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Rhythm and Vocalic Drift in Munda and Mon-Khmer

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Abstract:

Opposite rhythmic principles are responsible for the opposite typological tendencies of the Southeast Asian (Mon-Khmer) and Indic (Munda) branches of the Austroasiatic language family. The phonological divergence between Mon-Khmer and Munda is largely the result of stress-timing in Mon-Khmer and mora-timing in Munda; their vowel phonologies, especially, show how the two branches represent opposite phonological types. Mon-Khmer and Munda differ sharply in their vowel phoneme inventories, and also in the kinds of phonological processes that have applied throughout their histories. The phoneme inventories and process types of Mon-Khmer and Munda parallel those of other stress- and mora-timed languages, respectively, and they illustrate particularly well that rhythmic type is the most revealing and unifying aspect of phonological type.*

1. Unlikely cousins.

The genetic relationship of the Indian and Southeast Asian members of the Austroasiatic language family has been clearly established (Schmidt 1906, Pinnow 1959, etc.), but the respective branches are so opposite in structural type that Sir George Grierson (1904) remarked that it seemed that the original language had been adopted by races with opposite laws of thought. As outlined in Donegan and Stampe (1983), this polar oppositeness extends to every level, from syntax to phonology:[1]

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* Anyone who is familiar with the work of David Stampe will realize that many of the ideas on prosody presented here are his. I thank him for his help with many aspects of this paper. Any mistakes, of course, are my own.

1 Munda data cited in this paper, if not credited otherwise, are from online dictionaries and field notes and recordings for most of the languages by myself and David Stampe. The analysis of Sora cited here is from a phonological description I am preparing.

	MUNDA	MON-KHMER
Phrase accent:	Falling (initial)	Rising (final)
Word order:	Dependent-Head (SOV, AN, postpositions)	Head-Dependent (SVO, NA, prepositions)
	Variable	Rigid
Syntax:	Case, Verb agreement	Analytic
Word Canon:	Trochaic, Dactylic	Iambic, Monosyllabic
Morphology:	Agglutinative, Suffixing, Polysynthetic	Fusional, Prefixing or Isolating
Timing:	Isomoric	Isoaccentual
Syllable Canon:	(C)V(C)	(C)v or (C)(C)V(G)(C)
Consonantism:	Stable, Geminate clusters	Shifting, Tonogenetic, Non-geminate clusters
Tone/Register:	Level tone (Korku only)	Contour tones, Register
Vocalism:	Stable, Monophthongal, Harmonic	Shifting, Diphthongal, Reductive

It will be evident that these characteristics are also characteristic of most languages of the Indian and the mainland Southeast Asian linguistic areas, respectively. It is usual to explain such areal uniformities in terms of language contact. But while contact might explain why the characteristics of each area should be similar, it can hardly explain why the characteristics of the Indian area and those of the Southeast Asian area should be opposite at every level. Explaining this requires some opposite trait that pervades every level of structure and could thus coordinate the polar drift that is implied here. There is only one trait that could do this, and it is falling vs. rising accent.

In our 1983 paper, we argued from the nature and ordering of ancient Austroasiatic elements frozen in the innovated inflectional morphology of various Munda languages, that Austroasiatic must have originally had a typology resembling that of current-day Mon-Khmer languages, and that it was Munda that innovated. We rejected the view occasionally expressed by those unfamiliar with Munda that most of the innovated morphological complexity of the Munda languages developed under Dravidian influence and argued, instead, that this morphology developed independently. We further claimed that the complete reversal of structure that occurred in Munda began with a single change from rising to falling accent.

I will describe that change below, and briefly sketch how it led to a reversal of Munda structure. Then I will take up in detail the opposite phonological tendencies of Munda and Mon-Khmer, and their basis in their opposite prosodic structures.

2. Opposite accentuations, opposite structures.

In languages generally, new or asserted information takes the accent vis-à-vis old or presupposed information, and since the dependent element in a phrase presupposes the head of the phrase, the dependent typically gets the accent vis-à-vis the head. The tendency toward consistent ordering of dependents relative to heads in phrases (verbs relative to auxiliaries, objects to verbs, adverbs to verbs, adjectives to nouns, nouns to pre- or postpositions, etc.) can thus be viewed as a reflection of a deeper tendency for rhythmic regularity. Languages with falling (initial) phrase accent typically have a predominantly dependent-head word order, while languages with rising (final) phrase accent have head-dependent order.[2]

Furthermore, a change of word order type is accompanied by a corresponding change in the position of phrase accent. The best known example is the drift of most Indo-European languages, outside of India, from dependent–head to head-dependent order, with accompanying shifts from falling to rising phrase accent.

Falling accent and dependent–head word order are typical of Australia, India, central Asia, and northern Eurasia, while rising accent and head–dependent word order are typical of Africa, Southeast Asia, the Pacific, and modern Europe. The falling vs. rising rhythms are particularly noticeable in verse and song, and may even be reflected in the use of phrase initial rhyme (alliteration), as in the falling structures of Uralic or Old Germanic, vs. phrase final rhyme (end rhyme), as in the rising languages of Chinese or Thai or modern Germanic.

Proto-Austroasiatic had rising accent and head–dependent word order, like Mon-Khmer. Munda languages reversed the structure to falling accent and dependent–head order, but preserved the old word order in the morpheme order of complex words, as in these examples from Sora:

bɑ -ɲɛn	vs.	ɑnin bɑn	
at me		him at	
'at my place'		'at his place'	

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2 Dependent–head order is often called OV order (object–verb order), and head–dependent order, VO order. But those are not very apt terms, because the order of object and verb is among the first to change; thus Finnish has consistent dependent–head order except verb before object, while Khamti (Tai) has consistent head–dependent order except verb after object.

ədrɛ-im	-ən	vs.	kənsim-ən	ə	ədrɛ-n
egg -chicken	-art.		chicken -art.	poss.	egg-art.
'chicken egg'			'chicken's egg'		

kəɲid-im	-t	-e	-n	vs.	kənsim-ən	kəɲid	-t	-ɛ
kill -chicken	-pres.	-3	-intr.		chicken -art.	kill	-pres.	-3
'kills chicken'					'id.'			

Munda languages not only reversed the accentuation and syntax of Austroasiatic; they also moved from analytic structure with only derivational morphology, to synthetic or even polysynthetic structure with rich inflectional morphologies which include subject and verb incorporation (or at least agreement), case marking, and a far greater freedom of word order. A predominantly morphological grammar like this seems to be typical of dependent–head order. It seems inescapable that head-last order is difficult to process syntactically, and that that difficulty is overcome by 'flattening' syntactic clauses into phrases or even words, as in the one-word Sora conditional:

əd-	paŋ	-im	-l	-e	-n	-ay	-en	-ji	-dɛn
not-	carry	-chicken	-past	-3	intr.	-cislocative	-subjunctive	-pl.	-if

i.e. if they had not brought the chicken

or by using agreement and case, as in the (equivalent) Sora clause:

anin	-ji	kɛnsim	-ɛn	ə-dɔŋ	əd-	paŋ	-l	-ɛ	-n	-ji	-dɛn
he	-pl.	chicken	-art.	object	not-	carry	-past	-3	-subj.	-pl.	-if
				[lit. its body]							

If morphologization and head-last order were not already clearly associated in the world's languages, the rich flowering of morphology in each of the Munda languages, once they had adopted head-last order, would certainly make the association clear.

Like Mon-Khmer languages, Proto-Austroasiatic seems to have had only prefixes (occasionally infixed).[3] Some other head-first languages of mainland Southeast Asia (Tai, Chamic) allow only prefixes. On the other hand, many head-last languages (Dravidian, Uralic, etc.) allow only suffixes. Similarly, new

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3 Nicobarese alone among the Mon-Khmer languages has some suffixes, but they do not correspond to Munda suffixes, and therefore cannot be attributed to Proto-Austroasiatic.

affixes developed in Munda are mainly suffixes, though some prefixes (and infixes) of proto-Austroasiatic are retained. Some of the inherited prefixes even shift to suffix position (e.g. the proto-Austroasiatic nominalizing n- prefix or infix has become in Sora an article suffix on nouns as well; both uses are illustrated in j-ən-om-ən 'eating' from jom- 'eat').

These opposite preferences for affixation do not depend directly on opposite orderings of words, but rather on opposite accentuations of words. The distinction between rising and falling accent in phrases is usually copied in the accentuation of words. That is because a phrase can consist of a single word. Proto-Austroasiatic, like Mon-Khmer (and other mainland Southeast Asian languages) had rising accent not only in phrases but also in words. Munda shifted to falling accent not only in phrases but also in words. This indirect association of head-first order with rising word accent and head-last order with falling word accent is the default in most of the world's languages, and it is in turn responsible for the association of head-first order with prefixing and head-last order with suffixing, as first pointed out by Greenberg (1963). Accent is normally reserved for lexical formatives (nouns, verbs, adjectives) rather than grammatical formatives (adpositions, clitics, affixes). To keep affixes away from the accent, it is natural for rising-accented languages to prefix them and for falling-accented languages to suffix them. It has been frequently noted that case markers are normally suffixed. We can now see why that is so: since it is head-last languages that require case marking, and since head-last languages are falling-accented, their case markings are suffixed.

Although Munda accent is word-initial, in iambic words, i.e. words in which a light (open) initial syllable precedes a heavy (closed or long-voweled) second syllable, most Munda languages treat the light initial syllable as an anacrusis or pickup syllable, and put the heavy second syllable on the accent, as in Sora əbɔ́y 'one'. Disyllabic words of iambic shape thus have accent on the final syllable. In Munda such words are common enough that some observers, noting this final accent but not investigating what kind of rule puts it there, have concluded that Munda languages have final accent. But if additional syllables are added to such words in Munda, the accent stays on the second syllable from the beginning of the word. It does not track the end of the word, as in a suffixing but rising accented language like English: *géo, geómetry, geométric, geometricálity*. Furthermore, in Munda words with balanced light or balanced heavy syllables, we find initial accent, as in many of the Sora numbers 'two' to 'twelve': bɑgu, yɑ́gi, únji, mɔ́nlɔy, túdru, gúlji, tɑ́mji, tínji, gə́lji, gə́lmuj, mɨ́jgəl.

In Sora, əbɔ́y 'one' can optionally take initial accent, but in that case the syllabic ə lengthens and lowers to ɑː, a neutralization: [ɑ́ːbɔy].

