BOOK REVIEW

Zhang Jingwei. *A Sociophonetic Study on Tonal Variation of the Wúxī and Shànghǎi Dialects*

Reviewed by Phil Rose

1. Introduction

Language changes. It is comforting, in our post-postmodernist world, to have this undeniable fact from the era when linguistics *was* historical linguistics. In retrospect, the discovery of regular language change benefited from two properties of the variation in the observation data. There was large between-language variation, with many Indo-european daughter languages to bring the picture of relationships into focus. The story might have been very different had only Welsh and Srilankan survived. Most importantly, though, a well-established classical canon meant minimal within-language variability. Jacob Grimm could happily write that *p* in Sanskrit (*padas*), Latin (*pes*) and Greek (*poûs*) corresponded to *f* in Germanic (Gothic *fôtus,* Old High German *vuoz*), and from such correspondence sets deduce that part of the Erste Lautverschiebung which described how Indo-european voiceless aspirates had changed into fricatives in Germanic. It is difficult to imagine these insights being won if 18th and 19th century historical linguists had only myriad detailed descriptions of Germanic dialects comprising variation from individual speakers over time and social space as well as geography.

Or would it? The book I have been asked to review (Zhang 2014) shows, in the spirit of Labov (1974) and subsequent work how ongoing sound change might be recovered from precisely this kind of variation. The result of five hard years of doctoral research at Utrecht University, Zhang's study documents variation in selected citation tones and disyllabic tone sandhi in several varieties of Chinese Wu dialect spoken in and around Shanghai. The book is far too dense, and the results too numerous, to summarise in a few pages. So I will confine my review to information that may be of use to a potentially interested reader.

2. Background

The Wu dialects, spoken mainly in the East-Central China provinces of Jiangsu and Zhejiang, are considered a first-order subgroup of Middle Chinese, along with Mandarin, Hakka, Yue, Xiang and Gan. The sixth major dialect group, Min, is assumed to have diverged from Sinitic before Middle Chinese (Norman 1988, Rose 2001). Zhang's study is concerned with Wu varieties in two fairly proximate regions in Jiangsu: Shanghai and Wuxi (which, to the extent that such distances can be exactly quantified, my map shows to lie some 125 kilometers apart.) Specifically, she investigates urban and suburban Shanghai varieties, the latter comprising Baoshan 宝山, Songjiang 松江 and Nanhui 南汇; and urban and suburban Wuxi 无锡 varieties, with Huazhuang 化庄 representing the latter.

These sites are chosen primarily because they allow inferences on what urbanisation can do to tones. But they are also well chosen because there is good data available on their earlier states. The famous polymath Chao Yuen Ren included Shanghai, Baoshan, Songjiang, Nanhui and Wuxi in his pioneering survey of 33 Wu dialects in the late twenties (Chao 1928). It gets better: the same sites were visited and described some sixty years later by Chao's student Qian Nairong (Qian 1992). And there is additional descriptive material in dialect surveys, local gazetteers (县志) and more recent publications. Zhang uses these sources to gain a real-time perspective in addition to the apparent time she extracts from a comparison of different aged subjects. I am delighted to see use of these sources, so eminently suited to document changes in Wu.

Wu's main linguistic interest lies in its tonological complexity. Wu dialects display a bewildering variety of citation tonal shapes which include variation in duration and phonation type as well as pitch (Zhu & Rose 1998, Steed & Rose 2009, Rose 2015). They also boast highly complex morpho-tonemics, aka tone-sandhi (Rose 1990, 2002). The sandhi complexity resides in several areas of linguistic structure. It is typologically diverse: with both left- and right-dominant types; it is sensitive to syntax, with for example different tonal behaviour for phrases and words (*fried rice* vs. *to fry rice*); it is sensitive to morphological structure; derivationally, many of the tone-sandhi rules make little phonetic sense (Ballard 1980). Both citation tone and tone sandhi (in disyllabic expressions) are examined in this book.

