Clear, Muddy, Tongue Root, and Syllable Register*

1. The Trouble with the Traditional Interpretation of Clear and Muddy

In traditional Chinese linguistics, the terms "clear" and "muddy" are used to denote opposite values of syllabic initials. When tones split, the "clear" initials condition the upper register tones, which are believed to have comparatively higher pitch in history, and the "muddy" ones condition the lower register tones, with historically lower pitches. The phenomenon is similar to that found in other languages where voiceless and voiced initials (or finals) condition higher and lower pitches respectively. Therefore, a parallel is drawn between these two sets of terminology that "clear" and "muddy" are interpreted as "voiceless" and "voiced" respectively. The parallelism seems perfect and unquestionable, especially for occlusives and fricatives. The interpretation has become religious.

Meanwhile, linguists specializing in historical Chinese realize that there are exceptions in words with sonorant initials; that is, some syllables with sonorant initials do not belong to the lower tone registers as syllables with voiced initials are expected to do. These exceptions are treated as special cases such as onomatopoeias, expressive verbs, loan words and, especially, words with proto-voiceless-sonorant initials.[1] This treatment poses no problems for a small group of lexical items. There are, however, cases where the whole set of syllables with sonorant initials in the same lexical stratum split.[2] In certain tone categories, they have the identical tone values as syllables with other "clear" initials. Consequently, the parallelism fails to be true.

The "muddy" occlusives are also believed to be aspirated. Karlgren (1954:220–221) clearly expresses this view, which will not be repeated here. The problem is that his **b'-*, **d'-*, **g'-*, etc., are doubly marked as voiced and aspirated. If there were another set of occlusives besides **p-*, **t-*, **k-*, etc., and **p'-*, **t'-*, **k'-*, etc., it would be **b-*, **d-*, **g-*, etc., rather than **b'-*, **d'-*, **g'-*, etc.[3] Yet, Karlgren cannot reconstruct the expected **b-*, **d-*, **g-*, etc. He argues that "it is impossible to suppose an evolution... Anc. *ban* > *pan* > *p'an*, because all the time there existed simultaneously words of... *p-*..." (ibid.:220). His dilemma lies in not being able to recognize another oral configuration in Middle Chinese phonology.

2. Tongue-Root Position and Syllable Register

2.1 The Tongue Root

After Stewart (1967) and Purtle (1968), many researchers have put much effort into studies on tongue-root position and vowel register in relation to tones in East Asian and Southeast

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[1]For the literature on voiceless sonorants, see Chang Yü-hung (1992).

[2]Syllables belonging to different strata may have different phonetic tone values, e.g., in Sino-Vietnamese 園 'garden' is *viên* and *vườn*. The first reading corresponds to syllables with "clear" initials, and second to those with "muddy" initials. The initial *v-* is a reflex of the semivocalic initials 喻.

Sino-Vietnamese is treated here as a Chinese language, since literary Min has been so treated. If one, on the contrary, wishes to treat Sino-Vietnamese as systematic foreign loans, one also has to treat literary Min and other systematic literary forms in other Chinese languages as Sino-Min, etc.

[3]Jakobson (1958:23) has similar objections to the reconstruction of Proto-Indo-European voiced aspirated stops without their voiceless aspirated counterparts. The case of Tongcheng, Hubei (see §4 below) must be in the transitional stage of changes and must also be unstable.

Asian languages. The scope of this paper is limited to post-Qieyun periods in Chinese only, although examples and evidence will be taken from other languages. Additionally, this paper implies the same situation in languages other than Chinese. Since the contrast in tongue-root position affects the whole syllable, the resulting phonemic or sub-phonemic differences will be called "syllable register" rather than "vowel register".