Accenting the initial light syllable of an iamb not only obscures the phonology, it may also obscure the morphology, since the initial light syllable is often a (C)V- prefix, as in ə-yə́ŋ-ən 'his/her mother', and to accent it would background the root. Where a prefix has a VC- rather than a CV- form, it is typically infixed after an initial consonant: ər-éd-ən 'scratching instrument' (ed- 'scratch'), but j-ər-óm-ən 'eating instrument' (jom- 'eat'). Infixing a VC-prefix avoids creating a closed (heavy) syllable, which might attract the accent away from the root: *ə́r-jom-ən. This is presumably the reason why, not only in Austroasiatic but also in Austronesian languages, VC- prefixes are infixed in C-initial words.

In proto-Austroasiatic, all words seem to have had an iambic or monosyllabic structure. This structure remains typical of Mon-Khmer languages, and indeed it is typical also of the Tai, Chamic, and southern Sinitic languages of Southeast Asia. Shorto (1960) described the word in the Mon-Khmer language Palaung as consisting of a heavy 'major' syllable, preceded by an optional light 'minor' syllable. The major syllable is heavy, so its two moras fit into the accent: the rising accent is word-final. (We can contrast this with the rising accent of a language like Hawaiian, which also puts the last two moras of the word under the accent, but since those moras may be distributed over two syllables, e.g. *púka* 'hole' as well as one, e.g. *kâi* 'ocean', the word accent can be penultimate as well as ultimate.)

The minor syllable, if any, is left out of the accentual measure. It always has the anacrustic treatment typical of iambic words in Munda: like a pickup note in music, it lacks prosodic value: it can lose its vowel with no rhythmic effect on the following accented syllable. In Mon-Khmer, and probably proto-Austroasiatic, the vowels of such syllables have come and gone, i.e. the minor syllables have varied with initial consonant clusters. Indeed, Vietnamese and Muong have lost the minor syllables entirely, so that only stressed monosyllables remain.

In Munda, on the other hand, except in iambic words, initial syllables have been preserved, or perhaps even created through epenthesis in initial clusters, by the initial accent. Proto-Austroasiatic *bəlúː 'thigh' preserves mainly its final syllabic in many Mon-Khmer languages, e.g. Khmer *bhlau (phlou)*, Palaung *blau, bleu*, but it retains the initial syllabic in Munda languages, e.g. Santali, Mundari, Sora búlu, and in some cases may lose the final one, as in the Sora combining form -bul. Only in iambic words may Munda languages lose the vowel of the initial syllable, either just in allegro speech, as in Sora tərɨb ~ trɨb 'cloud', or generally, as in the Gtaʔ language, whose monosyllabic name is cognate with the name of its sister language Gutob.

3. Rhythm: word, syllable, or mora isochrony.

The precise coordination of gestures required in speaking and other intentional action depends on a neural metronome that emits a flexible but regular pattern in real time, onto which we map intended words and phrases for articulation. The shortest unit in this inner rhythmic pattern that is relevant in speech, verse, and song is the time needed to pronounce a short syllable, which I will refer to by the Greek prosodic term **mora**. But the shortest unit of time required to pronounce an independent word is two moras long, and I will refer to it by the musical term **beat**. As I shall use the term, a beat consists of two moras, the first strong and the second weak. When we map a word like *steady* onto a beat, the first syllable is mapped onto the first mora and the second syllable onto the second mora. Even a one-syllable independent word, like *stead*, must be mapped onto a whole beat, and it is prolonged to fill that beat. Even if there is no unaccented syllable to compare it to, we feel that the one-syllable word is accented. Some speakers, in prolonging the syllable, break it into two syllables, stɛəd, and in that case it is always the first syllable that is heard as accented.

A pair of beats, again ordered strong and weak, combine into a **measure**, as in English *báby-sìtter, báby-sìt, hóuse-sìtter, hóuse-sìt*. Note that there is a subtle lengthening of *sit* here when it is the only material in a beat. This temporal compensation is the basis of the widely attested sound change that lengthens an accented syllable when a following unaccented syllable is lost.

A pair of measures, strong and weak, combine into a larger measure, as in English *élevàtor-ôperàtor*, etc. And so on, creating a hierarchical binary rhythmic structure. The last example, equivalent to a bar of common time music, may represent an upper limit of purely rhythmic perception, but with intonational support, such as the slight rise at the end of the falling intonation characteristic of measures in Korean, very long measures can be perceptible. In falling-accented languages, where the falling measure structure matches the suffixing morphology and head-last syntax, phonological processes may operate over long measures. A Munda example is the spreading of low tone in Korku from its lexical locus through the last syllable of the measure.

The part of the syllable that is mapped onto the rhythmic pattern is only the 'rhyme', from the syllabic to the end. Any initial nonsyllabics, like the *st-* in *stead*, are treated as anacrustic, i.e. they have no rhythmic value. This is particularly audible in singing. Similarly, in *instead*, we treat the initial light syllable as anacrustic, like a pickup note in music, and map the main syllable onto a beat. Its extrametrical mapping is apparent when, in quick speech, we omit the anacrustic syllable—ˈ*stead* . But if the preliminary material is enough to fill a beat, as in *understand*, it is mapped onto the preceding beat: [ə̀ndr̩ |stǽnd] (the 'bar-line' here is meant to suggest that this rising-accented word straddles a measure in the inner rhythmic pattern). As these examples suggest, in rising type languages, where it is the final element of a word or phrase that is put on the accent, words and phrases are divided across measures, so phonological processes in those languages rarely have domains corresponding to whole words and phrases.

I have already mentioned the fact that Mon-Khmer languages treat 'minor' syllables as anacrustic, and that Munda languages do so with initial syllables in 'iambic' words like Sora əbɔ́y, but that there is sometimes the option to put the initial syllable on the beat. In that case, because the second syllable is heavy and cannot be squeezed into the beat, each syllable gets a beat, and the first syllable is lengthened: [ɑ́ːbɔ̀y]. In this falling-accented word, the entire word is within a measure in the rhythmic pattern. (As noted earlier, in Sora the lengthened ə is automatically lowered to ɑ, an intrinsically longer vowel, by a process that will be discussed later.) A word with two light syllables like bɑ́gu fits precisely into a two-mora beat, and a word with two heavy syllables like mɔ́nlɔ̀y fits precisely into two two-mora beats. The other misfit word type, tudru, with a heavy and a light syllable, is either given one beat, squeezing the first syllable, or two, stretching the second syllable.

The two-mora character of the beat is surely a human universal. It is echoed in the requirement, in ancient Germanic and Finnic metrics, that each of the four beats in a line must have either one long or two short syllables. It is responsible for the general lengthening of final vowels in accented monosyllables in Germanic, Austronesian, and some Japanese dialects; for the lengthening of a vowel or the gemination of a consonant in an accented light syllable in Scandinavian (so-called 'vowel balance'); for the shortening of a long vowel after an accented short syllable in prehistoric Latin (e.g. *égō > égŏ 'I'); for the shortening of the first element of compounds when the second element is shortened by the loss of accent in English (e.g. *wáistcòat* > *wéskĭt*, etc.); and countless other adjustments of words to the inner rhythmic pattern (Donegan & Stampe 1978).

Pike 1946, Abercrombie 1967, and others have drawn a distinction between 'stress-timed' languages, in which equal duration is allotted to each stress-group (for example, the words *stéad*, *stéady*, *stéadily* in English), and 'syllable-timed' languages, in which equal duration is allotted to each syllable. Dauer 1983 and Bertinetto 1989 summarize recent research. It seems particularly clear, from Kozhevnikov and Chistovich's work on production (1965) and Lehiste's on perception (1977), that the equivalences exist primarily in speakers' intentions and perceptions, and only secondarily in their actual speech. But that is true of phonology in general, and also of musical *performance.*

Let me put this in the context of the hypothesis that speech is mapped onto an inner rhythmic pattern. In our 1983 paper, Stampe and I conjectured that stress timing is an attempt to map each *word* onto an equal time in the rhythmic pattern. Since each word gets at least one beat, the intended and perceived durations of *stéad, stéady, stéadily* (and ignoring its pickup syllable, even (*in*)*stéad*) are equal regardless of the number of unaccented syllables. (In English, the three syllables of *stéadily* are squeezed into two moras, exactly as a triplet of notes is performed in the time of two in music. In many such words, like *ópera*, this triggers syncope: *óp'ra.* In early English, it led to shortening of the initial vowel: *sǎnity*, beside *sāne.*)

We proposed that the tendency to map each word onto a beat is a universal one, but that it can be realized fully only in languages in which the rhythmically relevant part of each word, the part from the accented syllabic to the end of the word, is sufficiently short and sufficiently invariable in length as to fit into one beat. This condition is most perfectly realized in languages of the rising pattern, and above all languages with accent on the final syllable, like the Mon-Khmer languages and other rising-accented languages of mainland Southeast Asia, in which the final syllable fits neatly into one beat, and a preceding syllable, if any, is treated as anacrustic.

We noted further that the one-word : one-beat condition is least perfectly realized in languages where the rhythmically relevant part of the word is long or varies in length, notably languages with accent on the initial syllable, or those allowing variable numbers of suffixes, particularly agglutinative ones, like the Munda languages or other falling-accent languages of the Dravidian, Uralic, Altaic, Korean, or Japanese type.[4] Rhythmic regularity—isochrony—in

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4 Stampe and I would include Turkic languages here, based on their alignment of the initial syllable with the downbeat, although they are described as having final accent. We believe that what is being heard as accent in Turkic speech is rising pitch at the ends of measures (as in Korean). And we include Japanese, though as is well known, it has a lexical pitch accent on various syllables; the syllable bearing the pitch accent, if it is not the initial one, is of only minor rhythmic import compared to the initial syllable, which is specially marked tonally only in the word-initial low tone of Tokyo Japanese, but which is clearly the syllable usually aligned with the beat in chants or hand-clapping games, and with bar lines in nursery and folk songs, and so on. We conjecture that exactly the same was true of proto-Indo-European, which has most of the characteristics of a falling type language, from syntax through phonology, despite having had a pitch accent that was positioned relative to the end of the word. This is the only explanation of why, despite their strong drift toward a rising typology, several daughter languages (Germanic, Celtic, prehistoric Latin) should have shown initial accent. As the nature

such languages cannot be based on the word, and so it is based instead on the syllable. Or more precisely, on groupings of syllables into beats, since even the canonical examples of syllable-timed languages invariably show binary groupings (an alternating accent, or, conversely, an alternating vulnerability to weakening by devoicing or reduction or deletion). Such a rhythmic pattern is perceived as syllable-timed.

