play a role. Nespor & Vogel (1986:187) observe that 'the higher a constituent is in the prosodic hierarchy, the more general the nature of its definition becomes.' We might thus expect a gradual transition in the relative importance of factors influencing the formation of prosodic phrases from level to level. There is now much evidence that the conditions on phonological phrase formation are also not strictly syntactic. The effects of the Designated Category Parameter are often modulated by other factors, notably the geometry of the prosodic tree. Geometric effects, such as whether a node branches, are particularly important in the formation of Tiberian Hebrew phonological phrases.

Cowper & Rice (1987) argue that P-phrase formation in Mende is obligatorily sensitive to syntactic branching. They observe that Mende consonant mutation applies within a phonological phrase that is delimited by the left edge of a branching Xmax. Thus, consonant mutation triggered by the subject affects the verb in structures 21a and 21b, since VP does not branch, but not in 21c, where the branching VP forms a P-phrase on its own.23 Cowper & Rice propose that branchingness be considered a parameter of P-phrase construction. Further evidence for the importance of this parameter has been adduced in the formation of phonological phrases in a number of diverse languages, including Mandarin (L. Cheng 1987), Kinyambo (Bickmore 1990), Korean (Cho 1990), and Hausa (Zec & Inkelas 1990).

(21) Mende P-phrases: branching Xmax left (Cowper & Rice 1987):

\[
\begin{align*}
\text{a.} & \quad S \quad \text{b.} \quad S \quad \text{c.} \quad S \\
& \quad \text{NP} \quad \text{VP} \quad \text{NP} \quad \text{VP} \quad \text{PP} \quad \text{NP} \quad \text{VP} \\
& \quad \text{V} \quad \text{V} \quad \text{NP} \quad \text{P} \quad \text{V} \quad \text{X} \\
& \quad \mid X_{\text{max-h}} \quad \mid X_{\text{max-h}} \quad \mid X_{\text{max-h}} \quad \mid X_{\text{max-h}} \quad \mid X_{\text{max-h}} \quad \mid X_{\text{max-h}}
\end{align*}
\]

Branchingness also plays an important role in the derivation of Tiberian Hebrew phrases, often to the point of swamping the effects of the End Parameter. Typically, a Biblical Hebrew conjunctive phrase consists of two prosodic words. Therefore, a syntactic unit that would normally be divided into two phrases forms a single phrase when it consists of only two words. In this connection, compare 22a and 22b.

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23 Cowper & Rice's analysis has been criticized by Tateishi 1988, on the grounds that Mende consonant mutation is a morphologically conditioned lexical rule; see also Bickmore 1990 and Hayes 1990 for discussion. Nevertheless, branchingness of the sort posited by Cowper & Rice for Mende has been shown to play a role in the phrasal phonology of a number of other languages, as discussed below.

Whether the syntax branches or not may be less important than the branchingness of the derived prosodic structure. To decide whether it is syntactic or prosodic branching that is the relevant factor we need more complex examples than those in 18. See Ghini 1993 for a study of this matter with respect to Italian. I am grateful to Mirco Ghini for bringing this issue to my attention.
(22) Effects of branching on phrasing:

a. Gen. 3.16: 2 phrases

```
PP VP     PP VP
NP P N V NP N V
(bū'-yōṣēḇ) (rēlī) shall.you.bear hānīm) D0
  in.pain    children
```

b. Gen. 3.14: 1 phrase

```
PP VP     PP VP
NP P N V NP N V
(būl-gōḥōnḵā) tēlēk) D1
  on.your.belly shall.you.crawl
```

Ex. 22a has a phrase boundary at the right edge of the PP, as we expect. However, 22b unexpectedly has only one P-phrase; hence, the initial t of tēlēk is spirantized by the preceding vowel. In 22b, the preposition has been cliticized to its object. Since only two words remain, they are combined into one phrase, annuling the phrase boundary that otherwise occurs in this position.

Conversely, syntactic units which are normally kept together if they consist of two words are broken up if they contain more than two words. An example of this can be found in 19a above, where the verb is separated from its branching complement. Another example of this situation arises when a pronoun subject precedes a verb and its complement. The pronoun does not count as the head of Xmax and so is usually phrased together with the verb. As there are now two words in the verb’s phrase, its complement must form a separate phrase, as shown in 23a. The typical situation with a lexical subject is shown in 23b, where the subject forms one phrase and the verb and its complement form another phrase. However, when the verbal complement contains two or more words, the verb must form a separate phrase; in certain circumstances, it may be phrased with a one-word subject, as in 23c.

(23) Phrasing of subject-verb-complement sequences:

a. (wūhū yōṣēḇ) (bīsdōm)
and.he dwelt in.Sodom (Gen. 14.12)

b. (wālōt) (yōṣēḇ bāṣāṯar-sādōm)
and.Lot sat in.the.gate-(of)Sodom (Gen. 19.1)

c. (wāṣeprōn yōṣēḇ) (bōtōk bānē-ḥēṭ)
and.Ephron sat in.the.midst (of)the.children-(of)Heth
(Gen. 23.10)

In this way, what appear to be eccentric phrasings from a syntactic point of view turn out to have a prosodic basis, produced by the combination of the Branchingness and End parameters. There is more to say about the formation of these phrasings, for instance, their prosodic basis, which is determined by the combination of Branchingness and End parameters. However, the conditions that govern these phrasings are subject to—edges, branchingness, and the conditions related to tempo and word length discussed below—are more appropriate to prosody than to syntax.
of C-phrases—they display a variability that we have been abstracting away from—but this topic cannot be addressed until we have looked at the hierarchy of disjunctive accents.

The hierarchy of disjunctive accents

5. Let us turn now to the hierarchy of disjunctive accents and the nesting of phrases it implies. The Designated Category Parameter and the End Parameter derive prosodic representations in which constituents of a lower level are contained within constituents of a higher level; at a given prosodic level there is no recursion or nesting of phrases. The reason is that this mapping procedure forms prosodic constituents by making a series of cuts at right or left edges of particular categories: since at any prosodic level these cuts are all of equal value, the constituents so created have no hierarchical organization. The hypothesis that prosodic representation is nonrecursive has come to be known as the Strict Layer Hypothesis, originally proposed by Selkirk (1984:26); Nesporn & Vogel’s formulation (1986:7) is given in 24:

(24) The Strict Layer Hypothesis:
1. A given nonterminal unit of the prosodic hierarchy, X\(^p\), is composed of one or more units of the immediately lower category, X\(^{p-1}\).
2. A unit of a given level of the hierarchy is exhaustively contained in the superordinate unit of which it is a part.

The intention of the Strict Layer Hypothesis is to prevent nesting of phrases, whereby a P-phrase is embedded in another P-phrase or I-phrases within larger I-phrases. It also rules out having a P-phrase dominated directly by U, without an intervening I-phrase. Prosodic structure in accordance with the Strict Layer Hypothesis is presented schematically in 25a.

(25) a. Strict Layer Hypothesis  
   b. Tiberian nesting

Tiberian accentual representations do not adhere to the Strict Layer Hypothesis. In the schematic example in 25b, hierarchical relations among C-phrases are indicated by the disjunctive accents which annotate them. If we regard each Di as defining a separate prosodic level, then C-phrases are not all dominated by the same levels of prosodic structure, in violation of principle 2 in 24: the first and third C-phrases are dominated by D1, the second by D2, and the fourth by D0. Conversely, a disjunctive accent of level \(n\) may dominate a disjunctive accent of level \(n + 1\), or it may dominate no disjunctive accent, in violation of principle 1. Further, the various disjunctive levels do not define
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distinct prosodic layers in the sense that P and I do. As far as the phonology goes, these are all P-phrases, with lower-level disjunctives being P-phrases nested in higher-level P-phrases, again in violation of the Strict Layer Hypothesis.

From the perspective of the phonology, the Strict Layer Hypothesis appears to be a plausible constraint on prosodic representations: if the rules of phrasal phonology serve as our main diagnostic of prosodic structure, we would posit only as many prosodic levels as are distinguished by the rules. In Tiberian Hebrew we have found rules applying in levels we have identified as W, P, and I, but we have found no rules that apply in domains we can associate with the hierarchy of disjunctive accents.

However, there is more to prosodic structure than its role in supplying domains for phonological rules. Prosodic structure stands at the intersection of a number of fields and has been studied (not always under that name) from a variety of perspectives—the phonetics of intonation, stress-focus relations, processing, discourse, and so on. No single coherent picture of prosodic structure has yet emerged from this variegated literature, nor is it possible to cite any of these areas as decisively supporting or refuting the Strict Layer Hypothesis. Nevertheless, there are lines of contemporary research into prosodic structure which provide evidence for recursive nested structures of the Tiberian type. These accounts of prosodic structure offer interesting contemporary parallels with the Tiberian accentual system, and provide further support for the hypothesis that the hierarchy of disjunctive accents has a prosodic basis.

