ASPECTS OF PIT RIVER PHONOLOGY

Bruce E. Nevin

A DISSERTATION

in

Linguistics

Presented to the Faculties of the University of Pennsylvania

in Partial Fulfillment of the Requirements

for the Degree of

Doctor of Philosophy

1998

_____

Supervisor of Dissertation

_____

Graduate Group Chairperson

To the Pit River people

In memory of Yámá·litw̓í·da

Dísdí sí·sá·dumá má č̓é suwí tús dit·é·wi,
amxágam t̓áxábá tól·ím dáx cú wíc st̓íjéuwí?
Qa ʔís ʔú w̓ó dis·i ʔuw̓á·géʔ tw̓ánuwí,
toljana winá·ji·wíní.

Abstract

Aspects of Pit River Phonology

Bruce Nevin

Eugene Buckley

Until recently, it has seemed that the Pit River language ("Achumawi") was reasonably well documented by de Angulo & Freeland (1930), Uldall (1933), and Olmsted (1956, 1957, 1959, 1964, 1966). My own fieldwork in 1970-74 disclosed fundamental inadequacies of these publications, as reported in Nevin (1991). We substantiate this finding, investigate its probable bases, and establish why my own data are not subject to the same difficulties. After this cautionary tale about the perils of restating a published grammar, we define a phonemic representation for utterances in the language and introduce Optimality Theory (OT). We then apply OT to a series of problems in the phonological patterning of the language: features of syllable codas, restrictions and alternations involving voiceless release and aspiration, and reduplicative morphology. Appendix A describes the physiology and phonetics of laryngeal phenomena in Pit River, especially epiglottal articulation that has in the past been improperly described as pharyngeal or involving the tongue radix (the feature RTR). Appendix B discusses certain ramifications of aperture features for the sonority hierarchy.

Contents

Figures

Preface

This dissertation describes a number of problems in the phonology of the Pit River language (Achumawi). It draws almost entirely on my own material collected in 1970–74 and 1992. It is organized as follows:

Chapter 1 places the Pit River language and my work on it in context. It situates the language in respect to geography, ecological regions, and linguistic neighbors. It recounts my engagement with the language and the people. It describes previous linguistic research on the language and identifies issues in the interpretation of earlier records, in particular exploring the reasons for deficiencies in the only work that has been published hitherto. It is therefore something of a cautionary tale about the perils of restating earlier publications. Text material of de Angulo, Uldall, and Olmsted is re-presented with some analysis. The difficulties experienced by earlier linguists also serve to introduce some of subject matter of Chapters 4–6. Portions of Chapter 1 have been revised from Nevin (1991) and Nevin (to appear).

Chapter 2 covers issues of phonological representation. It specifies a phonemic orthography in terms of mostly standard distinctive features.

Chapter 3 introduces optimality theory (OT) and a particular form of it called primitive optimality theory (OTP).

Chapters 4–6 describe phonological restrictions and alternations in the Pit River data and analyze them in optimality theoretic terms. Chapter 4 concerns features of syllable codas. Chapter 5 analyzes restrictions and alternations involving the aspirated stops primarily, but also released alternants of the laryngeal stops. Chapter 6 applies these results, together with some additional constraints, to the analysis of reduplication in Pit River.

Appendix A describes the physiology and phonetics of laryngeal phenomena in Pit River. Appendix B discusses certain ramifications of aperture features for the sonority hierarchy.

I apologize to my Pit River readers that this work is primarily a technical study. I hope to offer something more useful for your purposes before many more years pass.

I should like especially to acknowledge:

- Lela Rhoades, Johnnie Craig, Craven Gibson, Ima Bahnsen, Edna Webster, Rile Webster, Clara Schofield, Cora Wynn, Clifford Wynn, Ruby Miles, Donnie Quinn, and Aurelia Raglin.Túsý̰í qa ís tmijiý̰umá. Tól·ím c̰é suwí hw̰ duji gú suwá. Mijistú·ni w̰ó dis·i qá qxé tý̰anuwí, ís si·wa w̰ó dis·i ʔuw̰á·géʔ, má ʔilapl̰á·lawíʔ it·ú ya qá bi.
- Dorothy Brown, for her unfailing friendship, and for carrying on her grandfather's tradition of helping anthropologists.
- Reitha Amen, for her friendship and generosity. We don't have a kinship term, but it's there.
- Shirley Silver for my entrée into the field in 1970, for timely assistance at several critical junctures, and for serving on my committee.
- Dell Hymes, for starting me on Sapir's Yana and for handing me the invitation to the first Hokan conference.
- Mary Haas, for following up my paper on Yana with the question, would I like to work on a related language that was still spoken?
- Henry Hiž, for providing an impetus for my answer to that question, and for welcoming me back 17 years later. Life is what happens while you're planning something else.
- Rich Janda for his support and help, and for serving on my committee.
- Gene Buckley for helpful comments as chair of my dissertation committee.
- Jason Eisner for help in understanding and applying OTP.
- My employers, Bolt Beranek & Newman 1982-1995, and Cisco Systems since 1995, for educational support.
- The American Philosophical Society, for kind permission to reprint from manuscript material in the Boas Collection.
- My wife, Sarah, and my daughters Ruby, Ariadne, and Katrina. This degree has been unfinished business as long as each of them has known me. We help each other reach our respective goals. I am a lucky man.
- My late father, Edwin Nevin, and my mother, Doris Nevin, who were always most supportive, even when we disagreed. On a foundation of love, what cannot be built?

Chapter 1. The Situation of the Language

This chapter surveys the situation of the Pit River language in respect to geographical, ecological, and linguistic areas, with some hint of its history. It lists the people I have worked with as language consultants, and those remaining today who might be willing and able to help with further work on the language, and gives a brief account of my involvement in the field. It should be stated here, at the outset, that this is salvage linguistics with dwindling numbers of speakers and few occasions to observe the language in use. It is therefore important that in this chapter I survey earlier work by other linguists, identify some recurrent problems that some have had with the phonology and phonetics of the language, and explore reasons for their difficulties. I do this to enhance the usefulness of these earlier records, to explain discrepancies between my material and much that has been published, and as a prophylaxis for the quality of my own work.[1]

The examples in this chapter are written in the phonemic orthography that is introduced in Chapter 2, to which you should refer for detailed explanation. Minimal guidance to help prevent confusion about pronunciation is as follows:

- The plain stops written /bdjgq/ are voiced only after word boundary, consonant, or short vowel, that is, despite appearances this is not a voiced–voiceless opposition.
- /x/, the aspirated uvular stop, is pronounced as a uvular affricate or fricative.
- /ḥ/, while commonly described as a pharyngeal spirant, [ħ], is actually epiglottal.
- A vowel with an acute accent has high pitch, and an accentless vowel has low pitch.

1.1. The people and the territory

The territory of the Pit River people comprises some six million acres of the northeastern corner of California, extending from the origins of the Pit River (at Goose Lake near the Nevada border and the Warner range) downriver to Montgomery Creek on the west side of Hatchet Mountain. From there, the river continues through Yana and Wintu territory on to Redding, where it contributes 80 percent of the flow of the Sacramento river.

For a tribal name we probably ought to call them the Is, “man, person; people” (cognate to the Yahi word used as a name for Ishi), and refer to their language as ís si·wa ẘó dis·i “talking the Indian way,” or ẘó dis·i for short. Anthropologists call them the Achumawi or Achomawi. This term, from ajúm·á·wí, meaning dwellers on the ajúm·á, “river,” properly applies only to people in the Fall River valley, where the Fall River flows into the Pit from the north, midway along its course. In the present work I use the term Pit River for the people and the language, following their own current usage.

The territory of the Pit River people overlaps two ecological zones. Downriver are deeply wooded intermountain canyons and valleys with typically Californian deer and salmon, pine and oak. Moving upriver, the valleys become progressively higher, broader, and drier. There was formerly a spectacular waterfall and rapids where the Fall River joins the Pit. When the diversion for the Pit 1 power station was tunneled through the mountain, the main course of the river shrank to a placid stream below a weir in the town. In the canyon just below the junction of the Fall River is a place called wíníl̓ha·l̓íẘa, “where it turns back,” referring to salmon. Because of hydroelectric power stations and other intrusions the salmon have not swum so far up the river for many years, but the Fall River valley still marks a change from Californian ecology to the high plateau ecology of sagebrush and juniper, jackrabbit and elk that one associates with Nevada and eastern Oregon.

The downriver region is somewhat less extensive geographically, but supported a denser population. The name Pit River is commonly ascribed to Europeans' encounters with pitfall traps in which the people caught deer and other animals along the riverbank. European explorers surely saw too the people's semi-subterranean homes, which they may have thought of as pits.[2]

Kniffen (1928) mapped territories of nine bands of the Pit River people north of the river, and south of it their relations the Hat Creek (atsugé) and Dixie Valley people (apwáruge), collectively called the Atsugewi by anthropologists (see Figure 1).[3] The language falls into two dialect regions more or less conforming to the ecological division.

Speakers of downriver dialects place the division between Fall River Valley (Achomawi on the map) and Big Valley (Atwamsini on the map); speakers of upriver dialects say the two regions overlap in Big Valley.[4]

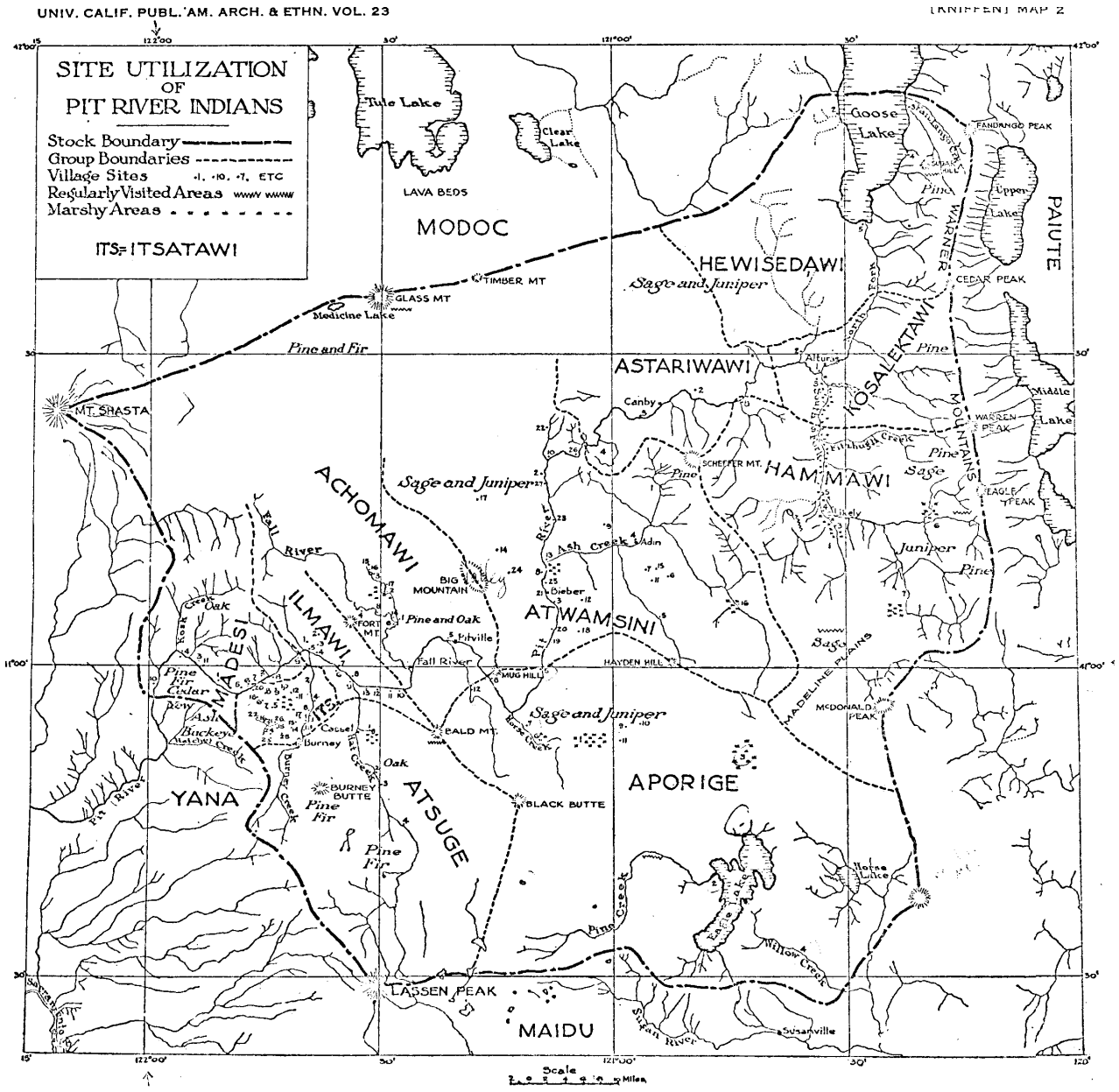


Figure 1. Map of Pit River territory from Kniffen (1928)

Their common ancestors were evidently among the earliest settled inhabitants of California, speakers of languages whose descendants in the postulated Hokan linguistic stock[5] include Shasta, Chimariko, and Karuk to the west, Yana/Yahi to the south, and much farther south other groups of languages, Pomoan and Yuman and perhaps others, now separated from this northern group by intervening populations. Linguistically unrelated neighbors include the northern Paiute upriver to the east of the Warner Range; the Modoc and Klamath to the north of Goose Lake and Glass Mountain; and the Maidu to the south, beyond the Dixie Valley people. Downriver, in the Sacramento Valley to the west of the Yana, are the Wintu.

If the postulated Hokan and Penutian affiliations of languages have historical validity (and this is by no means established), then by their geographical distribution it looks as though speakers of Hokan languages were pushed back out of the great Sacramento Valley by the speakers of Penutian languages.

This seemingly superficial interpretation of the linguistic map has some support in the archaology of the Pit River people and the Wintu people, based in differences of land use. From ancient times, those identified as Hokan-speaking people appear to have maintained an annual cycle of land use: descending to the great rivers to fish for salmon in the spring; scattering for the summer to small family camps in the cooler foothills and mountains to hunt and to harvest crops planted for them, as they saw it, by the hand of God; retiring for the winter (asjúy) to separated villages of permanent earth-covered homes (asjuy) in sheltered mountain valleys; then returning to the riverside for the salmon run, cycle after yearly cycle of life in The Garden.

After centuries, or perhaps millennia, ancestors of the Wintu people brought different forms of land use and social affiliation. Chase-Dunn (1992, 1998) contrasts them as riverine people vs. milling stone culture (Figure 2).[6]

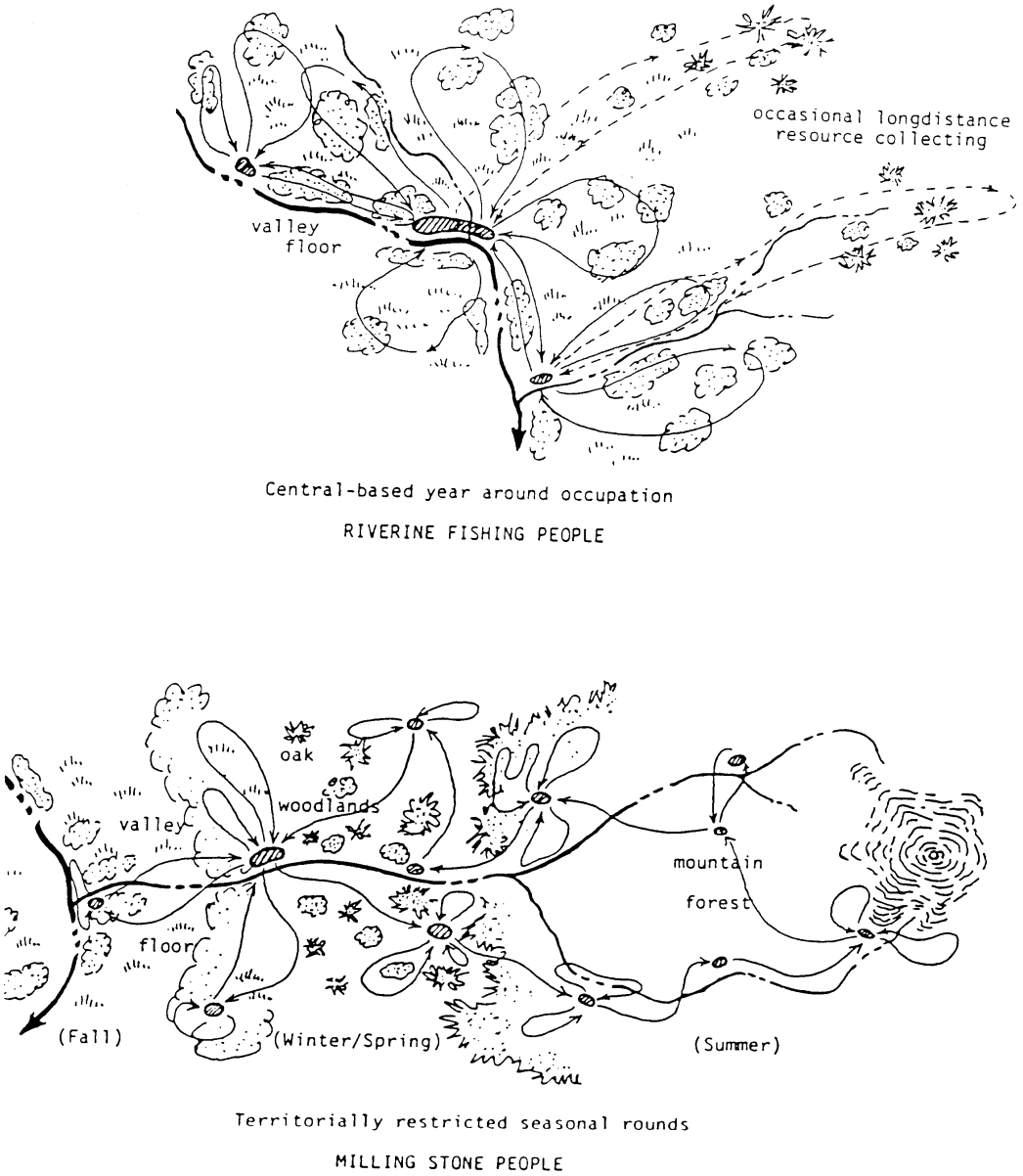


Figure 2. Differences of land use (Chase-Dunn et al 1992:26)

The Wintu were riverine people with a greater emphasis on fishing, using improved technology such as harpoon points for salmon. They also used acorn meal more extensively, grinding with a hopper mortar rather than the simpler “milling stone” technology of the incumbent population. With a greater emphasis on stored food, they had a more sedentary way of life, occupying their riverside villages throughout the year and making periodic expeditions for hunting, for the gathering of particular foods or craft supplies, and for slaves.

When the milling-stone people returning in the spring found a settlement of riverine people at some choice fishing spot, they shifted to another just as good, or almost as good. Gradually, a chain of new villages spread along the river, linked by ties of blood and marriage. If any one village fell into conflict with returning fishermen, their riverine relations up and down the Sacramento responded with quick allegiance. The autonomous families and bands of milling-stone people could not compete.

Gradually, with some recurrent conflict,[7] but with no evidence of settled warfare so far as we can tell today, the milling-stone people retreated from the great Sacramento Valley to outlying regions on its periphery, where they continued their way of life, adapting to changed ecological conditions where they needed to.[8] The annual “big time,” a reunion for the Spring salmon run in which now both peoples were represented, continued to be the occasion of celebration, with dancing, singing, trading, and courtship. This is not to deny that they were “always there” in their present territory, but rather to suggest that in earliest prehistoric times, before the arrival of riverine immigrants, their way of life also included annual use of the great central valley for fishing.

The course of the Pit River was relatively insulated from European intrusion by a curious historical circumstance. Peter Lassen had a ranch near Chico. He surveyed a branch of the Oregon Trail, so called, that crossed through Fandango Pass over the Warner Range into California, near Alturas, and followed the course of the Pit River down as far as the Fall River. There, he left the river and led the trail southward through some of the most rugged canyon country in the state, the territory of the Yana people, who were among the most resistant to European intrusion. Many hapless immigrants abandoned their wagons with broken axles or worse, emerging at last at his ranch to outfit themselves for the gold fields at Mr. Lassen's prices. Even though the course of the Pit River is a natural route into the state, much easier than Donner Pass for example, the trail got a bad name, and to this day US 299 remains but a 2-lane blacktop highway.

1.2. Speakers

The occasions on which the scattered handful of elderly speakers of Pit River could use the language to accomplish social ends had greatly diminished when I worked with them.[9] Consultants who helped me included the following, listed from downriver to upriver:

Name	**Dialect**	**Dialect Location**
Lela Rhoades	Itsatewi (ʔic̓á·day̓éwawíʔ)	Goose Valley, north of Burney
Ryle Webster	Madesi (madé·si)	Big Bend, west of Burney
Edna Webster, Clara Schofield, Cora Wynn, Clifford Wynn	Ilmawi (ílmé·wi)	Canyon below Fall River, near Pit 1 power station today
Johnnie Craig	Achumawi (ajúm·á·wí)	Fall River
Craven Gibson	Atwamwi (atẅamwí)	Big Valley
Ruby Miles	Hammawi (hm̓ám·á·ẅ́i)	Stone Coal Valley; Alturas

Most of my fieldwork was in the years 1970–1974. I worked with Mrs. Miles in the Fall of 1992, at which time the others named above were all deceased. These were my good friends and benefactors. I miss them.

