Obstruent Voicing and Glottalic Obstruents in Gitksan

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1. The main argument of Hoard (1978), "Obstruent Voicing in Gitksan: Some Implications for Distinctive Feature Theory" (hereafter referred to OVG), centres on the voicing of non-continuant obstruents in Gitksan. Hoard observes that Gitksan has a phonological rule that voices plain non-continuant obstruents. He claims that this rule also applies to certain of the glottalized non-continuant obstruents, which occur in three allophonic types: voiceless non-ejective preglottalized stops/affricates occur finally; voiceless ejective glottalized stops/affricates occur as first members of clusters; and voiced implosive stops/affricates occur before [+sonorant] segments. Hoard also proposes a revision of the features in Chomsky and Halle (1968) that distinguish amongst sound types differing in airstream and larynx features, and he says that some of these involve cooccurrence restrictions. One such restriction is that voiced segments are also characterized by glottal constriction. Thus, it follows that as glottalized stops/affricates become voiced, they also redundantly have glottal constriction, and as the closed larynx moves rapidly downward, so they are implosive.

Our paper is a critique of the substantive portion of OVG. It offers alternative formulations of the obstruent voicing and other phonological rules that are based on different articulatory phonetic observations and on consideration of a wider range of forms, distributions and alternations. It also provides instrumental evidence that Gitksan does not have voiced implosive stops; rather, it has lax glottalized stops that display a creaky voice quality at the margin of the vowel in pretonic (and syllable-final) environments.

2. The first part of OVG identifies and locates the language and makes brief comments on Lonnie Hindle, who served as the consultant in Hoard's field methods course at the University of British Columbia in 1971-72. It was Mr. Hindle's speech on which Hoard based his discussion of Gitksan phonetics and phonology. To this, we add the following:

Gitksan is the indigenous language of the Gitksan people, who live in a number of communities situated mainly in the Skeena River valley of British Columbia. It and its close sister language, Nisgha (formerly called "Nass" in the anthropological and linguistic literature), form an Interior Tsimshianic subgrouping that is coordinate with Coast Tsimshian and Southern Tsimshian. There are no longer any monolingual Gitksan speakers; no children are learning it exclusively as a first language, and English has been the language of children's play groups in all the Gitksan villages for at least a decade. Language shift is well underway - see Rigsby (1987) for a

fuller description of the current language situation among the Gitksan.

In May and June, 1986, Rigsby recorded samples of Gitksan speech (including most of the forms cited in OVG from two speakers for later instrumental anaysis. He used an Electro-Voice 635A omni-directional microphone and a Marantz CP430 cassette recorder. Mrs. Sarah Hindle, who has lived in Hazelton for many years,,is in her mid-sixties, and although she speaks more English in her daily life than Gitksan, she speaks both languages fluently and well. Lonnie Hindle, Mrs. Hindle's older son, is in his late thirties. He has lived in the Vancouver area for over fifteen years, and English is the language of his daily domestic and public life. He seldom has the opportunity to speak Gitksan now. Although his comprehension of Gitksan remains good, his speaking command of the language is less fluent than that of his mother and his knowledge of its vocabulary has lessened over the years. The Hindle family and I (BR) have had a close association for almost twenty years. Lonnie and I call Mrs. Hindle /na·ʔ/ Mum in Gitksan, and we call one another /wak/ brother. Mrs. Hindle and I've done language work together since 1966. In 1970-71, Lonnie and I developed the Gitksan practical alphabet and prepared a short practical Gitksan dictionary (Hindle and Rigsby 1973).

3. The second section of OVG presents a provisional phonemic inventory of thirty consonants, three short vowels, and three long vowels. It notes that Rigsby (1967) reported two additional long vowels, but Hoard suggests some of these are positional variants of the long high vowels, while others are secondary developments resulting from intermorphemic phonological processes. Hoard also describes the phonetic variation he found in the two laryngeal consonants, /h/ and /ʔ/.

