IV

THE

VOICE

GENERAL CONSIDERATIONS

More ink has been spilled on the subject of the voice, vocal training, and the art of singing than on any other aspect of music. Unfortunately for singers and composers, much of what has been taught and written is narrow-minded, culture-bound, or just plain nonsensical. Opinions on the subject are often held with the force of dogma, and an inordinately high proportion of trained singers are likely to reject any new or unconventional vocal technique either as physiologically impossible or as literally damaging to their vocal organs; nor will such opinions be readily discarded even after the technique has been demonstrated to them.

The reader should accordingly be aware that some of what follows in this chapter is controversial. Caution is particularly necessary in acting upon the discussions of registers, vibrato, and styles of singing. It should be emphasized, however, that the vocal phenomena treated below are not in any way freakish or dangerous; they are all a normal part of the potential repertoire of almost any trained voice.

CLASSIFICATION OF SOUNDS

The most striking characteristic of the human voice is the incredible variety of sounds it can produce. Equally remarkable is the fact that 80 or 90 percent of these sounds are used to form words in one or another of the world's languages and dialects. The study and classification of

vocal sounds has thus fallen largely to linguists and semanticists, who have dealt with them according to their function as fundamental units of speech, or "phonemes."

These are divided into sounds that are essentially static and self-contained (vowels) and those that are transitory (consonants). Vowels are described on the basis of the configuration of the lips and position of the tongue. Those formed with rounded lips, such as the vowel sounds in "b*oa*t" and 'b*oo*t," are called **rounded** vowels; all others, such as those in "b*ee*t" and 'b*u*t," are **unrounded**. By the position of the tongue a vowel is classed as high or low, front, back, or central. The italicized vowel sounds in the following words are, respectively, high front, low front, low back, high back, and central:

p*ea*t p*a*t f*a*ther f*oo*d ad*a*m*a*nt

Consonants are divided into those such as "p," "d," and "k," in which the stream of air is completely stopped for an instant (**plosives**, or **stops**), those such as "v," "s," and "h," in which the stream is merely constricted so as to produce a hissing sound (**fricatives**), and those such as "m," "r," and "l," in which an otherwise vowel-like sound is used in a transitory fashion (**frictionless open consonants**). A further broad division is made between **voiced** consonants such as "b," "z," and "l," which involve the use of the vocal cords, and **unvoiced** ones such as "p," "s," and "h," which do not. In addition, consonants are classified by the manner in which the blockage or constriction of the airstream is formed, as follows:

Constriction or Blockage Formed by	*Type of Consonant*	*Examples*
both lips	bilabial	"m," "p," "w"
upper teeth against lower lip	labiodental	"f"
tip of tongue against upper teeth	dental	"th"
tip of tongue against bump (*alveolus*) behind upper teeth	alveolar	"l," "n," "r," "s," "t"
underside of tongue tip against alveolus	retroflex	(no English examples)
top of tongue just behind tip against hard palate	palatal	"y"
sides of tongue against back teeth	lateral	"l"
middle of tongue against soft palate	velar	"k," "ng"

Constriction or Blockage Formed by	*Type of Consonant*	*Examples*
back of tongue against hanging flap (*uvula*) at back of soft palate	uvular	(no English examples)
constricted throat	pharyngeal	"h"

It should be obvious that the Roman alphabet is totally inadequate to distinguish all the possible vowels and consonants. The International Phonetic Association has devised an alphabet that is internationally recognized and uniform. Though this **International Phonetic Alphabet** is no longer used much by linguists (real languages are not as tidy as use of the I.P.A. suggests), it is a godsend to the composer, since it provides a universally accepted notation for all the minimally distinguishable sounds used in human speech. Listed and described below are the letters of the I.P.A., with its diacritical marks, by means of which still more sounds may be notated. Figures 58 and 59 show the configuration of lips and tongue for each of the alphabet's twenty-four vowels plus the sounds [u+] and [ɯ+]. (In composition, phonetic letters and phonetically spelled words should be enclosed in brackets, as here, in order to differentiate them clearly from ordinary letters and words.)

Despite the comprehensiveness of the I.P.A., the reader will easily be able to find sounds not included in it and not describable with its diacritical marks—the voiced and unvoiced labiodental plosives, for example, and a wide variety of clicks and "Donald Duck" noises. If such sounds are worked into a piece, they should be notated by symbols not readily confusable with the letters of the I.P.A.

THE INTERNATIONAL PHONETIC ALPHABET

Vowels

- i as in English "f*ee*t"
- ɪ as in English "f*i*t"
- e as in French "th*é*" or German "b*e*ten" (English "long A" is usually pronounced [e͡i])
- ɛ as in English "p*e*t"
- æ as in English "*ca*t"
- a as in French "p*a*tte." Halfway between [ɑ] and [æ]
- ɑ as in English "f*a*ther"
- ʌ as in English "*cu*t"
- ɤ like [o], but unrounded. Halfway between [ʌ] and [ɯ]
- ɯ like [u], but unrounded. High, back, unrounded vowel
- ɨ Russian letter ы ("yery"). Centralized [ɪ]
- ə as in French "l*e*," German "bitt*e*," English "app*e*tite"
- ɐ as in English "tub*a*"
- ɒ as in British "h*o*t"
- y as in French "l*u*ne" or German "H*ü*te"
- ʏ as in German "Gl*ü*ck." Like [ɪ], but rounded
- ø as in French "bl*eu*" or German "schön"

œ as in French "b*oeu*f" or German "Götter"

ɔ as in English "s*aw*"

o as in French "d*o*s" or German "S*oh*n" (English "long O" is usually pronounced [o͡u])

ω or ʊ as in English "b*oo*k"

u as in English "sp*oo*k"

ʉ halfway between [ω] and [y]

ɵ halfway between [o] and [ø]

Diacritical Marks for Vowels

ˌ Placed beneath fricative or frictionless open consonant; indicates consonant sustained and treated as a vowel

– Placed after a vowel; indicates that it is fronted

‿ Placed under a vowel; indicates that it is rounded (labialized)

° Placed above or below a vowel; indicates that it is whispered

˜ Placed above a vowel; indicates nasalization

◌ʰ [h]-colored vowels ligature [h]

˞ Attached to lower right corner of a vowel; indicates [ɹ]-colored

Diphthongs are ligatured: "pie" = [pa͡ɪ]; "cow" = [ka͡ʊ]; "boy" = [bo͡ɪ]; "theater" = [θɪ͡əɹ]

Small superscript letters give fine shades of pronunciation.