5.1. PAUSE DURATIONS AND RECURSIVE PROSODIC STRUCTURE. We will consider first linguistic representations obtained from experimental data involving pause durations, parsing judgments, and other phonetic and psycholinguistic measures potentially bearing on aspects of subjects’ analysis of sentences. These representations were sometimes called ‘performance structures’, because they were derived from performance tasks of various kinds and resembled, but were not the same as, the syntactic structures posited in theories of linguistic competence. Surveying some of this literature, Gee & Grosjean (1983) observed that performance structures are actually prosodic representations, also a part of a theory of linguistic competence. Prosodic structures obtained by these experimental paradigms display highly-articulated trees with nested phrases, like Tiberian accentual representations.

25 To decide whether a theory of prosodic structure is inconsistent with the Strict Layer Hypothesis, it is not enough to find that it posits hierarchical structures; it must be established that there is recursion of the same type of phrase. This is not an easy thing to establish, for in the absence of independent evidence bearing on the category of a phrase it is always possible to posit a new type of phrase, thereby adding hierarchical layers without violating the Strict Layer Hypothesis; cf. Kubozono 1992 for an example of this problem in Japanese. See Ladd 1992 for a review of the status of the Strict Layer Hypothesis in studies of intonation. Intonation theorists are divided on this issue: Ladd argues that prosodic structure must allow nesting of phrases and proposes a relaxation of the Strict Layer Hypothesis. See also Ladd 1986 and §7 below.
Grosjean et al. (1979) asked six subjects to read fourteen sentences, each at five different rates. The silent pauses at the end of each word (if exceeding 25 csec) were measured from oscillographic tracings. The pauses at each word boundary were pooled, and the mean durations were expressed as a percent of the total pause duration of the sentence. A hierarchical representation of every sentence was obtained from the pause values by the following procedure (Grosjean & Lane 1977):

(26) Clustering procedure:
   a. First, find the shortest pause in the sentence.
   b. Second, cluster the two elements (words or clusters) separated by that pause by linking them to a common node, and delete the pause. (If three or more adjacent words are separated from each other by the same pause duration, make one cluster of these words: trinary, quaternary, etc.)
   c. Finally, repeat the process until all pauses have been deleted.

An example sentence is given in 27, with proportional pausal values indicated between and under the words, and with the hierarchical representations derived from these values by the procedure in 26. Since adjacent words separated by exactly equal pauses occur relatively rarely, the analytic technique of 26 produces mostly binary splits at every node, guaranteeing a rich hierarchical structure with nesting of phrases.

(27) Performance structure obtained from pausing (Grosjean et al. 1979):

5.1.1. GROUPING OF PHRASES. More importantly, the results derived by this methodology reveal principles of grouping that have interesting parallels in Tiberian Hebrew. The following English examples are among those reported in Grosjean et al. 1979:

26 To bring them into line with the diagrams used elsewhere in this article, I have modified the representations of the tree diagrams presented in Grosjean et al. (1979:73) and in Gee & Grosjean (1983:423). Aside from inconsequential graphic alterations, in the original diagrams the height of each branch of the tree is in proportion to the pause duration between the constituents, a detail I have not attempted to reproduce, as the same information is conveyed by the numbers at each boundary.
(28) English sentences with main pauses:
   a. John (10) asked (17) the strange (8) young man (25) to be quick (19) on the task.
   b. The agent (18) consulted (11) the agency’s book (25) in which (13) they offered (10) numerous (10) tours.
   c. Our disappointed woman (24) lost (8) her optimism (28) since the prospects (15) were too limited.

Ex. 28a is the same sentence as shown in 27. Numbers in parentheses represent the percent pause duration obtained at the indicated boundary; only the largest pause durations are reproduced in 28.

Let us consider first where the largest pause occurs in these sentences. In 28a–b it does not occur at the greatest syntactic boundary, which is between the subject and verb in both cases, but rather at a subordinate syntactic division that is closer to the midpoint of the sentence. The same occurs commonly in Tiberian Hebrew when the main syntactic division occurs too near the beginning of the verse. In 29a, for example, the main prosodic break does not come at the main syntactic break after outsiders, but in the middle of the subordinate coordinate clauses. Another example along these lines is 29b.

(29) Tiberian Hebrew: phrasing above the sentence:
   a. Surely, he regards us as outsiders, /2 now that he has sold us /1 and has used up /2 our purchase price. (Gen. 31.15)
   b. Jehoshaphat constructed Tarshish ships to sail to Ophir for gold. /2 But he did not sail /1 because the ships were wrecked /2 at Ezion-geber. (1 Ki. 22.49)

These verses exemplify the Tiberian tendency to make the first half of a verse or phrase longer than the second half.27

Consider now how the verb is grouped when a subject precedes and verbal complements follow. In 28b–c there are larger breaks between the subject and the verb than between the verb and its object; in 28c, for example, the pause between the subject and the verb is equal to 24% of the entire measured pause duration for that sentence, whereas the pause between the verb and its object is only 8% of the total. This phrasing is the expected one in terms of the syntax. In 28a, however, the greater break is shifted to the right and comes after the verb, with a lesser pause after the subject. These pause values correspond to a structure in which the verb and the subject form a constituent, contrary to the syntax. The difference between the two types of cases has to do with the length and prosodic complexity (i.e. number of phrases) of the subject relative to the verb phrase (Gee & Grosjean 1983:442): in 28a, the combination of the subject and the verb is shorter and less complex than the object.

27 This tendency can be overruled, as in the following verse noted by Wickes 1887, where the main break comes after the first word:

   (i) And my flock /1 must they graze on what your feet have trampled /2 and drink what your feet have muddied? (Ezek. 34.19)
Compare now the groupings indicated by the Tiberian accents in 30.\(^{28}\)

(30) Hebrew: Phrasing as indicated by the accents:

a. *wahāšī D2 maṭṭē mōnaššē D1 lāqḥū D1f*
   and.the.half tribe (of)Manasseh /1 received
   *nahālātām*
   their.portions (Num. 34.14)

b. *wākōl D2 yēter hāšām D1 kārṣū ḫal-birkēhem D1f*
   and.all (of)the.troops /1 knelt on.their.knees
   *lisṭōt māyim*
   to.drink water (Jud. 7.6)

c. *wōriḇqā D2 ḥāmrā D1 ḥēl-yāqōb hōnāh D1f*
   and.Rebekah said /1 to.Jacob her.son
   *lēmōr*
   saying (Gen. 27.6)

d. *ūpišṭīm D2 lāqḥū D1 ēt D1f ḫārōn*
   and.the.Philistines captured /1 ACC the.Ark
   *hāḥēlōhim*
   (of)God (1 Sam. 5.1)

In all these examples the subject precedes the verb. Exx. 30a–b have long subjects and relatively short verb phrases, and the main break falls between the subject and the verb, as in 28b–c; 30c–d are similar to 28a in having short subjects, and the main break falls after the verb.

A third type of case involves the grouping of a series of postverbal complements. Within Hebrew verb-initial clauses, the usual Tiberian procedure is to place the main division before the last constituent of the clause. Outer constituents are successively peeled away until we have worked back inward to the verb, yielding a phrasing of the form (((V X) Y) Z)... Examples are given in 31.

(31) Phrasing in verb-initial clauses:

a. *(He) purchased /4 the parcel of land /3 where he pitched his tent /2 from the children of Hamor, Shechem’s father /1 for a hundred kesitahs. (Gen. 33.19) (((V NP) S) PP) PP)

b. *The Lord freed (lit. freed the Lord) /3 the Israelites /2 from the land of Egypt /1 troop by troop. (Ex. 12.51) (((V NP) NP) PP) PP)

Gee & Grosjean (1983:443) observe that their algorithm leads them to expect that a series of complements following the verb will be grouped into a left-

\(^{28}\) The notation Dif (f = final) in these examples refers to the terminal accent at level Di. We have been suppressing the distinction between Di and Dif as it has not been relevant, but we indicate it here because Dif represents a lesser disjuncture than a preceding Di in a right-branching structure; see further §8.1 below.
branching structure, just as in the Tiberian pattern in 31. They give the hypo-
theoretical (predicted but not tested) example in 32.