My principal consultant, Mrs. Lela Rhoades, was almost 90 years of age when I worked with her at her home in Redding. A number of her narratives describe the early days of European contact in the words of her grandparents and great-grandparents. Her father, Samson Grant,[10] was of the Hat Creek (atsugé) tribe. Like many Atsugé, he spoke both languages. In the early 1850s, when he was only a young boy, the majority of the Pit River and Hat Creek people were force-marched by soldiers to what was described to me as a concentration camp, the Round Valley reservation in Mendocino County. Mrs. Rhoades' mother's family evaded capture, retreating to a remote valley north of Burney called Wé·l̓á·mugí·ẅa, “where it gets shadowy early,” near Goose Valley. Of those who were taken, most subsequently returned, among them Samson Grant.

Like other Native Americans, their children were taken sometimes great distances to government boarding schools, where “for their own good” they were forbidden use of any language but English. Parents were advised not to teach the children their language because it would interfere with their success in school. In this way, agents of the

conquering people, with the best of humanitarian intentions, have deliberately encouraged the abandonment of this language.

1.3. Prior research

In this section, we survey briefly the extent and quality of contributions to the linguistic record of the Pit River language made prior to my own fieldwork.

1.3.1. Before 1900

In the anthropology archives of the Smithsonian Institute, there are brief notes by various investigators in the 19th century. I have not made use of these, but they should be included in any complete study of the language.

Stephen Powers (1877) recorded a short word list from two speakers on the Round Valley Indian Reservation in Mendocino County.

1.3.2. After 1900

Gifford (1922) recorded kinship terminology from two speakers of the Fall River dialect (Ajummawi) and on a separate occasion from a speaker probably of an upriver dialect, on the Klamath Agency in Oregon. In this same period, Alfred Kroeber worked with Charlie Green[11] on ethnography, but I have not seen any linguistic notes.

Edward Sapir recorded fragmentary notes from the speech of an unnamed Madesi (Big Bend) speaker during the course of his field work on Yana. I found these in the Survey Room at UC Berkeley[12] and copied them.

Paul Radin worked with an unnamed informant of "unusual linguistic ability" in Berkeley in the winter of 1919–1920, on internal evidence a speaker of a downriver dialect, possibly Charlie Green visiting Kroeber. In 1970, I copied two drafts of Radin's grammatical sketch, (ms. a) and (ms. b), in the Survey Room at UC Berkeley, but found no materials for the dictionary that it was supposed to accompany.

J. P. Harrington's field record of Pit River appears to be limited mostly to verification of ethnogeography. His Madesi informants, being half Yana, he did not regard as sufficiently pure speakers of the language to meet his very particular standards for linguistic work. (Personal communication, Grace Moody Martinez, 1992.) I have seen some brief word lists recorded by Harrington. Some of his notes in the Harrington

archives (Harrington ms. b) include Pit River material interspersed with other languages, but I have not seen this.

C. Hart Merriam's contribution is primarily in his glossing of botanical vocabulary and terms for certain types of artifacts, such as basketry. His idiosyncratic use of English-like orthography, mostly omitting articulations foreign to English, makes his work of very limited usefulness for phonological purposes.

The most extensive record was made by Jaime de Angulo, with some contribution from Nancy Freeland.[13] Hans Uldall worked with de Angulo for a few weeks in 1931. I will discuss this material in detail in the section on my own fieldwork and research.

David Olmsted redacted materials of de Angulo, Uldall, and Merriam in his *Dictionary* (1966). In the introduction, a biographical sketch of de Angulo, he extols the accuracy of de Angulo's transcription and the profundity of his analyses.

> In 1930 he […] went to an International Congress in Hamburg and there met Hans Uldall. Uldall later came to Berkeley and did a phonetic study of Achumawi, using an informant Angelo [sic] had brought down for the purpose. Essentially, though, Angulo had already done the language. His best and most complete work of linguistic analysis, "The Achumawi Language," appeared that year in the *International Journal of American Linguistics*. […] There, in a little more than 100 pages, he gives us the language.

Note that the grammar occupies just 43 pages of *IJAL* (pages 77–120), and that Uldall participated in "bringing down" Willard Carmony and a friend as informants. Nowhere does Olmsted discuss the extensive addenda and corrigenda to this "complete" grammar in the Boas collection (de Angulo and Freeland ms. a), though he acknowledges the loan of manuscript materials by Nancy Freeland.

Olmsted refers to texts that he collected (1966:7). In 1973 I wrote to him to request access to his tape recordings, texts, and other materials, to make them available to relatives and descendants of his informants (unnamed in the *Dictionary*) through an Indian Community Center I had helped to found. I received no reply. Not long after, he contributed a text to Golla and Silver (1977) that he obtained in 1953 from Frank Winn, Edna Webster's brother. In the introductory comments on this text, he says "for Mr. Winn, Ajumawi was obsolescent, and this text shows it" and "he died before I could get back to him to clear up inconsistencies." Frank Winn died in the early 1960s (Dorothy Brown, p.c.). Also living in Fall River Mills were his sister Edna Webster and her husband Rile, both quite fluent speakers, and two other sisters who were somewhat less fluent. At that time, in the early 1950s, there were upwards of a score of fluent speakers of the language in the Fall River valley alone, not far from the Winn home. People still

gathered at certain homes for traditional singing and gambling. It appears likely that he spent very little time actually in the field. [14] This was the first or one of the first texts that Olmsted recorded.[15] He had no prior fieldwork experience (Mary Haas, p.c.), and he was working, for some unspecified reason, without a recording device. It may have been the only text he collected, or, at least, he collected none that were more suitable for publication.

In his discussion (1977:70), Olmsted acknowledges that the forms in the text are entirely unanalyzed and often incorrectly glossed. The first two "sentences" from the text illustrate this. The version in the first two lines is Olmsted's, that in the second two lines is my reconstruction.

(1)	lawíjə	kamáʔwislá	wénúnú	iwúʔji.	(2)	misqəm	asjúi	tiasjúʔji.
	eagle	loon	sisters	were.		One	winter-house	they-were-wintering
	lá·wí·ja	ma	ʔqmá·ʔwislʔá,	wé·nún	iwíwji,	hamʔísqám	asjúy	ʔiyasjíwji.
	eagle	&	loon,	sisters	together	,	one-only	winter 2

wintered together.

The unstressed conjunction ma "and" is easily overlooked, especially in Olmsted's circumstances. Attention must immediately have focussed on how to pronounce that second noun with its difficult initial cluster. The suffix –íwji "together" on the 3rd person dual verb ʔiyasjíwji appears also in the appositional phrase wé·nún iwíwji, meaning "sisters of each other." The devoicing of the /w/ before the oral obstruent /j/ is what Olmsted heard as /ʔ/.[16]

Olmsted acknowledges that he did not include material from this text in the *Dictionary*. There are also spurious inclusions in the *Dictionary*. Karl-Heinz Gursky (1987) identified Eastern Pomo vocabulary. Olmsted, or his student assistants, apparently copied this material uncritically from an unpublished paper (de Angulo, ms.b) in which de Angulo was attempting to demonstrate that Pomo and Achumawi are *not* related. Indeed, it was immediately obvious to me even at the beginning of my fieldwork that these words are quite divergent from anything else in the *Dictionary*. For example, they are the only vocabulary with /r/, yet Olmsted did not remark this even in the course of adding /r/ to the segmental inventory provided with such mastery, as he says, by de Angulo and Uldall! That Olmsted did not notice the foreign vocabulary suggests a profound unfamiliarity with the language, or with his own word lists, or both. Needless to say, this casts a cloud over his writings on historical reconstruction of "Palaihnihan" (Olmsted 1956, 1957, 1959, 1964) based on these materials.[17]

Shirley Silver helped me to get started with fieldwork in 1970, and has continued to collect Pit River material up to the present. In 1974 I encouraged James Bauman to take up fieldwork in the upriver dialects, which he did, and at least some of his material is published (Bauman 1979, 1980). I understand (Silver, p.c.) that he as well as she collected downriver dialect material as well.

1.3.3. Use of older records

There is an anecdote about a student coming in from several weeks in the field, and Franz Boas gruffly demanding "Well? Did you get it all?" Any field record is inadequate. There are always questions that were not asked and crucial data that were not elicited. Conversely, valuable information can be gleaned even from the patently inaccurate records of early explorers.

As we evaluate older studies of languages, we need to place them in cultural context, beginning with the cultural context of the fieldworker, including his or her antecedent cultural predispositions, experience, training, institutional setting, and purposes.

For example, de Angulo was an "amateur linguist and sometime hanger-on at Berkeley" whom Kroeber did not trust without supervision (Darnell 1990:282, citing Leeds-Hurwitz 1983). He came to the field without formal training in the 1920s, a period when the methods of American descriptive linguistics were first being clarified and paradigmatic examples of work were few. Had Kroeber supported the continuation of Sapir's early career in California (Darnell 1990:27-29) it is possible that de Angulo's work might have developed on a more firm foundation, but this was not to be.

Olmsted did his dissertation on the phonology of Polish at Indiana under Voegelin (1950). He was briefly at Northwestern and at Yale before being hired on the faculty at Davis.[18] At the very inception of the Survey of California Indian Languages and of the Department of Linguistics at Berkeley in the summer of 1953,[19] but with no prior fieldwork experience, he set out to follow up de Angulo's work.[20] Davis was at that time raising itself from its roots as an agricultural college, with a desire for research results meriting esteem, but with limited resources put at the disposal of its researchers. If Olmsted reported that de Angulo's work was adequate and that it could be the basis for a dictionary and for historical reconstruction, with outside funding available (perhaps from the Survey) for research assistants, it was doubtless a perfect fit.

Regarding the cultural context of native speakers, Hymes (1964) has suggested questions like the following:

- Were rules of marriage and residence such that individuals who are related affinally or consanguineally all spoke the langage? Mostly? On a gender-related basis? (For example, matrilocal systems vs. patrilocal systems have obvious implications for development of distinctions between men's and women's speech.)[21]
- Did the architecture of dwellings and of the community hold speakers in proximity or in isolation?
- If exogamy was practiced, what were the favored or most common bilingual pairings?

The more information we can adduce about cultural context, the better equipped we are to interpret the texts and other materials that earlier workers developed, and the more it will turn out they will have succeeded in "bringing back." For example, for Pit River, we know that these were exogamous communities, that most if not all families included native speakers of other languages, and that multilingualism was commonplace. These observations bear directly on our conception of what "the language" is.

It is at minimum important to know what other languages an informant may know. I have mentioned Harrington's quest for "pure" monolingual speakers. Sapir's informant for Northern Yana, Betty Brown, was a Pit River woman related to Mrs. Rhoades. Her maiden name was Betty Nefice. In some of the Northern Yana "charm" texts that Sapir recorded from Betty Brown, the word *suwa* occurs as an exclamation, glossed as a formulaic expression of unknown meaning and origin. This is the first person future form of the Pit River attributive copula, as in

1. *al·u gú suwá* "I will be hungry,"
2. *yak yak gú suwá qá saỷéɬ̓* "my leg will ache" (lit. I will throb [in] the leg).

In isolation, *suwa!* might be glossed "Let me be so!" or "So I will it to be!" possibly something like the archaism "so mote it be!" used by English-speaking witches, and indeed, its use in isolation may be an archaism in Pit River.

If older text material lacks complex embedding or clause subordination, and in other ways suggests a simplification of syntax, we might interpret this as a sign of obsolescence. (We will consider this in some detail in Section 1.3.4 "Language obsolescence and attrition.") Conversely, we can use older text material in re-elicitation work with contemporary speakers who do not fluently control the devices that it

exemplifies, but who still recognize these structures and can control them in appropriate and legitimately informative ways with the support of such a structured situation.

Lamb argues for a positive correlation between geographical extension of one language (or language family) and corresponding extinction of others (Lamb 1964, quoted in Dorian 1981), so that reconstruction of migration and expansion patterns may bear on interpretation of historical consequences for geographically peripheral languages in terms of language obsolescence in neighboring or related communities.

In cognizance of the salient characteristics of language death—notably alienation and bilingualism, with the newly dominant language becoming the more functional choice—we should examine these materials with an eye to cross-grammatical interference. This includes not only calques and borrowed vocabulary, introduction of new contrasts and reinterpretation of existing ones, but also factors possibly influencing which constructions become preferred in the simplified grammar, pervasive use of metaphor, reinterpretation of existing semantic relationships, and so on.

The obvious suggestion (Swadesh 1948: 230-31) to compare data from more than one informant is not possible unless the collection of texts represents more than one speaker. Of course, the texts themselves can provide a standard of comparison with new field recordings, with the task of somehow determining whether differences are due to attrition or authentic dialect difference, and of distinguishing these when both are present.

Cook (1989) cites Sarcee data showing that Sapir's one informant had replaced final [d] with glottal stop in some verb stems, retaining the feature of imparting high tone to a following vowel. This contravenes a well-established pattern in Athabaskan tonogenesis of glottal stop imparting low tone. Cook (1989:250) cogently notes that “[i]f Sapir's data were the only source, one could easily be misled by this significant counterexample. …”

We also must take into consideration cultural attitudes toward language and toward language use. Exogamy, small populations, and an unpretentious attitude toward the language of one's family of origin[22] must have had considerable impact on processes of language change, the development of linguistic areas, and related matters in the linguistic history of California. If obsolescence is taken as a kind of background processual norm[23] in these communities, rather than a tragic exception,[24] then notions of describing “the” grammar of “the” language in a kind of ethnographic present “before obsolescence set in” must in all likelihood be relaxed.

There are other reasons for embracing the heterogeneity of language as an essential feature, rather than as something that interferes with our getting at competence vs. mere performance. Judgements of a speaker's proficiency by other native speakers

come freighted with difficulties for the linguist, including especially these cultural differences of attitude toward language variety and language choice that we have been discussing. Langdon (1976:55) reports that Diegueño speakers praise someone as a “good speaker” of the language, when to a non-member of the community it appears that the individual shows signs of less native control, such as by intermixing a good many loan words. What constitutes being a “good speaker” depends upon attitudes toward language identity and language use, including perceptions of what is good for the continuation of the speech community.

Such factors must be borne in mind when evaluating field records and the judgments of their collectors as to their value. One of these factors in particular is an overriding consideration in any salvage work such as this, or rather an effect of many of these factors, as we will see in the next section.

1.3.4. Language obsolescence and attrition

When the testimony of different linguists about a dying language is in conflict, an obvious question is whether the speakers from whom they obtained their materials were not all in as complete control of the language. Issues of language obsolescence therefore have particular relevance here.

When members of a speech community share more than one language, and one is of greatly less social prestige than the other, it comes to be used on fewer and more socially marked occasions. The process of children acquiring the less-used language is impeded, and their control of it less complete and less fully competent than that of their elders. The range of idiolectal variation that is normal in any speech community becomes more extreme, and this presents a disunified and confusing model of the language, further impeding language acquisition. Unless this changes, it builds to a runaway positive-feedback process within the community that can very quickly end use of the language for social purposes. In a span of a few generations, the language is reduced to individuals' memories of a few words (“Yes, I know some Indian”) and then is gone.

Cook (1989) advances the related hypothesis, that languages in process of obsolescence “come apart” in reverse order of their coming together—that language obsolescence in short mirrors language acquisition. This is then a prediction that features last acquired by individuals are the first to be lost by a speech community, or more exactly the first whose acquisition is not attained by its children. Cook's explicit assumption (1989:241) is that acquisition is slowed down, so that what should have been

acquired earlier is delayed, and what should be acquired latest is not acquired at all by the time language learners reach maturity and acquisition effectively ceases.

Tacitly behind this is the presumption of an innate language acquisition device with a biologically determined timetable imposing a specific acquisition order. Cook does not consider the interplay of biologically innate mechanisms and patently evident social processes.

Cook is of course aware (but does not emphasize) that the process of acquisition is in many respects not analogous to the process of obsolescence. Cook is comparing:

The developmental stages of child language acquisition, which are spoken at different, successive periods in the life of each child in turn in the community.	*Different dialects or idiolects that are all spoken contemporaneously, ranging from fluent monolingual speakers, typically older, to hesitant semi-speakers, typically younger.*

Diversification is exaggerated at puberty when adolescents construct a social identity for themselves (Labov 1963, 1972b).

The efflorescence of dialect and idiolect diversity in obsolescence represents attritional stages of the language by metaphor only. If the two processes, acquisition and obsolescence, mirror each other, it is in many respects a one-way mirror.[25] There are characteristics of child language acquisition that are not and cannot be characteristic of language death, for example:

- In the extreme case, obsolescence clearly is not going to terminate in a population of babblers. The adults in the population continue to be linguistically competent, only their competence is chiefly in an alternative language that is superseding the original.
- Reduplication is probably a universal feature of baby talk around the world,[26] but it is not characteristic of obsolescence.
- Labialization is a widespread phonological feature of child language,[27] and babbling universally has a high percentage of labials and dentals,[28] but these are not likely to be characteristics of language obsolescence.[29]

What is needed is evidence as to the relative timing of acquisition vs. loss of features characteristic of both child language and obsolescence. Why do we not have it?

In the Chipewyan case, Rice (1978)[30] describes a replacement of t by k, loss of vowel nasalization, merger of glottalized and plain series of obstruents (together with other changes), replacement of affricates by stops, affrication of the lateral fricative, and

syllable loss resulting in shortening and truncation of words. Cook reports concurring data from Snowdrift only for three features (t-k, loss of nasalization, and syllable loss). The hypothesis predicts from this that the Snowdrift community is less far along in the process of obsolescence, and that the t-k contrast, nasalization contrast, and explicit articulation of unstressed syllable were the last features acquired by Chipewyan children. The first prediction is testable, and the second is not, though one might adduce universals of child language acquisition (Cook does not).

The question of relative timing, and indeed as Cook (1989:236) points out the very proposition that language obsolescence mirrors language acquisition, is inherently untestable "because if the language is normally acquired by children it is not in the process of extinction" (Cook 1989:236). Thus, the acquisition research would have to have been done prior to the onset of obsolescence; but if it had, it would be of reduced relevance, and in any case relevant acquisition studies just have not been performed for that long. So in the strict sense, as Schmidt (1985) rightly says, there is not enough evidence to prove the proposition, and in the nature of things there cannot be.

The plausible connection between the two processes, acquisition and obsolescence, lies in Cook's notion of impeded acquisition. As younger speakers come to maturity using a simplified version of the language, the range of variation within the language community increases.[31] By this hypothesis, the increasing range of variation in the speech community confuses the language norms experienced by each child and increases the difficulty of acquisition. At the same time, the occasions for witnessing and participating in normal language use become fewer. It is this combination of factors that interferes with acquisition.

The socially dysfunctional status of the language interferes with children's acquisition of the language, which as the children grow to adulthood with reduced linguistic competence in turn both exacerbates that dysfunctional status and contributes another sort of impediment to acquisition in the form of increased variability and indeed (as Cook does not mention) uncertainty and insecurity as to what the appropriate norms of the language are.

There are other elements in Cook's account of language obsolescence that clearly can have no counterpart in child language acquisition. Cook cites the occurrence of a striking archaism in the Chipewyan data, a classifier ɬ whose usual reflex in Sarcee is s. Cook says (quoting Nancy Dorian):

> This idiosyncrasy … exists ironically despite the impeded nature of the acquisition process, probably because … it is "of relatively high frequency within a very dense communication network."

Preservation of this archaism, then, is effected by precisely the same mechanism that nourishes the hothouse diversity of girls'-clique subdialects in Dyirbal (Schmidt 1985). This kind of feature is certainly not going to be mirrored in child language acquisition, though it undoubtedly increases the complexity of language acquisition.

It seems clear that the decrepitude of language takes place in the social realm of communication among its users. Competition from a more favored alternative language means in practical terms that one loses status or is less able to function in social settings that matter if one uses the dying language instead. As is well known, if people do not use a language, even one learned from infancy, their skills may fall away.[32] This process, which is termed language attrition, is complementary to language obsolescence:

Obsolescence is a social process: reduced social significance and usefulness of the language with respect to a competitor impedes child language acquisition, and this, by diversifying language norms, recursively further impedes acquisition.	*Attrition is a personal process: in social conditions of non-use that include but are not limited to language obsolescence, an individual forgets or becomes unskilled at language competencies.*

Unfortunately, Cook sees attrition as irrelevant and therefore excludes it from the given definition of what constitutes a "semispeaker" (1989:236).[33] But there is every reason to believe that language attrition among adults and defective acquisition by children are concurrent in the same community, and that the two processes together contribute to obsolescence. Note that language attrition—losing competence that one once had in a language—has also been compared with child language acquisition and with aphasia.

