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Phonation types: a re-appraisal

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The Eighth International Congress of Phonetic Sciences (Leeds, 1975) provided an opportunity, at a discussion seminar called specially for that purpose, 'The larynx and language', for phoneticians anxious to put phonation distinctions on a more systematic footing to appeal to specialists in the aerodynamic aspects of laryngeal activity and in the physiology of the larynx to help them with criteria to define the phonation distinctions so far observed in languages. In introducing the topic at the discussion seminar E. J. A. Henderson confined her examples to Cambodian, to illustrate the 'sepulchral' phonation appropriate to what she terms the lower register (Henderson 1952:157); but a number of languages are listed in Catford 1964 as making lexically distinctive use of phonation types, Danish, Hindi, Nilotic, Javanese, and Gujarati (p. 36); and Ladefoged 1971 lists some of these and a considerable number of others, including Sindhi, Zulu, Hausa, Wolof, and French (pp. 12-19). In part this article is a continuation of that attempt to attract the attention of instrumental phoneticians to problems posed by phonation differences in languages such as these; but to a large extent it results from a re-examination of various published accounts of phonation distinctions that I undertook in the course of teaching general phonetics. The most comprehensive of these accounts, and the one that I shall chiefly refer to, is Catford 1964, and the tape-recording in which he illustrates a number of the phonation types that he distinguishes in that article;¹ but I have also drawn on Sweet 1877 (3rd edition, 1906), guided by Henderson 1971, Pike 1943, Heffner 1950, Abercrombie 1967, and Ladefoged 1971.

I. 'Stricture' and 'location' (Catford 1964)

Catford frames his analysis in terms of the two categories 'stricture' and 'location', with the former comprising five types, and the latter comprising four, as follows:

'stricture': breath, whisper, voice, creak, stop

'location': glottal, ligamental, arytenoidal, ventricular.

¹ This article was submitted before the publication of Catford's book *Fundamental problems in phonetics* (1977); but the following passage from the book makes it clear that he has not changed his analysis substantially: 'Since 1964 there have been one or two other attempts to characterize phonation types, . . . They do not, however, indicate the need for any radical change in the 1964 classification, which we therefore present here with little modification' (p. 95).

He combines the types of stricture, other than the stop, with each other in the following combinations:

breathy voice :	breath + voice
whispery voice :	voice + whisper
whispery creak :	whisper + creak
voiced creak :	voice + creak
whispery voiced creak :	voice + whisper + creak

(Catford 1964 : 30-3);

and there is an example of each of these five combinations in his tape-recording 'Phonation types', as numbers 6-10, with the addition of ligamental voice as number 11.

II. Activity and posture

The fact that Catford's five stricture types are not mutually exclusive, and enter into combinations with each other, suggests to me that they do not all belong to the same system, and that those which co-occur should be treated as members of separate and parallel systems. Further, in distinguishing these systems, the most important distinction appears to me to be not Catford's division into stricture and location categories but a division into (A) ACTIVITY, the activity of the vocal cords, and (B) POSTURE, the posture of the glottis. ACTIVITY I treat in terms of two systems: one of them, VOICING, deals with the vibration versus the non-vibration of the vocal cords; the other, TRILLIZATION, deals with the feature termed 'creak' by Catford (1964 : 32, possibly following Sweet 1906 : 13) and 'glottal trill' by Pike (1943 : 125-6), versus the trill-lessness, or CLEAR phonation, that contrasts with it.

The two terms of each of these two activity systems, (1) VOICING, and (2) TRILLIZATION, enter into various combinations with each other and with the terms of (B) POSTURE, the further system comprising various shapes or postures of the glottis, the two extremes of which are (1) the posture in which the vocal cords are wide apart, termed, since Sweet 1877 (3), BREATH (Henderson 1971 : 46), because it also serves, with minor variations (Heffner 1950 : 13-14; Ladefoged 1971 : 9), for breathing, and (2) the CLOSED position, as for the glottal stop (or glottal plosive).

As intermediate postures between these two extremes I would distinguish at least the following three: (3) ARYTENOIDAL, which Catford too terms 'arytenoidal', and associates with, for example, normal whisper, (4) APPROXIMATED, Catford's 'glottal', or 'full-glottis', position, which he associates especially with 'normal voice', and (5) following Catford (1964 : 31-2), LIGAMENTAL, which appears to be the location that Abercrombie 1967 (100-1) associates with 'tight' phonation. A more detailed account of the five terms

of this system is given in section (B) below. It is quite possible that further distinctions of this type need to be made; for Catford distinguishes a 'ventricular' location; but there is no example of this to be heard from his tape-recording; so, having no means of trying to imitate or distinguish it, I have had to exclude it from my POSTURE system for the present.