It has been clear from early studies that the tongue root is an important articulator in many languages, and that the contrast in syllable register conditioned by tongue-root position occurs in languages which are not related. The contrast of unadvanced versus advanced or retracted versus unretracted[4] tongue-root position is "realized in various cases by high versus low pitch, by tense versus lax articulation,[5] by fortis versus lenis onset, by shortness versus length, by clear versus breathy voice quality, by laryngealized versus clear voice quality, by contrastive vowel glides, or by contrastive vowel openness" (Pittman 1970:4–5), as well as by voiceless versus voiced onset (ibid.:5; Burton-Page 1955:113), by unaspirated versus aspirated onset (Burton-Page ibid.), or may also be realized by ballistic versus controlled syllable dynamic (Bauernschmidt 1965). Of these sub-phonemic realizations of syllable register, pitch (high/low), voice quality (clear/breathy or laryngealized/clear), initial voicing (voiceless/voiced), and aspiration (unaspirated/aspirated) are responsible for the development of tone registers in East Asian and Southeast Asian languages and for the aspiration or voicing of the so-called "voiced aspirated" initials in Chinese. The two syllable registers are referred to as the first and the second registers, which correspond to unadvanced and advanced tongue-root positions, respectively. Nevertheless, since there is still no empirical tongue-root evidence in modern Chinese phonetic studies, the "retracted tongue-root position" and the "advanced tongue-root position" concerning Chinese in this paper remain an abstraction. The two positions correspond to clear and breathy voice quality, respectively, and the contrast can easily be substituted by the concept of voice register.

2.2 Phonation Types[6]

Also in this paper, the whole syllable is taken into consideration, and "syllable features" are assigned to it, although some of the features affect only a portion of the syllable. The features chosen for discussions are the four realizations of the syllable register mentioned above, i.e., voice quality, pitch height, onset voicing, and aspiration. Notice that, when tongue-root advancement is contrastive, the four realizations are not distinctive, i.e., etic, and are interdependent. That is, when there is a contrast between advanced and unadvanced tongue-root positions, the differences in voice quality and in pitch height are concomitant and obligatory, and the voicing and aspiration of the onset are optional, i.e., the presence and absence of these features are in free variation.

The potentiality of onset voicing and onset aspiration are attested by many languages. In Gurungkura of Nepal, the syllable initials in the second register have "potential voicing and aspiration" (Burton-Page 1955:113). In Awankari (a Lahndi subdialect in the Panjab, India) the "unaspirated voiced plosives have a greater voice than their aspirated equivalents" (Bahri

[4]The proportional openings of the pharynx in unadvanced/advanced and in retracted/unretracted form parallel contrasts. For instance, in Sedang, the contrast is unretracted (clear) versus retracted (laryngealized), and in Jeh and Halang, the contrast is advanced (breathy) versus unadvanced (clear). i.e.,

	Sedang	**Jeh/Halang**
1stRegister	*Laryngealized(retracted)*	*Clear(unadvanced)*
2ndRegister	*Clear(unretracted)*	*Breathy(advanced)*

(See Pittman 1971, after Ken Smith.) This relationship is supported by cognates. In this paper, unadvanced/advanced is used to cover all the parallel contrasts, i.e., clear/breathy, laryngealized/clear, etc.

[5]Stewart (1967:194), however, rejects the tense/lax contrast for Asante-Twi.

[6]For recent accounts of phonation types concerning Sinitic and Tai, cf. Chang Yü-hung (1992).

1963:150), which may be another indication of the potential quality of initial voicing when the tongue root is advanced. Further evidence can be seen in Ningpo (Chao 1935:108) where [pfi], etc., and [bfi], etc., are in free variation.

These realizations are summarized in the following figure:

	+advanced	-advanced
voice quality	breathier	clearer
pitch height	lower	higher
onset voicing	(voiced)	
onset aspiration	(aspirated)	

The potential voicing of the initials may be caused by the stretching of the tongue root which pushes "the bundle of muscles above and in front of the glottis within the frame of the lower jaw" downwards (Stewart 1967:197) and vibrates the vocal-chords earlier than expected. Pike (1967:137) suggests that "with frequency of vocal-chord vibration involving tenseness, and tongue-root fronting also affecting tenseness, perhaps there could be some correlation." The potential aspiration perhaps is due to the similarity between aspiration and breathiness, which has a weak air stream.

In the passages to follow, a syllable is represented by a consonant preceding a dash. Muddy syllables are represented with the symbol $\hbar$, placed above the dash. Syllables with sonorant initials and those belonging to the first or clear syllables are not marked as such. The labial series is used to illustrate the manner of articulation. In this convention, the figure above is reinterpreted as the following figure:

	p−	p‘−	p$\underline{\hbar}$	m−	f−	f$\underline{\hbar}$
Breathy	−	−	+	±	−	+
Low	−	−	+	±	−	+
Voiced	−	−	±	±	−	±
Aspirated	−	+	±	±	−	±

/p−/, etc., include the affricates.