We observe that the phoneme inventory of Gitksan does include thirty consonants, and these pattern phonetically and distributionally into three sets, as seen in:

Obstruents	p	t	c		k̓	kʷ̓	q
	ṗ	ṫ	ċ	x̣	k̇	kʷ̇	q̇
			s	ɬ	x	xʷ	χ
Resonants	m	n		l	y	w	
	ṁ	ṅ		l̇	ẏ	ẇ	
(Non-resonant) Glides							ʔ
							h

The front dorsal series is underlyingly palatal, not velar. The palatal obstruents occur in a wide range of environments - prevocalic, postvocalic final, and pre- and post-consonantally - but they are not found before the coronal fricatives /s/ and /ɬ/. Instead, velars found there, and we derive these by phonological rule. Note the following alternations:

[wákyʰ]	man's brother	/wak/
[wágyɪḿ]	our brother	/wak-əḿ/
[wáksɪḿ]	your (pl) brother	/wak-siḿ/

Plain velar obstruents also develop from labiovelars by delabialization in a different set of environments, specifically before /i/ and /u·/. The contrast of short /i/ and /u/ is neutralized following labiovelars.

In native forms, there are five long vowels and three short ones that contrast in stressed position:

Vowels	i·	e·	a·	o·	u·
	i		a		u

Only the three long vowels /i· a· u·/ occur in unstressed positions, and pretonically, the contrast of unstressed short vowels is neutralized. We represent that vowel phoneme as /ə/, and in unstressed final position, only non-low /ə/ and low /a/ contrast.

Hoard is correct that the pairs, /i·/ : /e·/ and /u·/ : /o·/ are in near complementary distribution, and this is evidence that some long mid vowels arose historically from high vowels. However, there are so many contrasts in native forms and loans that it seems best to enter five long vowels in base form roots, rather than mark exceptions. In other words, synchronically there are now five organic or primary long vowels. The evidence is found in such forms as /mu·s/ scabby, scarred neck (archaic); also moose (recent loan from English, ultimately from some Algonquian language) and /mo·s/ thumb, big toe, and /tu·ɬ/ hunchback versus /to·c/ man's sister, man's daughter where one cannot predict which vowel will occur. The decision to regard [χé·qʰ] foam, blossom and [χó·χ] yawn (vi sg) as /χe·q/ and /χo·χ/, respectively, rather than as */χi·q/ and */χu·χ/, then follows. As well, there are a few native forms, such as [ʔó·qʰ] copper, that display some lowering before a uvular but do not ever drop down into the [ɔ·]-range. Thus it must be represented as /ʔu·q/.

Hoard's proposed derivation of [ʌ̓ɔɔtxʷ] mud-like from /X̌uq+txʷ/ is not correct, as there is no such customary form in the language. The conventional form for mud in Mr. Hindle's speech and in the wider speech community is /X̌o·ƛ/ or [X̌ó·ʔkyʰ], not [ʌ̓óqʰ]. However, it is true that some synchronic long /o·/s have come historically from short /u/ before a uvular that then elides before a consonant. There is a small subset of irregular plural forms that synchronically display a $C_1\acute{V}_1 \cdot \surd C_1 əC_2$ pattern, but these can be internally reconstructed as developing by lowering, stress shift and elision (Tarpent 1983). The following exhaust my knowledge of the subset in short /u/ before a uvular:

/luq/, /lo··lχ/ > [lóqʰ], [ló·laχ] be rotten (vi sg, pl)

/nəχ-nuq/, /nəχ-no··nq/ > [naχnóqʰ], [naχnó·naχ] supernatural being (n sg, pl); be skilled, clever (vi sg, pl)

/nuχ/, /no··nχ/ > [nóχ], [nó·naχ] mother, mother and mother's sisters

/ńa· nuʔ/, /ńa· no··nʔ/ > [ńa· nóʔo], [ńa· nó·naʔa] have a hole in it (vi sg, pl)

/wuq/, /wo··wq/ > [wóqʰ], [wó·waχ] sleep (vi sg, pl)

As vowels are not a major concern of ours here, the interested reader is referred to Rigsby (1986:196-225) for further and fuller discussion, but it bears mention that there is good evidence that short /e/ and /o/ are emerging or have emerged as separate phonemes, which gives a more symmetrical system of five long and five short vowels.