This disclaimer of relationship between attrition and obsolescence is rather remarkable, considering the history of Cook's notion of stages of loss mirroring stages of acquisition in reverse. "Ribot's Rule," dating from the 1880s, says that language attrition is a type of regression, with the most recently acquired features being the ones most easily and quickly lost. Freud (*On Aphasia*) wrote of the return of aphasics to earlier stages of linguistic development, applying the term "regression" that he later transferred to other contexts. Pitres argued that it is the *best*-learned forms (whenever learned) that are least vulnerable to loss. As is well known, Jakobson (1941) adopted the regression hypothesis and claimed that aphasic losses mirrored the stages of acquisition.

Unfortunately, this claim is not borne out by more recent research. Regression theories do not provide a complete explanation of what happens in aphasia (Berko-Gleason, 1982:17). Metalinguistic knowledge is an important differentiator. Aphasics are

aware that an utterance like “baby cry” (agrammatism in Broca's aphasia) is incorrect and may repeatedly try to correct it. Children are said not to have this metalinguistic awareness until over the age of four.

In illustration of this, my youngest daughter at 18–26 months systematically reorganized syllables beginning with either an s-initial cluster such as st and sn, or the affricate c:

[nowʔs]	snow
[noʔsmæn]	snowman
[næps]	snap
[tʌks]	stuck (contrasts with [tʰʌks] “tucks” and [dʌks] “ducks”)[34]
[tʌfs]	stuff
[gɪciys]	chicken (the affricate is not a cluster [ts])
[tæns]	stand (contrasts with [dæns] “dance”)
[tɪks]	stick (contrasts with [tʰɪks] “ticks”)

She apparently had no awareness that she was *not* approximating the adult model that she clearly intended.[35] Furthermore, her renditions of these words became functional once I caught on to what she was doing and the code was broken for family members. We knew that she had a stick, for instance, not ticks possibly carrying Lyme disease. Nevertheless, even though with this insight her speech became functionally adequate, still, after at least eight months of very consistent usage, sometime after her 26th month her pronunciation suddenly dropped this characteristic. Metalinguistic knowledge (at least on any conscious level) had evidently nothing to do with the process. And this seems to be typical of child language acquisition.

As with aphasia, so also in the case of both obsolescence and attrition, speakers who represent various phases of language obsolescence or attrition are adults with full metalinguistic awareness who are typically very much aware of their performance and how it differs from or resembles that of others.[36] In fact, this awareness is a very important reason that semi-speakers are reluctant to expose the attrition of their linguistic competence to others, preferring instead to use the dominant second language in which reduced competence is not socially significant in the same way, and whose features are more widely shared as a dialect of English (“Indian English”).

As we have seen, the increased variability that is commonly attributed to dying languages plays a crucial role in Cook's model of impeded acquisition. But there is age-graded variability of language in any community, and sometimes a quite considerable

range of social-dialect variation in a single community. J.M.Y. Simpson (in Haugen et al., eds., 1981) argues for the value of the heterogeneity of "minority languages" as a corrective for the unfortunate commonplace that "the" language can be described and understood as a single formal system, and its corollary that various forms of "the same" language are in some sense derivative (or even deviant) forms of that "real" standard. Studies of the details of speech as sociological variables have demonstrated sometimes pretty astonishing ranges of differentiation for English, which is scarcely a minority language (Labov, p.c.). To be sure, such detailed data are not available for Indian languages. Nonetheless, we can observe that in a flourishing language a speaker's use of one social dialect or another marks the speaker as a member of a socially functional category, such as a social stratum or an age group. By contrast, use of any variant of a dying language marks the speaker as a member of a socially dysfunctional group.

The kinds and extent of simplification found in obsolescence, however, are not typical of ordinary dialectal variation, and this may be diagnostic for distinguishing the two. Cook suggests that changes in Chipewyan are difficult to motivate as the result of normal sound change. For example, the lateral fricative has become affricated, while no other fricatives are similarly affected. This appears not to be normal sound change, but rather a kind of borrowing. Native speakers of English commonly reinterpret a lateral fricative as a /tl/ cluster. It seems more than plausible to suppose that English phonology has become the frame of reference, and bilinguals are reinterpreting the Chipewyan fricative in its terms. The term "superstratum" is customarily used to refer to the supposed influence of a socially superordinate language on the subordinate one.

In the next section, we will see that linguistic features found in my Pit River materials are absent from those of de Angulo and Olmsted. Several interpretations of this are possible. There is some simplification in some upriver dialects, particularly loss of final syllables (Silver, p.c.), so perhaps these earlier linguists worked with speakers of those dialects. Perhaps they worked with speakers for whom the language was obsolescent, as Olmsted suggested was the case for his text (1970). Perhaps these linguists could not hear important acoustic cues. Combinations of these are plausible. However, at least it cannot well be claimed that my material suffers from obsolescence and theirs does not, even though mine is later, because the relation of simplification goes the wrong way for that.

1.4. My fieldwork and research

My fieldwork began in company of Shirley Silver in the summer of 1970. I spent much of the period 1970-74 living in Pit River country, in Fall River Mills, Day, Lookout,

Montgomery Creek, and Redding. During that time, there was an ongoing political conflict with the U.S. government about ownership of the land. No treaty has ever been made with the Pit River people. About 85% of the land in that part of the country is leased by the Bureau of Land Management to lumber and other interests. Tribe members built a prominently visible campsite at Four Corners, where highway 89 cuts across 299 near Burney. They cut down some trees. This was against BLM regulations, so they were arrested. They went to trial in Sacramento, at their own expense of course. When the question of land title could no longer be avoided, the charges were dropped.

In the summer of 1971, I received a letter from a tribe member who was involved in this effort asking me to stop what I was doing and turn over all my records and notes to the Tribal Council. I wrote back that I had these materials in trust from the people with whom I had worked, and that I would give my notes and recordings to them if they asked for them. That autumn, a friend suggested that I might want to attend a Tribal Council meeting that had been called in Fall River Mills. At that meeting the chairman, Ross Montgomery, said “We thought about killing you and taking your notes and records. But we decided you already had the language, and probably there are copies back at the university, so we might as well let you go ahead. But we want to know how it is going to benefit us.” I read them a text obtained from Mrs. Rhoades, her grandfather's account of first encounters with Europeans in the 1820s or 1830s. I said that I was interested in living full-time in the area to work on the language more intensively than was possible on short field trips. I mentioned the possibility of their using my materials to teach the language to their children. After the meeting, Paul Hinze and some others approached me to see if I was willing to develop a program for the public school.

In the winter of 1972 I was funded under the Johnson-O'Malley Act[37] as half a teacher aide to teach the Pit River language K-12 in the Fall River Joint Unified School District. I met with grandparents and great-grandparents of my students twice a week for an evening adult literacy class, teaching a writing system and gathering additional field notes. The funding was cut three months later. I then worked with Paul Hinze and other parents to organize the Eastern Shasta County Indian Community Center, writing grant proposals by which we obtained funding from NEH, HEW, and the Akbar Foundation. We purchased a trailer, sited it at the Indian Mission Church on the west side of Fall River Mills, and provided after-school programs, with vans to take the children home.

In the spring of 1974, Paul Hinze, returning from a convention in Nevada for Directors of Indian community centers, fell suddenly ill and died. After helping find a new Director and organize continued funding, I gradually withdrew and then returned to U.C. Berkeley. Burnt out on Indian politics and dismayed by academic politics,[38] I left Berkeley in December 1974.

After I left, Clara Schofield, sister to Edna Webster, Cora Wynn, Clifford Wynn, and Olmsted's informant Frank Wynn (then deceased), was able to resume an informal version of the teaching program that I had begun in the Fall River Joint Unified School District.

In the intervening years, I kept working on my field notes when time and resources were available. In 1986, and again in 1987, I applied for NEH and NSF funding in support of renewed fieldwork while my consultants were still alive. In both years, my referees endorsed my application; in both years, the funding committees rejected my applications, saying that since I had not completed the Ph.D. they had no assurance that I would deliver a product for their money. In the fall of 1987, in part because of some linguistic publications of mine, I was invited to resume the PhD program at Penn. I had withdrawn from the program in 1970 to do fieldwork, so no new application was required to resume my matriculation. I carried forward with program requirements while working full time for Bolt Beranek & Newman and now for Cisco Systems. I completed coursework and exams by 1992.

With a small grant from the Center for California Languages, a foundation established by Robert Oswalt, I spent the month of September 1992 locating and working with a few remnant speakers, the people I had worked with in the 1970s having died.[39] I was fortunate to work with Ruby Miles in Alturas. This has special importance because I had not been able to gather much material on upriver dialects during my original fieldwork, due to intense political conflict between upriver and downriver moieties, especially between those associated with the XL Ranch reservation near Alturas and a group centered in Big Bend.

There remain only a few speakers of the Pit River language. Here are some that I contacted in that month:

Gloria (Hursey Cantrell) Melton	Big Bend. Madesi. May be fairly fluent, but is unwilling to participate because of an ancestor who urged them "never sell our stories to the white man."
Aurelia Raglin	Fall River Mills. Ajummawi. Good recall of words and phrases, helpful with re-elicitation. Teaching language classes with Donnie Quinn.
Ruby Miles	Alturas. Hammawi and Stone Coal Valley dialects primarily. Quite fluent.
Leo James	Near Alturas. Time and effort needed to establish a working relationship; may be fairly fluent, has a strong interest in songs.

Lucinda Moriah ("Lusanne")	In a trailer in Alturas. Was never home when I tried to visit.
Georgie Hess	On the XL ranch. Can recall words and phrases.
Geneva Barlese	Klamath Falls.
Lavina Anderson	Klamath Falls. There may be others in Klamath Falls as well who remember some words and phrases in an upriver dialect.
Donnie Quinn	Ajummawi. Lives in Nubieber. Works in the present Indian Center in Burney. Teaching language classes with Aurelia Raglin.

My efforts in 1992 to get some of these people together for conversation were unsuccessful. However, I am told that Donnie Quinn and Aurelia Raglin are currently teaching the language at the Indian Center in Burney, and use it with one another.[40]

Some younger people have asked for help in learning the language. I have sent them tape recordings of pedagogical materials as well as texts by native speakers, with written supporting materials, but I have urged them to contact their elders who still speak the language and work with them directly. I fear that conflicts about who will and will not talk with whom, and what it might signify if one did, will be an even greater impediment than the already great enough difficulties of learning. The prognosis for resuscitation is, therefore, not good.

I have worked up perhaps 30% of my field notes using SIL's Shoebox software. My databases have been publicly available in the University of Michigan linguistic archive for a number of years.[41] I intend to resume the work of developing a grammar, texts, and dictionary of the language when this dissertation is complete.

1.4.1. My assumptions based on earlier work

When I started my Pit River fieldwork in 1970 I had already spent some time studying Jaime de Angulo's grammar (de Angulo and Freeland 1930).[42] Voegelin guessed (1946:99) that the forms in de Angulo's grammar were mostly from the Alturas dialect, identified as Qosalektawi.[43] Probably this was to explain the differences between what he heard and what de Angulo had published, and because he knew de Angulo had a ranch near Alturas for a short time. Olmsted (1956:73) says that de Angulo "apparently recorded the upriver dialects in the main," but seems to have only Voegelin's supposition as authority for this stronger restatement. The grammar itself discusses dialect differences between the "upper reaches" and the "middle course" of the Pit River. By the "middle

course" de Angulo designated Big Valley and Fall River Valley, straddling the major upriver/downriver boundary.[44] Since at least some informants that he encountered working for ranchers in Big Valley were in fact from the Ilmawi band[45] it seems plausible that he was actually exposed to the upriver/downriver distinction. However, in part because of these statements that de Angulo had worked mostly with upriver dialects, and assuredly because of my great good fortune in working with a very fluent speaker of an undocumented downriver dialect, Mrs. Rhoades, I concentrated on the downriver dialects.

The notes by Sapir, Harrington, and Radin[46] all represent downriver dialects, probably Madesi. All three show a contrast of plain, aspirated, and glottalized oral stops, in three series. All three show devoicing of a second mora ("preaspiration") before plain and aspirated stops, and laryngealization in parallel fashion before glottalized stops. In these and other particulars, their records accord well with my own.

For these reasons, then, when I could not at first reconcile what I heard with de Angulo's record, I assumed it was because of dialect differences. For example, he claimed that long vowels were 4–5 times longer than short vowels, whereas they seemed to me perhaps twice as long. I did find that upriver informants make a greater distinction of length, giving the impression of "drawling" their speech more, but the estimate of 4-5 times as long seemed hyperbolic.

More perplexing, de Angulo claimed that plain, aspirated, and glottalized stops were in free variation with one another. I found plain, aspirated, and glottalized stops in contrast in upriver dialects as well as downriver. His difficulty hearing the distinction might be attributed to the more lenis articulation characteristic of upriver dialects. Even in the downriver dialects, glottalization can be difficult to hear because glottalized oral stops are not ejectives. Rather, the salient acoustic feature is laryngealization of adjacent vowels, particularly a preceding vowel.

Indeed, from this characteristic followed, I thought, de Angulo's assertion that "in a great many words" vowel length varied freely with glottal stop (1930:80). An example (*loc. cit*):

3.

de Angulo's record	**My record**	**Gloss**
wí·tu·pí ~ wíʔtu·pí ~ wíʔtuʔpí	wi̍tu·p̍í	"Rotten"

Of the glottal stop, de Angulo offers the following rather startling description (1931:79):

> The "glottal catch" is extremely strong. It is not merely a strong attack before a vowel, or a sudden closure of the epiglottis after a vowel. The walls of the larynx are pressed together tightly (with the epiglottis also closed firmly) for quite a long time. Then

> everything is released suddenly, so that some of the air in the mouth cavity is sucked backward into the larynx with a sort of click. In Shasta and Atsugewi this noise is usually replaced by *k*. In Achumawi, when this glottal catch is followed by a vowel, the effect is sometimes indistinguishable from the γ described above.

The k reflex that de Angulo mentions in cognate languages, and the association in his ear with the lenis voiced uvular fricative allophone of plain q (he describes γ as a "sonant" equivalent of ḥ), suggests a segment to which this description might indeed apply, to a degree, namely a glottalized uvular stop /q̓/. And indeed, when I re-elicited various forms that he cites with glottal stop, I frequently found /q̓/ or /k̓/, as for example:

4.

de Angulo's record	**My record**	**Gloss**
dí·màs'ádè	dí·macq̓ádi	"to remember"
máḥí'sà	máh̓·ík̓ja	"at night"
sálílá'tí	sálíl·éq̓di	"I like it"

I have mentioned the confusion of length and glottalization:

5.

de Angulo's record	**My record**	**Gloss**
yù'tò·gí	ʔiyut·u·gí	"They 2 arrived"

Audible release of the first member of a cluster may be lenited. A glottal stop appears in de Angulo's record occasionally where the first member of a cluster was not a glottalized stop:

6.

de Angulo's record	**My record**	**Gloss**
tsóʔtsà	c̓ókja	"Small"

In addition to having difficulty hearing laryngeal features in the speech of his informants, de Angulo may have tried to normalize his transcription on the model of citation forms. In this example are the mythical-quotative prefixes that are used in traditional stories:

7.

de Angulo's record	**My record**	**Gloss**
tsiguapsúdzí	cgwapsíwjí	"He thought."
tsigua·tí·dzí	cgwatí·jí	"He wept."
tsiguínímá·dzí	cgwiním·á·jí	"He found him."

The vowels i and u in de Angulo's *tsigu–* above might have occurred in abnormally slow citation forms, or this might merely reflect a difficulty with initial clusters for a native speaker of Spanish. But perhaps it reflects an expectation of finding the "real" shape of the word amid the variants. It is not inconceivable that, in the circle around Kroeber, de Angulo and Freeland were exposed to nascent principles of phonology being developed by American linguists in the 1920s and 1930s to resolve problems of phonological and morphological alternation in a principled way. Uldall in 1931 brought a Saussurian perspective by way of Hjelmslev and the Copenhagen School. However, a consistent effort at normalization would at least have recognized w– as a common 3rd personal prefix. Furthermore, de Angulo talks of free variation, and explicitly denies normalizing his material, e.g. on p. 78:

> *Consonants. p, t, k* are true "intermediates". The same person will pronounce either *p* or *b*, either *t* or *d*, either *g* or *k*, in the same words, under the same circumstances. We have not made any attempt to unify the spelling of our field-notes, and the reader is therefore warned to expect inconsistencies.

Judging only from his descriptions of sounds, de Angulo did not hear the uvular phonemes as free variants. His description of the glottal stop, quoted above, refers at least in part to /q̊/. On p. 78, de Angulo describes the aspirate, which we represent by /x/:

> *q* is pronounced with marked breath, sometimes even with a tinge of uvular trill. […] It must not be confused with the *h̓* to be discussed later.

And on p. 79 is the plain /q/:

> There is in Achumawi a "sonant" equivalent of the *ḥ*. It is produced exactly like the *ḥ*, except that the vocal cords are made to vibrate at the same time. It sounds exactly like the Arabic "raïn". It is quite a distinct sound, phonetically, from the *γ*, but since the true *γ* does not occur in Achumawi we have used this symbol to represent it. It occurs but rarely.

However, in practice de Angulo treated the plain, aspirated, and glottalized stops as free variants in the uvular place of articulation just as in every other place of articulation. For example:

8.

de Angulo's record	**My record**		**Gloss**
té·qá·dé	díq̓·a·ti	[q̓]	"Earth"
táqá	t̓áxá	[x̣]	"Again"
ìqús	iq·ús	[q·]	"Back" (body part)
qáswà	qásw̓a	[γ̣]	"Digging stick"

My confidence in the dialect-difference hypothesis eroded further when I looked at copies of de Angulo's texts, which I had obtained from the American Philosophical Society (APS) before I left Philadelphia in 1970.[47] Of the six texts, only two represent upriver dialects, one Hammawi[48] (near Alturas) and one Atwamsini[49] (Big Valley, de Angulo's "middle reach"). One is unattributed, but probably downriver, and the others are from downriver informants:[50]

Henry Wohl	"Creation Myth" (69 pp.)[51]
	"Beginning of a Creation Myth" (3 pp.)
Willard Carmony	"Reminiscences of an Achumawi Youth"[52]

De Angulo (ms.) says Henry Wohl[53] was "of the Adzumawi group" in Fall River valley.[54] However, Mrs. Webster identified him as Ilmawi,[55] the next band down the river, like herself. Willard Carmony was his grandson (Lela Rhoades, p.c.). In a ms. note, de Angulo says Carmony "was a youth of seventeen. He had travelled around a good deal and he sometimes made a mixture of dialectal variants." An obvious alternative interpretation is that Carmony's acquisition of the language had been impeded by

disruptive factors such as the relative importance of English, punitively enforced in government schools.[56]

This autobiographical text includes the following account by Carmony of de Angulo's relationship with this family. From the interlinear translation:

> We stayed ten days at Frank's house. My grandparents were there. We all came from Big Valley. We went picking cotton. We all picked cotton at Artois.[57] Then Louis offered to teach a certain man[58] to speak. He sent word and the man came. But Louis refused to go. Then my grandfather (mother's father) went. Then he couldn't speak right. Then they both came back together. Then Louis's wife taught him.[59] Then Louis and his wife quarreled. Then I went. I accompanied [him]. Over there I stay. I am teaching [him] in this way to speak.

The grandfather was Henry Wohl. The assertion glossed "Then he couldn't speak right" in interlinear translation[60] Angulo rephrases in his free translation as "but he doesn't know how to explain," suggesting that the problem was with Mr. Wohl's command of English.[61] From him, de Angulo had obtained a "creation myth" text (56 ms. pages) and a fragment of a second text, interrupted at 3 ms. pages. These texts, which are similar to stories of Fox and Coyote that Mrs. Rhoades has told me, seem to be well told and fairly well translated. Perhaps they didn't get along. It is likely that Wohl was unwilling to travel to Berkeley.

Also among the APS mss. is an "Appendix of Addenda and Corrigenda to the Grammar of the ACHUMAWI language. . . . With a new chapter on Phonology by H. J. Uldall" (uppercase in original). The Introduction to this Appendix is as follows:

> We had the opportunity during the summer of 1931 to make a further study of the Achumawi language in company with Mr. Hans Jörgen Uldall who has made a specialty of the subject of phonetics. Thanks to his help it was possible for us to make a finer and more accurate phonetic analysis. At the same time a number of errors in the grammatical sketch that we have already published came to light. Furthermore certain additions of importance to the morphology were also discovered. We therefore decided to publish this Appendix of Addenda and Corrigenda. Inasmuch as we are entirely in agreement with Mr. Uldall's phonetic analysis we incorporate his own report in toto. We have not changed his system of transcription (which is that of the International Phonetic Association) since it does not differ materially from our own.

Crossed out in the manuscript is the closing sentence "We have taken the liberty to add some footnotes to his text," suggesting perhaps some ongoing disagreements. Only Uldall (1933) was published. In that same year of 1933, de Angulo and some companions went

off a cliff near Big Sur with his 9-year-old son driving the car. When they were found, it was too late to save the son. Jaime de Angulo never returned to linguistic work.

