A SURVEY OF THE RESEARCH LITERATURE ON THE FEMALE HIGH VOICE

THESIS

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By

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The location of the available research literature and its relationship to the pedagogy of the female high voice is the subject of this thesis.

The nature and pedagogy of the female high voice are described in the first four chapters. The next two chapters discuss maintenance of the voice in conventional and experimental repertoire. Chapter seven is a summary of all the pedagogy. The last chapter is a comparison of the nature and the pedagogy of the female high voice with recommended areas for further research. For instance, more information is needed to understand the acoustic factors of vibrato, singer's formant, and high energy levels in the female high voice.

PREFACE

The purpose of this thesis is to collect research about the female high voice and to assemble the pedagogy. The science and the pedagogy will be compared to show how the two subjects conform, where there is controversy, and where more research is needed.

Information about the female high voice is scattered in various periodicals and books; it is not easily found. In addition, there is a paucity of research into the female voice itself. One of the leading singing-voice scientists in the world, Johann Sundberg, of the Royal Institute of Technology in Stockholm, Sweden, explains the rarity of investigations into the female voice as due to the difficulty of explaining the acoustiscal data. For instance, "One can seldom be sure if a difference between two vowel spectra is due to a difference in the phonation or in the articulation or to both."[1] When vowels have a fundamental frequency ranging from 250 Hz to 1000 Hz and above, it is very difficult to differentiate that frequency from the frequency of the glottal sound. It is difficult to decide whether the formant or the partial is responsible for the spectrum envelope. Comparing research and pedagogy will show how scientific knowledge is applied to the teaching of

the female high voice. Areas needing further research will also be identified.

End Notes

1. Johann Sundberg, "Studies of the Soprano Voice," The Journal of Research in Singing I/1 (1977), p. 25.

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CHAPTER I

A DESCRIPTION OF THE FEMALE HIGH VOICE

Introduction

The female high voice is frequently called the "head voice," a term, according to D. A. Clippinger, which grows naturally from the physical sensations felt in the head which accompany the production of higher vocal pitches.[1] Many teachers and singers employ the expressions "head voice," "head register," and "high voice" interchangeably. Jeffrey Monahan found that between 1777 and 1927 most writers used the terms "head," "medium," and "chest" for the different register mechanisms.[2] Philip Duey found these terms were used as far back as Ceroni (1566 - 1625).[3] Manuel Garcia in Hints on Singing uses the term "head register" in his description of the female voice. This register "is the highest, and its sonority is the most remarkable, particularly in sopranos."[4]

Mathilda Marchesi described the three registers of female singers as she observed them in her years of teaching as chest, medium, and head. She explains that "'medium' precisely and logically explains the position of that register in the compass of the voice, and, secondly, to avoid all confusion that might be caused by the term

'falsetto,' which belongs exclusively to men's voices."[5] The limit of the medium register varies, according to Marchesi, between F5 (698 Hz) and F5-sharp (740 Hz).[6] The head register is above that. She also observed that the registers were blended.

John Burgin in his book Teaching Singing[7] investigated published statements on singing between the years 1943 and 1971. In the thirty-three statements about registers the term "head" register appeared six times and "falsetto" twelve times, for the highest ranges of voices. Included is Brodnitz's statement that "falsetto lies above the male head voice and the whistle register above the female head register."[8] Of forty-three authorities quoted by Victor Fields in his compendium of published statements on singing,[9] thirty-five employ the term "head" for the upper part of the singer's range while the other eight use the term "falsetto." In The Science of Vocal Pedagogy Ralph D. Appelman utilizes the term "head" register for the upper part of the human singing voice. He quotes Manuel Garcia as supporting evidence. "Every voice is formed of three distinct portions or registers, namely, chest (lowest), medium (middle), and head (highest)."[10]

Since the majority of singers and teachers of singing use the terms "high voice" or "head register," the same terms will be used in this paper when speaking of the

upper part of the female voice.

Nomenclature

Marianne Moerner has summarized and classified 107 names for the various registers of the human voice, found in Table I. The names given to the famles voice are

a. English - head voice, falsetto voice, falsetto, high level.

b. German - Kopfton, Kopf register, Hoch register.

c. French - voix de tete, fausett-tete.

d. Italian - voce di testa.

The highest female register is known as:

a. English - 4th register, pipe register, flute, whistle, or highest range.

b. German - Pfeiffregister, Fistelstimme, Partialstimme.

c. French - flageolette, fasett, petit registre, voix de sifflet.

d. Italian - voce di campanello.

From research on ordinary speech the terms "loft register" and "light mechanism" also refer to the head voice.[11]

Although many of these terms are being used in the latest research, this paper will continue to use the more traditional and commonly employed terms of "chest," "middle," and "head" when referring to the female singing voice.

Table 1

Names of Vocal Registers

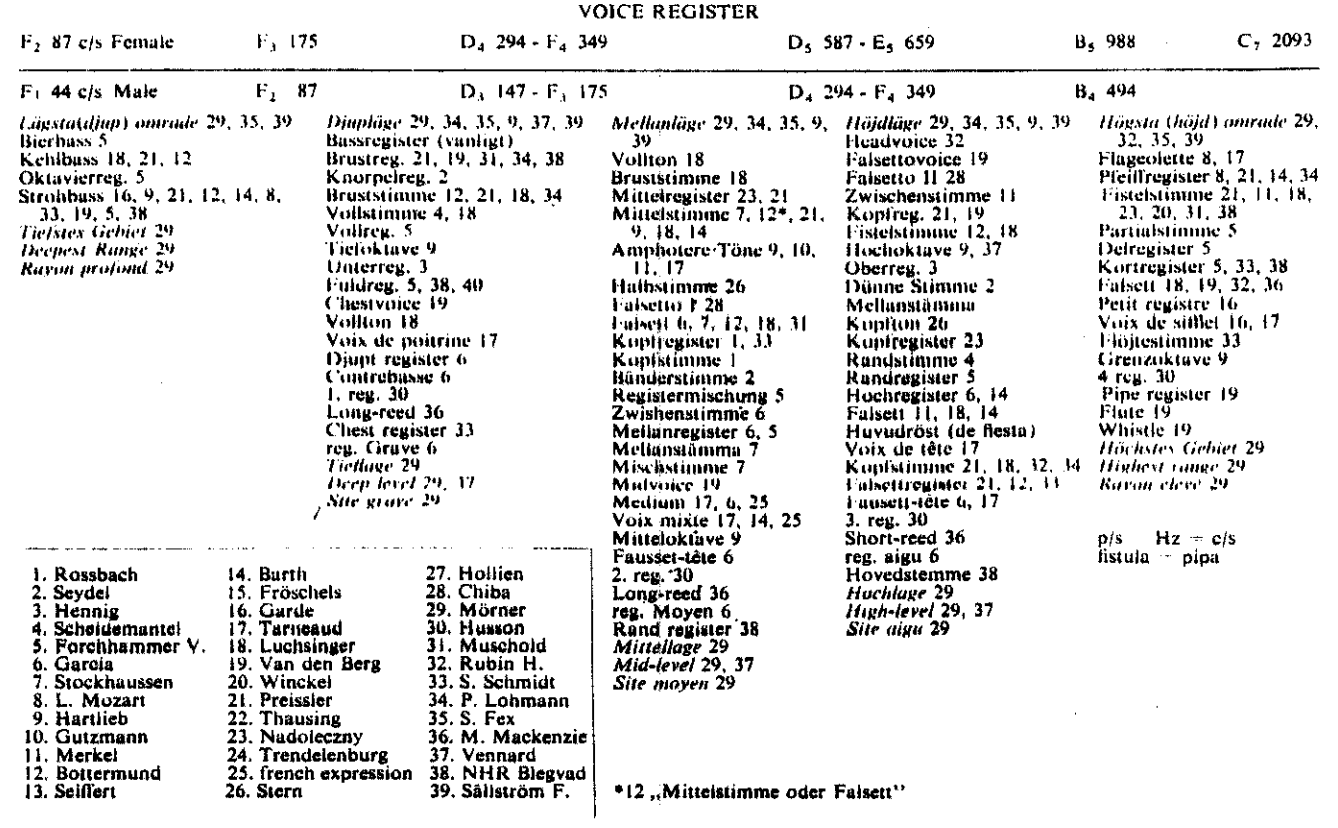


Fig. 2. Voice register terminology of various authors within a frame of five vocal pitch ranges. Terms recommended by M. Mörner are italicized. When necessary the word pitch should be inserted ahead of level in order to avoid confusion with the concept of intensity level.

M. Moerner, "Bidrag Till Internationell Nomenklature Tor Tonlagen Och Rostbeskrivning," Technical Report STL-1 1964. (Stockholm: Royal Institute of Technology, June 1983). Reprinted in Vocal Registers in Singing, Proceedings of a Symposium. The Hague: Mouton, 1973.

Passaggios of the High Voice

William Vennard defines the passaggio as a register transition. The one leading into the head voice is often called "secondo passaggio."[12] Ingo Titze says a passaggio is more easily identified than the vocal register itself,[13] especially if a noticeable "break" or timbre contrast occurs when the intrinsic musculature of the larynx is unbalanced. Much of the pedagogy of the voice is devoted to eliminating all audible register transitions by such means as mixing head and middle registers or light and heavy mechanism, "lifts" of the breath, and modification of vowels.

From Table II it can be seen that the female passaggio into the head register will vary in pitch depending on the type of voice being measured and the vowel chosen for vocalization. A contralto will have a lower fundamental frequency (pitch) than a lyric soprano. Table III shows the difference between the lowest and highest passaggios measured by the twelve authorities. Some seem to have measured only a few voice types. Those researchers measuring a small number of singers will have one frequency (pitch) or a small range of two or three semitones for the female secondo passaggio while those researchers measuring many different types of female singers can show a range of six to nine semitones between lowest contralto and highest soprano secondo passaggio. The lowest

Table II

Female Secondo Passaggio Measured

by Various Authorities[14]

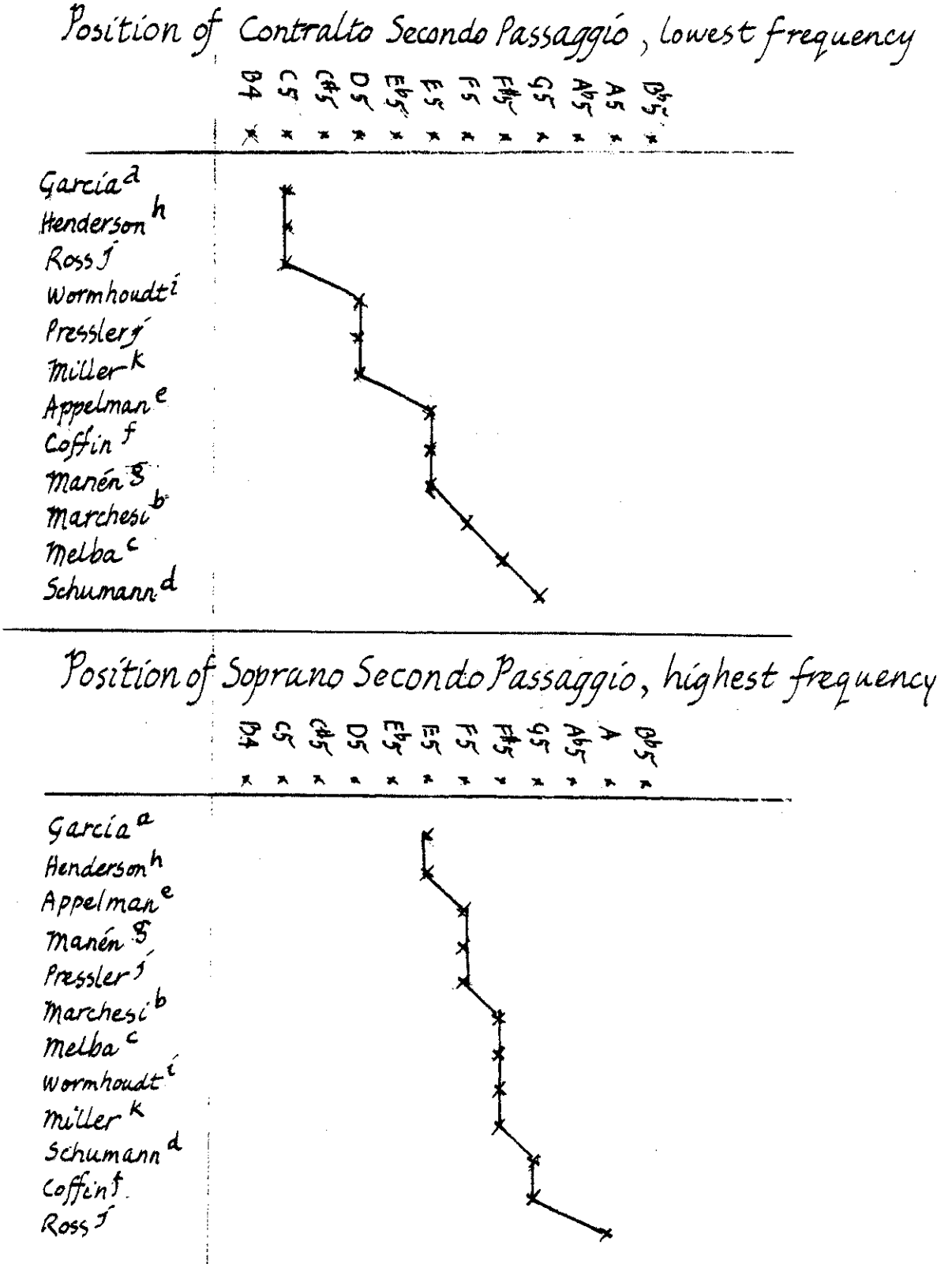


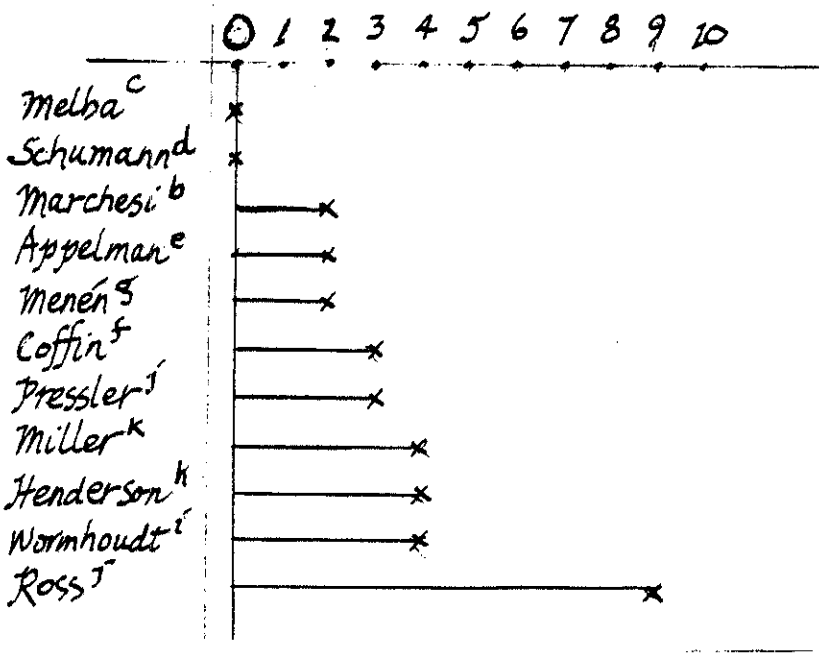
Table III

Difference between Lowest

Contralto and Highest Soprano

Secondo Passaggios Measured

in Semitones



Information taken from Table II.

female voice, contralto, can change from middle register to head register on C5, $C^{\#}5$, D5, $E^{b}5$, or E5. This register transition is not the same for each contralto but varies according to the lightness or heaviness of the voice and for the vowel sung when determining the transition pitch. The higher female voices, sopranos, are found to move into the head voice on $E^{b}5$, E5, F5, $F^{\#}5$, G5, $A^{b}5$, or A5. The number of subjects studied will also account for the variation in transitional points. William Ross found that the sung vowel and the voice category affected the passaggio. His measurements indicated that the passage into the head register can vary as much as nine semitones between sopranos and contraltos.[15] Elizabeth Schumann and Nellie Melba use only one pitch and must have used their own voices when limiting the passaggio to G5 and $F^{\#}5$ respectively. The relationship between vowel and voice category as it affects the secondo passaggio has been summarized by William Ross. His conclusions are shown in Table IV. It is most thorough in this respect and is expanded from his version in Table II.

The passaggios along with other factors (range, color, and comfortable tessitura) determine the vocal category.[16] Richard Miller considers the position of the passaggios a most reliable way of classifying voices.[17] Incorrect classification places limitations of range, causes tensions in the vocal production, and prevents fullest development of the voice. Robert Shewan finds that voices of

Table IV

Female Secondo Passaggio

after Ross

Vowel	Soprano	Alto
/i/	E (659Hz)	C (523Hz)
/u/	F (698Hz)	D (554Hz)
/e/	G (784Hz)	E (662Hz)
/o/	A (831Hz)	E (659Hz)
/a/	A (880Hz)	F (698Hz)

William Ross, Secrets of Singing, (Bloomington, Ind.: published by the author, 1959). Table of registers reprinted in "Towards an Integrated Physiologic-acoustic Theory of Vocal Registers", The NATS Bulletin, 30/4, (Feb./Mar. 1972), p. 20.

uncertain type should be monitored more closely and changes of classification be considered more thoroughly.[18] He would add anatomical observations to confirm a doubtful vocal category.

Eliminating audible breaks in the voice or keeping an even sound through the passaggio areas of the voice is an important element in vocal pedagogy. Identifying this passage from middle register to head register allows exercises to have a specific focus and gives a secure development of the voice.

Range or Extent of the Female High Voice

All voices have a head register, "The female head voice, even altos, lying within the compass $E^{b}5$ to $B^{b}5$."[19] Other teachers and researchers such as Manuel Garcia, Mathilda Marchesi, and Ralph Appelman, say the female head voice lies above the secondo passaggio. The previous section C, pages 4 to 11, was able to show that this passaggio can vary from C5 to $A^{b}5$, depending on the voice category and vowel chosen for phonation. Table II shows the position of the head register to the right of the solid line. This head register extends indefinitely.

Victor Fields[20] noted many conflicting opinions about the head voice. This conflict appears prominently after 1855 when Garcia presented a paper to the Royal Society in

London, his Observations on the Human Voice. The most puzzling feature was his chart of the Human Voice in its full extent showing falsetto in the middle of this complete range.[21] By 1894 with the publication of Hints on Singing[22] Garcia had changed his terminology and no longer referred to falsetto as part of the human voice.

"Head voice is that part of the compass lying above the speaking range,"[23] according to Clippinger. Hipster is quoted in Field's book, "It is the upper division of voice in which tones receive the larger part of their reinforcement from the resonance cavities in the frontal part of the head."[24] Douglas Stanley claims that the female voice goes into the falsetto range on the same note as the male voice "at about E^b on the top space of the staff."[25] Another way to define the range of the female high voice is to put those fundamental frequencies which have similar characteristics and are produced by the same mechanism into one register. Pearl Wormhoudt has summarized these typical qualities of the female high voice as:

a. The highest part of the range.

b. The softer it is, the lower it can be carried

c. The vocal folds are thin.

d. The vocal ligaments are in an active longitudinal tension.

e. There is no, or very negligible, closure of the glottis which accounts for the more breathy quality.

f. There is the production of a small number of partials from the glottal sound, giving a "simpler" tone like a flute.[26]

End Notes (1)

1. D. A. Clippinger, The Head Voice and Other-Problems, (Boston: Oliver Ditson, 1917), p. 15.

2. Jeffrey Brent Monahan, The Art of Singing: A Compendium of Thoughts on Singing Published Between 1777 and 1927, (Metuchen, N. J.: The Scarecrow Press, 1978), p. 141,

3. Philip Duey, Bel Canto in its Golden Age, (New York: King's Crown Press, 1951), p. 112.

4. Manuel Garcia, Hints on Singing, (London: Ascherberg, Hopwood and Crew, 1894), p. 9. Translated from the French by Beata Garcia. A question and answer format leads the reader through Garcia's thought and method on teaching singing.

5. Mathilda Marchesi, Bel Canto: A Theoretical and Practical Vocal Method, (New York: Dover, 1970), p. xiv. Reprinted from the Enoch and Sons ed.

6. There are two systems to describe frequencies in addition to staff notation. Middle C in the Helmholtz method is c^1. Using the method advocated by the U.S.A. Standards Association, middle C is C4. It is the latter system which will be used in this paper.

7. John Carroll Burgin, Teaching Singing, (Metuchen, N.J.: The Scarecrow Press, 1973). This book follows the format of Field's book for the years 1943-1971.

8. Ibid., p. 100.

9. Victor Alexander Fields, Training the Singing Voice, (New York: King's Crown Press, 1947). The first compendium of published statements about singing. The book covers the years 1928-1942.

10. D. Ralph Appelman, The Science of Vocal Pedagogy, (Bloomington, Indiana: Indiana Press, 1967), p. 88.

11. Pearl Shinn Wormhoudt, Building the Voice as an Instrument, (Oskaloosa, Iowa: William Penn College, 1981), p. 66.

12. William Vennard, Singing, the Mechanism and the Technic, (New York: C. Fischer, 1927), p. 248.

13. Ingo R. Titze, "Vocal Registers," The NATS Bulletin, 39/4, (Mar./Apr. 1983), p. 21.

14. Sources of Table II

    a. Garcia, op. cit., p. 9.

    b. Marchesi, op. cit., p. xv.

    c. Nellie Melba, quoted by Pearl Wormhoudt in her book, op. cit., p. 68.

    d. Elizabeth Puritz, The Teaching of Elizabeth Schumann, (London: Methuen, 1956), p. 87.

    e. Appelman, op. cit., p. 93.

    f. Berton Coffin, Overtones of Bel Canto, (Metuchen, N.J.: The Scarecrow Press, 1980), from the Vowel Chart.

    g. Lucia Manen, The Art of Singing, (London: Faber Music, 1974), p. 38.

    h. Laara Browning Henderson, How to Train Singers, (West Nyack, N.Y.: Parker Pub., 1979), p. 69.

    i. Wormhoudt, op. cit., p. 69.

    j. John Large, "Towards an Integrated Physiologic-acoustic Theory of Vocal Registers," The NATS Bulletin, 28/3, (Feb./Mar. 1972), p. 20.

    k. Richard Miller, The Structure of Music, hereafter known as Structure (New York: Schirmer Books, 1986), p. 134-135.

15. William Ross, Secrets of Singing, (Bloomington, Ind.: published by the author, 1959). Table of registers reprinted in "Towards an Integrated Physiologic-acoustic Theory of Vocal Registers," The NATS Bulletin, 30/4, (Feb./Mar. 1972), p. 20.

16. Miller, op. cit., p. 134.

17. Ibid., p. 135.

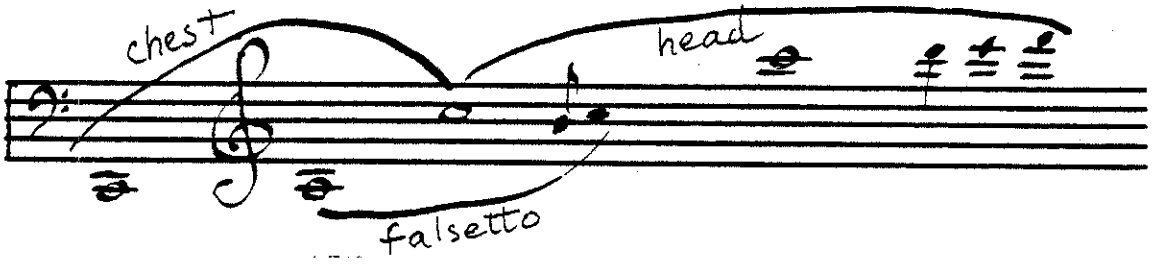
18. Robert Schewan, "Voice Classification: An Examination of Methodology," The NATS Bulletin, 35/3 (Jan./Feb. 1979) p. 25.

19. Clippinger, op. cit., p. 3.

20. Fields, op. cit., p. 151.

21. Manuel Garcia, Observations on the Human Voice. Reprinted from Proceedings of the Royal Society , 1855, 3, p. 399-408 in Contributions of Voice Research to Singing, John Large, ed. (Houston, Texas: College-Hill Press, 1980), p. 126.

Human Voice in its Full Extent



22. Garcia, Hints, loc. cit., p. 9.

23. D. A. Clippinger, "How to Escape Some Vocal Pitfalls in the Day's Work," Etude, 54 (1936), p. 316.

24. Fields, op. cit., p. 151.

25. Douglas Stanley, The Science of Voice (New York: Carl Fischer, 1939), 3rd ed., p. 323.

26. Wormhoudt, op. cit., p. 66.

CHAPTER II

PRODUCTION OF SOUND

Laryngeal

In 1854, Manuel Garcia presented his observations of the action of the larynx to the Royal Society of London using the laryngoscope which he had invented. In the late 1970s vocal scientists began to use fiber optics to observe the musculature of the larynx. In both cases not all movements have yet been seen or measured. Scientists do agree,[1] however, that the voice obeys these theories of phonation.

a. Phonation occurs when air is expired through the narrowed, cone-shaped tube at the top of the trachea. See Illustration I, fig. 1, 2.

b. Further constriction of the air flow is made by the vocal folds[2] which partially or completely close the glottis.

c. Both the vocal folds and the walls of the airway are elastic and yield under pressure. See Illustration II, fig. 3 - 5.

d. The vocal folds are able to change in length, tension, and contour--thereby regulating the size, shape, and position of the glottic opening--as well as making vibrating movements.

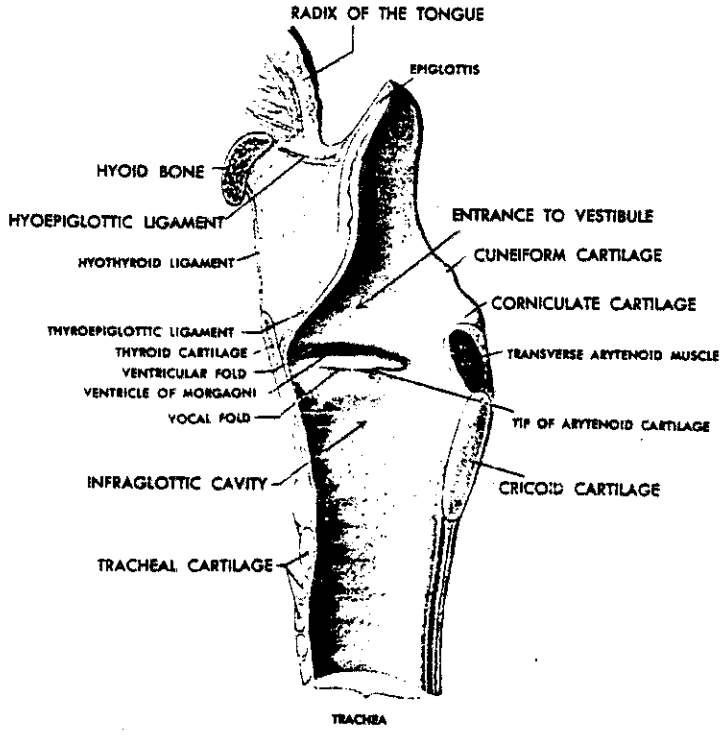


fig. 1 Laryngopharynx (Vestibule), Section, Lateral View

Source: Johannes Sobotta and Eduard Uhlenhuth, *Human Anatomy* (7th ed.; New York: Hafner Publishing Co., 1957).

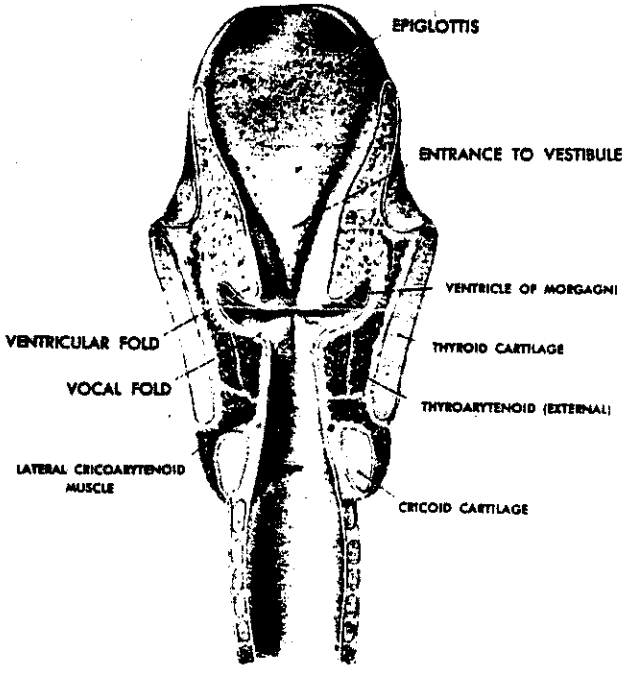


fig. 2 Laryngopharynx, Section, Posterior View

Source: Johannes Sobotta and Eduard Uhlenhuth, *Human Anatomy* (7th ed.; New York: Hafner Publishing Co., 1957).

Illustration I. Shape of vocal tract

Appelman, op. cit., p. 48, 49.

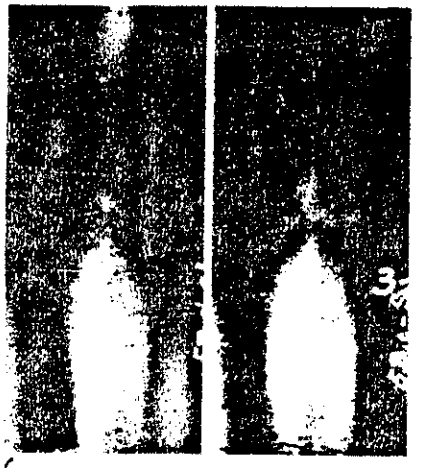


fig. 3 Light Soprano Singing F Sharp, 672 cps. Vowel [i]
Left, piano; right, forte.

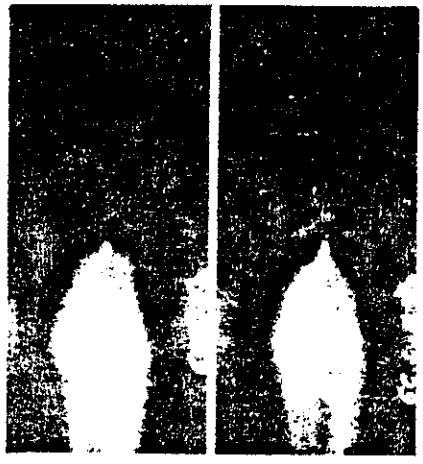


fig. 4 Dramatic Soprano Singing Middle C, 246 cps, Vowel [a]
Left, chest register, forte; right middle register, piano.