Hoard observed four h-type allophones in Gitksan: a voiceless pharyngeal fricative, a voiced laryngeal glide alternating with a voiced pharyngeal fricative, and a voiceless laryngeal glide. While he regarded these all as allophones of a single phoneme, he speculated that there might be more than one h-type phoneme. I myself have regularly observed only two h-type allophones: a voiceless vocalic glide [h] and a "voiced", actually murmurred, vocalic glide [ɦ]. Briefly, we can say that h-type allophones arise from several sources historically and synchronically. H-type sounds realize organic /h/ in a range of environments, and paradigmatic alternations demonstrate that they also regularly develop from immediately post-tonic intervocalic /χ/ and from /x/ and /xʷ/ in a more restricted set of intervocalic environments. Some illustrative alternations are seen in:

[nóχ]	mother, mother's sister	/nuχ/
[nóhɔý]	my mother, ...	/nuχ-əý/
[gúxʷ]	shoot (vt)	/kʷixʷ/
[gúhutʰ] ~ [gúwɪtʰ]	He shot it.	/kʷixʷ-ə-t/

(See Rigsby 1986:183-8 for further discussion).

Hoard noted that [ʔ] could be substituted for initial [h] in two forms, but he also noted more forms in initial [ʔ] where [h] could not be substituted. This led him to include [ʔ] among the allophones of /h/ and to exclude [h] from the allophones of /ʔ/. With respect to the former two forms, I have never heard or recorded /hənaq̓/ woman with an initial glottal stop and Hoard's second form, given as *hagwali* 'I ran a little'., was doubtless intended as a construction with the preverbal /hakʷ-əl/ slowly, gently, which never has an initial glottal stop. Thus, [ʔ] is not really among the allophones of /h/, nor is [h] an allophone of /ʔ/. However, Mrs. Hindle regularly pronounces the reduplicated plural of be good (vi) as [hamʔám], although [ʔamʔám] is conventional among other speakers; her plural shows initial

reduplicated [h] developing from root-initial /ʔ/ by "softening".

4. The third section of OVG first presents forms that provide evidence for the phonological rule that voices non-continuant obstruents, formulates the rule to operate before [+sonorant] segments, and notes four other consonant rules. These involve aspiration of plain stops, palatalization of the plain velar stop, preglottalization of final glottalized segments, and the syllabification of final post-consonantal nasals (or the insertion of an epenthetic vowel before them). The remainder of the section focuses on the three allophonic types of glottalized obstruents: weakly ejective voiceless final preglottalized obstruents, voiced implosive obstruents, and voiceless ejective glottalized obstruents. The second are said to display a downward movement of the larynx, while the third have the typical ejective upward movement of the larynx. Thus, the voiced and voiceless glottalized stops have the same allophonic variation as do the plain obstruents, and Hoard comments that the obstruent voicing rule ought to include both plain and glottalized non-continuants in its domain of operation.

Gitksan does indeed have a rule that voices noncontinuant obstruents, but contrary to Hoard's formulation, it applies only to the plain stops (including affricates), not to the ejective ones. Focusing first on the plain stops, one notes that there are three major allophonic subtypes that are in complementary distribution. Voiced stops are found in prevocalic position; voiceless stops with noticeable aspirate release are found in final position; and plain voiceless stops are found in the remaining preconsonantal positions. The following possessive paradigm of /nə-pip/ maternal uncle displays the [b ~ pʰ ~ p] alternations that are characteristic of the general plain stop and affricate allophony:

[nɪbípʰ]	maternal uncle	/nə-pip/
[nɪbíbiy̓]	my ...	/nə-pip-əy̓/
[nɪbíbɪn]	your (sg) ...	/nə-pip-ən/
[nɪbípthˑ]	his, her ...	/nə-pip-t/
[nɪbíbɪm̓]	our ...	/nə-pip-əm̓/
[nɪbípsɪm̓]	your (pl) ...	/nə-pip-səm̓/
[nɪbípdiˑthˑ]	their ...	/nə-pip-tiˑt/

Only the labial and plain dental stops occur in pretonic preconsonantal position; dorsal stops are lacking there. Some examples are:

[pdál]	rib	/ptal/
[pɬóʔɔn]	sea otter	/pɬuʔn/
[tk̓yɬɬxʷ]	child	/tk̓iɬxʷ/
[tɖá]	skin, hide	/tɖa/

[tx̌óxy]	halibut	/tx̌ux/
[x̌pɛ́axʷ]	be afraid (vi sg)	/x̌pɛaxʷ/

These distributional patterns, as well as markedness considerations, suggest that the plain stops should be represented underlyingly as voiceless stops and that their voiced and aspirated allophones should be derived by rule. Thus, we postulate:

Rule 1 Plain voiceless stops become voiced stops when they precede a vowel.

Rule 2 Plain voiceless stops gain aspirate release in final position.

Note that Rule 1 is similar to Hoard's obstruent voicing rule, but its environment is specified as prevocalic ([+sonorant, +syllabic]), while his is written to include final post-consonantal syllabic nasals too. Rigsby (1967:9) formulated the rule to operate non-iteratively before [+voice] segments, but by 1969, he had changed it to its current form. There is no need to write the voicing rule to apply before syllabic nasals because these always develop by a late reduction of /i/ or /ə/ plus nasal sequences. Rule 2 differs from Hoard's formulation, which aspirates stops also before non-continuant obstruents.

There is little to say of interest about our instrumental observations of the plain voiceless stops and the final voiceless aspirated stops, but the voiced stops bear some discussion. The principal acoustic correlate of the voicing feature of stops in prevocalic position is voice onset time (VOT). We can identify two kinds of "voiced" stops in a broader perspective. Spanish-type fully voiced stops have a negative VOT, i.e., a short period of "prevoicing" prior to the oral release, and VOT values vary with place of articulation. English-type voiced stops have VOTs that may range from somewhat negative values (typically -20 msecs) to positive values (+20 msecs, in velars). The Gitksan prevocalic voiced stops have VOTs that span the range from prevoiced to (weakly) voiced (which some phoneticians might label as "voiceless inaspirate"), but they fall mainly within the English-type range. We observed only a few instances of prevoiced Spanish-type stops, all labial or alveolar and from both speakers.

There are a number of anomalous forms in which a fourth allophonic stop subtype - prevocalic voiceless aspirated stops - occurs. Some are loans from English (which contrasts lax voiced and tense voiceless stops in all positions except after /s/), while others are native Gitksan forms. Their situation bears consideration because of the possibility that structural pressure from English loans may have brought about the phonemic split of the formerly plain voiceless stops series into two new distinctive voiced and voiceless series. This does not seem to be the case, but there obvious advantages to be gained by distinguishing voiced and voiceless stops in the Gitksan practical orthography, which is designed for people literate also in English.

Loans from English with anomalous voiceless aspirated stops include:

[haphé·nasxʷ]	paintbrush	/hə-phe·n-əsxʷ/
[thí·]	tea	/thi·/
[khá·]	car	/kha·/

It should also be remarked that English personal names predominate in vernacular speech, while Gitksan personal names are used mainly in ceremonial and traditional narrative contexts. Thus many English names, such as Peter [phí·tha] and Tom [thá·m], have been nativized with initial voiceless aspirated stops. All these anomalous forms can be reasonably represented underlyingly as clusters of plain stop followed by /h/.