There are improvements in transcription accuracy among the corrigenda, perhaps due to Uldall's influence. For example, de Angulo has in a number of places recorded q where previously he had glottal stop, as in:

Grammar	**Corrigenda**	**My record**	**Gloss**
tálílé?ti[62]	tálíléqti	dálíl·éʔqdi	"Like, want, desire"

Note for example the inflected form mijálíl·éʔqdi "would you 2 like (X)?", which de Angulo transcribes mədzálílá'qtí, corresponding closely to Uldall's _mi¯dzal¯l¯la'q¯ti (see 1.4.3 "Text transcribed by both de Angulo and Uldall").

1.4.2. Uldall's phonological sketch

Uldall (1933:74) describes a contrast of aspirated stops with nonaspirated, and in this respect his description differs from de Angulo's grammar. However, he does not recognize the glottalized series:

> The symbols *b*, *d*, *g* stand each for a variphone, whose principal member is an "intermediate" plosive with glottalized and voiced plosives as subsidiary members. […] What distinguishes this series from the [aspirated] series discussed above, is thus lack of aspiration. It has not been possible to find any rule as to when one should glottalize and when not; the same speaker will sometimes use g̊ and sometimes k' in the same word without, apparently, being aware of any difference except, possibly, one of emphasis.[63]

Thus, when we encounter *e.g.* t in Uldall's record, we are to assume [t^{h}], and where we see d in Uldall's record it may represent d, t, or t', which he understands to be in free variation. (The affricates written ts and dz are included by a subsequent statement.) He says further (*loc. cit.*) that:

> In medial position, the voiceless plosives and *ts* occur only after voiceless fricatives — *h* being in this position interchangeable with the glottal stop as already mentioned. Since this rule is absolutely without exception, the *h*'s before aspirated plosives have been left out in the transcription.

Thus, he hears but does not record preaspiration before aspirated t, etc.[64] However, he treats "preglottalization" not as an acoustic cue that a glottalized stop follows, but as a

free variant of the h of preaspiration. Echoing de Angulo quite closely, Uldall attributes this laryngeal feature (h supposedly alternating with ’ postvocalically) to an element of syllable length (1933:76), making no note of differences of vowel quality with length:

> The slight breath (or glottal stop) heard in front of aspirated plosives, is “taken from” the length of the preceding vowel, so that, while the vowel is shortened, the combined length of the vowel and the *h* is equal to the length of a vowel before, say, a liquid, i.e. a vowel with no *h*.
>
> […] in Achumawi you are left free to pronounce a fully long sound or break it off with a glottal stop, as long as you do not upset the length-value of the syllable.

Uldall says (1933:74) that he did try to analyze preaspiration as regressive assimilation, but decided this would not work. His reasoning follows from his prior conclusion (quoted above) that an underlyingly voiced segment is devoiced when affixed to a stem-final voiceless fricative. He found that the affricate in the auxiliary duji, normally voiced, is devoiced in certain syntactic environments. He concludes that in this auxiliary a suffix *-dzi* is attached to a stem *duh*- with final *h* in the role of “voiceless fricative,” where:

> […] ideally sonant plosives and affricates are replaced by their surd correspondants when added to a stem ending in a voiceless fricative.
>
> Examples [sic]: _ħay_du_tsi to think, ideally *_Hay_duh_dzi.
>
> The infinitive of the auxiliary verb “to be” is normally dudzi but in composition with certain unalterable particles (of which ħay in the example above is one), it is unaccountably altered to dutsi. The most common example is the composition with tse-, the negative particle: ¯tse_du_tsi, not to be. Here the unvoicing of dz is felt so strongly that the form _du_tsi carries a negative meaning even when the ¯tse is left out. Thus ¯dam_mi:¯gu_du_tsi_suw¯wa I will not eat (literally: of eating not to be I am).

The affricate and final vowel are indeed devoiced or partly devoiced in these examples. However, the environment is prosodic, not segmental. What is in fact going on here is devoicing of the final syllable of the auxiliary duji “do” under reduced stress in certain syntactic environments. This is related to utterance-final devoicing, which Uldall recognizes (1933:75). Because he thought a phonological segmental environment was necessary to account for the devoicing, Uldall reconstructed an underlying morphophonemic segment h in his *duhdji that never surfaced.[65]

Uldall thus first says that the h of preaspiration is a predictable alternant of vocalic length (alternating also with glottal stop) and so not to be recorded, and subsequently says

that it is underlyingly present (“ideal”) in certain morphemes. The inconsistency escaped his notice.

Uldall's interpretation of the pronunciation of the auxiliary duji suggests that, like de Angulo, he was listening for a voiced-voiceless opposition instead of hearing the plain-aspirated opposition. He was aware that the plain “variphones” that he transcribed as b, d, dz, and g have voiceless alternants. Nevertheless, he apparently confused the voiceless allophones of the plain stops with the corresponding (voiceless) aspirated stops.[66]

There are also important differences between instances of the voiceless affricate in his dutsi “in composition with certain unalterable particles”. The devoiced affricate in ɬa̰y̰ duji “to think, imagine” is lax and the following vowel is devoiced or breathy. In the imperative c̰é duj·óo “don't!” the affricate is not only devoiced, but also tense and geminated, and the following vowel is fully voiced. This geminate plain affricate, found for example in aj·át “ground squirrel,” contrasts with the geminate aspirated affricate found in mac·u “mother's father” (abbreviated form cún). Compare also the imperative of other verbs ending with –ji as in sdíl̰·ájóo wáh·ac “send me down bread!” where the affricate of the imperative is not geminate and not tense, and the final syllable jóo is fully voiced.

Certainly, de Angulo's grammar would predispose Uldall to expect a voiced-voiceless opposition. In addition, his initial contact was with upriver dialects, which have shifted or were shifting to a voiced-voiceless opposition.[67]

1.4.3. Text transcribed by both de Angulo and Uldall

The unpublished addenda and corrigenda to the grammar (de Angulo and Freeland ms.(a)) include de Angulo's transcription of the same brief text that appears at the end of Uldall (1933). The fact that both transcribed it suggests that it was recorded and that they both worked through the recording with their informant, but I have no direct testimony on this point.[68] We will now examine this brief text in detail as a demonstration of many of the suppositions developed in the preceding sections.

The de Angulo version is on top, labelled A. The version as published in Uldall (1933) is on the second line, labelled U. My version is on the third line, labelled N. Certain recurrent differences call for special mention:

- Uldall marks pitch with a high or low horizontal bar before each syllable.
- In de Angulo's manuscript, each word of the text is divided into syllables by vertical bars.[69] I have not included these marks here, though in fact they are crucial in a few places where de Angulo has omitted a schwa, apparently interpreting it as predictable epenthesis; I have indicated only the first of these in a note.
- The frequent differences in translation suggest that de Angulo's grasp of the language was not very deep, at least at this point in his work. I have broken their first sentence into three short sentences, to repair their mistranslation.

Willard Carmony's Story

A:	bál'mas	yu'to·gí[70]	MacArthur	wáídu …
U:	¯bal'_mas	_yu_to:¯gi	_mak¯á:_θə[71]	¯we_ye_du …
	Just now	*having arrived*	*MacArthur*	*from …*
N:	bálm̰as	ʔiyut·u·gí	magáθə	wáy̰du.
	Recently	*they 2 arrived*	*McArthur*	*from.*

A:	tsəhá'tsá·ládúwí	town …
	we were standing around	*town …*
U:	_tsi¯ha'¯tsa:¯la¯du¯wi	_tawn …
	we (2) were standing around	*town …*
N:	cihác̰·á·ládiwí	tawn..
	We 2 (excl.) were standing around[72]	*town.*

A:	… haktsan	wínílá·duwí	íyáqá·luwaygí
	… two	*white men*	*came driving.*
U:	… _hak_tsan[73]	¯nn¯la:_du¯wi[74]	¯i¯ya¯qa:_lu_wey¯gi.
	… two	*white men*	*they (2) drive hither.*
N:	hak̊jan	wíníl·á·diwí	ʔiyáq·á·luẘaygi
	Two	*white men*	*came driving out this way.*[75]

A:	mánndza	sdzílua'yá·dumá	tsú	itté·wí	tmidzií	Pit River–wa?	
	Then	*they (2) asked us (2)*	*do you (2) understand*			*Pit River–like.*	
U:	¯mann_dza	¯stse_lo_a'¯ya:_du¯ma	¯tsu:_wi¯te:¯wit_mə_dzi'¯i			¯pit¯ri_və_wa.	
	Then	*they asked us*	*"[query] understanding are you*			*Pit River–like?*	
N:	má ánja	sjílwaỷá·dumá	"cú	it·é·wi	tmijỉý	*Pit River*-wa?"[76]	
	And then	*they 2 asked us 2*	*"How*	*hearing*	*are you 2*	*Pit River-way?"*	

A:	há'à	tsəhi·s'í
	"Yes,"	*we said.*
U:	¯ha:¯a[77]	_dzi_hi:s¯'i
	Yes,	*we 2 said.*
N:	há·'á	cəhisỷí[78]
	Yes,	*we 2 (excl.) said.*

A:	má·	sdzílua'yá·dumá	tsú	məzálílá'qtí	Berkeley	dáí·dzugí·wa
U:	¯ma	¯stse_lo_a'¯ya:_du¯ma	¯tsu:_mi¯dzal¯l¯la'q¯ti		¯bə:k_li	¯day_yi'_dzu¯gi'_wa.
	Then	*they (2) asked us (2)*	*do you like*		*Berkeley*	*to go along?*
N:	má	sjəlʊwaỷá·dumá	"cú	məjálíl·éq̊di	Berkeley	dá·yiċ·ugí ẘa?"
	Then	*they 2 asked us 2 (excl)*	*"How*	*would you like*	*Berkeley*	*to go along?"*[79]

A:	há'à	tsəhi·s'í
	"Yes,"	*we said.*
U:	¯ha:¯a	_dzi_hi:s¯'i
	Yes,	*we 2 said.*
N:	há·'á	cəhisỷí
	Yes,	*we 2 (excl.) said.*

A:	mám	tsəhátsá·dumí	automobile-wádé
	Then	*we got in*	*in the automobile.*
U:	¯mam	_tsi¯ha'¯tsa:_du¯mi	¯a_ru_mu_bil_wa¯de.
	Then	*we 2 got in*	*the automobile.*
N:	mám	cəhác·átw̥amí	automobile wádé.
	And	*we 2 (excl.) got on*	*the automobile at.*[80]

A:	mánndza	díllú·dzi	tsəhéptê·má
	Then	*(to the) house*	*we went home.*
U:	¯mann_dza	¯dil¯lu:_dzi[81]	_tse¯hep¯te_e¯ma.
	Then	*[to our] house*	*we all went.*
N:	má ánja	díl·ú·ji	œhépdéumá.[82]
	And then	*house*	*we pl (incl.) went back to.*

A:	mánndza	tsəhiníssi·gí	ittú·ni	dissí·dzi
	Then	*we dressed*	*our*	*clothes.*
U:	¯mann_dza	_dzi_hi¯nis_si:¯gi	_i¯tu:_ni	_dis¯si:_dzi.
	Then	*we 2 dressed [in]*	*our*	*clothes.*
N:	má ánja	cəhinís·i·gí	it·ú·ni	dis·í·ji.[83]
	And then	*we 2 (excl.) dressed in*	*our*	*clothes.*

A:	mánndza	tsháiˈdzumí[84]	qa	Berkeley
U:	¯mann_dza	_tsi¯ha:_yi'_dzu¯mi	¯qa	bə:kli.
	Then	*we went on our way [to]*		*Berkeley.*
N:	má ánja	cəhá·yi·ʔɑumí	qa	Berkeley.
	And then	*we pl. (incl.) travelled to*	*the*	*Berkeley.*

A:	mánndza		Redding	tshu'tommá	má·	qehé	tshámmî·má
	Then		*Redding*	*we arrived*	*and*	*there*	*we ate.*
U:	¯mann_dza	¯qa	¯re_diŋ	_tse_hu_tom¯ma	¯ma	¯qe_i	_tsa¯ham¯mi_i¯ma.
	Then	*the*	*Redding*	*we all arrived*	*and*	*there*	*we all ate.*
N:	má ánja	qa	Redding	cəhú·tu·mí	má	xahé[85]	cahám·íumá.
	And then	*the*	*Redding*	*we pl. (incl.) arrived at*	*and*	*that*	*we pl. (incl.) ate.*

A:	yámmatswí·ga	taqá	tsəhuptê·má	máḥí·ga
	Having finished eating	*again*	*we went*	*all night.*
U:	¯yam_ma_tsu¯i_i_ga	_ta¯qa	_tse_hup¯te_e¯ma	¯ma¯ħay_ga.
	Having finished eating	*again*	*we all went*	*all night.*
N:	ʔiyám·aʔcʔwíʔyga	ʔtáxá	cəhúpdéumá[86]	máʔhí·ga.[87]
	When they 2 had finished eating,	*again*[88]	*we pl. (incl.) went*	*during (the) night.*

A:	mánndza	tsəhiná'tommá
	Then	*we arrived.*
U:	¯mann_dza	_tsi_hi¯na:_tom¯ma.
	Then	*we all arrived.*
N:	má ánja	cəhín·á·tu·mí.
	And then	*we pl. (incl.) arrived.*

A:	bá·láwídaktsa	tshaná'qo·wadzumá
	For a little while	*we sat around.*
U:	¯ba:¯la¯wi_dak_tsa	_tsi¯hi¯na'_qo:_wa_dzu¯ma.
	For a little while	*we all sat around.*
N:	bá·lá mʔít·aʔcjan	cəhínáʔq·u·wajumá
	Now at that time (dim.)[89]	*we pl. (incl.) sat around.*

A:	mánndza	tshaná'má·dumá
	Then	*we went to bed.*
U:	¯mann_dza	_tsi¯ha¯na'¯ma:_du¯ma.
	Then	*we all went to bed.*
N:	má ánja	cəhanáʔm·á·dumá
	And then	*we pl. (incl.) slept.*

1.4.4. Summary and conclusions

I began my fieldwork on Achumawi with the supposition that de Angulo's grammar described upriver dialects. I therefore attributed discrepancies between his record and mine to dialect differences. After exposure to upriver dialects, and having determined that much of his material in fact represented downriver dialects, I realized that de Angulo's record was deficient at least with respect to the contrasts of the plain, aspirated, and glottalized series of stops. Notes of Sapir, Harrington, Radin, and Voegelin corroborated this contrast. Ratification of another sort came from inspection of de Angulo's texts and of the text presented in the preceding section transcribed by both de Angulo and Uldall.[90]

The question remained, why did Uldall also fail to distinguish glottalized stops from plain stops, and why did he repeatedly confuse voiceless plain and voiceless aspirated stops, as though he were listening for a voiced-voiceless opposition instead of a plain-aspirated opposition?

Glottalization would have been especially difficult to hear if they were listening for the "popping" sound associated with release of an ejective (fortis glottalized) stop. It is reasonable that they would have been unable consistently to recognize the lenis glottalization or laryngealization characteristic of the Pit River language. Nonetheless, Uldall did record what appears to be the anticipatory glottalization ("preglottalization") that occurs between long vowel and glottalized stop, withou, however, recognizing that it was a glottalized stop that followed. On the other hand, he routinely omitted preaspiration because it was predictable, despite the inconsistency of his making the h of preaspiration an underlying ("ideal") segment in some forms and a predictable phonetic detail in others, and despite his statement that h and ' are free variants of vowel length. Under this misapprehension, he sometimes misheard consonant length or cluster as glottal stop. An example from the text cited above is his _tsi¯ha'¯tsa:_du¯mi "we (2) got on," where what he recorded as glottal stop is in my material in fact the first portion of a geminate consonant: cəhac·á·tumí

Aspiration is also problematic, for distributional as well as phonetic reasons. The strongly aspirated stops that I represent as p, t, c, k, x (or as p^h etc. phonetically) occur only syllable-initially. Uldall and de Angulo assumed that the voiceless-released alternants of the plain stops that occur in syllable-final position (where the plain-aspirated contrast is neutralized) are also aspirates.[91] Word-initially and after short vowel (with stress-related exceptions as noted), the aspirates contrast with the voiced alternants of the plain stops; intervocalically, they contrast with the voiceless alternants of the plain stops, which occur usually after long vowel (usually but not always with preaspiration). The voiceless alternants of the plain stops occur exceptionally after short vowel where a final syllable is devoiced as in ɦa̰y̰ duci and in geminate onset to a stressed syllable as in c̰é tuj·óo [c̰é duc·ô`] "don`t!". These exceptions to the general devoicing rule confused Uldall about the h of preaspiration; they may also have confused him about the interrelation of voicing and aspiration in the stop series.

Given this problematic context, it is possible that Uldall's young informants visiting in Berkeley for the second and longer part of his work on the language were of a generation who had begun to reinterpret Achumawi phonology along the lines of English phonology. I believe in particular that they had reinterpreted the plain-aspirated

opposition of the Pit River language as a voiced-voiceless opposition. In loan words like "sugar" the parents and grandparents of my oldest informants, the generations that first experienced effective contact with English, interpreted a voiced medial stop of English as the voiceless alternant of the plain stop: [sú·ka]. Older speakers, even those showing some characteristics of obsolescence or language loss, have no problem reading or writing the voiceless alternant of the plain stop [t] as *d*, but for younger semispeakers its devoicing is somewhat problematic. They tend to associate it acoustically with the voiceless-released alternant, which is simply reassigned with the aspirate to English-like *t*. The contrast with the relatively less common medial aspirate /t/ is not so keenly felt. (And correspondingly for stops at other places of articulation.)

Many younger speakers with whom I worked, people in their 50s and 60s in 1970 who were in their late teens and early twenties forty years before in 1931, age-mates of Willard Carmony and the two unnamed visitors to Berkeley, showed exactly this shift in their speech, reinterpreting the triple contrast of *e.g.* d–t–t̓ (with including both voiceless and voiced /d/) as a binary d–t contrast (with voiced d). For them the glottalized series was most problematic and subject to uncertainty, usually merged with what they take to be the voiced series or (occasionally in syllable-final position) with the aspirates, although glottalized stops medially after long vowel were sometimes represented by syllable-closing glottal stop as the first member of a C̓ cluster.[92]

The distribution of these alternants for older speakers and for younger speakers who have reassigned contrasts on the model of English phonology, are shown in the following table:

		V___V C___V #___V	V·___V	___C ___#
Older speakers	aspirated	t‘	ʰt‘	—
	plain	d	ʰd	t‘
	glottalized	t̓	ʔt̓	t̓ ~ t̓‘
Youngest speakers	voiceless	t	t	t
	voiced	d	(d)	—
	cluster or merger	d (t)	t̓ ~ t (d̓ ~ d)	’ ~ t

Parentheses indicate speaker uncertainty and variability. Speakers of an intermediate age, a decade or so older than the youngest noted in the table, did retain a glottalized series, but were typically uncertain whether or not glottalization was present in a particular form. I assume this reflects attrition, but as I have noted the effects of the personal process of language attrition are difficult to disentangle from those of the social process of obsolescence.

Since most of Uldall's work was with the two young men visiting Berkeley, his baseline of comparison must be contact with older speakers in Alturas earlier in the summer of 1931, and de Angulo's attestations. He may also have worked with older speakers of the language during the brief visit to Alturas in the summer of 1931, for example, he may have met Willard Carmony's grandfather, Henry Wohl, or Mary Martin. He makes two observations that he says apply "especially among younger people": a tendency to substitute palatal for laminal s (p. 73), and to substitute ey for ay (p. 75). (Unfortunately, he gives no examples illustrating these changes.) It seems fair to say, however, that discernment of diphthong quality and recognition of an English-like palatal sibilant bear no relation to his failure consistently to distinguish three stop series.

It seems that Uldall generalized what he heard from his young informants in Berkeley as characteristics of "the language" as a presumed homogeneous entity, disregarding or overlooking the contrasts presented by older speakers who were probably more difficult to work with.

It has been suggested on the basis of his work with Pomoan languages[93] that Uldall simply was not as good a phonetician as he was made out to be, and this is certainly an obvious and much less labored alternative interpretation of the facts at hand. The regularities in the inaccuracy of Uldall's records of Achumawi could be interpreted either as being due to the influence of English on Achumawi in process of obsolescence, or to the influence of Danish and English on Uldall's hearing. My experience with speakers of the same generation as Willard Carmony lend credence to the former interpretation without prejudice to the latter. Both could concurrently be true.

My experience with obsolescence in Achumawi, and my interpretation of the testimony given indirectly by de Angulo and Uldall, if correct, bears upon the question whether dying languages "come apart" in the reverse of the order in which children learn them. It appears that one factor in this situation is a recasting of the phonology of Achumawi on the model of the dominant and replacing language, English. Specifically, the three-way contrast of plain, aspirated, and glottalized stops has been replaced by a voiced-voiceless opposition, with glottalization maintained only with uncertainty and

variability. A similar “superstratum” interpretation can be made for some of the facts reported by Cook for Chipewyan.