Consonants

p as in English "*p*et"

b as in English "*b*et"

ʘ bilabial pop

t roughly as in English "*t*op." More precisely, English (alveolar) "t" is [t̪]; French (dental) "t" is [t̪]

d roughly as in English "*d*og." More precisely, [d̪] (alveolar); contrast French [d̪] (dental)

ǀ dental click (unvoiced). English "*tisk*"

ǂ alveolar click (unvoiced)

ʈ like [t], but retroflex

ɖ like [d], but retroflex

c unvoiced palatal plosive; halfway between [k] and [t]

ɟ voiced palatal plosive; halfway between [g] and [d]

ɮ lateral click (unvoiced)

k as in English "*c*at"

g as in English "*g*et"

ǁ velar click (unvoiced)

q unvoiced uvular plosive

ɢ voiced uvular plosive

ʔ glottal stop (for many speakers of English, used in words like "bu*tt*on")

ˈ glottal stop superimposed upon the consonant it precedes or follows

m as in English "ti*m*ing"

m̪ like [m], but labiodental rather than bilabial

n as in English "o*n*us"

ɳ like [n], but retroflex

ɲ as in English/French "co*gn*ac"

ŋ as in English "si*n*k"

ɴ like [ŋ], but uvular rather than velar

ɸ unvoiced bilabial fricative. Like [f], but bilabial

β voiced bilabial fricative. Like [v], but bilabial

ɒ rolled bilabial fricative (English "*brrr*")

w as in English "*w*ay"

ɥ as in French "n*u*it." Formed like [y]

ʋ like [w], but labiodental

ʍ like [w], but unvoiced (for many speakers of English, used in words like "*wh*ite")

f as in English "*f*er"

v as in English "*v*oid"

θ as in English "*th*ick"

ð as in English "*th*en"

ʊ simultaneous [s] and [f]

ʚ simultaneous [z] and [v]

ɻ simultaneous [ʃ] and [f]

ʒ simultaneous [ʒ] and [v]

s as in English "*s*ide"

z as in English "*z*oo"

ʃ as in English "*sh*ip"

ʒ as in English "vi*s*ion"

ɕ intermediate between [s] and [ʃ]

ʑ intermediate between [z] and [ʒ]

ʂ like [ʃ], but retroflex

ʐ like [ʒ], but retroflex

ɾ like [ʒ], but r-colored, as in Czech "Dvořák"

r rolled "r" of Spanish, Italian, Russian

ɾ like [r], but with just one tap rather than a full roll

ɽ like [r], but retroflex

ɺ intermediate between [d] and [l]

ɹ as in English "*r*abbit"

ç unvoiced palatal fricative, as in (high) German "*ich*"

j voiced palatal fricative, as in English "we *y*ield" (English "y" in most positions is pronounced [ɪ̯])

ɬ unvoiced lateral fricative

ɮ voiced lateral fricative

l as in French "*all*er" or German "*all*e" (English "l" is usually pronounced [ɫ]

ɭ like [l], but retroflex

ʎ like [l], but palatal

x unvoiced velar fricative, as in German "a*ch*" or Spanish "*J*uan"

ɣ voiced velar fricative, as in German "bewe*g*t"

χ unvoiced uvular fricative

ʀ rolled uvular "r," as in French "a*rr*acher"

ʁ unrolled uvular "r," as in French "peu*r*"

ɧ simultaneous [x] and [ʃ]

h as in English "*h*at"

ɦ like [h], but voiced; roughly as in English "uh-*h*uh"

ɳ like [ɦ], but nasal

ħ like [h], but with throat constricted (pharyngealized) (the sound of a polite cough is roughly [ʔħ])

ʕ like [ħ], but voiced

Diacritical Marks for Consonants

ˬ Placed beneath voiceless consonant; indicates voiced form

° Placed above or below a voiced consonant; indicates voiceless (whispered) form

ˇ Placed above a vowel; indicates vowel shortened and treated as a consonant

ˠ or ˤ Placed above a consonant; indicates pharyngealization or velarization (constriction of throat)

ʷ Placed beneath a consonant; indicates labialization (rounded lips)

ʲ Attached to lower right corner of consonant; indicates palatalization (middle of tongue raised, as for [ç] or [j])

n͡ŋ Nasalized consonants ligature [ŋ]

Small superscript letters give fine shades of pronunciation.

TEXT UNDERLAY

The text of any voice part, whether consisting of real words or meaningless sounds phonetically notated, should be written out syllable by syllable below the staff. Traditionally there must be at least one note for each syllable, but occasionally the pronunciation of a word is telescoped into fewer than the usual number of syllables. In such cases a ligature should be used to indicate the elision, as in the following examples:

"trying," when pronounced [tɹa͡ɑin], should be written "try͡ing"
"every," when pronounced [ɛvɹi], should be written "ev͡ery"

Each syllable should be placed directly under the first note on which it is sung, and if this results in a word being broken on the page, hyphens should be used to bridge the gaps, thus: "di---a-mond." If the last syllable of a word is to be sung on several notes, a solid line should be drawn from the end of the word up to the last note involved, thus: "im--pact___." Note that terminal consonants are given as part of the syllable to which they belong, not separately at the end of the line like this: "im--pa____ct." Punctuation, if any, can be placed either before or after such a line, but one should maintain consistency.

Vocal music is now notated just like instrumental music. Until fairly recently, however, the system in Figure 60 was used. The old system is still occasionally seen in new music.

The position of vocal parts in a score is not entirely standardized. The commonest and perhaps most logical solution is to place them between brass and percussion, but often scores show the voices at the top, at the bottom, between percussion and keyboards, or between keyboards and strings.

VOWEL FORMANTS

When writing for voice, the effect of pitch on the perceptibility of vowels must be taken into account. The distinctive timbre of each vowel is determined by a number of frequency bands called **formants** (the lowest pair of which is the most important) that are not dependent