But many such languages distinguish between light and heavy syllables. This may correspond to a distinction between syllables with short and long vowels, or a distinction between open and closed syllables, or both. In these languages, light syllables are normally mapped onto one mora, and heavy syllables onto two moras. Most Munda languages lack phonemic distinctions of vowel length, but all of them treat open vs. closed syllables as one mora vs. two. And a couple of languages, of which Sora is one, treat syllables with certain intrinsically short vowels (such as ə and ɨ) as one mora even if the syllable is closed. Whatever the details, it seems clear that in any typology of languages in terms of which units are treated as isochronous, we have to distinguish mora-timing from syllable-timing proper, which treats all syllables alike.

One respect in which mora-timed languages differ from both syllable-timed and stress-timed languages is when consonants in a cluster assimilate completely to each other, as in Sora mɔnlɔy 'five' → mɔllɔy (Tekkali dialect). Because the *n* in the first syllable is mapped onto the second mora of the first beat in the word, it retains at least a rhythmic distinctness when it assimilates to the following lateral. In a syllable- or stress-timed language where a syllable-final consonant does not have an independent association with a mora in the rhythmic pattern, complete assimilation of the consonant effectively deletes it (Hutcheson 1973). For this reason there are mora-timed languages in which all or most consonant clusters are geminates (by complete assimilation without deletion of geminates). And for the same reason, there are syllable- or stress-timed languages where all or most consonant clusters are non-geminates (by deletion of geminates without complete assimilation), or where there are no consonant clusters (by both complete assimilation and deletion of geminates).

Regarding the phonetic manifestation of accent, I will mention only stress and pitch. Stress accent seems to be a combination of greater effort and greater length. If speech is mapped onto a pattern of beats and measures, it is obvious that a stressed syllable can be lengthened only if other syllables in its beat are

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of rhythmic and melodic organization becomes clearer, even such readily accessible languages as English and French present many surprises.

shortened in compensation. This is precisely like dotted rhythms in music: the accented note is lengthened by half, and any other notes in the same beat are shortened by half. Falling-accented languages are typically mora-timed, and in that case there can be no lengthening of accented syllables, and so they mark accent, if at all, with pitch. But rising-accented languages, if they are stress-timed, are free to lengthen accented syllables, and they mark accent with stress. It is stress that encourages strengthening changes such as those in the Germanic consonant and vowel shifts. In Southeast Asia, stress has led to consonant shifts that left register and tone phonemic. As I will show, stress has had equally vivid effects on the vowel systems.

4. Vowel features and processes.

The features and symbols which will be used in the following discussion of phonological processes appear in Figure 1. The theory of vowel phonology assumed here (presented in Donegan 1978) is based on comparison of vowel substitutions—context-free and context-sensitive, synchronic, diachronic, and acquisitional—across a variety of language families. The context-free or dissimilative processes that apply in accented syllables are fortitions—processes which optimize the features of individual segments. These differ from lenitions (assimilations, deletions) which optimize segment sequences.

	-------Palatal-------		----------Non-Palatal----------		
	-----------Non-Labial-----------			--------Labial--------	
High	i	ɪ	ɨ	ʊ	u
Mid	e	ɛ	ə	ɔ	o
Low	æ	a	ɑ	ɒ̆	ɒ
	Tense	------------------Lax---------------			Tense

Figure 1.
Vowel Features and Symbols

This framework assumes that no more than three degrees of height are phonologically relevant, and that apparent four-height systems involve differences in tenseness, which is equivalent to intensity of color (palatality or labiality), for a given vowel height. Non-palatal, non-labial vowels, then, are lax.

A monophthongal vowel represents a compromise between, on the one hand, maximal openness and consequent sonority (intrinsic intensity) and, on the other, maximal constriction (palatality, labiality, velarity etc.) and resulting auditory 'color' (acuteness or brightness, vs. gravity or darkness, etc.). Each fortitive or segment-optimizing phonological process changes a single feature to maximize one of these properties at the expense of the others. For example, [o] is neither as sonorant as (low back tense rounded) [ɒ], nor as labial as [u]. A fortition, or strengthening, process like Raising ([o] → [u]) increases labiality and decreases sonority, while a process like Lowering or Laxing ([o] → [ɔ], or [o] → [ə]) increases sonority but decreases labiality.

Fortitive processes are phonetically motivated and consequently apply in phonetically natural implicational patterns. Raising maximizes color at the expense of sonority; it applies to palatal or labial vowels, but not to achromatic (non-palatal, non-labial) vowels. Lowering maximizes sonority but decreases color; non-palatal, non-labial vowels are especially susceptible, since they have no color to lose. Palatalization and Labialization create color, with some loss of sonority; higher (less sonorant) vowels are more susceptible to these processes. Depalatalization and Delabialization eliminate color and increase sonority; more sonorant vowels are more susceptible, since their color is relatively weak. Since tenseness is relative intensity of color (for a given degree of height), Tensing increases color and decreases sonority, and Laxing increases sonority and decreases color. Tenseness thus makes vowels more susceptible to raising, and laxness makes vowels more susceptible to lowering or depalatalization or delabialization. Figures 2 and 3 show, in simplified form, how the favored applications of these processes (indicated by bold and/or double-shafted arrows) yield the familiar five-vowel systems of Munda languages.

Maximal Palatality | Maximal Labiality

i	⇐	ɪ	⇐	ɨ	⇒	ʊ	⇒	**u**
↑								↑
e	⇐	ə	⇐	ə	⇒	ɔ	⇒	**o**
↑								↑
æ	←	a	←	**ɑ**	→	ɒ̆	→	ɒ

Maximal Sonority

Figure 2.
Processes that maximize color:
Palatalization, Labialization, Raising, Tensing.

Maximal Palatality								Maximal Labiality
i	→	ɪ	→	ɨ	←	ʊ	←	u
				⇓				
e	⇒	ə	⇒	ə	⇐	ɔ	⇐	o
				↓				
æ	⇒	a	⇒	ɑ	⇐	ɒ̆	⇐	ɒ

Maximal Sonority

Figure 3.
Processes that maximize sonority:
Depalatalization, Delabialization, Lowering, Laxing.

5. Vowel inventories reflect prosodic differences.

Many Southeast Asian vowel systems, including those of Proto-Austroasiatic and many Mon-Khmer languages, include a series of back or central unrounded vowels. These vowels have been eliminated in the typical Munda five-vowel system (See Fig. 4), but they are reconstructed for every Munda subgroup: for Kherwarian (Munda 1969) and Korku-Kherwarian (N. Zide 1966), for Kharia-Juang (Pinnow 1960), Gutob-Remo-Gta? (Zide 1965, DeArmond 1976), and Sora-Juray-Gorum (Stampe 1963, A. Zide 1982). According to these various witnesses, Proto-Munda would have had a seven-vowel system, as in Figure 5.[5] Non-low vowels that are non-front and non-rounded ([ɨ, ə]) have been lowered, fronted, or rounded independently in every language but Sora. Only Sora has a system with three real series, with nine vowels, and no length distinction. (See Fig. 6.) Most Munda systems lack distinctive vowel length; this is atypical in languages with falling accent and syllable timing, but, pace Pinnow (1959), Proto-Munda does not seem to have had a length distinction. Some North Munda languages, like Ho, do have a length distinction resulting from loss of certain intervocalic consonants: e.g. Mundari hoṛo, Ho hoː 'human', but this appears to be a relatively recent development. Generally speaking, in the Munda languages, words are poly-syllabic, and unstressed syllables contain the same range of vowel qualities as stressed syllables do.

[5] In the following figures, I have used the symbols and the groupings of the cited sources. Some rearrangement or reinterpretation might be needed to fit some systems into the pattern sketched in Figure 1. (Backness is not indicated in Figure 1, as it would require an additional dimension.)

In contrast, the combination of final accent and stress timing has made the words of Mon-Khmer languages typically monosyllabic, with a single heavy syllable (as noted above), or disyllabic, with one heavy, accented, final syllable and an optional light 'minor' initial syllable.[6] Although the vowels of minor syllables are extremely limited, the vowel inventories for the heavy or major syllables display an extraordinary number of vowel distinctions. Khmer, for example, is reported to have 30 or 31 contrastive vowels (cf. Huffman 1978, Pinnow 1979); Bruu is analyzed as having 37 (Diffloth 1983) or 68 vowels[7] (Theraphan 1979); Nyah Kur has 42 (Ferlus 1983); and Kui has 50 (Theraphan 1989). Mon-Khmer inventories often show nine to twelve 'simple' vowels, often in three series, like those of the Sora system. (Nyah Kur is typical; see Fig. 7). They further include a variety of diphthongs—either in-gliding or up-gliding—and register or voice quality distinctions, and distinctive length. Hrê, for example, has a relatively small system, for Mon-Khmer, with only seven simple vowels and four diphthongs, but with tense and lax registers through the entire system, for a total of 22 vowels (Fig. 8). Bru has a larger system, with eleven simple (or short) vowels, but with length, register, and diphthongization (Fig. 9). Tone distinctions also exist in some Mon-Khmer languages, but these distinctions are typically not included in the vowel tally, perhaps because they interact less with vowel quality than register does. Thus Vietnamese, for example, has a more modest inventory, with eleven vowels and four diphthongs (Fig. 10). For Proto-Mon-Khmer itself, Shorto reconstructs a seven-vowel system, with distinctive length and three diphthongs (Fig. 11).

---- +palatal ---		---------- -palatal ----------
---------- -labial ----------		----- +labial ----
i		u
e		o
	ɑ	

Figure 4.
The Typical Munda Vowel System:
Gutob, Remo, Gorum, Mundari, Kharia, Juang
(DeArmond 1976, Osada 1992, Pinnow 1959)

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6 This latter type has been called *sesquisyllabic*, or "syllable-and-a-half" (Matisoff 1973a) [Ed.]

7 Theraphan includes nasalized vowels and diphthongs, as well as normal and breathy vowels, in this number.

---- +palatal ---	---------- -palatal ----------	
---------- -labial ----------		----- +labial ----
i	ɨ	u
e	ə	o
	a	

Figure 5.
Proto-Munda Vowels
(Munda 1969, N. Zide 1965, 1966, Stampe 1963, DeArmond 1976, A. Zide 1982).