The notion of impeded acquisition is surely a useful explanatory principle in the description of language obsolescence. It may be the case that successively younger speakers of a dying language have stopped learning the language at successively earlier stages of the acquisition process. I have seen no good evidence for this aspect of the process, and for reasons discussed none may ever be forthcoming, though the hypothesis crucially requires it. However, even if it is the case, it is evidently also true that characteristics of the socially predominant replacing language influence the development of a semispeaker's reduced competence in the socially subordinate language as a “superstratum,” the reverse of the influence intended by the term “substratum”. Absent some third explanatory principle, our very inability to account for all changes observed in language death as interference artefacts may be construed as indirect evidence in support of the probably untestable hypothesis of impeded acquisition.

A demonstration of “superstratum” interference as a factor in language death suggests that language-contrastive instruction may be helpful for language maintenance or attempts at resuscitation, though of course in the absence of a social matrix of communication using the threatened language, nothing can avail.[94]

This is salvage work. The people I worked with, then in their 70s and 80s, did not use the Pit River language in an active speech community, with the exception of couples like Rile and Edna Webster, and Johnnie and Nadine Craig. Their abilities differed among them for various reasons, as language skill and linguistic aptitude vary among individuals in any community. Clyde Thompson, who was described as a “walking dictionary,” was alas gone some years before my arrival in 1970. I was not able to find Weaver Bainbridge, reputedly a nearly monolingual old man who lived a hermit’s existence near Glenburn, and of course who knows how fluent he might have been if he were willing to talk to me. Some refused to “sell their stories to the white man,” and some refused to have anything to do with the oral tradition, but would “testify” as in church. Mrs. Rhoades, the source of most of my material, said she had not used the language for 60 years, but her fluency and her skill at recounting stories were impressive. Because my consultants were taught to discourage their children from learning the language, the differences were extreme between their command of the language and that of the generation then in their 50s. Even among their peers there were very great differences, as for example between Edna Webster and her siblings, though not so much affecting phonology. Had I worked with these others my data would show signs of language attrition in those individuals and of language obsolescence in the community. Indeed, even among those ten years younger were individuals who had essentially forgotten the

language. Whatever the varying degrees of language attrition may have been my data are consistent with respect to the phonological patterns reported here (allowing for the differences between upriver and downriver dialects), and that is what is important for the present work.

---

[1] Some of the material in this chapter is revised from a presentation to the Hokan-Penutian Workshop held July 1-2, 1991 in Santa Cruz, California, as part of the LSA Linguistic Institute. It has benefitted from comments made there by Anthony Grant, Bill Jacobsen, Margaret Langdon, and Sally McLendon. An earlier version of part of it will appear as the introduction to my contribution to a collection of stories in English translation to be published by the Smithsonian, edited by Herb Luthin.

[2] Described in Kroeber (1925:312). Rather differently described in de Angulo (1953:2-3), which generally has not much if anything to do with the Pit River people.

[3] Locally, at least in the white communities, the term Pit River Indian often includes the Hat Creek and Dixie Valley groups in a generic whole.

[4] Bauman (1979:2).

[5] On Hokan, see for example Sapir (1917), Langdon (1974, 1976, 1979), Langdon and Silver (1976), Jacobsen (1979). This is a very incomplete list.

[6] The Yana fit this description as well. I do not know how well Chase-Dunn's analysis of land-use patterns extend to other tribes whose languages have been identified with the northern Hokan grouping and their Penutian neighbors such as the Klamath, the Modoc, and the Maidu.

[7] For example, the Klamath and Modoc in the north and the Wintu in the west made slave raids. The Pit River word for slave, jah·óm, means also "dog" and (obviously after European contact) "horse." I heard schoolchildren protest (in English) "I'm not your dog!" with the "slave" meaning obviously in mind. The more proper word for "dog" is ʔá·l̥á·m̥ugíʔ, etymologically something like "flop-ear".

[8] This account is due to Christopher Chase-Dunn of Johns Hopkins University, and S. Edward Clewett and Elaine Sundahl of Shasta College in Redding. See Chase-Dunn (1997). To be sure, it is based on a reconstruction of social structure and intergroup relations from archaeological evidence for one tribe, the Wintu, and their neighbors, but it seems to me entirely plausible.

[9] In her comments on my presentation at the 1991 Hokan Conference (Nevin 1991), Margaret Langdon objected to the use of the term "semispeaker." I recognize that it reflects the judgmental attitudes about language use that are prevalent in our culture but probably misleading when applied to the Pit River language and people, and that it may be taken as demeaning to individuals so labelled. No alternative term has been suggested that is equally compact and convenient for linguistic discussion. Perhaps "recaller" or rememberer" of the language is not much more awkward than "semispeaker."

[10] See also Park (1986) and Rhoades and Curtis (1973).

[11] Mr. Green lived in Fall River valley. He reciprocated by learning about the legal and economic systems of the invading culture, and sought to benefit others with his knowledge. There is an exhibit on his contributions, now held in storage by the National Park Service. He was actively interested in helping Kroeber and Kniffen understand the culture and needs of his people. He responded to a call to San Franciso to see if he could communicate with Ishi. He was the father of Ima Bahnsen and grandfather of Dorothy Brown of McArthur. Dorothy has been many times a benefactress to me, to Jim Bauman, and others, continuing a tradition of helping anthropologists.

[12] Adjacent to the linguistics department, and used by students and fieldworkers associated with the Survey of California and Other Indian Languages.

[13] Freeland told Olmsted (1966:5) that she had little to do with it. Participants in the Hokan Conference in 1991 suggested that she was by far the better linguist.

[14] I could find no one in the Pit River community who had any recollection or knowledge of him. The *Dictionary* appears to be entirely redacted from the work of others, primarily de Angulo. He acknowledges (Golla and Silver 1970:70) that it does not even include material from his one published text.

[15] Olmsted says "I was new to Ajumawi [sic] when this tale was taken down" (1977:70).

[16] It may be that the last word, tiasjúʔji, was *they asjíwji* or *they ỷasjíwji* as Olmsted's gloss suggests, but when I heard this sort of intrusion of an English "he" or "they," it was a narrative infinitive that followed, e.g. *de dasjíwji* "they dasjíwji." Olmsted gives sentence 3 as: *ti tiasjúʔji qa páywa*, "they 2 wintered in Paywa (a place name)," which could be either *they dasjíwji qa páywa* or *ʔiyasjíwji qa páywa*. (Bear in mind that, following de Angulo, he assumes that plain, aspirated, and glottalized stops are in free variation.) It is entirely plausible that "they" intruded in the course of Mr. Winn

attempting to clarify the form for Olmsted in English, but would not occur in a natural telling of the story at all.

[17] Reviewed by Bright (1965) and Silver (1966).

[18] Bright, p.c.

[19] Bright (1957:v). It was much later that "and other" was added to the name of the Survey to justify out-of-state work.

[20] Possibly Olmsted's interest in Pit River began with his Polish studies. His presentation at the 1970 Hokan conference was a biographical sketch of Jeremiah Curtin, in which he expressed great admiration for Curtin's translation of Sienkiewicz' *Quo Vadis*. Curtin was a linguist and a collector of Native American stories in translation, including Pit River stories.

[21] Schmidt (1985) reports that Dyirbal has developed tightly focused microvarieties that serve to mark membership in tiny cliques of young women. It appears also that young men were reluctant to use the language with her.

[22] See McLendon (1980, in the Klar et al festshrift for Madison Beeler). She describes a continuation of Pomo speakers' "pre-contact pattern of pragmatically acquiring other languages as they needed them. . . ."

[23] Folk attitudes toward usage commonly do take it as a norm, viz. the "English is becoming degenerate" pronouncements of Language Commentators in the popular press. It is a common perception that important distinctions are becoming lost.

[24] Due to our preoccupation, in our culture at least, with what seems to us self evident but in fact is the highly problematic idea that we have a separated personality, or identity, individuality (see Carrithers, Michael *et al* (eds).) The point I am making is not that we do not (both extremes are indefensible), but rather that others may see individuals predominately as placeholders in lineage, clan, etc. By extension, the metaphor of ego by which we become chauvinistic about our language tends to work rather in the opposite way for cultures that differ from ours in this way.

[25] There is some parallel to the extent that the diverse models of language competence presented to a child by other children of various ages in the community compete with the language of adults for attention in the acquisition process, but adult language is generally understood to be the primary reference.

[26] Ferguson 1964. One of the languages for which Ferguson describes baby talk is Comanche. Baby talk is relevant insofar as it reflects phonological competence of babies.

[27] Ferguson 1964.

[28] Locke (1983), Stoel-Gammon and Cooper (1984), Boysson-Bardies and Vihman (1991).

[29] There are other features of child language reported by Ferguson that are also found in language obsolescence: replacement of r by another consonant (liquid l, y, w or apical stop t, d), replacement of velars by apicals; interchange among sibilants, affricates, and stops (but not in Comanche child language); loss of unstressed syllables; simplification of consonant clusters. Cook also cites a tendency to levelling of morphophonemic alternations in obsolescence, another characteristic shared by child language.

[30] Cited by Cook, as reported earlier in Haas (1968).

[31] "If one looks at individual idiolects of semispeakers, there is a remarkable reduction in the system, but the varieties of idiolects that constitute a dying dialect render the total structure much greater in variability or complexity. *In other words, what looks like a simplification at the level of individuals amounts to a complication at the level of the total community*." (Cook 1989:239, emphasis in original.)

[32] That there are exceptions, including many remarkably fluent last or almost-last speakers of languages, underscores what is perhaps most disquieting about proposals like that of Jakobson and of Cook, their imputation of a mechanically deterministic process. A speaker may maintain fluency by speaking to herself daily, by remembering what elders said and imagining what they would say in various circumstances as they arise, by remembering and reciting stories and songs, and so on.

[33] As noted earlier, I use the established but impolitic term "semispeaker" reluctantly.

[34] That is, unaspirated [t] is properly neutralized for the st cluster of English.

[35] Note, in passing, that a developmental stage of this sort is extremely unlikely to be mirrored in the process of either obsolescence or attrition.

[36] Though only more competent speakers can usually specify those differences in detail, for the obvious reason that they do so by example.

[37] This legislation was passed in the 1920s to provide for the education of Indian children when reservation schools were closed or otherwise unavailable. This was the first year that the California legislature had allowed it in the state. Perhaps the delay was because,

under terms of the legislation, the funds could only be used for Indian students, not part of the general school budget, and this was seen as probable occasion for political difficulties. In the event, I was bound by this requirement, and this is the likely reason the funding for my work was cut after three months.

[38] See Harris (1993).

[39] Cora Wynn was comatose in the local hospital when I was there, and has since died. Edna Webster was at home with her granddaughters, but unresponsive. I read some of Mrs. Rhoades' texts to her for about an hour. When I paused to rest, she looked at me with warm intelligence and said ẘó is·í? (“Speaking Pit River?); after a moment of incredulity, since she had been unresponsive for an hour or more, I answered hí·ʔí, ẘó sisý̰ chiý̰ (“Yes, I was talking.”), but already she had turned away and said no more.

[40] Dorothy Brown, p.c. Addendum May 1999: Sadly, Mrs. Quinn died about a year after my writing this section.

[41] This archive appears no longer to be extant. It was at linguistics.archive.umich.edu where it was administered by John Lawler.

[42] Olmsted (1966:5) reports Nancy Freeland as saying that she had little to do with the Achumawi Grammar, so I refer to it hereafter as de Angulo's grammar.

[43] Kniffen’s Kosalektawi. An analysis of this word appears in Chapter 5.

[44] The distinction between the speech of Mr. Craven Gibson of Big Valley on the one hand, and that of his friend Mr. Johnnie Craig (Fall River) and of Mrs. Edna Webster (Ilmawi) on the other, is quite marked.

[45] I had not at the outset of my fieldwork yet studied de Angulo’s texts from the American Philosophical Society.

[46] All in the collection of the Survey of California and Other Indian Languages when I examined them ca. 1970.

[47] These mss. were made property of the American Council of Learned Societies (ACLS) when delivered to Boas, and are now in the Boas collection at the American Philosophical Society. In addition to the texts mentioned here, there are texts of a few songs collected by de Angulo. Aside from the APS mss, there is a text collected by Radin that was at the Survey of California and Other Indian Languages when I copied it in 1970,

and Olmsted has published a text in *NATS*. I have approximately 50 texts and numerous songs.

[48] "Creation Myth" by Jack Folsom, 16 handwritten pages, editor's notes in German. Hammawi is from ẖám·á "upriver from here" plus -wi "dweller".

[49] "Coyote's Race with Porcupine and his Adventure with the Coot Girls" by Mary Martin. 41 typed pages, 20 handwritten pages. Atwamjini or Atwamsini is from atẘam, "valley," referring to Big Valley, just upriver from Fall River valley.

[50] In addition, Uldall (ms.) names informants Artie Griffith, Jack Folsom (miscopied as Foesom in the accession record), and someone identified only as Jessie. Jack Folsom, grandfather of Ruby Miles (Gooch 1990:109fn), lived near Alturas. These were probably all three upriver informants.

[51] APS ms. 497.3 B63c H 1a.7. Editor's notes in German.

[52] APS ms. 497.3 B63c H 1a.5 bearing the printed return address of the ACLS and a handwritten note "received from Dr. Voegelin, March 1966."

[53] In a photograph I have seen, he is identified as Henry Wool.

[54] From ajúm·á "river," -jum "flow, run," whence "Achumawi."

[55] From ílmá, a place name of undetermined etymology; according to Mrs. Webster, the pronunciation was ilmé·wi.

[56] The same note says Carmony is "of the Adzumawi group," but in this autobiographical text young Mr. Carmony says that he and both his parents are from q̇ac̰ ádé, "millstone-place," which is in the Ilmawi section of the river near the present site of "Pit 1" power station). He describes catching salmon from a canoe in his childhood, and there were no salmon upriver from the Ilmawi.

[57] Artois is in the Sacramento valley south of Orland and west of Chico.

[58] Carmony uses the phrase hamẘís ís "one person." This use of hamẘís may be a calque on the English indefinite article. The noun ís, "a man," is usually taken to refer to Indians in distinction from winílá·diwí "a white man".

[59] Mary Martin was the source of a long text in the Big Valley dialect. In the ms. the name Mary Bieber appears, with Bieber crossed out and replaced by Martin. Bieber is a town in Big Valley.

[60] The phrase is má·nja ʔcé táyuwí dísdí ʔwó dis·i “And then evidently he could not speak correctly.”

[61] We cannot dismiss the possibility that Mr. Wohl grew exasperated with de Angulo’s pronunciation.

[62] Number 58, p. 100 of de Angulo (1930).

[63] His g̊ seems to correspond to unaspirated voiceless [k].

[64] The fact that he was hearing preaspiration in words like só·té·wí [sɔ̊ʰté·wí] “I hear, I understand” confirms that Uldall's informants during most of his work with Achumawi (the 2-month visit to Berkeley in the Fall of 1931) were speakers of a downriver dialect.

[65] Note that he uses * to indicate an underlying or reconstructed form. I believe this was Hjelmslev's practice.

The forms Uldall cites are as follows in my record:

ʰhaʔy duji	thought to do (i.e. to think)
ʔcé duji	not to do
dám·i gú duji suwá	eating fut. to do I shall [not] (i.e. I won’t be eating)

Compare the first with ʰhaʔy sinúuwí “I thought, I imagined”. Compare the last with dám·i gú ʔcé duji suwá, in which the negation is explicit, and contrast both of these with the affirmative dám·i gú suwá “I shall eat”. The reduction of a morpheme to zero when it is redundant in synactic context is of course not a surprise.

[66] This makes more understandable his specification of the environment for his predictable h of syllable length. He says that it is predictable before “voiceless plosives,” then in the same paragraph (1933:74) says that it is predictable before “aspirated plosives”.

[67] One obvious influence for such a shift is contact of upriver bands with neighboring northern Paiute, which long antedated European contact. This accounts for why the upriver dialects are most affected, even though the downriver bands had the earliest and most extensive contact with English.

[68] Wax cylinder recordings of Ishi’s Yahi were made under Kroeber’s auspices almost two decades earlier, and the equipment was still available. There may have been more sophisticated equipment on campus, such as that used by Harrington.

[69] For most of the first sentence, de Angulo has also marked each syllable with combinations of sc, sv, lc, and lv (short and long consonant and vowel, respectively). Substituting C, V, C· and V·, the following excerpts are especially of interest:

de Angulo's record	**Syllabification**	**My record**	**Gloss**
yù'|tò·|gí	CV·| CV·| CV	yut·u·gí	"They 2 arrived"
–wá|í|dù	CV|V| CV	–wáy̌du	"From"
tsə|há'|tsá·|lá|dú|wí	C|CV·| CV·|CV|CV|CV	jiháč·á·la·díwí	"We were standing around"
hàk|tsàn	CVC|CVC	haǩjan	"Two"

The first and third examples interpret consonant length as syllable-final glottal stop, not too far off the mark for jiháč·á·la·díwí"we were standing around." In –wáy̌du "from" he treats the diphthong ay̌ as two vowels and omits the glottalization, interpreting it as a freely varying feature of the following d.

[70] Uldall represents the mid vowels with epsilon and turned c. For typographic simplicity I have normalized these as e and o respectively, since he does not use these symbols. Similarly, de Angulo's cursive z character (with descender) is here an ordinary z.

[71] The town name "MacArthur" is pronounced with unaspirated k in the English of the region today, including that of elderly Indians. According to Uldall's definitions, k is aspirated and an unaspirated velar stop should be g̊. Either Indian English has changed, or Uldall is listening for a voiced-voiceless opposition, as discussed earlier.

[72] Carmony is using the narrative past appropriate for storytelling. Here and throughout he has used the inclusive dual "thou and I" instead of the exclusive dual "he and I". The simple narrative exclusive "he and I" is slh–, inclusive "thou and I" is lh– (epenthetic schwa between l and h). The exclusive narrative past form probably should be scəh- with the s- prefix transposed before the past tense c–, but the distinction may have been lost in

Carmony's speech. I have corrected the gloss without changing the prefix. The –uma suffix is the plural.

[73] This is the numeral haḵ̓ "two" plus suffix –jan, a diminutive which is often semantically empty (frozen or "morphemized"). Consider for example the pair yét` "Mt. Shasta" vs. ye˙tí˙cana "Mt. Lassen" (perhaps "little yét" or "the other yét"). Uldall shows the tense H, de Angulo had a dot under his h indicating the same distinction, but crossed it out. I believe the indeterminacy of the initial segment, which has troubled me as well, is due to subphonemic spread of laryngealization from the final /ḵ̓/ of haḵ̓.

[74] The form means something like "one who moves around, wanders." Until 1850 the only European contact was with trappers and others passing through.

[75] Normal VSO word order would be ʔiyáq·á·luẘaygi haḵ̓ wíníl·á·diwí.

[76] The correct locution is ís si·wa ẘó dis·i, "talking the Indian way".

[77] This interjection of affirmation always has two nasalized vowels, alternately hí·'í, almost always with high pitch throughout. In one of the other texts (ms. p. 20 nr. 76), de Angulo records it with rising tone (low pitch followed by high pitch) on a short vowel.

[78] Based on character spacing, which is in general quite regular in this "fair hand" copy, de Angulo appears to have inserted the colon in this form later. Elsewhere, de Angulo uses a raised dot for length; it is Uldall who generally uses a colon. These facts suggest revision under Uldall's influence. I cannot say why Uldall heard, or this speaker produced, a long vowel in this form. It is never long in my experience.

[79] cú as above. Earlier, we saw the verb dálíl·éq̓di "like, desire" as an example of de Angulo's problems with glottalization. Under Uldall's influence, apparently, he hears the back-velar closure now, where previously he quite consistently wrote only glottal stop. For the subordinating particle ẘa, compare dám·í ẘa síuwí "I want to eat."

[80] Compare duj·átẘam "Get on!", transferred since buckboard days to the present English idiom "Get in!" when offering a ride in a car.

[81] If Carmony produced a voiced j in díl·ú·ji it suggests an upriver dialect. This may reflect the dialect mixture de Angulo referred to. Similarly for dis·í·ji in the next sentence. However, both Uldall and de Angulo describe voiced and voiceless obstruents as free variants, so the transcription is not determinate enough to be sure of this.

[82] Plural suffix –umá, on stem –épté– "go back, return".

[83] The in- prefix often indicates repetitive or durative action, and -gi may be the directional "hither" frozen in this form. The root is probably the same as in dis·í·ji. The 1st person plural possessive pronoun it·ú·ni is from it 1st pl., –u possessive (enclitic, taking pitch opposite adjacent stem syllable), –ni plural. The –ji suffix is probably the same as in the auxiliary duji "do."

[84] Here and subsequently, de Angulo omits the schwa, but he marks the syllable boundaries ts|há|ì·|dzù|mí. qa is the determiner, usually with pitch opposite that of the following syllable.

[85] xé and xahé means "that one," so it sounds like they ate Redding. This word should instead be something like xé·ʔwa "there, in that place."