A. ACTIVITY

1. VOICING system (VOICE, VOICELESSNESS)

a. VOICE

Clearly VOICE, with its wide powers of combination, is fully entitled to be a term of one of the ACTIVITY systems; and it is fortunate that there is no difficulty over defining it: Catford's 'periodic vibration of the vocal folds' (31) accords with definitions made over the last hundred years from Sweet 1877 (3) to Ladefoged 1971 (7-8) and O'Connor 1973 (27). The vibration of the vocal cords does not combine with the glottis position of complete closure, my CLOSED POSTURE (Catford's 'stop' type of stricture; 1964:32); but it does combine with my posture-system terms ARYTENOIDAL, APPROXIMATED, and LIGAMENTAL (nos. 3-5), in Catford's 'whispery voice', '(full-glottis) voice', and 'ligamental voice' respectively.

'Breathy voice: voice + breath.'

Catford goes further, and treats VOICE as combining with BREATH too, in his 'breathy voice': 'combination of breath + voice: glottis relatively wide open: turbulent airflow as for "breath" plus vibration of the vocal folds. The vocal folds do not meet at the centre line: they simply "flap in the breeze"' (1964:32). Abercrombie, too, describes "'breathy" phonation' in similar terms: the vocal cords 'may be adjusted so that a lot of air escapes through them while they are vibrating, resulting in "breathy" phonation' (1967:93).

I have separated this combination of Catford's from the other three combinations containing a voice component because the impression of Catford's 'breathy voice' that I gained from the example (no. 6) on his tape-recording was that the 'breath' illustrated in that example was a different use of the term *breath* from that given in his description of the 'breath' type of stricture (1964:30-1): it seems to me to be breath in the sense of heavy, or forced, breathing, with the vocal cords sufficiently approximated for the vibration of his 'voice' type of stricture (my APPROXIMATED posture). In fact, to put it paradoxically, his example of 'breathy voice' sounds breathless, like the voiced breathing of someone panting and out of breath.

My provisional conclusion, then, is that Catford's example of 'breathy voice' is not a combination of voice with my posture

term no. 1, the BREATH posture, but a special case of the combining of voice with my posture no. 4, the APPROXIMATED posture—a special case because of the high flow of breath, possibly the maximum compatible with that posture.

In other words, I am assuming that voice, the vibration of the vocal cords, is incompatible with the width of glottis appropriate to the BREATH posture, and with the high rate of air-flow that that width makes possible: Lehiste points out that 'the production of [h] involves a rate of airflow that is approximately six times higher than that of the following phonated syllable nuclei' (1964: 141; I take the breathed vowel ([h]) to be a fair example of the rate of airflow of the breath posture). Catford, too, gives 'critical rate of air-flow about 25 cl/sec., maximum about 890 cl/sec.' for his 'breath stricture', and 'the liminal rate of flow is about 5 cl/sec., maximal about 23 cl/sec.' for his 'voice stricture', though he qualifies the latter figures with the words: 'these are mean flow-rates: during the open phase of vocal fold vibration flow-rates much in excess of these must occur' (1964: 31).

In my view, then, voice does not combine with the two extremes of the posture system, BREATH and CLOSED; but it does combine with the three intermediate terms, ARYTENOIDAL, APPROXIMATED, and LIGAMENTAL; and, further, in these three types of posture it contrasts with an activity other than VOICE, which I term VOICELESSNESS.

b. VOICELESSNESS

An accepted definition of VOICELESSNESS is not as easily achieved as the accepted definition of VOICE given at the beginning of section (a) above: two quite different uses of the term appear in the literature of phonetics. Clearly Catford's combinations 'whispery creak' (as opposed to 'voiced creak') and 'whisper' (as opposed to 'whispery voice') require a contrasting type of articulation in which the vocal cords are not vibrating. This type of glottal activity could, therefore, be referred to simply as non-vibration; but VOICELESSNESS seems to me to be the most suitable term to oppose to VOICE in spite of its being ambiguous. The ambiguity is due to the fact that some phoneticians have defined voicelessness in terms of position of the vocal cords, while others have defined it in terms of vocal-cord activity. Sweet (1908: 19), for example, treats voicelessness as an alternative to the breath position of the vocal cords: 'breath (voicelessness) is indicated when necessary by adding the breath modifier' (Henderson 1971: 40); and the term 'voiceless', equally, he treats as an alternative to his more common terms 'breath' and 'breathed' (Henderson 1971: 45-6, 57, 65, 154).