----- +palatal -----		--------- -palatal ---------		
--------- -labial ---------			------ +labial -----	
i		ɨ		u
	e	ə	o	
	ɛ		ɔ	
		a		

Figure 6.
Sora Vowels (Stampe 1965)

First Register						Second Register					
ii	ɨɨ	uu	i	ɨ	u	ìi	ɨ̀ɨ	ùu	ì	ɨ̀	ù
ee	əə	oo	e	ə	o	èe	ə̀ə	òo	è	ə̀	ò
ɛɛ	aa	ɔɔ	ɛ	a	ɔ	ɛ̀ɛ	àa	ɔ̀ɔ	ɛ̀	à	ɔ̀
iɛ	ɨa	ua				ìɛ	ɨ̀a	ùa			

Figure 7.
Nyah Kur Vowels (Ferlus 1983)
` marks second-register vowels.

Tense Register					Lax Register				
i		u	ia	ua	ì		ù	ìa	ù
e		o	ea	ɔa	è		ò	èa	ɔ̀a
ɛ	a	ɔ			ɛ̀	à	ɔ̀		

Figure 8.
Hrê Vowels (Phillips 1973)

In-gliding diphthongs:						Short vowels:			
íʌ	ìɛ	ɯ́ʌ	ɯ̀ə	úʌ	ùɔ		i	ɯ	u
éa	ìa			óa	ùa		e	ə	o
							ɛ	ʌ	ɔ
							a		ɒ

Up-gliding diphthongs and long vowels:					
éi	ìi	ə́ɯ	ɯ̀ɯ	ʌ́u	ùu
ɛ́e	èe	áɯ	ə̀ə	óu	òo
ɛɛ			ɔɔ		
aa			ɒɒ		

Figure 9.
Bru Vowels (Diffloth 1983)
´ and ` mark first-register and second-register vowels, respectively.

Simple vowels				Diphthongs		
i		ɯ	u	ia	ɯa	ua
e	ə	ɤ	o			
ɛ	ʌ		ɔ			
	a					ʌu

Figure 10.
Vietnamese Vowels (Liem 1970)

Short vowels			Long vowels			Diphthongs	
i		u	ii		uu	iə	uə
e	ə	o	ee	əə	oo	ai	
	a	ɔ		a	ɔɔ		

Figure 11.
The Proto-Mon-Khmer Vowel System (Shorto 1976)

6. Munda vowel systems and changes parallel those of other syllable languages.

The vowel systems of the Munda languages, with their polysyllabic words and more-equally-timed syllables, show a modest number of vowel quality distinctions, as noted above. Sora, with its nine vowels, has the largest set of vowel qualities in any Munda language. We find few true diphthongs in Munda; glides typically function as consonants. We find only marginal length distinctions, or none at all: Kharia's length distinction arises in the adoption of loan words, and the long vowels of the Kherwarian branch result, as noted above, from the loss of intervocalic /h/ or /r/. There are no register distinctions, and there is a single marginal tone distinction (reported for Korku in Zide 1966).

6.1 The absence of a 'central' (non-palatal, non-labial) vowel series.

Many of the Munda languages have eliminated altogether the high and mid central vowels which, because of their intrinsic shortness[8], serve as reduced vowels in many languages; instead, all syllables contain a more-optimal 'full' vowel from the set [i, u, e, o, a]. Sora retains ɨ and ə, but only before consonants.[9] The 'central' (or back) unrounded vowels may become palatal: Gutob-Remo-Gta? *ɨ becomes Gutob [i]. Or they may become labial: Gutob-Remo-Gtaʔ *ɨ and *ə became [u] and [o] in Remo. Thus

Gutob-Remo-Gtaʔ	*dɨg	'to utter'	>	Gutob dig, Remo dug
	*pɨg	'to break'	>	Gutob pig, Remo pug
	*jər	'descend'	>	Remo jor
				(DeArmond 1976, 220).

The Gutob palatalization is like a change that occurred in Yellow Lahu, where vowels corresponding to Black Lahu /ɨ/ and /ə/ have merged with /i/ and /e/ (Matisoff 1973b, 12), or like the palatalization of /ɨ/ to /i/ in Common Mongolian (Poppe 1955, 33). The Remo labialization is like the change of the 'enunciative' vowel of Dravidian, elsewhere /ɨ/, to [u] in Kannada and Telugu (Bright 1975, 41).

A similar change occurred in Latin, and here the relationship to timing is clear: *ɨ and *ə—unstressed alternants in stress-timed, initial accented Pre-Latin—became /i/ and /e/ (or /u/ and /o/, near labial consonants), when they began to receive equal time in mora-timed Classical Latin. In Pre-Latin, the original /a/ of *fa̲cio* was reduced to [ɨ] in post-stress open syllables and to [ə] in post-stress closed syllables, when prefixation moved the stress. With the shift of Classical Latin away from stress accent, when these unstressed syllables began to receive sufficient time to become full syllables, they became /i/ and /e/: as in *infi̲cio, infe̲ctus*. A change much like this Latin change seems to have occurred in Gutob. Compare the language-names *Gutob* and

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8 Other things being equal, higher vowels are shorter than their lower counterparts, and less-chromatic (less palatal, less labial) vowels are shorter than their more-chromatic counterparts (cf. Jakobson, Fant and Halle 1969, Perkell 1969, Peterson and Lehiste 1960, Elert 1964).

9 Apparently the intrinsic shortness of these vowels has come to limit their occurrence to syllables that are closed or that can be closed by a following consonant: ɨ and ə can occur in open syllables only when another syllable follows; neither can occur root-finally or word-finally.

Gtaʔ, originally *gɨtəb, and Gu. sulob, Gt. slaʔ, from *sɨləb 'tree' The accent in these words was on the second, heavy syllable, and the unaccented vowel was raised, as in Latin. Then, when the central vowels were labialized in Gutob, the initial-syllable *ɨ became /u/, and the accented *ə became /o/. (In Gtaʔ, the unaccented vowel was lost, and the accented *ə became /a/.)

The vowel harmony systems of other mora-timed languages (e.g. Finnish), suggest a similar elimination of earlier *ɨ, *ə. In Finnish, front vowels like /æ, y, ø, œ/ co-occur in stems only with other front vowels, but never with /u, o, ɔ, ɑ, etc./. /i, e/ however, can occur in stems with either front or non-front vowels. This suggests an earlier stage at which vowel harmony was regular and some of the present-day [i]'s and [e]'s were non-front *ɨ's and *ə's, and that these non-front vowels were later fronted, becoming exceptions to the vowel harmony restriction on stem forms. This would mean that at some point in the history of Finnish a context free change made *ɨ and *ə become i and e.

Another process which can eliminate [ɨ] and [ə] is lowering. Sora-Gorum *ə became /ɑ/ in Gorum:

Sora gəd-, Gorum gɑd- 'to cut'

Similarly, Gutob-Remo-Gtaʔ *ɨ became /ɑ/ in Gtaʔ:

Gutob-Remo-Gtaʔ	*dɨg	'to utter'	>	Gtaʔ dɑg.
	*pɨg	'to break'	>	Gtaʔ pɑg-či

(DeArmond 1976, 220)

We might compare this to the way that English [ə] is borrowed as /ɑ/, in mora-timed, five-vowel languages like Japanese or Hawaiian.

6.2. The absence of vowel reduction.

The equal time allotted each syllable in the Munda languages—i.e., the absence of overlong stressed syllables and overshort unstressed syllables—makes the vowels of these languages and the changes that affect them resemble the systems and changes of other mora-timed languages and language families, like Modern French, Classical Latin, early Germanic, Finno-Ugric, Altaic, Dravidian, and Indo-Aryan.

In the Munda languages, as in other mora-timed languages, there is little evidence of vowel reduction, which is the loss of palatality, labiality, and sonority in unaccented syllables. The degree of vowel reduction is directly related to the shortness of the unstressed vowel (Lindblom 1963a,b). But in mora-timed languages, the minimal time allowed for each syllable is sufficient to assure that each vowel is a fully palatal or labial or sonorant vowel, rather than a raised or 'centralized' reduction.

6.3 Vowel harmony.

One phonological phenomenon in Munda that does appear to be shared by many other languages of similar type (with similar word order, syllable structure, and accentual pattern) is vowel harmony. The Altaic and Finno-Ugric languages, which are principally mora-timed, display 'horizontal' vowel harmony—assimilations of palatality (frontness) and/or labiality among the vowels within a word. Early Germanic—initial-stressed, mora-timed, with head-last word order—corresponded to Munda in type; it displayed both umlaut, a regressive assimilation of palatality, and 'vertical' vowel harmony, a regressive vowel height assimilation across syllables. Japanese, too, seems to have gone through a period of vowel harmony, deducible from the orthography, although its phonetic nature is not clear.

Vowel harmony is clearly evidenced in the Munda languages. Bodding (1923) describes a full vowel-harmony system for Santali, involving height or tenseness assimilation to high vowels within disyllabic groups. Generally speaking, however, vowel harmony in Munda is not as pervasive, or as evident in synchronic alternations, as the vowel harmony of Turkish or Finnish. But certain infixes and prefixes in Munda languages show complete vowel harmony. The *-Vn-* nominalizing infix in Kharia is a good example. The vowel of this infix is matched to the vowel before which the infix is inserted:

si-	'to plow'	sini	'a plow'
joʔ-	'to sweep'	jonoʔ	'a broom'
koi-	'to shave'	konoi	'razor'
ped-	'to blow'	pened	'a flute'
*gɑd	'to reap' (Juang gar-)	gɑnɑd	'a sickle'.

There is also a harmonizing prefix of inalienable possession in Juang:

Ju.	iji	'foot'	cf.	Sora	jeʔe	'leg'
Ju.	ese	'louse'		Kharia	seʔ	'louse'
Ju.	omod	'eye'		Kharia	mod	'eye'
Ju.	ɑlɑ	'tongue'		Kharia	lɑ	'tongue'
Ju.	iti	'hand'		Kharia	tiʔ	'hand'
Ju.	uluj	'male genitals'		Kharia	loj	'male genitals'

Sora, a particularly conservative Munda language, has /ə/ in both of these affixes. That is, the nominalizing infix is -ən-:

ped-	'to blow'	pəned	'flute'
gad-	'to cut'	gənad	'sickle'

And the inalienable possession marker is ə- :

ə-jɔ	'fruit (of a tree)'	ə-laŋ	'one's tongue'

There is some evidence for vowel harmony of the 'vertical' type in Mundari. Osada observes that high vowels and mid vowels do not co-occur within a morpheme, and that this restriction may apply to loans (e.g. *suri* for English 'sorry'), but he notes that the harmony does not affect the entire word: 'only personal pronominal suffixes, including dual and plural suffixes, undergo the vowel harmony rule beyond a morpheme', and that the assimilation in *suri* is regressive, while the assimilation of pronominal suffixes is progressive (1992, 39).