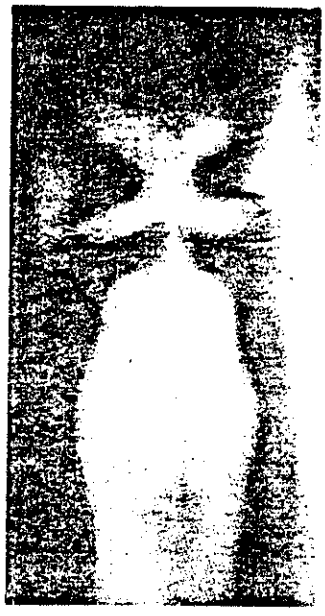


fig. 5 Bass, Spoken Sound, Vowel [a]

Source: Guiseppe Bellussi and Allesio Visendaz, "Il Problema Dei Registri Vocali Alla Luce della Technia Roentgenstratigrafica," *Archivo Italiano di Otologia Rinologia e Laringologia*, March-April 1949.

Illustration II. Flexibility of the vocal tract

Appelman, op. cit., p. 81.

e. The laryngeal muscles do not produce the vocal sound. Phonation is the result of aerodynamic action in which various muscles adjust and maintain the vocal folds in a certain position, tension, and shape. The modulation of the expired air stream, caused by the movement of the vibrating vocal folds, makes the sound. The resulting pressure variations create the multiple sine waves which comprise the complex vocal sprectrum.

According to John Large[3], vocal function

> is produced by the vibrating cords (Ferrain, 1741) which are activated by the stream of air delivered by the lungs and trachea. The frequency of the tone, heard as pitch, and the intensity, heard as loudness, are dependent primarily on the tension of the vocal folds and on the subglottic air pressure (Muller, 1837). Periodic air puffs escaping through the glottis are the primary source of sound, setting the air above the glottis into vibration (Garcia, 1855: Helmholtz, 1863). The Bournoulli effect--a sucking force caused by the negative pressure developed as the air currrent passes through the narrow glottic passage--assists the elastic recoil of the vocal folds in the closing action of the glottis (Tonndorf, 1925). The quality of the acoustical end-product is determined not only by the shape of the glottal pulse but also by the transmission characteristics of the supraglottal vocal tract (Negus, 1929). The principles described above are essentially those of the myoelastic-aerodynamic theory of voice production (Van den Berg, 1958).[4]

There are other theories which attempt to explain phonation: the comparison of vocal folds to reeds theory, comparing vocal folds to strings theory and the neurochronaxic theory of Husson.

The vocal folds do lengthen and shorten much as the

fingers move on a string to create different pitches. However, the vocal folds can change in thickness which stringed instruments cannot do. The string and vocal fold comparison cannot be maintained.

According to the reed theory, the vocal folds vary the pitch in the same way a wind player changes pitches by moving the lips, thus making the aperture larger or smaller, loose or firm, and by changing the force of the air stream. The fallacy of this argument, according to Appelman, is that the pitch of the blown note depends on the natural shape of the instrument rather than the natural frequency of the reed or mouthpiece. In singing the lips of the vocalis muscle create the frequencies which are then augmented by the resonance system. In wind instruments the column of air set in motion by the player's lips creates the frequencies coupled with the natural frequencies of the instrument. This natural frequency is changed by lengthening and shortening the tube.[5] The human vocal tract or tube does not change in length so drastically as do the wind instruments. Again this comparison does not stand up to scrutiny.

Husson and his co-workers produced the neurochronaxic theory that "muscle impulses activated by the central nervous system cause rhythmic contractions of the thyroarytenoid muscles producing the vibrations necessary for any given tone."[6] Negus and others have pointed out that

the thyroarytenoid muscles contract only to 110 cycles per second while tones as high as 2,048 cycles per second have been recorded by the human voice.[7] Some parts of the string and reed theories have been incorporated into the Large statement of vocal function but the Husson theory has been discredited.

During phonation, there is a unified and inter-related action of the muscles of the larynx. At first, the intra-arytenoid muscles slide or revolve the arytenoid cartilages to approximate the vocal folds and close the glottis. This action is shown in Illustration III, fig. 6, 7, 8.

The cricothyroid muscle depresses the thyroid cartilage and elevates the arch of the cricoid cartilage or draws the thyroid cartilage forward and downward. This combined action increases the distance between the arytenoid and thyroid cartilages which in turn elongates and tenses the vocal folds, so long as the arytenoids remain fixed. This action allows the singer to increase intensity or raise the pitch. See fig. 9, 10, 11, of Illustration IV.

The paired thyroarytenoid muscle is divided into the vocalis muscle and the external thyroarytenoid. The two sections run parallel to each other but some fibers of the vocalis muscle are short and do not extend into the arytenoid cartilage. The space between the paired thyroarytenoid muscles is called the glottis. In females

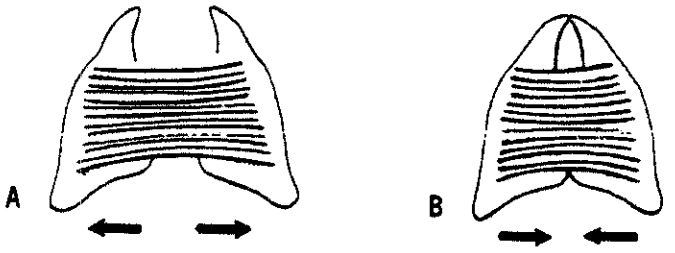


fig. 6 Transverse Arytenoids, Origin and Insertion
B, Transverse Arytenoids, Action

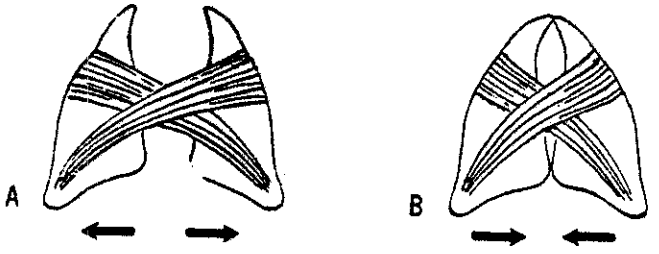


fig. 7 Oblique Arytenoids, Origin and Insertion
B, Oblique Arytenoids, Action

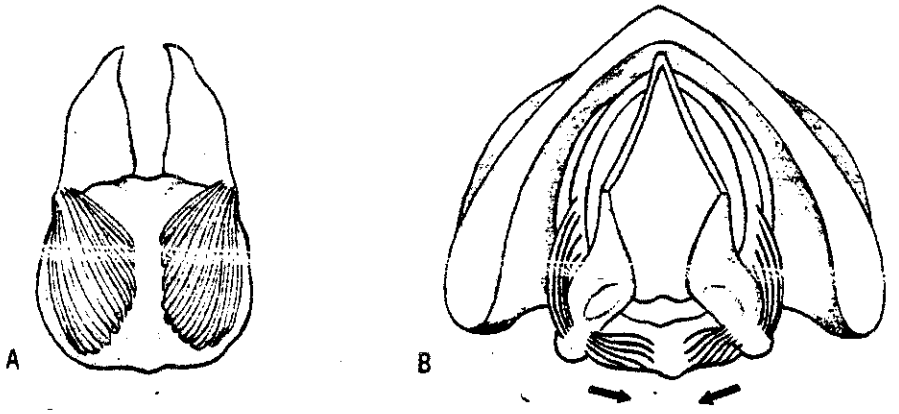


fig. 8 , Posterior Cricoarytenoids, Origin and Insertion
B, Posterior Cricoarytenoids, Action

Illustration III. Arytenoid muscles

Appelman, op. cit., p. 52, 53.

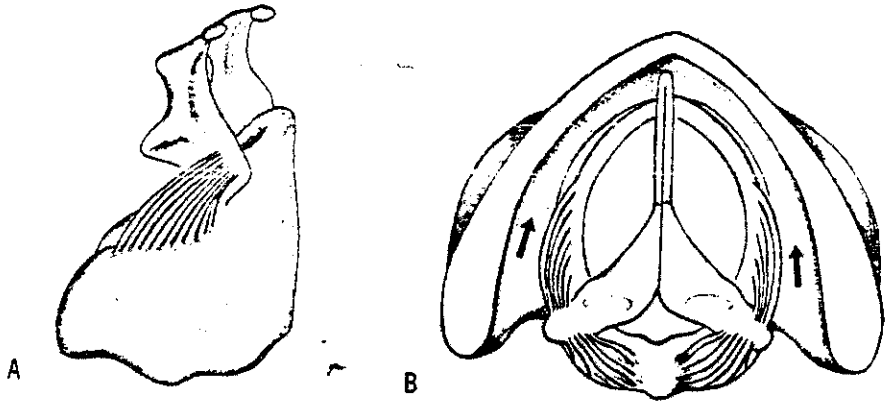


fig. 9 Lateral Cricoarytenoids, Origin and Insertion
B, Lateral Cricoarytenoids, Action

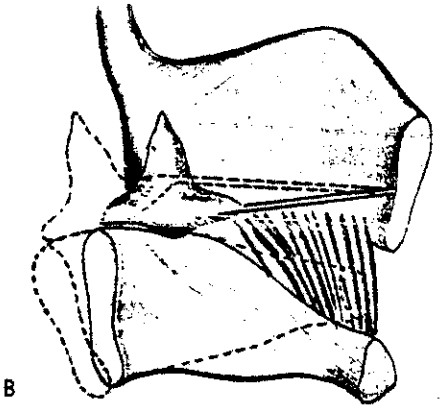


fig. 10 Cricothyroid, Action

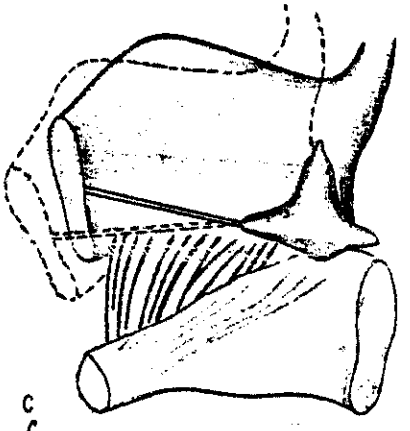


fig 11. Cricothyroid, Action

Illustration IV. Cricoarytenoid muscles

Appelman, op. cit., p. 54, 55.

the glottis is about fifteen millimeters long.

The thyroarytenoid muscles may:

a. relax and shorten the vocal ligament by drawing the arytenoids toward the thyroid cartilage for singing low pitches. See fig. 12 in Illustration V.

b. draw the vocal processes of the arytenoids downwards and inwards, approximating the vocal folds, fig. 13.

c. pull the vocal folds apart by their lateral contraction.

d. become stabilized throughout their entire length and, thereby, aid in raising the pitch of the phonated sound.

e. vary both the length and the thickness of the vibrating segment.

f. keep a portion of the vocal fold tense while the remainder is relaxed; thus an elliptical opening between the folds is maintained for the production of higher pitches. See fig. 14.

This control over the size of the glottic opening comes from certain fibers of the vocalis muscle fastened to the border of the vocal ligament. Joel Pressman believes that a complex interaction of these fibers takes place after the vocal folds have been "strongly and completely approximated and tensed by the adductor group." The internal fibers of the thyroarytenoid muscle "contract and pull apart, against the tension of the adductors, those portions

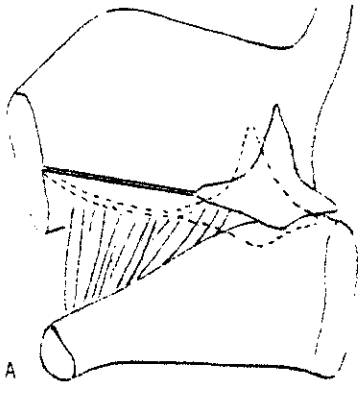


fig. 12 Thyroarytenoid, Action, Lateral View

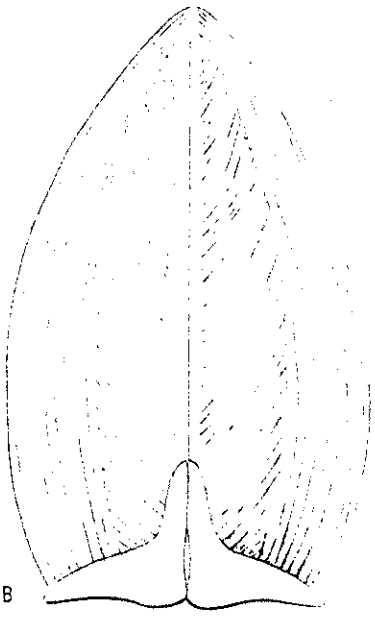


fig. 13 Thyroarytenoid, Action, Superior View

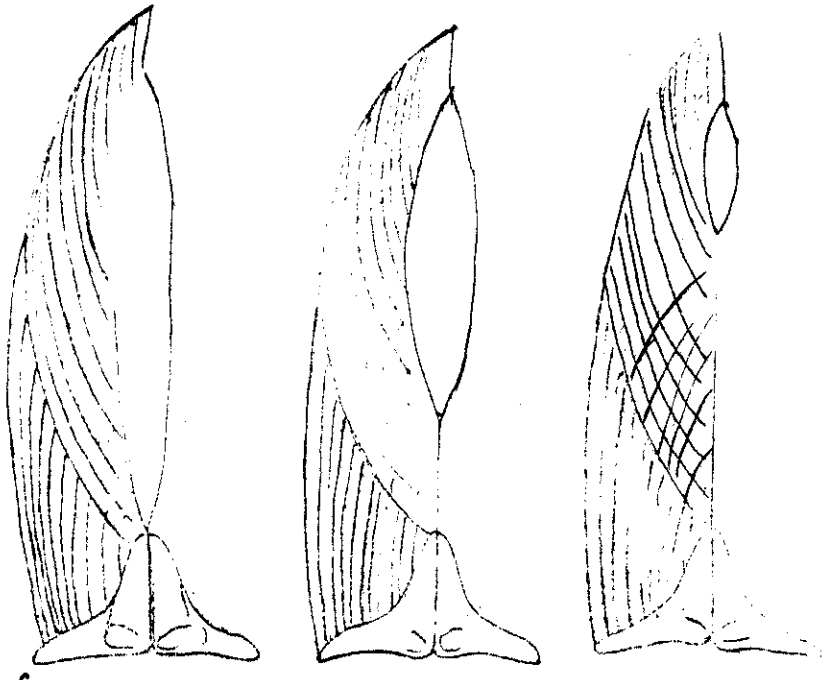


fig. 14 Adduction of the Vocal Folds Causes a Rise in Pitch by Contraction of the Fibers of Vocalis Muscle

Source: Joel J. Pressman, "Physiology of the Vocal Cords in Phonation and Respiration," *Archives of Otolaryngology*, Vol. 35 (1942).

Illustration V. Thyroarytenoid muscles

Appelman, op. cit., p. 55, 60.

of the vocal folds into which they insert."[8] See fig. 14. When this pull is relaxed, the vocal fold returns to the midline. The variation in the length of the vocal fold pulled apart is important for variation in pitch, particularly highest pitches. This would be of greatest interest to sopranos.

The delicate and intricate adjustments of the musculature of the larynx, which have been described with accompanying diagrams in this section, apply equally to women and to men. Perhaps the only difference is the obvious movement of the "Adams apple" (larynx) in a man's neck, but less noticeable in a woman's, due to its smaller size, especially in sopranos.

The muscular movements of the larynx have been grouped by Donald Read and Clifford Osbourne as those affecting the length and tension of the vocal folds, the mass of the folds, and the approximation or closure of the folds. They believe that these three muscular adjustments can be identified by the quality of sound or its timbre. For tone to have brilliance and power the length and tension of the vocal cords must be balanced. If this adjustment is unbalanced Read and Osbourne say the tone will be shallow with unmusical brightness. Unbalanced mass of the vocal folds will give a vocal tone lacking brilliance and real power. Body and depth will be part of the vocal tone when mass is balanced with length-tension and proper closure of the vocal folds. On the other hand, a tone which sounds

hollow and emphasizes the "floating, heady" quality of vocal sound will probably lack a balanced approximation of the vocal folds. Balance gives a velvet quality (the emotional and beautiful qualities according to Read and Osbourne), and makes a true pianissimo tone possible. Read and Osbourne summarize their theory, and the workings of the larynx, in this table:[10]

Function	Shape	Quality (of Tone)
Length-tension	width	brilliance
Mass	depth	body
Approximation	height	velvet

To achieve brilliance, body, beauty, and emotion in the sung tone, the three muscular actions within the larynx must have a continual and delicately adjusted balance.

Acoustical

Most students of singing think of acoustics in terms of pure vowels and balanced resonance. Singers often use such subjective terms as clarity, focus, loudness, fullness, and color to describe acoustical effects. Acoustical production involves the fluttering of the vocal folds with their varying thickness, length, closing and opening times, and relative elasticity, giving the sound of the fundamental and its partials.

When a woman sings a pitch of 400Hz (approximately g

above middle C), the larynx produces a series of partials as shown in Table V. This graph corresponds to the properties of all sounds with definite pitch. The partials[12] are the fundamental multiplied by 2, 3, 4, etc. which gives the usual harmonic series of octave, perfect 5th, perfect 4th, major 3rd, minor 3rd, major 2nd, and minor 2nd. The graph of this spectrum shows that at the level of the larynx most of the energy is found in the fundamental vibration of the vocal cords, and energy decreases as the partials rise as shown in Table V, fig. 1. This series of partials can also be shown in wave form as in fig. 2 and 3 which is called the partials summation wave. The fundamental pitch, I of fig. 2, corresponds to the amplitude of the 400 Hz frequency of fig. 1. The second partial, II, corresponds to the amplitude of the 800 Hz frequency, III or third partial, to the 1200 Hz frequency, and continuing on to the ninth partial. The summary of all these partials is shown in fig. 3 of Table V.

Fritz Winekel who analysed the tones of many singers, both trained and untrained, found that the number of overtones remained the same for each singer. Singers limit the number of partials because the higher partials create a dissonance with the fundamental tone.[13] To this regular progression of the fundamental and its partials is added the acoustic properties of the vocal tract.

The vocal tract is a series of cavities which have

Table V

The Partials Spectrum of a 400 Hz Sung Tone[11]

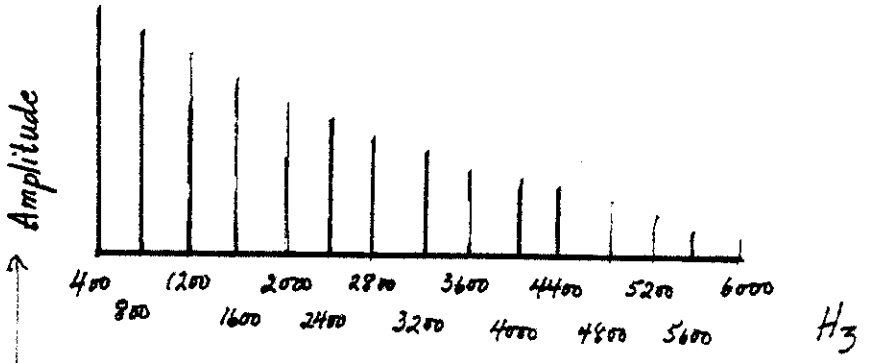


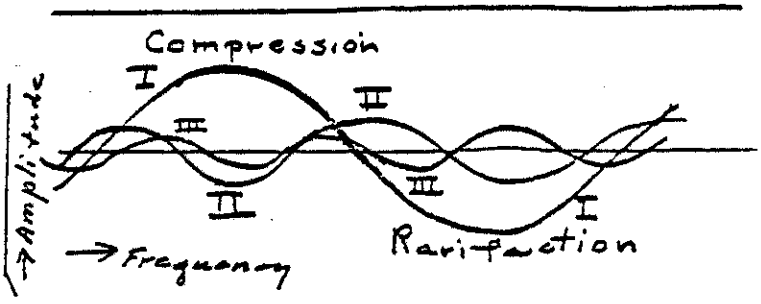
fig. 1

The partials spectrum[1] of a 400 Hz sung tone

fig. 2

Frequency-amplitude partials of Taole III shown as sinusoidal wave forms.

I = fundamental pitch
II = 2nd partial (twice the frequency, one octave higher, decreased intensity.
III = 3rd partial, 3x fundamental pitch
IV etc, V etc.

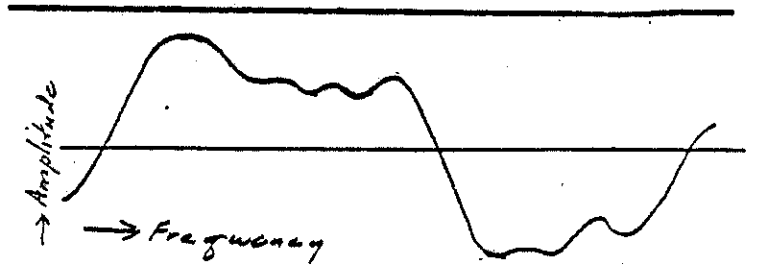


The amplitude curve reflects the amount of energy in the oscillation frequency, and shows the compression and rarifaction halves of the cycle

fig. 3

Summary of Fig. 5, through the 9th partial, adding all the compression amplitudes (above the line) and subtracting the rarifaction amplitudes (below the line).

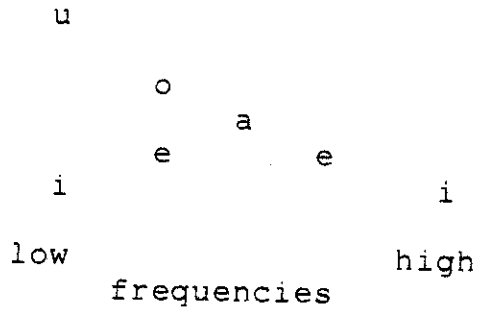
This is the PARTIALS SUMMATION WAVE, showing the Voice-Source Spectrum in wave form.



Data based on Benade, Denes and Pinson, Sundberg, Vennard, Winckel.

Wormhoudt, op. cit., p. 33.

their own frequencies of vibration called formants. These formants are affected by the chosen vowel because vowels change the shape of the tract; /u/ and /o/ have one strong overtone each, /e/ and /i/ have two widely separated overtones each, /a/ has two overtones quite close together. The relative frequencies of these formants can be shown as a double triangle which is a short form of William Vennard's graph[14] found in Table VI. Modern

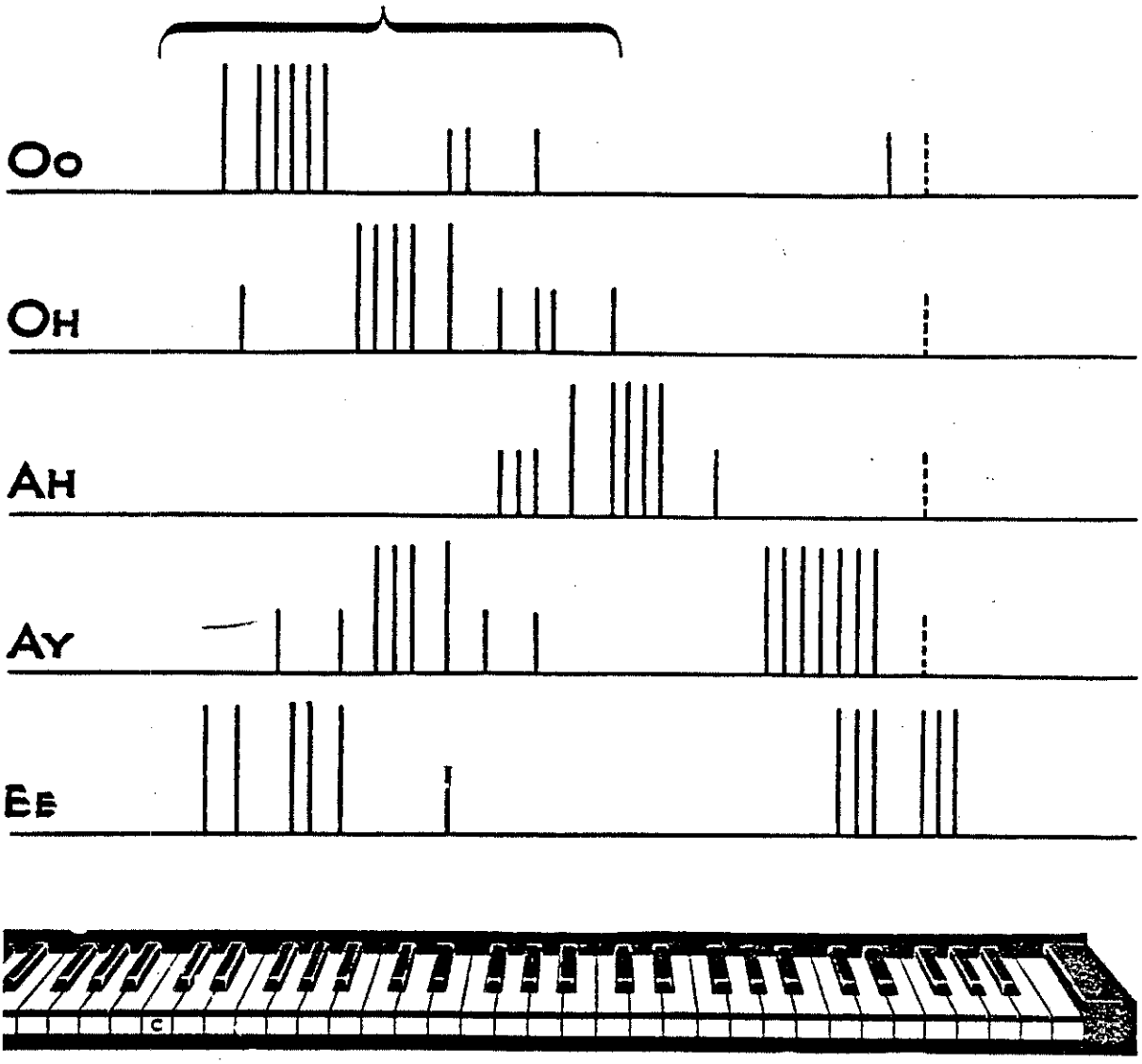


phoneticians find the triangle inadequate and a more complete diagram is shown in Table VII.

As a soprano sings higher pitches (fundamental frequency) the formant also rises. The first formant stays above the fundamental as long as the fundamental frequency is below the first format. When the sung pitch is above the first formant, then the two are joined together. Sopranos accomplish this by lowering the jaw. Johann Sundberg's pictures of a soprano singing /u/ and /i/ on increasingly higher pitches shows this quite clearly (see Illustration VI). Lowering the jaw or increasing the mouth opening raises the first formant according to the Laws of Cavities.[15]

Table VI

Vowel Formants

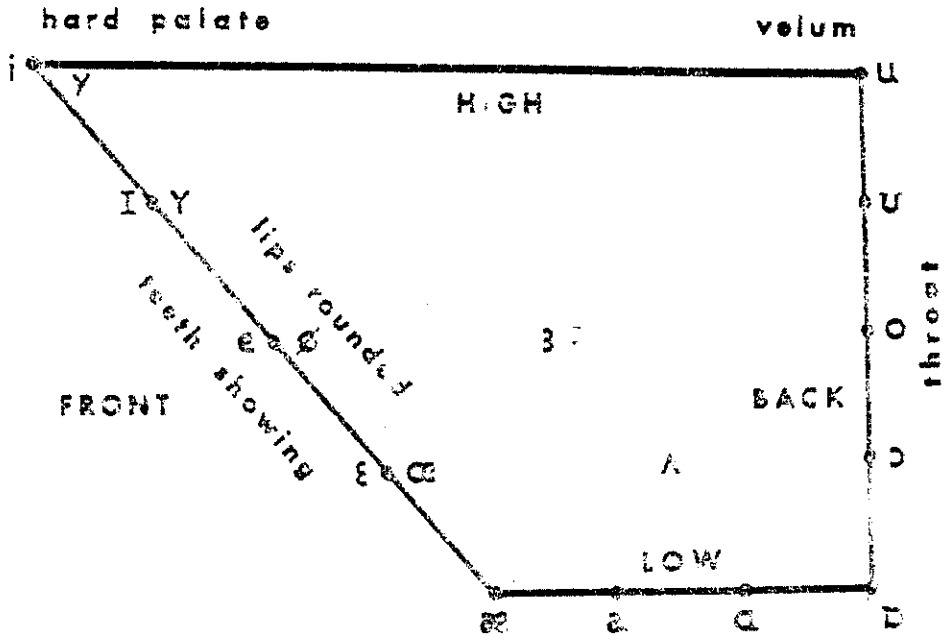


This table shows the formants for the "five pure" vowels, as derived from various acoustical investigations. Each line in the five spectra represents the finding of physicist for that particular vowel which is related to the piano keyboard rather than shown in numbers of frequencies.

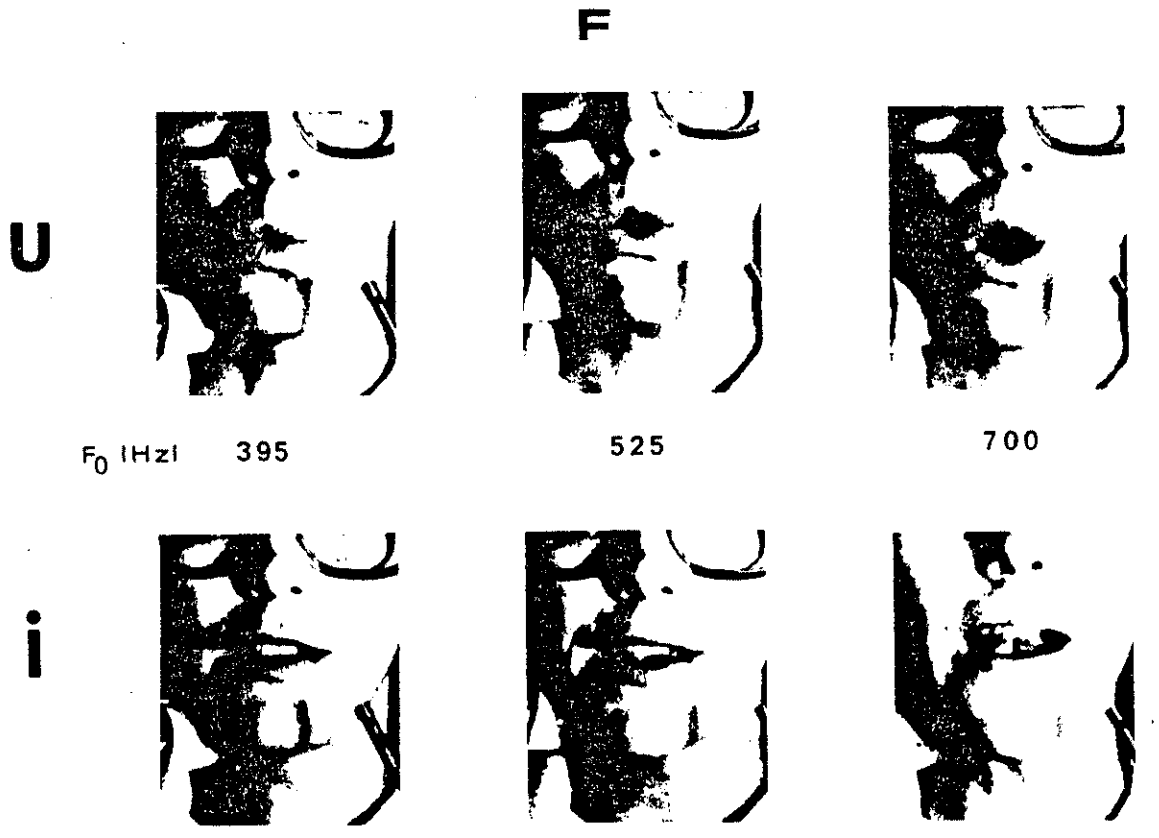
Vennard, William. Singing, the Mechansim and the Technic. New York: Carl Fischer, 1967, p. 127.