[86] Compare sləhépdéumá "went back, returned," above and dupté "go!" vs. depté "go back!"

[87] The vowel is lowered and diphthongized because of the preceeding pharyngealization with /ʔ/. The suffix –wa, here with the /w/ elided, is usually translated as instrumental.

[8888] Carmony may have been reluctant to translate the gerundive construction accurately.

[89] Compare gíʔtač "when." –ja(n) is a frequent diminutive suffix, seen in haʔkjan vs. haʔk "two," and often in frozen expressions where the diminutive sense is lost, as in mád·íkja(n) "day," ámit·éʔwjan "woman."

[90] Transcriptions in the unpublished Addenda and Corrigenda to the Grammar show improved accuracy (notably for glottalized qʔ). It is a great pity that de Angulo (and Nancy Freeland!) did not continue to work with the language after 1933. He would doubtless have had more to say even than in the unpublished Addenda and Corrigenda. It is a shame almost as great that the limitations of his published material were not made known long since.

[91] For a practical orthography it might make sense to write syllable-final t‘ etc. with the same character *t* as syllable-initial tʰ, precisely because younger speakers have reinterpreted the phonology in terms of the English voiced-voiceless contrast. In that case, it would be the voiced stops whose distribution would be defective, being limited to syllable-initial position. As we shall see presently, these semispeakers do not seem to

have difficulty with the devoicing of medial plain stops even if they are represented by d etc.

[92] This is complicated by the existence of clusters of glottalized continuant plus plain stop. For example, the /wj/ cluster in the suffix –íwji "together, reciprocally" is devoiced for older speakers dowriver; but in jíẘji "bone," both occurrences of syllable-initial /j/ are voiced. In upriver dialects, both these forms are voiced, jú?ji and –ú·ji respectively. It may be that Carmony and his friend were slipping into an upriver dialect, or it may be that younger speakers with diminished control of the language also showed these traits, influenced by English. De Angulo records them jú·jí ~ jú'ji and –ú·ji ~ –ú'ji, but as always it is difficult to guess whether the variation was there in the speech or in the hearing.

[93] Sally McLendon, p.c.

[94] Dorian (1991) reports that Hornberger (1988) demonstrates this point for Quechua.

Chapter 2. Representations and Descriptions

This chapter presents describes how Pit River utterances are represented in terms of segments and features. The description is of downriver dialects, with occasional notes about upriver dialects.

2.1. Phonetics and Segmental Orthography

First, we provide an explanation of the phonemic orthography. Some phonetic detail is deferred to later chapters because of its relevance to problems dealt with there.

2.1.1. Consonants

It is useful to discuss the consonants under two headings, oral stops and continuants. The inventory of consonant segments is as follows, ranked in the usual way left to right according to articulatory position, and vertically according to the type of articulation:

Oral Stops							
plain	b	d	j	g	q		
aspirated	p	t	c	k	x		
laryngealized		p̓	t̓	c̓	k̓	q̓	ʔ
Continuants							
voiced	m	n					
		l					
	w		y				
voiceless			s			h	
glottalized	m̓	n̓					
		l̓					
	w̓		y̓			h̓	

2.1.1.1. Oral Stops

Phonemically, there are three oral stop series:

Aspirated	p	t	c	k	x
Plain	b	d	j	g	q
Laryngealized	p̓	t̓	c̓	k̓	q̓

In each series are contrasted five oral positions of stop articulation: bilabial, anterior coronal (apical), posterior coronal (laminal), anterior dorsal, and posterior dorsal. (The latter four are also identified in terms of passive articulators as alveolar, palatal, velar, and post-velar or uvular.)

The contrast of plain and aspirated stops is neutralized in syllable codas and before a consonant (including in an onset cluster). Preconsonantally, the aspirates are frequently affricated, and /c/ and /c̓/ are fronted to [t^{s}] and [t̓^{s}]. In syllable onset, the uvular segments /q/ and /x/ are often given affricate or fricative articulation, and /k/ may be affricated.

The laryngealized stops are not ejectives, that is, they are not produced with a glottalic airstream mechanism to the exclusion of the lungs.[1] The most prominent cue distinguishing the laryngealized stops from the plain and aspirated stops is laryngealization of adjacent vowels (creaky voice). This is because the acoustic affects of laryngeal tension increase as supralaryngeal air pressure rises (and as the trans-glottal pressure differential consequently drops) in the progress of the oral occlusion for the stop. During the stop phase, creaky voice ceases, and the glottis usually closes. This is especially obvious when laryngealization builds to closure during the second half of a preceding long vowel.

2.1.1.2. Continuants

The consonants other than oral stops include nasals, the lateral, semivowels, and fricatives. The inventory is as follows:

Nasals	m	n			
Lateral		l			
Semivowels	w		y		
Fricatives			s	h	ħ̓

Glottalization of continuants and semivowels is discussed separately, below, as is the epiglottal fricative /ħ̓/.

2.1.1.3. Nasal stops

Nasal stops occur regularly in bilabial and apico-alveolar articulation, [m] and [n]. The coronal nasal /n/ is not velarized to [ŋ] before velar stops. An example is –dán-gi "downward hither". However, in the upriver speech of Ruby Miles, a posterior dorsal (uvular) nasal occurs before the uvular aspirate /x/ where downriver dialects have [m] in the word amxá "but, however". As is well known, a constriction at the back of the oral cavity has an acoustic effect that is similar to that of a labial closure at the front of the

oral cavity. I consider this nasal segment to be an allophone of /m/ in Mrs. Miles's dialect.

2.1.1.4. Semivowels

There are two semivowels /w/ and /y/, pronounced as in English.

2.1.1.5. Lateral

There is one lateral [l], with light and dark (fronted and backed) allophones as in English. Since this distribution is found in the oldest and most conservative speakers, it is probably not due to influence of English, as they show no such influence in other details.

2.1.1.6. Fricatives

There are three voiceless continuants or fricatives, written s, h, and ẖ.

The sibilant /s/ has generally a somewhat posterior coronal (laminal) articulation, fronted to anterior coronal (apical) before a stop or front vowel. It is seldom articulated as far back as has been described for the more palatal allophones of the so-called "California s," whose articulation is described as ranging between the es and esh sounds of English.

The voiceless vowel (aspirate) segment /h/ is pronounced as in English.

In addition to the ordinary laryngeal /h/ there is an epiglottal spirant [ħ], represented by /ẖ/ as though it were a "laryngealized" /h/. In fact, there is some support for this symbolization, in the spread of laryngealization from /ẖ/ within a word, and in the laryngeal tension involved in its production. The epiglottal articulation of this sound is described in Appendix A, where it is shown that the epiglottis is an integral part of the larynx, both anatomically and functionally. In this description, I account the phonetic contribution of the active articulator, the epiglottis, among the laryngeal features.

2.1.1.7. Glottalized continuants

The continuants m, n, l, w, y may be glottalized.[2] Consistently with the sonority hierarchy, the glottal closure occurs at the syllable margin (before the continuant in the

onset, after the continuant in the coda), as shown by the following alternation for the verb root -p̊al- “foam”:

10. p̊al̊p̊al̊ duji [b̊alʔ b̊alʔ dʊcɪʰ] “to get sudsy”

11. digup̊a·l̊i [dɪgub̊á·ʔliʰ] “to make sudsy with the hand”

The acoustic cues for glottalization can be confusing in clusters, e.g. in jíẘji “bone,” which can be misinterpreted as jíwc̊i or júc̊·i. (Olmsted 1966 has jóje, but, redacting de Angulo, he frequently misses glottalization entirely.)

The epiglottal spirant /ʜ̊/ was described in the previous section.

2.1.1.8. Glottal stop

In most of its occurrences, the glottal stop is a predictable surface phenomenon.

When a glottalized semivowel appears after pause or a consonant and next to a homorganic vowel, it alternates with a simple glottal stop. In these cases, I assume an underlying glottalized continuant.

12. datỷí [datʻʔyíʰ], [datʻʔíʰ] “mother”

13. waỷí [waʔyíʰ], [waʔíʰ] “father”

14. ẘó dis·i [ʔwó dɪs·iʰ], [ʔó dɪs·iʰ] “to speak; word”

15. asẘú [asʔwúʰ], [asˀ̥ ʔúʰ] “tree”

Glottal stop alternates with zero word-initially before vowel.

16. qá as [qá ʔʌs], [qá ʌs] “the water”

17. qa áp [qa ʔʌ́pʻ], [qa ʌ́pʻ] “the mouth”

18. xhé ánja [qˣhé ʔʌ́njʌ] “that one only; just that one”

Certain dual pronominal prefixes involve the glottal stop in this position:

19. c̊é ʔiyúj·óo [c̊é ʔiyúc·ôʰ] “don’t! (dual)”

20. ʔiyáw·awɂ́ájóo [ʔíyáw·awʔyajôʰ] “You two give it to him!”

In a few cases, intervocalic glottal stop alternates with zero between two central vowels [a], so that the glottal stop cannot be attributed to the presence of a glottalized continuant:

21. dáx sl̓aʔám [dʌ́qˣ sʔlʌʔʌ́m], [dʌ́x̣ slʌʌ́m] “What shall I eat!”

22. ʔánjíʔ l̓aʔá·já [ʔáncíʔ·lʌ́ʰcáʰ] “I hope he doesn’t get any!”

These instances of intervocalic glottal stop appear to occur only with the first person volitional prefix l̓- (which is followed by an epenthetic vowel). There is a tendency of the laryngeal gesture to spread from a laryngealized consonant (including /ɦ̓/) to continuants and vowels at other sites in a word. It therefore could be argued that the glottal stop in these forms amounts only to rearticulation of the vowel at the margin of the verb stem. On this analysis, the underlying forms are sl̓aám and l̓aá·ja. When the tone sequence on the vowels is LH, a glottal stop is likely; when the tone sequence is HL, the cluster surfaces as a long vowel with falling tone, no glottal stop, as in síuwí “I want”:

23. dám·í wɂ́a síuwí [dʌ́m·í·ʔwʌsíiwíʰ] “I want to eat”

Glottal stop occurs at word margins with every appearance of being affixes on verb stems deriving certain adjectival and gerundive forms, but (as above) alternating with zero:

24. ʔehwɂ́a·ɂ́íʔ [ʔeɦ̓ʔwa·ʔyíʔ‘], [eɦ̓wa·ʔyí] “light (in weight)”

25. ʔám·íʔ [ʔʌ́m·íʔ], [ʌ́m·í] “eating (participle)”

26. ʔu·sa·yíʔ [ʔu·sa·yíʔ], [u·sa·í] “digging (participle)”

27. ʔijoq̓·ú·ɂ́áʔ [ʔɪjoq̓·ú·ɂ́áʔ], [ɪjoq̓·ú·ɂ́á] “fish-spearman”

28. wím·acq̓ádí twiɂ́í [wɪ́m·ʌl̓sq̓ʌ́díʰ t‘wɂ́iʔí], [wɪ́m·ʌl̓sq̓ʌ́dɪ́t‘ ʔwiʔí]
“He is one who knows about it.”

29. xhée wím·acq̓ádíʔ gam, ikim chgisɂ́í. "He already knew that, he just said it."

This affixed glottal stop alternating with zero may be diagnostic of word boundary vs. stem boundary within a word. For example, it occurs after the suffix -ámeʔ at the end of a verb stem, often before the ergative particle ga(m).

30. dám·á·meʔ gam "without eating"

31. dím·ásútẘameʔ gam "without stopping."

32. ʔinumá·míʔ gam "while it was burning him"

33. ẙas·íʔ gam "while he was singing"

Because this -ʔ affix is generally restricted to word margins, it is better not to analyze ga(m) as a suffix. However, compare the less clear case of (34) and (35), below. A syllable-final glottal stop occurs in the following adverb, alternating with zero:

34. balaʔ "already, soon, first"

There is a noun that may be derived from this adverb by the addition of the common derivative suffix -ji (possibly the morpheme seen as verb root in the auxiliary duji "make, do"), in which the glottal stop is retained:

35. balaʔji "son"

The glottal stop does not appear to be a readily predictable surface phenomenon in these examples. I leave them for now as a residuum.

2.1.2. Vowels

The Pit River language has a basic 5-vowel system /ieaou/ with a single degree of contrastive length. Each vowel has a more peripheral or tense allophone when long and (except for /o/) a more centralized or lax allophone when short. Phonetically, there is also an epenthetic [ə] that usually assimilates somewhat in quality to neighboring segments, as for example:

36. lhuwá [luhuwá] "we 2 will be"

37. lhám [ləhám] "let's us 2 eat!"

Phonetically, then, the main vowel allophones are as follows:

	peripheral (tense)		**centralized** (lax)	
high	i	u	ɪ	ʊ
mid	e	o	ɛ ʌ	ə
low	a			

The lax allophones [ɪ], [ɛ], [ʌ], and [ʊ], which occur as reduced vowels in unstressed syllables, are centralized relative to their more peripheral tense allophones [i], [e], [a], and [u]. The lax high and mid vowels [ɪ], [ɛ], and [ʊ] are also somewhat lowered relative to their tense counterparts [i], [e], and [u]. Epenthetic [ə] may range as high as [ɨ].[3]

The lax vowels and [ə] are always short. Tense vowels may be short when masked by laryngeal phenomena (see the next section, on length). In these cases, the tense vowel quality is almost always diagnostic of underlying vowel length. However, short /i/ and /u/ are tensed next to a homorganic consonant, as when /i/ is assimilated to following /y/ or /u/ to following /w/. A less obvious exception is in word-final position, where length does not occur (or is masked by devoicing), and where short /i/ is not reduced to [ɪ]. Lax vowels and [ə] are always in unstressed syllables. Any of the lax vowels may be made tense if stressed, as for example in careful citation of isolated words.

2.1.3. Length

Geminate consonants and long vowels are marked with /·/ for length.

It is only before the voiced continuants /mnlwy/ that vowel length is realized phonetically as a continuation of the fully voiced vowel over a longer duration. Before voiceless oral stops (plain and aspirated stops), vowel length is realized as preaspiration; before laryngealized stops it is realized as progressive laryngealization (creaky voice) which usually culminates in glottal closure. The difference in vowel quality between long and short vowels is the most prominent cue for distinguishing between VC̰· (a geminate laryngealized stop after short vowel) and V·C̰ (prelaryngealization as the length component of a long vowel before a laryngealized stop). For example:

38. di·c̰i·lági [diʔc̰i·lágiʰ] “money”

39. dic̰iy̰ú·t̰i [dic̰iʔyúʔt̰iʰ] “to crush fruit with the feet”

40. dic̰ixh̰ó·ti [dic̰iqʻħóʰtiʰ] “to crush chalk with the feet”

Geminate plain stops are devoiced. The auxiliary duji “do” (stem -uj-) brings the contrast into sharp relief. It normally has a non-geminate (and voiced) affricate:

41. al·u duji gú lhuwá. “We’re going to get hungry.”

However, the affricate in this morpheme also occurs geminate (and devoiced) in the negative imperative:

44. c̰é duj·ó! [c̰é duc·ó] “don’t! (singular)”

The entire final syllable, including the affricate, is devoiced when this auxiliary is used as the carrier of verb morphology for certain stative predicates, as in (45–47):[4]

45. c̰é k̰uji [c̰é g̰uc̰i̥] “you shouldn’t do (it)”

46. h̰ay̰ duji [ħayʔ duc̰i̥] “to think, imagine, remember”

47. h̰ew̰ duji [ħewʔ duc̰i̥] “to forget”

Length contrasts with vowel and consonant clusters; see 2.1.5 Clusters.

2.1.4. Pitch

Syllables may have high or low pitch or tone, marked as acute accent vs. null over the vowel, e.g. /á/ vs. /a/, as in these two monosyllabic words:[5]

48. áp [ʔʌ́p‘] “mouth”

49. as [ʔʌs] “water”

A few cases of falling tone are analyzed in the usual way, as high tone followed by low tone on successive vowels in a vowel cluster. An example is the “plant, bush, tree” suffix –(C)óo seen in (50):

50. batdilóo [bʌt‘dilóo] “wild plum bush”

Another example occurs when the pronominal suffix –umá follows a stem ending with a vowel with high pitch, as in (51):

51. sí·sá·diníumá [sɬ̥ʰsáʰtɪníimá], [síʰsáʰtɪníʊmá], [síʰsáʰtɪnímm̲á]
“I was told (remote past)” ([m̲] low pitch)[6]

2.1.5. Clusters

In this section we sketch the phonotactics of consonant clusters and vowel clusters.

2.1.5.1. Consonant clusters

Intervocalically, no more than two consonants can occur in a cluster. The first member of a consonant cluster is almost always devoiced, the exception being a cluster of two sonorants. One consequence, as we have seen, is that plain stops do not occur before another consonant,[7] because an oral stop before another consonant (or in syllable coda) always has a voiceless release that is perceived as aspiration, even though the release is less fortis, and the delay of voice onset less long, than for the prevocalic aspirates. For this reason, in phonetic notation I distinguish e.g. [t‘] in batdi “plum” from [tʰ] in tís “salt.”

The aspirate /h/ does not occur syllable finally, and clusters of /h/ plus stop do not occur.[8] However, the epiglottal spirant /ɦ̥/ does occur in syllable codas:

53. láɦ̥ [láħ], [ʔláħ] “head”

54. c̥íloɦ̥p̥i [c̥̊íloħb̥̊iʰ] “spider web”

Clusters of three consonants may be found at the beginnings of verbs, in the pronominal prefixes. (The aspirate /h/ occurs among these prefixes, but not the spirant

/ɦ̊/.) In most cases, epenthetic vowels simplify what would otherwise be clusters due to prefixing, as in examples (55–58):

55. twiẙ́ [t‘wiʔíʰ], [t‘uyʔíʰ] “he is (stative)”

56. cmic̊dáh̊ [cʰmɪ̊tsdʌ́ɦ], [cʰʊmɪ̊tsdáɦ] “eyebrow”

57. cgápdé [cʰgáp‘déʰ], [cʰ˭gáp‘déʰ] “he went (mythical)”

58. cgúuwí [cʰ˭gúuwíʰ], [c‘gúuwíʰ], [cʰ˭gú·wɪ́ʰ], [cʰ˭gúwʰ]
“he was, it was (attributive, mythical)”

However, if the third member of the cluster is a semivowel, epenthesis is less likely to occur.

59. cgyá·sá [c‘gyáʱsáʰ], [c‘gɪyáʱsáʰ] “he sang (mythical)”

60. cgwané·k̊a·l̊í [c‘gwʌnék̊al̊íʰ] “he wrapped it up (mythical)”
[c‘gʊwʌnék̊al̊íʰ]

If a preceding word ends in a vowel (and is in the same phrase with the verb), the initial consonant of a cluster may be pronounced in the coda of the preceding syllable:

61. asẘú tỳ́anuwí [ʔasˑʔút‘ ʔyánuwɪʰ] “It’s a tree.”

62. bám·é tsgiẙ́ [bʌ́m·é tskiʔíʰ], [bʌ́m·ét‘ skiʔíʰ] “You didn’t know me!”

63. dó·si tẘiẙ́ [dó‘sit‘ ʔwiʔíʰ], [dó‘siʰ t‘wiʔíʰ] “He’s a deer.”

This results in an alternation when a morpheme that begins with a cluster is reduplicated (here, a dot [.] in the phonetic representation separates syllables):

64. xɦ̊ot xɦ̊ot ẙuwí [qˣɦot‘.qˣɦot‘ ʔyuwɪ́ʰ] “it’s crumbly (like chalk)”

65. diguxɦ̊ó·di [dɪ.guq‘.ɦóʰ.tiʰ] “to crumble with hands”

There are no medial (intervocalic) clusters of more than two consonants, and no final consonant clusters.

2.1.5.2. Diphthongs and vowel clusters

A vowel may form a diphthong with a following w or y glide (plain or laryngealized).

66. c̓áyc̓á·yá [c̓jáyj̓á·yʌ́ʰ] “California bluejay”

67. ʔiwíwjiʔ [ʔiwɪ́wᵠciʔ‘] “together”

68. sq̓oy̓ [sq̓ˣoyʔ‘] “pipe (for smoking)”

69. ʔasjúy [ʔascúyʰ] “winter”

Distinguished both from diphthongs and from vowel length are vowel clusters across morpheme boundary (see 2.1.1.8 Glottal Stop 0and 2.1.4 Pitch for examples).

2.1.6. Fronting and spirantization

The posterior dorsal (back-velar) plain stop /q/ is normally pronounced as a voiced uvular spirant, similar to a common lax pronunciation of English g in “cigarette” and the voiced spirant ɣ of Modern Greek. The aspirated back-velar stop x is frequently affricated; the aspirated velar stop k may be aspirated also, albeit to a lesser extent. The cluster /xh/ is usually pronounced as a back-velar spirant, but can be strongly affricated instead. The 3-way contrast between q, x, and xh is seen the following pair of examples.