3. Procedure

Zhang's study is not primarily descriptive — for example only a subset of tones is investigated with no details of speakers' overall raw tonal acoustics; or segmental

data other than the pan-N.Wu system of Simmons (1999). Rather the study is statistical-analytic in extracting features from appropriately transformed tonal acoustics and then testing these features for information on the requisite variables — to see for example if old speakers differ from younger speakers, or urban from suburban, in aspects of their tones (they do); and to see if sound change can be deduced from these differences (it can). It will therefore be useful to orient the would-be reader by giving them a more concrete idea of which tones are covered. To this end Figure 1 shows the tonal acoustics — F0 plotted as a function of absolute duration — of a rather old female speaker of a dialect fairly closely related to those analysed by Zhang. The speaker is from Changyinsha 常阴沙, about 60 kilometers from the Wuxi varieties Zhang analyses. She is conservative in having eight separate tones, i.e. each of the panels shows the acoustic allotone of a separate toneme.

Zhang follows a very strong Chinese tradition in using Middle Chinese tonal categories as the initial grouping principle. Thus tones are identified according to the Middle Chinese tonal category of the character with which their morphemes are written, using the labels T1 through T8. It will help the reader to remember that these labels are historical and do not refer to a particular modern tone. "T1" for example means any tone or tones which is/are a reflex of Middle Chinese Yinping/Ia. "T1" in Zhang's data may therefore correspond to a single modern tone or a group of different tones. Table 1 gives the Changyinsha tones' auditory properties together with labels used by Zhang and their more conventional names, e.g. Yinping/Ia.

Zhang's study focusses on tones in Wuxi and Shanghai which are reflexes of Middle Chinese tonal categories Ib IIb and IIIb, and cognate with the unstopped Changyinsha tones 2, 4 and 6 in the bottom row. Zhang chose these three tones because they show differential patterns of merger that can be investigated as a function of apparent time and linguistic, sociological and stylistic features. For example, in Wuxi, Ib and IIIb — shown as separate in Chao (1928) with transcriptions very similar to the tones in Figure 1 — have now merged, and IIb is in the process of merging with the result. The details of how this is happening are shown very nicely in the book. The tone sandhi in which these tones participate is also characterised by variability which Zhang investigates.

Figure 1 shows a single speaker. Her overall variance has only two sources, associated with within- and between-tone variability: this is essentially safe, unproblematic data. Contrast this with the one hundred and twenty speakers Zhang recorded and processed. Many more than two sources of variance now, but consequently much more information. With five speakers making up each minimal cell, her subjects break down into age, sex and location factors thus: 6 sites * 2 age groups * 2 sexes * 5 individuals = 120 speakers. Subjects in the old generation age
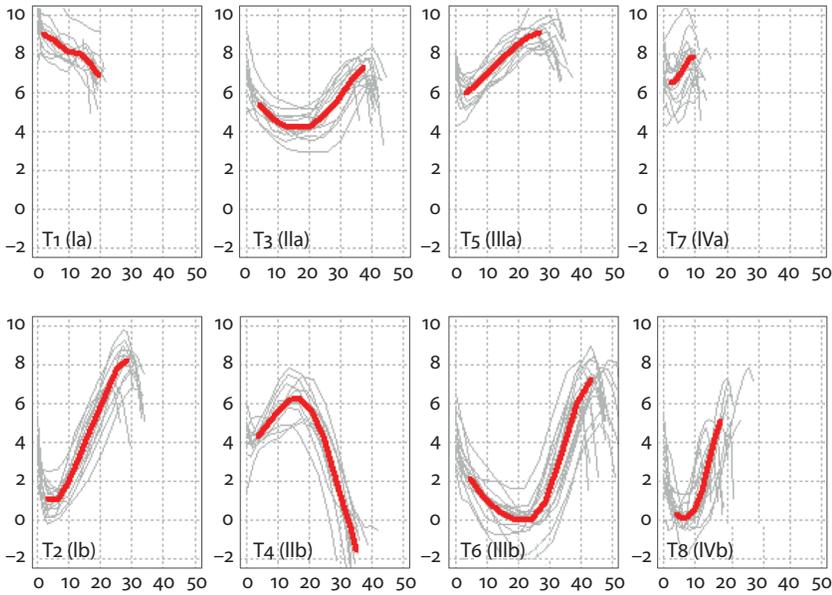
Figure 1. Citation tone acoustics of a female *Changyinsha* speaker. X-axis = duration (csec.), y-axis = F0 (semitones relative to tone 6 trough). Thick lines = mean values, thin lines = individual tokens.