Table VII

Chart of Tongue Positions for Vowels



Vennard, op. cit., p. 136.



Photos of the lip opening of a soprano singing the vowels (u) and (i) (upper and lower series) at the fundamental frequencies (F_0) indicated. The lip and jaw opening are seen to increase with rising fundamental frequency. Sundberg 1977.

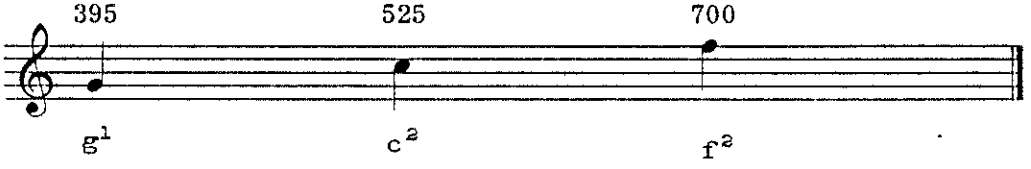


Illustration VI. Lip opening of a soprano

Johann Sundberg. "Studies of the Soprano Voice," The Journal of Research in Singing, I/1, (1977), p. 25.

Johann Sundberg estimated the formant frequencies of a soprano subject by several methods. His results are shown in Table VIII. The dotted lines refer to the first formant, the dashed lines to the second formant, and the solid diagonal lines are the frequencies of the eight lowest spectrum partials. As can be seen from the graph, the first formant is never much lower than the frequency of the first partial. "If the fundamental almost coincides with the first formant, it will gain amplitude and dominate the spectrum."[16]

Normally the fundamental is the strongest partial of the source spectrum but if a soprano wishes to produce vowels of high frequency with the least effort, she will tune the fundamental with the first formant. As has been shown this is best accomplished by lowering the jaw.

When this lowering of the first formant leads to less vowel intelligibility, the soprano will change to the second formant. Finally, according to Berton Coffin, above F5, 698 Hz, sopranos can compensate by rounding the lips to gain head register. He says sopranos will still be producing five partials when singing high C, C6, or 1046 Hz.[17]

Table IX is a summary of the partials of a sung pitch (frequency) including the partials summation wave, fig. 3 of Table V, the partials of the vowel /a/, and the singer's formant. Although the frequencies quoted by

Table VIII

Frequencies of Six Vowels

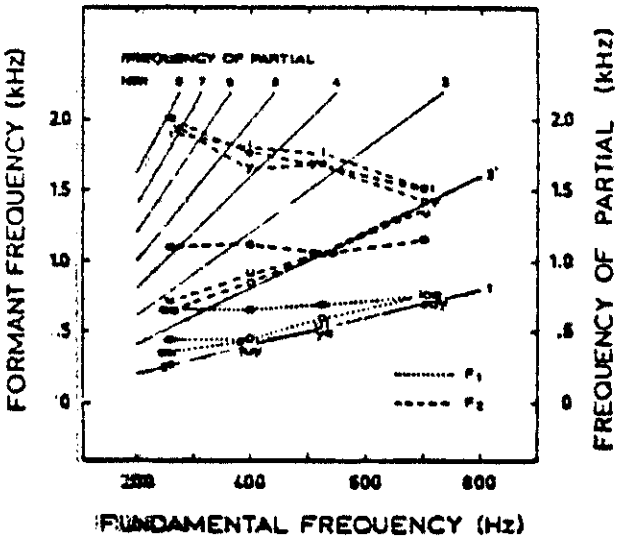


figure 1

Figure 1 shows the frequencies of the two lowest formants in six vowels sung at different pitches.

Sundberg, op. cit., p. 136.

Wormhoudt apply to male singers, the pattern will remain the same for female singers. Sundberg reports these frequencies will be about 15% higher for female singers.[18] The singer's formant has been found to be about 3200 Hz for mezzo-sopranos and contraltos, and up to 4000 Hz for sopranos.[19]

Formants are the result of the shapings of the vocal tract for the vowel being sung. Another summary of these formants is shown in Table X. The frequencies, which may be higher for female singers, are shown notated on the treble staff. The formants for /1/, /e/, and /u/ will affect the partials summation wave in a very different fashion from /a/ as they have two widely separated resonant frequencies.

Balanced resonance occurs when the adjustments of the tongue, the velum, the lips, jaw, soft palate, and pharynx within the vocal tract give formants which agree with the partials of the fundamental frequency (sung pitch). Since this is an area of involuntary muscular control, teachers of singing often accomplish this by suggesting vowel modification, or lowering the jaw or rounding the lips. Ease of vocal production is a result of balanced resonance.

Breath Management

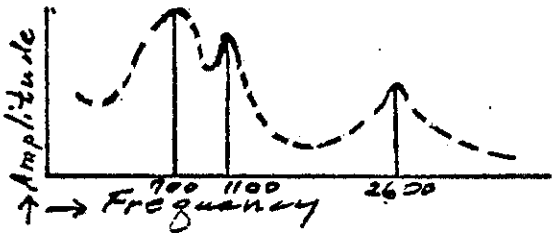
The earliest experiments in vocal research involved the breathing mechanism. The extrinsic musculature is the most obvious and most accessible part of the body having to

Table IX

Spectrum Envelope of Vocal Tract Tuned to /a/

Vocal tract resonances when the vocal tract is tuned for the vowel "ah" [a].

The resonances, tuned for a given vowel, act on the Voice-Source Spectrum or Wave (Figs. 4 and 6).



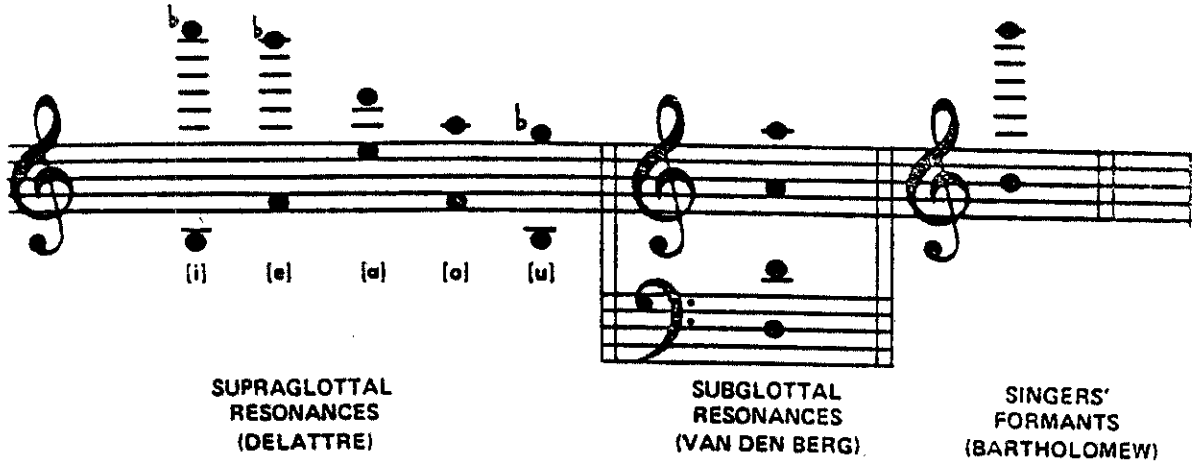
Formants of the vowel a (ah):
F_1 around 700 Hz
F_2 " 1100 Hz
F_3 " 2600 Hz
Dotted line is the "spectrum envelope."

Data based on Appelman, Benade, Coffin, Denes and Pinson, Sundberg, Vennard, Winckel.

Wormhoudt, op. cit., p. 35.

Table X

Frequencies of Vowel Formants, Singers' Formant



John Large, Science and Pedagogy of the Voice, Handout (Denton, Texas: University of North Texas, 1983).

do with singing. Raymond H. Stetson measured the movements of the rib cage, of the epigastric, mesogastric, navel and lower abdominal levels by means of tambours with bosses, both sitting and standing. He found no perceptible difference in either stance. Although most of the subjects were male, women's movements proved to be essentially the same.[20]

In singing, Stetson found that there is an immediate fixation of the thoracic and abdominal muscles at the end of inhalation or inspiration when the breath is taken through the mouth and nose. The abdominal muscles are kept poised and adjusted for the decreasing chest volume. This slow respiratory movement is the main element in phrasing. All movements of singing are executed from the posture of slight fixation. As breath is used in singing there is a steady recession of the ribcage, clearly a slow movement, nicely adjusted between the action of the abdominal wall and the internal intercostal muscles of the ribcage.

Stetson also found that the main difference between legato and staccato singing is found in "the air pressure just outside the mouth."[21] There is an unbroken flow of tone in legato singing but a disturbance of air pressure outside the mouth in staccato singing. Often there is no general recession of the chest wall; even slight breaths can be taken between the pitches in stacato singing.

To sustain a legato line, subglottic pressure must

also be maintained. Bouhuys, Proctor, and Mead measured subglottic pressure by various methods.[22] They found that a continuously changing respiratory effort is required if subglottic pressure is to be maintained. Both inspiratory and expiratory muscles participate in this finely coordinated effect.

The inspiratory muscles keep the chest wall from collapsing during phonation. These researchers state in "Kinetic Aspects of Singing" that they believe this muscular action may correspond to "atemstutze," appoggio", or breath support in the literature of singing.[23] By analyzing the difference between transdiaphragmatic and abdominal pressure, they found that pleural pressure[24] can be reduced below the relaxation values without the use of the diaphragm. Singers do this by expanding the ribcage beyond relaxation values. This reduces the abdominal pressure and elevates the diaphragm. This action is only limited by the hydraulic pull of the abdominal contents, being greatest in the upright position. By using the ribcage muscles to control subglottic pressure, the singer has a more finely graded control of breath pressure than by using only one large and strong muscle, the diaphragm.

This view of the work of the breathing muscles is supported by Dr. Donald F. Proctor of John Hopkins University in a paper presented at the 1979 Symposium on the

Care of the Professional Voice held at The Juilliard School, New York City. During phonation "the two sets of intercostal muscles keep a delicate balance, the diaphragm always relaxes during singing, and the abdominal muscles furnish a steadily increasing expiratory effort."[25] Proctor also points out that far more power is available from both the elastic forces of the chest and the expiratory muscles than the singer needs. Inspiratory muscle force must be used to control that available power to produce the small subglottic pressure needed.

The effect of pitch (variable fundamental frequencies) and volume (sound intensities) on transglottic air flow and subglottic air pressure was measured by Rubin, LeCover, and Vennard.[26] They found that glottal resistance is far more important in supporting a tone of increasing loudness than air flow.

In their experiments it was found that there was a greater transglottal flow of air with increasing vocal loudness and rising pitch. However, when the fundamental frequency (pitch) was held constant and vocal loudness (intensity) was increased, air flow was variable. This can be explained in terms of the variable physical structure of the singer's instrument and the acoustic effects of the vocal tract. This subject was treated at length in the previous acoustical section in this paper (pages 27-37).

When sound intensity was held constant (volume stayed the same) as the pitch rose, Rubin and his colleagues found that air flow usually increased although in some subjects it could remain unchanged. They also found that a poor vocal technique had a disturbing effect on pressure-flow relatonships; inadequate breath support impaired vocal quality by causing glottal tensions.[27]

Collapsing of the chest wall (rib cage) is often seen in young women singers according to Pearl Wormhoudt.[28] This causes excess breath pressure (forcing), breathiness, and loss of breath for long phrases. Singers must be taught breath support; that is, not allowing the expiratory muscles to tense nor the inspiratory muscles to relax too soon. Fullest support is obtained by adding tension to the lower abdominal muscles precisely at the end of the breath expansion which adds just enough strength for the most difficult phrases. Wormhoudt states that extra support is only needed for advanced music that is very loud, very soft, very long, or very high.

Singing teachers have long been aware of the importance of managing the breath during phonation. Out of 370 statements about cultivating breath control, Victor Fields found 275 had a technical approach while 95 used psychological means.[29] Typical of a non-scientific approach are those teachers who say that singers should breathe

naturally (48 statements), or that singing itself develops breath control, while others say that the interpretation of songs will control breathing. Frieda Hemple, like many other performers, says singers should not be troubled with complicated theories of breath support unless a definite need arises.[30]

Douglas Stanley believed that artificial breathing exercises tended to obstruct phonation and that singing demands unique breathing coordination which cannot be developed by gymnastics but only by the act of singing.[31] Manuel Garcia said just the opposite, "that breathing can be improved by exercises.[32] In a proclamation the American Academy of Teachers of Singing states: "The correct practise of singing in itself tends to develop and establish mastery of breath."[33] Van Christy, quoted by Fields, adds that "the student will develop more rapidly if taught how to breathe."[34]

Fields quotes other singers who say that breathing cannot be controlled locally but only by the demands of singing. "We breathe to sing, just as we breathe to speak. The only difference is that we prolong the act."[35] In this same book John F. Williamson claims that breath control is the result of good phrasing and not the cause of it.[36] Jessica Dragonette insists that the quantity of breath taken must always suit the length and intensity of the musical

phrase and that the interpretation must therefore govern the breathing behavior.[37]

Victor Fields' book, a compendium, used published statements about various aspects of singing during the years 1928 to 1942. Nearly forty years later Jerome Hines interviewed forty famous opera singers, twenty of them female.[38] Of these twenty singers seventy percent used conscious methods of breath control. Although the basic experiments concerning breath management were begun during the 1930s, it has taken nearly fifty years for this information to be a part of the accepted knowledge of a performer. Stetson; Bouhuys, Proctor, Mead; Rubin, LeCover, Vennard; and Garcia, all have shown that it is desirable to take control of the muscles of the ribcage and the diaphragm. That control of breath management and support leads to better singing can be heard in the performances of Marilyn Horne, Regine Crespin, Zinka Milanov, and other well-schooled singers in the major opera houses of the world.

End Notes (2)

1. D. Ralph Appelman, op. cit., p. 62.

2. The term vocal folds is the same as vocal cords.

3. John Large, "Statement of Vocal Function," a handout in the class Pedagogy and Science of Singing, (Denton, Texas: NTSU, 1984).

4. References cited by John Large.

   Jw. van den Berg, "Myoelastic-aerodynamic Theory of Voice Production," Journal of Speech and Hearing Research, 1, 1958, p. 227-244.

   A. Ferrein, "De la formation de la voix l'homme," Hist. acad. roy. sc. (Paris, 1741), p. 409.

   Garcia, Observations, loc cit.,

   H. Helmholtz, On the Sensations of Tone, (Braunschweig: Verlag von Fr. Vieweg u. Sohn, 1863).

   J. Muller, Handbuch der Physiologie der Menschen. (Coblenz: Holscher).

   V. Negus, Mechanism of the Larynx (London: Heineman, 1929).

   J. Tonndorf, "Die Mecanik bei der Stimmlippenschwingung und beim Schnarchen," Z. Hals, - Nasen - in Ohrenhelik, 12, pp. 241-245.

5. Appelman, op. cit., p. 63.

6. R. Husson, "Excitabilite recurrentielle et entendues masculines et feminiennes des voix adultes cultivees, semicultivees et incultees," Review of Laryngology, Otolaryngology, and Rhinology, suppl., 110, 1954, p. 260.

7. Appelman, op. cit., p. 62.

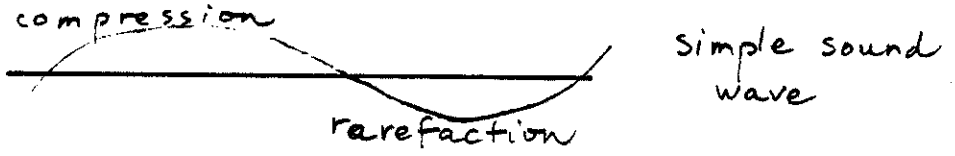
8. Joel L. Pressman, "Physiology of the Vocal Cords in Phonation and Respiration," Archives of Otolaryngology, 35, (1942), p. 355.

9. Vennard, op. cit., p. 110.

10. Donald Read and Clifford Osbourne, "Three Basic Variables in Vocal Tone," The NATS Bulletin, 36/3 (Jan/Feb. 1980), p. 8.

11. Partials spectrum - the relative intensities of the partials shown in one graph.

    Amplitude - intensity of sound, refers to the width of the sound waves.



    Frequency - the rate of recurrence of a vibration.

12. Overtone means the same as a partial, but it is more usual to refer to the fundamental and its overtones as partials.

13. Wilhelm Ruth, "The cause of the individual differences in the sensation of head resonance in singinng," The NATS Bulletin, 23/1 (Oct. 1966).

14. William Vennard, op. cit., p. 127.

15. Paget, Laws of Cavities (as quoted by William Vennard in his book Singing the Mechanism and the Technic), is as follows: "the effect of joining two resonators . . . is in general to lower the resonance of each . . . . The minimum fall occurs . . . when the front orifice (the mouth) is large compared with the central orifice."

16. Johann Sundberg, op. cit., p. 27.

17. Wormhoudt, op. cit., p. 39. Letter from B. Coffin

18. Sundberg, op. cit., p. 27.

19. Boris Lastotchkine Pelsky, "La structure de quelques voyelles changees," Archives neerlandaise de phonetiques experimentals, 17, pp. 123-124. n.d. but sometime in the 1930s.

20. R. H. Stetson, "The Breathing Movements in Singing," from Archives Neelandaises de Phonetique Experimentelle, 1931, pp. 115-164. Reprinted in Contributions of Voice Research to Singing, ed. John Large. (Houston, Texas: College Hill Press, 1980), pp. 5-47.

21. Ibid., p. 32.

22. These subglottic pressures can be measured by various techniques, needle puncture of the trachea, a catheter in the glottis (requires local anesthesia), and esophageal balloon, all combined with recording devices.

23. Arend Bouhuys, Donald F. Proctor, and Jere Mead, "Kinetic Aspects of Singing," Journal of Applied Physiology 21/2 (1966), pp. 483-496. Reprinted in Contributions of Voice Research to Singing. op. cit., pp. 58-87.

24. Pleural pressure is the difference in pressure between pleural and body surfaces.

25. Donald Proctor, Transcripts of the Eighth Symposium Care of the Professional Voice (New York: Voice Foundation, 1979).

26. H. J. Rubin, M. LeCover, W. Vennard, "Vocal Intensity, Subglottic Pressure, and Air Flow Relationships in Singers," Folia Phoniatrica 19 (1967), pp. 393-413. Reprinted in Contributions of Voice Research to Singing. op. cit., pp. 88-107.

27. Ibid., p. 97.

28. Wormhoudt, op. cit., p. 22.

29. Fields, op. cit., pp. 70-71.

30. Ibid., p. 75.

31. Stanley, op. cit., p. 314.

32. Garcia, op. cit., p. 4.

33. Proclamation of the American Academy of Teachers of Singing. "Care and Development of the Human Voice," Music Education Journal 25 (1938), p. 26.

34. Fields, op. cit., p. 77, (Van Christy).

35. Ibid., p. 78, (W. Warren Shaw).

36. Ibid., p 78, (John F. Williamson).

37. Ibid., p. 79, (Jessica Dragonette) from an interview in the Etude music magazine).

38. Jerome Hines, Great Singers on Great Singing (Garden City, N.Y.: Doubleday, 1982).

CHAPTER III

SENSATIONS OF GOOD QUALITY SINGING

Correct Placement

Phonation produces physical sensations which help singers remember efficient vocal production. When established, these sensations of correct vocal technique will help the singer to gain "the warmest, most beautiful, and controlled tones possible."[1] These physical sensations have many names. Some are associated with "placement," forward placement and masque placement for example. Other teachers call these physical feelings "resonance"; head or chest resonance are common expressions. Richard Miller calls these sensations "timbre."[2]

"Voice placement" or the ways in which the resonators are connected is the subject of considerable research in singing. Vocal scientists believe that the resonators are those cavities of the vocal tract which are connected at the back of the mouth. The upper portion of the pharynx connects with the oral cavity, in which the tongue, soft palate, and uvula govern the relative sizes of these two orifices. Since control of these organs is indirect, imagery and vowel forms are the most frequent techniques employed to change the shaping of the resonators.

It is in this area of pedagogy that teachers of singing show their most characteristic bias and strongly reflect the heritage of European schools of singing.

Typical of the English school of singing are such expressions as "up into the back of the head and over into the forehead" and an admiration of the "cathedral tone."[3] Such a tone usually has an absence of vibrato and is sometimes sought in the performance of church and early music. This kind of production tends to reduce the upper partials and take away from the vibrancy of the tone, according to Miller.

"Chantez dans le masque," (singing in the mask), "Ouvrez la bouch, (open the mouth), or "Come on parle" (as one speaks), are common expressions in the French teaching style. Because of the language, it sometimes leads to too much nasality in the sound according to non-French assessors.

German teachers rely heavily on sensations to prove technical proficiency, and are the most prone to separating the voice into isolated registers and then "rebuilding" the voice. First, speech qualities are removed from singing by changing the shape of the pharynx. The teacher asks the student to add "more room in the throat" and to place the sound "to the rear of the throat wall." Phrases such as "Prinzip des Nach-hinten-singen" (sing to the rear), or

"Hinen ganz breit machen" (more room at the back) are often heard in German voice studios.[4] A fuller, warmer sound through this alteration in the shape of the pharynx is the goal.

Second, a mixture of breath into the sound is wanted to give sanftheit or gentleness and softness to the sound. Breath is aimed at the forehead. These two tonal qualities along with low abdominal breathing and less erect stance lead to abdominal tensions, and subglottal pressure on the vocal cords. This results in a breathy sound in high, soft tones, unwanted register changes, and stark contrast in tonal quality.

The Italians on the other hand do not separate resonance factors from breath management tecniques. Placement of the voice (forward sensations including all areas of the face, even the forehead) is bound up with vowel formation and the appoggio or balancing of the breathing muscles. There should be no muscular tension as in the German school. The tone should be balanced, too, and should consist of bright and dark elements or chiaroscuro. This is in contrast to the English and French styles which seem to look for one kind of color.[5]

The bringing of either the upper vowel formant or the singer's formant into the sound, and resulting sympathetic resonances felt in the bone structure of the head, account

for such familiar studio expressions as "placement" or "focus." "A forward sound" or "singing in the masque," expressions heard in French studios, are also used by North American teachers whose students lack the appropriate sound qualities. Pearl Wormhoudt believes these are legitimate examples of imagery based on sensations.[6]

The risk in using imagery is that the student, and even the teacher, may confuse sound sensation with sound source. Lucie Manén is one English teacher and researcher who has fallen into this trap. She believes that head resonance is achieved by making the air vibrate in the ethmoidal and frontal sinuses. "The air has to be directed from the middle partition of the nose towards both sides into the sinuses. The vibrations are felt to extend upwards into the frontal sinuses."[7]

In fact, sound vibrations cannot be directed at all. They move in all directions, and can even set bones into vibration. Sympathetic vibrations can be set up in a mass of air or bone which possesses the appropriate natural frequency. It may produce a sensation of which the singer will be conscious.[8] Vennard further adds that these vibrations contribute nothing to the sound which reaches the audience. These sympathetic vibrations may help or hinder the singer, depending on how she adjusts to it. Psychologically it may help in terms of "placement" or it may

deceive her into preferring a tone which pleases her but not the audience.

On the other hand, if the singer understands the functions of the mechanism of singing, then she can "train herself to associate emotional and creative experiences with sensations that result from specific kinds of physical coordination."[9] This belief in the power of the singer to learn and trust sensations is echoed by Jeffrey Foote,[10] James Lawson,[11] William Leyerle,[12], William Vennard,[13] Pearl Wormhoudt,[14] and many others.

Thus far, changing the shape of the resonators has been the result of using vocal imagery, or the sensations singers feel in the various parts of the vocal instrument. Herbert Witherspoon wrote in 1925, "while pitch must be perfect, vowel sounds and colors for expression are modified in relation to pitch."[15] This is an early indication that teachers were looking for another way to tune the resonators. Berton Coffin is the leading exponent of this other way to shape the resonators, which is known as vowel modification. He believes "vowels have pitch which act as resonators to sung pitch if they are shaded to allow for greatest resonance."[16]

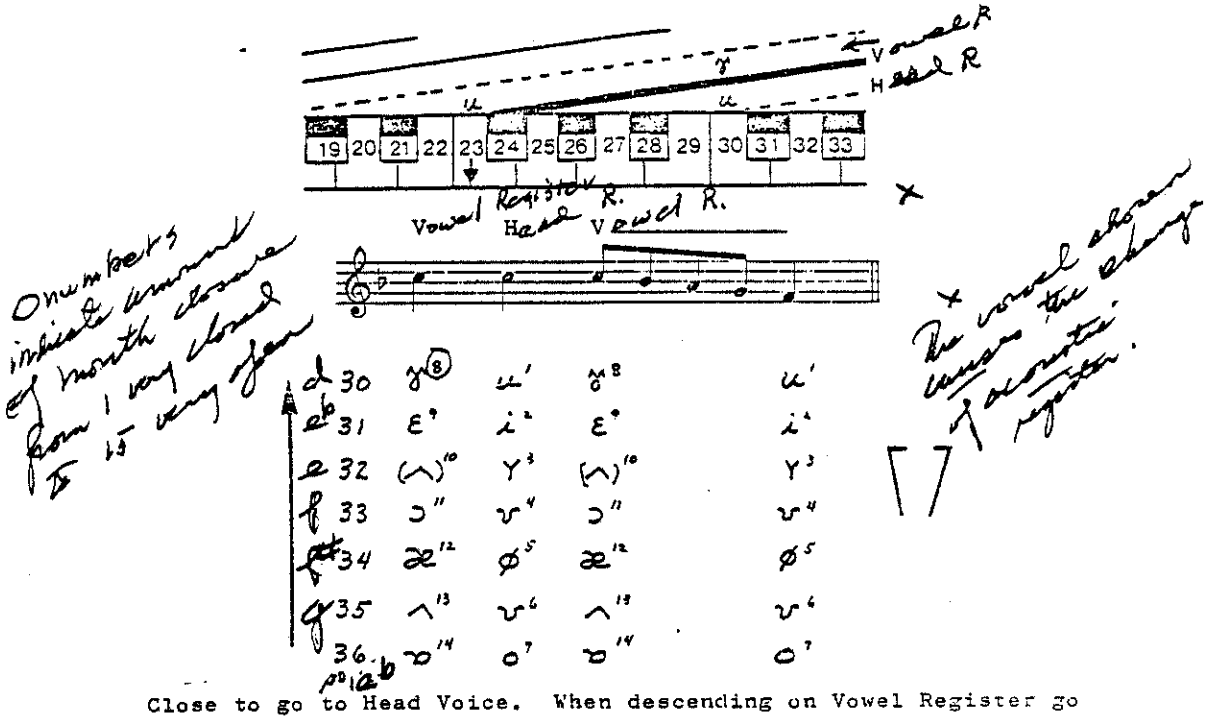
This modification of vowels has been codified by Berton Coffin in his Vowel Chart. The chart notates register events, pitch, and vowel color in the same

exercise. Each pitch can be sung in two or three different registers depending on the vowel and mouth spacing (open or closed or in between). One, usually a green vowel, gives best resonance with least effort. The red vowels need to be shaded toward the umlaut version according to Coffin. To give the throat flexibility in the shaping of vowels, about sixty different exercises and vocalises are given to the female voice. They require the singer to change vowels in many ways. Pearl Wormhoudt has given an explanation of one exercise in Illustration VII.[17] The vowel chosen and degree of mouth opening affect the ease of vocal production and the level of intensity in the sound.

A third way to shape the resonating cavities of the throat is by visual imagery. Lilli Lehmann was one of the first to show in a diagram the sensations felt by sopranos and tenors singing higher pitches.[18] Illustration VIII shows the site of physical sensations experienced by sopranos and tenors singing higher pitches and relates them to actual pitches. These sensations are given definite places on the musical staff.

Leyerle has a similar idea. As higher tones are sung, sensations travel to the back of the head.[19] These impressions are shown as successively larger circles emitted from the back of the head. The two diagrams are shown in Illustration VIII.

Vowel Register to Head Register Transitions.



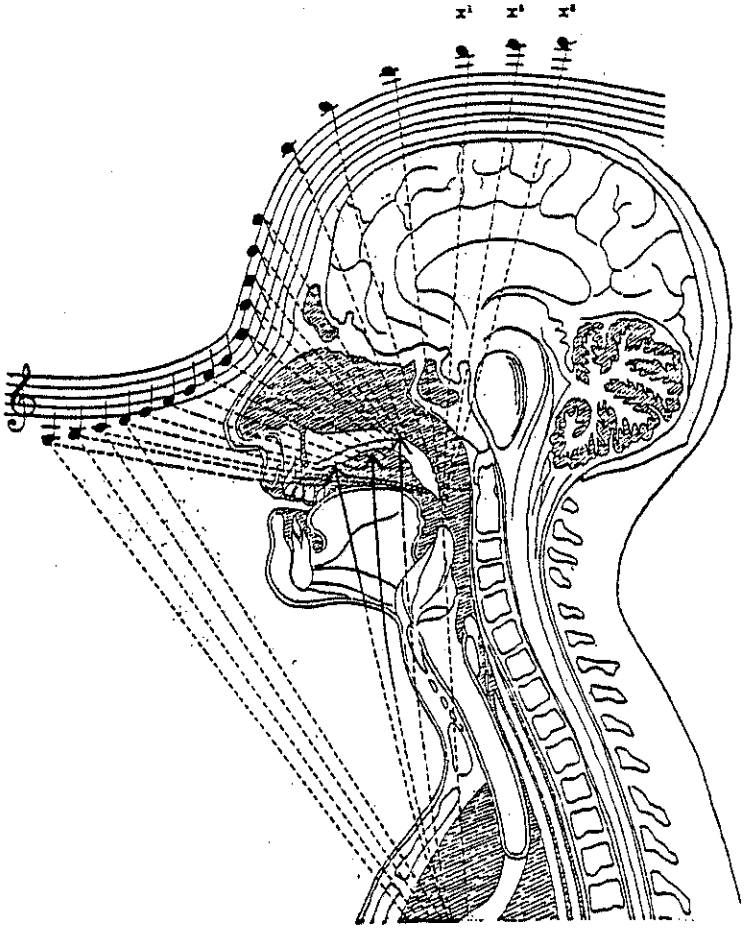
Close to go to Head Voice. When descending on Vowel Register go from open to more close.