Vowel harmony may have the same function in mora-timed languages that vowel reduction has in stress-timed languages—that of reducing articulatory effort. Vowel reduction takes away positive features like palatality, labiality, openness, etc. from the very short vowel of an unaccented syllable and thus 'neutralizes' the reduced vowel. Vowel harmony, in contrast, seems to assimilate these features across adjacent syllables within a word, and is the alternative chosen in languages where each syllable retains at least a minimal timing allotment, and thus requires a full vowel.

Another possible interpretation of vowel harmony, however, suggests itself when we look at the kind of harmony that occurs in Munda. Many of the harmonizing vowels appear to have arisen from central vowels, as the Sora cognates above show. Others occur in positions where some Mon-Khmer cognates lack any vowel:

'forest, hills'	Sre	bri	Santali, Mundari bir		
	Riang	pri?	(perhaps via intermediate *biri)		
	Palaung	brei			
	Khmer	brai			
	Wa	brai?			
'thigh'	Khmer	bhlau	Santali, Mundari	bulu	
	Palaung	blau, bleu	Sora	bulu, bul	
	Wa	plauŋba			
'six'	Huei	treu	Santali	turui	
	Suk	trou	Korku	turu	
			Sora	tudru	(Pinnow 1959)

The rarity of synchronic phonological (as opposed to morphologized) vowel harmony suggests that, in many cases, vowel harmony is a historical development: a language goes from a stage where its unstressed vowels are shortened and reduced and neutralized to a stage where each syllable is allotted a minimal time and requires a full vowel (cf. Section 6.1). The acoustics of coarticulated vowels make it likely that the reduced vowels will be interpreted as full vowels similar to the stressed vowels of their accent group (cf. Öhmann 1966), and the principle that similarity of vowel quality adds to 'ease of articulation' reinforces such interpretation. When the unstressed vowels are given full-vowel qualities, alternations are introduced in affixes and morpheme-structure harmonies arise. These alternations and harmonies, however, may not represent real constraints on pronunciation—the original constraint required only that *unaccented* vowels match adjacent accented vowels in certain features, and unaccented vowels no longer exist in the new timing system. Thus, the constraints may not extend to loan words, and they may be subject to exceptions right from the beginning.

6.4 Monophthongization.

The assimilations of vowel harmony take place across syllables within the word, but they are the same assimilations that are responsible for monophthongization. A consonant may intervene between harmonizing vowels, but it has been established (Öhmann 1966) that vowel articulation is continuous across syllables, and that consonant articulations are superimposed on this vocalic continuum. It is further observed (e.g. Perkell 1969) that vowel articulations are accomplished by the larger extrinsic tongue (and jaw) musculature, and that consonant articulations are to some extent independently accomplished by the smaller intrinsic tongue muscles. The vowels of adjacent syllables are thus, in a phonetic sense, truly adjacent.

It appears that assimilation or harmony of vowels across a syllable group implies assimilation within a syllable: when Germanic words like **badi* 'bed' underwent assimilation to forms like **bedi* (modern *Bett*), words like **stain* 'stone' underwent the same assimilation, thus, *Stein*. If all phonological processes have prosodic domains (Donegan and Stampe 1978), the difference between vowel harmony and monophthongization is principally a difference of domain (word vs. syllable). It is hardly surprising, then, that languages in which the vowels within syllables are monophthongal should, to some degree, 'monophthongize' or assimilate across syllables, within an accentual unit or measure.

6.5 Diphthongs in Munda languages.

Although the vowel phonemes are monophthongs, phonetic diphthongs do occur in Munda languages. In Sora, for example, sequences like [ɑy], [ɨy], [oy], as well as [yɑ], [yɛ], etc. are not uncommon, e.g., yɛrtay [yɛrtɑy] 'I go', əboy [əboy] 'one', tɨy-l-ɛ [tɨylɛ] 'he gave', etc. However, such sequences represent vowel-plus-consonant (or consonant-plus-vowel), rather than vowel-offglide sequences. Sora has a strict syllable canon: syllables may be (C)V(C), where C represents a single consonant. If the vowel is followed by a glide /y/, the /y/ counts as the offset consonant: phonemic sequences of the form /CVyC/ are not permitted as syllables. In many Mon-Khmer languages, a sequence of vowel-plus-offglide would represent a single vowel phoneme, but in Sora it represents vowel-plus-consonant. E.g., the determiner suffix in Sora, which is -ən when it follows a consonant, is -n after a vowel; a stem-final /y/ acts as a consonant, giving the -ən form:

kɨnad-ən 'the crab' pusi-n 'the cat' tɑŋlɨy-ən 'the cow'.

Syllable initial /y/ also patterns like a consonant. The negative prefix əd- is ədn- before a vowel:, but before verb-initial /y/, we find əd- :

ədn-ed-l-ɛ	'he didn't scratch',	ədn-iy-l-ɛ	'he didn't go'
əd-yɛr-r-ɛ	'he didn't come',	əd-gij-l-ɛ	'he didn't come'

Nevertheless, diphthongizations of an assimilative type do occur in Munda languages. In Sora, a non-palatal vowel develops a palatal offglide before a palatal consonant in the same syllable:

/daj-l-e/	'he climbed up'	[dai̯j'lɛ]	/daj-a/	'climb up!'	[daja],
/tuɲtuɲ/	'he shot'	[tui̯ɲtui̯ɲlɛ]	/tuɲtuɲ-a/	'shoot!'	[tui̯ɲtuɲa].

(Here, /j/ is a voiced palatal stop, glottalized when syllable-final, and /ɲ/ is a palatal nasal.)

6.6 Conservatism.

It is difficult to cite many further examples of vowel changes in the Munda languages, partly because mora-timed languages tend to be conservative in vowel phonology. The vowels of mora-timed languages or families, like Munda, Japanese, Dravidian, Indo-Aryan, etc., are neither 'stretched' (elongated) under accent nor 'squeezed' and reduced due to a complete lack of accent, by the timing of the languages. As a consequence, these languages may maintain relatively consistent vowel quality over centuries.

7. Vowel changes in Mon-Khmer parallel the changes of other stress languages.

The parallels between the vowels of the Mon-Khmer languages and the languages of other families in which stress timing has played a major role are striking—and they are perhaps more remarkable than the parallels among the typically conservative mora-timed families. First, the Mon-Khmer languages are like other stress-timed languages in favoring large vowel inventories. We can compare the Mon-Khmer inventories with the relatively large inventories of the stress-timed Germanic languages, of Brazilian and Insular Portuguese, of Old French, and of Thai. Second, in these languages the vowels undergo an extraordinary variety of changes: diphthongization, vowel reduction and vowel shifts are common. Except for the development of register and tone distinctions, the vocalic changes which have affected the Mon-Khmer languages are paralleled change for change in the Germanic languages and in early Romance. To be sure, the changes take somewhat different forms and occur in different combinations in different languages and families, but the similarities are remarkable.

7.1 Vowel reduction.

Vowel reduction usually refers to the processes of shortening, raising, laxing, depalatalization, and delabialization as they affect the vowels of unstressed syllables. Reduction is behind alternations like English *photograph/ photography*: [ˈfotəˌgræf] ~ [foˈtɑgrəfi]. Stress-timed languages are so often characterized by vowel reduction that its presence can be considered an indicator of stress-timing. There is a well-established relationship between vowel shortness and reduction (e.g. Lindblom 1963a,b), so that vowel reduction in unstressed syllables is clearly related to the shortening of those syllables in languages with a strong stress-timing principle.

In Mon-Khmer languages, the vowels of minor (unstressed) syllables are short and seem 'reduced', even though they do not alternate synchronically with full vowels. They show no quality contrast, or a severely limited set of contrasts. For example, in Jeh, there are seven basic vowel nuclei, /i, ia, e, a, u, ua, o/, and there are further contrasts of length, 'deepness' (register), and nasalization. But the vowel of the Jeh 'presyllable' may only be /ɑ/, except after glottal stop, where either /ɑ/ or /i/ is allowed (Gradin 1976). In Halăng, the main-syllable vowels include /i, ia, e, ea, a, u, ua, o, oa/, with further contrasts of length and breathiness (register), but the presyllable vowel is always (breathy) /à/, except when there is reduplication, in which case any short vowel (/i, e, a, u, o,/) may occur (Cooper and Cooper 1966).

7.2 Diphthongization.

Diphthongization occurs when, in a vowel of extended duration, a fortitive process which increases a particular vocalic property (see Sec. 3) affects only the onset or only the offset of a vowel. This allows the property that would ordinarily be diminished by that process to be retained in the unaffected part of the vowel. In fact, the property that is diminished in one half of the vowel is often increased in the other half by a further, 'opposite', dissimilation. For example, when, by delabialization, a long [oː], which we may represent as [oo̯], becomes [əo̯], the syllabic increases its sonority and loses labiality, but the non-syllabic maintains the labiality. An 'opposite' process, raising, may then increase this labiality: [əo̯] → [əu̯]. (Further dissimilative processes may affect the syllabic, eventually yielding [ɑu̯] or [ɛu̯].)

Thus, diphthongization results from fortitive changes—the same changes that may elsewhere occur context-free—that sequence and polarize the conflicting properties within a vowel. And the principal contributing factor in this sequencing is vowel length, whether that length is phonemic (lexically specified) or context-conditioned. (The conditions for such lengthening may include the presence of stress, the absence of a following unstressed syllable, the absence of syllable-closing consonants or of particular consonant types, or some combination of these factors.) The lengthening of the vowels of accented syllables is the common condition on which diphthongization in Mon-Khmer and diphthongization in other stress-timed languages depend. The vowels of the mora-timed Munda languages do not undergo such diphthongization because they do not undergo this kind of lengthening.