group were 60 and above at the time of recording and grew up in non-urbanised China; subjects in the young age group were between 18 and 23 and grew up in "fast-paced urbanisation."

Read-out speech was elicited, but using several different tasks to enable investigation of factors associated with style. Subjects read out Chinese characters representing both free and bound morphemes, disyllabic words, minimal pairs (again with free and bound morphemes) and a familiar passage about Chinese names. Spontaneous speech was also elicited in a "structured interview", but was not used.

After investigating the phonetic domain of tone, the elicited data were preprocessed by extracting tonally relevant F0, correcting it if necessary, and modelling its trajectory with a second-order polynomial. It is good to see the whole F0 trajectory quantified in this way rather than just turning points; and given the fairly simple F0 shapes involved a quadratic is a sensible option. The raw acoustics won't tell you everything, at least not yet. A human is still required to work out the categories before quantifying them acoustically. So it is nice to see that preprocessing involved Zhang's pitch transcription of the tones (pitch *qua* auditory percept, not *qua* acoustic fundamental frequency).

Speech acoustics enable the quantification necessary for a study like this, but they also bear the imprint of the individual vocal tract that produced them, and

Table 1. Auditory properties and names of Changyinsha tones in Figure 1.

Zhang's name	Conventional names	Auditory characteristics	example
T1	Ia, Yinping	level pitch in speaker's upper pitch range	[taʊ] *knife*
T2	**Ib, Yangping**	rising pitch from low in speaker's range to high	[d̥ʊ̥ŏŋ] *poor*
T3	IIa, Yinshang	dipping pitch in speaker's mid pitch range	[tǐ ŋ] *to wait*
T4	**IIb, Yangshang**	mid-falling pitch with depressed onset	[ma] *to buy*
T5	IIIa, Yinqu	rising pitch in speaker's upper pitch range	[taʊ] *to arrive*
T6	**IIIb, Yangqu**	dipping pitch, rising from low in the speaker's pitch range to high after a low-falling pitch component	[ma] *to sell*
T7	IVa, Yinru	short, slightly rising pitch in speaker's upper pitch range with abrupt phonation offset from glottal stop	[pǐʔ] *pen*
T8	IVb, Yangru	short, rising pitch from low in speaker's pitch range to mid, with abrupt phonation offset from glottal stop	[b̥ǐ̥ʔ] *white*

this needs to be controlled for before any meaningful analysis to extract correlations with variables under examination. A z-score normalisation will not be suitable for this purpose, as it will maximally globally reduce the variance and represents an optimum normalisation technique only when one is sure that the objects to be normalised represent the same information. Different transformations were therefore tested (pp. 97–119) to find a method which minimised between-speaker differences in F0 associated with sex, whilst preserving other (socio-) linguistically relevant information, like toneme, and age. It was nicely demonstrated that the optimum method was to transform a speaker's F0 by converting to semitones relative to the mean F0 of the tones under consideration. I was unable to find an explanation of how that mean was calculated, however.

Discriminant analysis failure is used to evaluate the efficacy of a transformation. To the extent that discriminant analysis cannot recover sex differences from transformed data, the transformation is deemed to have effectively removed such differences (which Zhang uses as a proxy for anatomically related between-speaker differences in F0). A neat idea. A stronger test would have been to co-opt likelihood ratio-based methodology from forensic voice comparison with its information-theoretic log likelihood ratio cost (C*llr*) (Rose 2013). C*llr* is the current metric of choice for likelihood-ratio based detection systems and directly quantifies the amount of information in a system (Brümmer & du Preez 2006). This is preferable, I think, to assessing this negatively, with lack of discrimination.