Abercrombie (1967: 26, 69) and Ladefoged (1971: 8) also define 'voicelessness' and 'voiceless' in terms of glottis position.

An opposed view of the term 'voiceless', complementing the definitions of 'voice' in terms of vocal-cord activity referred to in section (a) above, appears in Heffner 1950: 'consonants of the type [p], [t], [k], are produced without voice vibrations from the larynx. They are therefore properly called voiceless' (p. 121); and a corresponding definition is implied by passages in Catford 1939 in which he refers to 'voicis g.s. [glottalic suction] stops' (3, 5), for the closed-glottis position of these stops is the very antithesis of the breath position, and in Pike 1943 (91-2), in which he refers to ejective and other articulations made with the glottis closed, and therefore non-vibrating, as 'voiceless': 'all sounds with this mechanism are, in the nature of the case, completely voiceless, since voice is a function of the vocal cords during the action of the pulmonic mechanism' (92-3). In fact the glottal stop can be used as something of a touchstone to distinguish the former view of voicelessness from the latter, because adherents of the former view must classify the glottal stop as belonging to a third category, neither voiced nor voiceless, while for the latter view the glottal stop is simply voiceless.

Whisper can be used as a touchstone too: Sweet seems deliberately to avoid applying the term voiceless to whisper by referring to it as 'without vibration' (1908: 19; Henderson 1971: 40), because, presumably, he identifies voicelessness with 'breath'; Pike, on the other hand, treats whisper as voiceless (1943: 141).

It is interesting to note, in passing, that Pike's view of the glottal stop and whisper as being voiceless can claim spectrographic support: the voice bar lends itself to a twofold distinction, voiced versus voiceless (vibrating versus non-vibrating vocal cords), and aligns the glottal stop with such other voiceless stops as [p] and [t], in spite of the fact that, from the point of view of glottal aperture, they are at opposite extremes of articulation. Whisper, too, the spectrograph, through its voice bar, treats as voiceless.

It is this latter view, then, that I shall be following in using the term VOICELESSNESS in preference to non-vibration for the vibration-free activity of the vocal cords and for the term of the VOICING system that contrasts with the VOICE term; and I shall be following Catford, Pike, and Heffner in regarding the closed posture, as for the glottal stop, as combining exclusively with voicelessness.

At the other extreme of the scale of glottis postures I take it that it is only voicelessness that can combine with the first, or breath, term of my posture system, in which the glottis is characterized by the wide-apart position of the vocal cords, too far apart, in that position, for vibration to take place (cf. the closing part of

section (a) above). A breathed sound is, therefore, voiceless, e.g. [h p m]; but a voiceless sound is not necessarily breathed; for voicelessness in this sense can combine equally with the constricted position of the glottis for whisper, my arytenoidal posture (cf. Catford 1964: 31), in which the abducted position of the arytenoid cartilages allows a turbulent flow of voiceless air to pass with fricative hiss, e.g. (using Sweet's device of prescript apostrophe to symbolize whisper) ['a 'b 'z 'tʃ] (cf. Lehiste 1964: 141-2, 157, 177).

Indeed voicelessness, unlike voice, can combine with all five terms of my provisional glottis posture system, exclusively with the two extremes, the breath and the closed postures, and in contrast with voice in the case of the three intermediate postures, the arytenoidal, approximated, and ligamental (cf. the table at section (IV)).

2. TRILLIZATION system (TRILL, CLEAR)

The second of the two activity systems, the TRILLIZATION system, comprises the two terms TRILL, so named from Pike's 'glottal trill' (1943: 126-7; cf. Sweet's 'creaky quality of voice', 1906: 13, and Catford's 'creak', 1964: 32), and its contrasting non-TRILL feature, which I term CLEAR, following Heffner 1950: 'as a form of voice production this glottal trill may be substituted for clear voice' (134).

Catford, followed by Ladefoged 1971 (8, 14-15), locates 'creak' entirely in the ligamental glottis: 'only a very small section of the ligamental glottis, near the thyroid end, is involved' (1964: 32; cf. also Pike 1943: 127). Abercrombie, on the other hand, locates 'creaky voice' in the cartilage, or arytenoid, glottis: 'the cartilage glottis is vibrating very slowly, while the rest of the glottis is in normal vibration' (1967: 101).