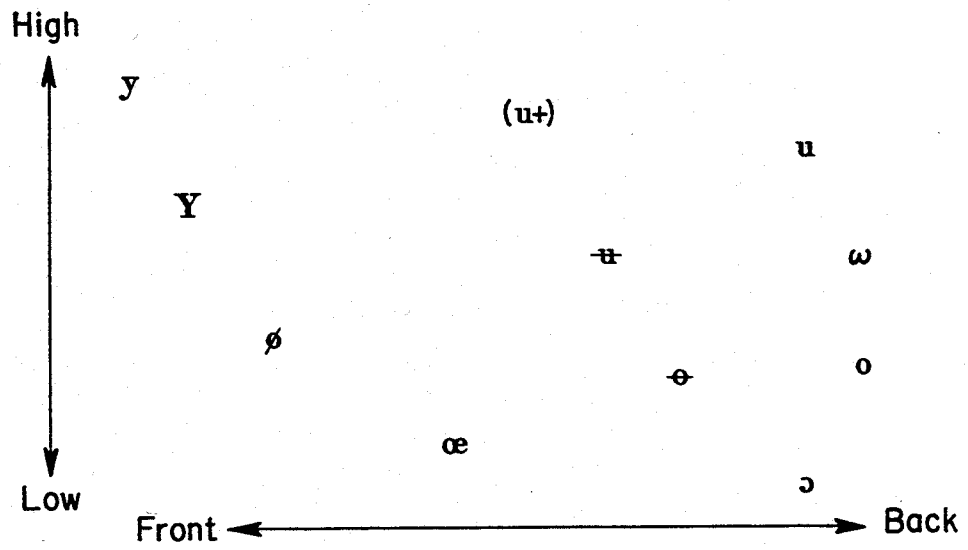


FIGURE 58. *Placement of the tongue for rounded vowels.*

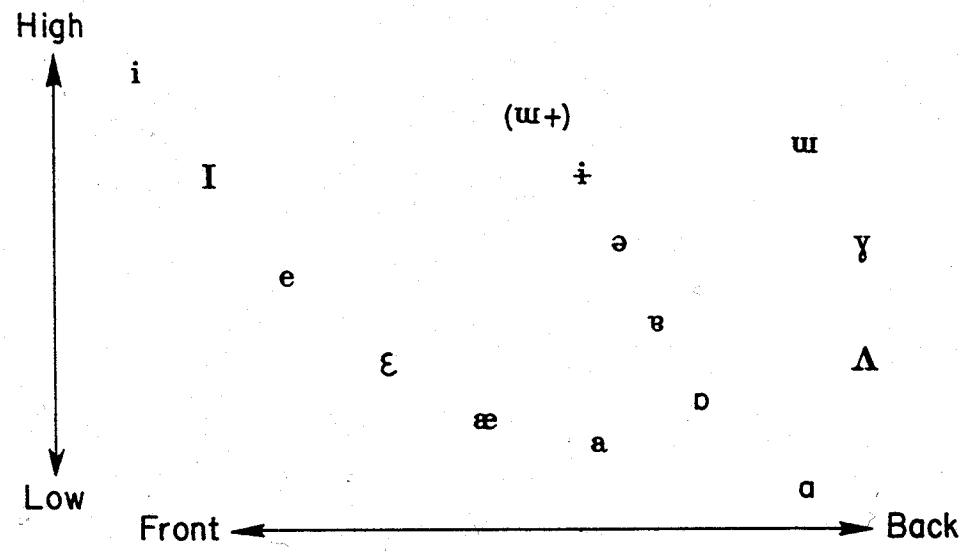


FIGURE 59. *Placement of the tongue for unrounded vowels.*

upon the pitch at which the vowel is sung. If the sung pitch is so high that only one or two partials lie within the lower two formant bands, the vowel is difficult to distinguish from others; and if the fundamental pitch lies above both bands the vowel disappears altogether, becoming a colorless, neutral sound. Figure 61 gives the *approximate* pitches at and above which different pairs of vowels become indistinguishable from each other. It will be noted that most of the vowels of the standard European languages are mutually indistinguishable above c^3, and that therefore words sung at or above this pitch are largely unintelligible. It is probably this more than anything else that has established c^3 as the traditional top of the vocal range, for, as we shall see, many women and almost all children can sing well above "high C." Singers are used to altering high-pitched vowels, partly to aid intelligibility and partly to

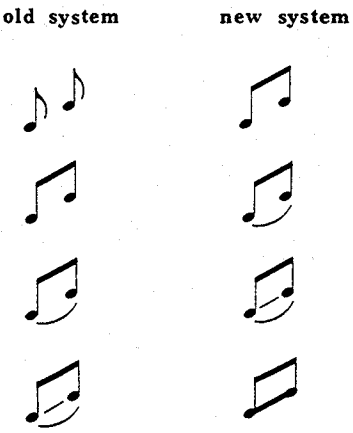


FIGURE 60. *Comparison of old and new systems of vocal notation.*

make them easier to sing. As a general rule, high and front vowels will be increasingly lowered and backed as the scale is ascended above about f^2. If this is not desired, some special instruction to the singer is probably necessary.

Nasal vowels have a very high harmonic development, and as a result of this they are distinguishable, as a group, from non-nasal vowels at even the highest singable frequencies. A pair of nasal vowels become indistinguishable from *each other*, however, at approximately the same pitch as the equivalent pair of non-nasal vowels. Because nasal vowels have such strong partials, those within the lowest formant band can easily be picked out by the ear. If one holds any pitch from about c^1 down and, starting with the sound [m̩], gradually opens the lips to [ã], then gradually fronts and raises the tongue to [ĩ], the lower formant will "scan" the audio range, picking out one after another the various upper partials of the note sung, starting with the second or third and ending somewhere between the sixth and the twelfth, depending on how low the sung pitch is. In his *Stimmung*, Stockhausen successfully bases an entire one-hour piece on this effect. The I.P.A. is insufficient in and of itself to specify this effect: if it is desired, one should notate the vowel as precisely as possible, appending a note to the singer such as "bring out fifth partial."

VOCAL TYPES AND REGISTERS

Acoustically, the voice resembles both strings and winds. The motion of air past the vocal cords causes them to vibrate against each other, like the lips of a brass player or the blades of a double reed; unlike these wind instruments, however, the frequency of the vibration is almost entirely determined by the length, mass, and tension of the cords themselves—exactly like a taut string. The cavities of the throat and mouth, while they strongly affect the timbre of the note produced, are too short and irregularly shaped to govern the vibrating frequency of the vocal cords. Rather, the frequency of a sung note is determined by the tension put on the vocal cords by the muscles of the larynx.

These muscles can cause the cords to vibrate in four distinct ways. These "modes of vibration" are somewhat analogous to the registers of woodwinds. The analogy is imperfect, however: although different partials are emphasized in each of these vocal *registers* (as they