Native Gitksan forms with apparently anomalous initial and intervocalic voiceless aspirate stops are of three kinds, which are seen in the following groups:

[phyántxʷ]	suddenly appear (vi)	/pxantxʷ/
[thyáýtxʷ]	thunder	/txaýtxʷ/
[sɪthyé·wa]	trade (vi)	/sə-txe·xʷ-a/
[thún]	this (one)	/t=xʷin/
[dɪphún]	these (people)	/təp=xʷin/
[thústh]	that (one)	/t=xʷist/
[dɪphústh]	those (people)	/təp=xʷist/
[thɔ́·sth]	belongings, gear	/tho·st/
[sɪthɔ́·qh]	coax, deceive, lead on (vt)	/sə-tho·q/

It is not desirable to represent the first group of forms with underlying /py/ and /ty/ clusters because other distributional phonotactic evidence leads us to expect that intramorphemic stop-plus-resonant clusters are not permitted. It is also relevant to note that allophones of the palatal fricative /x/ occur in all phonetic environments except this pretonic prevocalic one. Thus it is appropriate to represent these forms as underlyingly /px/ and /tx/ and to postulate a gliding rule, similar to one that is needed elsewhere to characterize the same change in other (post-tonic intervocalic) environments. Indeed, */px/ and */tx/ (< earlier */pk/ and */tk/) may be their historical source (Marie-Lucie Tarpent suggested this solution to BR in 1981).

The four forms of the second group have Nisgha cognates in [tgún], [dɪpgún], [tgús] and [dɪpgús], respectively, whose underlying shapes are /t=kʷin/, /təp=kʷin/, /t=kʷis/ and /təp=kʷis/. (While we cannot just transfer phonological solutions that are motivated and

justified in Nisgha across to Gitksan, it is useful to refer to Nisgha forms, bearing in mind that the two languages are closely related and that the identity or near-identity of many of their base-forms reflects their recent common linguistic ancestry. Indeed there is a fossilized marginal unrestructured reflex of earlier */kʷin/ preserved in the Gitksan form [ɖáyɪmgûn] nearby, near here. Its post-resonant environment has blocked fricativization). Here too, as it was with the palatal fricative, we note that allophones of the labiovelar fricative /xʷ/ in Gitksan are found in all phonetic environments except the pretonic prevocalic one. As well, we elsewhere need a rule to change [xʷi]-type sequences to [xu] ones, together with another gliding rule to characterize the [xʷ ~ w] alternation in other (post-tonic intervocalic) environments. Thus it completes the parallelism with the /tx/ forms if we represent this second group of Gitksan forms with /txʷ/ clusters. I've also heard very old speakers pronounce these forms as [txún], etc., which gives some confidence in this treatment.

The rules needed to map all these underlying forms onto phonetic representations are:

Rule 3 xʷí ---> xú

Rule 4 $p, t \begin{bmatrix} x \\ x^w \\ xú \end{bmatrix} \text{---} > p^h, t^h \begin{bmatrix} y \\ w \\ ú \end{bmatrix} / \# \_$

The two forms of the final group present another problem for the phonological representation of their anomalous voiceless aspirate stops because their Nisgha counterparts have voiced stops, i.e. [dɔ́·sth] and [sɪdɔ́·qh], respectively /to·st/ and /sə-to·q/. Also similar is the anomalous intervocalic [ph] found in the intransitive verb pair [gyɪpýáykwh] and [li·pháyakwh] (with alternant in [lɪpháykwh]) fly (vi sg, pl). The corresponding Nisgha forms are [gyɪbáykwh] and [li·báykwh]. I propose that the Gitksan forms should be represented with clusters of stop plus /h/, as in /kəphaykʷ/ and /li·phaykʷ/. The rule that operates on these forms is:

Rule 5 $\begin{bmatrix} t \\ p \end{bmatrix} h \text{ ---} > \begin{bmatrix} t^h \\ p^h \end{bmatrix}$

The prevocalic voiceless aspirate stops were found to have a positive VOT of 20 msecs or more (the values varying with place of articulation), and they are clearly distinct from the prevocalic voiced stops in this respect. Perceptually, they strike us as laxer than their English counterparts, but they are clearly aspirated.