This passage from Abercrombie implies that TRILL can combine only with voice; but Catford's tape-recording gives an example of TRILL combining with voicelessness, in his no. 8, 'whispery creak'. In fact both TRILL and CLEAR can combine equally with both voice and voicelessness; Catford demonstrates all four combinations in his 'voiced creak', 'whispery creak', 'voice', and 'whisper' (nos. 9, 8, 3, and 2).

The relations of the two terms trill and clear with the five terms of the posture system closely parallel those that the two terms of the voicing system, voice and voicelessness, have with the five terms of that system, no doubt for similar reasons. Only the clear term can combine with the breath posture and the closed posture: the vocal cords are too wide apart, in the breath posture, for either voice vibration or glottal-trill vibration, and too close together, in the closed posture, for either of these two types of vibration. All

examples of breath sounds, whether consonantal or vocalic, are clear as well as voiceless, e.g. [h p s m̥ t̥]; and the same is true of [ʔ] and of all sounds articulated with the glottalic (Pike's 'pharyngeal') air-stream mechanism, i.e. ejectives (Catford 1939: 3; Pike 1943: 91-2), e.g. [p' f' m̥'], and injectives (Catford's 'glottalic suction stops', the *implosives* of Pike 1943: 91, but not the "implosives" of his page 95).²

Both trill and clear terms combine with the remaining three postures, arytenoidal, approximated, and ligamental, and with both voice and voicelessness in each case. The resulting twelve combinations will be examined in detail in section III, and identified, where possible, with the categories proposed by Sweet, Pike, Heffner, Catford, Abercrombie, and Ladefoged.

To symbolize the trill feature I have used the subscript *tilde* that Ladefoged has introduced for 'laryngealization' (1971, p. 8), e.g. [a m̃ l], as distinct from the clear phonation of [a m l]; thus, the sound children make to imitate a cat purring can be symbolized as [m̃:].

B. POSTURE SYSTEM (BREATH, CLOSED, ARYTENOIDAL, APPROXIMATED, LIGAMENTAL)

1. BREATH

The first of the terms of the posture system has been named BREATH because it corresponds to the position of the glottis that has, from the time of Sweet (1877: 3), been commonly referred to as the breath position: it closely resembles the position of normal (voiceless) breathing, with the vocal cords wide apart at their arytenoid ends (cf. Zemlin 1964: 111, 140), and is responsible for the breath component of, for example, [h p s m̥ t̥].

2. CLOSED

The term CLOSED for the second of the two extreme glottis postures refers, of course, to the closing of the glottis by the vocal cords (Catford's 'stop' type of stricture), the posture for the

² The term injective, the reverse of ejective, was first suggested to me by M. Ashby, of University College, London, partly because of that relationship, and partly because of the need to avoid the ambiguity of the term IMPLOSIVE, used in Pike 1943 (though with typographical differences) for two rather different phonetic categories: (i) (voiceless) ingressive pharyngeal-air-stream sounds, the '*implosives*' of page 91 (Catford's glottalic suction stops; 1939: 3), and (ii) mixed-air-stream sounds, the "implosives" of page 95, ingressive pharyngeal and egressive pulmonic. Bhaskararao 1972 also uses the term INJECTIVE in a somewhat similar sense (p. 51). For examples of injective sounds from Tojolabal, of Mexico, and Cakchiquel, of Guatemala, see E. V. Pike 1963: 'ingressive pharyngeal air sounds, optionally called "implosives"' (pp. 104, 107).

glottal stop and for glottalic sounds (or pharyngeal sounds; Pike 1943: 91-2), both egressive (ejective), e.g. [ʔ p' s' m'], and ingressive (injective), reported in E. V. Pike 1963 for Tojolabal and Ceqchiquel, e.g. 'pp^ɔopp^ɔ ' to be able ' (106), 'k^ɔolonel ' Savior ' (107).³

3. ARYTENOIDAL

The third posture, and the first of the three intermediate postures, corresponds to the position referred to by Catford as the 'arytenoid location' (1964: 33), in which the ligamental glottis is closed or nearly so, but the cartilage glottis is open, with the bodies of the arytenoid cartilages separated; I have therefore given it the name ARYTENOIDAL.

