VOCAL ACOUSTIC *Pedagogy*

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I recently published a book with Pendragon Press, *Practical Vocal Acoustics: Pedagogic Applications for Teachers and Singers*, in which I make a case for a coherent, fact-based approach to the acoustic aspects of teaching singing. There are many important facets to a comprehensive pedagogy, and the acoustic piece is but one. However, due to our increasing knowledge of the effects of vocal tract resonances on vocal fold function, and of how awareness and anticipation of those effects can make our teaching more effective, there is now a rapidly growing interest among voice teachers in mastering the basic acoustic principles involved. At the 1981 convention of the National Association of Teachers of Singing in Minneapolis, a paper was presented on the relationship of the singer's formant frequency to voice category. During the presentation a synthesized tenor voice was played singing an F major scale on the vowel /a/. Remarkably, the tenor's vocal quality migrated through the distinctive color changes associated with male *passaggio*, though no changes in the vocal tract formants or source input had been programmed other than the change of pitch (fundamental frequency).

Although *passaggio* was not the focus of the presentation, I was struck with the notion that the timbral shifts of vocal cover were not due to changes in laryngeal register, rather to some resonance phenomenon not yet understood. Thus began my journey into the area of vocal acoustics.

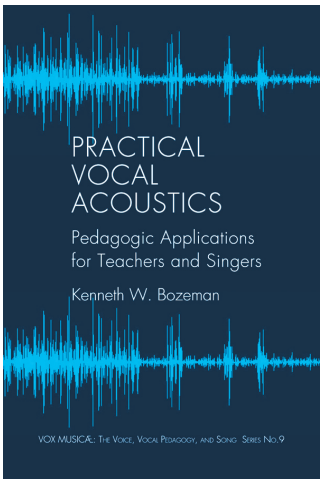
Eight years later in a voice lesson with the late Richard Miller during a sabbatical at Oberlin, my voice "turned over" while singing an /e/ vowel on D4. I had previously thought that the male voice began to prepare for the upper voice during the *zona di passaggio*—roughly D4-G4 for a tenor—but only turned over near the *secondo passaggio*, at G4. I was also surprised at the quality of the vowel, which sounded odd to my internal hearing. When I asked if what I had just done was acceptable, Richard had me sing the passage again and, without further explanation, affirmed that it was fine. That was the second major step in this journey. I was practicing during the sabbatical in the new laboratory Richard was developing at Oberlin, and was regularly using the Kay Elemetrics 5500 Sonagram with its real time spectrography. In very short order, I realized that the voice turned over and "closed" in a parallel relationship to the first formant locations of vowels. It would be a few years before I knew precisely what the factors were, but from that point on my teaching of male *passaggio* was transformed.

Over the next decade I tried a few times to interest members of the voice science community in testing this hypothesis, but without success. I didn't know that at about the same time, Donald Miller and Harm Schutte were observing this and other acoustic phenomena in their lab in Groningen, Netherlands. Though I had real time spectrography in my own studio from 1993 forward, it was not until I was provided with Svante Granqvist's Madde voice synthesizer that I could prove with precision what I had long suspected: that the male voice turns over when the second harmonic rises above the first formant. By this time Miller and Schutte had documented this and related phenomena, and in a subsequent visit to Lawrence University where I teach, Donald confirmed my observations. I have since enjoyed very informative conversations with Donald and a number of other voice scientists, most of whom now acknowledge the phenomenon of the F1/H2 turn of the voice.

I am not a voice scientist. I am a voice teacher. It is not my intention with this bit of personal history to encourage voice teachers to presume to know what we don't—there's enough of that already in every profession—rather, to realize that we each bring something of great value to the conversation. While voice teachers need to be open to learning from the voice science community, and willing to relinquish ideas that run counter to reality, we also have vitally important things to contribute. Ongoing open and honest collaborations between voice teachers and voice scientists—both of whom are humble enough to consider perspectives other than their own—are needed to advance voice pedagogy.

The text *Practical Vocal Acoustics* represents an attempt to distill those insights and principles emerging from voice research that have proven fruitful for studio pedagogy, and to present them in a manner that is accessible to the general voice community. It aspires to contribute both to better pedagogy and to more productive, better-informed, mutually respectful and beneficial conversation between the pedagogic and scientific communities.

Awareness of the acoustic events caused by the interactions of voice source harmonics with vocal tract formants can form the basis of a coherent acoustic pedagogy. A stable vocal tract length results in harmonic/formant crossings that are accompanied by passive vowel modifications, that is, timbral migrations that are



caused by a change of pitch, not a change of shape. Detailed awareness of these phenomena is a great practical aide in training male *passaggio*. Furthermore, as has long been established by Johann Sundberg, first formant/first harmonic tracking is essential for timbral fullness in treble voices when singing pitches above normal first formant locations. A *chiaroscuro* balanced timbre, facilitated by a generally convergent, *voce chiusa* resonator orientation creates interactive resonance, which can assist vocal fold efficiency so that greater power can be had at lower breath pressure levels. Knowledge of the specific roles of formants, the acoustic characteristics of open, close, yell, and whoop timbres, the ways in which the first formant, second formant, and the singer's formant cluster are tuned, and the typical pattern of first formant locations is essential to implementing effective acoustic strategies. *Practical Vocal Acoustics* presents and explains this information in a deliberately user-friendly format, and demonstrates its application with a voice synthesis application and a DVD of student-performed exercises.