(32) Phrasing of series of VP complements (Gee & Grosjean 1983):

\[
\begin{array}{c}
1 \\
\downarrow \\
1 \\
\downarrow \\
1 \\
\downarrow \\
\downarrow \\
1 \# \text{ gave} \\
\downarrow \\
\phi \\
\downarrow \\
\phi \\
\downarrow \\
\phi \\
\downarrow \\
\phi \\
\downarrow \\
\end{array}
\]

Further support for this type of phrasing comes from quite a different di-
rection. Culicover & Rochemont (1983) develop hypotheses about English pro-
sodic structure in order to account for phenomena involving stress and focus. They propose a phrasing algorithm (1983:129–30) which assigns the prosodic consti-
ency shown in 33b to a phrase with the syntactic structure shown in

(33) Phrasing of VP (Culicover & Rochemont 1983):

a. Syntax:

\[
\begin{array}{c}
\text{VP} \\
\downarrow \\
\text{NP} \\
\downarrow \\
\text{N'} \\
\downarrow \\
\text{PP} \\
\downarrow \\
\text{NP} \\
\downarrow \\
\text{N'} \\
\downarrow \\
\text{NP} \\
\downarrow \\
\text{NP} \\
\downarrow \\
V \\
\downarrow \\
\text{DET} \\
\downarrow \\
N \\
\downarrow \\
P \\
\downarrow \\
N \\
\downarrow \\
P \\
\downarrow \\
P \\
\downarrow \\
\text{send} \\
\text{a} \\
\text{book} \\
\text{about} \\
\text{Nixon} \\
\text{to} \\
\text{Mary}
\end{array}
\]

29 Culicover & Rochemont use x as a place-holder to label new nodes generated in the mapping to prosodic structure. They also carry over some syntactic phrasal node labels into the tree in 33b which I have omitted here. See Kidd 1989 for a review of the literature on stress/focus and proposals for improving on the phrasing algorithms. See also Rochemont & Culicover 1990.
b. Constituency in prosodic structure:

```
V         D  N     P    N    P    N
send     a  book  about Nixon  to Mary
```

We see, then, that the hierarchical structures indicated by the Tiberian accents have striking points of contact with some contemporary research into hierarchical prosodic structures.\(^{30}\) There is thus no need to attribute this system to a special Tiberian theory of syntax, or to arcane principles developed for the sole purpose of annotating the Biblical text.\(^{31}\)

5.1.2. Phrasing Algorithms. The data pertaining to pause durations suggest how phrases are to be grouped, but they do not directly determine what the principles are for deriving these groupings. Thus, Grosjean et al. (1979) propose a top-down algorithm: various procedures locate the predicted largest pause, which splits the utterance into two parts; then each part is divided, and so on. Cooper & Paccia-Cooper (1980) develop a different algorithm to derive similar facts. The algorithm proposed in Gee & Grosjean 1983 departs from both of these in assuming a bottom-up procedure for deriving prosodic structure from syntax, first building P-phrases and then joining them into higher-level structures.

Similarly, the Tiberian accents give us representations, not principles for deriving representations. We do not know what algorithm the Masoretes used in creating accentual representations, or even if they had one; their main concern would in any case have been to reflect correctly the reading tradition as

\(^{30}\) Potentially relevant to this topic (allowing for differences in terminology and prosodic units) are the rules for mapping syntax into prosody developed by Crystal 1975, and taken up by Cruttenden 1986 and Altenberg 1987.

\(^{31}\) Aronoff (1985:53) proposes that the characteristic Tiberian phrasings follow from ‘a general principle, which appears to be basic to the Masoretic theory of phrase structure’; this he calls the Masoretic Parsing Principle:

‘Given a constituent \(X_i\) of category \(X\), divide it into two continuous subconstituents such that one of them is the maximal continuous constituent of the same category \(X\) within \(X_i\).’

Though it is not necessary to invoke a Tiberian theory of phrase structure, the principles of phrasing proposed by Aronoff must still be evaluated on their merits; that is, to the extent that the Masoretic Parsing Principle is descriptively adequate, it is because it is part of a general theory of prosodic structure. Janis (1987:248–68), in an extended critique of this principle, argues that it is in fact not adequate in a variety of cases—e.g., it does not distinguish between divisible and nondivisible coordinate structures, such as those in 19.
they knew it. A number of proposals have been made for obtaining the phrasings indicated in the texts, including prominently the work of Wickes (1887), who proposed what he called the Law of the Continuous Dichotomy:

(34) **THE LAW OF THE CONTINUOUS DICHOTOMY:**

Every verse is divided into two parts (dichotomy); each part is in turn divided by a minor dichotomy. This process is repeated until the conditions for division are no longer met.

Top-down algorithms based on the Continuous Dichotomy have dominated the field since Wickes 1887, but the issue is far from settled. Janis 1987 proposes a new algorithm for deriving Tiberian accentual structure which is quite different: the derivation of accentual representations begins with lower-level groupings of words, which are then combined into higher-level phrases.

It is not my purpose here to assess the relative merits of these phrasing algorithms. What the above parallels show is that the study of algorithms for assigning the Tiberian accents is not merely an esoteric pursuit, but is properly to be understood as a part of the study of the theory of prosodic structure.

5.2. **MELODIC CONTOURS.** Another paradigm which generates recursive prosodic structures is that reported in Rossi et al. 1981; see also Martin 1987 and the references therein. Martin (1981, 1987) proposes that relations of dependency between constituents and subconstituents in French sentences are indicated by contrasts of melodic slope. Abstracting away from various complications: given a phrase divided into two units, A and B, if B ends with a falling contour, A ends with a rising contour, and vice versa, as illustrated in 35.

(35) French contours (Martin 1987):

a. Two prosodic units: b. Four prosodic units:

```
Pierre est-parti

La-soeur de-Paul adore les-cerises
```

32 There is a grammatical treatise called Diqduqe hateSamim, attributed to the Tiberian accen-
tuator Aaron ben-Asher (Dotan 1967), in which are collected different rules regarding vocalization
and accentuation. Like many traditional grammars, the treatise tends to concentrate on special
cases and does not provide a systematic guide to the basic principles underlying the system of
accentuation.

33 Janis (1987:216–40) suggests that Wickes’s principle of Continuous Dichotomy has contributed
to the view that the Tiberian system of accents is an artificial creation removed from linguistic
reality. This may be so, but the fact that similar algorithms have been proposed to account for
phrasing in contemporary languages shows that there is nothing inherently artificial about such a
principle; of course, it is an empirical question whether it is correct. In fact, to account for the
prosodic readjustments to be discussed below, Janis also has to allow for a top-down influence in
his phrasing algorithm. Thus, after words are grouped into nested phrases, the higher-level phrases
affect the regrouping of lower-level phrases. I would like to thank Elaine Gold for her insightful
analysis of Janis’s algorithm.
Ex. 35a contains a simple example with two prosodic words forming a relation of subject to predicate. Since the contour of the second word is falling, the contour on the first is rising. Ex. 35b contains a slightly more complex example of the same basic structure, where again the predicate ends in a falling contour and the subject ends in a rising contour. In this example the subject and the predicate each consist of two words: since A depends on B and B is rising, A has a falling contour; similarly, C has a rising contour in contrast to D.

A more complex example containing further levels of dependency is the sentence in 36, reported by Martin (1981:268). Ex. 36a shows the melodic contours assigned to the words in this sentence, in which the phrasing mirrors the syntactic structure indicated by the square brackets. The symbols $C_a$, $C_1$, ..., $C_5$ represent contours with the indicated slope. Different contours with the same slope differ with respect to phonetic parameters such as amplitude and length: the higher the number of the contour, the smaller the break it signals and the smaller its phonetic manifestation. Under these contours, in 36b, are ranged the Tiberian disjunctive accents which would be assigned to these words, given the indicated parsing and assuming that each $C_i$ ends a phonological phrase. There is an interesting parallelism between the shape and size of the French melodic slopes and the distribution of the Tiberian accents, deriving from the fact that both incorporate dependency relations of similar types.

(36) French contours and Tiberian accents:

```
Le père [de Max] et la sœur [de Maurice]
```

```
[['C3' 'C4' 'C1'] ['D3f' 'D2' 'D1']
[['sont partis' 'en vacances'] ['dans le sud' 'du Mexique']]]
```

```
C4 C3 C5 C1
D2f D1 D1f D0
```

'Max’s father and Maurice’s sister went away on vacation in the south of Mexico.'

Since the melodic contours reflect hierarchical relations of dependency, the representations needed to derive them must also be hierarchical. These dependency structures are not always syntactic, as Martin demonstrates, for they can be influenced by rhythmic considerations as well as syntactic ones. In short, melodic contours are derived from hierarchical prosodic structures.

The studies of pause durations and melodic contours reviewed above suggest something of what may have been the phonetic reality behind the Tiberian accents. Though languages differ in what the phonetic correlates of prosodic

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34 In the normal Hebrew phrasing, each left dependent would be replaced by a conjunctive accent. I also assume that this sentence occupies a half-verse: in a complete verse, the main division indicated by $C_1$ would be assigned D0. See Rossi et al. 1981 for further details regarding these French melodic contours. According to Martin (1981:269), the full intonational structure shown in 36 is not always realized, even in read speech.
structure are, and how they are deployed, it is significant that the fullest articulation of this structure appears at slow, even artificially slow, rates of speech. Hence, the extremely detailed Tiberian notation is most similar to the prosodic structure of very deliberate speech. The recitation of the Biblical text is not uniformly slow, however, as we shall see in the next section.

PROSODIC READJUSTMENTS

6. I have now discussed two central aspects of the Tiberian accentual system—the formation of C-phrases and their grouping into larger phrases—and have argued that both these facets of the system have properties that identify them as prosodic representations. One more property remains to be accounted for in these terms: the great variability in the size of C-phrases. We systematically abstracted away from this property in §4 in order to isolate the effects of the End Parameter and the Branchingness Parameter. In this section we will consider this variability in some detail and show that it, too, provides evidence for the prosodic nature of the system.