According to the foregoing statement and the above figures, voice quality is determined by tongue-root position.[7] When tongue-root advancement is contrastive, breathiness, pitch height, onset voicing, and aspiration are concomitant. Only when the contrast in tongue-root position is not present or is lost, i.e., when breathiness is etic, may pitch height, onset voicing, and aspiration become emic. That is, when there is no contrast in tongue-root position, there will automatically be no contrast in voice quality. There still can be, however, contrasts in pitch, voicing, and aspiration, if aspiration is a distinctive feature in the language. A subsequent choice has to be made among these remaining variables for rephonologization. The details will be discussed in the following two sections.

3. How Muddy are the Liquids?

The traditional Chinese term indicating syllables with a sonorant initial is "secondary muddy", which might imply the ambiguous status concerning the voice register of these syllables. The figure above shows that for homorganic occlusives there is a contrast in tongue-root position, but for a sonorant, there is no such contrast. The lack of contrast in tongue-root position in sonorant syllables serves as the factor for these syllables to wander between the two registers. If the initial voicing were the main factor for a syllable to belong to the second register, it would be expected that all syllables with sonorant initials were also in the second register, which, as

[7] For further discussion on the correlation between tongue-root and voice quality, see Stewart (1967:199), Ladefoged (1964:38), and Pike (1967:131,137).

already mentioned, is not the case. Conversely, if the syllables wander between the two registers, some other factor will cause them to settle down in one or the other register. This factor, in Chinese, is the pitch.

Various Chinese languages and dialects demonstrate that syllables with a sonorant initial have a first register tone rather than a second register tone. In the following discussions, the four historical tones are called A, B, C, and D, corresponding to *píng, shǎng, qù*, and *rù*, respectively, and the two registers are called 1 and 2.

In literary Hokkien, in Hunan dialects in Xiang (1960:167), and Tang Zuofan (1960:117), in all the Hubei dialects in Chao et al. (1948), and in 100 out of the 101 Yunnan dialects in Yang (1969), /m$\underline{^{B}}$/ behaves exactly like /p$\underline{^{B}}$/ and /p‘$\underline{^{B}}$/, as opposed to /p$\underline{^{\hbar B}}$/ with regard to modern tone values. That is,

1st Register	2nd Register
m$\underline{^{B}}$	p$\underline{^{\hbar B}}$
p$\underline{^{B}}$	
p‘$\underline{^{B}}$	

As a matter of fact, in most Chinese languages and dialects, the reflexes of */p$\underline{^{B}}$/, */p‘$\underline{^{B}}$/, and */m$\underline{^{B}}$/ form a group, whereas the reflexes of */p$\underline{^{\hbar B}}$/ form a contrastive group, except in some cases such as Cantonese and the Baoshan 寶山 dialect of Wu.

A similar phenomenon is observed for tone D in Hubei. Whenever */p$\underline{^{D}}$/ and */p‘$\underline{^{D}}$/ split into D1 and D2 syllables, */m$\underline{^{D}}$/ also split into /m$\underline{^{D1}}$/ and /m$\underline{^{D2}}$/; but in languages and dialects where */p$\underline{^{\hbar D}}$/ splits into /p$\underline{^{D1}}$/ and /p$\underline{^{D2}}$/, */m$\underline{^{D}}$/ never splits. In the cases where D splits and merges with other tone categories, the reflexes of */p$\underline{^{D}}$/, */p‘$\underline{^{D}}$/, and */m$\underline{^{D}}$/ go to register 1, and those of */p$\underline{^{\hbar D}}$/ go to register 2. That is,

1st Register	2nd Register
m$\underline{^{D}}$	p$\underline{^{\hbar D}}$
p$\underline{^{D}}$	
p‘$\underline{^{D}}$	

In a stratum of Sino-Vietnamese, */p$\underline{^{A}}$/, */p‘$\underline{^{A}}$/, and */m$\underline{^{A}}$/ belong to the first register, while */p$\underline{^{\hbar A}}$/ belongs to the second register, i.e.,

1st Register	2nd Register
m$\underline{^{A}}$	p$\underline{^{\hbar A}}$
p$\underline{^{A}}$	
p‘$\underline{^{A}}$	

For example, see note 2.