4. APPROXIMATED

The fourth position is that commonly referred to as the voice position, because it is the position of the glottis in which the vocal cords are approximated throughout their length as for 'normal voice', though it should not, on that account, be identified with the voice activity to the exclusion of voicelessness: 'this is the location of "normal" voice, and one type (perhaps not the most common) of whisper' (Catford 1964: 32); I have therefore used the term APPROXIMATED for it.

5. LIGAMENTAL

Lastly, the fifth type of posture corresponds to Catford's 'ligamental location' (1964: 32-3), in which 'the arytenoid cartilages are tightly occluded' and 'phonation is thus actively restricted to the ligamental glottis', perhaps regularly 'accompanied by upper larynx constriction. The auditory effect in voice and creak is a "sharper" "clearer" sound than in full glottal phonation, often accompanied by a slight "ainish" ([ʔ]-like) quality'. In order to take advantage of Catford's description I therefore apply the term LIGAMENTAL to my fifth, and last, glottis posture; it seems to give rise to what Abercrombie has termed 'tight' phonation (1967: 100-1).

III. Combinations; terms from all three systems

BREATH and CLOSED

Certain combinations of terms from the three systems have already been dealt with (section II) in the course of pointing out the limited powers of combination of the BREATH and the CLOSED postures: these two combine only with the voiceless term of the

³ See note 2.

voicing system and with the clear term of the trillization system, e.g. [h p s m ɹ tʃ] and [ʔ p' s' m'] (cf. the table; section IV).

The remaining three postures, the arytenoidal, the approximated, and the ligamental, each seem to combine equally with both the voice and the voiceless terms of the voicing system, and with the trill and the clear terms of the trillization system.

APPROXIMATED

To take this more common posture first, then, like Sweet, Pike, and Catford before me I can produce both voiced and voiceless articulations for the APPROXIMATED posture with clear phonation: the voiced possibility is the so-called 'normal voice', e.g. [a b m z ʒ tʃ]; and the voiceless possibility is described by those three authorities as a form of whisper (Catford 1964: 32); indeed Sweet distinguishes it as 'weak whisper' (1906: 10). The instructions given in Pike 1943 (126-7) are a good guide for acquiring it.

Sweet gives the final sound of *thieves* as an example of whisper: 'a final buzz preceded by a buzz or a voiced stop is completely whispered in English; as in *thieves, rage*' (1906: 61); but he does not say whether he regards it as an example of 'weak whisper' (my voiceless clear approximated) or 'strong whisper' (my voiceless clear arytenoidal). I should expect it to be the former, continuing the approximated posture of the preceding voiced approximated sound ([v]), with the voice vibrations dying away ([ʔ]).⁴

Sweet's examples of this type are confined to 'a final buzz'; but they raise the question whether initial voiceless lenis (or lax) sounds too, and sounds other than 'buzzes', are not also to be regarded as examples of my voiceless clear approximated category (Sweet's 'weak whisper'). I am thinking particularly, here, of the so-called lax (or lenis) plosives and affricates of Chinese, e.g. [d̥ d̥ʒ b̥], as in the final syllable of *Mao Tse-tung* or the initial syllable of *Chou En-lai* and *Peiping* (with the voicelessness alternating with voice under certain conditions of junction and tempo for the same lexical item), and wondering whether it might not be possible, by instrumental means, to compare a representative air-pressure level, or a degree of glottal aperture, of sounds of my voiceless clear approximated type with those of the Chinese voiceless lenis initial plosives and affricates in something like the same way as Lehiste has established degrees of 'rate of airflow' for breathed vowels ([h]), whispered vowels, and voiced vowels: 'although the rate of airflow during whispered speech is more than twice as high as that of

⁴ Delattre 1964 attributes whisper to the word-final sounds of such French words as *peuple* and (less commonly) *âpre* (pp. 46-8), and could, I suppose, do so for *Delattre* too.

phonated speech, the airflow during an initial [h] in whispered speech is still twice as high as that of the following syllable nuclei' (1964: 141). If instrumental support were forthcoming for my identification of [d̥ d̥̤ b̥], etc., with my voiceless clear approximated type ('weak whisper'), then the transition from the initial voiceless lenis plosives and affricates of Chinese to the following syllabic vowel would be purely one of voicelessness to voice, the approximated posture being common to both sounds, as I presume it is for the [-v'z] of *thieves* (a similar posture has indeed already been proposed as a feature of the syllable initial in an earlier stage of the language through the reconstruction of so-called voiced-aspiration initials *pʰi, *kʰi, etc., discussed in my arytenoidal section below; cf. Pulleyblank 1970: 'Kan'on renders the "muddy" initials as unvoiced in contrast to the earlier Go-on which renders them as voiced, e.g. --- /kʰiən/ --- /pʰiən/ ---. It seems probable therefore that they were --- like the corresponding phonemes in modern Wu dialects, unvoiced consonants accompanied by a voiced aspiration which spreads through the rest of the syllable giving it a "muddy" quality' (209).