The glottalized stops of Gitksan (and Nisgha, see Boas 1911a:76-77, 1911b:287-88; Sapir 1915:29-30; and my own Nisgha fieldnotes and recordings), when compared to those of other Pacific Northwest languages such as Sahaptin and Kiksht (Upper Chinookan), have a definite lenis character. Sapir (1949:225) lists a large number of Amerindian languages that have glottalized stops and affricates, and he

notes that in most languages, they are "fortes" (Chinookan and Athabaskan), but "lenes" in others (Chitimacha and Taos). Aoki (1970) also surveys the occurrence of glottalized stops in some Amerindian languages, and his instrumental findings indicate that Nez Perce has fortis-type glottalized stops. Montler (1986:8) says that the glottalized obstruents of Sechelt, a Coast Salish language of Vancouver Island "are ejective but weakly so. It is often difficult, especially in the anterior consonants, to perceive the contrast." Price (n.d.; 1906), a missionary at Kitwanga village on the Skeena for several decades from the 1890s who knew the language well, generally wrote the glottalized stops as voiced ones. Wickstrom (1974), who made an instrumental study of the glottalized obstruents and resonants in Gitksan, found (p. 63) in the spectrograms of glottalized stops produced by an older speaker (Mrs. Sarah Marshall) that, "There is a definite tendency to have voicing as evidenced by a light voicing bar. This is probably due to some vibration of the vocal cords during the glottal release". Hoard, as we have seen, described some of the glottalized stops in Lonnie Hindle's speech as voiced implosives, and he commented (p. 115) that he mistakenly recorded voiced stops when he failed to hear their glottalization on first hearing, as I myself tend to do. But on the other hand, Wickstrom (1974) and Powell's Eastern and Western pedagogical materials frequently represent the glottalized stops incorrectly as voiceless ones. Clearly, the situation called for instrumental work to complement impressionistic articulatory observation in order to ascertain and clarify the description of the phonatory mechanism of the Gitksan (and Nisgha) glottalized stops. There may also be interindividual variability in the production of these glottalized obstruents.

Our articulatory observations of the glottalic stop allophones in Gitksan differ significantly from those of Hoard, and they are confirmed by instrumental measurements. We discuss these in the order of the magnitude of the differences in our observations.

Hoard says (p. 115) that the final glottalized allophones "are only weakly ejective (i.e. there is little or no larynx movement), although glottal closure is clearly audible before the onset of a glottalized stop or affricate and glottalic closure extends through the articulation of these stops and affricates". We agree that they are preglottalized, that the glottal closure precedes the oral closure, but we observe no ejection. Instead, the oral release is accompanied with distinctly noticeable aspiration, except that the final preglottalized allophone of /x̌/ lacks such aspiration. Acoustically, the glottalization of these final obstruents is manifested in a way very similar to the that of the initial lenis glottalized obstruents, i.e., as creaky voice quality at the margin of the vowel. The period of the glottal cycle changes as the last glottal pulse prior to oral closure is approached, and there is a sharp fall in pitch over the last five or so cycles as compared to the negligible fall for final plain obstuents. No observable differences in the closure period or the oral release gesture between the final glottalized and plain obstruents were found.

Later in OVG, Hoard (p. 118) says that the Gitksan final glottalized allophones are the same type of sounds as the final preglottalized allophones found in English hit and stop. We disagree. In Rigsby's speech (basically, a Midland variety of American English), such words may end either in voiceless stops with aspirate release or

with unreleased preglottalized stops. The latter definitely differ from the Gitksan final type that has perceptually audible glottal closure and aspirate release.