Use dimple falsetto on the second note.

Illustration VII. Berton Coffin exercise as explained by by Pearl Wormhoudt

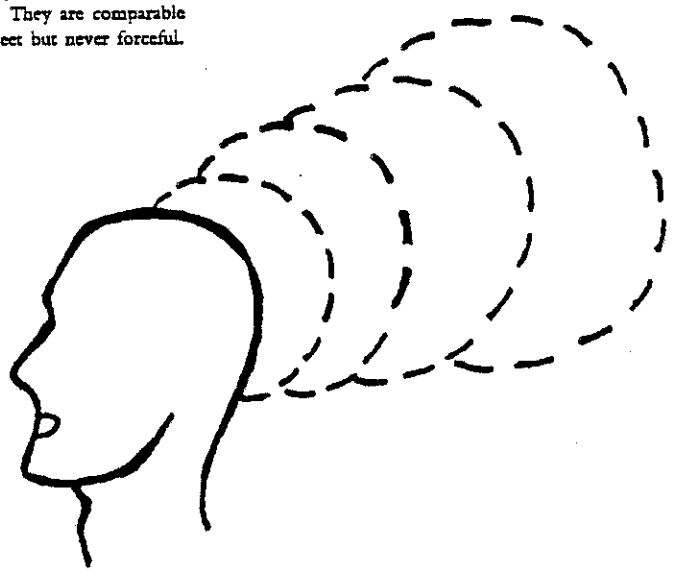
Pearl Shinn Wormhoudt, letter to Roberta Stephen dated June 4, 1984.

Very good description of perception of a High Soprano (according to Lilly Lehmann "Meine Gesangskunst". Verlag der Zukunft, Berlin, 1909).



The highest notes x¹ x² x³ should not be placed and felt at the palate. If forced, they sound shrill and unfeminine, more or less like an electric bell. They are comparable to flagiolet notes on a string instrument : they must sound sweet but never forceful.

Lilli Lehmann
How to Sing.[18]



The circles represent the sensations felt by singers as they sing successively higher frequencies.

William Leyerle,
Vocal Development Through Organic Imagery.[19]

Illustration VIII. Head tone sensations

Another famous singer and teacher, Elizabeth Schumann, also used visual imagery for herself and her students. Elizabeth Puritz in her book about Schumann's teaching mentions some of these images, "the vault of a great cathedral" or "the open plain of a still sea."[20]

Resonance or the acoustics of the human throat is the third and equal part of the singer's equipment, the other two being breath management and laryngeal freedom. This balance of force is not controlled by conscious action but trained indirectly mainly using imagery and vowel modification.

Passing into the Head Voice

Female singers do not experience extreme register events when moving into the head voice (voce di testa). Sometimes the soubrette voice and light sopranos feel only a slight change while passing through the seconda passaggio, E5 - F#5, while other heavier, more dramatic voices have a distinct head sensation in that area of the voice.

Laara Browning Henderson believes when women move into the head register other sensations can be felt:

a. a strong mask sensation
b. a dome-shaped arch inside the mouth
c. a feeling of strength across the bridge of the nose
d. a heady impression
e. a forward placement
f. a swinging or loose jaw[21]

It should be emphasized that sensations are not always consistent, but these are the experiences of many female singers.

The sensations women experience on passing into the head voice are the result of muscular adjustments in the vocal mechanism. There is a "thinning of the vocal cords with less mass available for resistance to subglottic pressure"[22]; the number of resonances diminishes. There may be fewer partials, with the first vowel formant reinforcing the fundamental frequency.[23]

In a description by Richard Luchinger and Godfrey Arnold, the vocal folds "are sharp-edged, thin, and taut."[24] When high pitches are sung the cricothyroid muscles dominate the action of the vocal folds. If the vocalis muscles remain too thick and breath pressure is increased, a point is reached where this adjustment cannot be sustained; the voice will "break" or will not sound. This sudden adjustment of laryngeal action is undesirable. A more "gradual balancing of laryngeal muscles vibrating vocal-fold mass, subglottic pressure, and air flow rate"[25] will smooth the entrance into the head voice. As has been shown, singers accomplish this balancing of muscular action by indirect means, explained at length in the previous section, (pp. Mechanical instructions can also be used.

Wormhoudt states sopranos who need to raise the

first formant can shorten the vocal tract by making a slight smile.[26] Sundberg observed that sopranos lower the jaw as they sing higher pitches. Vowel intelligibility is impaired as the soprano sings increasingly higher pitches. Miller observed that with a balanced breath support and modification of vowel for ease of production, this loss of intelligibility can be delayed.[27] Composers often compensate for this loss of intelligibility by repeating words or phrases in lower pitches or by using the /a/ vowel on these high frequencies.

Female singers who have learned to balance breath with laryngeal action in the middle of the voice negotiate the secondo passaggio more easily. They need only add some vowel modification or a more "heady" feeling to the voice so that the passage to the head voice becomes effortless.

Vocalizing in the Extended Range

The extended range or the flageolet register is above the head voice in female singers. Its many names in various languages suggest the bell-like, echo quality of the sound: bell flute, or piccolo register; echo voice; registre de flageolet, de flute; die hohe quinte, die zweite Hohe; voce di campanello.[28]

The flageolet or bell register, frequently considered as an extension of the head voice, begins about a fifth above the secondo passaggio, and most often extends a

fourth or fifth above that. The flageolet register can sometimes have a great extension, as much as an octave above the head voice.[29] The French and Italian schools of singing often use this range as "the key for brilliant development of the upper range" of sopranos.[30]

Most researchers imply that no further adjustments are made by female singers when using this extended range. The same sensations of head voice are assumed; light mechanism (Vennard[31]), and forward projection (Wormhoudt[32]). Performers using this flageolet register, on the other hand, say there are different feelings as they vocalize in the extreme range. The voice seems childlike and small. The production seems effortless.[33]

Another passaggio above the head voice is frequently felt by sopranos and mezzo-sopranos as they move into the flageolet register. Miller says this passage usually starts at Ab5 for contraltos and ends about C6 for sopranos.[34] Contraltos rarely develop this register as there is little vocal literature requiring this range, but mezzo-sopranos and sopranos of all classes (fachs) have repertoire suited to the flageolet register of their voices.

Not all singers fit so neatly into Miller's chart. Cristina Deutekom, a dramatic coloratura, says she has three sections to her voice, one below Bb4, her first passaggio, another between Bb4 and Eb5-F5, and a third above Eb5-F5 which

seems to have no upper limit.[35]

Vocal researchers have found that when females sing in the extreme high range, there is a "high rate of longitudinal tension of the vocal ligaments, considerable damping of the posterior portion of the vocal folds, and high subglottic pressure and air flow rates."[36] Vennard says air flow and muscle activity in the larynx have an "inverse correlation with intensity" in this range.[37] There is, in addition, a heavy concentration of upper partials which can make the voice sound dry and brittle.[38] Many researchers have found vowel intelligibility is greatly impaired in the flageolet register, more so than in head voice. The earliest work in intelligibility was done by Pierre Delattre in 1959.[39] Further experimentation was carried out by William Vennard[40] and the Russian scientist V.P. Morozov.[41] The only vowel consistently recognized in pitches near high C (C6, 1046 Hz), was found to be /a/. Because the first two formants of /a/ are near 1046 Hz the listener identifies any sung vowel near that pitch as /a/.

On the other hand, Berton Coffin's experience and research indicated that as long as two vowel formants are present in the sung vowel, voice quality and intelligibility should not be impaired.[42] He found that sopranos singing high C still have five formants in the sound.

The most common type of voice with a well developed

flageolet register is the coloratura soprano. Vennard says voices at the extremes of the human compass, like coloratura sopranos and basses, are always rare. The flageolet register has a simple flute-like character which to the female singer feels small and high in the head. There is a sensation of a third passaggio above the head voice which varies in pitch depending on the voice category. The acoustic factors of the flageolet register do not yet seem to be fully understood. G. Bloothooft hints that there may be more factors than the singer's formant to account for favorable timbre considerations in the female upper range.[43]

End Notes (3)

1. Laara Browning Henderson, How to Train Singers (West Nyack, N.Y.: Parker Publishing, 1977), p. 42.

2. Richard Miller, Structure, op. cit., pp. 205-206.

3. Richard Miller, English, French, German, and Italian Techniques of Singing (Metuchen, N.J.: The Scarecrow Press, 1977), p. 77. Hereafter known as National Schools.

4. Ibid., p. 67.

5. Ibid., p. 78.

6. Warmhoudt, op. cit., p. 38.

7. Lucie Manén, The Art of Singing (London: Faber Music, 1974), p. 31.

8. Vennard, op. cit., p. 94.

9. Miller, Structure, op. cit., pp. 189-199.

10. Jeffrey Foote, The Vocal Performer (Mount Pleasant, MI: Wildwood Music, 1983), p. 26.

11. James Terry Lawson, Full Throated Ease (Vancouver, B.C.: Western Music, 1955), pp. 29, 38.

12. Leyerle, op. cit., p. 15.

13. Vennard, op. cit., p. 117.

14. Wormhoudt, op. cit., p. 133.

15. Herbert Witherspoon, Singing (New York: G. Schirmer, 1925), p. 25.

16. Berton Coffin, Overtones of Bel Canto (Metuchen, N.J.: The Scarecrow Press, 1980), p. xii.

17. Pearl Shinn Wormhoudt, letter to Roberta Stephen dated June 4, 1984.

18. Lilli Lehmann, How to Sing (Wheeling, Illinois: Collage, 1978 reprint), p. 81.

19. Leyerle, op. cit., p. 43.

20. Elizabeth Puritz, The Teaching of Elizabeth Schumann (London: Methuen, 1956) p. 9.

21. Henderson, op. cit., p. 107.

22. Miller, Structure, op. cit., p. 113.

23. Coffin, op. cit., p. 11.

24. Richard Luchinger and Godfrey E. Arnold, Voice-Speech-Language, translated by Godfrey Arnold and Evelyn Robe Finkbeiner (Belmont, CA: Wadsworth Pub., 1965), p. 97.

25. Miller, op. cit., p. 290.

26. Wormhoudt, op. cit., p. 34.

27. Miller, op. cit., p. 155.

28. Ibid., p. 148.

29. Miller, National Schools, op. cit., pp. 119-120.

30. Ibid., p. 135.

31. Vennard, op. cit., p. 66.

32. Wormhoudt, op. cit., p. 38.

33. Miller, Structure, op. cit., p. 148.

34. Ibid., pp. 134-135.

35. Jerome Hines, Great Singers on Great Singing (Garden City, N.Y.: Doubleday, 1982), p. 96.

36. Miller, op. cit., p. 148.

37. William Vennard, Minora Hirano and John Chala, "Chest, Head, and Falsetto," The NATS Bulletin, 27/2, (Dec, 1970), pp. 30-37. Reprinted in Contributions of Voice Science to Singing, John Large ed. (Houston, Texas: College-Hill Press, 1980), p. 176.

38. Miller, National Schools, op. cit., p. 135.

39. Pierre Delattre, "Vowel Color and Voice Quality," The NATS Bulletin 15/1 (Oct. 1958), p. 4.

40. Vennard, op. cit., p. 158.

41. V. P. Morozov, "Intelligibility in Singing as a Function of Fundamental Voice Pitch," Soviet Physics-Acoustics 10/3 (1956), pp. 279-283. Reprinted in Contributions of Voice Research to Singing, op. cit., pp. 395-402.

42. Wormhoudt, op. cit., p. 38. Letter from B. Coffin.

43. G. Bloothooft, "A Note on Voice Quality in Professional Singing", Journal of Research in Singing 10/2 (June 1987).

CHAPTER IV

THE PEDAGOGY OF THE FEMALE HIGH VOICE

The Beginning Female Student

Goals

Older generations of singing teachers often expressed pedagogical objectives in such subjective terms as an "attractive sound," or a "resonant tone." D. A. Clippinger is representative of this school of teaching in wanting "to produce a beautiful tone throughout the vocal compass."[1] Reaching this goal depended on the experience and ear of the teacher. Objective terminology was seldom used and methods were infrequently specific or detailed.

At the present time vocal researchers would agree that the goal of beautiful singing is largely a function of the vocal tract. Cornelius Reid reports:

> The information supplied by scientific studies has conclusively demonstrated that: (a) the larynx, the vocal folds, and their associated musculatures constitute the sound source, (b) the adjustments made by the adjacent pharyngeal cavities select and energize those frequencies that define and resonate the various vowel phonemes, (c) the infra--and suprahyoids must be brought into balanced tension to ensure laryngeal stability, (d) the larynx must be effectively positioned if it is to perform as a primary resonator, and (e) the responsible muscle systems must function with exquisite

> precision if the utlimate tonal product (voice) is to emerge freely and with great beauty.[2]

Berton Coffin would add that beauty of sound comes from a flexible vocal tract which has the most varied colors in its sound. "The voice is a flexible instrument and lives best on change."[3]

Most singing teachers would agree with Wormhoudt's pedagogical goals[4] and Gordon Troup's signs of good teaching.[5] They have summarized as follows:

a. By learning to manage the breath through a correct breath intake and by balancing the muscles of inhalation, a proper flow of air into the elastic musculature of the larynx is achieved. The student should understand the actions of the breathing mechanism and be conscious of the sensations which accompany correct actions of the breathing mechanism.

b. There should be no tension in the jaw, tongue, throat, neck, and shoulders.

c. By learning proper closure of the vocal cords the musculature at the level of the larynx is made more efficient.

d. Precise tuning of the vocal tract, gives a more resonant tone. This is achieved by a proper coupling of the vocal cavities. Wormhoudt uses

Coffin's vowel exercises for this purpose.

e. Proper production of high notes, according to Troup, involves the mechanics of lowered larynx, widening of the pharynx, and droppping of the lower jaw.

These tasks as stated are suited equally to female and male singers. Unless these physical actions are learned, Troup believes the pedagogy will be harmful to the singer.

There are, as well, some teachers who believe there should be differences in the teaching of female and male singers. Lisa Roma believes that the female voice has "its forte or strength in the middle or higher portion of its range."[6] It is an inherent quality of women's sound. Much of the male pedagogy is devoted to developing the upper range of the man's voice, though by comparison less applies to the female upper range. Coffin in his book has separate chapters of exercises and vocalises for women and for men, implying a different pedagogy for each. Vowels are also treated differently by Coffin. When female singers ascend into the head register the vowels can have an unattractive quality which Coffin calls a spread vowel.[7] In his vowel chart these vowels are red in color. (A safe vowel is green). Men also can have spread vowels in the head register, but women, according to Coffin's Chart, can have dangerously spread vowels throughout their whole vocal compass. Coffin, Wormhoudt, and Roma would have some vowels

modified towards an umlaut to prevent a spread sound.

Wormhoudt states that the "covering" of vowels is different for men and women.[8] She believes women cover when descending into the chest register while men cover when ascending into the head register. Both Reid and Coffin state that both females and males cover when moving through passaggios. Nellie Melba used "turning" to describe the sensation of changing from middle to head register.[9] It seems that there is some change in vocal production when females and males move into another register, though the terminology and vocal pedagogy for this change is in dispute.

In conclusion, most singing teachers would agree that the main pedagogical goal for their students is a beautiful sound throughout the compass of the voice. This goal is more efficiently achieved if the teacher knows the muscular coordinations involved in the act and art of singing. The student can then be offered the appropriate image or correct sensation, the simple mechanical suggestion, or a suitable modification of the vowel to more closely approach this goal of beauty in sound.

Unless the teacher knows the physical elements of good singing, has a clear mental image of beautiful tone, and the ability to apply scientific knowledge to vocal problems, the goal of beautiful singing will be difficult to attain. The good ear of the teacher and the experience of

hearing excellent singing will supplement and enrich the teacher's art.

Ways to Reach Goals

Attaining predetermined goals is the heart of voice teaching. William Vennard says:

> Vocal pedagogy is so much more intangible than instrumental pedagogy . . . . Learning to sing is a slow and patient undertaking, in which a good ear is the prerequisite, the imagery is supplied by the teacher, and the experience is gradually accumulated until it is so powerful that merely calling up the memory will reproduce it.[10]

In the literature of vocal pedagogy there seem to be two extreme styles of teaching. One uses only the knowledge of acoustics, mechanical function, and physiological actions of the vocal tract as the rationale for teaching suggestions. The other extreme uses imagery, the similes and metaphors of poetry, to guide the student to artistic performances.

Further researach reveals several other methods. Phonetics, used in the seventeenth and eighteenth centuries, is still is use. Vennard endorsed demonstrative teaching. Step-by-step is another style. Involving the unconscious, since much of the voice is produced below the level of direct control, constitutes the holistic way of teaching. The best teachers incorporate the appropriate products of science, combine it with the tools of imagery and the

teacher's auditory perception of good quality to produce an effective pedagogy.[11]

The most frequent pedagogical approach is the use of imagery, the comparisons of poetry. The sensations of singing are compared to placement, timbre, and resonance, but are most useful if accompanied by "the actual sensation, partly kinesthetic and partly auditory."[12] The student is leaving certain attitudes behind and replacing them with more positive ones so the word symbols chosen should invite the correct physical response.

Imagery has its limitations. Vocal freedom can be inhibited by focusing the mind on localized parts of technique unrelated to the total response of singing. With the example of Lucie Manén in mind, sensations of sympathetic vibration can be confused with the source of sound. That is why imagery should be connected to objective fact.[13]

The opposite approach is the mechanistic in which the teacher believes that the "mental concept of tone should be as specific as possible and should include objective data."[14] This kind of teacher continually seeks more knowledge about singing techniques and vocal science. Miller cautions that the teacher should have a solid body of knowledge in order to judge the validity of new ideas. Although singing is a total response, additions may be made

by learning new habits which then become unconscious and part of the whole.

The drawback to a totally mechanistic approach is that scientists have not discovered all the physical details of singing, and much of singing is not consciously controlled. The mechanistic approach can also lead to the "technically intense teacher."[15] He is so intent on the technicalities of singing that he produces singers who lack communicative powers through the neglect of musicianship and artistry.

The Italian language with its few and pure vowels was used by teachers of the seventeenth and eighteenth centuries as one of the vehicles of beautiful singing. Contemporary teachers use this approach too. In this type of mechanistic teaching, reliance on phonetics, especially the purity of vowel leads to efficient coupling of the resonators and intensity of the formants. Teachers emphasize the positions of the tongue, opening or closing of the nasal port, space between the teeth, or the size of the mouth opening. Chewing motions, the original and still the most primitive way of using the vocal tract, can free an very tense production.[16]

An extremely direct way of dealing with a student and her vocal problems is demonstrative teaching. The use of a good model is helpful because the ear is a monitor of

sound. Vennard believed a teacher with a versatile voice can model, first, a good sound; second, the student's poor sound, even an exaggerated version of it; third, a model to help the student overcome her fault. He favored "judicious demonstration and guided imitation."[17]

Teaching in a step-by-step progression is the center of Laara Browning Henderson's series of vocalises.[18] Using seven basic exercises with variations and elaborations and including consonants and vowels, a dependable vocal technique will be developed. Mathilda Marchesi using her series of exercises and vocalises produced singers with an even and freely produced sound capable of flexible colorature.[19]

Support for this idea of using graduated steps in teaching was indicated in a short term experiment by Mary Ella Collins.[20] She stated that the principles of individualized instruction should include:

a. small steps

b. feedback and reinforcement

c. model-supported practise

d. specifically defined goals

This progressive pedagogy includes the "moment of readiness."[21] Either the student has a flash of insight and sings particularly well or else the student asks an astute question. Both of these situations allow the teacher to

seize this moment to capitalize on a well-sung tone or a thoughtful question. Perhaps the teacher will improvise a vocalise, have the student repeat the desired sound, and at the end, the teacher will verbalize using poetic imagery or objective terminology to fix the idea firmly in the student's mind.

Finally there is the inspirational or holistic teacher. He knows that the singer must invoke the "genie," the unconscious force that controls the vocal instrument. Much of the voice is produced below the level of the conscious and is subject to indirect control (the genie of Vennard).[22] Clippinger would go so far as to say that knowledge of the mechanics of singing is of little value and anatomical information is useless because singing is a mental activity.[23] Vennard says that many of the details of vocal technique may not be as important as the subjective details of "tonal memory, mental concept, emotions, and faith."[24] In other words, there is a total response which recognizes "growth potential and the need for patient optimism."[25] According to Vennard, "profound learning consists of adaptations which take place in an individual as she attempts to achieve a challenging goal which involves her whole personality."[26] It is then the responsibility of the teacher to provide a series of steps to her goal. The performance of song is the ultimate destination of the

singer, so the alert teacher will often use songs for pedagogical purposes.

These styles and methods of teaching apply equally to female and male singers. The best teachers have always used a variety of modes to help the singer sing beautifully and fully. Only in the application of specific techniques will females have a unique pedagogy. Miller suggests ideal teacher follows three principles:

> a. Stability through possession of a constant body of factual information,
>
> b. Growth or the willingness to incororate new concepts and information (after weighing them against fact) and the ability to change,
>
> c. Artistic imagination and musicianship.[27]

If a teacher can follow these ideals he is quite likely to fulfill the goals of beautiful singing.

Finding the Head Register

When to Try

For the average beginning female singer, finding and exploring the extremes of the voice follows logically as the middle voice gains correct physical coordinations, the student obtains clear mental concepts of tone, and acquires confidence in the vocal instrument. Vennard affirms the main purpose of the lesson time is to "practise the coordination

of the vocal act."[28] The student learns to manage breath, coordinate breath with proper closure of the glottis, and to balance the resonators. This coordination takes time to acquire, for the nerves which govern this complex interaction of muscles need to be trained. For most young female singers, the training of this learned coordination begins in the middle register.

The main characteristic of the middle register is its ability to have a varying registration. There can be lighter or heavier mechanisms on closely related pitches. It is this ability to use the mixture of the two mechanisms which tells the ear of the teacher that the singer is ready to move into the extreme ranges.

If the young female singer can lighten the mechanism in ascending passages and use a heavier mechanism as the voice descends, then the coordination involved in singing is ready for expansion. The young soprano can use the head register and not lose the connection to the breath support, and the young mezzo-soprano can leave the heavy mechanism to soar into the head voice. Marchesi would only allow about five minutes of vocalizing when beginning to work in a different register.[29] Richard Miller will only work on the high voice after vocalizing the the middle register, and only stay in the extreme for a short time.

Vennard[30] and Wormhoudt[31] agree that many female

beginners have an unused register. Light sopranos sing mostly with the head voice and do not use the chest register. Mezzo-sopranos and contraltos, and "belters" or those who sing some types of popular music, sing largely in the chest. When both of these kinds of singers cultivate the "middle" register, the vocal development really begins.

Singers with an "unused" register should bring the undeveloped register into the middle. Light sopranos gently descend in five-note patterns into the chest register, or speak in the low register and then sing these pitches. The "unused" head register on the other hand is sometimes found through sighing exercises, bringing the high voice by that means into the middle.

Clippinger[32] says in preparing the head voice, the student must begin with a tone that is free from resistance and build from that. It usually means practising with a light, soft tone. He is one teacher who will work from a piano tone. Most other teachers, including Henderson, Marchesi, Vennard, and Wormhoudt advocate a medium tone, mezzo-forte, or moderately loud.

When the goals of singing are achieved in the middle range, control of the breath, support of the breath, and proper closure of the vocal cords then work on the extremes is facilitated.

How to Try

The range of the voice can be expanded just as an elastic band is stretched if the weight of the voice is controlled. If a heavy mechanism, as Vennard calls it, is used beyond the developed normal or middle range, the voice will not phonate, or it will have a radically different quality, most often a poorer quality. In trying for the upper range Sister Heizler recommended that:

a. only a few tones be tried at one time. The exercise being used should be transposed up by chromatic steps.

b. volume should not be forced.

c. the singer should persevere, even if initial sounds are not pleasing.

d. the singer should experiment with the weight of the voice. There should be a balance of light and heavy mechanisms as the voice moves through the passaggio into the head voice.[33]

Marchesi said the young singer should not sing too long at a time, about five or ten minutes, but that vocalises could be repeated after long intervals, three or four times a day. The singer should gradually increase the practise time to one half hour. She also stated exercises should be practised in full voice, not forcing or shouting.[34]

Wormhoudt believes that there are three problems to

be solved in singing an even scale, or singing from head voice, through middle register, and into tne chest. They are:

a. Bridging the passaggio.

b. Involving some register change in singing the messa di voce exercise.

c. Whether to cover or not to cover the voice and how to do it.[35]

Solving these problems involves breath management, tuning the resonance cavities, and positioning the larynx. Wormhoudt uses exercises and songs for this purpose. Some principles to follow when choosing vocalises are:

a. Alternate diatonic and arpeggiated exercises.

b. Alternate front and back vowels.

c. Alternate fast and slow tempos.

d. Rethink the vowel on every pitch even in fast runs and embellishments.

The light, breathy mechanism used by the young soprano would be enhanced, according to Wormhoudt, by using both ascending and descending exercises in and out of the low, less used register. By developing the low or chest register, the young soprano strengthens the whole range of the voice. It is important to "turn" or lift the middle register into the head voice no later than F5.[36] Sopranos can round the lips to pass more easily into the head voice,

according to Wormhoudt, or use the vowel /ɔ/. Appelman uses descending scales sung on the neutral vowel /ʌ/ to help strengthen this upper point of transition.[37]

Estelle Liebling makes the following suggestions to achieve a blending of registers:

a. When ascending into the passaggio (the second transition area), sing more gently with the mouth less open than normal, but with full breath support.

b. When descending through the passaggio, sing more firmly with the mouth more open than normal, and with a full tone.[38]

If a young soprano is incorrectly classified as an alto, as sometimes happens at the high school level, she may have a fear of high notes. Wormhoudt says much work must be done on breathing and support to gain the higher notes, and even more work to gain confidence as a soprano.

"Belters" or "pop" singers who have carried the chest register too high and loud have a "pernicious" technique which will lead to a loss of the head voice and damage to the vocal cords, according to Miller.[39] Leyerle states there is another kind of singer who uses both light and heavy mechanism but prefers the dominant chest register.[40] It could be the more dramatic singer who performs the Wagnerian roles or it might be a safe belting sound. Henderson states this kind of sound seems to be made in the

nasal cavity and has no restriction in the throat. There is a feeling of support along with nasal resonance. The focus of this technique is complete support of the lower abdominal area which is beneficial to all singers.[41]

Those singers who do not have a safe chest sound can benefit from singing descending five-note scales and rapidly descending arpeggios in a comfortable range using the vowel /ɔ/. Wormhoudt advocates a rhythmic catch breath between arpeggios.[42]

The safest singing belongs to those performers who have learned to use an appropriate sound with a judicious blend of light and heavy mechanism. If used with caution even a heavy, chesty sound may be used with certain kinds of literature.

Developing the Head Register

As the singer's voice develops and changes the teacher should use some system to continue this growth, especially growth in the head register. Some teachers use song repertoire for this purpose (the progressive approach), for instance songs which have long phrases are used for managing the breath, or arias which require flexibility of the voice, or which use the head register are chosen to develop these qualities in the voice. Other teachers use exercises and vocalises for this purpose[43].

When the middle range or register has a free and well adjusted production, or at least is well on its way, it is time to extend the voice into the upper register. The exercises chosen should:

a. move smoothly through the secondo passaggio

b. strengthen the range of the high voice

c. develop control including a range of dynamics

d. acquire agility

Estelle Liebling gave shrewd advice, "it is not necessary to study a multitude of exercises, but rather a few well-chosen vocalises that are designed for specific purposes."[44]

The exercises were judiciously chosen to illustrate the various types used by a number of teachers.

a. Exercises to bridge registers

Vennard's "yawn-sigh" exercise uses a portamento to bring a light mechanism or head register through the middle register and into the chest range, because is is easier to coordinate the registers in a descending pattern than in an ascending one.[45] Wormhoudt uses descending scales which bring more focus into the voice but have the same purpose as the yawn-sigh, to give freedom and ease to the descending voice.[46]

Henderson uses /ŋ / to focus the sound which is then able to bridge the passaggio more easily.[47] A more difficult exercise to bridge the passaggio and practise adjusting from

heavy, to light, and back to heavy mechanism is a Douglas Stanley exercise adapted by Vennard.[48] This exercise (#3) uses a three-note figure in chest register, then a portamento leap into the head register followed by a diminuendo on the same pitch, returning with a descending scale into the chest register.

Richard Miller uses vowels /e/ and /ɔ/ in descending patterns to bring head voice into the middle register. These descending patterns are alternated with hummed glissandi (see Exercises #4, #5, and #6). These glissandi echo the portamento of the yawn-sigh exercise but in a more sophisticted manner[49].

b. Exercises to extend the range of the head voice

Henderson employs a "wide snuff" to open the nasal cavities, the pharyngeal area, and to eliminate tension.