6.1. VARIABLE GRAIN, TEMPO, AND NESTING OF PHRASES. Branchingness and the choice of designated category both play a role in determining how big phonological phrases in a language are—what we could call the grain of a language’s prosodic structure. Languages with small phrases are relatively fine-grained; those with large phrases are more coarse-grained. Grain appears to be highly variable from language to language. For example, Kenstowicz & Kisseberth (1990:194) observe that ‘the prosodic structure of Chizigula is considerably less articulated than that of Chimwiini’, its sister Bantu language, despite having a similar syntax.

Tiberian Hebrew phonological phrases show a systematic variability of grain. Our observation that phrases of two words are the norm implies a fixed grain and is an oversimplification of the actual situation. In Tiberian Hebrew, grain depends on context: in prominent positions of the prosodic tree phrases tend to be very small; in less prominent positions they tend to be larger. An example of this variability can be seen by comparing 18b and 22b above. The two have identical syntax and the same cliticization pattern. Nevertheless, they are phrased differently because they occupy different positions in the prosodic tree: the phrase in 22b ends in a D1 accent, but 18b ends in D0, which is to say that 18b is in a more prominent prosodic position than 22b. In prominent positions words appear to have more weight, and each word in 18b forms a C-phrase of its own. Conversely, in deeply embedded positions in the prosodic tree (i.e. in the domain of lesser disjunctive accents) phrases can be expanded, resulting in the multiword phrases given above in exxs. 6 and 8. Although none of the theories for deriving prosodic representation discussed above account for variable phrasing, this too is a phenomenon which can be best explained in terms of prosodic principles.

To the extent that it has been studied, what we have called variability of grain has been associated with different rates of speech. The case of Mandarin tone sandhi (C. Cheng 1973, Shih 1986) is well known in this connection: a
third tone (3) is changed to a second tone (2) when it precedes another 3 tone in the same phrase. The domain in which this rule applies expands as the speech rate increases. In the example in 37, every word has an underlying 3 tone. At a deliberate tempo (37a) only the first and fourth words undergo tone sandhi, presumably because only those words are in phrases where they are followed by another word with a 3 tone. At a faster tempo (37b) the last two phrases are simplified into a single phrase, and the third and fourth words both undergo tone sandhi. At a faster tempo still (37c) the whole utterance forms one phrase, and all tones but the last undergo the rule.

(37) Mandarin tone sandhi (C. Cheng 1973):

\[
[[\text{lau} \ \text{li}][\text{mai} \ [\text{hao} \ \text{jiu}] outside]]
\]

Old Li buys good wine

3 3 3 3 3 Underlying tones

a. (2 3) (3) (2 3) Adagio
b. (2 3) (2 2 3) Allegro
c. (2 2 2 2 3) Presto

As Cheng points out, the effect of faster tempo is to allow sandhi rules to apply to increasingly wider domains, where less important boundaries are erased before more important ones. In examples like 37, the syntax provides the nested constituents: if tone sandhi is directly sensitive to syntax, then it follows that the boundary between the verb and its object must be erased before the one between the subject and the verb. Yet we have seen that syntactic structure is not in general a reliable guide to prosodic operations. Shih 1986 argues that the various adjustments in the domain of Mandarin tone sandhi associated with tempo changes are carried out on prosodic structure, itself mapped from the syntax. It follows then that prosodic structure must contain nested phrases which provide the input to rules of prosodic readjustment. In 37, for example, the syntax would map directly into an isomorphic prosodic structure; as tempo increases, phrase boundaries are erased, starting with the most embedded.

Another example of variable grain is provided by Italian. Nespor & Vogel (1986:173) propose that Italian has small P-phrases, as in 38a, as well as a prosodic restructuring rule, given in 38b.

(38) P-formation and restructuring in Italian:

a. Form small P-phrases by grouping a head with its specifiers on the left (Right end of X\text{head}).

b. A nonbranching P which is the first complement of X on its recursive side is optionally joined into the P that contains X.

Restructuring is posited to account for the optional occurrence of raddoppia-

\[35\] At a normal ('moderato') speaking rate, tone sandhi, which is a cyclic rule, has a chance to apply again in the largest domain to the tone sequence (2 3 3 2 3), where it affects the tone of the second word, creating the tone pattern (2 2 3 2 3).

\[36\] See also L. Cheng 1987 for a similar conclusion. Shih 1986 proposes that all tempo-sensitive sandhi rules apply to prosodic structure, not syntax.
mento sintattico (RS) in nani in 39. The initial assignment of P-phrases, according to 38a, is 39a, which would not permit RS to apply to nani unless it is restructured as in 39b. Restructuring does not occur when the first complement branches, as shown in 40, where molto does not undergo RS.

(39) Restructuring of nonbranching P:
   a. Right end of X^head: (I caribù) (nani) (sono estinti)
      ‘Dwarf caribous are extinct.’
   b. Restructuring: (I caribù n:ani) (sono estinti)

(40) First complement branches:
   a. X^head Right: (Hanno) (dei caribù) (molto piccoli)
      ‘They have some very small caribous.’
   b. No Restructuring: (Hanno) (dei caribù m:olto piccoli)

Nespor & Vogel (1986:173–4) suggest that restructuring is more frequent in fast speech than in slow speech; that is, the grain of phrasing becomes coarser in fast speech.

As with Mandarin, adoption of a version of the Continuous Dichotomy and nested P-phrases leads to a more elegant formulation of this restructuring entirely in terms of prosodic structure. In this case, we would first divide the sentence in 39 between the subject and the predicate. As the predicate contains only two words and meets the conditions for a P-phrase, it is subject to no further division. The phrase containing the subject is divided into two smaller phrases which may be optionally subject to restructuring, as shown in 41.37

(41) Italian P-phrase restructuring with nested phrases:

```
           I
           |
           P
            |
           P
            |
           P
            |
W W W W W W
```

What the Tiberian Hebrew data suggest is that nonprominent phrases have characteristics of fast speech and prominent phrases have characteristics of deliberate speech. Thus, we observe systematic tempo variations even within one utterance. To account for these variations, we must assume that Tiberian Hebrew accentual representations are derived in stages. The principles discussed in §§4 and 5 guide the first stage of the mapping from syntax to prosodic structure. In this initial mapping, a syntactic structure is converted into a prosodic structure: constituents are reorganized according to principles discussed

37 The account of Italian phrasing given here is no doubt greatly oversimplified. Ghini 1993 studies a wider range of Italian constructions and concludes that phrase formation is also sensitive to mechanisms that take into account phonological weight, eurhythmicity, and length balancing.
above, and prosodic labels are assigned to these constituents. Following this, a series of prosodic readjustments occur, depending on where a phrase is in the prosodic tree.

These readjustments are of two types: division of phrases, whereby a two-word phrase is further divided, and its opposite, simplification, in which a phrase boundary is removed so as to create a longer phrase. Each process can be broken down into a number of subcases; the basic idea is that division applies to phrases in prominent positions of the tree, while simplification applies to phrases that are not prominent. The disjunctive accents indicate how deeply embedded a phrase is and, in the case of simplification, which phrases to join together. Let us now turn to some examples of these processes.38

6.2. Division. Some examples of division rules are given in 42 (Breuer 1982: 108ff.).

(42) Division rules:
1. When a DO phrase consists entirely of a single conjunctive phrase, it is divided.
2. A two-word phrase in a prominent position of a prosodic tree (in the domain of DO or D1) is divided if one of the words is long.

The application of Division Rule 1 is exemplified in 43; the DO phrase has only two words, so it is divided, leaving each word alone in a phrase:

(43) Division Rule 1:

\[(\text{wəhaṭṭūr haššēnī})\text{DO} \rightarrow ((\text{wəhaṭṭūr})\text{D} 1\text{f (haššēnī)})\text{DO}\]

and the row the second

The second row (Ex. 39.11)

Division Rule 2 refers to the notion of long word. The definition of a long word is given in 44, and some examples are shown in 45 and 46:

(44) Long word:
A long word is one which has at least two vowels before the stressed vowel, not counting reduced vowels (i.e. schwa or ḥatef), or else contains a vowel marked with meteg (i.e. has secondary stress).