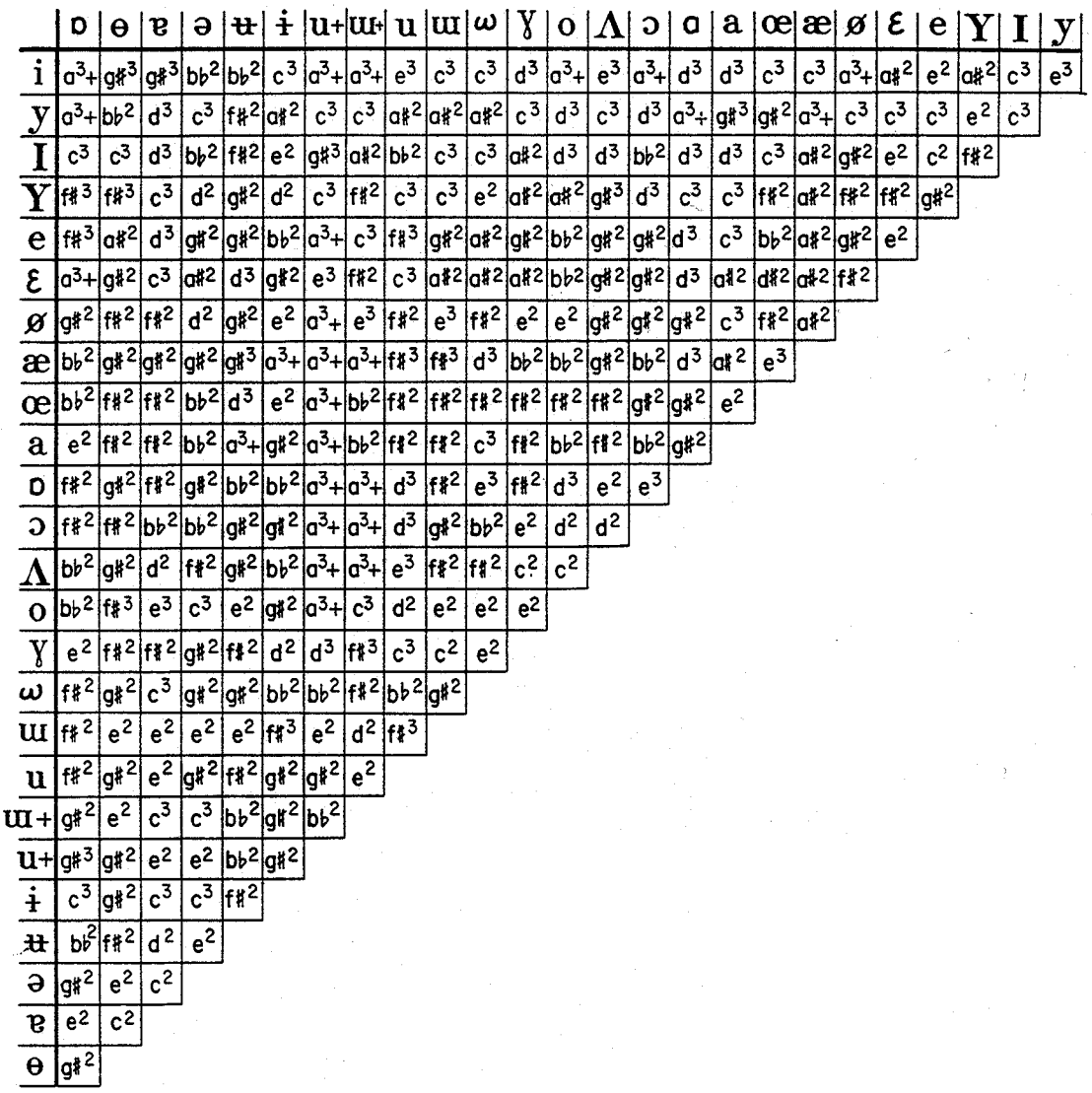


FIGURE 61. *Approximate pitches at (and above) which pairs of vowels are indistinguishable from each other. Those marked "a^3+" are still distinguishable at a^3.*

are in fact called), there is no true overblowing. An equally valid analogy could be made to the muscles of the legs, which behave differently in the three modes of ambling, walking, and running. From top to bottom, the four vocal registers are the whistle register, falsetto or head register, chest register, and growl register. Of these, only the chest and falsetto registers have been widely exploited.

The characteristic sound of each register is partially a function of the pitch range in which it is used. Thus, the average woman's chest register sounds very similar to that of a high-pitched man; on the other hand, the chest register of children, because it lies in essentially the same range as their falsetto register, is virtually indistinguishable from it in timbre.

The **chest register** is the one normally used in speaking. A few women speak with the falsetto register instead, as do many children. A very few men speak with their growl register—soft, gravelly, and very deep.

The chest register of both men and women is warm, rich, and sonorous. It is the most

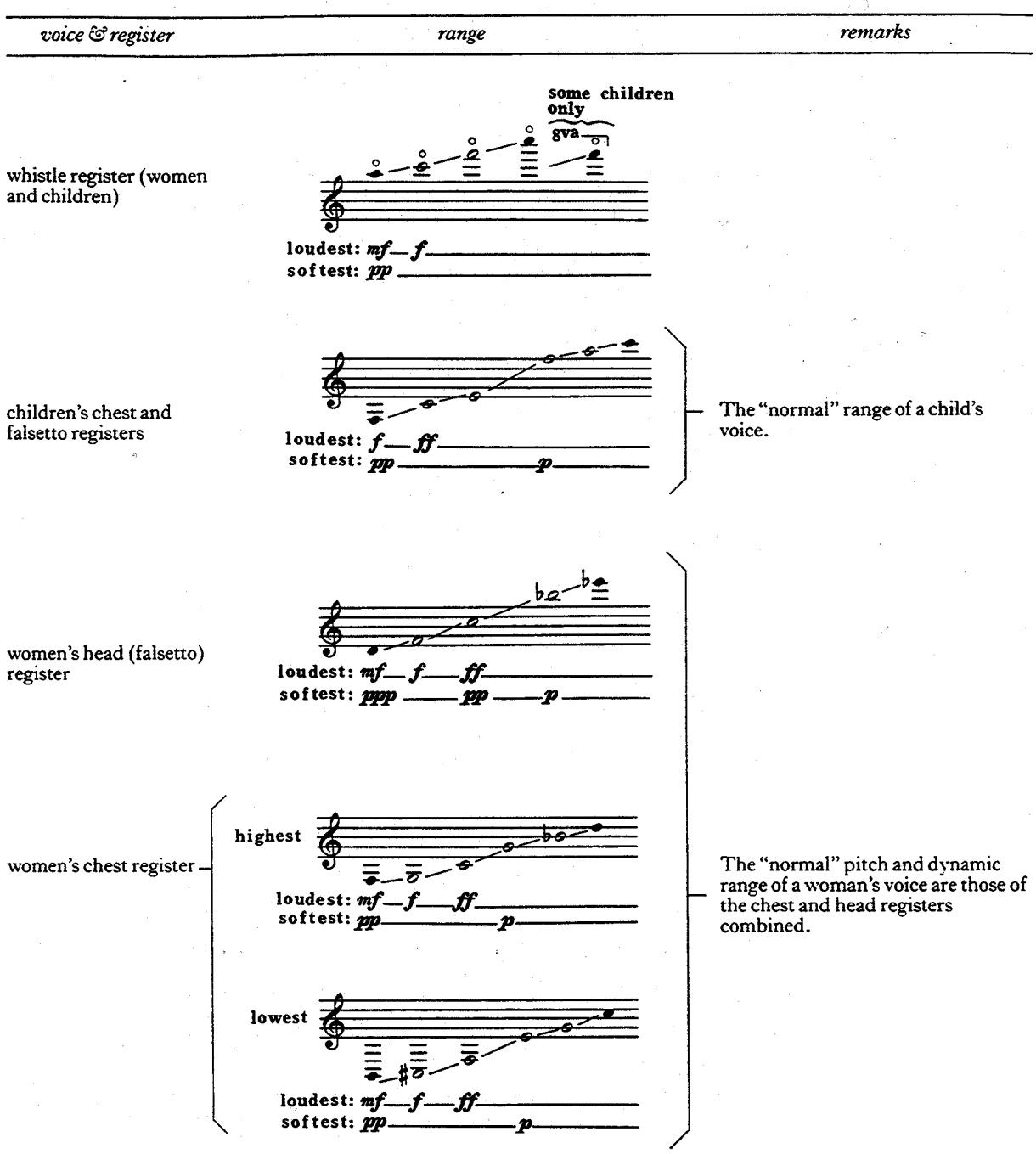
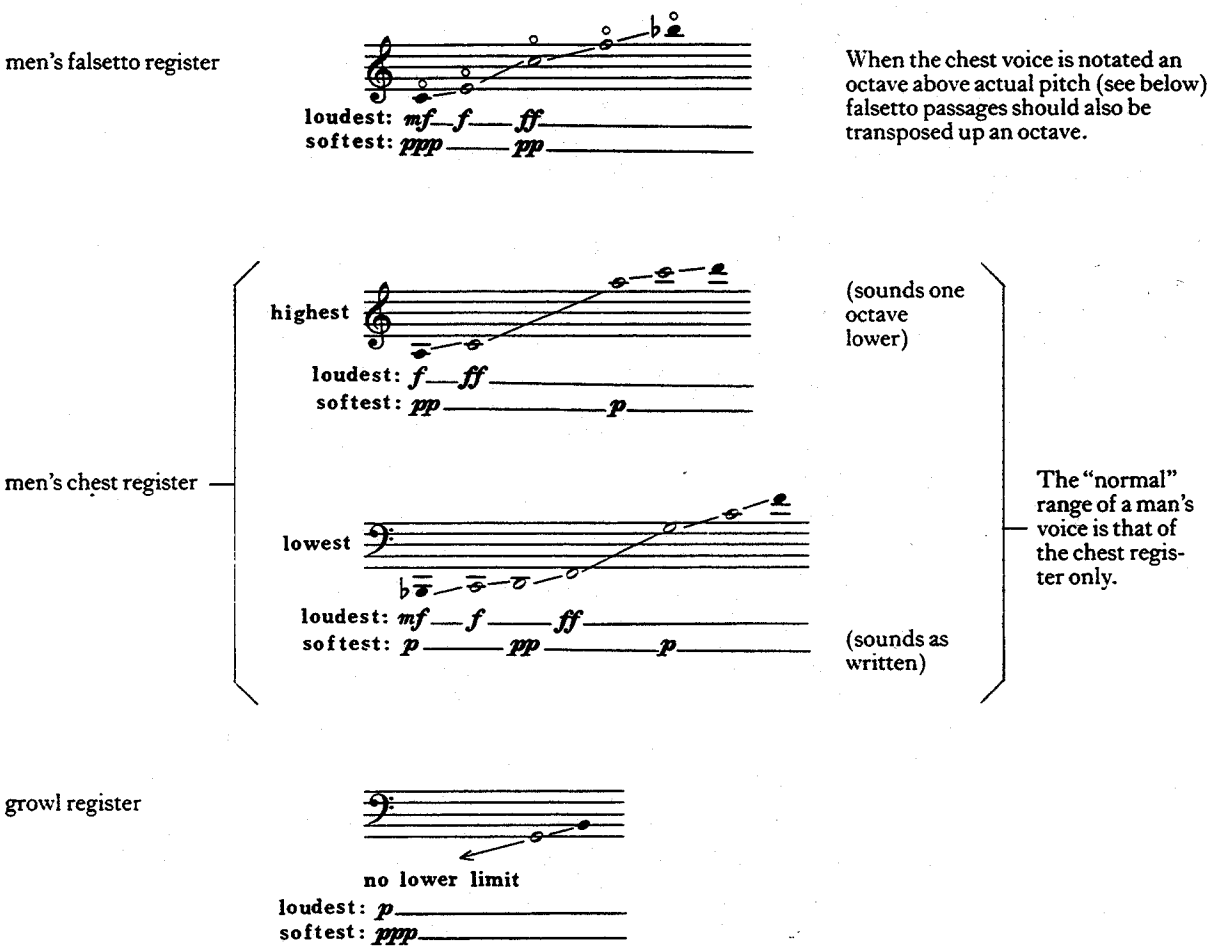