Hoard describes the second glottalized allophonic type - the voiceless ejectives - as having an upward movement of the larynx (p. 115), and he illustrates these with four forms, which are [t̓daa], [t̓da], [p̓dal] and [t̓gˆa], phonemicized as /t̓t̓aa/, /t̓t̓a/, /p̓t̓al/ and t̓Ka/, respectively. However, our articulatory and instrumental observations of these forms are different. [pdál] rib /ptal/ and [tɋ́ɬ] skin, hide /tɋa/ in fact have plain initial stops, which phonetically are voiceless inaspirates, followed by a plain voiced alveolar stop in the first case and by a glottalized uvular stop in the second - refer back to earlier section of our paper. And the two reduplicated forms have "weakened" plain voiced stops:

[dɪt̓á·]	sit (vi sg) (durative)	/tə-t̓á·/
[dɪt̓á]	lice	/tə-t̓a/

(See Rigsby 1970:213 and 1986:96-103 for further description of initial reduplication in Gitksan, which displays phenomena similar to Grassmann's Law in Indo-European). Lice, by the way, does not have a customary plural form in older people's speech, and Mrs. Hindle does not accept it. Thus, we have no evidence for the existence of Hoard's second, preconsonantal allophonic type.

Elsewhere, according to Hoard, one finds voiced implosives, which have a significant downward movement of the larynx. Again, our articulatory and instrumental observations are quite at variance, but we agree that the glottalized allophones found in these positions, e.g. initial pretonic, etc., are perceptually quite different from the fortis ejectives found in some other Pacific Northwest languages. They have an overall lenis articulatory set, and they do strike the casual observer as having a "voiced" character.

Acoustic analysis of the time-series waveform confirms our impressionistic phonetic judgement that these Gitksan glottalized obstruents are quite lenis in character. They are only weakly ejective and their distinguishing features lie primarily in the nature of the vowel onset. Although the oral release burst is highly damped, as expected for ejectives, its amplitude relative to the peak amplitude of the following vowel is low, indicating relatively low intra-oral air pressure prior to release and a comparatively weak compression gesture. The voice onset time for these glottalized obstruents is shorter and more variable than that which is found for fortis ejectives (Hogan 1976; Kingston 1985:27-35), but nevertheless it is typically greater than that of the prevocalic voiceless aspirated stops. Variability in VOT may arise as a consequence of the glottal configuration at the vowel onset. Unlike the prototypical fortis ejective, where the vowel begins with a sharp glottal release, many Gitksan pretonic glottalized obstruents have a gradual rather than abrupt vowel onset accompanied by several cycles of laryngealized or creaky voice. The gradual onset may be observed in the amplitude envelope of the vowel onset. The creaky voice quality may be observed in the amount of jitter (pitch period perturbation) and in period by period frequency changes in the first

few glottal pulses. In other words, there is a lax glottal configuration. Details of our analysis are found in Ingram and Rigsby (1987).

There also also other allophones of the glottalized obstruents that Rigsby has identified. Preglottalized voiceless allophones also occur preconsonantally following stress, and these are not aspirated. In Rigsby's earlier work, he derived all the preglottalized allophones by a rule that segmentalizes the preconsonantal and the final glottalized obstruents into /ʔ/ followed by the relevant homorganic plain voiceless stop or affricate. The latter segment in final position then undergoes the aspiration rule as formulated in Rule 2 above. Examples are:

[ƛ̓ú·ćxʷ]	be black (vi sg) metal, knife	/ƛ̓u·ć-xʷ/
[ƛ̓úʔcʰ]	charcoal	/ƛ̓u·ćʔ/

In the past, Rigsby has also tended to hear slightly preglottalized voiced allophones in intervocalic position following primary stress especially, as in:

[ƛ̓úʔʒɪl]	pupil (of eye)	/ƛ̓u·ć-əl/

and he derived these by the same segmentalization rule, letting the obstruent voicing rule catch the second, voiceless obstruent segment before a vowel. This of course is similar to Hoard's proposal, although it yields egressive pulmonic voiced stops. We have not had the opportunity yet to study these other allophones instrumentally, and so we can say nothing further about them.