70. qa xhé [ɣa xéʰ], [qa qˣéʰ] “that one”

71. qa xahé [ɣa q‘ahéʰ] “that one” (alt. pronunciation).[9]

Before another oral stop, the release of oral stops may be lenited (no release). Sometimes the alveolar stop /t/ is affricated, with fronted articulation:

72. batdi [bʌtdiʰ], [bʌt‘diʰ], [bʌtˢdiʰ] “wild plum”

In syllable final position, the affricates /c/ and /c̓/ are fronted.[10]

75. c̓ac̓c̓á·ja [c̓ʌc̓tsc̓áʰcʌʰ] “wren”

76. i·p̓ác̓ [iʔp̓ʌ́c̓ts] “strong, strongly”

The laryngealized affricate /c̓/ is fronted before tense front vowel:

77. ná·c̓i [náʔc̓tsi‘] “seed”

2.1.7. Orthography

In summary, here is the inventory of symbols used to represent Pit River utterances in this work. The only non-standard symbol, in Americanist usage at least, is /x/ for the aspirated /q/, with its affricated and spirantized allophones.

Vowels:	high		i		u		
	mid		e		o		
	low			a			
Consonants:	Oral Stops						
plain	b	d	j	g	q		
aspirated	p	t	c	k	x		
laryngealized	p̓	t̓	c̓	k̓	q̓	ʔ	
	Continuants						
voiced	m	n					
		l					
	w		y				
voiceless		s				h	
laryngealized	m̓	n̓					
		l̓					
	w̓		y̓			h̓	

2.2. Phonological features

The set of distinctive features employed in generative phonology is intended to be universal. Consequently, in the ongoing effort to accommodate the variety of phonological patterning in the languages of the world it has undergone considerable change over the years since Trubetzkoy (1939), Jakobson, Fant, and Halle (1952), and Chomsky and Halle (1968). Jakobsonian features were at first defined primarily in acoustic terms, because of the essentially social nature of language learning and use. Over the years, however, acoustically defined features such as grave, acute, and diffuse have been replaced by features that indicate the location and degree of constriction by various articulators during the production of each segment. Important recent contributions to this shift have included work associated with Haskins Laboratory (e.g. Browman and Goldstein 1989, 1992) and work by Ladefoged and his colleagues at UCLA (e.g. Ladefoged 1989).

A second important change concerns the interdependence of features with one another and with the concept of segments. The original conception was of a feature matrix in which each column was a feature specification for a segment. Phonological rules operated upon features or groups of features taken segment by segment.

This conception has changed in two respects. First, the features are now organized in a hierarchy of feature categories. The branching relationships of this hierarchy are termed feature geometry, and rules may operate on classes of features defined by the nodes of the hierarchy. The feature hierarchy is intended to express natural classes of phonological features in a way that severely restricts what is possible as a phonological rule. (Rather, it restricts what is simple to state; we will return to this distinction presently.) Conversely, the requirements for phonological description in various languages drive the process of defining and redefining the nodes and their relationships of dominance and subordination in the feature hierarchy.

Secondly, in a nice demonstration of the usefulness of taxonomy, the nodes of the feature hierarchy define phonological environments of a different order than those defined by strings of segments. These new environments are expressed in terms of autosegmental tiers; adjancency of autosegments on each tier may supervene adjacency of the linear segments onto which the autosegments are mapped. For a simple example, the consonants C of a CVCVC sequence are not adjacent to each other in their representation as linear segments (being separated by vowels V), but they are adjacent to each other on a consonantal tier, as indeed the vowels are adjacent to each other on a vocalic tier. New possibilities become available for more simple statements in the grammar. For example, not only rule environments, but also rules may often be stated now in terms of linking and delinking of lower and higher nodes over adjacent segments in a representation, where linking represents the spreading of features (e.g. for assimilation), and delinking represents the loss of features (e.g. for dissimilation). Depending upon the nodes that are named in it, a given rule may apply to any natural class defined by the feature taxonomy, down to an individual feature.

Feature geometry constrains the set of natural phonological classes to those that fit together in a hierarchy of class nodes. Linguistic generalizations are supposed to apply to all features subsumed under a given node of the feature hierarchy.

Padgett (1996) describes important exceptions to the generalizations that underlie the notion of a hierarchy of feature class nodes. These “partial class phenomena” support an argument for *feature class theory*, in which features are categorized by their sharing some common property, rather than by their dependence on a class node.

Partial class phenomena were actually overlooked in earlier work because "feature geometry theory, with its incarnation of feature classes as nodes, makes it difficult to *see* certain legitimate generalizations because they involve partial class behavior" (*ibid.* p. 386). Feature class theory became possible with the development of optimality theory (OT), with its property of gradient constraint violation, which we will take up in Chapter 3. The point to be retained for the present is that, while feature geometry can be a useful organizing structure (for example, for the presentation in this chapter), it is almost certainly not to be taken very literally as a component of Universal Grammar. Phonological natural classes are not constrained in the ways that were predicted by feature geometry.

We will now examine a proposed set of features and their organization into a feature hierarchy adequate for describing the contrasts of the Pit River language. Because we treat the feature hierarchy as a descriptive device, no longer motivated by the arcana of derivation through serial application of rules, certain simplifications become possible.

2.2.1 The feature hierarchy

The feature hierarchy presented in the synthesis of Clements and Hume (1995) provides a place to start.

2.2.1.1. Sonority features

Associated with the root node are three features: [±sonorant], [±approximant], and [±vocoid]. Together, these define the sonority hierarchy as a function of positive feature values (Clements 1990, Clements and Hume 1995), as follows:

	[sonorant]	[approximant]	[vocoid]	Sonority rank
Obstruent	–	–	–	0
Nasal	+	–	–	1
Liquid	+	+	–	2
Vocoid	+	+	+	3

The feature [±vocoid] is the terminological converse of the feature [±consonantal], and replaces it in Clements and Hume's hierarchy.

2.2.1.2. The Pharyngeal node

Omitting the three features that are directly associated with the root node, [±sonorant], [±approximant], and [±vocoid], the portion of the tree that is closest to the root node looks like this:

root
    pharyngeal
        laryngeal
        tongue root
    oral cavity
        continuant
        C-place

Instead of a tree rooted at the top, we use an outline representation rooted on the left. Subordination or dependency of nodes is shown by adjacency of table columns rather than by graphically drawn branches. In the above table, for example, the pharyngeal node[11] and the oral cavity node are subordinate to the root node.

So far, the root node dominates just those two nodes, the pharyngeal node and the oral cavity node. The pharyngeal node expresses the fact that in many languages glottal, pharyngeal, and uvular sounds behave as a natural class. Earlier in this chapter, and in Appendix A, are noted some facts about the Pit River language that support this classification:

- Socalled “pharyngealization” tends to accompany glottalization or laryngealization. (This is probably a universal.)
- The /ʰ̰ħ/ phoneme, an epiglottal spirant with some pharyngeal involvement, is associated with laryngealized onsets of following vocoids and voiced continuants and with alternating glottalized vs. plain continuants in adjacent syllables.
- The uvular stops /qxq̰/ tend to induce some pharyngealization of adjacent vowels. This is most strongly observed with the laryngealized stop /q̰/.

The additional features under the laryngeal and tongue root nodes are as follows:

root
  pharyngeal
    laryngeal
      spread
      constricted
      voice
    tongue root
      ATR
      RTR

The feature [ATR] (advanced tongue root) is not used in Pit River.

The feature [RTR] (retracted tongue root) is supposed to characterize the uvular consonants /q/ and /x/ and the pharyngeal spirant /ʢ̊/. However, all these sounds can easily and naturally be produced with the tongue fully extended. (It is difficult to see how the root of the tongue may be retracted when the tongue is fully extended from the mouth.) The uvular sounds /qxq̊/ are made by raising the posterior portion of the dorsum, bringing it in contact with the uvula and velum. In the articulation of /ʢ̊/, the active articulator is not the tongue root, it is the epiglottis, which is "advanced," as it were, back between the faucal pillars toward the pharyngeal wall. The faucal pillars are concurrently brought together and forward. However, although this part of the gesture is visually prominent, it is merely a side effect of the acoustically relevant gesture of raising the larynx toward the underside of the epiglottis so as to enhance turbulence in the air passage between the larynx and the epiglottis. (See Appendix A.)

It might be argued that RTR is a phonological category, of which elevation of the posterior dorsum (for e.g. /q/) is one phonetic realization and posterior extension of the epiglottis is another.[12] To support such a claim, it could be pointed out that so long as the two articulators, tongue and epiglottis, are not used in independently contrastive ways then they are used in complementary ways, and can be classed as complementary elements of one abstract category. However, even this caricature of structuralist description is not available, since it appears that the articulation of Pit River /ʢ̊/ vs. /x/ involves the contrast of the epiglottis and the tongue as active articulators under the pharyngeal node.[13]

It appears likely that there is underutilized capacity for phonological contrast under what has been termed the pharyngeal node, which may not be exploited in any

single language to the extent that the capacities under the oral cavity node (described next) are exploited. We will return to this problem farther on, in a reassessment of the feature hierarchy.

At this point, it seems that we should tentatively consider adding the epiglottis to the pharyngeal node as an articulator on a par with the larynx and the tongue root, as follows:

- root
  - pharyngeal
    - laryngeal
      - spread
      - constricted
      - voice
    - tongue root
      - ATR (not used)
      - RTR (or: posterior dorsum)
    - epiglottal

We will revisit this decision in 2.2.5.2 2.2.5.2 Obstruents [–sonorant, –approximant].

2.2.1.3. The Oral Cavity node

The next feature directly under the root node is the oral cavity node:

- root
  - pharyngeal
    - laryngeal
      - spread
      - constricted
      - voice
    - tongue root
      - ATR (not used)
      - RTR (or: posterior dorsum)
    - epiglottal
  - oral cavity
    - continuant
    - place

The feature [±continuant] is under the oral cavity node, together with the place node. Clements and Hume (1995) justify this arrangement with examples of intrusive

stop formation, such as the [p] heard in "warmth" and the [t] heard in "false" in some pronunciations. The explanation is that when the oral cavity features of the stop are attached to the root node of the next segment (phonetically, when the associated gestures are prolonged to overlap gestures associated with the next segment), the fricative comes to have two oral cavity nodes under the root node. Other constraints[14] disqualify it from being a contour segment like an ordinary affricate.[15]

2.2.1.4. The Place node

Under the place node are features naming the active articulators in the oral cavity:

root
- pharyngeal
  - [...]
- oral cavity
  - continuant
  - place
    - labial
    - lingual
      - coronal
        - anterior
        - distributed
      - dorsal

(In this and following displays of the feature hierarchy the features under the pharyngeal node are elided for clarity.) The lips and tongue are the active articulators in the oral cavity. Under the lingual node, the coronal node refers to the blade and apex of the tongue, and the dorsal node refers to the back or dorsum of the tongue. Under the coronal node, [distributed] further defines the active articulator, as follows:

[+distributed]	Laminal
[–distributed]	Apical

The articulator-bound feature [anterior] refers, however, to the passive articulator, as follows:

[+anterior]	Dental and alveolar (fronted)
[–anterior]	Palatal and palato-alveolar

2.2.1.5. Two Place nodes

Clements and Hume (1995) identify two difficulties with the feature hierarchy thus far defined. One is that it provides no means for describing secondary articulations of

consonants such as palatalization and labialization. The second is that it provides no means for referring to consonants and vowels by distinct nodes in the feature hierarchy, something that is required so long as this is to be a predictive hierarchy (constraining possible rules and domains of rules) and not merely a descriptive hierarchy.

They propose to resolve both problems by duplicating the place node with its dependents (plus some additional ones) at a lower place in the hierarchy, since the same oral cavity features apply both to vowels and to consonants (with some additional aperture features). They propose that the two place nodes should be named V–place and C–place. Under C–place is the vocalic node, and under that in turn is V–place, as follows:

root
- pharyngeal […]
- oral cavity
  - continuant
  - C-place […]
    - vocalic […]
      - V-place […]

Filling in enough detail to show the duplication of place features, the hierarchy is as follows:

root
- pharyngeal
  - […]
- oral cavity
  - continuant
  - C-place
    - labial
    - lingual
      - coronal
        - anterior
        - distributed
      - dorsal
  - vocalic
    - aperture
      - open
    - V-place
      - labial
      - lingual
        - coronal
          - anterior
          - distributed
        - dorsal

The differences between the two place hierarchies are slight. Where the C-place hierarchy is adjacent to the feature [±continuant], the V–place hierarchy is adjacent to the aperture node, which has the feature [±open] under it; different vowel heights are described by assigning this feature on more than one tier.[16]

Thus, for a simple 5-vowel system, the combinations of features on two tiers are as follows (after Clements and Hume 1995:283):

	i, u	e, o	a
Tier 1	[–open]	[–open]	[+open]
Tier 2	[–open]	[+open]	[+open]

This redundancy in the feature hierarchy, representing the place node hierarchy twice, overlays an already existing redundancy. First, recall the three "sonority features" associated with the root node, [±sonorant], [±approximant], and [±vocoid]. The last, [±vocoid], being the converse of [±consonantal], distinguishes consonants from vowels.

Secondly, outside the feature hierarchy proper, a phonotactic mechanism determines the sequence of C and V slots in syllable structure. Thus, what was marked by the feature [+consonantal] in e.g. Chomsky and Halle (1968) is now specified redundantly in three ways in the current system: the timing tier (or the CV tier in some systems), the feature [±vocoid], and the distinction between the C–place node and the V-place node.

The justification for distinguishing the C-place node and the V-place node is that in descriptions of various languages some derivational rules that affect place-node features of vowels ignore intervening consonants (e.g. vowel harmony), or, the converse, rules that affect place-node features of consonants ignore intervening vowels (e.g. consonant harmony). But the differences between consonant harmony and vowel harmony are accounted for more simply with the separation of features on different autosegmental tiers for consonants and vowels. Given other means for handling these cases, so that they do not have to be accounted for by rules referring to feature geometry, the motivation for this elaboration of the feature hierarchy disappears.

2.2.2 Serial baggage

Additional simplifications of the feature hierarchy are possible when we recognize that it has now become a purely descriptive convenience bereft of deep explanatory revelations about derivations by serial application of rules.

2.2.2.1 The Features [continuant] and [open]

To begin with, it is tempting to draw parallels between the aperture feature for vowels and the feature [+continuant] for consonants. Indeed, the sonority hierarchy as described above aligns well with a scale of increasing aperture, evoking early descriptive work of Pike, Hockett, and others (2.2.2.20 2.2.2.2 The sonority hierarchy).

If the C–place and V–place nodes are merged, then the feature [continuant] is formally equivalent to the feature [+open] on a tier in addition to those described above for distinguishing vowel heights. That is, the following two descriptions are equivalent. (Negative feature values are omitted from these tables for clarity.)

First, a matrix employing the feature [+continuant] under the oral cavity node:

	t	s	i	e
laryngeal				
[voice]			+	+
oral cavity				
[continuant]		+	+	+
aperture				
[open]		+	+	
[open]			+	
[coronal]	+	+	+	+

Second, the same matrix, only this time employing the feature [+open] on an additional (highest) tier under the aperture node:

	t	s	i	e
laryngeal				
[voice]			+	+
oral cavity				
aperture				
[open]	+	+	+	
[open]		+	+	
[open]			+	
[coronal]	+	+	+	+

The three [+open] features are equivalent to the three kinds of aperture nodes proposed by Steriade (1991), as follows:

A_0 stop, blockage of airflow

A_f fricative, the degree of oral aperture sufficient to produce a turbulent airstream

A_{max} the "degree of oral aperture insufficient to produce a turbulent airflow (as in oral sonorants and the release phase of stops)" (Clements and Hume 1995:255).

The correlation of aperture features with the [open] feature is as follows:

		A_0	A_f	A_{max}		
		t	s	i	e	a
aperture						
	[open]	–	+	+	+	+
	[open]	–	–	+	+	+
	[open]	–	–	–	+	+
[coronal]	+	+	+	+	–	
[dorsal]	–	–	–	–	+	

The aperture nodes A_0, A_f, and A_{max} are unable to distinguish degrees of openness of vowels. For that reason, we will use the convention of multiple [+open] features under the aperture node.[17]

2.2.2.2 The sonority hierarchy

Recall that the sonority hierarchy was simply defined as a function of positive feature values, as follows:

	[sonorant]	[approximant]	[vocoid]	sonority rank
Obstruent	–	–	–	0
Nasal	+	–	–	1
Liquid	+	+	–	2
Vocoid	+	+	+	3

The rightmost positive feature value in this table says, informatively, that vocoids are vocoids. With the proposed consolidation of the feature hierarchy, we can replace the feature [±vocoid] with the feature [±open].

With this change, the definition of the sonority hierarchy in terms of positive feature values is as follows:[18]

	[sonorant]	[approximant]	[open]	Sonority Rank
Obstruent	–	–	–	0
Nasal	+	–	–	1
Liquid	+	+	–	2
Vocoid	+	+	+	3

That is, vocoids have (at least) one degree of openness. Phonetically, the sonority hierarchy can be understood roughly in terms of degrees of supralaryngeal aperture. Nasals are articulated with a secondary aperture past the lowered velum, and liquids are articulated with a secondary aperture around the sides of the [–spread] tongue. The sonority hierarchy corresponds to degrees of supralaryngeal aperture, ranging from 0 for obstruents, 1 for the lowered velum, 2 for lateral egress in the oral cavity, and 3 for any frank opening of the oral cavity, continuing beyond the above table through the degrees of openness of the vowels.[19]

2.2.3. Omissions

Clements and Hume note two lacunae in their scheme, stridency and lateral articulation. We will see if we can accommodate them here.

2.2.3.1 The feature [strident]

The feature [±strident] is an acoustically-based feature for which there appears to be no simple corresponding articulatory feature. It distinguishes "noisy" [+strident] fricatives and affricates from "mellow" [–strident] fricatives and affricates, as follows:

[+strident]	labiodentals, sibilants, uvulars
[–strident]	bilabials, dentals, palatals, velars

However, no argument is advanced for the cohesiveness of these phonetic categories as phonological natural classes. The function of these features is distinctive only, and uvulars, for example, are distinguished already on articulatory grounds and by their placement under the pharyngeal node.

A purely articulatory characterization could extend the feature [±distributed] and [±anterior] to other articulators than the front of the tongue (represented under the coronal node).[20] This broaches another potential simplification of the feature hierarchy, along the lines suggested above for the V-place node. The pharyngeal node includes the uvular consonants (under the feature [±RTR]) because of some phenomena of rule transparency in Semitic and perhaps other languages. With respect to other phenomena, the uvular consonants do not pattern with pharyngeals and laryngeals, but this is attributed to uvulars being marked [+dorsal] under the oral place node as well as [+RTR] under the pharyngeal node (Clements and Hume 1995). I do not know the reinterpretation of those transparency phenomena in optimality theory. Assuming that properties of serial derivations are not germane, a descriptive feature hierarchy might describe the uvulars as [+dorsal] and [–anterior], and the velars as [+dorsal] and [+anterior]. Indeed, it might be possible to distinguish [±strident] fricatives and affricates by this means, as follows:[21]

	[labial]	[coronal]	[dorsal]
[+anterior]	bilabials	sibilants, dentals	velars
[–anterior]	labiodentals	palatals uvulars	

I will leave these questions open for now. Their resolution is immaterial here, since stridency is not contrastive in Pit River.

2.2.3.2 Laterals

The second omission discussed by Clements and Hume is the feature [±lateral]. I propose here to represent laterals by a combination of primary and secondary articulations:

	l
laryngeal	
[voice]	+
oral cavity	
aperture	
[open]	– +
[open]	– –
[coronal]	
[anterior]	+ –
[distributed]	– +

Alternative treatments for “light” and “dark” laterals are possible A “light” lateral could have an additional [–open] feature specification for the secondary articulation, as for the high vowels; for a "dark" lateral the secondary articulation would be [+open] like the mid vowels. Alternatively, a [dorsal] feature specification could mark velarization.

2.2.4. A descriptive hierarchy for Pit River

The simplifications proposed so far lead us to the following descriptive hierarchy of distinctive features for the Pit River language:

- root
  - pharyngeal
    - laryngeal
      - spread
      - constricted
      - voice
    - epiglottal
  - oral cavity
    - aperture
      - open
    - place
      - labial
      - lingual
        - coronal
          - anterior
          - distributed
        - dorsal
          - posterior

This hierarchy identifies the universal, natural phonological classes that apply to the description of this language.

2.2.5. Feature matrices

Matrices of feature values describe the segmental phonemes of the language in terms of features located in the feature hierarchy that we have identified.