FIGURE 62. *The voice—vital statistics.*

clearly "vocal" in quality of the four registers, and most clearly conveys to the listener the immense load of emotional and psychological associations the voice always bears in speech however deadpan, in song however abstract. The chest register is the only one of the four that varies much in pitch from person to person, and because it is so important, the voice as a whole is regarded as high, medium, or low almost entirely on the basis of whether the chest



The voice—vital statistics, continued.

register is high, medium, or low. In this regard it should be mentioned that the extreme ranges given in Figure 62 are the highest and lowest that are common enough not to be considered freakish or physiologically abnormal. The extension tones given for all four registers are not a matter of training but of biology, and while voices do exist with both the bottom and top extension tones as indicated, such voices are *extremely* rare, and one will be the more likely to find a singer the less extreme the range demanded. Similarly, intermediate-range voices are much more common than the high and low extremes given in Figure 62. In writing for massed voices (chorus), the range of each part should not generally exceed two octaves for women, or a major thirteenth for men or children.

The chest register is considerably less agile than the falsetto register, and rapid runs and ornaments tend to sound blurred and muddy. As mentioned above, the chest register of children is almost completely overlapped by the falsetto register, and is very similar to it in tone. Boys' parts are occasionally written down to f^0, the additional notes being available in the

chest register of some boys when their voices are just about to break.* A few girls also have these low notes, and their speaking voices have a startlingly grown-up quality.

Compared to the chest register, the **falsetto register** is relatively thin and colorless—though it has a great deal more character than the tone of, say, the flute. When trained, it can be quite brilliant and powerful in the range above about c^2, but it will always be somewhat weak and thin below that pitch. In ordinary adult speech it is used only in shrieks. It also appears (inadvertently) when the chest voice has been exhausted by prolonged loud talking or when one is in the grip of a strong emotion.

In traditional Western classical music the falsetto register of men has been used only by specialists called **countertenors** (about whom more later), who are not expected to use the chest register; otherwise it occurs only rarely, as a parody of a woman's voice or to signify (through its emotional flatness) madness or idiocy. In a traditionally trained woman's voice, however, the falsetto register takes over the main job of singing, and the chest register is completely subordinated to it. It is for this reason that women's voices are supposed to sound different from men's, although in ordinary speech and certain kinds of popular singing (as well as in most non-Western vocal styles) the difference is actually very small.

The falsetto register of both men and women is very agile and flexible, capable of executing with precision the most rapid runs and trills. A child's falsetto register is just as flexible, but it is extremely rare to find a child with the intelligence, musicianship, and dedication necessary for the acquisition of a coloratura technique. When composing for children's voices it is necessary to take into account these technical limitations; the maximum credible demands upon a child soprano are made in the soprano solos of Bach's cantatas, which can be adequately sung by only a handful of boys in each generation. The falsetto register of children of both sexes (as well as the virtually interchangeable chest register) is strong and liquid in tone; the difference between this sound and that of a woman's falsetto register is mostly due to the very small size of the resonating cavities in the child's mouth, nose, and chest. Despite great similarities, boys' and girls' voices do differ slightly in timbre, and as the boys' sound is the more distinctive there has been much more written for boys' voices than for girls'.†

The **whistle register** is most frequently heard in the incredibly high-pitched shrieks of children at play. It is a normal component of every child's voice, but has never been used in music, probably because of the indistinguishability of vowels at such high frequencies. Most adult women retain a usable whistle register, but it is rather difficult to control, and the vast majority of singers are, for no particular reason, not trained to use it. It is a colorless, thin, piping sound whose musical potential has been so far almost completely ignored. The few places this register has been required (invariably mixed with some falsetto component) are for the most part intended to portray a spectacular kind of insanity—Mozart's psychotic

* When a boy's voice breaks, the chest register parts company from the falsetto register and, in the space of one or two years, descends to its adult pitch. During this time the chest register is absolutely useless for singing, and to attempt to train the voice then may damage it. The adolescent's suddenly lengthened vocal cords are as clumsy as his suddenly lengthened limbs, and will "trip" into the falsetto register at unpredictable moments. Girls' voices also change at puberty, but much less dramatically than boys'—there is no sudden break, and no loss of control.