(45) Some long words:
- a. yēlkū ‘they (m. pl.) will go’
- b. tēḏūn ‘you (m. pl.) will know’
- c. yēʔākél ‘it (m. sg.) will be eaten’
- d. ḥāʔātād ‘the thorn’
- e. ḥel-bālāq ‘to Balak’
- f. lammaṭṭē ‘to the tribe’

(46) Some short words:
- a. sē ‘lamb’
- b. bənō ‘his son’
- c. mōšē ‘Moses’
- d. ʕālēhēm ‘upon them’
- e. ʔēkākā ‘how?’
- f. ʕātannēpēm ‘I shall soil them’

The rule applies in the derivation illustrated in 47. Here we have a verse divided into two parallel halves. The first division comes at the end of the first half,

38 The rules in this section are discussed in some detail in Breuer 1958, 1982; see also Cohen 1969 and Janis 1987. Janis refers to these as pacing rules, since they slow down or speed up the pace of the reading.
where we assign D0; another D0 goes at the end of the verse. Each half is in turn composed of two clauses, which mark the second division, D1. Each phrase now has two words, so we stop there. But the last word in the first half, ḥelḇāšēnā, is prosodically a long word; since its phrase is D0, it is divided, as in 47b. The word that ends the second half, ṣāṭannōpēm, looks long but is not, because of its reduced vowels.

(47) Division:

a. Continuous Dichotomy:

\[(\text{pašāṭi } \text{ẹt-kuttonti})D1f (\text{ẹkākā } \text{ḥelḇāšēnā})D0\]
I had taken off Acc-my.robe how was I to don it

\[(\text{raḥāṣṭi } \text{ẹt-ragldy})D1f (\text{ẹkākā } \text{ḥatannōpēm})D0\]
I had bathed Acc-my.feet how was I to soil them

b. Division Rule 2:

\[(\text{pašāṭi } \text{ẹt-kuttonti})D1 ((\text{ẹkēkā})D1f (\text{ḥelḇāšēnā}))D0\]
I had taken off Acc-my.robe how was I to don it again?

\[(\text{raḥāṣṭi } \text{ẹt-ragldy})D1f (\text{ẹkēkā } \text{ḥatannōpēm})D0\]
I had bathed Acc-my.feet how was I to soil them again? (Cant. 5.3)

The readjustment does not end at 47b, though, since the division of the D0 phrase causes a reassignment of the accents of the words preceding it. The first phrase of the verse is promoted from D1f to D1, which is higher in the tree. Since its second word is long, it too is divided, yielding the final phrasing in 47c. The hierarchy of disjunctive accents is required in order to know which phrases are subject to Division.

From a theoretical point of view, we might ask why long words should be defined as in 44, and why they should play this special role in the accentuation system. I have argued elsewhere (Dresher 1981a, b, c) that a long word is a word with two or more metrical feet; that is, a long word is a word which branches at the foot level. In certain prosodic positions this branching at the foot level appears to count as if it were branching at the word level.

If we extend the prosodic hierarchy below the level of the word to include the foot, we can account for this division elegantly in terms of the notion of INCORPORATION proposed by Halle & Vergnaud (1979):39 in prominent positions of the tree, the foot level is incorporated into the prosodic tree. Thus, a word with two feet counts as branching in terms of the prosodic tree, and joining it with another word would result in a phrase that branches more than once. The operation of this rule is illustrated in 48. In 48 the phrase P2 initially contains two words, designated W3 and W4. W4 has two feet, and because it terminates

---

39 This notion is discussed in a chapter written by Jean-Roger Vergnaud, to whom I am grateful for this and other interesting suggestions. Dresher & van der Hulst (1993) observe that the asymmetry in incorporation, whereby only prominent phrases may have access to the foot structure of their constituent words, is found at all levels of the phonology, where the head in any domain (the most prominent phrase, the foot which bears main stress, the stressed vowel in a foot, etc.) frequently has access to lower-level structures that are opaque to its dependents.
a D0 phrase, its foot level is incorporated into the prosodic tree, with the effect that W4 counts as if it were two words. Consequently, the final phrase is divided as shown. It is noteworthy also that in this formulation the division rule can be stated entirely in terms of units of the prosodic hierarchy.\footnote{40}

(48) Division Rule 2:

\[ \begin{array}{c}
  \text{I} \\
  \text{P1 D1f} \\
  \text{P2 D0} \\
  \text{W1 W2 W3 W4} \\
  \text{F F F F}
\end{array} \quad \rightarrow \quad \begin{array}{c}
  \text{I} \\
  \text{P1 D1} \\
  \text{P2' D1f} \\
  \text{P3 D4} \\
  \text{W1 W2 W3 W4} \\
  \text{F F F F}
\end{array} \]

6.3. SIMPLIFICATION. We have seen that conjunctive phrases may be divided in certain circumstances in prominent positions of the prosodic tree. Constituency also plays a crucial role in the opposite sort of adjustment, whereby two phrases are combined into one. Following Cohen (1969:60), we will refer to such adjustments as simplification.

The conditions under which simplification occur are quite complex, and I will not attempt to review them all here (see Breuer 1958, 1982 and Cohen 1969 for detailed discussions). The general trend, however, can be simply stated: in prominent prosodic positions, i.e. in phrases ending with D0 or D1 accents, simplification is rare and occurs only in special circumstances; as we proceed down to lower prosodic levels (phrases ending in D2 or D3 accents), the conditions on simplification become progressively more liberal. The sample observations in 49 are taken from Breuer (1982:83–107).

(49) Simplification:

1. A phrase of the form \(((W1 W2)D2 W3)D1\) is simplified to \((W1 W2 W3)D1\) only if \(W1\) is easily cliticizable.
2. A phrase of the form \(((W1 W2)D3 W3)D2\) may be simplified to \((W1 W2 W3)D2\).
3. A phrase of the form \(((W1 \ldots Wn)D3 (Wn+1 \ldots Wn+m))D3\) is simplified to \((W1 \ldots Wn Wn+1 \ldots Wn+m)D3\).

An example of Simplification Rule 1 is given in 50.

(50) Simplification Rule 1:

\[ \begin{array}{c}
  W1 \quad W2 \quad W3 \\
  (((\text{påšér \ xänõkĩ})D2 (hölěk))D1 \rightarrow (\text{påšér \ xänõkĩ hölěk})D1 \\
  \text{that \ I \ walk (Gen. 28.20)}
\end{array} \]

\footnote{40} Long words have been observed to induce strong boundaries in modern languages; see Cooper & Paccia-Cooper 1980 and Gee & Grosjean (1983:445) for English. Rossi (1981:206–207) notes the following contrast in French:

(i) \text{Il mange / des poissons blancs.} \quad \text{‘He eats white fish.’}
(ii) \text{Il mange des poissons / multicolores.} \quad \text{‘He eats multicolored fish.’}
In 50 the initial phrasing puts a phrase boundary between the subject, which is grouped with the word to its left to form a two-word phrase, and the verb. \(W_1\) is the relative clause particle \(\text{מְשֶר, a short function word that is often cliticized to a following word. According to Breuer, } W_1 \) is effectively an escaped or virtual clitic in cases such as these; the simplified phrase is thus equivalent to \((W_1-W_2 W_3)\), a two-word phrase.

Ex. 51 shows an example of Simplification Rule 2; the configuration is the same as for Rule 1, but without the special conditions on \(W_1\).

(51) Simplification Rule 2:
\[
W_1 \quad W_2 \quad W_3
\]
\[
((\text{ayil tāmīm})D_3 \quad ((\text{min-hāssōn}))D_2 \rightarrow
\quad \text{ram without blemish from the flock (Lev. 5.15)}
\]
\[
((\text{payīl tāmīm min-hāssōn})D_2
\]

At the lowest levels of the disjunctive hierarchy the conditions on simplification become very free, as suggested by Rule 3, presented here without its various refinements and subconditions. An example of simplification at this level is shown in 52.

(52) Simplification Rule 3:

a. Initial parse
\[
((\text{pāser šāsā})D_3 \quad ((\text{liśnē-sārē})D_3
\quad \text{what he did to the two commanders}
\]
\[
((\text{ṣīb ?ōt yīsrāʾēl}))D_3
\quad \text{(of the forces of Israel (1 Ki. 2.5))}
\]

b. Simplification Rule 3 (applied twice):
\[
((\text{pāser šāsā liśnē-sārē ṣīb ?ōt yīsrāʾēl})D_3
\]

As with division, we would not know which phrases are subject to simplification if we did not have a highly articulated tree which can distinguish the various levels of embedding that play a role in the conditions of simplification.

Simplification can also be achieved through cliticization, as shown in 53.

(53) Simplification via cliticization:
\[
(\text{rōʾē (miqnē ṣəḥām)})D_1 \rightarrow (\text{rōʾē miqnē-ṣəḥām})D_1
\]
\[
\text{herdsman cattle Abram}
\]
\[
\text{‘herdsman of Abram’s cattle’ (Gen. 13.7)}
\]

This kind of cliticization leads directly to simplification by reducing the number of words in the phrase. Again, what is important here is how the various P-phrases are organized.

The readjustments discussed in this section clearly have a prosodic character: words are stretched out toward the ends of phrases and are passed over more quickly in the middle of phrases. The conditions that enter into these operations, relating to position in the utterance and the length of words and phrases, have no place in syntax or in a system of logical and semantic relations; rather, they belong to prosody.