The transformed F0 data were then used for further analysis. The meat of the study is in Chapters 5 and 6 which document and analyse the variation in citation tone and tone sandhi in the two main areas of Wuxi and Shanghai respectively.

Below I reproduce some results from tone 4 in Wuxi to give a flavour of the kind of insights gained.

The left panel of Figure 2, from Zhang's Figure 5.1 (p. 129) shows the mean acoustics of the three main tonal variants she observed in Wuxi for reflexes of Middle Chinese tone 4 (IIb, Yangshang). The four panels show a break-down by age (old on left) and location (suburban on top, urban below). Within each panel can be seen the trajectories (transformed quadratic polynomial F0 plotted as a function of equalised duration) of the three variants: convex, rising and concave.
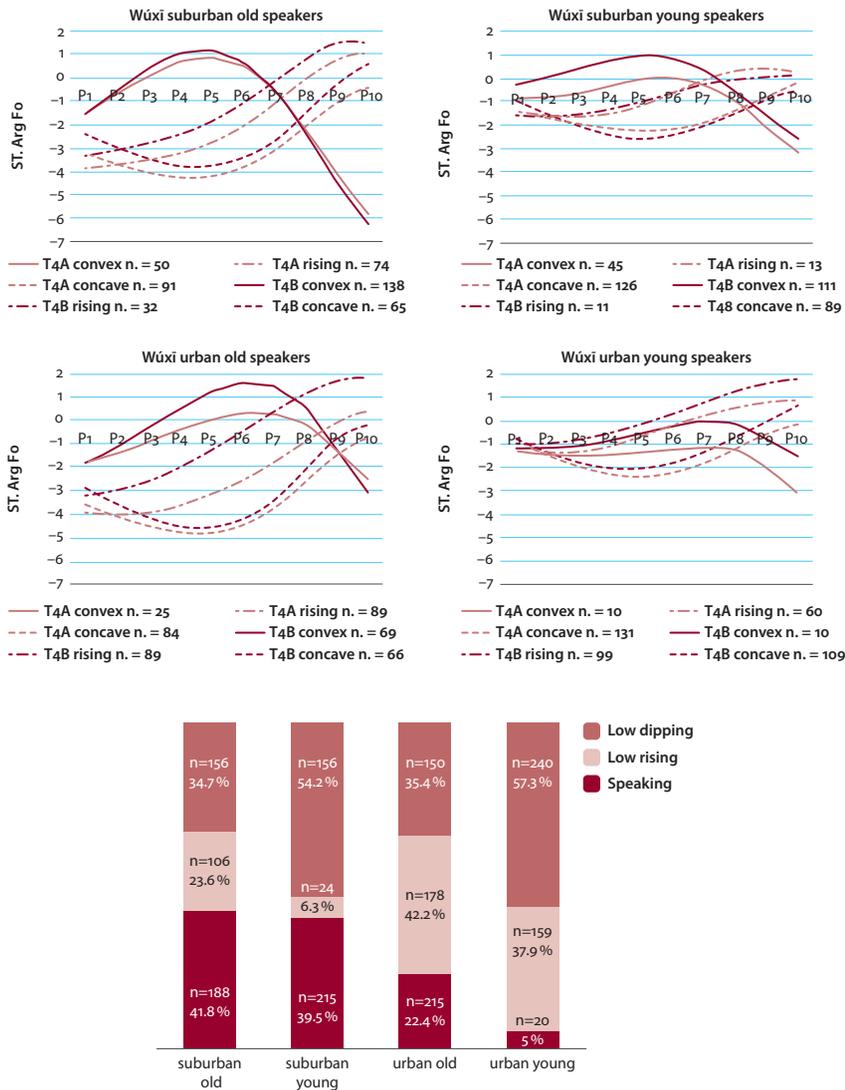

Figure 2. Analytical results on Wuxi T4.