The parallels being noted here are of course not based on isolated or unusual cases of diphthongization, either in the Mon-Khmer languages or the non-Mon-Khmer parallels (mostly European) cited here. The European diphthongizations are typical of vowel changes which characterize many of the Germanic languages, Modern English and German dialects, and Romance at one period of its history. Similarly, the Mon-Khmer diphthongizations cited are typical of shifts in Mon and Khmer, in the Waic languages, in Bahnaric, etc. Diphthongizations in both Europe and Southeast Asia are accompanied by quality changes in the monophthongal vowels, but since changes in monophthongs allow fewer variables, the similarities in monophthongal changes seem less striking.

7.2.1 Dissimilations of height and color.

There are clear parallels between the diphthongizations in many European languages and those which account for certain Mon-Khmer developments. First, diphthongization may involve the sequencing of vowel height (the principal manifestation of sonority) and (labial or palatal) color. The change of long [iː] and [uː] to [ei̯] and [ou̯] and thence to [ɑi̯] and [ɑu̯] involves such a sequencing: lowering and depalatalization or delabialization increase the sonority but decrease or remove the color of the syllabic, while the maintenance of the palatal or labial glide allows the maintenance of color on a relatively low-sonority vocalic element. These changes are well-known in the respective histories of English and German. (The developments of the two vowels are independent, as is shown in Scots English, where Middle English [iː] became [ɑi̯], but [uː] did not become [ɑu̯].) Both changes, [iː] → [ɑi̯] and [uː] → [ɑu̯], occur in Mon-Khmer languages but not in Munda (citations here are from Pinnow 1959 and Luce 1965):

'hand'

Khar., Mund.	Sant., Korku	Old Mon	Khmer	Palaung	Wa	Vietn.
tiʔ	ti	tei	dai	dei or dai	taiʔ	tay

'louse'

Sora	Mundari, Korku	Bahnar	Danaw	Mon	Khmer	Sre
iʔi,	siku	si	tsi	cai	cai	sai

'forest, hills'

Santali, Mundari	Sre	Riang	Palaung	Khmer	Wa
bir	bri	priʔ	brei	brai	braiʔ

'thigh'

Santali, Mundari, Sora	Khmer	Palaung	Wa	Tareng
bulu	bhlau (phlou)	blau, bleu	plauŋba	pelau

'six'

Santali	Korku	Sora	Mon	Kaseng	Huei	Suk
turui	turu	tudru	turow (taraw)	tarau	treu	trou

Such diphthongizations are sometimes seen simply as dissimilations of vowel height, but the interaction of lowering on one element and color increase on the other reveals that polarization of sonority and color is the motivation.

In some cases, of course, we see that the diphthongization in the Mon-Khmer language goes only as far as [ei̯] or [ou̯]; in others, loss of color in the syllabic gives [ə i̯] or [əu̯]. We find parallels in German dialects, where Middle High German /iː, uː/ have become /ɑ i̯, ɑu̯/ in Standard German, but only /əi̯, əu̯/ in some dialects, like Bärndeutsch or Zuritüütsch (Keller 1961, 42 et passim). Similarly, Middle English /iː, uː/ have generally become Modern English /ɑ i̯, ɑu̯/, but in Scotch-Irish and Canadian (Gregg 1973) and some Virginia (Kurath and McDavid 1961, 109) dialects, the results of the diphthongization remain [ə i̯, əu̯] in some environments. Lowering, the last step in the change, occurred only in certain (lengthening) environments, so that some words, like *strike, light*, have [ə i̯] while others, like *fly, ride*, have [a i̯].

The diphthongization of [e] and [o] to [ɑ i̯] and [ɑu̯] (or [ɑ e̯] and [ɑ o̯], or even [æe̯] and [ɒu̯]) represents the same kind of dissimilation of sonority with palatality or labiality. Diphthongization of [ə] to [ɑ ɯ̯] may represent dissimilation of sonority with backness. Diffloth (1980, 52 ff.) points out that this kind of up-gliding diphthongization has affected Proto-Waic *e, *ə and *o in various Wa languages, either in both registers, or only in first-register (clear) vowels.

Stress-timed languages are continuingly susceptible to such dissimilations. In most dialects of Modern English, [iː] and [uː], as in *me* and *you*, are pronounced [ɪ i̯] and [ʊu̯], and in some, they are becoming [ɛ i̯] and [ɔu̯] (e.g. Andersen 1972, 24). Further, [eː] as in *pay* and [oː] as in *go* have become [ɛ i̯] and [ɔu̯], and a change of this [ɛ i̯] to [ʌ i̯ ~ a i̯], and [ɔu̯] to [ʌ u̯ ~ ɑu̯] occurs in the Southern U.S. (Donegan 1978) and in Australia (Mitchell and Delbridge 1965). Finally, [æː] and [ɒː], as in *bad* and *law*, shift to [ae̯] and [ɒ̆o̯] or [ɑe̯] and [ɑ o̯] in many southern U.S. dialects.

7.2.2 Dissimilations of color.

Like vowel height, vowel colors may also dissimilate. There are context-free changes that palatalize or labialize vowels that are non-palatal and non-labial: [ɨ, ə, ɑ] → [i, e, æ] or [i, ə, ɑ] → [u, o, ɒ] (See Donegan 1978, for context free applications). These processes seem to be especially applicable where a segment with the 'opposite' color occurs in the environment. Thus, dissimilative labialization occurs before a palatal glide, and [ʌ e̯] or [ɑ e̯] may become [ɔ e̯], as when

Old Mon ti(ʔ) > *təi̯ > Spoken Mon tɔeʔ earth' (Khmer dɤy),
Old Mon jik > *jəi̯k > Spoken Mon còik 'cultivate' (Khmer cìːk 'dig')
(Shorto 1976)

This change is similar to the change, in Early Old French 'while the tonic stress was still strong' (Pope 1934, 104), of [e i̯] (from Latin /i, eː/) to [o i̯] (or perhaps, more accurately, to [o e̯]):

Late Latin mẹ (earlier meː) > Old French moi 'me'
Late Latin fẹde (earlier fĭdem) > Old French feiθ > foi 'faith'
(Pope 1934, 105, 238).

A similar labialization, changing [ɑ i̯] to [ɒ i̯], has occurred in various dialects of English—in Cockney (Sivertsen 1960), in Coastal North Carolina (Labov et al. 1972), and in Australia (Mitchell and Delbridge 1965):

e.g. [lɑi̯n] > [lɒe̯n] *line*, [bɑi̯] > [bɒe̯] *by*.

Palatalization, too, may apply dissimilatively in diphthongs, before a labial glide: [əu̯] may become [ɛu̯] or, with tensing, [eu̯]. We find such palatalization of the syllabic in Old French and in Insular Portuguese:

Early Old French [ou] (< Late Latin /ọ/) became Old French [eu̯], now [ø]
(Pope 1934, 103-106)
Portuguese [ou̯], in the São Miguel dialect, became [øu̯] ~ [ø]
(Rogers 1948, cf. Donegan 1978)

In Modern English, the same palatalization occurs in various forms. In the Eastern U.S. (Baltimore, Philadelphia), [ou̯], which is often delabialized to [əu̯], becomes [ɛu̯]: [gou̯ ~ gəu̯ ~ gɛu̯] *go*, [hou̯m ~ həu̯m ~ hɛu̯m] *home*. In Virginia and elsewhere in the southern U.S., the palatalization extends to the delabialized syllabic of the high vowel, so that [uu̯] > [ɨu̯] > [ɪu̯]: [tuu̯ ~ tɨu̯ ~ tɪu̯] *two*. A similar palatalization affects the low syllabic in a wider range of English dialects, where /ɑ o̯/ > [a o̯] or, with tensing, [æ o̯]. *This may be* dissimilated by raising (as in Baltimore and Philadelphia) to [e o̯]: [hao̯s ~ hæo̯s ~ heo̯s] *house*, [kao̯ ~ kæo̯ ~ keo̯] *cow*.[10]

Dissimilative palatalization seems not to have occurred regularly in most Mon-Khmer languages (most of the diphthongizations seem to have favored lowering) but there are some examples of [eu̯] (or monophthongized [ø]) for *u, presumably via changes like: uː > ʊu̯ > ɨu̯ > ʌu̯ > ɛu̯ (> eu̯) (> øː). Thus, *'thigh'*

Santali,	Korku,	Sora	—	Palaung	Rumai	Kedah
bulu	bulu	bulu		bleu	ble-ɑːuː	bløʔ

[10] It is worth noting that word pairs like *load* [lɛu̯d] and *loud* [leo̯d] or *no* [nɛu̯] and *now* [neo̯] are <u>not</u> homophonous in these Baltimore and Philadelphia dialects.

'six'				
Santali,	Korku,	Sora	—	Huei
turui	turu	tudru		treu

(Pinnow 1959, 97)

7.2.3 In-gliding diphthongs.

In the diphthongizations we have mentioned so far, the offglide that follows the syllabic is more strongly colored (more palatal or more labial—higher, tenser) than the syllabic, which acts as the element of increasing sonority. But it is also possible for the off-glide to lose color and increase sonority, becoming lax or schwa-like, and the syllabic to increase its color by tensing or raising. Lax or lower vowels seem to be especially susceptible to this kind of diphthongization.

Correspondences between [o] or [ɔ] and [uə̣̯], and between [e] or [ɛ] and [iə̣̯], occur in many Mon-Khmer languages, including Mon and Khmer (Shorto 1976), the Mnong languages (Blood 1968), and the Wa languages (Diffloth 1980). The direction of change is not always agreed upon in sketches of language histories. For example, Diffloth also proposes a change of Proto-Katuic *iɛ to *ɛɛ and *uɔ to *ɔɔ in Proto-Bru-Sô (1983, 70). The Katuic reconstruction seems to be motivated by a 'crowded' system, but clear examples of assimilation of the syllabic to a lax or lower offglide are hard or impossible to find. Diffloth (1980, 67 ff) also claims that Proto-Waic breathy *ʊ > [uə̣̯] > Wa [u], and *a > Wa [ɛạ̯] or [eạ̯]. Unlike the questionable iɛ-to-ɛɛ monophthongizing pattern, this pattern of in-gliding, with a lax or low vowel undergoing tensing and raising of the syllabic, shows up in numerous changes in stress-timed languages.

For example, Late Latin lengthened (unchecked) /ę/ and /ǫ/—which were probably lax (or low) vowels – diphthongized with in-glides, becoming early Old French [iẹ̯] (via [iə̣̯]) and [uẹ̯] (via [uə̣̯]):

Late Latin pęde (earlier pĕdem) > Old French pieθ, Mod. Fr. [pje]
Late Latin fęra (earlier fĕra) > Old French fierẹ, Mod. Fr. [fjeʀ]
Late Latin bǫβe (earlier bŏwem) > Old French buef, Mod. Fr. [bœf]
(Pope 1934, 240, 248).