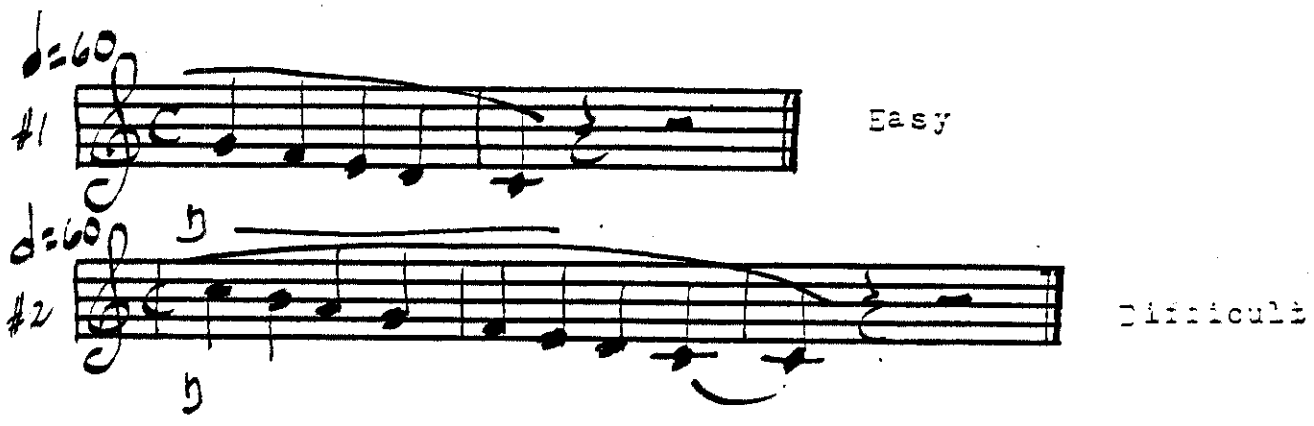
> The cushions under the eyes are consciously pulled up, the jaw drops loosely (but not too far) at the hinge, not disturbing the cushions under the eyes. The tip of the tongue is front, against the lower front teeth. Inhale slowly through the nose (the flanges of the nose will always widen). Be sure not to involve the muscles of the neck on inhalation. It is a gentle inhalation. Now lower the tongue to a wide position and exhale through the mouth slowly and silently.[50]

Two classic arpeggio exercises are used by Wormhoudt to extend the range of the top voice.[51] Light mechanism and forward placement are required. The slow tempo of the first exercise (#7) allows the singer to find the focus or the resonator adjustments in her voice. An agile version of the

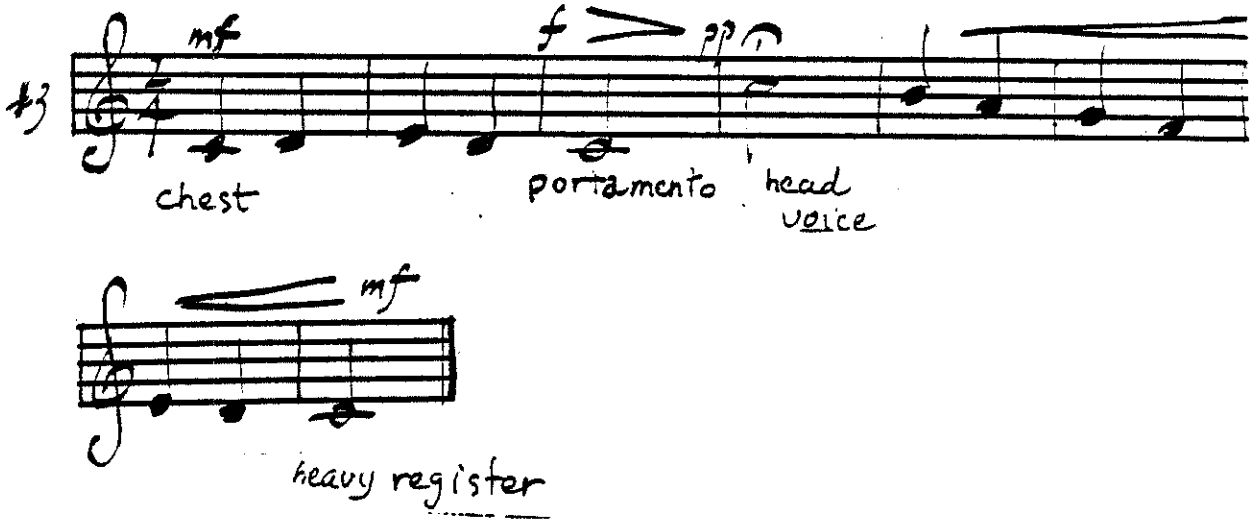
Table XI

Vocalises (a)

Henderson

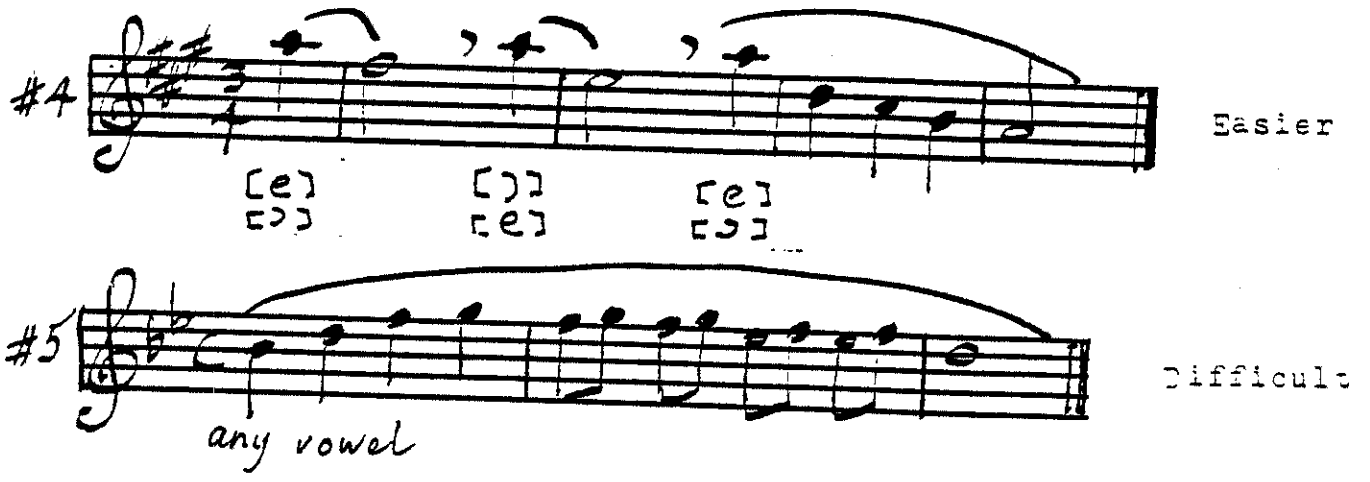


Vennard

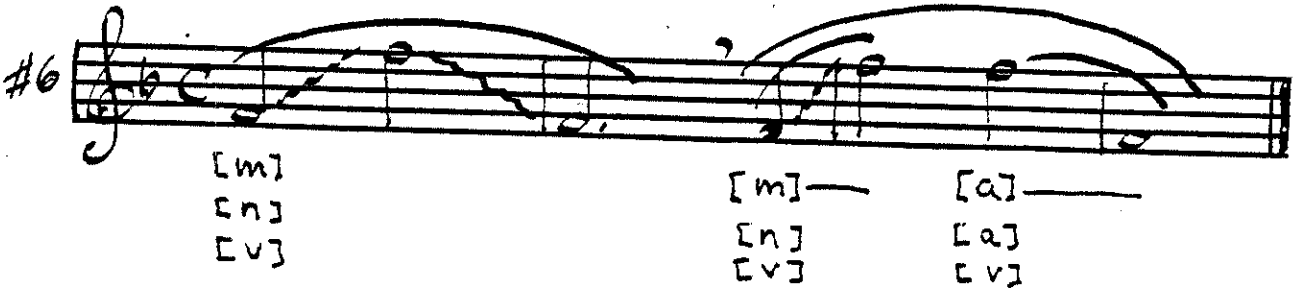


Vocalises (b)

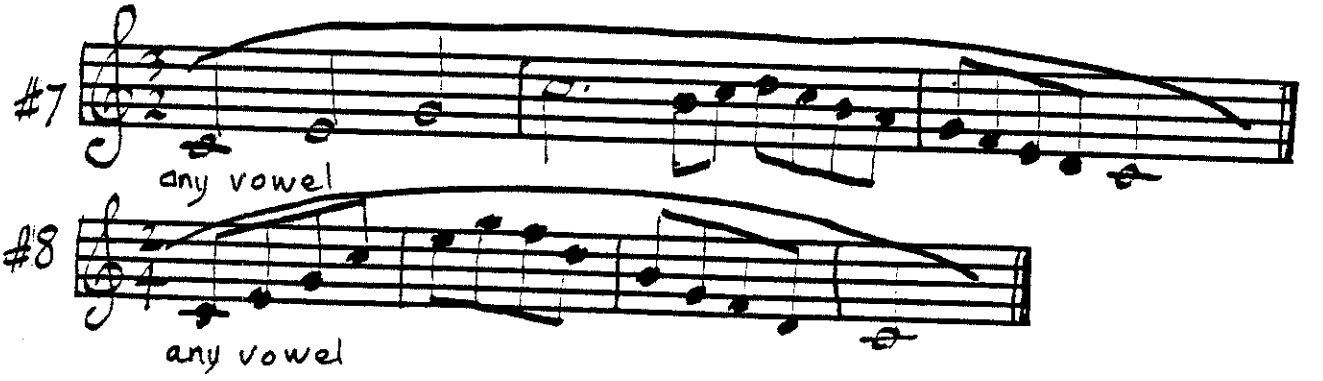
Miller



Alternate with a glissando exercise



Wormhoudt



previous exercise, #8, intensifies the quick coordinations required.

A strenuous exercise for the advanced singer, #9, requires a quick adjustment of registration from heavy to light as the voice negotiates the octave skips.[52] In fact, the lower notes need as much light mechanism as possible but with full support. The jaw should be loose and will drop comfortably for the pitches in the high register.

c. Exercises to build strength and dynamic variety in the upper range

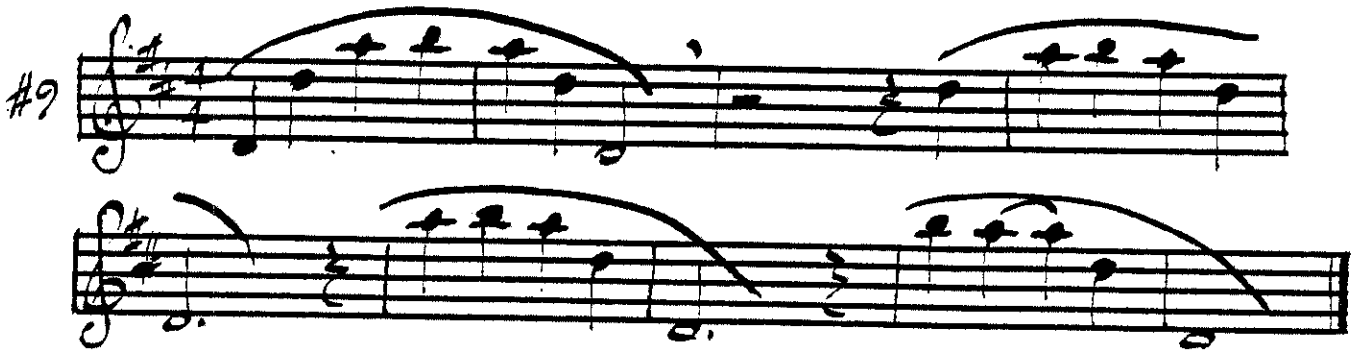
Henderson advocates a nasal consonant leading into a sequence of vowels on arpeggiated figures so that a focused head voice from the lowest pitch onwards will be achieved.[53] The jaw should not drop too soon or the singer will lose the spring into the top notes (ex. #10). Another exercise from Henderson, #11, uses the messa di voce on the top climatic note to add fullness and depth to the upper register.[54] This vocalise requires proper breath management and development of registers as the crescendo adds heavy mechanism to the upper voice which is replaced gradually by light mechanism in the decrescendo.

d. Exercises to acquire agility

Mathilda Marchesi's classical vocalises and exercises allow the singer an opportunity to sing melodies in a relatively safe vocal range as she learns to manipulate

Vocalises (c)

Miller



Henderson

Henderson

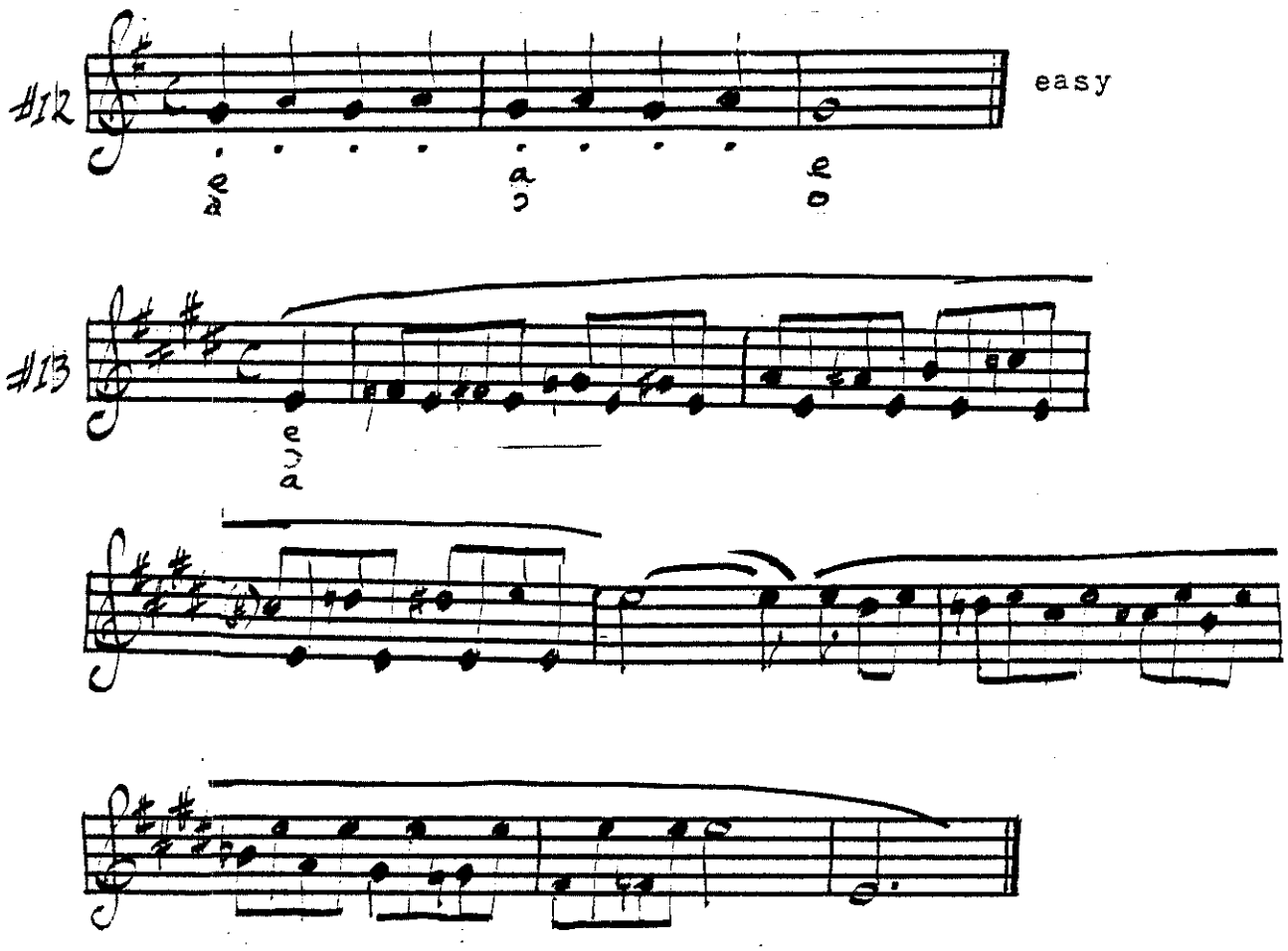
her technique. Henderson believes these vocalises will help the singer "to acquire the natural agility and a basic strength that are necessary for coloring and ornamenting" the vocal line.[55] After Henderson's seven basic exercises are mastered the Marchesi op. 1, Ex. 8-18 are introduced.[56] Those singers whose technique is more advanced continue with Exercises 19-14.[57]

Richard Miller uses staccato exercises to build agility into the voice, but soon adds more complex patterns of legato and staccato to the student's repertoire of vocal gymnastics. A chromatic vocalise (#13) has been included to emphasize the delicacy and skillful coordination of musculature which is needed to successfully negotiate agility patterns.[58]

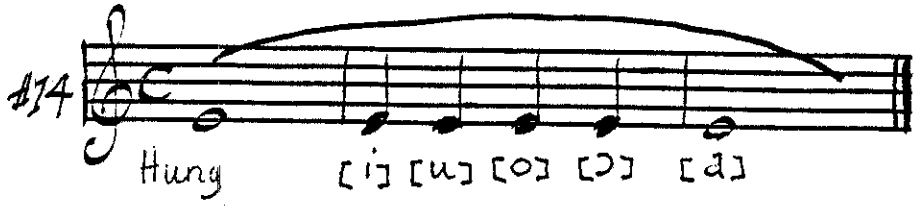
Fillebrown's resonance exercise rounds off this collection of exercises and adds a sense of completeness.[59] This exercise or some variation of it seems to be a part of most teachers' or performers' repertoire of vocalises. Fillebrown used it to allow singers to discover the "masque" resonance or to feel the "forward" placement of the voice. Its ease and uncomplicated nature make it ideal for those singers who begin with gentle exercises and, after the voice is warmed-up, exercise the voice more strenuously.

Vocalises (d)

Miller



Fillebrown



End Notes (5)

1. D. A. Clippinger, The Head Voice and Other Problems (Boston: Oliver Ditson, 1917), p. 3.

2. Cornelius Reid, "Science and Vocal Pedagogy," Journal of Research in Singing 7/2 (June, 1984), pp. 21-33.

3. Berton Coffin, Overtones of Bel Canto (Metuchen, N.J.: The Scarecrow Press, 1980), p. 12.

4. Wormhoudt, op. cit, p. 43.

5. Gordon Troup, "The Physics of the Singing Voice," Physics Reports 74/3 (1981), pp. 379-401. Reprinted in Journal of Research in Singing 6/1 (Dec. 1982), pp. 1-26.

6. Lisa Roma, The Science and Art of Singing (New York: G. Schirmer, 1956), p. 70.

7. Spread tone is a vocalized sound with reinforced inharmonic partials. Reid says it is caused by an imbalanced chest registration coupled with a set "smiling" mouth position and over-singing to achieve "brightness" or "ring" in the sound.
Cornelius Reid, A Dictionary of Vocal Terminology (New York: Joseph Patelson, 1983), p. 350.

8. Cover is a term used to denote ajustments in the larynx during the singing of high pitches according to Fields. Reid adds it is a resonance adjustment by "darkening" tone qualities commonly heard as "too open." It is also used for soto voce effects, or for interpretive reasons.
Victor Alexander Fields, The Singer's Glossary (Boston: Boston Music Co., 1952), p. 17.
Reid, op. cit., p. 77.

9. Wormhoudt, op. cit., p. 68.

10. William Vennard, Singing, the Mechanism and the Technic (New York: C. Fischer, 1967), p. 80.

11. Carol Schoenhard and Harry Hollien, "A Perceptual Study of Registation in Female Singers," The NATS Bulletin 39/1 (Sept./Oct. 1982), p. 22.

12. William Vennard, Developing Voices (New York: C. Fischer, 1972), p. 7.

13. Richard Miller, The Structure of Singing (New York: Schirmer Books, 1986), p. 164.

14. Vennard, op. cit., p. 7.

15. Miller, op. cit., p. 209.

16. "Therapists, like Emil Froeschels, find that speech disorders can be cured by getting back to the primary function, chewing." Quotation from Vennard, p. 8.

17. Vennard, op. cit., p. 6.

18. Laara Browning Henderson, How-to Train Singers. (West Nyack, N.Y.: Parker Pub., 1979).

19. Mathilda Marchesi, Bel Canto: A Theoretical and Practial Vocal Method (New York: Dover Pub., 1970). Republication of Enoch & Sons ed. p. xv.

20. Mary Ella Collins, "Goal Identification and Systematic Instruction in Private Voice Lessons," Journal of Research in Singing, 7/1, (Dec. 1983). pp. 56-66.

21. "Moment of Readiness" is part of the Progressive Method of teaching pioneered by John Dewey. Essentially the student teachers himself through a series of guided steps owards a goal initiated by the student.

22. Vennard, op. cit., p. 1.

23. D. A. Clippinger, The Clippinger Class-Method of Voice Culture (Philadelphia: Oliver Ditson, 1933), p. 42.

24. Vennard, op. cit., p. 1.

25. Ibid., p. 1.

26. Ibid., p. 8.

27. Miller, Structure, op. cit., p. 213.

28. Vennard, Singing, the Mechanism and the Technic, op. cit., p. 212.

29. Marchesi, op. cit., p. xv.

30. Vennard, op. cit., p. 191.

31. Wormhoudt, op. cit., p. 72.

32. D. A. Clippinger, The Head Voice and Other Problems (Boston: Oliver Ditson Co., 1917), p. 7.

33. Sister Louis Marie Heizler, O. P., Basic Techniques for Voice Production (New York: Exposition Press, 1973), p. 44.

34. Marchesi, op. cit., p. xv.

35. Wormhoudt, op. cit., p. 64.
Covering means to change from an open production in the middle of the voice to one more closed or covered as the passaggio is approached. The vowel used is shaded toward the umlaut, for example if /i/ is too bright, add some /u/ to the sound.

36. Ibid., p. 68.
By "turning" Wormhoudt means a term used by Nellie Melba to describe the sensation of changing from the middle register to the head.

37. Appelman, op. cit., p. 94.

38. Estelle Liebling, The Estelle Liebling Vocal Course for Coloratura Soprano, Lyric Soprano, and Dramatic Soprano (New York: Chappell Music, 1956), p. 44.

39. Miller, National Styles, op. cit., p. 134.

40. Leyerle, op. cit., p. 70.

41. Henderson, op. cit., p.165.

42. Wormhoudt, op. cit., p. 82.

43. The use of songs and arias for development of the high voice will not be explored; it could be the subject of another paper. There is, however, a description of exercises and vocalises as they have been used by reputable teachers. This is a shorter and more manageable topic, capable of being used in a systematic fashion.

44. Liebling, op. cit., p. 16

45. Vennard, op. cit., p. 122.

46. Wormhoudt, op. cit., p. 81.

47. Henderson, op. cit., p. 79.

48. Vennard, op. cit., p. 155

49. Miller, op. cit., p. 144.

50. Henderson, op. cit. p. 96.

51. Wormhoudt, op. cit., p. 139.

52. Miller, op. cit., p. 168.

53. Henderson, op. cit., p. 113.

54. Ibid., p. 113.

55. Ibid., p. 114.

56. Mathilda Marchesi, Vocalises, Op. 1, No. 1 (New York: Schirmer, 1928), numbers 8-18.
_____, Bel Canto: A Theoretical and Practical Vocal Method (New York: Dover, 1970), p. 7, no. 13-15; p. 8, no. 16, 17, 18; p. 9, no. 21; p. 11, no. 38, 39. These are identical exercises. Some are included in the Appendix.

57. Ibid., Schirmer ed., No. 19-24. Dover ed., p. 13, no. 42, 43; p. 14, no. 44, 45; p. 15, no. 46, 47. Some are included in the Appendix.

58. Miller, op. cit., pp. 42 and 44.

59. Thomas Fillebrown, Resonance in Singing and Speaking (Bryn Mawr, Penn.: Oliver Ditson, 1911), p.60.

CHAPTER V

MAINTAINING THE HEAD VOICE

Advice from Famous Singers

"You must lead a regimented life," Rise Stevens told Jerome Hines in an interview about the art of singing.[1] Hines had been questioning many famous singers for a book on great singing. This regularity of routine was mentioned by many of the singers he interviewed. The routine includes daily exercising of the voice, a sensible diet, and includes some kind of working of the whole body, often brisk walking.

Hines found that most singers vocalize about thirty minutes every day. Shirley Verrett[2] and Rosa Ponselle[3] begin with short scale passages and arpeggios, trying out the voice softly and carefully. When the voice warms up, then they add sustained exercises; Verrett particularly likes the Great Scale of Lilli Lehmann.[4] The major scale is sung very slowly with a messa di voce on each pitch. Some singers, such as Cristina Deutekom[5] and Fiorenza Cossotto[6], do just the opposite, slow sustained exercises are followed by ones for agility. Rita Shane[7] and Marilyn Horne[8] do glissandi to awaken the voice. Shane's are short, sharp ones high in the voice while Horne uses Vennard's yawn-sigh throughout the

compass of her voice.

A wholesome diet is important to a sensible lifestyle and was stressed by Roberta Peters[9] and Patrice Munsel.[10] In addition Martina Arroyo[11] believed in avoiding alcohol. Renata Scotto believes audiences want a singer to "look good.[12]

The routine of an opera singer should include healthy exercise, too. Shane, Peters and Munsel are very careful to include it as part of the daily practise schedule. Munsel even exercises strenuously at the ballet bar on the day of a performance. She alleges it warms the voice as well as the body.

Mental attitudes are just as important as the physical workings of the body. The joy found in the singing profession is reflected in the sound as Jerome Hines observed in the performances of Beverly Sills[13] and Regine Crespin.[14] Elly Ameling needs the refreshment that a serene life and surroundings of beauty will give to her performances.[15] Hines also found the tranquil personality of Gail Robinson[16] was reflected in the ethereal quality of her voice. Being truthful to the voice and the inner person seems to give longevity to a career.

Keeping to the proper voice category or "fach"[17] is part of the reality of the voice. Magda Olivero[18] and Anna Moffo[19] both stress that the voice must be allowed to find

its own quality and the roles must suit the size of the instrument. Sometimes a change in voice category is necessary as the instrument changes with age. Helga Dernesch moved from soprano to mezzo-soprano roles when she was about forty.[20] Her singing of Wagner roles has since given her career even more acclaim. Regina Resnick adds "the voice is not something you can make grow at will."[21] Maturity of voice will vary with the individual whether this growth is physical, technical or built on stage experience.

Perhaps the strict life style of an opera singer made two women, Rise Stevens and Beverly Sills, retire at fifty. Sills said it was not early as she had been singing since she was seven, "so for me it's forever."[22]

Successful singers lead a regulated life which includes daily vocalizing, regular exercise of the whole body, and a sensible diet. Singers are aware of their own voice so that opera roles are chosen carefuly to suit the character and size of the voice (fach) and the truth of the personality.

Advice from Teachers

Those with the most experience in maintaining the voice, especially the head register, are teachers. For this reason five representative teachers were chosen to discover their ideas of keeping a voice healthy.

Edward Baird, professor of singing at the University of North Texas, recently gave a series of voice refresher sessions to a young soprano opera singer. His observations will be incorporated into this report. Noelle Barker, a singing teacher from England, has taught young professional singers from Great Britain and North America. Her views on maintaining full vocal prowess during a performing career were obtained during an interview in Banff, Alberta. Advice on voice maintenance from Laurel Miller, professor of singing at the University of North Texas, is valuable because though over fifty, she is still performing. Pearl Wormhoudt, a singing teacher, writes about the voice from a scientific point of view. She was asked to expand some of her ideas about maintaining the voice. Richard Miller, recent editor of The NATS Journal, was interviewed in Calgary, Alberta, during a vocal workshop. His ideas on conserving the singing voice are also part of this review of voice maintenance.

These five teachers represent an international style of teaching though influenced by English and American traditions. All have varying amounts of performing experience. In addition, each has extensive experience as a singing teacher.

Working on the acoustic factors of the voice will preserve the ease and flexibility of the voice. Changing

vowels on a descending scale is one exercise Pearl Wormhoudt uses from the many recommended by Berton Coffin in Overtones of Bel Canto. She also monitors posture, relaxation, and the general factors of health, exercise, diet, and rest to keep the physical instrument in optimum condition.[23]

Noelle Barker believes the teacher must help the student discover the "real sound the singer was meant to make from birth."[24] Self-criticism; a good warm-up, physical and vocal, spoken and sung; appropriate exercises for the voice; and on-going study of repertoire give confidence, joy, and longevity to a singing career.[25]

Maintaining a soprano voice was a task presented to Edward Baird during the summer of 1987.[26] A former student, now a professional opera singer in Germany, wished to have some refresher lessons as a way of maintaining her voice, especially her upper register.

The procedure followed was:

a. The first one hour session was devoted to vocalizing using familiar exercises as the teacher monitored and evaluated the voice.

b. As deficiencies were observed, breathiness in the sound in the middle range and a lessening of breath support on the high notes, the exercises were repeated with instructions to the singer. These problems were soon

remedied as the subject was an experienced and able singer.

c. The upper range was adjusted through vowel modification and coordination of breath support.

d. Adding more focus to the vowels was part of the remedial process. The bright vowels were preceded by /n/ and the dark vowels were preceded by /ŋ/.

Altogether the soprano had four sessions devoted to renewing the technique and maintaining the voice. Baird, in addition to relating this specific work with one singer, made some general comments on maintaining the voice. There must be a regular routine of vocalizing. Although the voice suffers fatigue from time to time, from long rehearsals or strenuous and lengthy opera seasons, the vocal mechanism should require only short periods of rest for complete recovery if the singing technique is secure. Know your voice, its strengths and weaknesses. The amount of rest that is needed in general and after strenuous vocal work should be kept in mind by the singer as well as the amount of singing before fatigue sets in. Its recovery time must also be considered. Knowing one's voice includes its normal functioning and the kinds of roles suited to it (its fach). Maintaining the body is a part of keeping the voice healthy. Healthful diet and brisk exercise should be a regular part of life. Procedures before a performance need careful consideration. Every singer has her successful

routine. Even starting a career needs much thought, not so much about the quality of the voice, but the fragility or robustness of the body,(including the stability of allergies), and its ability to handle stress.

A performer who teaches many students as does Laurel Miller, faces a different set of problems from an opera singer whose sole responsibility is to sing.[27] Daily vocalizing needs explicit goals. Therefore it is necessary to program recitals throughout the year. Some portions of the voice may need more attention than others, the secondo passaggio being one. The repertoire chosen by Miller will use that part of the voice so it will not be neglected. The middle of the voice must be kept healthy or the upper register may be unreliable. The use of hormones may be advisable for the post menopausal singer so that the membranes of the vocal cords will be moist and flexible. Being aware of the total extent of the voice is part of the monitoring of the healthy vocal mechanism. A pianissimo is a good test of the well-being of the instrument.

Specific exercises to maintain the voice by Miller include soft lip trills, done without tension, going up into the head register. Various kinds of humming exercises, sometimes with a slight staccato, take away tension. Light rolled /r/ and alternation of front and back consonants are a way to loosen the tongue. The full extent of the speaking

voice should be used. Miller has noticed that one register, usually the chest, is persistently overused.

Richard Miller stipulates that daily vocalizing, abstaining from alcohol, not smoking, and avoidance of noisy rooms will help maintain a healthy singing voice.[28] He advocates learning to "mark" during a rehearsal if the voice is fatigued or if there is a performance later in the day. Preventative medicine takes into account a proper diet, active exercise, and most of all, peace of mind.

It is salutary to note that advice from teachers of the present seems to echo advice from the past. Duey noted that seventeenth and eighteenth century singing manuals refer to "proper diet, regular sleep, and good physical care of the body" as having a beneficial effect on the voice.[29] Forcing the tone was universally regarded as harmful. Vocal strain was to be avoided especially by boys whose voices were changing and by girls during puberty.[30] Johann Adam Hiller noted that high voices are more easily harmed than low voices so more care and attention must be given these kinds of singers.[31]

As can be seen from these remarks from teachers, a daily regime which includes exercising the voice and the body, attention to diet and rest are very important. Knowing the voice and monitoring it is also significant. Attentions to these elements of a healthy voice and body

should lead to a long and productive career.

Advice from Medical Experts

The voice is an instrument which cannot be removed for repairs, for rest, or for improvement. The singer carries it with her always. Keeping the voice healthy is also part of keeping the whole body healthy. To have a stable and long lasting career, a singer should practise preventative medicine. It is better to forestall a cold, or other illness, than to take mitigating measures after its onset.

Advice on averting sickness was sought from four otolaryngologists in Canada and the United States. The published reports from The Annual Symposium on Care of the Professional Voice sponsored by The Voice Foundation,[32] the series of articles "Laryngoscope" in The NATS Journal,[33] and Friedrich Brodnitz' classic text Keep Your Voice Healthy[34] were all consulted for the best advice on keeping a healthy voice in a healthy body. Recommendations and advice from these experts has been summarized and quotations from some of the writers is included in the following paragraphs.