Each variant has two similar curves, representing F0 on Rhymes with different consonantal onsets (the lighter shade indicates F0 on rhymes with obstruent onsets, the darker is F0 after sonorant onsets). One of the most interesting and repeated findings is the more compressed semitone range shown by younger speakers. Zhang attributes this (p. 261, 262) to their insecurity about their dialect and calls it "contour loss", but since the term *contour* is pre-empted phonologically, and the young speakers still clearly preserve their contour tones, it might be better to term it *range compression*. It can also be seen that there are differences in the tones' trajectories corresponding with the sociological factors: suburban convex tones peak earlier than urban, for example.

The right panel of Figure 2 shows, again broken down by age and location, the proportions of the three different reflexes of tone 4 (IIb) (the tones are named differently in this figure from the previous: "peaking" = convex; "low rising" = rising, "low dipping" = concave). From apparent-time snapshots like this and the real-time descriptions Zhang can nicely capture two changes in progress: the change of the original convex/peaking reflex of tone 4 (IIb) into a rising tone; and a shift in the latter from a low-rising to a low dipping pitch (which can be shown to be at least partially due to influence from Standard Chinese). It is clear too that generally the urban area leads the change, with the suburban area being conservative. Further analysis investigates the detailed correlation between this tonal variation and social, linguistic and stylistic variables. For example it is shown that urban females have later peaks than males; and earlier peaks occur more frequently in word lists than paragraph reading.

4   Critique

4.1 *Construal of tone*

We read (p. 7) that:

> In … Wu, each morpheme has a fixed tone, which is a phonologically contrastive fundamental frequency (F0) pattern over a syllable. Segmentally identical syllables are lexically distinct by carrying different tones.

Now, this may reflect the way tone *qua* linguistic category is broadly conceived, although the received definition of a tone language makes reference to the necessary presence of pitch in the phonological representation of lexical morphemes, not F0; and Zhang herself demonstrates in the book that it is not over a syllable that the tonally relevant F0 is distributed. But there are two main reasons other than these why from a Wu perspective this view of tone may be misleading.

Firstly, the point was made in an insightfully iconoclastic analysis of Shanghai phonology (Sherard 1980: 20 et pass.) that tone contrasts in Shanghai involve much more than pitch, including not only extrinsic duration and phonation type differences but also tight phonotactic relationships with segmentals. The same state of affairs has been documented for other varieties, like Zhenhai (Rose 1990). So in Zhenhai, for example, tone 1 (e.g. [ta 41] *send*, [ti 41] *fill*) contrasts *minimally* with tone 6 ([d̪ǐ¹ʔ 24] *to tread on*, [d̪ṳě¹ʔ 24] *straight*) in pitch, phonation type,[1] duration, phonation offset, and quality and potential contrasts in onset segment and vowel — you can hear some examples from the embedded audio in Rose (2015). All these features are in complementary distribution with no non-arbitrary way of distinguishing conditioned from conditioning.

Secondly, given the right-spreading tone sandhi of Northern Wu, if a morpheme never occurs on its own or in word-initial position, it makes no sense to imagine that it has a lexical tone, so not all morphemes can be said to have one, although they are of course *given* one when read out as characters. This was pointed out in one of the classical papers in Chinese Linguistics — the first to describe left to right tone sandhi spreading in the North Wu dialect of Tangxi 塘溪 — by another insightful iconoclast (Kennedy 1953). This may be one of the reasons for the between- and within-speaker variability with respect to the reading of characters representing bound morphemes that one commonly observes when working with Wu informants. Tang et al. (1990: 107) for example noted of their informants that

> Tones on free morphemes are stable, corresponding regularly with the Middle Chinese tone categories, but tones on bound morphemes exhibit relatively serious changes and do not correspond regularly with the Middle Chinese categories. (舒声雕里能单用的字的声调稳定,跟中古音调类的对应也很整齐; 不能单用的字的声调有较严重的窜调现象,跟中古音调类的对应不整齐.)

It would be nice to be sure that the variability Zhang observed in character readings is due to sound change and not uncertainty arising from lexical representation. If possible it might have been a good idea to work just with free morphemes rather than a mixture of free and bound.