The implications of acoustic pedagogy are both notable and remarkably practical. For example, a voice does not turn over or close on the same pitch for all vowels. That simple, necessary conclusion constituted a paradigm shift in my own vocal journey. Rather, a voice turns over or goes from open to close timbre at completely predictable locations: an octave below the first formant of the vowel being sung. And since first formant locations vary by as much as an octave in a given voice, so do the pitches of turning vary by vowel by as much as an octave. The timbre of an /i/ closes at about

an octave below the pitch at which an /a/ closes. Acoustic pedagogy explains exactly why male and female (or treble) range and resonance strategies have to be handled differently.

Women eventually sing through and above the first formant locations of all of their vowels, resulting in whoop timbre for much of their range. Male range (other than countertenor) only includes the pitches of the first formants of the closest vowels /i/, /u/, and /y/. Women fashion their timbre out of rather fewer resonated harmonics than men—roughly half as many. Acoustic pedagogy therefore gives the teacher a factual basis for great specificity in guiding vowel resonance, and registration choices. Let me reassure those who may be concerned about the complexity of acoustic pedagogy that—with a little work up front—it can actually be rather simple. If one is willing to learn the first few intervals of the harmonic series, the pitch contour made by the first formant locations of about seven cardinal vowels, and which harmonic/formant interactions generate which effects, pedagogic applications become obvious and predictable. As with much of what we do, the teacher can decide how much detail the singer need know in order to find better acoustic arrangements. As long as the student understands enough of how and why voice acoustics work to be able to reproduce in varied circumstances beneficially interactive vocal tract configurations, the singing will be greatly improved. I teach in a college conservatory setting, and assume that my students' futures will eventually include some teaching. Therefore, I cover acoustic pedagogy in some detail, especially in our voice science and pedagogy course and in tutorials on voice acoustics. It is a means to an end that can be quite "natural" and need not result in inhibitive micro-management. In the final analysis, effective acoustic pedagogy, like all good pedagogy and technique, must faithfully and inconspicuously serve intuitive, communicative, heartfelt artistry.

For more information, please consult:
Practical Vocal Acoustics: Pedagogic Applications for Teachers and Singers
Pendragon Press
http://www.pendragonpress.com/book.php?id=731
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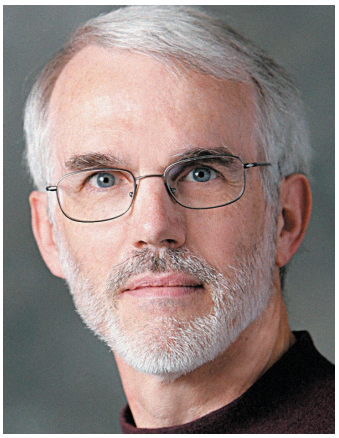
(At press time of this article, only available in spiral bound.)

***Kenneth Bozeman**, tenor, Frank C. Shattuck Professor of Music at Lawrence University Conservatory of Music in Appleton, Wisconsin, holds performance degrees from Baylor University and the University of Arizona. He subsequently studied at the State Conservatory of Music in Munich on a fellowship from Rotary International. He is chair of the voice department at Lawrence, where he teaches voice, voice science, and pedagogy.*

Mr. Bozeman has received both of Lawrence University's Teaching Awards (Young Teacher Award, 1980; Excellence in Teaching Award, 1996). He was awarded the Van Lawrence Fellowship by the Voice Foundation in 1994 for his interest in voice science and pedagogy and is the chair of the editorial board of the NATS Journal of Singing.



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*His students have sung with opera companies including Houston Grand, Boston Lyric, Opera Colorado, Washington, Wolf Trap, Seattle, Deutsche Oper Berlin, New York City, San Francisco, the Metropolitan, and Santa Fe. He has both been a frequent presenter at voice science conferences and universities, and written several articles on the topics of voice acoustics, especially as applied to male passaggio training (*Choral Journal, Journal of Singing, Logopedics Phoniatrics Vocology*) and a book,* Practical Vocal Acoustics: Pedagogic Applications for Teachers and Singers.

Mr. Bozeman presented on the acoustics of male passaggio *at the 2012 NATS convention in Orlando, was selected to be a master teacher for the 2013 NATS Intern Program at Vanderbilt University, and will present at the 2014 NATS convention in Boston on acoustic vocal pedagogy.*

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