References

Aoki, Haruo
1970 "A Note on Glottalized Consonants," Phonetica 21:2:65-74.

Boas, Franz
1911a "Introduction." Handbook of North American Indian Languages. Bureau of American Ethnology. Bulletin 40, Part 1. Pp. 5-83.

1911b "Tsimshian." Handbook of American Indian Languages. Bureau of American Ethnology. Bulletin 40, Part 1. Pp. 283-422.

Chomsky, Noam and Morris Halle
1968 The Sound Pattern of English. New York: Harper & Row.

Hindle, Lonnie and Bruce Rigsby
1973 A Short Pratical Dictionary of the Gitksan Language. Northwest Anthropological Research Notes 7:1:1-60.

Hoard, James E.
1978 "Obstruent Voicing in Gitksan: Some Implications for Distinctive Feature Theory," Pp. 111-119 in Linguistic Studies of Native Canada. Ed. by Eung-Do Cook and Jonathan Kaye. Vancouver: University of British Columbia Press.

Hogan, J.T.
1976 "An Analysis of Temporal Features of Ejective Consonants," Phonetica 33:275-284.

Ingram, John and Bruce Rigsby
1987 "Glottalic Stops in Gitksan: An Acoustic Analysis." Paper to appear in the Proceedings of the Eleventh International Congress of Phonetic Sciences. August, 1987. Talinn, Estonia. 4 pp.

Kingston, John
1985 "The Phonetics and Phonology of Athabaskan Tonogenesis." Unpublished paper. University of Texas at Austin.

Montler, Timothy
1986 An Outline of the Morphology and Phonology of Saanich, North Straits Salish. Occasional Papers in Linguistics No. 4. Linguistics Laboratory, Department of Anthropology, University of Montana.

Price, Rev. A. E.
1906 Amit'l Ma'l'lasq'li 'Tamis St. Luke Ligi The Gospel According to the St. Luke. Translated into Gitkshian from the Revised Version. Translated and Printed at Gitwingak, by A. E. Price, C.M.S. Skeena River. B.C. On Press and Type part grant from S.P.C.K. Kindly assisted in final revision by R. Tomlinson, Esqr.

n.d. Gitkshian Readers. K'sgau.gam An.suwilak'sa. Primer, Part I. Translated and printed by A. E. P. C. M. S. [A. E. Price, Church Missionary Society]. Gitwingak [Kitwanga], B. C.

Rigsby, Bruce
1967 "Tsimshian Comparative Vocabularies with Notes on Nass-Gitksan Systematic Phonology." Unpublished paper presented at the Second International Conference on Salishan Languages.

1970 "A Note on Nass-Gitksan Speech-Play," International Journal of American Linguistics 36:3:212-215.

1986 Gitksan Grammar. Unpublished reference grammar manuscript prepared for the Linguistics Division, Provincial Museum of British Columbia. 442 pp.

1987 "Indigenous Language Shift and Maintenance in Fourth World Settings". Paper submitted for publication. 21 pp.

Sapir, Edward
1915 "A Sketch of the Social Organization of the nass River Indians," Canada Geological Survey. Museum Bulletin No. 19. Anthropological Series No. 7. Ottawa.

1949 [1938] "Glottalized Continuants in Navaho, Nootka, and Kwakiutl (With a Note on Indo-European)". Pp. 225-250 in Selected Writings of Edward Sapir. Ed. by David G. Mandelbaum. Berkeley: University of California Press.

Tarpent, Marie-Lucie
1983 "Morphophonemics of Nisgha Plural Formation: A Step Towards Proto-Tsimshian Reconstruction," Studies in Native American Languages II. Kansas Working Papers in Linguistics 8:2:123-214.

Wickstrom, Ronald W.
1974 A Phonology of Gitksan, with Emphasis on Glottalization. M.A. Thesis. Department of Linguistics, University of Victoria.