Now, it is important to realise that these observations are based on Wu varieties of yesteryear. Given how quickly Wu is changing, things may well also have changed in the varieties Zhang describes. Perhaps her unsuccessful attempt (pp. 119–123) to quantify "breathy" phonation type with the usual parameters, for example, indicates that it no longer exists. I could not find any statement as to whether non-modal phonation was actually audible: if it isn't then there is no

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1. The superscript [¹] indicates a growled phonation type, with epilaryngeal, as opposed to specifically aryepiglottal vibration (Rose 2015).

point in trying to quantify it; and if it is, then it will most assuredly be resolvable acoustically. And perhaps too there has been simplification of the three-way stop system to weaken correlation between tone and onset consonant. But the reader should have been made aware of these problems, if only to discount them.

The section on the phonetic domain of tone (pp. 81–92) essentially replicates previous findings, e.g. Rose (1982, 1998) and could have been omitted. I would also have welcomed reassurance about the consequences of equalising away duration and treating it as a variable independent from tone. Duration has to be sure been shown to be an important predictor of tonal F0 contour in running speech (Kratochvil 1985), but if one analyses tonal F0 as a function of equalised duration, as Zhang does, one runs the risk of distorting tonal F0 contours (Rose 1993: 214).

4.2 *Explanations*

The methodical quantification is admirable, but a wider audience is entitled to more explanation of the numerical processing — how linear discriminant analysis works, for example; or why in likelihood ratio tests a log-odds greater than unity is significant (p. 128). Chao's (1928) musical tonal representations are also given alongside his conventional 5 point 'tone letters' (e.g. p. 34) without explanation. The potential reader also needs to be aware that some of the explanations and justifications are a little confused and sometimes wrong. For example longer vocal folds are said (p. 98) to cause lower formant frequencies. It is well-known that, according to the received acoustic theory of speech production, formant centre frequencies are a function of the supralaryngeal vocal tract, not the vocal folds. Or (p. 84) "Syllables with voiced initials in the Wu dialects are all associated with the tonal categories of the Yang register." But there are plenty of common Yin register morphemes in Wu that begin with a sonorant, e.g. Shanghai mma *mother*, ling *carry*; Ningpo me *very*. The picture of Wu as a direct descendant of Middle Chinese is also simplistic. Several authors (e.g. Ballard 1981, Pan 1991) have suggested interaction with non-Sinitic substrata and pointed out that some of Wu's internal diversity is likely to be a function of successive waves of immigrants from the north bringing with them their northern Chinese forms of speech. *Plus ça change*: in a sense the study nicely documents the latest influence from Standard Chinese on Wu tones!

4.3 Exposition/Clarity

I understand this book reproduces Zhang's original Ph.D. thesis intact, without any obvious modification. This is perhaps because publication may be a requirement of the Netherlands doctorate. Now, because they have different goals, a thesis

is not a book, nor a book a thesis. In the former the candidate has to satisfy their examiners they know their stuff; in the latter the author has to communicate their findings to an audience with a wider range of interests. A potential reader needs to be warned, therefore, that I found the study not particularly easy to read, because, I suspect, it retains the original thesis format and content. All the numerical results of different modelling, with their tables, and discussion, follow each other in the main text. This is not necessary: a single table, with results and explanation should have been included; the remainder relegated to an appendix for the reader to consult should they wish. This would also have gone to alleviate the problem for the reader of holding in their head the meaning of the host of abbreviations used. I also had problems following some of the exposition. For example, in trying to find out what the relationship was between the Wuxi tone sandhi patterns in disyllabic words and the tone on their first syllable morpheme (one of the first questions the interested researcher will ask), one reads (p. 49):

> T2.X is predominantly /24.31/ while T6 is predominantly /22 44/.