**The Prosodic Structure of Tiberian Hebrew**

7. I would now like to sum up what we have observed about the prosodic structure of Tiberian Hebrew, and what lessons we can draw from it concerning
prosodic structure in general. First, we have seen that Tiberian Hebrew phonology is sensitive to a series of prosodic levels consistent with modern conceptions of the prosodic hierarchy. In particular, we have to distinguish levels of the phonological word (W), the phonological phrase (P), and the intonational phrase (I). We have seen also that P-phrases (and presumably I-phrases; the Tiberian notation does not systematically distinguish them) are grouped into larger phrases. These further levels of structure should not, however, be considered new levels of the prosodic hierarchy, since they do not form domains for phonological rules. Rather, they are organizing phrases which indicate constituency within prosodic levels.41 We will designate an organizing phrase at level X as X'; schematically, prosodic structure can be represented as in 54.42

(54) Prosodic structure: discrete levels:

The organizing phrases are invisible to phonology, which is not sensitive to nesting within a prosodic level. A phonological rule which applies in P, for example, applies to any P, no matter how deeply embedded it is. Organizing phrases are nevertheless significant for the phonology, because they provide the input to the rules of prosodic readjustment, such as division and simplification of phrases. These adjustments are akin to changes that have been connected to tempo changes in modern languages, and they show that tempo can vary within an utterance: phrases in prominent positions are said more slowly and those in subordinate positions are said more quickly, with concomitant adjustments of the size of phrases. The organizing phrases may also have been reflected in the phonetics of the spoken language upon which the Biblical cantillation was overlaid; based on what we know about contemporary spoken language, it is plausible to suppose that the nesting of phrases was reflected

41 These organizing phrases are not to be confused with the organizing nodes proposed in Avery & Rice 1989 as part of the theory of segment structure. It is possible, though, that all levels of the phonology encode a formal distinction between substantive and organizing nodes.

42 The organization of the I-phrase level is not represented in the Tiberian notation, but is inferred from pausal phonology.
in varying pause durations, in intonational contours, and in other phonetic effects, such as lengthening of vowels.

It emerges from this general picture that phonology and phonetics are sensitive to different aspects of prosodic structure in a way that corresponds to a central distinction between the two components: phonology is discrete, and phonetics is continuous. For example, for purposes of phonology, vowels are either short or long (in languages in which this contrast plays a role); but phonetically, vowel duration exists on a continuum, with vowels in more prominent positions (whether short or long) being longer than corresponding vowels in less prominent positions.43 Similarly, phonology is sensitive to discrete prosodic categories (W, P, I, etc.). A phonological lengthening rule applies at a given prosodic level or it does not, whereas a phonetic lengthening rule may be sensitive to finer distinctions within prosodic categories, applying variably to phrases at the same prosodic level but in different positions of embedding.

The existence of organizing phrases necessitates a modification of the Strict Layer Hypothesis. To the two clauses in 24 I propose to add 55:44

(55) ORGANIZING PHRASE HYPOTHESIS:
Units at a given level of the prosodic hierarchy, X\textsuperscript{p}, may be hierarchically organized into constituents X\textsuperscript{p}'.

I will call the hypothesis that phonological rules apply discretely (in the sense intended above) the Discrete Level Hypothesis, given in 56:

(56) DISCRETE LEVEL HYPOTHESIS:
Phonological rules do not have access to hierarchical distinctions within levels of the prosodic hierarchy.

The model proposed here thus allows for nested phrases, but it still has the effect of the Strict Layer Hypothesis in terms of the operation of phonological rules, which are blind to the nesting of phrases within a prosodic level.

The prosodic structures discussed above are derived from syntax by a mapping procedure which has many affinities with mapping algorithms proposed in connection with other languages. Phrasing at the lowest levels is influenced by the presence of right edges of syntactic constituents, but the overriding influence is geometrical: two-word phrases are preferred, subject to further division in prominent prosodic positions and to simplification in embedded positions. At the higher levels, grouping of phrases is influenced by a variety of factors which have been observed also in modern languages, including syntactic constituency and considerations of rhythm and balance.

FURTHER CONSEQUENCES OF A PROSODIC VIEW OF THE ACCENTS

8. A prosodic view of the Tiberian system of accents can put in a new light some puzzling features of the accentual representations themselves. In this

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43 See Khan (1987:44–80) for evidence bearing on the phonetic (but nonphonemic) lengthening of stressed vowels with disjunctive accents.

44 Ladd (1992) also proposes to modify the Strict Layer Hypothesis to allow limited recursion of phrases at the same level, though he does not distinguish between substantive and organizing phrases.
section we will consider two such problems. The first concerns a long-standing controversy over whether two occurrences of a repeated accent in the same verse represent equal or unequal disjunctures, and the second concerns the apparently anomalous behavior of the D3 level of accents.

Both these issues involve the labelling of the prosodic tree. In the Tiberian system, construction of a prosodic tree must be to some degree independent of labelling. We have already seen much evidence that there is no consistent match between a syntactic boundary and a level of the prosodic hierarchy. Moreover, prosodic representations derived from the initial mapping procedure are subject to a series of readjustments which affect constituent labels. I have discussed accent assignment informally so far, and the general principles should by now be fairly clear; however, it is now necessary to consider this topic more systematically. We shall begin, therefore, with a brief account of how accents are assigned to a prosodic tree.

8.1. Labelling the Prosodic Tree. The assignment of accents is determined mechanically by the geometry of the prosodic tree, as indicated in 57. Although accents appear on words, it is useful to treat them as being assigned to phrasal nodes.

(57) Assigning accents to words:
   a. Accents are assigned to all nodes of the prosodic tree.
   b. There are four levels of disjunctive accents, D0, D1, D2, and D3.
   c. An accent assigned to a node percolates down its right branch.
   d. The left branch of a node with accent $D_i$ is assigned accent $D_i + 1$, with the following exceptions:
      (i) a D3 phrase is divided by D3;
      (ii) the first left daughter under the root node of the verse is usually assigned D0.
   e. At each level except D0, there is one nonfinal accent which may be repeated, and a terminal accent designated $D_i f$ (f = final).
   f. When the left branch dominates a word, it receives a conjunctive accent.

An accent percolates down the rightmost daughter of the node it is assigned to.\(^45\) The derivation of the accents in the schematic example 2d is illustrated in 58, which shows the tree in 2d, this time with intermediate nodes labelled. Proceeding down from the root node A, each half of the verse is assigned a D0 accent. There are only two such accents: one terminates the first half of the verse and percolates down to W4, while the other terminates the whole verse and is realized on W9. The assignment of D0 accents represents a special case and is not subject to the typical pattern which holds at the lower disjunctive levels; it is exemplified here in the division of the half-verses B and C. Each half-verse branches. Since the half-verses terminate with D0, their left branches are assigned D1. In the first half-verse, B, no further division into C-phrases occurs, hence W2 is assigned D1. In the second half-verse, the left branch

\(^{45}\) See Dresher 1981a for a more detailed discussion.
(node D) is itself divided, and so its left branch is assigned D2. Hence, W5 receives a D2 accent, and D1 percolates to W7.

(58) Tree representation (2d) with intermediate nodes labelled:

\[
\begin{array}{cccccccc}
\text{A} & & & & \text{B} & & & \text{C} \\
| & & & & \text{D0} & & & \text{D0} \\
| & & & & \text{E} & & \text{F} & \text{G} \\
| & & & & \text{D1} & \text{D0} & \text{D2} & \text{D1} \\
| & & & & \text{W1} & \text{W2} & \text{W3} & \text{W4} \\
| & & & & \text{C} & \text{D1} & \text{C} & \text{D0} \\
\end{array}
\]

8.2. BRANCHING ASYMMETRIES. Inherent in this system is an asymmetry between left-branching and right-branching structures, shown schematically in 59. The Pi in 59 represent C-phrases, leaving out the words they contain. In the left-branching 59a, each Pi occurs at a more important boundary than the phrase before it, and thus terminates in a greater disjunctive. In this example, the level of each disjunctive accent mirrors the relative importance of the boundary it marks. By contrast, in a right-branching structure such as 59b, phrases P1, P2, and P3 are all assigned the same level of disjunctive accent, despite the fact that they do not occur at equally important boundaries. This is because each of these phrases ends a constituent which is the left sister of a D0 phrase. According to Wickes (1887:31), even when the same accent is repeated, ‘from the very nature of the continuous dichotomy, IT LOSES IN DISJUNCTIVE VALUE EACH TIME OF REPETITION’ (emphasis in original).

(59) a. Left-branching structure:  
b. Right-branching structure:

\[
\begin{array}{cccccccc}
P1 & & & & P2 & & & P3 \\
P3 & & & & P4 & & & \\
D3 & D2 & D1 & D0 & & & & \\
\end{array}
\]

\[
\begin{array}{cccccccc}
P1 & & & & P2 & & & P3 \\
P3 & & & & P4 & & & \\
D1 & D1 & D1 & D0 & & & & \\
\end{array}
\]

There is no doubt that in many verses a series of repeated accents marks decreasingly important syntactic breaks. Some typical examples are given in 60.