Finally, in Huangqiao of Hunan (Tang 1960:117), there is a case in which */p$\underline{^{C}}$/, */p‘$\underline{^{C}}$/, and */m$\underline{^{C}}$/ belong to modern tone C category, while */p$\underline{^{\hbar C}}$/ and */p$\underline{^{\hbar B}}$/ merge as modern B2, i.e.,

1st Register	2nd Register
m$\underline{^{C}}$	p$\underline{^{\hbar C}}$ → p$\underline{^{\hbar B}}$
p$\underline{^{C}}$	
p‘$\underline{^{C}}$	

The exclusive assignment of /m−/ to one or the other register also occurs in other languages. In Cambodian, all sonorant syllables, except those with historically retroflexed sonorant initials and the sonorant syllables with diacritics added in the orthography, belong to the second register. Henderson (1952:152) says that “in modern Cambodian... diacritics may be added to entire

surd or sonant symbols to signal a register other than that normally to be expected. Words having such diacritics are, however, relatively rare, and a high proportion of them are easily recognizable as of foreign origin." The Cambodian case is well-expected by most linguists. On the other hand, in Gurungkura of Nepal, all the /m−/'s belong to the first register (Burton-Page 1955:112).

It is, therefore, clear that, under the condition that tongue-root positions are in contrast, there can be two sets of sonorants. It is, however, not clear whether there is any language in which the unadvanced /m−/'s can form a group of lexicon large enough to be comparable with the advanced /m−/'s, or vice versa. Most of the Cambodian /m$\underline{1}$/'s are loans. The Asante-Twi examples (Stewart 1967, Boadi 1963) are ambiguous, for vowel harmony will change the register of the syllables. The number of voiceless sonorants in Yao (Lombard 1968) is too small, much smaller than that of their voiced counterparts. In other words, although there can be sonorant syllables belonging to both registers in a language, the syllables in one of the registers are exceptional, being borrowed, being derived, or belonging to different strata.

4. The Development of "Muddy Occlusives"

With regard to the explanation of Middle Chinese occlusives in muddy syllables, abbreviated as "muddy occlusives" hereafter, the hypothesis of tongue-root position or voice quality is also easier and more adequate than Karlgren's reconstructions, i.e., as voiced aspirated. It is also more adequate than the modern Chinese linguistic treatment, which interprets the muddy occlusives as simply voiced.

In practically all Chinese languages and dialects, early and modern, there is a contrast in aspiration in the first register, i.e., /p−/ versus /p'−/. In the second register, however, there is no such distinction at all. The "muddy occlusives" can either be [+aspirated] or [−aspirated]; that is, they are [±aspirated], as stated in §2.2. The muddy syllables are also specified by [±voiced], as attested by Gurungkura, and possibly by Awankari. (See §2.2 also.)

Register 1	Register 2
−voiced −aspirated	
−voiced +aspirated	±voiced ±aspirated
+voiced −aspirated	

The aspiration and voicing potential is also attested by the alternation between [pfi] and [bfi] in the Ningpo dialect of Wu and by the change of [pfi] to [b] in intervocalic positions in many Wu dialects (Chao 1935:108).

A non-physiological factor, the lack of contrast in the second register, with regard to voicing and aspiration, also contributes to the alternation in their feature specifications, i.e., [±aspirated] and [±voiced]. In the first register, there can be as many as three contrastive syllables, [−voiced, −aspirated], [−voiced, +aspirated], and [+voiced, −aspirated], but in the second register, there is no contrast at all. The specifications of both features are potentially in free variation.

If [±voiced, ±aspirated] is realized as [+voiced, +aspirated], it must be in the environment that the language has also [−voiced, −aspirated] syllables, [−voiced, +aspirated] syllables, and [+voiced, −aspirated] syllables, which possibly is the case in the non-Chinese Awankari and many other Indic languages.[8]

[8] I cannot gather from Bahri's description whether Awankari /p−/, /p'−/, and /b−/ occur in the same register, i.e., the first register, and /b'−/ occurs in the other register, i.e., the second register. If it is so, Awankari /b'−/

Register 1	Register 2
−voiced −aspirated	
−voiced +aspirated	+voiced +aspirated
+voiced −aspirated	

In Chinese, [±voiced, ±aspirated] is either realized as [−voiced, ±aspirated], such as in most Wu dialects,

Register 1	Register 2
−voiced −aspirated	−voiced ±aspirated
−voiced +aspirated	

or stays in free variation, such as in Ningpo, Zhejiang. Nevertheless, all these cases are only phonetic realizations of the second register. The tongue-root positions are still in contrast, i.e., [+breathy, +low] remain at the same time.