Van Lawrence tells singers to drink plenty of fluids. Drinking fluids prevents many vocal problems and alleviates others by keeping the mucous membranes of the

larynx coated with a watery, slick, and thin liquid. Phlegm, coughing, post-nasal drip, or the sensation of an obstruction in the throat causing a cough, are all mainly due to dehydration.

Lawrence also recommends not smoking tobacco. It irritates and burns the tissues of the larynx, reduces the capacity of the lungs, and induces a non-productive cough. It is also addictive.

Smoking marijuana does greater damage to the vocal tract because it burns at an even hotter temperature than tobacco. In addition it interferes with the delicate balances of the singing musculature, as well as with auditory feedback, and promotes insensitivity to vocal sensations.

Drinking alcohol causes the same kind of interference with the delicate action of the vocal mechanism as does the smoking of marijuana. It dehydrates the mucous membranes of the larynx and can be addictive, leading to a shortened career.

Robert Feder cautions singers about the dry, rather cold atmosphere of jet planes.[35] The high noise level and the variable ozone levels can cause headaches and nose and throat irritation. His advice includes avoiding unnecessary conversation, drinking fluids continuously (not cold but at least above room temperature), sitting in the non-smoking

section, and keeping the body warm and comfortable. Feder says the singer should eat lightly, avoid alcohol, and walk up and down the aisle occasionally on long flights to decrease the jet lag effect. The singer with an upper respiratory infection should consult a physician before flying. It takes about twenty-four hours of rest, according to Feder, before the singer returns to her normal physical condition after a long flight.

Singers, in particular the high sopranos, should consider the side effects of aspirin and birth control pills. Aspirin can bind the calcium ion in the circulatory system and promote capilliary fragility, which can lead to hemorrhages of the vocal cords. Sopranos (and tenors) who must use high levels of breath pressure to sustain high pitches should use caution in taking aspirin.

Birth control pills of small dosage and predominately estrogen type have little or no effect on the singer's larynx. However, the progestine-dominant pill has a masculine or virilizing effect on the female larynx; the voice lowers and the top notes are lost. Chemotherapy for breast and female genital tract malignancy has the same virilizing effect.

The side effects of all drugs ingested by singers should be discussed with the physician. Many, such as the antihistamines, tend to dry secretions of the body. In

general singers should avoid dehydration. If taken before a performance, a drug containing a sedative leads to lackluster singing, another reason the singer needs to know the side effects of drugs.

Robert Bastian[36] says hoarseness can be a sign of tired muscles caused, perhaps, by a long rehearsal. A short rest should restore the voice. Hoarseness can also be a sign of a cold or an allergy for which Bastian recommends care in singing and drinking plenty of liquids. Hoarseness is also a symptom of nodules and other abrasions of the vocal cords. Recovery of the voice depends on removing all irritating influences including smoking, excessive consumption of alcohol, and especially abusive vocal behavior in speech and singing. Lawrence adds that a refresher course in singing may also be valuable. Hoarseness in the morning may be due to acid reflux laryngitis. If suffering from this condition both Bastian and Lawrence recommend that obesity should be avoided; do not eat before going to bed and avoid coffee and alcohol. They also suggest elevating the head of the bed to prevent hoarseness.

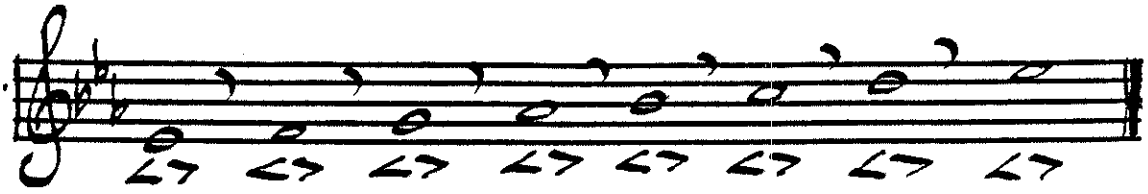
Choosing a physician sensitve to the special needs of singers is very important. Allan Keaton would have a singer ask other singers or teachers of singing for recommended doctors, and investigate specialists in otolaryngology and head and neck surgery (formerly known as

ear, nose and throat specialists).[37] It is also essential that the singer provide the doctor with a complete medical history. The singer should discuss recommendations and ask questions, and should not hesitate to ask for a second opinion if unsure of the advice given. Surgery, especially of the vocal tract, should be treated with extreme caution Non-surgical methods should be tried first.

Perhaps the best advice for singers and their medical advisors to heed is the ancient medical dictum "primim non nocere"--the first thing is not to do harm.

End Notes (5)

1. Jerome Hines, Great Singers on Great Singing (Garden City, N.Y.: Doubleday, 1982), p. 314.
2. Ibid., p. 343 (Verrett).
3. Ibid., p. 256 (Ponselle).
4. Lilli Lehmann's Great Scale.



5. Hines, op. cit., p. 97 (Deutekom).
6. Ibid., p. 72 (Cossotto).
7. Ibid., p. 230 (Shane).
8. Ibid., p. 141 (Horne).
9. Ibid., p. 233 (Peters).
10. Ibid., p. 192 (Munsel).
11. Ibid., p. 31 (Arroya)
12. George Heymont, "Renato Scotto," Fugue (April 1980), p. 39.
13. Hines, op. cit., p.305 (Sills).
14. Ibid., p. 78 (Crespin).
15. Ulla Colgrass, "Ameling--Voice of the Art Song," Music Magazine, (May/June, 1981), p. 9.
16. Hines, op. cit., p 283 (Robinson).
17. Fach is a German System of classifying voices according to the roles suitable for a particular voice type.
18. Hines, op. cit., p 205 (Olivero).

19. Ibid., p. 188 (Moffo).

20. Stephanie von Buchau, "Lucky Lady" Opera News (June 1985), p. 20.

21. Robert Jacobsen, "Regina Reflects," Opera News (Dec. 8, 1984), p. 59.

22. Hines, op. cit., p. 305 (Sills).

23. Pearl Shinn Wormhoudt, letter to Roberta Stephen dated June 4, 1984.
_____, Building the voice as an instrument. op. cit.

24. Noelle, Barker, O.B.E., a Scottish soprano, is Head of Vocal Studies at the Guildhall School of Music and Drama, London, England. During the 1985 Spring term she was Voice Instructor for the Music Theatre Studio Ensemble at the Banff Center School of Fine Arts, Banff, Alberta, Canada. During an interview for the Ensemble Diary, her ideas on prolonging a career were discussed.

25. Noelle Barker, interview in Ensemble Diary, The Banff Centre Music Theatre Studio Ensemble, 7 (May, 1985).

26. Edward Baird, Professor of Music at University of North Texas, teacher of singing, Director of Graduate Studies in the School of Music, and is immediate Past President of NATS. He is an active performer in opera (65 roles) and soloist with orchestras throughout the United States. His students sing with the Metropolitan Opera, New York City Opera, with opera companies in Germany, England, Austria, and elsewhere.

27. Laurel Miller, Associate Professor of Music at University of North Texas, teacher of singing and Italian diction. She holds the B.S. and M.S. degrees from the Julliard School of Music. She has been active as a performer in opera and concert in New York City, and throughout the United States and Italy.

28. Richard Miller, Structure, op. cit., pp. 218-239.
_____, interview in Calgary, 1986.

29. Philip A. Duey, Bel-Canto in Its Golden Age (New York: King's Crown Press, 1951), p. 139.

30. Ibid., p. 142.

31. Ibid., p. 144.

32. Transcripts of the Proceedings: Care of the Professional Voice, (New York: The Voice Foundation), ed. Van Lawrence.
7th edition, 1978
8th edition, 1979
9th edition, 1980
10th edition, 1981
were consulted and some information incorporated into the section on advice from medical experts.

33. Van L. Lawrence, "Larynogoscope," The NATS Bulletin. Much of Lawrence's advice was duplicated and suggestions were combined from two or more articles so that it was diffficult to attribute specific essays. All relevant articles are listed in chronological order.
a. 37/3, (Jan/Feb. 1981),"Handy Household Hints: To Sing or Not To Sing," p. 23.
b. 37/4, (Mar./Apr. 1981), "Upper Respiratory Infections," p. 41.
c. 37/5, (May/June, 1981), "Vitamin C," p. 24.
d. 38/1, (Sept.Oct. 1981), "What about Cortisone?", p. 28.
e. 38/2 (Nov./Dec. 1981) "Nodules and Other Things that Go Bump in the Night," p. 27.
f. 38/3, (Jan./Feb. 1982), "Cigareets and Whiskey and Wild, Wild Women," p.27.
g. 38/4, (Mar./Apr. 1982), "Singers and Surgery" (Part I: Surgery in General), p. 22.
h. 38/5, (May/June 1982), "Singers and Surgery" (Part II: Vocal Tract Surgery), p. 20.
i. 39/1, (Sept./Oct. 1982), "Post-nasal Drip," p. 27.
j. 39/2, (Nov./Dec. 1982), "Glue in the Gizzard: Phlegm", p. 24.
k. 39/3, (Jan./Feb. 1983), "When all else fails, read the directions," p. 16.

34. Friedrich S. Brodnitz, Keep Your Voice Healthy (New York: Harper and Brothers 1953).

35. Robert Feder, "Singing and Flying," The NATS Bulletin, 41/1, (Sept./Oct. 1985), p. 26.

36. Robert W. Bastian, "Hoarseness in Singers," The NATS Bulletin, 40/3, (Jan./Feb. 1984), p. 26.

37. Allan Keaton, "A Singer's Guide to Medical Care," The NATS Bulletin, 40/1, (Sept/Oct. 1983), p. 24.

CHAPTER VI

TWENTIETH-CENTURY EXTENDED VOCAL TECHNIQUES

This paper has been concerned with the training of singers for the usual repertoire of the old Italian school, nineteenth century Lied, French art song, and other kinds of more conventional music. The song literature of the twentieth century is also a part of the responsibility of the singer. Sharon Mabry has written a series of articles which deal with avant garde vocal music.[1] For many years Dorothy Dorow gave a course in the Netherlands devoted to contemporary repertoire.[2] The recommendations of these singers have been incorporated into the body of this report.

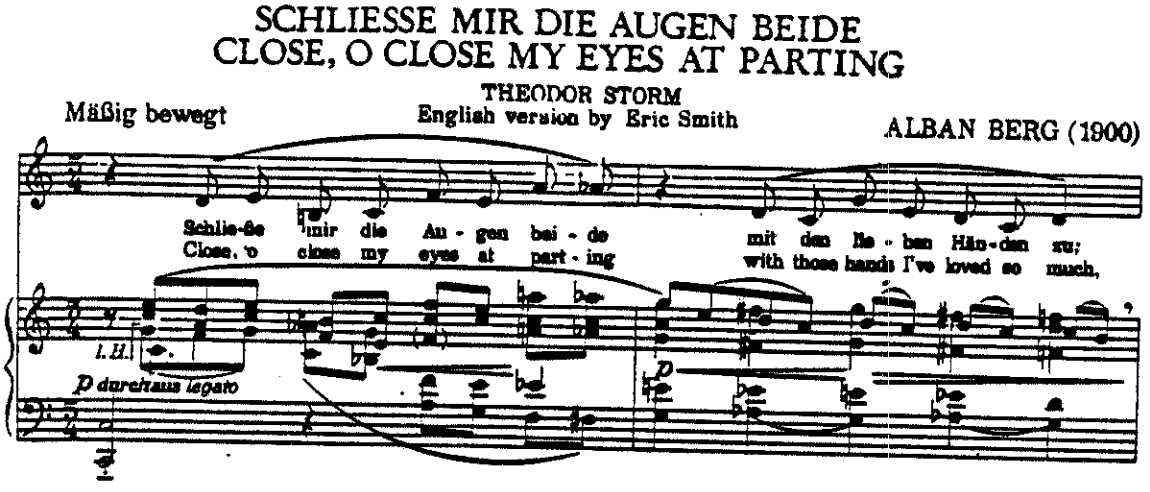
Composers in the later half of the twentieth century tend to be influenced by composers such as Igor Stravinsky, Bela Bartok, and Arnold Schoenberg, and his disciples Alban Berg and Anton Webern. Composers such as Stravinsky who use traditional notation, formal structures, clarity of expression and complex rhythms pose few vocal problems for singers with a reliable technique. However, greater demands are made by composers who use the twelve-tone system developed by Schoenberg. This music often has a dense texture, can be extremely chromatic, and is usually strictly

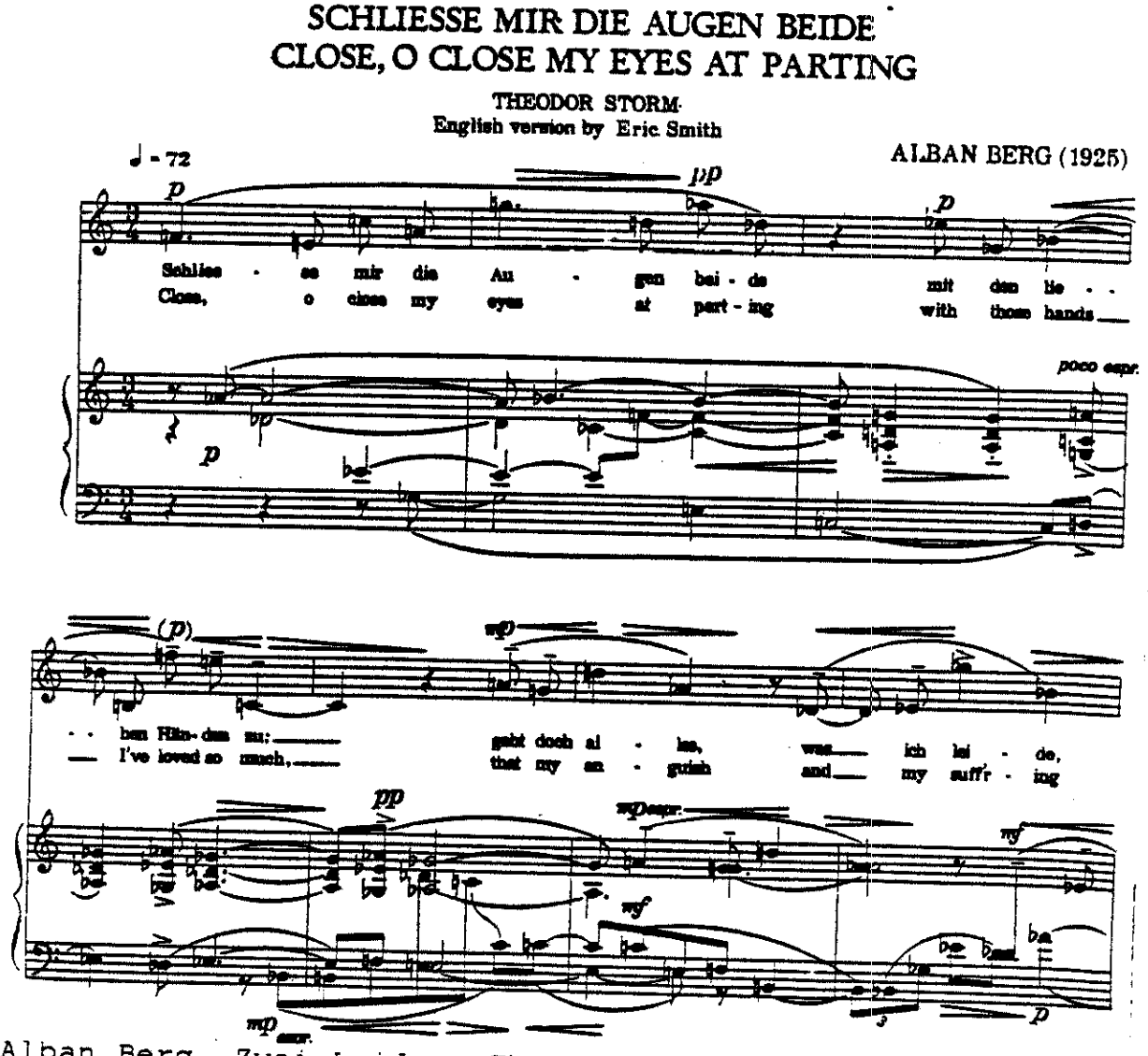
controlled in all aspects, pitch, meter, accent, and expression.

The evolution of the twelve-tone system of composition, commonly known as serialism, can be seen by comparing Alban Berg's two settings of the Theodor Storm poem "Schliesse mir die Augen beide," one in 1900, the other 1925.[32] The first setting of the Storm poem resulted in a conventional but attractive song. The vocal line has modest leaps of fourths and fifths with some chromaticisms adding color to the melody and its accompaniment. The second setting uses a tone row quite strictly both in the singer's line and in the piano part. In addition, the intervals of the vocal line are wider, ranging from sixths and sevenths, to twelfths, more dynamic markings are indicated in the score which expand the implied rubato and expressive qualities of the first setting. The two performers, singer and pianist, consequently have quite independent lines as can be seen in Illustration XII which contains the first few measures of these two songs.

Istvan Anhalt, a Canadian composer and professor at Queen's University in Kington, Ontario, investigated Post-Webern vocal compositions.[4] He found a radical enlargement of the scope of music and a greater use of improvisation. In some ways the performer almost becomes the composer. Some composers have a greater sensitivity to the human voice, its

XII Alban Berg, Two Storm Lieder





Alban Berg, Zwei Leider, Theodor Storm, (Vienna: Universal, 1960, c. 1955).

unique use of vowels and consonants, and the more indirect control of its production compared to instrumental performance. This understanding of the human singing voice may be due to an intimate connection with a singer. Luciano Berio's association with soprano Cathy Berberian, and R. Murray Schafer's with mezzo-soprano Phyllis Mailing are examples of this collaboration.

Many composers continue to use conventional notation though in the latter half of the twentieth century other composers have invented different ways to show their musical intentions. Schoenberg was the creator of a transitional mode between speaking and singing called sprechstimme or sprechgesang subsequently used by many other composers. Kurt Stone makes a distinction between sprechstimme meaning closer to speech and written on the staff with stems but without noteheads, and sprechgesang, meaning closer to singing, using "x" either on the stem of a regularly notated pitch, or in place of the notehead,  or .[5] Both forms are mixtures of speech and singing. Dorothy Dorow advocates learning the actual pitches of sprechgesang or sprechstimme and then changing to a speech-like quality by letting the voice move in the direction of the next pitch. The singer should avoid a lengthened vowel sound as practised in bel canto style[6]

Spatial notation shows duration and approximate

pitch by placement within marked sections, often timed in seconds. This notation can be seen in Betsy Jolas' Caprice.[7] An arpeggiated phrase sung staccato is shown in figure 1 of Illustration XIII. An unmeasured phrase or motive is pictured in figure 2 from the same solo work. This notation is frequently alternated with conventional or more graphic notation within the same selection.

Graphic notation is the more common way of writing sounds encountered in contemporary music. Some pitches and rhythms can be shown on a three-line staff showing high, middle, and low registers of the voice. Some composers use depictions of natural sounds such as the falling water found in Miniwanka[8] by R. Murray Schafer or from comic strips as in Stripsody[9] by Cathy Berberian.

Instead of using poetry, some composers break up words into phonemes, often written in IPA symbols, although other composers use graphic signs for the desired sounds. Meaningless speech is used for artistic purposes and to suggest hysteria. Composers will sometimes disintegrate and transform speech with an emphasis on articulation and freeing it from associative words. Unconventional sound production, such as chest cavity tones, and onomatopoetic utterances are also used by composers.

Seventy-five examples of sounds encountered in scores or invented by the performers were codified by the

XIII Betsy Jolas, Caprice

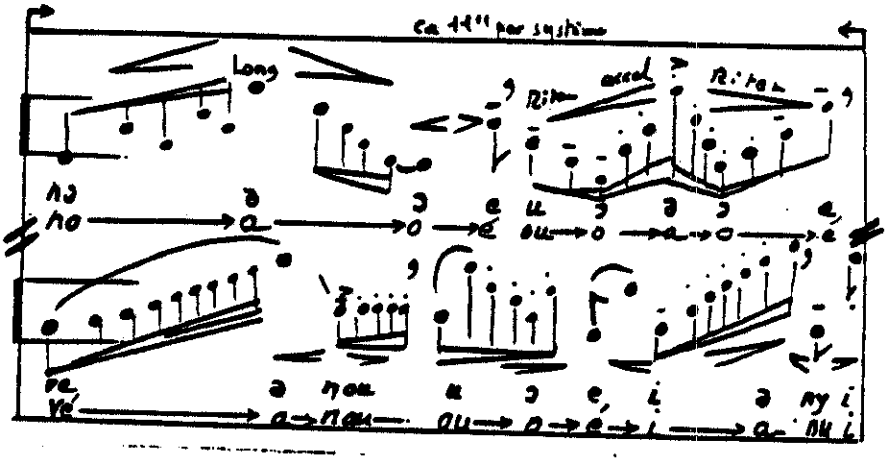


fig. 1

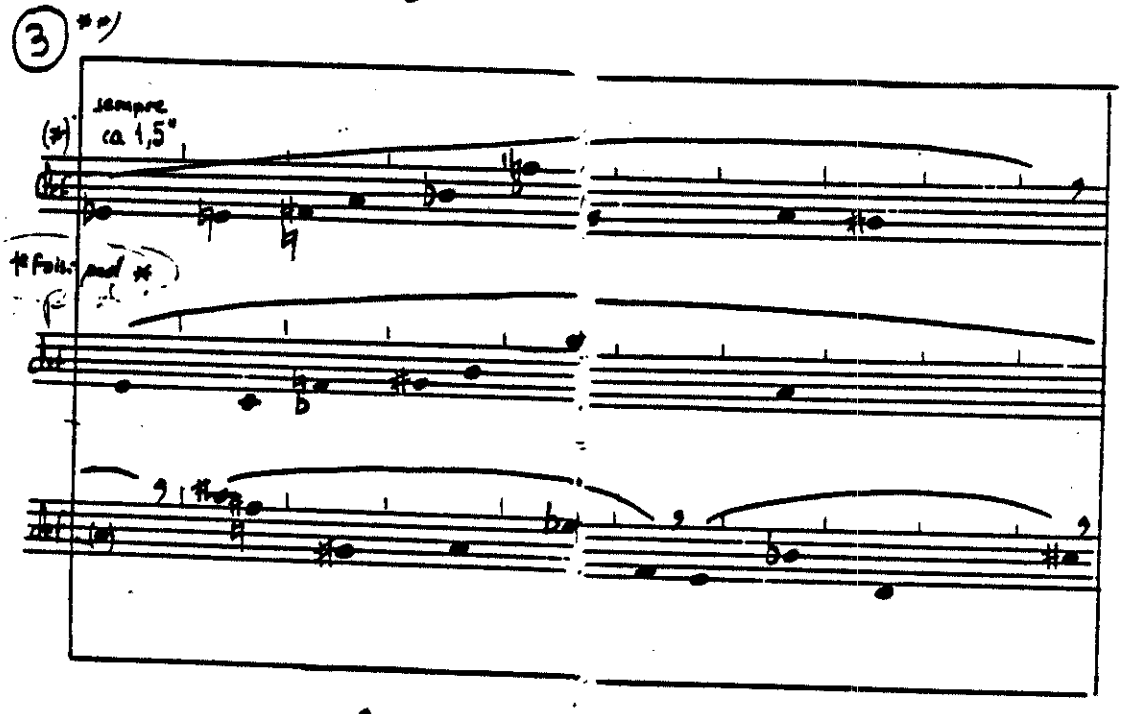


fig. 2

Betsy Jolas, Caprice (Paris: Heugel, 1975).

Extended Vocal Techniques Ensemble at the Center for Music Experiment and Related Research in San Diego.[10] These phonemes were divided into monophonic (reinforced harmonics or flutters), multiphonic sounds (Tebetan chant or cross register ululations), and miscellaneous sounds such as buzzes, squeaks, and water clicks. This catalogue of sounds is found in Table XIV.

Singing disjointed, angular lines is not the only difficulty to be faced by performers of extended vocal techniques. Actual vocal damage can be the result of singing some sounds imposed upon performers. A study of these sounds related to vocal health was undertaken by John Large and Thomas Murry.[11] Vocal teachers at the 1975 National Association of Teachers of Singing convention in Philadelphia were asked to rank seventy-five sounds from dangerous to safe. The most dangerous sounds were perceived to be forced blown multiphonics. The safest sounds were judged to be monophonic, interrupted sounds like flutters, tongue clicks, or water drops. The complete results are included in Table XIV.

A prerequisite for singing most contemporary vocal music, according to both Dorothy Dorow and Sharon Mabry, is a good grounding in conventional sound production with an emphasis on flexibility and range extension. An easy introduction to improvisation, unusual sounds, and

Table XIV

Lexicon of Extended

Vocal Techniques

TABLE 3

EXTENDED VOCAL TECHNIQUES LEXICON
DAMAGE RISK EVALUATION

Item	*Technique*	*MSV*	*DRN*
A1	Reinforced harmonics, non-nasalized, low, male:	29.23	46
A2	female:	21.63	59
A3	high, male:	16.15	66
A4	female:	20.89	61
A5	nasalized, low, male:	29.07	47
A6	female:	19.42	64
A7	high, male:	25.79	50
A8	female:	24.11	54
A9	Whistle stop:	63.30	27
A10	Ululation, egressive, single low & high, gliss, male:	24.50	53
A11	female:	11.29	75
A12	ingressive, male:	21.63	60
A13	female:	22.63	58
A14	Fry, egressive, unvoiced to voiced,	53.26	34
A15	ingressive	70.74	23
A16	Shake, male:	45.29	40
A17	female:	46.51	39
A18	cross-register, low:	59.84	31
A19	high:	83.90	12
A20	Harmonic oscillation:	21.09	55
A21	Flutter, voiced to unvoiced, tongue tip:	20.01	63
A22	tongue blade:	14.97	68
A23	uvular:	11.72	72
A24	lip:	16.14	67
A25	lip-tongue:	14.61	69
A26	hand cheek:	23.72	56
A27	lip finger:	11.50	73
A28	snore:	18.21	37
A29	headshaker:	32.98	45
A30	slurp:	49.10	36
A31	Treble rip:	72.51	21

_____ Lowest ranked Mean Scale Values (safest)

MSV = Mean Scale Value

DRN = Damage Risk Number

TABLE 4

EXTENDED VOCAL TECHNIQUES LEXICON
DAMAGE RISK EVALUATION

Item	*Technique*	*MSV*	*DRN*
B1	Chant, low, male: (Also: I, 37, 381)	56.15	32*
B2	female:	43.60	11
B3	high, male:	85.31	11*
B4	female:	85.31	10*
B5	Glottal overpressure, male:	61.28	29
B6	female:	83.2.	13
B7	cross-register:	93.93	3*
B8	screech, male:	77.12	18
B9	female:	86.47	8*
B10	Forced blown, egressive, simple, male:	79.19	15
B11	female:	82.69	14
B12	complex, male:	95.02	2*
B13	female:	95.86	1**
B14	ingressive, complex, male:	91.86	4*
B15	female:	88.50	6*
B16	female:	87.02	7*
B17	Cross-register ululation, egressive:	61.18	28
B18	(whistle stop):	76.84	19
B19	(whistle stop):	78.60	16
B20	(whistle stop):	66.25	26
B21	ingressive, low:	77.66	17
B22	medium:	85.76	9*
B23	high:	67.02	25
B24	Voiced whistle, straight to shake of both:	21.97	52
B25	Voiced lip buz:	60.54	30
B26	lip squeak:	40.79	43
B27	double lip squeak:	23.07	57
B28	snore:	54.06	33
B29	uvular buzz:	89.86	5*
B30	ingressive lip buzz (to unvoiced):	26.26	49

*Highest ranked Mean Scale Values (greatest damage risk)

MSV = Mean Scale Value

DRN = Damage Risk Number

TABLE 5

EXTENDED VOCAL TECHNIQUES LEXICON
DAMAGE RISK EVALUATION

Item	*Technique*	*MSV*	*DRN*
C1	Buzzes:	18.51	65
C2	Squeaks, lip:	24.93	51
C3	Clicks:	12.00	71
C4	Belches:	20.53	62
C5	Death rattle:	73.71	20
C6	Car crash:	40.37	44
C7	Buccal speech (w/finger):	43.19	42
C8	Glottal speech:	53.13	35
C9	Tongue squish:	68.36	24
C10	Tongue-teeth slap:	28.16	48
C11	Bat sound:	12.32	70
C12	Cricket sound:	71.52	22
C13	Water drops, solo to duet:	11.42	74

____ Lowest ranked Mean Scale Values (safest)

MSV = Mean Scale Value

DRN = Damage Risk Number

John Large and Thomas Murry, "Studio of Extended Vocal Techniques," The NATS Bulletin, 34/4 (May/June 1978), p. 30.

unorthodox notation is to sing Schafer's melisma from his booklet "When Words Sing."[12] He asks the performer to sing her highest and lowest sounds, a fast moving series of pitches, a smooth phrase, a laugh, making a personal vocalise while exploring the limits of her voice. The complete melisma is found in Illustration XV.

For advanced singers Sharon Mabry recommends the opening vocalise of George Crumb's Ancient Voices of Children to practise extended vocal techniques.[13] There are rapid alternations of vowels and consonants, ornaments, humming, and an extreme range of dynamics from pppp to ffff. Part of this vocalise is found in Illustration XVI.