This diphthongization originated at a period when Latin displayed many stress-timed characteristics; it has left reflexes in Spanish and Italian as well as in French.

A modern example of such in-gliding occurs in New York City English, where /ɒ/ has become [oə̯] or [uə̯], and /æ/ has become [eə̯] or even [iə̯] when lengthened, as in:

man	/mæn/	>	[meə̯n ~ miə̯n]
lawn	/lɒn/	>	[loə̯n ~ luə̯n]
bad dog	/bæd dɔg/	>	[beə̯d doə̯g ~ biə̯d duə̯g]

(cf. Wells 1982, 510-513).

The existence of such changes supports proposals (such as Diffloth's) that *ɔ or *ɒ (lax or low labial vowels) become oɑ, uɑ or uɑ, and that *ɑ or *ɛ became [eɑ̯], [iɑ̯] or [ie̯].

It is possible for up-gliding diphthongs to become in-gliding, if the glide loses its color. The shift of Old Mon [ɔi̯] or [ɔe̯] to Spoken Mon [oɑ̯] represents such a change:

Old Mon moy > Mon /mòɑ/, /mùɑ/ 'one' (PMK *muəy, Nyah Kur /mùɑy/)
Old Mon tei, Mon tɑi, tɔi > Mon /toɑ/ 'hand, arm' (PMK *tiiʔ, Nyah Kur /təy/)

(Shorto 1976, 1062, 1054; Huffman 1990, 61).

In diphthongs with low syllabics (despite our usual transcriptions with [i̯] or [u̯] offglides), the glide is ordinarily not really high, but is lowered to reduce the distance between the target elements: thus [ɑi̯] may be pronounced [ɑe̯] or [ɑɛ̯]. When this [ɑe̯] became [ɒe̯], by dissimilative labialization, the introduction of a new 'color', labiality, apparently made it possible for the offglide to lose its palatality and still maintain the changing quality essential to a diphthong: thus ɒe became [ɒe̯]. Increase of the labial color by dissimilation from the non-labial offglide then gives [oə̯] or [oɑ̯].

By a similar series of changes ([ei̯] > [əi̯] > [ɔi̯] > [ɔe̯] > [ɔɑ̯]), Middle High German [ei̯] became [ɔɒ̯] in Upper Austrian, as in:

broad 'broad, wide' *Goas* 'goat' (cf. Mod. Std. German *breit*, *Geiß*)

(Keller 1961).

The final stages of the change are echoed today in the Southern U.S. (Great Smoky Mountains) change of [ɔe̯] to [oɑ̯] or [oə̯], as when

boy	/bɔi̯/	>	[bɔɑ̯]
coin	/kɔin/	>	[kɔə̯n]

oil /ɔi̯l/ > [ɔə̯l] etc. (Hall 1942).[11]

The converse change, dissimilative palatalization before a labial glide, with lowering and delabialization of the glide, occurs in the Southern U.S. dialects where [au̯] > [æu̯] > [æo̯] > [æə̯]:

plow /plau̯/ > [plæu̯] > [plæo̯] > [plæə̯]
ground /grau̯nd/ > [græu̯nd] > [græo̯nd] > [græə̯nd] (Hall 1942).

A similar change took place when Germanic *au became Old English [ea̯] (Campbell 1959, 15, 53), which eventually became [i] in Modern English:

Germanic *au̯ > æu̯ > æə̯ > OE eə̯ > Brit. dial. [iə̯] > Mod. Eng. [iː].

Compare German *Baum*, *laufen*, *Haupt*, which reflect a vocalism like the proposed Germanic original, with their English cognates *beam*, *leap*, *head*, which have Modern English /i/ or, through shortening, /ɛ/. The Mon-Khmer languages do not provide many such examples, but the sequence of changes from Germanic to Modern English, coupled with the pattern of diphthongization where [u] > [au̯], suggests a sequence of changes whereby [u] may be related to [iə̯]:

Santali ɲu, Mu nu, Bhumij, Ho, Korku nu; Wa ɲau and Srê ɲu 'to drink'
Stieng, Chrau ɲieːt, and Phnong, Prou (Brou) ɲiet, Lave niet to drink'
(Pinnow 1959, 92).

7.2.4 The effects of adjacent consonants.

The consonants which follow the vocalic nuclei have important effects on the occurrence of diphthongization. In many cases, the effect of a particular final consonant is a matter of the degree to which it affects the length of the preceding vowel. Thus, in the U.S. dialects where /æ/ and /ɒ/ are diphthongized to [ea̯] or [iə̯] and [oa̯] or [uə̯] before certain voiced consonants, vowel length is crucial. The vowel is lengthened and consequently diphthongized before the voiced consonants or fricatives of English because these consonants

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[11] This is similar, though not identical, to the path by which Early French ǫi, became oę or uę, by a shift of syllabicity to the second element of the diphthong. This change from VV̯ to V̯V is, of course, a shortening, as are monophthongization and the loss of syllable-offset consonants—all of which contributed to the French equalization of syllable-lengths in its changeover to syllable-timing. Eventually this uę became [u̯a] in Modern French.

exx. oizęls (*avicellos) > u̯ęzẹaus > [u̯azo] 'oiseaux'
mǫi (< mẹ) > mu̯ę > [mu̯a] 'moi'
(Pope 1934, 195).

are lax and short. The same vowels remain monophthongal before voiceless stops because these are tense and longer and, other things being equal, the vowel is shorter before the longer consonant.[12]

Not only the voicing or tenseness (and corresponding length) of final consonants, but also their quality may affect diphthongization. In some cases, diphthongization begins with assimilation. A palatal final consonant may produce a palatal offglide and thus begin the diphthongization of a vowel. This happens in many Mon-Khmer languages: we find that Proto-Wa *a diphthongizes before a palatal consonant in Bible Wa and Drage's Wa:

	Bible Wa	Drage's Wa	South Wa	Kawa
Proto-Wa *baɲ 'white' >	paing	pain	paɲ	paɲ

(Diffloth 1980, 44).

This kind of diphthongization also occurs in Thai Mon, where mid and low vowels (and high non-palatal vowels) acquire a palatal offglide [i̯] before a syllable-final palatal consonant:

/kləc/ [klə·i̯c] 'pig' /*cùc*/ [*cu·i̯c*] 'bone'
(Huffman 1990, 42).

(The italic here indicates second-register, 'lax' quality.) A similar off-gliding occurs in Burmese Mon, but it is more limited, affecting only /a, o, ɑ/ before palatals (Huffman 1990, 35). The palatal off-glide occurs generally before palatals in the Palaungic languages Lamet and Lua (Charoenma 1983, 40, 44).

This is typical of Mon-Khmer (and it occurs in Munda as well—cf. Sec. 6.5), but it occurs elsewhere, too. In some Midwestern U.S. dialects (Southern Ohio, Indiana, Illinois) I have observed, /æ/ becomes [æe̯] or [æi̯] before [š], as in [mæi̯š] *mash*, [æi̯š] *ash*. But /æ/ remains [æ] before non-palatals: [mæs] *mass*, [hæv] *have*. A velar that is palatalized after a front vowel may also create such an offglide. In these same U.S. dialects, [hæi̯ŋ́] *hang*, [bæi̯ǵ] *bag*, occur, while *hand*, *bad*, etc. fail to acquire an [i̯] offglide.

One might expect to find similar assimilative off-gliding toward [u̯] before labial consonants, or toward [ɯ̯] or [ɨ̯] before plain velar consonants, but this does not seem to occur—at least not with similar frequency.

[12] A following syllable that is unstressed (thus, in the same beat as the stressed vowel) will also shorten the stressed vowel and prevent diphthongization, but such syllables do not occur in Mon-Khmer.

Alternatively, a particular final-consonant quality may *prevent* diphthongization (or condition re-monophthongization). Proto-Wa *a was diphthongized, in Wa proper, to [e a̯] or [i ə̯] *except* before syllable-final palatal consonants:

	Proto-Wa	South Wa	Kawa	Bible Wa	
	*ɲaʔ	ɲeʔ	ɲìɛʔ	nyeh	'house'
	*lak	leak	lìak	lehk	'to buy'
but	*wac	vac	vàc	vait	'sword'

(Diffloth 1980, 42).

Similarly, Proto Mon-Khmer *ɔ became Khmer [u ə̯] in (the second register), but it is [u] before labials:

	Spoken Mon /kòŋ/ 'to be brave'	Khmer /kùəŋ/ 'invulnerable'
	Spoken Mon /təŋòt/ 'to study'	Khmer /rùŋkùət/ 'to explore'
but	Spoken Mon /ròm/ 'to respect'	Khmer /rùm/ 'worthy'

(Shorto 1976, 1054-5).

A parallel inhibition shows up in the Middle Atlantic (U.S.) variant of the /æ/-diphthongization; here /æ/ develops a schwa-offglide and diphthongizes to [e ə̯] *except* before palatals: *mass* is [meə̯s], but *mash* is [mæːʃ]. Velars, too, presumably palatalized by the front vowel, also prevent the diphthongization, so that *bag* [bæːg] and *bang* [bæːŋ] have monophthongal vowels while *bad* [beə̯d] and *ban* [beə̯n] have in-gliding diphthongs. Apparently, in such cases the palatal quality of the following consonant is enough to prevent the depalatalization of the offglide portion of the vowel, so that even though the final fricative lengthens the vowel, the in-glide does not arise. It is apparently the presence of the in-glide that conditions raising, so the vowel remains low. Thus, the [æː] ([ææ̯]) does not become [æə̯], so it does not get raised to [eə̯]. In the above case of Mon-Khmer *rɔm > Khmer /rum/, the raising of the syllabic suggests that diphthongization may have occurred despite the following labial, with the offglide being re-labialized later.

7.2.5 The effects of register.

Among the most interesting aspects of the vowel systems of the Mon-Khmer family are the register distinctions which arise in connection with the *loss of a voicing distinction in initial consonants.* These appear to be without parallel in European languages, and they clearly do not appear in Munda. *Register is not universal in the Mon-Khmer languages, of course;* some languages (e.g. Stieng, Brao, Lawa) retain a voicing distinction in initial consonants; others seem to have had register but lost it in favor of other distinctions.