When tongue-root position is no longer contrastive, different changes can occur. The first change is that voice quality, which is conditioned by tongue-root position, will not be contrastive. One or more of the variables left will then be rephonologized in order to keep the existing syllabic distribution, and the values of [±voiced] and [±aspirated] must become either positive or negative. Supposing that [±voiced] becomes [−voiced], [±aspirated] may become [+aspirated] in all environments, such as in Hakka and some dialects of Hubei, such as Chongyang 崇陽; [±aspirated] may become [−aspirated] in all environments, such as in literary Min of the main stratum and in Tongshan 通山, Hubei; and [±aspirated] may become [+aspirated] in some environment (Tone A) and becomes [−aspirated] in other environments (Tones B, C, and D), such as in Northern Mandarin and in Hefeng 鶴峰. Finally, suppose that [±voiced] becomes [+voiced], [±aspirated] may become [−aspirated], such as in Xiang.

Chao (1935:103, note 3) discovers a single case of modern [+voiced, +aspirated] in Tongcheng 通城, Hubei. Later, Puqi 蒲圻 is also found to have voiced aspirated onsets (Chao et al. 1948:1275–1298). Nevertheless, not all such syllables are the reflexes of the historically muddy syllables. Many of them correspond to syllables with modern voiceless aspirated occlusives in other Hubei dialects. (Cf. Chao et al. 1948:1302, 1308–1317.)

$$\left.\begin{array}{l} */p\underline{\underline{\hbar}}/ \\ */p\text{`}-/ \end{array}\right\} \rightarrow [b\text{`}-]$$

As a result, [p−] syllables only occur with an upper register tone, and [b`−] syllables occur with a tone of either register. The latter thus bears no evidence for Karlgren's reconstructions. Note that there is no [p`−] nor [b−] in Tongcheng and Puqi. The etical voiced aspirated syllables are emically /p`−/, i.e /p`−/[b`−].

The developments of second register syllables are summed up in the following figure:

must be /p$\underline{\underline{\hbar}}$/. If it is not so, then the traditional non-register analysis will stand. It is also interesting to notice that the "voiced aspirated" occlusives are already lost in another West Panjabi called Ludhiani (Jain 1934:7).

voiced	aspirated	breathy	Examples
±	±	+	Ningpo; Gurungkura
−	±	+	most Wu dialects
−	+	−	Hakka; Chongyang (Hubei)
−	−	−	Literary Min; Tongshan (Hubei)
−	+ (A) − (B, C, D)	−	Northern Mandarin; Hefeng (Hubei)
+	−	−	Xiang
+	+	−	Tongcheng (Hubei); Puqi (Hubei)

5. Concluding Remarks

One may ask that if the differences in register, whether vowel register or tone register, are indeed conditioned by tongue-root positions rather than the voicing of the initials, why do both Chinese rime tables and the Cambodian script indicate the differences in the initials. The Chinese called the initials "clear initials" and "muddy initials". In Cambodian script, the initial symbols for the first register syllables generally correspond to Sanskrit surd alphabets and those for the second register, to Sanskrit sonorants, though modern Cambodian does not distinguish the voicing of the initials.

The answer is found in the many variables correlated to advanced or unadvanced tongue-root position. For a Chinese compiler of a rime table, he could choose among voice quality, pitch, or initial voicing.[9] Nevertheless, since segmentals are more tangible than suprasegmentals, the feature which was chosen to show the distinction was voicing, at least perceptual voicing, as in most modern Wu dialects. Furthermore, of the segmentals, consonants are more tangible than vowels. For a Khmer who adopted the Indic alphabet for his language, he also had choices among voice quality, vowel height (including different degrees of glides), and the voicing of the onsets. Again voicing was chosen. In modern Cambodian, since the potential voicing of the initials when the tongue root is advanced is no longer realized as such, a Cambodian has to choose among whatever is left. This time vowel height is chosen. Henderson (1952:155) says that "the different vowel 'colour' inherent in the registers... insures that no vowel nucleus of the first register can ever have exactly the same quality as a vowel nucleus of the second register, no matter how alike their general description may be apart from the question of register".