Despite the difficulty of much of this repertoire, many singers find the performance of music by contemporary composers very rewarding. "Voice students of today will be spending most of their singing careers in the twenty-first century. Isn't it time they learned to sing the music of the twentieth century? They will surely be better prepared musically for whatever lies ahead."[14]

Table XV

R. Murray Schafer,

Melisma

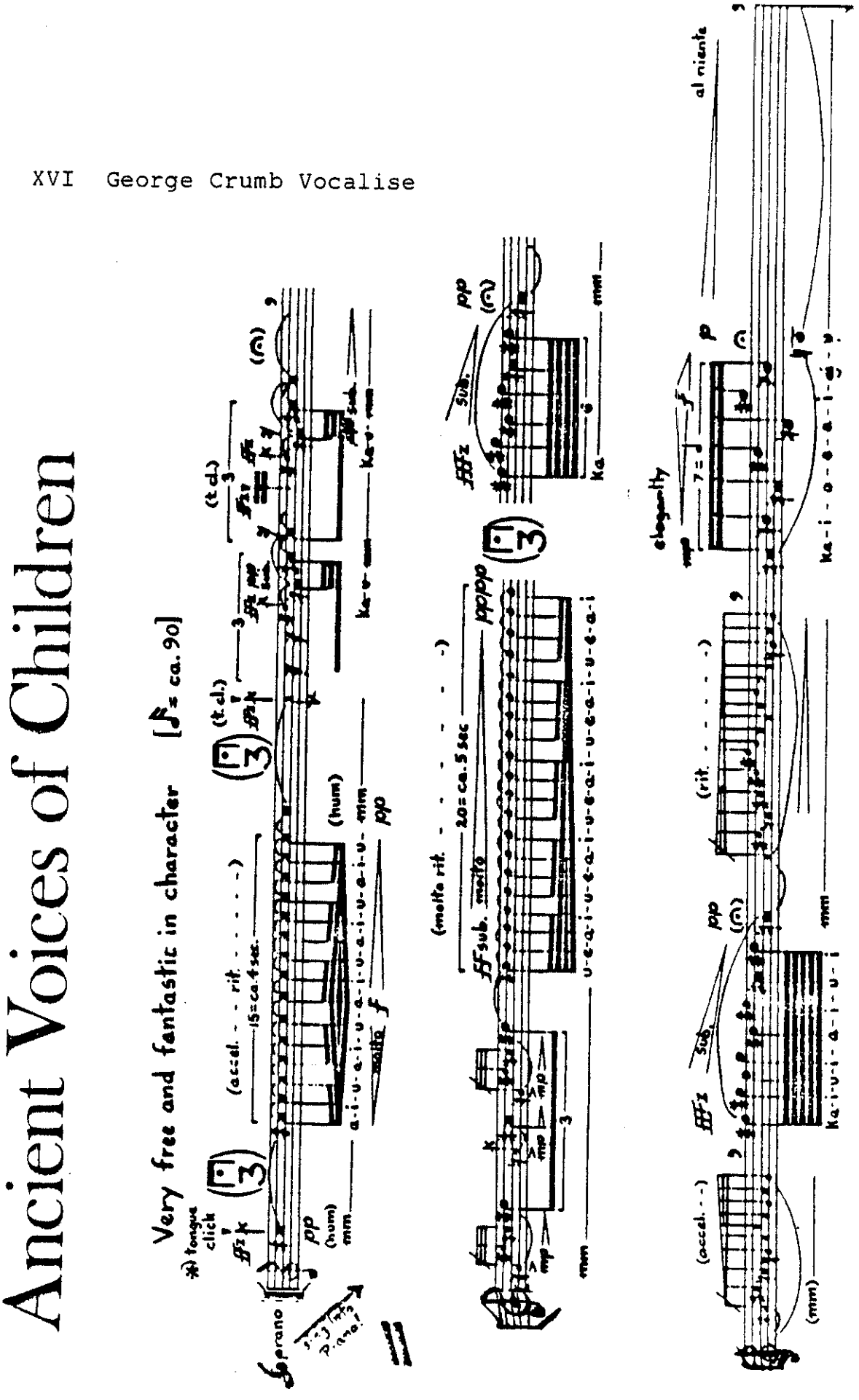
1. The highest sound of which you are capable
2. The lowest sound
3. The softest sound
4. The loudest sound
5. The smoothest sound
6. The roughest sound
7. The funniest sound
8. The saddest sound
9. A stern sound
10. A boring sound
11. An interrupted sound
12. A rhythmic, repeated sound
13. An unrhythmic sound
14. The highest sound again
15. Now suddenly, the softest
16. Gradually modulating to the funniest

(You laugh at your voice. Good. Listen to the sound of your own voice laughing at itself.)

If you have a tape recorder, tape your voice performing the above exercise. Listen to the curious vocal warble that is you. Then play it back again and try to counterpoint it with your live voice performing opposite effects to each of those on the tape.

R. Murray Schafer, "When Words Sing," Creative Education (New York: Schirmer, 1976), p. 163.

XVI George Crumb Vocalise



George Crumb, Ancient Voices of Children (New York: Peters, 1970), pp. 2, 3.

End Notes (6)

1. Sharon Mabry, B.M.E., M.M. and D.M.A. studied voice with Louis Nichols and Elena Nikolaidi, is professor of Music at Austin Peay State University, and a frequent performer of contemporary music in concert and on records.

2. Dorothy Dorow, a graduate of the Trinity College of Music in piano and composition, studied singing with Maggie Teyte. She has an international reputation as a performer of eighteenth and twentieth century music. She records for BMV, Phillips, and DGG en Archive, and regularly conducts a course in The Netherlands on vocal techniques of the twentieth century.

3. Alban Berg, Zwei Leider, Theodor Storm (Vienna: Universal, 1960, c. 1955).

4. Istvan Anhalt Alternative Voices (Toronto: University of Toronto Press, 1984).

5. Kurt Stone, Music Notation in the Twentieth Century (New York: Norton, 1980), p. 297.

6. Dorothy Dorow, Interpretation Course for Twentieth Century Vocal Music (Vught, The Netherlands, August 1-14, 1976). Demonstrations, class notes and examples as reported by Roberta Stephen.

7. Betsy Jolas, Caprice (Paris: Heugel, 1975).

8. R. Murray Schafer, Miniwanka (Bancroft, Ontario: Arcana, 1971).

9. Cathy Berberian, Stripsody (New York: Peters, 1971).

10. John Large and Thomas Murry, "Studies of Extended Vocal Techniques," The NATS Bulletin, 34/4, (May/June 1978), p. 30.

11. Ibid.

12. R. Murray Schafer, "When Words Sing," Creative Education, (New York: Schirmer, 1976), p. 163.

13. George Crumb, Ancient Voices of Children (New York: Peters, 1970), pp. 2, 3.

14. Sharon Mabry, "Singing New Music," The NATS Bulletin, 42/1, (Sept./Oct. 1986), p. 34.

CHAPTER VII

SUMMARY OF THE PEDAGOGY OF THE FEMALE HIGH VOICE

Typical Voice--Lyric or Mezzo-soprano

All singers, female or male, soprano or contralto, need to understand that breath control is the first requirement of singing. The singer works with the body, not against it, when she allows the breath to enter the lungs in a poised, support-renewing, quick, and easy manner. The manner of allowing the breath into the lungs will either help phonation or lead to tensions in the throat. Garcia says the diaphragm contracts and lowers, the ribs are raised and expanded so that "the lungs have their free action from side to side, front to back, from top to bottom."[1]

James Lawson and Garcia practise correct breathing by drawing a breath slowly through a minute opening of the lips, until no more air can be taken, then exhaling freely. As a variation of this breathing exercise, the singer inhales and exhales slowly, or breathes freely and retains breath for ten or more seconds. All singers, female or male, need to master this slow intake of breath. In

addition, singers should learn a quick inhalation which does not disturb the basic posture. When inhaling through the open mouth and throat, Wormhoudt recommends concentrating on the open vowel space to preserve the openness and freedom of the vocal tract.[2]

To allow sufficient breath for legato singing, the expiratory muscles must balance the slow relaxing of the inspiratory muscles, which includes the diaphragm. Support actually means not allowing the expiratory muscles to tense nor the inspiratory muscles to relax too soon, but to have a continuing balance between the two sets of muscles. For full support in the singing of very loud, high, soft, or very long phrases, sopranos and other singers will add tension to the lower abdominal muscles just before the phrase is begun. Wormhoudt describes the process as adding tension in the lower abdominal surface muscles precisely at the end of the breath expansion which will add just enough strength for the most difficult phrases.[3]

Traditionally, the acoustic factors of the voice have been treated as a matter of voice "placement." In the Italian School of singing, Miller observed that both breath management and resonance factors are included in the term appoggio.[4] Although imposto refers to placement sensations, these are considered part of breath management. Distinct and recognizable sensations are felt in all parts

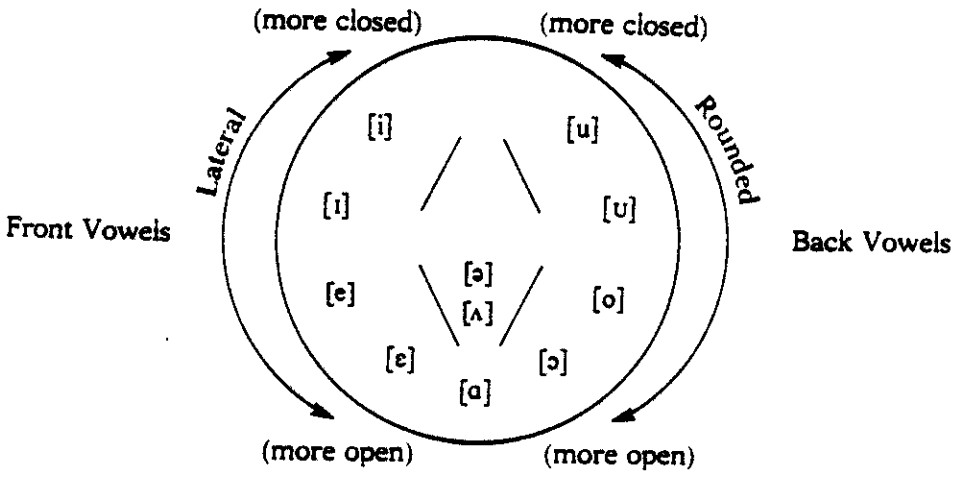
of the vocal tract as a result of resonator coupling. The resonance balance, or placement, relies on the mouth and pharynx making sensitive adjusting movements.

These adjusting movements tune the vocal tract to the most resonant partials of the fundamental (pitch) coupled with the frequencies of the vowel formant (shape of the vocal tract). The singer identifies this action as adding more intensity to the sound. These shapings of the vocal tract are related to vowel modification. Miller's chart of vowel modification is a clear demonstration of this phenomenon.[5] The chart is shown in Table XVII. Miller believes as the voice sings upward into the head register, some change in the vowel must take place to avoid too much brightness; an /i/, for example, will modify toward a neutral, in this case, /I/. This can also be accomplished in another way, by dropping the jaw. Coffin's Vowel exercises[6] have distinct advantages according to Miller because alternating neighboring vowels on the vowel series, helps to achieve common qualities of resonance and projection for similar vowels.

As the soprano moves into the head register the support mechanism is retained and the jaw is comfortably placed.[7] The soprano should experiment with the weight of the voice in order to "turn" or lift smoothly into the head. The high register feels lighter or more "heady," often with

Table XVII

Vowel Modification Chart (Miller)



Richard Miller, The Structure of Singing (New York: Schirmer Books, 1986), p. 157.

a strong mask sensation and a forward placement.

In order to strengthen this upper area of the voice, female singers begin with an exercise like Fillebrown's resonance exercise, or with a glissando, such as Vennard's "yawn-sigh." After this short preparatory period, the lighter voices often favor vocalises for agility while heavier, more dramatic voices continue with sustaining exercises. Of course all voice types eventually use a variety of exercises to mobilize all parts of the vocal mechanism in the daily vocalizing.

Coloratura Soprano

Robert Rushmore calls the coloratura voice small and girlish. Often the voice quality is matched by the physique of the singer, too.[8] The Queen of the Night (Die Zauberflote), Marie in The Daughter of the Regiment, and Amina of La Sonnambule are roles typical of this voice type (fach).

When perfectly produced the high pitches of the coloratura voice seem to have an unearthly quality. Mary Garden was absorbed by the high C of Nellie Melba and described it: "The note came floating over the auditorium of Covent Garden: it left Melba's throat, it left Melba's body, it left everything, and came over like a star and passed us in our box, and went out into the infinite.[9]

The coloratura soprano has the same childlike, tiny sensations in the flageolet register as other sopranos and mezzo-sopranos, but her extreme register has an extension "with no limit" as Deutikom described it.[10] She has less need of the chest register than other sopranos, but still needs to cultivate some of the heavy mechanism to bring about an even scale.

Ingo Titze describes singers as sprinters and long-distance runners.[11] It is this need of vocal sprinters to cultivate the acrobatic qualities and the clear bell-like sounds that control much of the vocalizing and the repertoire of this kind of singer. Exercises to develop these qualities abound. Some are the familiar classics of Marchesi and Liebling, others have been collected by Miller and Wormhoudt.[12] There are even a few designed to gain facility needed in contemporary music. A graded series of interval studies by Rebner and Bettag,[13] and Modus Novus by Lars Edlund[14] are recommended.

Flageolet Register

All that has been said about the coloratura soprano applies to the flageolet range of other sopranos and mezzo-sopranos. The coloratura specializes in the upper range and extends it more than other female singers. The balance between the breathing mechanism and some vowel modification

allows a free production in the upper register. However there is some loss of vowel intelligibility in this high range.

Too much flageolet sound can produce an undesirable thinness and shrillness in the upper range. Miller advocates a comfortable opening of the mouth, as does Liebling, and an increase in breath support to modify the flageolet timbre and unite it with the more normal head voice.[15] Wormhoudt and Leyerle agree that extra support is needed when singing in this extreme range. Leyerle notes female singers will be more aware of a forward expansion of the breathing mechanism caused by the movement of the rectus abdominus muscles.[16] More breath is needed to quicken and intensify the extremely high notes.

The muscle coordinations of light mechanism learned in the flageolet register benefit the range just beneath this upper register. The lightness and exactness impart freedom to the head voice. Working in this area is a useful tool for improving agility, focus, and ease of production in the head voice of the female singer, especially the sopranos.

For the coloratura and soubrette voices, vocalizing in the flageolet register is essential. The lyric soprano and some heavier soprano voices should practise agile arpeggios and scales which extend into the flageolet region

after the other areas of the voice have been vocalized.[17] A few minutes at each practise session is sufficient. The even scale is a result of work in all registers of the voice. Work on the upper and lower extremes of the voice helps the sound of the middle register, just as a well balanced middle voice strengthens the head, flageolet, and chest registers.

A full circle has now been achieved. To reach the goal of beautiful singing throughout the compass of the voice, it has been necessary to consider breath management, and the free production of tone in the larynx and the resonating chambers of the pharynx and mouth. The sensations of well-proportioned singing have been discussed using vowel modification and mechanical suggestions of lip rounding and mouth opening to allow the voice to reach its upper limits. It is still valuable to remember Clippinger's advice. Teaching singing requires an educated and refined ear.[18]

End Notes (7)

1. Manuel Garcia, Hints on Singing, op. cit., p. 4.
2. Wormhoudt, op. cit., p. 17.
3. Ibid., p. 26.
4. Miller, Structure, op. cit., p. 61.
5. Ibid., p. 157.
6. Coffin, op. cit., The Vowel Chart.
7. Liebling says the jaw is less open when ascending and more open when descending.
8. Robert Rushmore, The Singing Voice, 2nd. ed. (New York: W. W. Norton, 1984), p. 127.
9. Rupert Christiansen, Prima Donna (New York: Viking, 1985), pp. 131-132.
10. Hines, op. cit., p. 96.
11. Ingo Titze, "Fundamental frequency scaling and voice classification," The NATS Bulletin, 37/1, (Sept./Oct. 1980), p. 20.
12. Marchesi, op. cit.
    Liebling, op. cit.
    Miller, Structure, op. cit., pp. 42-47.
13. Wolfgang Rebner and Ingrid Bettag, A New Approach to Singing (Frankfurt: Peters, 1972).
14. Lars Edlund, Modus Novus (Stockholm: Nordiskmusik-forlaget, 1964).
15. Miller, Structure, op. cit., p. 148.
16. Leyerle, op. cit., p. 19.
17. Roma, op. cit., p. 104.
18. D. A. Clippinger, The Head Voice and Other Problems, (Boston: Oliver Ditson, 1917), p. 3.

CHAPTER VIII

THE RELATIONSHIP BETWEEN THE NATURE AND THE PEDAGOGY OF THE FEMALE HIGH VOICE

Conformity

The 1930s saw the beginnings of the modern style of investigating the singing voice by making a minute study of individual sung tones. Over 6000 sung tones were compared by Wilmer Bartholomew.[1] Carl Seashore and his associates tested a similar number of tones to find some of the acoustical factors of "quality" singing.[2] Each suggested many areas worthy of further research in their writings of this period. Even in 1986, Bloothooft[3] could still assign three articles by Bartholomew as significant reference sources.

In the years following the publication of Seashore's and Bartholomew's work, much of the voice research was concentrated on understanding the basic actions of breath management, the muscular action of the larynx, and the acoustical factors of singing. Most of this fundamental research applied equally to female and male singers. The workings of the breathing musculature made known by

Stetson;[4] Bouhuys, Proctor, and Mead;[5] Rubin, LeCover, and Vennard[6] now constitute the basis of all effective teaching and performance. Efficient methods of inhaling and controlled exhalation are generally understood and are a part of accepted vocal pedagogy.

By 1967 Appelman could summarize the areas of conformity of vocal researchers on the action of the larynx.[7] He summarized them as follows:

a. Phonation occurs when the air is expired through the narrowed, cone-shaped tube at the top of the trachea.

b. Further constriction of the air flow is made by the vocal folds which partially or completely close the glottis.

c. Both the vocal folds and the walls of the airway are elastic and yield under pressure.

d. The vocal folds are able to change in length, tension, and contour--thereby regulating the size, shape, and position of the glottic opening--as well as making vibrating movements.

e. The laryngeal muscles do not produce the vocal sound. Phonation is the result of aerodynamic action in which various muscles adjust and maintain the vocal folds in a certain position, tension and shape. The modulation of the expired air stream, caused by the movement of the vibrating vocal folds, makes the sound.

The resulting pressure variations create multiple sine waves which comprise the complex vocal spectrum.

The acoustical factors in phonation are not always understood, especially in the female high voice. It is believed that the fundamental and its partials make the initial frequency, but the formants of the vocal tract, which are vowel dependent, make changes to the frequency or spectrum envelope. Instead of the regular progression of octave, fifth, fourth, major and minor third, some of these partials are emphasized at the expense of others. These points of emphasis are called formants. In addition, vocal scientists believe that the singer's formant, around 3200 Hz for women, adds another quality to the sound, often referred to as "ring," or "brilliance."[8] This is probably true for the lower female voices but other factors may be at work in the head voice and flageolet register of the high sopranos.

The physical factors, those most readily observed, have been the subject of much research by vocal scientists. The management of breathing for singing is understood, as is the workings of the larynx. Though the process has taken about fifty years, the knowledge gained by vocal scientists is now largely accepted by teachers of singing.

Controversy

Singing teachers, vocal scientists, and performers

have two important areas of disagreement, terminology and methods of production. The most obvious problematic terms are "falsetto" and "covering." The vocal production of "pop" music is the other disputable area.

Philip A. Duey in his investigation of vocal practise in the Bel Canto era found falsetto defined as a false voice, or tones sung in a feminine manner.[9] Tosti, as translated by Galliard (1687-1749), said "falsetto is a feigned voice, which is entirely formed in the throat, has more Volubility than any, but no substance."[10] Mathilda Marchesi wrote that falsetto should be reserved for men's voices.[11] Support for this view is added by Willi Apel in the Harvard Dictionary of Music. His definition of falsetto is "an artificial method of singing by male singers, particularly tenors, to reach notes beyond their ordinary range"[12] Garcia in his illustration of the "Human Voice in its Full Extent" placed the falsetto range so that it overlapped the chest voice and extended into the head voice.[13] This is surely a puzzling position, and one which he abandoned in his late writings. Vennard, on the other hand, used falsetto as a synonym for light mechanism for all voices.[14] Leyerle uses a different terminology, as shown in this table.[15]

	ALL VOICES	WOMEN	MEN
1.	Low	Chest	Chest
2.	Middle	Middle	Head
3.	High	Head	Falsetto

Theophile M. Otto who edits a "Checklist of Recent Research" for the Journal of Research in Singing uses the term falsetto for the upper range of female and male voices. It takes ten pages for Reid to describe the use of falsetto to enrich the male head voice. He says that females also possess a falsetto register, most often a natural part of their instrument.[16]

Since falsetto can mean the high-pitched, resonant, upper part of a man's voice; or, the imitative, effeminate, high voice of a male singer; or, the high register of female and male singers; or, the false voice of the Italian school of singing, it seems wiser to eliminate its use. As was suggested in Chapter I, second section, page 3, the term falsetto should be reserved for the production by male singers of very high pitches above the normal head voice. The terms head voice or register, high range, or highest register would then be used for the upper part of female voices.

The other troublesome vocal term is covering. Reid says it means to make a change of resonance adjustment by 'darkening' those vowels phonated in the area of the primary

register 'break' (E4-F#4), and also at the so-called 'upper break' in women's voices, lying an octave above, in order to avoid tone qualities which are commonly perceived to be 'too open.'[17] Leyerle has two definitions to describe two different perceptions. The one definition, applied to resonation, has "a dark vowel pronunciation and light registration[18]." The other, applied to registration, has a covered voice or voce coperta.[19] This Italian term, refers to a physical sensation, particularly in the male upper range, where "the light mechanism dominates the heavy mechanism without resorting to the use of 'falsetto'"[20] according to Leyerle. Marchesi equated voice coperta[21] with the German expression gedecktes Register, and with Garcia's voix mixte.[22]

However, Garcia, as quoted by Vennard, would not agree with Marchesi in equating voix mixte with voce coperta. Exaggerated timbre sombre, dark timbre, according to Garcia, will have a covered, choked, and muffled sound. Conversely if timbre clair, light timbre, is exaggerated the sound becomes white, shrill, and screeching (or yelping). At the same time both women and men can carry the chest voice in timbre sombre, from E4 to B4, so that the sound does not appear to be covered. Such tones Garcia called voix mixte.[23] This does not appear to be the usage claimed by Marchesi. Wormhoudt apparently uses the same concept as

Garcia when she says females cover when descending into the chest register and men cover when ascending into the head register.[24] Garcia, and Y. R. Diday and Petrequin describe the physical movements of the vocal tract during the phonation of these two timbres. The larynx is high and the soft palate low in clear or open timbre, while in dark or covered timbre, the larynx is low, the velum high, and the pharynx is strongly rounded.[25]

Miller, Brodnitz, and Vennard would not use the term "covering" or its darkened production. Vennard considers the term old-fashioned and its production throaty[26]. Covering, according to Miller, encourages fundamental changes in the mechanical function of the larynx and the shaping of the resonators.[27] These alter the harmonic spectra and would not permit an even production throughout the compass of the voice. Vennard, Wormhoudt, Coffin, and Miller would use vowel modification when approaching a passaggio, also for high sopranos in their head voice, especially the flageolet register.

Covering is also related to the national styles of singing. The Nordic singers often have a more "covered" production.[28] Since Johann Sundberg, one of the leading voice researchers in the world, lives in Stockholm, Sweden, the tonal ideals of his subjects would be different from the Italian school. Miller wonders if subjects with other tonal

qualities would alter his conclusions.

Belting as defined by Reid is the "practise of driving the chest register too high in the tonal range."[29] He says it is not a legitimate use of the vocal mechanism and can be injurious to vocal health. This unsafe kind of vocal delivery can lead to nodules on the vocal folds. Miller calls it a pernicious and dangerous style of singing.[30] Wormhoudt observes much of the early work with young mezzo-sopranos involves blending the chest register into the head. She would agree that belting is not desirable in classical styles of singing. Yet three teachers, William Leyerle,[31] Laara Henderson,[32], and Jo Estill,[33] admit there is a safe way to "belt." It is like the stentorian voice of authority or the commanding voice of a mother.[34] It is loud with either the second or third partial dominating the spectrum envelope to make this voice appear higher than it really is. There is a high level of energy. Ethel Merman is an example of a successful singer with a long performing career who used a "belting" delivery. This heavy, chesty quality is favored by the dramatic voices, observes Leyerle.[35] When it is first attempted it can have a "whiney," unpleasant sound, Henderson says.[36] With consistent and careful practise the tone will grow in strength and color. As not enough is known about the production of a belted sound, Estill advocates more

research be done before any firm conclusions are made about the safety of this particular mode of vocal production.

I can see no way of forcing voice researchers, singing teachers, and performers to define commonly used vocal terms. Perhaps a long and sustained educational project would lead to some agreement. This would need to be sponsored by some large, international body of interested professionals. Perhaps the Voice Foundation in New York could undertake this responsibility. Its annual symposium is the meeting place of international experts.

It is helpful to remember the advice of Barthmolomew from a 1953 speech,

> We can try to be more careful with our use of words, more willing to use a dictionary, more unwilling to jump to conclusions, more loath to pontificate, less careless in speaking of our colleagues' work behind their backs, and more willing to take time to sit down with them and try to reach a common understanding of terminology.[37]

Areas of Further Research

Several voice researchers have begun to investigate the female voice. Their conclusions are tentative and would need to be connected to practises in the voice studio. The sensations of phonation and the imagery used by teachers also need to be related to objective fact.

Sundberg and Bloothooft are making investigations

into the acoustic factors of female performers. Since most of their conclusions are rather tentative, their recommendations for further research will be listed with some appropriate comments.

In 1977 Johan Sundberg wrote that acoustic investigations of female singing are comparatively rare.[38] The difficulty in explaining the acoustic data certainly accounts for this lack of research. It is difficult to know whether the fundamental and its partials or vowel formants are responsible for the acoustic data. Sundberg compared vowels sung in chest and mid-range. A study comparing vowels sung in mid and high registers is also needed to give valuable information about:

a. using formants for ease of vocal production, especially during register transitions and intensity variations.

b. the role of vibrato in vowel intelligibility. It is not understood[39].

Miller has suggested that Sundberg's research on the soprano voice might give different results with the study of sopranos from the Italian school of singing.[40] The Nordic has different tonal ideals from the Italian. Sundberg's investigations on vowel intelligibility, "covered" or darker colors of the voice, and questions regarding the position of the larynx and pharynx might have different answers. Miller

does not question Sundberg's research but only the subjects for study.

Bloothooft[41] in his investigation of "good" quality singing recommends studies to find reasons

a. why the spectrum envelope for female high-pitched singing is rather steep,

b. why the spectral requirements for a "rich" or "brilliant" sound quality seem to depend on pitch and may not require a singer's formant,

c. why there is a concentration of energy around 3 KHz,

d. why a subtle changing combination of vocal intensity and pitch is needed for a stable relative sound level of the singer's formant over a wide fundamental frequency range,

e. why the mechanisms responsible for timbre recognition in high pitched singing are not identified, except for the singer's formant.

Bloothoof adds that "teachers of singing should be aware of the many different interpretations of voice quality in order to avoid endless and discouraging controversies."[42]

Coffin's claim that sopranos singing high C, C6, need not sacrifice vowel intelligibility should have more investigation. Most researchers have shown that the formant for /a/ is in this same vicinity as C6 so all vowels will appear to sound like /a/. Even though the soprano still has

five formants at this frequency, it is still difficult to perceive a vowel diffent from /a/.

In the subjective area of sensations much thought and research is needed to connect sensations with the appropriate action in the vocal mechanism and a corresponding "color" in the voice. Donald Read and Clifford Osborne have shown a plausible theory in which the responsible muscular action in the larynx accords with the corresponding color in the voice.[43] The three basic variables in vocal tone are length-tension, mass, and approximation. When the effects of each variable are exaggerated in turn, we can learn more about the unresonated tone. The variations within physical limits are almost infinite and account for the basic characteristics of unresonated tone.

If the vocal folds are tensed, according to Read and Osbourne, without any balanced adjustments, the sound will be shallow with unmusical brightness. Singing the vowel /e/ occasionally gives this unwanted quality. An exaggerated mass or thickness of the vocal folds gives a deep tone (associated with chest register) with a sensation of body. The resulting tone lacks brilliance and real power. When balanced with the other parts, mass gives body and depth to the sound. Approximation (closure of the glottis) gives a hollow, dark, almost a velvet quality to the tone in its exaggerated version. Approximation is responsible for the

feeling of height (associated with head register) in the vocal sound. Again, when balanced with the two other aspects of tonal production, its velvet quality makes the tone emotional and beautiful, and is responsible for making a finely graded pianissimo. All three variables must be constantly adjusted whether the move in pitch is large or small.

Another area of research is the use of imagery associated with the physical functions of the larynx. In Seashore's description, imagery "consists largely in forming the habit of noting relationships which become fixed in the memory so that where a situation is anticipated or recalled the image presents it in accurate and vivid detail."[44] Imagery is an integral part of the teaching of singing. The danger of its use can be the divorcing of the physical aspect of singing from its physiological, psychological, and aesthetic qualities.[45] All are necessary for beautiful singing.

If Miller's bibliography for the Structure of Music is accurate in reflecting current research, there is a dearth of material related to female singing.[46] Out of approximately six hundred articles in the bibliography about forty deal with the female voice, 6 percent. Of those forty only eleven, or one fourth, were published after 1977, the year Sundberg's article on the soprano voice appeared. That

small percentage includes two interviews from Jerome Hines' book Great Singers on Great Singing.[47]

It would seem that investigating the female voice is a field rich in possibilities for the vocal researcher. Measuring devices have become more sophisticated; machines for synthesizing the vocal sound are more complex; and, automated methods for using old devices are now available. It should then be easier to decipher the sounds of the high sopranos using this new equipment. There is also a trend, shown in articles by Collins,[48] Large,[49] Reid,[50] and others, to making a scientific study of studio practises. All this research if directed towards the female voice should give some answers to the questions posed by researchers. It will also move the amount of study of the female voice towards parity with existing male research. Relating facts uncovered by vocal scientists may be associated with appropriate sensations of phonation and to imagery used in teaching.

End Notes (8)

1. Wilmer Bartholomew, "A physical definition of 'good voice quality' in the male voice," Journal of the Acoustical Society of America, 6/27, (1934), pp. 25-33.

2. Carl E. Seashore, The Psychology of Music (New York: McGraw Hill, 1938).

3. Gerrit Bloothooft, "A note on voice quality in professional singing," Journal of Research in Singing, 10/2, (June, 1987).
The three articles are:
Wilmer Bartholomew, op. cit., pp. 3-16.
_____, "The paradox of voice teaching," Journal of the Acoustical Society of America, 11 (April 1940), pp. 446-450.
_____, "The role of imagery in voice teaching," Proclamation of the Music Teachers National Association, pp. 2-19.

4. Stetson, op. cit., pp. 5-47.

5. Bouhuys, Proctor, and Mead, op. cit., pp. 58-87.

6. Rubin, LeCover, and Vennard, op. cit., pp. 88-107.

7. Appelman, op. cit., pp. 62-63.

8. Vennard, op. cit., p. 125.

9. Duey, op. cit., p. 40.

10. Ibid., p. 113.

11. Marchesi, op. cit., p. xiv.

12. Willi Apel, "Falsetto," The Harvard Dictionary of Music, 2nd. ed., (Cambridge, Mass: Harvard University Press, 1972), p. 305.

13. Refer to end notes page 15 for this illustration.

14. Vennard, op. cit., p. 67.

15. Leyerle, op. cit., p. 53

16. Cornelius Reid, A Dictionary of Vocal Terms (New York: Joseph Patelson, 1983), pp. 113-120.

17. Ibid., p. 77.

18. Leyerle, op. cit., p. 70.

19. The term voce coperta has been attributed to Salvator Marchesi.

20. Leyerle, op. cit., p. 70.

21. Voce coperta as defined by Miller "occurs in rising pitch without engendering mechanical changes" in vocal production.
Miller, Structure, op. cit., p. 156.

22. Voix-mixte, a term probably introduced by Garcia, is a combination of light and heavy mechanism (Vennard) or chest voice and falsetto (Reid) used by males to bridge the passaggio into the head register and females from chest into head.