(60) Repeated accents, unequal syntactic breaks:

a. that we may be distinguished, I and Your people D1 from every people D1 that (is) D1f on the earth (Ex. 33.16)
b. And he said I brought you up from Egypt D2 and I brought you into the land D2 which I had promised D2f to your fathers (Jud. 2.1)46

In 60a the main syntactic and semantic division (not counting the break after the verb, which is downgraded according to principles of phrasing discussed above) is marked by the first D1 (‘distinguish NP1 D1 from-NP2’). The second D1 indicates an internal division in the noun phrase, marking off the relative clause. The final D1 divides the relative marker from the rest of the clause. Similarly, in 60b we have a series of D2 accents. Excluding the introductory formula, which is usually subordinated, the first D2 divides the phrase into two parallel parts (‘I brought you up from X D2 and I brought you into Y’). Subsequent D2 accents mark increasingly subordinate divisions. As commonly understood, then, a sequence of accents of equal level corresponds to a right-branching tree, as in 59b.

The geometry of the tree in 59b is influenced by our knowledge of syntactic and semantic relations. On the phonological side, however, I am aware of no evidence for Wickes’s assertion that a repeated accent loses in disjunctive value each time it is repeated. In particular, there do not appear to be any phonological or prosodic phenomena that require us to distinguish between repeated disjunctive accents of the same level.47 Indeed, if we take them at face value, we would expect a series of repeated accents to mark off equal prosodic boundaries. Interpreting the geometry of prosodic trees as dictated by the accents and not by our own sense of the syntax, we would leave left-branching trees such as 59a intact, since the accents indicate different hierarchical relations; but right-branching trees such as 59b can be further transformed in prosodic structure so that equal accents mark off equal constituent breaks, as in 61.

(61) Division into equal phrases:

```
P1 P2 P3 P4
D1 D1 D1f D0
```

It follows that there is no difference, in the Tiberian system, between the representation of a right-branching structure and an n-ary branching structure. It is therefore not necessary to insist, with Wickes, that every sequence of

46 Because there is a rule that transforms the D2 accent revia into the D2f pashta when it closely follows another revia, the actual sequence of D2 accents in this verse is revia pashta revia pashta, i.e. D2 D2f D2 D2f. Except for its melody, the transformed second accent acts no differently from a regular D2, so it is considered a D2 rather than D2f.

47 This discussion concerns repeated accents at a level and does not include the final accents, as the difference between final and nonfinal accents does appear to be prosodically significant. This is shown by the fact that some of the prosodic readjustment rules distinguish between them. Moreover, the fact that they have a special form suggests that there may be significant prosodic differences between final and nonfinal accents (perhaps excluding final accents which are actually nonfinal, as mentioned in n. 46).
equal accents must correspond to a right-branching structure. Indeed, some students of the accents (e.g. Price 1990) have seen in this claim an artifact of Wickes’s own theory, and have suggested that in some cases the accentuators may have intended to indicate n-ary branching phrases, with no subordination of a disjunctive accent to a preceding one of equal rank. Some cases where such a parsing is plausible are given in 62, where the repeated D1 accents may correspond to equal syntactic breaks.

(62) Repeated accents, equal syntactic breaks:

a. *And if a person is an enemy of another D1 and lies in wait for him and sets upon him D1 and strikes him D1f and he dies* (Deut. 19.11)

b. *Baal-hanan died D1 and Hadad succeeded him as king D1 and the name of his city D1f (was) Pai* (1 Chr. 1.50)

The issue is complicated by the fact that syntactically parallel phrases are typically arranged in groups to create balanced phrases, as in 63.

(63) Parallel syntax, uneven accents:

\[
\text{limdu} \ h\text{heth} \ D2 \ dir\acute{s}u \ \text{mispat} \ D1 \ ?\text{as}s\acute{r}u \ \text{hamos} \ D0
\]

Learn to do good demand justice aid the wronged

\[
\text{sigtu} \ y\text{atom} \ D1 \ \text{ribu} \ D1f \ ?\text{almana} \ D0
\]

uphold the rights (of) the orphan defend the widow (Isa. 1.17)

In 63 a series of five parallel clauses is organized into two main groups, with the extra clause joining the first group. The first group of three clauses is then organized into a left-branching structure so that the main break within the half-verse comes after the second clause. Therefore, the distribution of accents in such verses does not bear on my claim that accents of equal rank have equal prosodic value, a claim which leads to the conclusion that we cannot distinguish right-branching structures from n-ary branching ones.

48 Janis (1987:77) proposes that multiple-branching structures are equivalent to left-branching structures, and not to right-branching structures, as is suggested here. Such an interpretation, however, appears to contradict the logic of the accentual system, in that accents of unequal rank must be considered to be prosodically equal, while accents of equal rank are prosodically unequal. Further, the representations which follow from this theory do not allow for as good an account of prosodic readjustments, which suggest that phrases ending in a lower disjunctive are nested in phrases ending in a higher disjunctive.

49 Ladd (1988, 1992) reports a result which may bear on this issue. He observes that in sentences of the form A and B but C and A but B and C, where A, B, and C represent clauses, the F0 and pause-duration cues preceding the but boundaries are greater than those preceding the and boundaries, suggesting the prosodic organization in (i)a,b:

(i) a. ((A and B) but C) b. (A but (B and C)) c. (A but B and C)

\[
\text{a. D2f D1f D0 b. D1 D1f D0}
\]

Ladd notes an asymmetry in his results: the differences between the and but boundaries are more noticeable in the left-branching structure, (i)a, than in the right-branching one, (i)b; the latter more nearly approximates an n-ary branching structure, (i)c.

Ladd is cautious about the significance of this finding, but it is intriguing when juxtaposed with Tiberian accentuation. If these structures were assigned Tiberian disjunctive accents, they would appear as in (ii); note that the boundaries of the left-branching structure (ii)a have accents of unequal rank, but the boundaries of the right-branching structure (ii)b have accents of equal rank. These parallels, and similar asymmetries in the shape of French melodic contours, suggest that there may be a general asymmetry between left-branching and right-branching prosodic structures.
Further investigation may yet turn up evidence bearing on whether two accents represent equal or unequal disjunctures. However, such evidence must be drawn from the phonology side of the grammar, broadly defined, and not from syntax or semantics. The reason is that the accents themselves are units in a prosodic representation which is nonisomorphic to syntax in many ways.

8.3. The D3 Level of the Accents. Recognizing that the Tiberian accentuation system has a prosodic basis can help account for some apparently anomalous phenomena involving the lowest level of disjunctive accents. We observed above that the hierarchy of disjunctive accents runs out at the fourth level down, i.e. the level of the D3 accents. If a phrase demarcated by a D3 accent must be further divided, D3 accents are used over again as many times as needed. Some students of the accentual system have seen here a shortcoming in the Tiberian system, a failure to carry through the basic scheme all the way to the end.50 Whereas at the higher levels the sequence of accents indicates hierarchical relations unambiguously, a series of D3 accents is ambiguous, potentially corresponding to a number of different structures. For example, the sequence of D2 accents in 64a is uniquely derived from the right-branching tree in 64b (excluding for the moment the possibility of n-ary branching trees).

(64) Sequence of accents above D3 is unambiguous:
   a. (W1 W2)D2 (W3 W4)D2 (W5 W6)D2 (W7 W8)D1
   b. 

```
  /\   /
 /  \ /  \\
D - E - F - G
  \  /    \
 W1 W2 W3 W4 W5 W6 W7 W8
```

(65) Ambiguity of a sequence of D3 accents:
   a. (W1 W2)D3 (W3 W4)D3 (W5 W6)D3 (W7 W8)D2
   b. 

```
  /\   /
 /  \ /  \\
D - E - F - G
  \  /    \
 W1 W2 W3 W4 W5 W6 W7 W8
```

50 See, for example, Breuer (1982:76) and Aronoff (1985:63).
By contrast, the sequence of D3 accents in 65a may be derived from the same structure, but it need not be; the trees in 65b or 65c would yield the same sequence. As Breuer (1982:76-77) points out, the D3 accents to all intents and purposes divide phrases into equal parts. If we view the accentual system as being designed to indicate unambiguous logico-syntactic relations, then the lack of levels below D3 would indeed be a flaw in the system.

From the perspective of prosodic representation, however, the matter appears different. Recall that from the point of view of current approaches to prosodic representation, the accentual system above the level of D3 appears to be overarticulated. It is the ‘flattened’ D3 level, not the articulated structure of the higher levels of the system, that most closely corresponds to notions of phrasing that accord with the Strict Layer Hypothesis. It may be, then, that the Tiberians stopped at the D3 level not simply because of the practical difficulties of adding new levels of accents (with new melodies), or out of failure to complete the system, but because they intended to. Just as in the case of perception of stress levels, there is a ceiling effect in the perception of prosodic distinctions. Since the distinctions at the D3 level are already attenuated, any further distinctions which might theoretically exist may have been deemed to be irrelevant for purposes of phrasing.