This means, I think, firstly, that most disyllabic words whose initial syllable morpheme etymologically carries a reflex of Middle Chinese tone 2 (i.e. Ib or Yangping) have a first syllable tone with a low to high rising pitch followed by a mid-falling pitched tone on the second (/24.31/). And secondly that most disyllabic words with an etymological tone 6 (IIIb, Yangqu) on their first syllable morpheme have a low level — high level pitch shape (/22.44/). But on the following page one finds:

> WXD [Wuxi dialect] mainly uses /22.24/, /22.44/, and /24.31/ patterns for bisyllables initialled by T2, T4 and T6.

This now seems to be equating tone 2 with a /22.24/ pattern, and not the aforementioned /24.31/, which is now associated with tone 6. Then on page 157 we have:

> T2.X is mostly transcribed into /22.44/.

Perhaps it's even more frustrating if, like me, you are salivating in eager anticipation of the results.

In discussing the different Wuxi tone sandhi patterns observed in words with etymological tone 2 on the first syllable morpheme (p. 161) we find:

> Among the 51 total phrases, 43 of them were realised as /24.31/. In the total 1700 valid observations of those 43 phrases, 91.4% of them use /24.31/.

If 43 out of the 51 words were realised as /24.31/, it is difficult to see how then only a percentage of these 43 were so realised. Perhaps the following was intended to clarify:

> Those 43 phrases are grouped together because each of them has at least 30 valid observations of /24.31/ by 40 speakers. The remaining eight phrases have 312 valid observations, 75.3% of which use /22.44/. Each of those eight phrases has at least 20 valid observations of /22.44/ by 40 speakers.

I was not able to follow this and had to go the table in appendix V to try to sort it out (an expedient a potential reader might find useful).

Typos are a bit like the plate, fork and mustard pot in the *Wind in the Willows* (Grahame 1908:14). After the picnic you think you have packed them all away in the hamper but there is always one you missed. In a thesis of this complexity they are probably inevitable and I spotted several.

I am sure that the last thing Zhang would have wanted at the end of five years' hard slog — and extracting acoustic measurements from 120 speakers *is* hard slog, make no mistake — is to revise yet again; but things might have benefitted from more careful editorial checking, like the odd phantom reference in the text that has not made it into the bibliography at the end.

5.   Summary

As far as I can see, the criticisms outlined above do not bear substantively on the results, which is the essential thing. In all I would certainly concur with the book's back cover blurb that its contents will interest sociophoneticians and language variation and change people (for both methodology and findings). It can also be read in the context of early sociolinguistic findings on the heteronymy of urban Shanghai with respect to suburban Pudong (Xu 1989).

Many areas of Wu phonology have simplified in the period between Chao (1928) and Qian (1992). Contrasting vowel nasalisation has disappeared, tone contrasts have been lost, tone sandhi simplified and even the three-way initial obstruent contrast conventionally taken as diagnostic of Wu is disappearing in some sites. Zhang's fine-grained, well-controlled study of many speakers is probably the only way of revealing how some of this might have taken place. Chinese dialectologists and historical linguists will therefore also benefit from this insight into ways tones can change (although I think a more intriguing question is still how the Wu varieties become so complex in the first place). At the very least it will help ram home that in and around urban centers is not the place to look for conservative Wu varieties.

In all, therefore, the study is a very useful contribution, and will repay the effort to mine for information on tone change. It was high time that someone had the patience to investigate this kind of variation, and the necessary support for the

project in the Netherlands and China is also to be applauded. It is gratifying to see a start in this book. I look forward to an account of the remaining tones.

References

Ballard, W.L. (1980) 'On Some Aspects of Wu Tone Sandhi.' *Journal of Asian and African Studies* No. 19: 83–163.

Ballard, W.L. (1981) 'Aspects of the Linguistic History of South China.' *Asian Perspectives* 24/2: 164–185.

Brümmer, N. & du Preez, J. (2006) 'Application independent evaluation of speaker detection.' *Computer Speech and Language IEEE Odyssey 2004 Issue* 20/2–3: 230–275.

Chao Yuen Ren (1928) 現代吳語的研究 *Studies in the Modern Wu-Dialects*. Tsing Hua College Research Institute Monograph 4.

Grahame, K. (1908) *The Wind in the Willows*. Methuen. 1959 Reprint.