23. Vennard, op. cit., p. 153.

24. Wormhoudt, op. cit., p. 78.

25. Vennard, op. cit., p. 151.

26. Vennard, op. cit., p. 155.

27. Miller, op. cit., p. 150.

28. Ibid., p. 152.

29. Reid, op. cit., p. 32.

30. Miller, National Styles, op. cit., p. 134.

31. Leyerle, op. cit., p. 69.

32. Henderson, op. cit., p. 165.

33. Jo Estill, "Observations about the Quality Called 'Belting,'" Transcripts of the Proceedings: Ninth Symposium Care of the Professional Voice (New York: The Voice Foundation, 1980), p. 82.

34. Ibid., p. 82.

35. Leyerle, op. cit., p. 70.

36. Henderson, op. cit., p. 165.

37. Wilmer Bartholomew, "Terminology in Voice Teaching," read at the Convention of the National Association of Teachers of Singing in St. Louis, MO., December 28, 1953. Reprinted in Journal of Research in Singing 6/2 (June 1983).

38. Sundberg, op. cit., p. 27.

39. Ibid., p. 27.

40. Miller, Structure, op. cit., p. 152.

41. Bloothooft, op. cit., pp. 3-16.

42. Ibid., p. 14.

43. Read and Osbourne, op. cit., p. 8.

44. Seashore, op. cit., p. 171.

45. Wilmer Bartholomew, "The paradox of voice teaching," op. cit., p. 450.

46. Miller, op. cit., pp. 315-365.

47. Hines, op. cit.

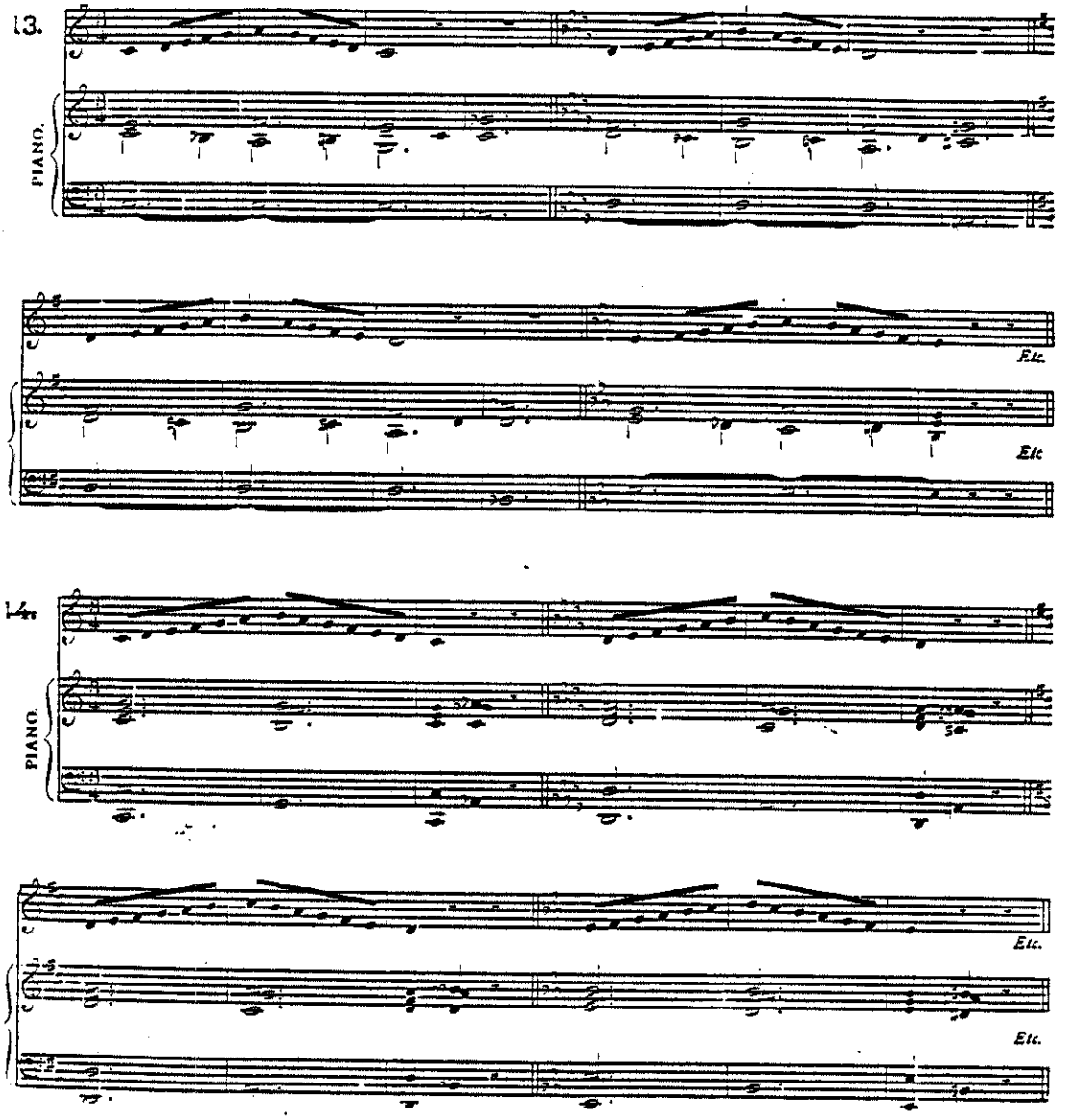
48. Colling, op. cit.

49. John Large, "How to Teach the Male High Voice, Part One: The Tenor," Journal of Research in Singing IX/2 (June 1986), pp. 3-20.
_____, "How to Teach the Male High Voice, Part Two: The Baritone and Bass," Journal of Research in Singing X/2 (June 1987), pp. 17-29.
_____, "The Pedagogy of the Even Scale," The NATS Journal 44/2 (Nov./Dec. 1987), p. 12-16, 27.

50. Cornelius Reid, "The Nature of Natural Singing," Journal of Research in Singing XI/2 (June 1988), pp. 3-29.

APPENDIX

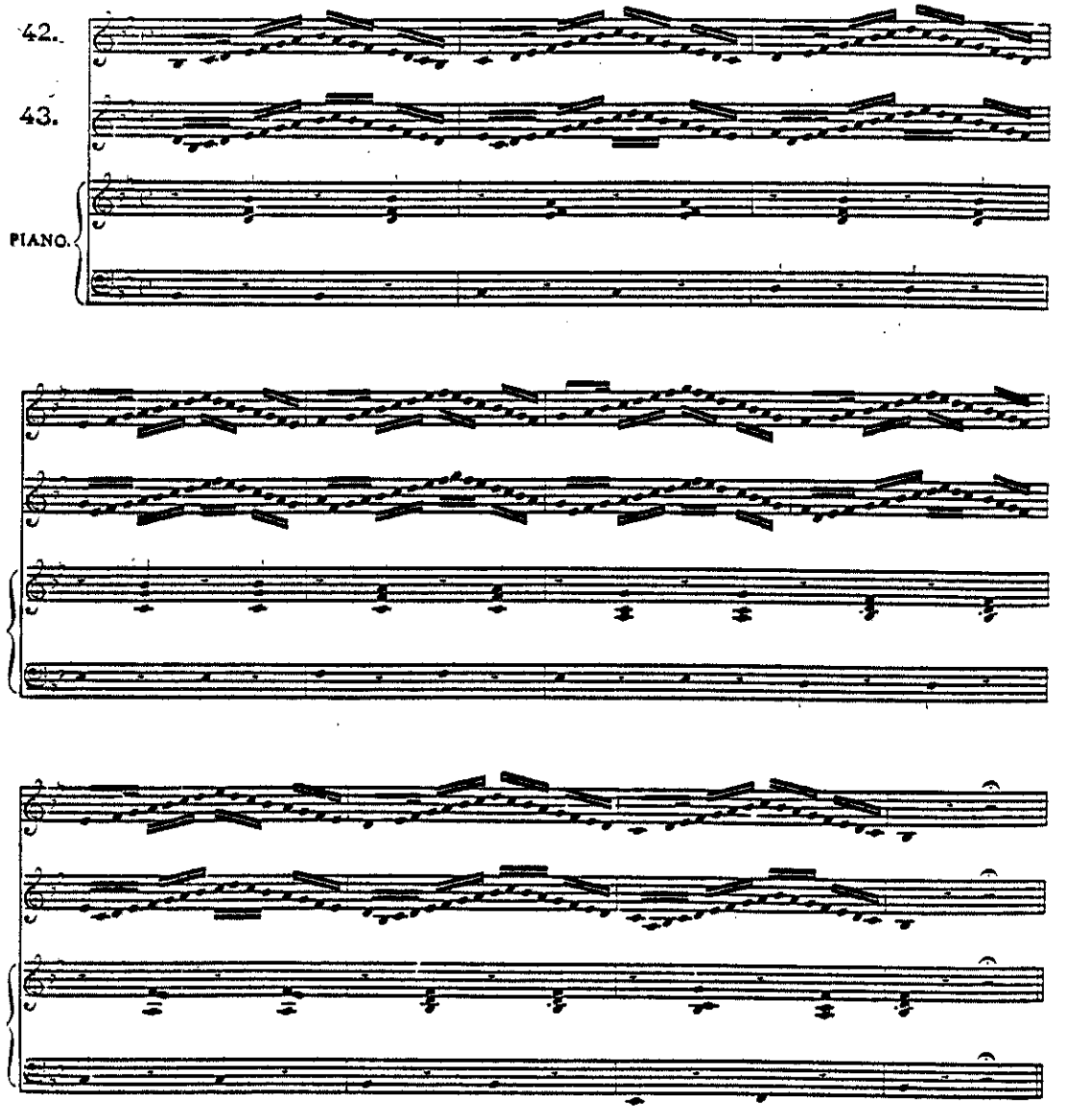
Marchesi Exercises



#13 corresponds to #9 of the Schirmer ed. of Marchesi's exercises.

Mathilda Marchesi, Bel Canto: A Theoretical and Practical Vocal Method (New York: Dover, 1970, p. 7.

Marchesi Exercises (continued)



#42 corrsponds to #19 of the Schirmer ed. of Marchesi's exercises.

Marchesi, op. cit., p. 13.

BIBLIOGRAPHY

American Academy of Teachers of Singing. Terminology in the Field of Singing. New York: G. Schirmer, 1969.
Eighty terms were defined.

Anhalt, Istvan. Alternative Voices. Toronto: University of Toronto Press, 1984.
An abstruse treatise on the compositional uses of the voice in avant-garde music of the latter half of the Twentieth Century. He uses three works in great detail.
Berio, Luciano--Sequenza III for female solo voice.
Ligeti, Gyorgy--Nouvelles Aventures for three solo voices and small instrumental ensemble.
Lutoslawski, Witold--Trois Poemes d'Henri Michaux for large chorus and orchestra.

Appelman, D. Ralph. The Science of Vocal Pedagogy. Bloomington, Ind.: Indiana Press, 1967.
A standard text on the science of singing with very clear diagrams.

Bachner, Louis. Dynamic Singing. New York: L. B. Fischer, 1944.

Barker, Noelle. "Discovering the Real Sound," interview in Ensemble Diary, music theatre studio ensemble, The Banff Centre, 7, (May 1985), p. 14.

Bartholomew, Wilmer T. Acoustics of Music. New York: Prentice-Hall, 1942.
It is still useful as a starting point for contemporary vocal research.

_____. "The Paradox of Voice Teaching," Journal of the Acoustical Society of America, 11 (1940), pp. 446-450.

_____. "A Physical Definition of 'Good Voice Quality in the Male Voice'", Journal of the Acoustical Society of America, 6/27, (1934), pp. 25-33. Reprinted in Contributions of Voice Research to Singing, ed. John Large. Houston, Texas: College-Hill Press, 1980.

Bastian, Robert W. "Hoarseness in Singers," The NATS Bulletin, 40/3, (Jan./Feb. 1984), p. 26.

Berberian, Cathy. Stripsody. New York: Peters, 1966.

Berg, Alban. Zwei Lieder, Theodor Storm. Vienna: Universal, 1960, c. 1955.

Bloothooft, G. "A Note on Voice Quality in Professional Singing," Journal of Research in Singing 10/2 (June 1987), pp. 3-16.

Bloothooft, G. and R. Plomp. "The sound level of the singer's formant in professional singing," Journal of the Acoustical Society of America 79 (1986b), pp. 2028-2033.

_____. "Spectral analysis of sung vowels I. Variations due to differences between vowels, singers, and modes of singing," Journal of the Acoustical Society of America 75 (1984), pp. 1259-1264.

_____. "Spectral analysis of sung vowels II. The effect of fundamental frequency on vowel spectra," Journal of the Acoustical Society of America 77 (1985), pp. 1580-1588.

_____. "Spectral analysis of sung vowels III. Characteristics of singers and modes of singing," Journal of the Acoustical Society of America 79 (1985a), pp. 852-864.

Bouhuys, Arend, Donald F. Proctor, and Jere Mead. "Kinetic Aspects of Singing," Journal of Applied Physiology 21/2 1966, pp. 483-496. Reprinted in Contributions of Voice Research to Singing, ed. John Large, Houston, Texas: College-Hill Press, 1980, pp. 58-87.

Brodnitz, Friedrich S. Keep Your Voice Healthy. New York: Harpers & Brothers, 1953.
It is the standard text on the subject, highly respected.

_____. "Psychological Considerations in Voice Therapy," Transcripts of the Proceedings: Eighth Symposium Care of the Professional Voice. New York: The Voice Foundation, ed. Van Lawrence, 1979.

Bunch, Meribeth. Dynamics of the Singing Voice. Wien, New York: Springer-Verlag, 1982.
A continuation and up-dating of the Vennard text. The picture and diagrams are of high quality.

Burgin, John. Contributions to Vocal Pedagogy," The NATS Bulletin 34/3 (Feb. 1978), pp. 13-22.
It is a continuation of his compendium, Teaching Singing, covering the years 1972-1975.

_____. Teaching Singing. Metuchen, N.J.: The Scarecrow Press, 1973. This book is a compendium of thoughts about singing published during the years 1943-1971. It follows the format of Victor Fields' book, Training the Singing Voice.

Christiansen, Rupert. Prima Donna: A History. New York: Viking Penguin, 1985.
A highly readable book with many quotes by contemporary critics of the voice quality of singers.

Clippinger, D. A. The Clippinger Class-Method of Voice Culture. Philadelphia: Oliver Ditson, 1933.

_____. The Head Voice and Other Problems. Boston: Oliver Ditson Co., 1917.

_____. "How to Escape Some Vocal Pitfalls in the Day's Work," Etude 54 (1936), p. 316.

Coffin, Berton. Coffin's Overtones of Bel Canto. Metuchen, N.J: The Scarecrow Press, 1980.

Colgrass, Ula. "Ameling--Voice of the Art Song," Music Magazine May/June (1981), p.9.

Collins Mary Ella. "Goal Identification and Systematic Instruction in Private Voice Lessons," Journal of Research in Singing VII/i (Dec. 1983), pp. 56-59.

Cope, David. New Music Notation. Dubuque, Iowa: Kendal/Hunt, 1976.
It contains a table of recommended symbols of some vocal sounds, with composers' names who use the symbols. Other instruments are included.

Crumb, George. Ancient Voices of Children. New York: Peters, 1970.

Delattre, Pierre. "Vowel Color and Voice Quality," The NATS Bulletin 13/1 (Oct. 1958).

Duey, Philip. Bel-Canto in its Golden Age. New York: King's Crown Press, 1951.
This is a reliable history of the use of the term bel canto. It has a useful bibliography.

Edlund Lars. Modus Novus. Stockholm: Nordiskamusik-forlaget, 1964.
Excellent ear training exercises prepare singers and instrumentalists for music of the twentieth century.

Estill, Jo. "Observations about the Quality Called 'Belting'," Transcripts of the Proceedings: Ninth Symposium Care of the Professional Voice. New York: The Voice Foundation, ed. Van Lawrence, 1980.

Feder, Robert. "Singing and Flying," The NATS Bulletin 41/1 (Sept./Oct. 1984), p. 26.

Fields, Victor Alexander. The Singer's Glossary. Boston: Boston Music Co., 1952.
This small book is still useful and reliable.

_____. Training the Singing Voice. New York: King's Crown Press, 1947.
The first compendium of published statements about music covers the years 1928-1942.

Fillebrown, Thomas. Resonance in Singing and Speaking. Bryn Mawr, Penn: Oliver Ditson, 1911.
He was one of the first writers to stress resonance as a part of good quality singing.

Foote, Jeffrey. The Vocal Performer. Mount Pleasant, MI: Wildwood Music, 1983.
This publication is typewritten, with loose pages in a folder.

Garcia, Manuel. Hints on Singing. London: Ascherberg, Hopwood & Crew, 1894. Translated by Beata Garcia.
A question and answer format leads the reader through Garcia's thought and method on teaching singing.

_____. Observations on the Human Voice. Proceedings of the Royal Society 3 (1855), pp. 399-408. Reprinted in Contributions of Voice Research to Singing, John Large, ed. Houston, Texas: College-Hill Press, 1980.

Heizler, Sister Louis Marie, O.P. Basic Techniques for Voice Production. New York: Exposition Press, 1973.

Helmholtz, Herman L. F. On the Sensations of Tone, translated by Alexander J. Ellis. Reprinted New York: Dover, 1970.
This is a classic text.

Henderson, Laara Browning. How to Train Singers. West Nyack, N.Y.: Parker Publishing, 1979.
It is a reliable source of exercises to build a basic technique.

Heymont, George. "Renato Scotto," Fugue, April 1980, p. 39.

Hines, Jerome. Great Singers on Great Singing. Garden City, N.Y.: Doubleday, 1982.
This book is a responsible set of interviews with detailed responses on breathing, open throat, and daily vocalizing of famous singers.

Howie, John and Pierre Delattre. "An Experimental Study of the Effect of Pitch on the Intelligibility of Vowels," The NATS Bulletin 18/4 May 1962, pp. 6-9.

Husson, R. "Excitabilité Recurrentielle et Entendues Masculines et Feminienes des Volk Adultes Cultivées, Semicultivées et Incultées," Review of Laryngology, Otolaryngology, and Rhinology, suppl. 110 (1954).

Jacobsen, Robert. "Regina Reflects," Opera News, Dec. 8, 1984, p. 59.

Katsuki, Yasuji. "The Function of the Phonatory Muscles," Japanese Journal of Physiology 1 (1950), pp. 29-36.

Keaton, Allan. "A Singer's Guide to Medical Care," The NATS Bulletin 40/1 (Sept./Oct. 1983), p. 24.

Large, John W. "An Acoustical Study of Isoparametric Tones in the Female Chest and Middle Registers in Singing," The NATS Bulletin 23/2 (Dec. 1968), pp. 12-15.

_____. "How to Teach the Male High Voice, Part One: The Tenor," Journal of Research in Singing, IX/2 (June 1986), pp. 3-29.

_____. "How to Teach the Male High Voice, Part Two: The Baritone and Bass," Journal of Research in Singing, X/2, (June 1987), pp. 17-29.

_____. "The Pedagogy of the Even Scale," The NATS Journal, 44/2 (Nov./Dec. 1987), pp. 12-16, 27.

_____. "Towards an Integrated Physiologic-acoustic Theory of Vocal Registers," The NATS Bulletin, 28/4, (Feb./Mar. 1972), pp. 18-36.

_____. "Statement of Vocal Function," a handout in Pedagogy and Science of Singing. Denton, Texas: NTSU, 1984.

_____. ed. Vocal Registers in Singing. Proceedings of a Symposium. The Hague: Mouton, 1973.

Large, John and Thomas Murry. "Studies of Extended Vocal Techniques: Safety." The NATS Bulletin, 34/4 (May 1978), pp. 30-33.

Lawrence, Van L. "Larygoscope," The NATS Bulletin. A Series of articles listed below in chronological order:

3/73 (Jan/Feb. 1981). "Handy Household Hints: To Sing or Not to Sing," p. 23.
37/4 (Mar/Apr. 1981). "U.R.I's," p. 41.
37/5 (May/June, 1981). "Vitamin C," p. 24.
38/1 (Sept./Oct. 1981). "What about cortisone?" p. 28.
38/2 (Nov/Dec. 1981). "Nodules and Other Things that Go Bump in the Night," p. 27.
38/3 (Jan.Feb. 1982). "Cigareets and Whiskey and Wild, Wild Women," p. 27.
38/4 (Mar./Apr. 1982). "Singers and Surgery (Part I: Surgery in General)," p. 22.
38/5 (May/June 1982). "Singers and Surgery (Part II: Vocal Tract Surgery)," p. 20.
39/1 (Sept./Oct. 1982). "Post-nasal Drip," p.27.
39/2 (Nov./Dec. 1982). "Glue in the Gizzard: Phlegm," p. 24.
39/3 (Jan/Feb. 1983). "When all Else Fails, Read the Instructions," p. 16.

Lawson, James Terry. Full Throated Ease. Vancouver, B.C.: Western Music, 1955.
This book is a medical doctor's advice on the procedures of correct singing. Pictures of proper stance and breathing are very clear.

Lehmann, Lilli. How to Sing. New York: MacMillan. 1952. Translation by Richard Aldrich. Reprinted Whitehall: 601 Skokie Blvd., Northbrook, Ill. 60062, 1972.
Her method is based on the sensations of singing.

Lehmann, Lotti. More Than Singing. London: Boosey & Hawkes. Reprinted New York: Dover, 1985.
She made an interpretive analysis of standard works, including Debussy, from a nineteenth century viewpoint.

Leyerle, William D. Vocal Development Through Organic Imagery. Geneseo, N.Y.: Leyerle Publications 1977.
He has a very individual use of pictorial imagery which may be useful for some students.

Liebling, Estelle. The Estelle Liebling Vocal Course for Coloratura Soprano, Lyric Soprano, and Dramatic Soprano, New York: Chappell Music, 1956.
It contains mostly exercises and vocalises.

Lowery, A. A Guide to Musical Acoustics. New York: Dover, 1966.

Luchinger, Richard and Godfrey E. Arnold. Voice--Speech--Language. Translated by Godfrey Arnold and Evelyn Robe Finkbeiner. Belmont, CA: Wadsworth Pub., 1965.

Manén, Lucie. The Art of Singing. London: Faber Music, 1974.
She has an English approach to teaching singing. It is accompanied by recording.

Mabry, Sharon. "New Directions," The NATS Bulletin. A series of articles listed below in chronological order.
42/1, (Sept./Oct. 1986), "Singing New Music," p. 34.
42/2, (Nov./Dec. 1986), "Finding New Music,", p. 40.
42/3, (Jan./Feb. 1987), "But It Says 'Soprano'," p. 36.
42/4, (Mar./Apr. 1987), "Song Repertoire for a Moderately Advanced Singer," p. 26.
43/1, (Sept./Oct. 1987), "George Crumb's Ancient Voices of Children: Part 1," p. 37.

43/2, (Nov./Dec. 1987), "George Crumb's Ancient Voices of Children: Part 2," p. 36.
43/3, (Jan./Feb. 1987), "A Song Recital for a Soprano," p. 26.
43/4, (Mar./Apr. 1987), "A Song Recital for a Mezzo-Soprano," p. 38.

_____. "Vocal Problems in the Performance of Schoenberg's Pierrot Lunaire," The NATS Bulletin 35/3 (Jan./Feb. 1979), p. 28.

Marchesi, Mathilda. Bel Canto: A Theoretical and Practical Vocal Method. New York: Dover, 1970. Republication of Enoch & Sons ed.
It contains many exercises for agility with vocalises similar to Concone.

Meryman, John. "A Tour of Two Great Throats," Life 68 (1970), p. 63.
There are pictures of Joan Sutherland and Marilyn Horne on stage in an interview with little substance.

Miller, Richard. English, French, German, and Italian Techniques of Singing. Metuchen, N.J.: The Scarecrow Press, 1977.
This is a valuable source on the national styles of European singing.

_____. The Structure of Singing. New York: Schirmer Books, 1986.
This is the most recent book on the science of voice related to vocal pedagogy. He can be very opinionated.

Moerner, M. "Bidrag Till Internatinell Nomenklatur Tör Tonlägen Och Röstbeskrivnig," Technical Report STL-1, 1964. Stockholm: Royal Institute of Technology, June, 1963. Reprinted in Vocal Registers in Singing. Proceedings of a Symposium. The Hague: Mouton, 1973.

Monahen, Jeffrey Brent. The Art of Singing. Metuchen, N.J.: The Scarecrow Press, 1978.
It is a compendium of thoughts on singing published between 1777 and 1927. It was modelled on Victor Fields' book, Training the Singing Voice.

Morozov, V. P. "Intelligibility in Singing as a Function of Fundamental Voice Pitch," Soviet Physics-Acoustics, 10/3 (1956), pp. 279-283. Reprinted in Contributions of Voice Research to Singing, ed. John Large, Houston Texas: College-Hill Press, 1980, p. 395.

Pelsky, Boris Lastotchkine. "La structure de quelques voyelles chantees," Archives neerlandaises de phonetiques experimentale, 17. N.D. but sometime in 1930s.

Pleasants, Henry. "Bel Canto in Jazz and Pop Singing," Music Educators Journal 59/9 (May 1973), pp. 54-59. He uses Frank Sinatra and Ella Fitzgerald as models of melodic ornamentation.

_____. The Great Singers. New York: Simon and Schuster, 1966. It is a readable history of singing with a useful bibliography.

Pressman, Joel I. "Physiology of the Vocal Cords in Phonation and Respiration," Archives of Otolaryngology 35 (1942).

Puritz, Elizabeth. The Teaching of Elizabeth Schumann. London: Methuen & Co., 1956. This is an account of a quite personal style of singing. Breathing management is the foundation of her method.

Read, Donald and Clifford Osbourne. "Three Basic Variables in Vocal Tone," The NATS Bulletin 36/3 (Jan./Feb. 1980),pp. 8-11.

Rebner, Wolfgang and Ingrid Bettag. A New Approach to Music. Frankfurt, Peters, 1972. These interval studies are useful as a preparation for singing serial music.

Reid, Cornelius. A Dictionary of Vocal Terminology. New York: Joseph Patelson, 1983. A very useful book.

_____. "The Nature of Natural Singing," Journal of Research in Singing XI/2 (June 1988), pp. 3-29.

_____. "Science and Vocal Pedagogy," Journal of Research in Singing, VII/2, (June 1984), pp. 21-33.

Ristad, Eloise. A Soprano on Her Head. Moab, Utah: Real People Press, 1982.

Roma, Lisa. The Science and Art of Singing. New York: G. Schirmer, 1956.

Rose, Arnold. The Singer and the Voice. London: Faber and Faber, 1962.
An English-American style of describing voices with contemporary examples in typical opera roles is the most useful section.

Ross, W. Secrets of Singing. Bloomington Ind.: published by the author, 1959. Reprinted in "Towards an Integrated Physiologic-acoustic Theory of Registers." The NATS Bulletin, 30/4, (Feb./Mar. 1972), pp. 18-36.

Rubin, H. J., M. LeCover, and W. Vennard. "Vocal Intensity, Subglottic Pressure, and Air Flow Relationships in Singers," Folia Phoniatrica, 19 (1967), pp. 393-413. Reprinted in Contributions of Voice Research to Singing, ed. John Large. Houston, Texas: College-Hill Press, 1980.

Rushmore, Robert. The Singing Voice. New York: W. W. Norton, 1984.

Russell, Florence. The Subject is Singing. Los Alamitos, CA: Hwong Pub., 1979.

Ruth, Wilhelm. "The cause of the individual differences in the sensation of head resonance in singing," The NATS Bulletin, 23/1, (Oct. 1966).

Sable, Barbara Kinsey. The Vocal Sound. Englewood Cliffs, N.J.: Prentice-Hall, 1982.

Schafer, R. Murray. Miniwanka. Bancroft, Ont: Arcana. 1971.

_____. "When Words Sing," Creative Music Education. New York: Schirmer, 1976.
He uses an unconventional approach to reach the creative abilities of students.

Schoenhard, Carol and Harry Hollien. "A Perceptual Study of Registration in Female Singers," The NATS Bulletin, 39/1, (Sept./Oct. 1982), p. 22.

Seashore, Carl E. Psychology of Music. New York and London: McGraw-Hill, 1938.
This is a classic text in the field.

Slawson, A. W. "Vowel Quality and Musical Timbre as Functions of Spectrum Envelope and Fundamental Frequency," The Journal of the Acoustical Society-of America, 43/1, (1986), p. 87.

Stanley, Douglas. The Science of Voice. New York: Carl Fischer, 1939, 3rd. ed.

Stetson, R. H. "The Breathing Movements in Singing," Archives Neerlandaises de Phonetique Experimentelle (1931), pp. 115-164. Reprinted in Contributions of Voice Research to Singing, ed. John Large. Houston, Texas: College-Hill Press, 1980. pp. 5-57.

Stone, Kurt. Music Notation in the Twentieth Century. New York: Norton, 1980.
This book is a comprehensive text.

Sundberg, Johan. "Formant Techniques in a Professional Female Singer," Acustica, 32/2, (1975a), pp. 89-96.

_____. "Studies of the Soprano Voice,"The Journal of Research in Singing, 1/1, (1977), p. 24.

Swing, Dolf. "Teaching the Professional Broadway Voice." The NATS Bulletin, 29/3, (Feb./Mar. 1973), pp. 38-41.

Titze, Ingo. "Fundamental frequency scaling and voice classification," The NATS Bulletin, 37/1, (Sept./Oct. 1980).

_____. "Vocal Registers," The NATS Bulletin, 39/4, (March/April, 1983), pp. 21, 22, 27.

Triplett, William. "An Investigation Concerning Vowel Sounds on High Pitches," The NATS Bulletin, 23/3, (Feb. 1967), pp. 6-8, 50.

Troup, Gordon. "The Physics of the Singing Voice," Journal of Research in Singing, 6/1, (Dec. 1982) reprinted from Physics Reports, 74/5, (1981), pp. 379-401.

Van den Berg, Janwillem, William Vennard, Diomys Bergen, and Christy Shervanian. Voice Production--The Vibrating Larynx. Medical research film produced and distributed by Stichting Film en Wetonschap, Utrecht, 1960.

Vennard, William. Developing Voices. New York: Carl Fischer, 1973.
He has a logical, comprehensive covering of pedagogical approaches to singing.

_____. "How to Sing High Notes," In Memoriam, Wm. D. Vennard, 1909-1971.

_____. "Letter to the editor," The NATS Bulletin 19/1 (Oct. 1962), p. 5.

_____. Singing, the Mechanism and the Technic. New York: Carl Fischer, 1967.
This was the first standard text of the science of the singing voice.

Vennard, William, Minora Hirano and John Ohala. "Chest, Head, and Falsetto," The NATS Bulletin 27/2 (Dec. 1970), pp. 30-37. Reprinted in Contributions of Voice Research to Singing, John Large, ed. Houston, Texas: College-Hill Press, 1980.

von Buchau, Stephanie. "Lucky Lady," Opera News, (June 1985) p. 20.

Witherspoon, Herbert. Singing. New York: G. Schirmer, 1925.

Wormhoudt, Pearl Shinn. Building the Voice as an Instrument. Oskaloosa, Iowa: William Penn College, 1981.

_____. Letter to Roberta Stephen dated June 4/84.