† It should be remembered, however, that the initial impetus for the use of boys' voices was the liturgical prohibition of female singing in church. A girl's voice is, with the rare exceptions mentioned earlier, clearly identifiable as a child's voice, and the distinction between boys' and girls' voices has almost certainly been overstressed by our culture.

Queen of the Night is perhaps the best and best-known example. There is no reason why this should always be the case, although it must be admitted that this sound, which forms no part of normal human speech, can be decidedly eerie. Very few men possess a whistle register, and those who do have merely a few harsh and painful squeaks widely separated from the rest of their range.

If the chest, falsetto, and whistle registers are roughly analogous to the lower, upper, and altissimo registers of woodwinds, then perhaps the **growl register** is best compared to the privileged-frequency pedals of brass instruments. It is a weak, flabby, low-pitched noise of rather indefinite pitch. Because they are so poorly resonated by the body, these tones are more an undefined rattle or buzz than a specific pitch, and it is very difficult for the singer to pinpoint a pitch when producing this register. Accordingly, it should be composed only as a non-pitched sound, or at least as *sprechstimme* (q.v.). Incredible as it may seem, there is no lower limit to the growl register, and with a little practice anyone can produce isolated clicks at frequencies of 1 Hz or less. These are, needless to say, almost inaudible, and are certainly not heard as pitches. For some reason the growl register, in contrast to the other registers, is most easily performed on the inhale.

Everything that has been said so far in this chapter about registers applies to the voice as an unmodified bio-acoustical entity, as reflected in the speech and song of ordinary people all over the world. When we examine voices that have received a traditional Western classical training the situation becomes more complex.

Classically trained singers are taught to suppress as much as possible all distinctions between registers; for the most part, this is accomplished by mixing the registers. Since the registers of the voice are created by the use of specific combinations of throat muscles, it is possible to mix registers by using intermediate or combined muscular configurations, and by this means the timbre of the voice can be made smoothly continuous across a large portion of its range. Women singers borrow from the chest voice to shore up the power of their falsetto register below c^2 or d^2, and modify the upper part of the chest register to make it sound as much like falsetto as possible. Because the lowest fourth or fifth of the chest register cannot be convincingly modified in this way, it is usually sacrificed. At the other end of the scale, high-note specialists (**coloratura sopranos**) borrow from their whistle register to make the notes above c^3 more secure and less of a strain. Many singers consider the range between approximately d^1 and c^2, where the chest and falsetto (head) registers are strongly blended, to have a distinct register of its own, the "throat" or "middle" register. This "register" is, however, an artifact of training; it is simply a mixture of chest and falsetto tone.

The chest and falsetto registers of men are so distinct from each other in range that the subtle blending accomplished by women is out of the question. Accordingly, since uniformity of timbre is a major goal of classical voice training, the falsetto register is sacrificed altogether, and singing is restricted to the pure chest register. Classically trained male voices of all ranges do, however, borrow from their falsetto register to make their highest chest tones smoother and more secure, calling the resultant mixed timbre the "head register" by faulty analogy with the female voice. The rare **basso profundo**, with chest tones below D_0, reinforces these low notes by borrowing from the growl register. For the performance of early music, some men are trained as **countertenors**, singing for the most part only in the falsetto register, with the lowest tones shored up by some chest quality, and perhaps a few modified chest tones at the bottom to take the compass down to f^0. Countertenors usually have trained

		Light	*Dark*
Women:	high	lyric soprano	dramatic soprano
	medium	lyric mezzo	dramatic mezzo
	low	×	alto
Men:	high	lyric tenor	dramatic tenor
	medium	baritone	bass-baritone
	low	basso cantante	basso profundo

Women with a tone quality of intermediate darkness are often called **spintos.** Light-voiced and spinto women with great range and agility are called **coloratura** sopranos or mezzos.

FIGURE 63. *Classical vocal types classified by basic vocal range and timbre.*

chest registers, too, and can sing a perfectly good tenor, baritone, or bass, but the use of *both* registers equally in the same piece is not found prior to about 1960.*

In addition to being uniform in timbre, a classically trained voice must be able to project clearly to the back of a large hall, and compete unamplified with an orchestral tutti. To this end singers are taught to acquire a timbre that is somewhat darker and fuller than that of the untrained voice. Persons with naturally dark, rich voices are rare, but many singers are able to acquire this sound through training. The extent to which one is born with or can acquire the dark quality determines the kind of voice into which one is trained (see Fig. 63).

Note that the pitch ranges associated with these various vocal types do not exactly jibe with the actual range of the voice concerned. A woman with a light, low voice (an extremely common type) will *not* be trained to sing alto, but will more likely be taught to sacrifice her "unsuitable" chest register and end up as a lyric soprano! Bass-baritones are expected to be strongest at the bottom of their range, despite the fact that that range may be no different from that of an ordinary light baritone, and bassi profundi are expected to sing as much as a fourth lower than bassi cantanti. A trained voice often becomes darker with age, and because naturally dark voices are so rare, most singers whose voices fall into one of the dark categories tend to be at least in their late thirties: that is why so few Siegfrieds and Brünnhildes come up to Wagner's expectations of youth and beauty. In writing for dark voices, one must be aware that their power is gained at the expense of both agility and pitch range—dramatic sopranos who attempt a light coloratura role usually fare disastrously. Women who have trained their voices to darkness are likely to have suppressed their whistle register altogether.

In writing for the voice, one must expect to hear the part sung in one or another of the traditional vocal styles described above. If one desires a "natural," popular, non-Western, or otherwise non-traditional vocal quality it should be specified. The easiest way to make such a specification is either to name the style involved or to refer to a famous singer who uses that style. Whistle-register notes should be notated as if they were harmonics, as should individual male falsetto tones. If unmixed chest or falsetto tone is desired in the throat-register range of a woman's voice, the term "pure chest" or "pure head" should be used (many women singers use the term "falsetto" to refer to the whistle voice, so "head voice" is less ambiguous).

* Prior to about 1830, it was customary for tenors to take high notes in falsetto, rather than straining after b^1s and c^2s in the chest register as they do now.

PERFORMANCE CHARACTERISTICS OF THE VOICE

Let it be stated at the outset, at the risk of belaboring the obvious, that singers must be allowed to breathe! Though professional singers sing somewhat more efficiently than other people, their breath control is nonetheless limited, and one will never go wrong in restricting vocal writing to passages that one can oneself take in a single breath. In fact, a good general rule for vocal writing is: "If *you* can sing it, *they* can sing it." Cyclic breathing is *not* possible for the voice, but it is possible to sing on the inhale. Unless the singer has practiced this unorthodox technique long and hard, the sound will invariably be somewhat gasping. In writing for inhaled singing, extremes of pitch or dynamics should be avoided. The alternation of inhaled and exhaled song does not enable the production of an indefinitely continuable tone as cyclic breathing does—because each time the direction of the breath changes the sound must stop for an instant—but it does enable the production of nonstop sixteenth-note chatter. Whenever inhaled singing is desired it must be specified, and the composer should bear in mind that inhaled plosives (**implosives**) sound different from exhaled ones.