Trill, too, combines easily with voice for this posture, and was at one time, I believe, my normal usage in preference to the clear term. I do not necessarily agree with Heffner, therefore, in associating the voice-trill-approximated combination with laziness or with corpulence; but it does seem to me to be a relaxed type of articulation, and quite different in this respect from the combination of trill and voice with the ligamental posture discussed below. Sweet, Pike, Heffner, and Ladefoged associate 'creaking voice' (Sweet 1906: 13), 'glottal trill' (Pike 1943: 126), 'laryngeal trill' (Heffner 1950: 134-5), and 'laryngealization' (Ladefoged 1971: 8, 14-15) with low pitch; and this supports my assumption that it is a combination corresponding to my combination of trill with the approximated posture that they have in mind here rather than the combination of trill (and voice) with the ligamental posture, which is also, of course, a possible combination (Catford's 'ligamental voiced creak', 1964: 33). Abercrombie 1967 (100-1) distinguishes between "'tight phonation'" (my ligamental posture) and "'creaky voice'" (my trill trillization term), but does not mention the possibility of combining them.

Pike treats 'glottal trill' as, on occasions, an alternative to voice: 'in the speech of people who are talking in a tone of voice very low as compared with normal style --- the glottal trill is substituted for voice' (1943: 126); and the combination of 'trillization' with 'superimposed voice' he terms 'laryngealization'. In terms of my voicing and trillization systems, though, his substitution of glottal trill for voice would have to be translated into a substitution of trill

plus voicelessness for *clear plus voice*; for my trill term cannot occur unless combined with either the voice or the voicelessness term of my voicing system. Similarly, while Catford's 'creaky voice' ('phonation types' no. 9) seems to me to correspond to my combination of trill with voice, so also does his example of 'creak' ('phonation types' no. 4) correspond to my trill with voicelessness.

ARYTENOIDAL

The ARYTENOIDAL posture is particularly associated with 'normal whisper', though voice, in fact, combines with it as readily as voicelessness. The voiceless-clear-arytenoidal combination of my classification I take to correspond to the whisper, or 'kind of whisper', of Sweet 1906 (10), Heffner 1950 (20-2), Zemlin 1964 (111, 168), Catford 1964 (31), and Ladefoged 1971 (8). The only symbolization available for this combination is Sweet's use of a prescript apostrophe, e.g. ['a 'b 'm 'z]; he apparently intends it for both his 'strong' whisper (my voiceless clear arytenoidal) and his 'weak' whisper (my voiceless clear approximated) without distinction.

The corresponding voiced combination is referred to by Sweet under the term 'voice-aspirate', and exemplified from *behold* in English and from Bohemian 'initially as well as medially' (1911: 466; Henderson 1971: 175), and, under the term "'sonant aspirates'", for 'Sanskrit and its modern descendants - - -, as in Sanskrit *dhanu*' (1911: 465-6, Henderson 1971: 172); he does not give a symbol for it. Pike refers to sounds with this type of phonation as 'timbres of "voiced [h]"' (1943: 141) and as 'frictionalized vocoids' if vocoid, and as frictionalized contoids if contoid (142), e.g. 'frictionless laterals with voiced glottal local friction'; Heffner refers to 'half-voice', and to vowels of this type as 'murmured' (1950: 86); Catford refers to all such sounds under the term 'whispery voice: - - - glottis narrowed as for whisper: vocal folds vibrating but not occluding, so that whisper hiss continues throughout' (1964: 32), Abercrombie to 'breathy phonation', with a description corresponding to Catford's (1967: 100), and Ladefoged to 'murmur: "Breathy voice"' (1971: 8).

The Association's symbol for this type of phonation (my voiced clear arytenoid), [fi], is now in competition with a modifier, the subscript *umlaut* symbol proposed by Ladefoged (1971: 8), which has the advantage of making it possible to symbolize the so-called 'voiced aspirates' of such words as *ghar*, *dhobī*, and *bhāsā* in Hindi-Urdu, for example, as [g̥ʌ-], [d̥o-], and [b̥ɑ-] respectively, and the *mh-* of the Newari example *mhītke* as [m̥i-], visibly bringing the initial consonant within the scope of the arytenoid posture (and,

incidentally, making it easier for students to avoid errors of timing: 'in the production of a breathy consonant the vocal cords attain the same position as in the case of a breathy vowel' (Bhaskararao 1972: 65)*.