Kennedy, G. A. (1953) 'Two Tone Patterns in Tangsic.' *Language* 29/3: 367–373.

Kratochvil, P. (1985) 'Variable Norms of Tones in Beijing Prosody.' *Cahiers de linguistique Asie orientale* 14/2: 153–174.

Labov, W. (1974) 'On the Use of the Present to Explain the Past.' *Proc. 11th Int'l. Cong. of Linguists*: 825–851.

Norman, J. (1988) *Chinese*. Cambridge University Press.

Pan Wuyun (1991) 'An Introduction to the Wu Dialects.' Journal of Chinese Linguistics Monograph Series No.3 *Languages and Dialects of China*: 237–293.

Qian Nairong 钱乃荣 (1992) 当代吴语研究 [*Studies in the Contemporary Wu Dialects*]. Shanghai Educational Press.

Rose, P. (1982) 'Acoustic Characteristics of the Shanghai-Zhenhai syllable-types.' In D. Bradley, (ed.) *Tonation*. Pacific Linguistics Papers in South-East Asian Linguistics 8: 1–53.

Rose, P. (1989) 'Phonetics and phonology of the yang tone phonation types in Zhenhai.' *Cahiers de Linguistique Asie Orientale* 18/2: 229–245.

Rose, P. (1990) 'Acoustics and Phonology of Complex Tone Sandhi.' *Phonetica* 47: 1–45.

Rose, P. (1993) 'A Linguistic Phonetic Acoustic Analysis of Shanghai Tones.'.*Australian Journal of Linguistics* 13: 185–219.

Rose, P. (1998) 'The Differential Status of Semivowels in the Acoustic Phonetic Realisation of Tone.' *Proc. 5th Int'l Conf. on Spoken Language Processing,* Vol. 2: 61–64.

Rose, P. (2001) 'Chinese Languages: Wu.' In J.Garry & C. Rubino (eds.) *Facts About the World's Languages*. New England Publishing Associates: 158–161.

Rose, P. (2002) 'Independent depressor and register effects in Wu dialect tonology: Evidence from Wenzhou tone sandhi.' *Journal of Chinese Linguistics* 30/1: 39–81.

Rose, P. (2013) 'More is better: Likelihood ratio-based forensic voice comparison with vocalic segmental cepstra frontends.' *Int'l J. of Speech Language and the Law* 20/1: 77–116.

Rose, P. (2015) 'Tonation in Three Wu Dialects.' *Proc. Int'l Cong. of Phonetic Sciences*.

Sherard, M. (1980) *A Synchronic Phonology of Modern Colloquial Shanghai*. Computational Analyses of Asian & African Languages Monograph 5.

Simmons, R. (1999) *Chinese Dialect Classification: A Comparative Approach to Harngjou, Old Jintarn, and Common Northern Wu*. John Benjamins Publishing Co.

Steed, W. & Rose, P. (2009) 'Same tone, different category: linguistic-tonetic variation in the areal tonal acoustics of Chu-qu Wu.' *Proc. Interspeech*: 2295–2298.

Tang Zhenzhu 汤珍珠, You Rujie 游汝杰, Chen Zhongmin 陈忠敏 (1990) '宁波方言(老派)的单字调和两字组变调.' [Citation tones and disyllabic tone sandhi in conservative Ningpo dialect]. 语言研究 [*Yuyanyanjiu*]: 106–116.

Zhang Jingwei (2014) *A Sociophonetic Study on Tonal Variation of the Wúxī and Shànghǎi Dialects.* LOT Netherlands Graduate School of Linguistics.

Zhu, S. & Rose, P. (1998) 'Tonal Complexity as a Dialectal Feature: 25 Different Citation Tones from Four Zhejiang Wu Dialects.' *Proc. 5th Int'l Conf. on Spoken Language Processing*, Vol. 3: 919–922.

Xu Weiyuan (1989) *The Sociolinguistic Patterns of Pudonghua in Duhang.* M.A. thesis, The Australian National University.

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