VIBRATO

It is not generally realized, even by singers, that four distinct types of vibrato are available in singing. **Diaphragm vibrato**, the type used by wind players, is employed by singers in exactly the same way. It causes a fluctuation in the loudness of the tone without affecting either pitch or timbre, and can be varied in both speed and amplitude. The **throat vibrato** is made with the muscles of the pharynx, is also variable in both speed and amplitude, and affects only the loudness of the tone. It is most easily produced at a somewhat higher speed than the diaphragm vibrato. At high amplitude it becomes the *trillo* ("goat's trill") of Monteverdi and his contemporaries; at even higher amplitude it becomes a series of glottal stops.

The **laryngeal vibrato**, often confused with the throat vibrato, is an entirely different entity. This is the so-called "natural" vibrato that does indeed come naturally to most untrained singers and forms an invariable part of the tone of all classically trained singers except children and countertenors. This kind of vibrato is formed in the larynx, probably as an interaction between two adjacent registers. Into the actual register in which the note is sung is admixed a small but fluctuating component of the other register, which creates a vibrato affecting both pitch and timbre. The fluctuation is the result of a natural give-and-take of the muscle groups involved, responding to the physiological/acoustical instability inherent in the mixing of registers, and the frequency of a laryngeal vibrato is usually a fixed and invariable quality for any given singer. The amplitude of this vibrato can, however, be adjusted; it can be suppressed entirely if desired, or augmented to help form a trill—in fact, the usual classical trill is performed in just this way.* Men do not seem to be able to produce a laryngeal vibrato when singing falsetto, nor does this kind of vibrato come very easily to children; since the laryngeal vibrato is the only kind usually recognized in classical voice training, children

* Trills can, however, be produced by other means, and are not limited to the range and registers in which the laryngeal vibrato can be produced.

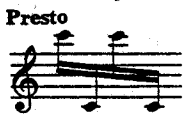
and countertenors are usually taught to sing without any vibrato at all. In practice, the laryngeal vibrato is occasionally supported by a superimposed throat or diaphragm vibrato.*

Unlike the other three kinds of vibrato, the **mouth vibrato** forms no part of classical voice technique. It is produced by moving the jaw and/or tongue, and is thus a fluctuation of timbre rather than of pitch or loudness. Mouth vibrato is normally used in the West only in certain kinds of popular singing. It is variable in both speed and amplitude, and can be performed simultaneously with any of the other forms of vibrato—at a different speed if so desired.

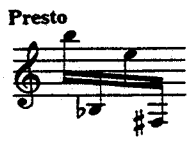
To sum up: all trained singers (except countertenors and children) and most untrained singers will normally sing with a mild to moderate laryngeal vibrato, possibly supported by the throat or diaphragm. If it is desired to have a passage sung without vibrato, the instruction "senza vibr." should be used. If any modulation of vibrato speed or amplitude is desired, instructions to that effect must of course be given, and if mouth vibrato is desired it must be specified. Modulation of the vibrato speed will automatically be performed with the requisite diaphragm or throat vibrato without any special instruction to that effect—nonetheless, one occasionally finds singers so tied to the laryngeal vibrato that they must be taught, or at least reminded, that other possibilities exist.

PITCH LOCATION

Within a given register the voice can produce infinitely subtle gradations of pitch, the only limit being the acuteness of the singer's ear. In order to reproduce a pitch accurately, the singer must be able to feel, at least subconsciously, the precise adjustment of the laryngeal muscles necessary to produce that pitch, and accordingly must be able to hear the note clearly in his or her head *before* attempting to sing it. This, combined with the fact that the singer's "feel" for the laryngeal muscles is disoriented when their configuration must be greatly changed, means that large leaps cannot be executed at the fastest speeds. This is particularly true when awkward intervals are involved, so that while



may be possible for some singers (and I do not claim that it is),



certainly is not. Again, the limits on vocal acrobatics are much stricter for children than adults.

* It is physiologically impossible to perform combinations of these three types of vibrato at different speeds simultaneously.

Singing	*Speaking*
voice moves from one discrete pitch to the next	pitch constantly fluctuates
usually with vibrato	without vibrato
tone supported by the diaphragm and rib cage and focused by the throat muscles*	tone unsupported and unfocused except in stage speech
all registers used	usually only chest register used
rhythm usually moves in discrete, proportional units	rhythm free, flexible
dynamic range usually broad	dynamic range usually narrow
pitch, rhythm, and dynamics have *musical* meaning	pitch, rhythm, and dynamics have *grammatical* meaning
classically with darkened tone	with ordinary light tone

*Singing without support produces a very weak and "private" sound, almost like singing to oneself. Unsupported singing is practiced in various Western folk traditions and in some non-Western classical styles.

FIGURE 64. *Differences between speaking and singing.*

Very few singers can begin singing out of the blue and hit a given pitch correctly without reference to some previously heard pitch. That pitch may be several octaves away from the one that is to be sung, or it may be at some outlandish, dissonant interval; it may even be the last pitch of the previous song, desperately kept in the head through bows and curtain calls; but, one way or another, it must be there: the composer *must* provide some pitch for the singer at the end of any long rest in the voice part. It is flatly unreasonable to expect a singer to hit any specific pitch accurately after, say, five minutes of indeterminacy or unpitched noises. (The beginning of a piece is an exception to this rule, since the singer can get a note from a pitch pipe while in the wings, or from an instrumentalist while tuning up on stage.)

SPEECH/SONG HYBRIDS

By now it should be clear to the reader that there are numerous and considerable differences between singing with the voice and speaking with it. Figure 64 shows these differences in tabular form. It should be pointed out that ordinary speech is almost never found in any musical context; where spoken dialogue occurs, the supported and focused tones of **stage speech** are used. If genuine ordinary speech is desired, an instruction such as "ordinary speech—do not project or support" will be needed. Many kinds of vocalization intermediate between speech and song exist and are recognized musically, as follows.

1. Rhythmically free singing. This is notated with stemless note-heads and the instruction "in the rhythm of ordinary speech."
2. Rhythmically notated speech. Here the rhythm is controlled by the composer while all other aspects of the sound are produced as in normal speech. It is notated with headless stems and beams.
3. Modulated speech. This resembles rhythmically notated speech, but the positions of

the stems on the staff indicate the general pitch contour of the spoken line. If desired, the rhythm can be left free, but there is no standard notation for that contingency.

4. **Sprechstimme.** The tone quality is halfway between speech and song. In addition, each notated pitch is briefly touched in passing but speech inflections are maintained. Sprechstimme is notated by ordinary notes with X's through the stems. It may be employed in free rhythm, in which case stemless note-heads are used and the X's are placed just above or below them.
5. **Parlando.** This is fully sung, except that the notated rhythms are bent somewhat in the direction of normal speech rhythms; to a lesser extent, the pitches are bent as well. This is the style of singing used in the *recitativo secco* of eighteenth-century Italian opera. It is notated as if fully sung, with the instruction "parlando."