Abercrombie, too, refers to the "voiced aspirated stops" of 'many languages of India' as examples of his 'breathy phonation', and describes it, like Catford, as being 'produced by part of the glottis being in vibration while the cartilage glottis is sufficiently open to allow air to pass freely through it' (1967: 100); I suspect that this is a different use of the term 'breathy phonation' from the use I referred to above (IA1a; Abercrombie 1967: 93) as resembling Catford's description of his 'breathy voice' (Catford 1964: 32). Indeed it is not Catford's example of 'breathy voice' ('phonation types' no. 6) but his example of 'whispery voice' ('phonation types' no. 7) that sounds like the [fi bfi mfi], etc., of the languages in question; and this is in accordance with his statement: 'whispery voice (or, possibly, breathy voice) is utilized contrastively in Hindi, Urdu, and some other North Indian languages' (1964: 36).

Furthermore, Catford's airflow figures for 'whisper', and therefore, *a fortiori*, for 'whispery voice', are relatively low, especially when compared with those for 'breath' (1964: 30-1), and support my impression that my clear voiced arytenoid phonation is not specially breathy in the sense of having a high flow of breath. Possibly the glottal friction of [fi m l], etc., gives the ear an impression of a breathiness that goes beyond the airflow data.

The combination of voicelessness and voice with the arytenoid posture is clearly symbolized in Pike 1943 in the form of a relationship of whispered vocoids ('voiceless vocoids with added local glottal friction') to timbres of "voiced [h]" (i.e. voiced vocoids with glottal local friction), and a parallel drawn between these two, symbolized as 'W' and '[fi]', with the relationship of 'voiceless vocoids' to 'voiced vocoids'; while I find the voicing parallel (voicelessness versus voice) exact, I do not find the postures comparable: whisper and 'voiced [h]' are an example of the same (arytenoid) posture; but [h] and 'V' are an example of different postures; for the [h] is produced with the 'breath' posture of the glottis, but the so-called 'normal vowel' is produced with the glottis in the approximated posture. The much wider opening of the glottis in the breath posture results in a rate of airflow for [h] 'that is approximately six times higher than that of the following phonated syllable nuclei' (Lehiste 1964: 141).

* The subscript umlaut was approved by the Association in 1976: see *JIPA* 6.1.—*Editor*.

In the Hindi-Urdu and Newari examples referred to above it is clear trillization that is to be heard in combination with voice and with the arytenoid posture; Panjabi, on the other hand, seems to combine the trill term of that system with those two features for the syllable initials of cognate words, the 'low-tone' words of Gill and Gleason 1963 (44) and 'tone-1' words of Joshi 1973 (11), though in Panjabi it is only the vowel that is affected, the syllable-initial consonant being voiceless (and, in Joshi's opinion, breathed), e.g. [^vk_A-] *ghar*, [^vt_Q-] *dhobī* (cf. Joshi 1973: 14, 20, 53-6). It is Catford's 'whispery voiced creak' ('phonation types' no. 10) that seems to me to correspond most closely to this type of phonation.

The fourth possible combination, voicelessness, trill, and arytenoidal, is not difficult to produce, and is demonstrated, as 'whispery creak', in Catford's recording ('phonation types' no. 8). One would expect it to be the form of whisper used by speakers who, in their speech aloud, use the voice, trill, and arytenoidal combination, i.e. by Panjabi-speakers for whispering 'low-tone' words.

Whispering raises something of a problem for articulations that have the arytenoid posture as a component, a problem illustrated, in part, from Hindi data, in the following table (*bāt* v. *bhāt*, *dān* v. *dhān*, *jor* v. *jhor*); e.g.