Huffman (1976) reviews the characteristic pattern by which register is thought to have developed: it appears to arise as variation in vowel phonation type or pharyngealization which is allophonic and depends on the initial consonant. Vowels following original voiced or lax consonants become lax or breathy, while vowels following voiceless or tense (and glottalized or implosive) consonants are tense or clear. When the initial consonant voicing distinction is neutralized (probably first in the continuants), the vowel difference becomes distinctive. Huffman proposes five stages in the development of register, and he argues for the above sequence of events by describing Mon-Khmer languages which synchronically attest each of the proposed stages. The vowel difference that results may be what Henderson (1952) called register, where vowels following original voiced or lax consonants are lax or breathy or buzzy or characterized by pharyngeal expansion, while vowels following original voiceless consonants are tense or clear or occasionally creaky, or characterized by pharyngeal constriction. True register differences may be accompanied or replaced by differences of vocalic timbre or diphthongization.[13]

The vowels of different registers may undergo various quality changes, including diphthongization. In particular, it appears that the different registers or vowel classes are susceptible to different kinds of diphthongization. In languages with a register difference, first-register ('clear' or 'tense' or 'constricted' vowels appear to diphthongize as up-gliding diphthongs, where the offglide is higher and more intensely colored than the syllabic, and second-register ('breathy' or 'buzzy' or 'lax' vowels diphthongize to in-gliding diphthongs, where the offglide is lax, or centering, or lowered, and the syllabic is tensed and/or raised. Huffman's study of register in fifteen Mon-Khmer languages showed this: second-register mid and low vowels diphthongize by raising of their initial elements in Alak, Souei, Nge$^{?}$ and Bru, and the second-register low vowel /a/ does so in Tampuon (1976b, 580). Similar first-element raisings occur in Khmer and Mon (Shorto 1976), and such diphthongizations have also been described by Diffloth (1980) for the Wa languages.

Gregerson (1976) drew a connection between such raising and the feature of tongue-root advancement. He suggests that tongue-root advancement is a means of pharyngeal expansion, associated with maintaining air flow across the glottis during the production of voiced obstruents. This advance-

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[13] Diffloth (1980) observes that in Pacoh (E. Katuic), register exists but seems unrelated to a lost voicing distinction, and compares this with N. Bahnaric, where registers exist although the voicing distinction remains.

ment, given the tongue's constant mass, results in raising of the vowel (a higher tongue-blade or tongue-back position). Conversely, tongue-root retraction would be associated with voiceless preceding obstruents consonants, and it results in lowering of the vowel.

However, it also seems relevant that the diphthongization patterns of first and second register vowels in Mon-Khmer languages parallel the diphthongization patterns of tense and lax vowels in many languages. In Donegan 1978, tenseness vs. laxness was defined as relatively strong vs. relatively weak palatality or labiality. In diphthongization, tense vowels typically become up-gliding (e.g. [e] → [ɛ i̯], or [i] → [ɛ i̯]), like first-register vowels, and lax vowels become in-gliding or down-gliding (e.g. [ɛ] → [e ə̯], or [ɛ] → [i ɛ̯]), like second-register vowels.[14] The connection between second-register vowels and laxness (weak palatality or labiality) is not surprising, when we consider that second register is often described as having generally less-energetic articulation or lax voicing (e.g. Huffman 1976, Gregerson 1976).

We find a conflict, however, when we consider that second-register vowels, which seem 'lax', and which diphthongize as -Tense (non-peripheral) vowels do, would be characterized as having advanced tongue root in Gregerson's view. Elsewhere, +ATR vowels have been identified with +Tense vowels (Halle and Stevens 1969, Perkell 1971). Nonetheless, it seems that second-register vowels and lax vowels both share some phonetic property that would explain their tendency to undergo parallel diphthongizations. Perhaps the resolution is simply that second-register vowels, like lax vowels, are susceptible to development of an in-glide, or loss of 'color' at the end of the vowel.

The connection of pharyngeal expansion or tongue-root advancement to in-gliding diphthongization may be this: the conditioning factor—the preceding consonant—would have its effect more strongly on the first part of the vowel. If diphthongization occurred, the +ATR ('lax-' or second-register) vowels, which involve some raising of the tongue arch in their initial portion, might be expected to become down-gliding or in-gliding diphthongs, and the -ATR ('tense-' or first-register) vowels, which might have lowering of the tongue arch in their initial portion, would become up-gliding diphthongs.

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[14] Cf. Labov et al. 1972, where the distinction is between 'peripheral' vowels (which acquire up-glides) and 'non-peripheral' vowels (which acquire in-glides). Labov et al., however, view [ɑ] as peripheral (tense) although they show no examples of its diphthongization. In Donegan 1978, [ɑ] and other non-palatal, non-labial vowels are lax. (Backness or retraction may, however, be a third 'color' in addition to labiality and palatality, which may occasion the diphthongizations which create [ɯɑ̯, ɤɑ̯], etc.)

The connection of Tense/Lax to up-gliding and in-gliding diphthongization is well-established, but phonetically less obvious. Tense vowels have, for a given degree of height, intense 'color' (palatality or labiality), and Lax vowels have weak color. Tense vowels are also intrinsically longer than their lax counterparts. Presumably because greater length offers more time for the more extreme gestures involved in producing tense vowels, long vowels are often tense, and short vowels, which provide less time for the palatal or labial gesture, often become lax. This superimposition of a quality difference on the quantity distinction becomes crucial if the long vowels are compressed or the short vowels are lengthened by a stress-timing system. The weak color of lax vowels may not be maintained throughout the added length, and such vowels thus acquire in-glides. In contrast, the strong color of tense vowels may be exaggerated through their duration, giving them more strongly colored, up-gliding off-glides.

7.3 Vowel shifts, and continuing innovation.

In Donegan 1978, it was argued that each substitution that is part of any vowel shift can occur independently—that similar changes occur as isolated sound changes, as stylistic markers of hyperarticulate (emphatic or emotive) speech, and in the speech of young children. From this we can conclude that the individual substitutions that make up vowel shifts are phonetically motivated. This motivation always has to do with the increase of a particular phonetic property of the individual segment—that is, the processes are fortitive.

The question remains, however, why some languages are conservative in their vowel phonology, and why other languages undergo the extensive reshufflings of vowel quality that we call vowel shifts. It appears that the languages that undergo such wholesale shifts are stress-timed languages. Three aspects of vowel phonology that are typical of stress-timed languages contribute to the occurrence and continuation of vowel shifts. They are vowel length, system size, and diphthongization.

Vowel shifts, it should be noted, affect only the vowels of accented syllables. A common characteristic of the vowels of accented syllables in stress languages is their length. Stressed vowels are particularly long in monosyllables, or in stressed final syllables (where the stressed syllable occupies the entire 'beat'). The length and accent of stressed syllables and the concomitant loss of information in the shortened (or deleted) unstressed syllables create a high degree of foregrounding of stressed syllables. This means that speakers will be inclined to increase or optimize the phonetic properties of these syllables. And of course, the extra duration of their vowels means that speakers will have time to do this by diphthongization.

Diphthongization, as noted above, involves the sequencing and polarization—and thus, the optimization—of the conflicting properties of an individual vowel. If [ɛː] becomes [ɛɑ̯], it increases its sonority while maintaining its palatality; if it becomes [iɑ̯], it increases both its palatality and its sonority. The cost of this optimization is that the speaker must achieve two articulatory targets instead of one, and that takes more time. That is why length is the principal conditioning factor in all kinds of diphthongization.

The length of stressed vowels, in many cases, also underlies the large size of the vowel inventories of stress languages. In the European languages where vowel shifts occur, the originally long vowels are of course long in stressed syllables—but the originally short vowels may become long in stressed syllables, too. And in unstressed syllables, the opposite may happen, with originally long vowels being shortened. In many cases, a quality difference is superimposed on the length distinction, so that the old long vowels are tense and the old short vowels are lax.[15] In effect, such a change doubles the inventory of vowel qualities. In the Mon-Khmer languages, it is often the development of register that doubles the inventory of vowels, but it is also true of these languages that the stressed syllables are lengthened at the expense of the unstressed syllables. Because of the length of the vowels in stressed syllables, and the many vowel qualities that are to be distinguished, diphthongizations may affect the originally long (tense) and the originally short (lax) vowels, or the first-register and second-register vowels. Diphthongization may apply or not, depending on the number and nature of following consonants or following syllables, and if these conditioning elements change, then the results of such diphthongization may become new vowel phonemes. Even a small set of such changes may produce a rather large vowel system.

In stress languages, then, we find the following:

a) foregrounding of the vowels of stressed syllables, with considerable dependence on those vowels for information regarding the form of morphemes.
b) lengthened, often diphthongal vowels, in which one element may change while the other retains its original quality, and
c) large systems, with many distinctions to be maintained.

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[15] The greater intrinsic length of tense vowels (or shortness of lax vowels) makes it possible—even likely—for the tense-lax difference to reinforce the long-short difference, even in languages where the timing poses no threat to the length distinction. Or it may be that there is no tense-lax stage, and that newly-added length is maintained, on originally short vowels, with a glide of relatively neutral quality, while the length (in stressed syllables) of an originally long vowel is maintained with a glide marked by exaggerated palatality or labiality. This, too, would double the inventory of vowel qualities. Then, too, either set of vowels may maintain its original quality.

This seems to be an ideal situation for the application of phonetically motivated, fortitive processes. Few communities of speakers seem to be able to resist such motivation.

But at the same time, speakers of stress languages, like speakers of all languages, are also motivated to lenite vowels—to assimilate or monophthongize, because a single vowel target may be articulatorily preferable, especially in connected (fast) speech. Thus, even while diphthongization is affecting some vowels in a system, re-monophthongization may be affecting others. For example, Middle English /iː/ diphthongized, becoming Modern English /ai/, but in some contemporary Southern U.S. dialects, this diphthong, /ai̯/, is being re-monophthongized to [aː]—even while the same speakers are diphthongizing Modern English /æ/ to [æi̯]: while 'side' becomes [saːd], 'sad' becomes [sæi̯d] (cf. Wells 1982, 532- 536).

The vowel shifts of stress languages, however, do not alter the conditions (like a-c) which seem to give rise to them. That is, the factors that promote the optimization or exaggeration of particular vowel features remain in the language, even after its shift. Thus, in many languages, vowel shifting continues to occur for centuries.

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