SPECIAL EFFECTS

Voices are second only to woodwinds in ability to produce multiphonics. With the voice, these are produced by attempting to sing simultaneously notes from two different registers. As with woodwinds, it is folly to notate them as chords, since this tells the singer nothing about how to make the sound—in any case, few, if any, singers have enough control to produce multiphonics so precisely and the sound of a vocal multiphonic is even more unitary than that of a woodwind one. Most vocal multiphonics are harsh, gritty affairs, and even the occasional bare octave or twelfth sounds coarse and constricted. One should, as with woodwinds, merely give the main pitch of the multiphonic, together with an indication of the general tone-quality desired. Multiphonics are hard on the throat, and singers should not be required to produce them over long stretches of music. They are easier to produce and easier on the throat when inhaled. An exception is the multiphonic produced by attempting to sing falsetto just a little too low. This sound—produced by many people as a sigh of exasperation—can only be performed on the exhale and is not at all hard on the throat.

A number of devices exist for altering the timbre of the voice in ways similar to the mutes of brass instruments. The **kazoo** is a tube in one side of which is a hole loosely covered by a small membrane. When one inserts the tube into the mouth and sings through it, the membrane rattles sympathetically with the vibration of the air column, making a buzzing sound. It is of course impossible to form bilabial or labiodental consonants while using the kazoo, and the tube suppresses the various vowels rather strongly, so that only three or four distinguishable vowels can be produced through it. The buzzing sound can be stopped simply by covering the membrane with a finger. As an alternative to the usual way of playing the kazoo, the far end of the tube can be covered with one hand while one hums through the nose. In this case the buzzing will stop whenever the sounds [n̥], [ŋ̥], [ɴ̥], etc.—all of which will sound alike because of the tube—are articulated.

Singing through a cardboard **mailing tube** makes the voice sound covered, distant, and mysterious. The natural resonating frequency of the tube dominates the sound and obscures the vowels.

The **megaphone** is simply a cardboard, plastic, or metal cone that concentrates the voice and projects it forward. In addition to making the voice slightly louder, it increases its "presence" and cuts out a large number of high overtones. The **bullhorn** is an electronic mega-

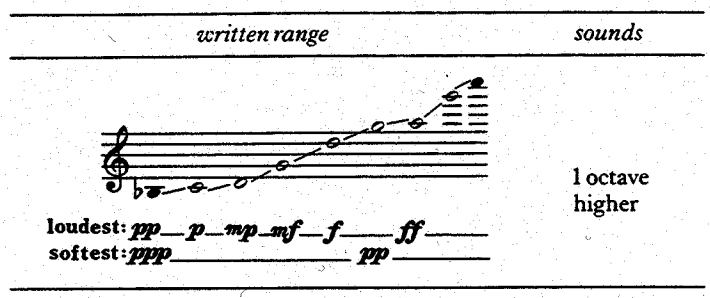


FIGURE 65. *Whistling—vital statistics.*

phone consisting of an amplifier, a very small loudspeaker, and a flared metal cone. Since the device is equipped with a squelch mechanism to keep it from responding to soft background noises, it will only respond when sung or spoken into *forte* or louder, reproducing the sound at levels ranging from *ff* to *fff*. The bullhorn reproduces high and low frequencies very weakly, and thus sounds somewhat like a cheap radio turned up loud. Because of the squelch, plosives become veritably *ex*plosive, and the whole effect is almost luridly apocalyptic.

Finally, one can alter the sound of the voice by singing into a drinking glass, cupped hands, or other cavity. This produces an echo-like timbre in which the resonant frequencies of the cavity are reinforced. If one covers the open mouth tightly with a glass or bottle and then hums through the nose, a different sound results; in this case, the cavity resonance is added to that of the natural cavities of the throat, nose, and chest, adding an additional vowel formant and changing the whole character of the voice, which then sounds thin and nasal—almost as if the singer were inside the bottle. This effect works best when the cavity is fairly large (milk-bottle or wine-bottle size), and if it is large enough (gallon-jug size), one can even sing directly into the bottle through the mouth for a second or two until the air pressure inside it becomes too great.

WHISTLING

Whistling is one of the great unexplored regions of music. Despite the great range and flexibility a practiced whistler can command, very little music has specifically been written to be whistled. For those wishing to give it a try, Figure 65 says virtually all that has to be said. A whistled note has *no* overtones, its timbre being due entirely to its envelope and the slight component of hiss produced by the air as it passes between the lips. In whistling, the stream of air is directed by the top of the tongue downward and outward between the lips, which act exactly like the embouchure hole of the flute. The pitch is determined by the distance between the tongue and the lips. The sound can be varied from a pure, clean whistle, to a hissy or breathy whistle, to colored noise, or all the way to simple white noise (the sound [ʍ̥]).

Whistling can be extremely agile, and good whistlers can execute the most rapid runs and trills cleanly. Large leaps are subject to the same restrictions as for the voice, except that here it is the tongue rather than the vocal cords that must feel the correct position for each note. Articulation in whistling is performed by the glottis, throat, and diaphragm except in extremely rapid figures such as grace notes, when the notes are articulated by the tongue with alternating [d̥l̥] and [l̥ə̥]. Very clean trills can be produced in this way by some whistlers; others simply move the tongue back and forth rapidly between the two notes of the trill. A

tasteful vibrato is impossible in whistling. Some whistlers indulge in a kind of perpetual trill that is supposed to be a vibrato—it sounds awful.

Whistlers, like everyone else, must breathe, but they have an advantage over both singers and wind players in being able to perform easily and convincingly while inhaling as well as while exhaling. The highest and lowest notes of the range cannot be performed on the inhale, nor should one make the mistake of assuming that a whistler can hold a single note or draw out a slur for an indefinite length of time, for the note or slur cannot be held while the breath changes between inhale and exhale.

It is possible to fluttertongue while whistling, but only in the range from (sounding) f^2 to a^3.

There are perhaps one or two people in the world who can whistle and hum two different musical lines simultaneously. It is, however, relatively easy to whistle a tune while humming a fixed note, and vice versa. It is somewhat more difficult, but still within the realm of realistic options, simultaneously to hum and whistle the same tune in strict parallel harmony. The most interesting sound is that produced when the whistle reinforces one of the partials of the voice. Whistling and humming in actual unison (*not* an octave apart) sounds so eerie as to be unsettling. Remember that there is no rule which says that a singer must know how to whistle, and that at least as of this writing far more men than women are virtuoso whistlers.

Musical Examples

"NATURAL" VOICES:

Partch, *The Delusion of the Fury* (Act II)
Weill, *Die Dreigroschenoper*

WOMEN'S VOICES:

Schoenberg, *Herzgewächse*
Maxwell Davies, *Revelation and Fall*
Berio, *Sequenza III*

MEN'S VOICES:

Stravinsky, *Renard*
Henze, *El Cimarrón*
Maxwell Davies, *Eight Songs for a Mad King*

CHILD'S VOICE:

Stravinsky, *Mass*
Xenakis, *Oresteia Suite*
Crumb, *Ancient Voices of Children*

MIXED SINGLE VOICES:

Stockhausen, *Stimmung*
Ligeti, *Aventures/Nouvelles aventures*

CHORUS:

Schoenberg, *Friede auf Erden*
Stravinsky, *Les Noces*
Xenakis, *Nuits*

WHISTLING:

Ives, *Memories* ("A: Rather pleasant")