<i>spoken aloud</i>	<i>whispered</i>
[b-]: voice, clear, approx.	voicelessness, clear, aryten. [‘b-]
[b _h -]: voice, clear, aryten.	? [‘b-]

One might reasonably expect the approximated-versus-arytenoid distinction between the 'voiced non-aspirated' and 'voiced aspirated' plosive initials that is to be heard when they are spoken aloud to cease when the lexical items containing them are whispered; but my recordings of Hindi examples in speech aloud and in whisper clearly maintain a distinction: the so-called 'aspirated' initials have an audibly higher rate of airflow in whisper than the contrasting 'non-aspirated' initials. A study with the help of the segmentator led me to the tentative conclusion that lexical items spelt with *gh-*, *dh-*, etc., achieve this by using the breath posture for the vowel when they are whispered, and could therefore be symbolized (again following Sweet in using the apostrophe for whisper) as: [‘bh- ‘dh-], etc. My tentative conclusion has the support of Bhaskararao, both, after listening to the segmentated recording and from his own kinesthetic impression of this type of syllable initial in whisper, of which his name is itself an example. That [b_h- d_h-], etc., should alternate with [‘bh- ‘dh-], etc., in this way is not unreasonable if one recalls Lehiste's observation that 'the airflow during an initial [h] in whispered speech is still approximately twice as high as that

of the following whispered syllable nuclei' (1964: 141). In other words, if an arytenoid posture is used for the Hindi *b*-initial type of word, the only available posture for maintaining the distinction between the *bh*-initial type of word and that type of word in whisper through a difference in airflow is the breath posture, with vocal cords wide apart: BREATHED VOWEL.

Since voicelessness combines with the approximated and arytenoid postures (and, below, with the ligamental posture) to produce the three different types of sound that Catford treats as kinds of whisper, 'full-glottis', 'arytenoidal', and 'ligamental', and does not merely combine with the breath posture, there are advantages in avoiding the term 'voiceless vowel' for [h] sounds, and specifying such sounds as BREATH VOWELS OR BREATHED VOWELS.

LIGAMENTAL

Examples of the ligamental posture when combined with the clear term of the trillization system and with voice may be heard in Hindi and other North Indian languages, in which, according to Catford, 'it is commonly the "normal" voice (contrasting with whispery voice)' (1964: 33). I have also heard it used to indicate a Prussian, or military, type of German speech. It is a reasonable guess that when such speakers have recourse to whispering, it is the corresponding voiceless articulation that they use, the combination of voicelessness with clear, and with ligamental, phonation (Catford's 'ligamental whisper'; 1964: 33).

In Burmese the ligamental posture also combines with the trill term as a lexically distinctive characteristic of certain lexical items, and as an alternative, and grammatically significant, feature of others. Though common, I doubt whether the trill term is essential to the combination; but for those who use it it is reasonable to expect the voiceless-trill-ligamental combination in whisper speech (Catford's 'ligamental whispery creak'; 1964: 33).

IV. Table

The table below is an attempt at a synopsis of the various relationships between the two terms of my voicing and my trillization systems and the five terms of my posture system, with specimen symbolizations of some of the resulting sounds, using I.P.A. symbols supplemented by Sweet's use of a prescript apostrophe for whisper, and Ladefoged's use of a subscript diaeresis for his 'murmur', and a subscript *tilde* for his laryngealization, which I have equated with the trill term of my trillization system; in the absence of a recognized symbol for ligamental phonation I have used a superscript apostrophe.

POSTURE	ACTIVITY		TRILLIZATION system
	VOICE	VOICELESSNESS	
BREATH	— —	— Breathed e.g. [h p s m (ŋ)]	TRILL CLEAR
CLOSED	— —	— Glottal stop; ejective, injective? [ʔ] e.g. [p' s', p ^ʕ]	TRILL CLEAR
ARYTENOIDAL	'whispery voiced creak' e.g. [a̠ m̠ l̠] 'whispery voice' e.g. [a̠ b̠ m̠ l̠ (ŋ̠)]	'whispery creak' e.g. ['a̠ 'm̠] '(strong) whisper' e.g. ['a̠ 'b̠ 'm̠ 'l̠ (ŋ̠)]	TRILL CLEAR
APPROXIMATED	'voiced creak' e.g. [a̠ b̠ m̠] '(normal) voice' e.g. [a b m z (g (ŋ))]	'creak' e.g. [a̠ m̠] 'weak whisper' e.g. [a̠ b̠ m̠ 'z̠]	TRILL CLEAR
LIGAMENTAL	'ligamental voiced creak' e.g. [a̠ b̠ m̠] 'ligamental voice' e.g. [a̠ b̠ m̠ z̠]	'ligamental creak' e.g. ['a̠ 'b̠ 'm̠] 'ligamental whisper' e.g. ['a̠ 'b̠ 'm̠ 'z̠]	TRILL CLEAR

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