This interpretation of the D3 level helps to account for a peculiar pattern of simplification which has long appeared to be a quirky, even antilogical, aspect of the Tiberian system. This case involves the transformation of one of the D3 final accents, known as GERESH, into a conjunctive accent (via simplification), even where what appear to be more minor divisions in the domain of geresh are preserved. Consider the example in 66:

(66) Simplification of phrase marked by geresh:

\[
\text{w\text{"e}h\text{"e}nip} \quad \text{hakkoh\text{"e}n \text{"o}t\text{"a}m} \quad \text{\text{"a}l le\text{"e}hm habbikk\text{"u}rim}
\]

and shall elevate the priest ACC.these with bread the first fruits
t\text{"o}n\text{"u}p\text{"a}
elevation offering ...

‘The priest shall elevate these together with the bread of first fruits as an elevation offering....’ (Lev. 23.20)

a. Initial phrasing (with some D3 simplification):

\[
((\text{w\text{"e}h\text{"e}nip} \text{hakkoh\text{"e}n \text{"o}t\text{"a}m})D3 (\text{\text{"a}l le\text{"e}hm habbikk\text{"u}rim}))D3f (\text{t\text{"o}n\text{"u}p\text{"a}}))D2
\]

b. Simplification of geresh:

\[
((\text{w\text{"e}h\text{"e}nip} \text{hakkoh\text{"e}n \text{"o}t\text{"a}m})D3 (\text{\text{"a}l le\text{"e}hm habbikk\text{"u}rim \text{t\text{"o}n\text{"u}p\text{"a}}}))D2
\]
In the initial phrasing of this example (66a), the outer disjunctive (D3f) is divided by the inner one (D3). At any higher level of the disjunctive hierarchy, the inner disjunctive would be at a lower level than the outer one; but since there is no D4 level, the D3f phrase is divided by another D3. Despite this logical relation between the two D3 accents, the outer D3 disjunctive (D3f) is simplified (66b), but not the inner one. The result is a rebracketing of the phrases, as shown in 67. Simplification here appears to demote a major division (between words 6 and 7) while leaving intact a more minor one (between words 3 and 4). However, if successive D3 accents indicate equal phrases, as in 68, the change is not so paradoxical: the readjustment of the tree in 68 does not reverse prosodic relations.

(67) Rebracketing due to simplification:

(68) Simplification with equal D3 phrases:

Indeed, the phrasing indicated by the accents actually leads us to expect this pattern of simplification. Recall that a sequence of accents of the same level is usually interpreted as a right-branching structure (cf. 64b), which, as I argued above, is indistinguishable from an n-ary branching structure. If this interpretation is extended to the D3 level as well, the restructuring would look like 69.

(69) Simplification of D3 phrases, right-branching structure:
It follows that the mapping of syntax to prosodic structure does not preserve the original syntactic or logical hierarchical distinctions at the D3 level because these are not relevant to the phrasing. Sequences of D3 accents, however derived, are interpreted in the canonical fashion, i.e. as a right-branching structure.

THE TIBERIAN TRANSCRIPTION AS LINGUISTIC DATA

9. The mapping from syntactic to prosodic structure in Biblical Hebrew is quite complex, and a question naturally arises as to what extent this complexity is a true reflection of processes found in natural language. Might it not rather be attributed to special circumstances pertaining to the Biblical texts, circumstances which perhaps do not extend to normal spoken language?

I will consider here two reservations along these lines. First, it has been argued that the Masoretic system does not reflect an earlier pronunciation, but is to some extent an artificial creation. To the extent that this is so, at least some of the complexity of the system may be attributed to the work of the grammarians. Even if one does not hold, with Kahle (1961), that much of the vocalization was created by the Masoretes, one might still be skeptical about certain details of the phrasing, as well as the phonology that depends on it (cf. Aronoff 1985, cited above). Thus, even conscientious conservers of traditional practice might, in matters of fine detail where judgments may be uncertain, allow their theory to decide what the proper pronunciation should be; to the degree that the theory is flawed, the results will be a deviation from any actual preexisting practice.

While such a possibility can never be excluded, our best guide, short of further philological or historical investigation, is the overall naturalness of the system as we find it, viewed in the light of other languages known to us. I have argued above that what appears to be an unnatural system from the point of view of syntactic representation is more natural in the light of prosodic representation. There is thus no reason derived from linguistic theory to doubt that the Tiberian transcription reflected actual recitation with reasonable accuracy.51

A second type of reservation rests on the musical aspect of Biblical recitation. It has been suggested that certain properties of the accentual system are to be attributed to musical influence; hence, even if we grant the basic accuracy of the Masoretic system, the fact that the text was chanted may result in phrasings that are uncharacteristic of ordinary language. There undoubtedly are musical influences on the choice of accents. However, the clear instances of these have not been discussed here, as they typically involve the substitution of one accent for another of the same rank in certain contexts, and hence have no effect on phrasing or on phonology. Moreover, such musical effects are also often characterized by contexts that play no role in Hebrew phonology.

51 It is not necessary to stress that every transcription implies an abstraction from data, and hence a ‘theory’ which affects every aspect of the transcription (e.g. how many distinctions to recognize). In these matters, then, there is no clear-cut distinction between a pure theory on one side and a pure phonetic record on the other.
For example, the D2 accent PASTHA is replaced by YETIV, an accent of equal disjunctive value, when it would be due on a monosyllable. Wickes (1887:106) proposes that 'the substitution is entirely on musical grounds. In the chanting of Pashta's word, an ANACRUSIS or APPOGGIATURA was needed, when the tone came on the FIRST LETTER and no servus preceded.' This substitution would be hard to explain on phonological or prosodic grounds, especially since the distinction between monosyllables and polysyllables (unlike the distinction between long and short words) does not correspond to any independently needed phonological or metrical distinction. Indeed, even vocal schwa could count as a first syllable, contrary to the treatment of schwa in the phonology: compare wəʔš‘and a man' (Ex. 34.3) with pashtə and ʔš‘a man' (Ex. 12.4) with yetiv. This substitution, then, relates to the musical side of the cantillation, and has no consequences for phonology or prosody.

By contrast, the prosodic transformations discussed in this article, which do have such consequences, are also sensitive to categories that have independent phonological (notably metrical) or prosodic status—e.g. a long word (i.e. parsable into at least two feet) or the end of a major phrase. They are thus integrated into the phonological/prosodic system in a way that the purely musical transformations are not. While this does not show conclusively that there was no musical influence here as well, it does count against a purely musical interpretation of these phenomena.

An example of a prosodically relevant example which may show limited musical influence is Division Rule 1, which requires that a D0 accent must always be preceded by a D1 accent. Most scholars agree that there is a strong musical influence here, since the melody of D0 must have required a foretone (or cadence), supplied by D1f. Even if this is so, it is surely not an accident that a cadence is required precisely at a major prosodic break. In this case the musical requirement serves to heighten and make obligatory a tendency that already exists in ordinary speech.52

To sum up, there is reason to suppose that the system described above is based on a careful transcription of a tradition of formal recitation. Such formal speech may differ in some respects from casual everyday language with respect to its prosody. However, such differences, as elsewhere in the case of formal speech, most probably represent a heightening and exaggeration of certain features of ordinary speech, rather than a total departure from it. If this interpretation is correct, then we might expect some of the complexities of Masoretic prosody to occur in other languages as well.

CONCLUSION

10. I have argued that the Tiberian Hebrew system of accents is best understood as a prosodic representation. Viewing it as such accounts for a number of its characteristics that otherwise remain elusive: (a) why the structure indicated by the accents resembles syntax but deviates from it; (b) why phonology nevertheless follows it; (c) why the deviations from syntax take the form that

Cf. Khan (1987:47 n. 74): 'In the Biblical Hebrew reading tradition the musical accents underscored prosodic features which were inherent to the language.'
they do; (d) why the placement of pausal forms could not be consistently assigned to a specific level of the Tiberian system; (e) why the disjunctive accents run out at the fourth level; and (f) why there is a peculiar pattern of simplification at the fourth level.

Conversely, the Tiberian transcription can contribute in a number of ways to the development of prosodic theory. First, with over 23,000 verses meticulously transcribed and phrased, the Hebrew Bible provides us with a rich source of data. Second, the transcription reveals that in Tiberian Hebrew, and hence possibly in other languages as well, the mapping from syntax to prosodic structure is not based on a fixed correspondence of designated syntactic constituents and prosodic levels, but rather varies with the geometry of the prosodic tree. And third, the Tiberian notation provides an elegant mechanism for capturing this variability, in terms of nested organizing phrases.

We have only begun to investigate phonology above the word and the mapping from syntax to prosody. The modern language data which have been looked at with regard to this question have been relatively restricted when compared with the data supplied by the Biblical corpus. A prosodic interpretation of the Tiberian transcription suggests aspects of prosodic structure which remain to be explored. It may be expected, in turn, that continuing study of the prosodic structure of modern languages will shed more light on the prosody of Biblical Hebrew and on the Tiberian system of accents.

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