The native speaker's intuition, as contrary to linguistic analysis, may also be illustrated by Hokkien. (Cf. Bodman 1955 & 1958 and Peng 1966 for the disagreements.) In Hokkien, there are two sets of vowels, oral and nasal. Voiceless initials may occur before both series of vowels, but voiced stops occur only before oral vowels, and nasal consonants occur only before nasal vowels. Voiced stops and nasals are therefore treated as allophones of the same phonemes conditioned by the vowel quality. However, a native speaker is not aware of the nasality of the vowels following nasals, no matter how strong the nasalization may be. Consequently, he will treat the voiced stops and their nasal counterparts as separate phonemes. Analogically, the cases of Middle Chinese and Cambodian recognition of voiced initials can suitably be explained in the light of the different analyses of Hokkien voiced initials specified by [−continuant].

Pike (1967:137) says, "Since tones have long been known to be allophonically affected by consonants, or themselves to affect the distribution of consonants, perhaps these problems should also be reinvestigated to see if a hypothesis of tone variants conditioned by tongue-root position might sometimes be useful." I take the second possibility one step further to assert that tongue-root position or any other oral configurations that produce the same voice quality, manifested as pitch heights etc., condition the distribution of consonants in Middle Chinese and in the Cambodian of the time when the Indic alphabet was introduced.

[9] But not aspiration, for there was already a contrast between aspirated and unaspirated for "clear occlusives".

What this paper is intended to propose is that there are no phonologically voiced consonants in Middle Chinese. Voicing, in other words, is not a distinctive feature in the whole Middle Chinese consonant system. It is unmarked for sonorants as a language universal and, therefore, is also irrelevant to the sonorants. There are only two sets of stops and affricates, i.e., aspirated and unaspirated. As for fricatives, nasals, lateral, and glides, aspiration is irrelevant. Besides pitch, contour, and aspiration, the phonology of Middle Chinese syllables also includes syllable registers. The syllable registers determine whether the obstruents are tending to be voiced or not, or tending to be aspirated or not. The articulator differentiating the syllable register could be the tongue root. (See §2.)

As there is no register contrast for */m−/ in Middle Chinese, */m−/ can be [m−] or [m$\underline{\underline{\hbar}}$] depending on dialects and tone categories. (See §3.) This freedom explains why certain */m−/'s with certain tone categories in certain dialects belong in a certain register but belong in the other register in other dialects. This freedom, however, is not enjoyed by obstruents, which have to belong to one or the other register. Moreover, since there is no contrast in aspiration for obstruents in the second register, aspiration is also an optional second register feature. (See §2, §4.) At the time when the contrast in tongue-root position is lost, aspiration may be rephonologized and yield aspirated obstruents; or it may also be lost and yield unaspirated occlusives.

$$/p\underline{\underline{\hbar}}/\left[\left\{\begin{array}{l} p\underline{\underline{\hbar}} \\ p\text{`}\underline{\underline{\hbar}} \\ b\underline{\underline{\hbar}} \\ b\text{`}\underline{\underline{\hbar}} \end{array}\right\}\right] \rightarrow \left[\left\{\begin{array}{l} p- \\ p\text{`}- \\ b- \\ b\text{`}- \end{array}\right\}\right]$$

The interpretation in terms of tongue root or voice register does not only take care of Middle Chinese "primary muddy" syllables (全濁, */p$\underline{\underline{\hbar}}$/, etc.) and "secondary muddy" syllables (次濁, */m$\underline{\underline{\hbar}}$/, etc.), but also explains the modern *aspirated fricative* reflexes of "tertiary muddy" syllables (又次濁, */f$\underline{\underline{\hbar}}$/, etc.) Fang Jin (1966) reports that aspirated fricatives occur in a Wu dialect that are in contrast with their unaspirated counterparts. These aspirated fricatives are, as a matter of fact, reflexes of Middle Chinese fricative syllable initials in the second register. The potential aspiration is rephonologized as aspirated. (See the last figure in §2 for the potentiality of voicing and aspiration in fricative syllables.)

Whether voice register is conditioned by tongue-root position or by the airstream mechanism in the glottis, or both, the configurations affect the whole syllable or even the whole word (such as the African cases of vowel harmony), not just the initial or the final ("rime" in the Chinese sense) or the tone; therefore, one has to look for syllable features or even word features that lie behind the problems.