2.2.5.1 Sonorants

Feature matrices for the vocoids /w, u, o, a, l, y, i, e / and for the glides[22] /h, ʔ/ are as follows:

	w	u	o	a	l	y	i	e	h	ʔ	
laryngeal											
[spread]									+		
[constricted]										+	
[voice]	+	+	+	+	+	+	+	+			
[nasal]											
oral cavity											
aperture											A_0
[open]	+	+	+	+	–+	+	+	+	+		A_f
[open]	+	+	+	+	–+	+	+	+	+		A_{max}
[open]			+	+				+			mid
[open]				+							low
[labial]	+	+	+								
[coronal]											
[anterior]					+–						
[distributed]					–+	+	+	+			
[dorsal]	+	+	+	+							
[posterior]											

(Marginal notes A_0, etc. are added at the right of this table to clarify the multiple [open] features. For clarity, negative feature specifications are shown in these and subsequent tables only when required, as we will see in 2.2.5.30 2.2.5.3Complex segments and contour segments.) The burden of the C–V contrast between e.g. /u/ and /w/ is born by the skeletal tier and the metrical structure, not by the feature hierarchy.[23] The lateral /l/ is a complex segment, because the pairs of aperture features are expressed concurrently through the anterior and distributed features of the coronal node (2.2.3.20 2.2.3.2 Laterals, 2.2.5.3 2.2.5.3 Complex segments and contour segments.) The aperture specification for /h/ is meant to indicate at least the openness of the high vowels.[24]

The other sonorant consonants, the nasals /m/ and /n/, are represented as follows, with the feature specifications for /w/ and /y/ repeated for comparison:

	m	n	w	y
laryngeal				
[voice]	+	+	+	+
[nasal]	+	+		
oral cavity				
aperture				
[open]			+	+
[open]			+	+
[labial]	+		+	
[coronal]				
[anterior]		+		
[distributed]				+
[dorsal]			+	
[posterior]				

2.2.5.2 Obstruents [–sonorant, –approximant]

It is convenient to present the obstruents from several perspectives to simplify the displays of feature matrices printed here. First, the plain stops illustrate contrasts as to place of articulation:

	b	d	j	g	q
laryngeal					
[voice]					
[nasal]					
oral cavity					
aperture					
[open]			–+		
[labial]	+				
[coronal]					
[anterior]		+			
[distributed]			+		
[dorsal]				+	+
[posterior]					+

The aperture features of /j/ are represented phonologically (and realized phonetically) consecutively over a single place feature rather than concurrently over a pair of place features (2.2.5.30 2.2.5.3 Complex segments and contour segments). The aspirated stops can be considered to be contour segments like the affricates (Steriade 1991, Clements & Hume 1995:255). The plain stops are assumed to be underlyingly voiceless. (We will see later how underlying voice would complicate the description.)

The laryngealized oral stops follow the same places of articulation as the plain stops, differing from them only in the [+constricted] feature on the laryngeal node as follows:

	p̰	t̰	c̰	k̰	q̰
laryngeal					
[spread]					
[constricted]	+	+	+	+	+
[voice]					
[nasal]					
oral cavity					
aperture					
[open]			–+		
[labial]	+				
[coronal]					
[anterior]		+			
[distributed]			+		
[dorsal]				+	+
[posterior]					+

The epiglottal fricative /ḥ̰/ is distinguished from /h/ (and from all other segments) by its seemingly contradictory combination of laryngeal node features, as well as by the feature specification [+epiglottal]. I have shown /ḥ̰/ as characterized by [+constricted] as well as [+spread] (as in whispering), because of evidence that the feature [+constricted] spreads from it.

	ḥ̰
laryngeal	
[spread]	+
[constricted]	+
[epiglottal]	+
oral cavity	
aperture	
[open]	+
[open]	+

The two feature specifications [+epiglottal] and [+constricted] are redundant, so that one can be omitted from the phonological representation and derived from the other in the phonetic specification of the segment. Phonetically, the epiglottal stricture is the primary gesture; phonologically, this segment patterns with the laryngealized consonants. Because

of this, and since the feature [+epiglottal] is useless for any purpose other than characterizing this segment, we choose the apparently contradictory [+constricted] specification, and omit the feature [epiglottal] from the phonological representation, reserving it for the phonetic specification.

The spirant /s/ is distinguished from these by the oral cavity feature [coronal]. It is represented in the feature matrix as follows, with the feature values of /ʜ̊/, /h/, and /ʔ/ repeated for comparison:

	ʔ	ʜ̊	h	s
laryngeal				
[spread]		+	+	+
[constricted]	+	+		
[voice]				
[nasal]				
oral cavity				
aperture				
[open]		+	+	+
[open]		+	+	
[coronal]				+

The oral cavity aperture for /h/ and /ʜ̊/ specifies two [+open] features, signifying at least that degree of openness as a default. The number of [+open] features is derived from context. There could be more in the environment of a mid or low vowel. Recall that the first [+open] feature value specifies a spirantal degree of aperture, A_f in the aperture node scheme of Steriade (1991), formally equivalent to using [+continuant], but not limited to a C-place node as in the scheme of Clements and Hume.

2.2.5.3 Complex segments and contour segments

Complex segments and contour segments are similar in having two features specified for a single node.

For complex segments, the pairs of features are expressed concurrently. One aperture specification is associated with the primary Place feature, the other is concurrently associated with a secondary Place feature. The single example[25] of a complex segment in Pit River is the lateral /l/, where the stop articulation ([-open], [-open]) applies to [+anterior] and the vocoid articulation ([+open], [+open]) applies to [+distributed].[26]

For contour segments, there is no secondary Place feature available, so the pairs of aperture specifications are expressed sequentially at the same place of articulation. Examples in Pit River are the affricates and the aspirated stops. Just as one [+open] feature represents the sibilant /s/, one [+open] feature represents the sibilant portion of the affricates. Just as two [+open] features represent a close vowel, two [+open] features represent the voiceless vocoid release of the aspirated stops, and it is this that distinguishes them phonologically from the plain stops.

This is summarized as follows:

	l	j	c	t	d
laryngeal					
[spread]		+	+	+	+
[constricted]					
[voice]	+	–	–	–	–
[nasal]					
oral cavity					
aperture					
[open]	–+	–+	–+	–+	
[open]	–+		–+	–+	
[labial]					
[coronal]					
[anterior]	+–			+	+
[distributed]	–+	+	+		

The complex segment /l/ has paired aperture values for more than one oral cavity feature, permitting the paired aperture features to be expressed concurrently. The contour segments like /j/ have paired aperture values for only one oral cavity feature, so that the paired aperture feature values have to be expressed sequentially. The aspirated or voiceless–released series, represented above by /c/ and /t/, have a second [open] feature specification identical to the first, differentiating them from the plain series, which has only one.

These relations can be displayed on a time line[27] in which labelled brackets represent the beginning and ending points of features, not in terms of absolute chronology, but relative to one another, as either coinciding with, preceding, or following one another.

	l	j	c	t	d
laryngeal					
[spread]	$_{-}[\ \ ]_{-}$	$_{+}[\ \ ]_{+}$	$_{+}[\ \ ]_{+}$	$_{+}[\ \ ]_{+}$	$_{+}[\ \ ]_{+}$
[constricted]					
[voice]	$_{+}[\ \ ]_{+}$	$_{-}[\ \ ]_{-}$	$_{-}[\ \ ]_{-}$	$_{-}[\ \ ]_{-}$	$_{-}[\ \ ]_{-}$
[nasal]					
oral cavity					
aperture					
[open]	$_{-}[\ \ ]_{-}$ $_{+}[\ \ ]_{+}$	$_{-}[\ ]_{-+}[\ ]_{+}$	$_{-}[\ ]_{-+}[\ ]_{+}$	$_{-}[\ ]_{-+}[\ ]_{+}$	$_{-}[\ \ ]_{-}$
[open]	$_{-}[\ \ ]_{-}$ $_{+}[\ \ ]_{+}$			$_{-}[\ ]_{-+}[\ ]_{+}$	$_{-}[\ \ ]_{+}$
[labial]					
[coronal]					
[anterior]	$_{+}[\ \ ]_{+}$ $_{-}[\ \ ]_{-}$	$_{-}[\ \ ]_{-}$	$_{-}[\ \ ]_{-}$	$_{+}[\ \ ]_{+}$	$_{+}[\ \ ]_{+}$
[distributed]	$_{-}[\ \ ]_{-}$ $_{+}[\ \ ]_{+}$	$_{+}[\ \ ]_{+}$	$_{+}[\ \ ]_{+}$	$_{-}[\ \ ]_{-}$	$_{-}[\ \ ]_{-}$

In general, all of the left brackets align at the left edges of the segment and all of the right brackets align at the right edges of the segment. For contour segments, there are segment-internal brackets that do not align with segment margins. For example, for the contour segment /j/, the labelled brackets $]_{-open}$ and $_{+open}[$ under the laryngeal node are segment internal. This transition is interior to the segment.

By contrast, for the complex segment /l/, the simultaneity of e.g. [+anterior], [–open] with [–anterior], [+open], is expressed by stacking them vertically, and their pairwise associations are expressed by their parallel ordering.[28]

Phonetically, the aspirates are characterized by delayed onset of voicing of a following vowel or other voiced segment (delayed voice onset time or VOT). The above representation takes the delayed onset of voice to be an effect rather than a cause. With the aspirates, exemplified by /c/ and /t/ above, a vocoid articulation (the second [+open] aperture feature) coincides with the latter part of the span of the [spread glottis] feature under the laryngeal node. The drop in supralaryngeal air pressure with the oral release is what delays the onset of voicing for a following [voice] segment and results in a voiceless vocoid (aspiration) at the onset of a following vowel. With the plain series, exemplified

by /j/ and /d/ above, there is no vocoid articulation (no second [+open] aperture feature) corresponding to the [spread glottis] feature under the laryngeal node, supralaryngeal air pressure does not drop, and the onset of voicing in a following segment is not delayed.

Phonetically, the aspirates are characterized by delayed onset of voicing of a following vowel or other voiced segment (delayed voice onset time or VOT). The above representation takes the delayed onset of voice to be an effect rather than a cause. With the aspirates, exemplified by /c/ and /t/ above, a vocoid articulation (the second [+open] aperture feature) coincides with the latter part of the span of the [spread glottis] feature under the laryngeal node (equivalent to [+open] on the laryngeal node). The drop in supralaryngeal air pressure with the oral release is what delays the onset of voicing for a following [voice] segment and results in a voiceless vocoid (aspiration) at the onset of a following vowel. With the plain series, exemplified by /j/ and /d/ above, there is no vocoid articulation (no second [+open] aperture feature) corresponding to the [spread glottis] feature under the laryngeal node, supralaryngeal air pressure does not drop, and the onset of voicing in a following segment is not delayed.

---

[1] The justification for not calling them glottalized stops also involves other issues of laryngeal and pharyngeal articulation described in Appendix A. Ladefoged (1964:16) anticipates this in his description of laryngealized consonants in Hausa.

[2] I do not believe there is a glottalized sibilant /s̰/. I have analyzed e.g. [ɤótdí·ʔ‘si‘] "shovel" as qótdíy̰si and [wisʔí] " he said" as wisy̰í (see 0 2.1.1.8. Glottal stop, below). Presumably, [ʔs] and [sʔ] are not both phonetic realizations of an intervocalic glottalized sibilant /s̰/, and neither need be interpreted as such. The cluster in qótdíy̰si provides the only occurrence of [ʔs] that I have observed, and [sʔ] is also not common.

[3] Olmsted (1966) postulates a sixth vowel phoneme /·/ which appears in the main to combine some reduced occurrences of the five vowel phonemes described here with some occurrences of epenthetic vowels.

[4] This alternation is possibly a function of an intonation contour (compare interrogation, overriding high pitch with sentence-final syllable devoiced.) In any event, it gives rise to one: if the negative c̓é is omitted the alternant /duj·i/ with voiceless geminate suffices to carry the sense of negation. Contrast these examples:

42. dám·i gú duji suwá "I will not eat"

43. dám·á·mé? gam duji gú lhuwa, lhám! "We will be without eating, let's eat!"

In (43), the negation is carried by -á·mé? "without" (gam is probably ergative). Example (42) is from Uldall (1933:74). Dám·i gú can be a nominalization meaning "food" as well as the future infinitive.

[5] I have extended this convention (null for low pitch) to citations from de Angulo's transcription and Olmsted's redaction, although they explicitly indicate low pitch on ì, è, à, ò, ù, and they indicate falling pitch with circumflex.

[6] For the suffix –umá, compare:

52. sí·sá·dumá [sɬ̓sáʰtʊmá] "I was/am told"

[7] This is consistent with the hypothesis that the prevocalic aspirates originated historically from clusters. See Chapter 5.

[8] If clusters such as /hb/ did occur, they would contrast with preaspiration as the phonetic realization of vowel length. Vowel quality would be an important cue. For example, /ahba/ [ʌhpa] would contrast with /a·ba/ [aʰpa]~[a·pa], because of the difference in quality of the preceding vowel.

[9] It is possible that this originates from qa + *hé (an obsolete deictic, if such can be reconstructed), and stands here as a relic of the cluster origin of stops. Compare the pronominal prefix c- (underlying t-s-) discussed in Chapter 5.

[10] A fronted allophone before a vowel may suffice to locate word juncture.

73. q̓ac̓ ádé [q̓ʌc̓tsʌ́déʰ] Millstone place (place name).

The fronting indicates that the locative morpheme ádé (postvocalic alternants wádé, ládé, yádé) is a postfix rather than a suffix.

Mrs. Rhoades extended the fronting of the affricate as far as interdental position before s and glottalized t̰ in the expression

74. dáqh chú wích sθ̰íjéuwí [wíθˀθíjéuwí‘] "What's it *look* like I'm doing?!"

[11] Also called the guttural node. Both terms refer etymologically to the throat, in Greek and Latin respectively, and I should emphasize that I do not regard the pharynx as an active articulator, but rather as denoting a region encompassing a number of active articulators: the anterior dorsum of the tongue, the epiglottis, and the larynx. These articulators produce, respectively, the uvular /q/ and /x/, the socalled “pharyngeal” /ħ̰/, and the laryngeal /h/ and /ʔ/ sounds of Pit River.

[12] It might even be claimed that the epiglottis is a kind of nether extremity of the tongue radix, but this would surely be sophistry since it is plain that the epiglottis is the active articulator and the root of the tongue is not essential for the speech sounds in question, and the tongue root has not been claimed as an articulator for any other speech sounds. Ladefoged and Maddieson (1995) do argue for the interimplication of the tongue and epiglottis in articulation of pharyngeal sounds. However, this is a phonetic assessment, and not decisive regarding what is considered to be contrastive in language phonologies. While it is possible that languages differ in this respect; for Pit River, at least, the claim is that any lingual articulation is secondary.

[13] Although, to be sure, the one is a fricative and the other a stop, phonologically.

[14] Clements and Hume, in their account of contour segments, propose a No Branching Constraint, which forbids any class node (including the root node) from immediately dominating more than one node occurring on the same tier. Additional principles must be defined to restrict the possible sequences of root nodes that may be sequenced under a given timing slot to form a contour segment. Clements and Hume refer to Rosenthal (1988) for suggestions.

[15] Selkirk (1990) and Padgett (1991) explain the same phenomenon with [±continuant] directly under the place node. The difference is not germane here.

[16] For other treatments of the differentiation of vowel height by an aperture feature or particle, see e.g. van der Hulst (1989), van der Hulst and van de Weijer (1995), Schane (1995).

[17] An additional [+open] feature may be required for the low vowel, and for languages with complex vowel systems. (In other words, as is usual with any phonological representation, some of the work is left to phonetic specification.) Alternatively, the aperture features could be retained, with the addition of [+open] features for vowel height distinctions, or a multi-valued instead of binary feature could be used.

[18] If the feature [+continuant] is replaced with a new topmost [+open] feature, it must be stipulated that the feature mentioned here is in addition to that, that is, the first whose positive values mark vocoids. The concatenation [+open], [+open] expresses this.

[19] It does not follow, however, that nasalizing a lateral or vowel makes it more sonorant. This phonetic observation about sonority is not a matter of counting [+open] feature specifications.

[20] Halle and Clements (1983:6) suggest that the feature [±distributed] "may also distinguish bilabial sounds from labiodental sounds".

[21] Several possibilities suggest themselves for an articulator-based feature representation for the distinction between sibilants and dental fricatives (presumably, interdental). Dentals might be doubly [+anterior], in the way that the feature [open] is used on more than one tier for different vowel heights. The feature [distributed] might also distinguish them.

[22] The glottal stop /ʔ/ has been accounted a sonorant at least since Chomsky and Halle (1968) because of its phonological status as a glide. Intuitively, one would think it was an obstruent because it stops the flow of air. Indeed, it seems to fail the definition of sonorants as "sounds produced with a vocal tract cavity configuration in which spontaneous voicing is possible," and it seems to fit the definition of obstruents as sounds "produced with a cavity configuration that makes spontaneous voicing impossible" (Chomsky and Halle 1968:302). Technically, closure at the glottis may be accounted not a "cavity configuration", but that would be terminological legalism and not science. Similarly, /h/ is accounted a sonorant for phonological and not phonetic reasons, being a configuration in which spontaneous voicing is by definition not possible.

[23] For clarity, negative feature specifications are shown in these and subsequent tables only when required, e.g. for complex or contour segments.

[24] An alternative notation might use a variable, as in [αopen], where the value of the variable is determined by values of the same feature in adjacent vowel segments.

[25] The complex articulation of /h̊/ is analogous in a way that cannot be expressed in the present feature hierarchy.

[26] The fact that mid-central vowel has the reverse relation of these feature pairs, closure at the lamina (posterior coronal) and aperture at the apex (anterior coronal), is ignored.

[27] This is a preview of the timeline notation introduced in a later chapter for primitive optimality theory (OTP).

[28] This reflects a limitation of this notation with labelled brackets for complex segments, and has no deeper significance.

Chapter 3. Optimality Theory

Optimality Theory (OT) has become a preferred mode of linguistic analysis and description since its inception in the early 1990s.[1] In earlier systems of grammar-making, rules are applied to abstract structures to produce yet other abstract structures to which further rules apply, in derivational sequences that ultimately yield phonemic and phonetic representations of speech. Optimality Theory dispenses with most of the abstract superstructure that its predecessors required.[2]

In Optimality Theory, a prolific generative function GEN maps underlying forms (inputs) onto a set of alternative candidate surface forms (outputs).[3] A set of constraints filters out all but one of the outputs. An EVAL function imposes on the set of constraints a partial[4] order or ranking that is characteristic for the given language. A highest-ranked set of constraints includes those that are thought to be universally undominated.[5] The ranking is not temporal or logical in the manner of ordered rules, but rather in terms of precedence if two constraints conflict. This will be made clear by examples presently.

In contrast to older theories of constraints on rules and derivations, these constraints are not inviolable. They limit one another, in the sense that one constraint may be violated in order to avoid violating another. For example, consider the following constraints:

- A constraint Ons, stipulating that syllables begin with an onset
- A family of faithfulness constraints, stipulating that outputs correspond to inputs

Given an input form that lacks an onset, these constraints are in conflict. The resolution of the conflict is provided by a fourth item, a ranking of the constraints. If Ons is ranked above the faithfulness constraints, then those productions of GEN in which an epenthetic onset occurs are superior to (more optimal than) those that lack this violation of

faithfulness. If Ons is ranked below the faithfulness constraints, then output forms without an onset are more optimal, despite the violation of Ons.

In general, where input forms may bring two constraints into conflict, one constraint must have precedence in the grammar. Violation of the lower-ranked constraint is ignored, in the sense that speakers do not perceive an optimal output form as anomalous even though it violates lower-ranked constraints. We will turn in a moment to a methodology that is suggested by this observation.

Given the constraints and their ranking, and given underlying forms of the language, the process of determining the surface pronunciation for a given underlying form can be expressed as follows:

A. GEN blindly generates a prolific set of candidate pronunciations.

B. The candidates are tested against the constraints in parallel, starting with the highest-ranked constraint(s).[67]

C. If more than one candidate satisfies the current constraint, they (the survivors) are tested against the constraint with the next-lower ranking.

D. When only one candidate remains, it is the optimal pronunciation for the underlying form, even if it violates other constraints that are of yet lower rank.

The constraints, in their language-specific order, eliminate all but one member of the pool of candidate output structures. The relationships between underlying forms and surface forms are optimal in the sense that they satisfy the highest-ranked constraints possible.[8]

The identification of the universal constraints is a cardinal aim of Optimality Theory; the ranking of constraints for a given language[9] is one of the central problems in grammar-writing in an OT framework. According to the theory, the relative ranking of the universal constraints is where language differences arise.

However, the ranking of constraints is not the only descriptive problem in the realm of language particulars. The underlying forms cannot be assumed as givens, not even (as is so typically the case) when one is recasting an existing grammar in OT terms. For example, the abstract underlying forms that seemed necessary and appropriate for derivations by serial application of rules in SPE-inspired phonologies are not appropriate for an OT grammar, in which underlying forms are much more surface-faithful.

There are four kinds of things to be determined, then, for an OT description:

- Constraints

- Constraint ranking
- Underlying forms
- Surface forms

For the constraints, we will refer to the OT literature. Examples of forms and of alternations (the motivation for differences between underlying and surface forms) have been described in Chapter 2, and more are described in the next chapters in the course of an OT description.

3.1 Principles for determining constraint ranking

Two kinds of evidence help us to determine the ranking of constraints in a given language. The primary evidence is found when a form that is acceptable to native speakers (and therefore optimal) violates a known constraint. Reverting to an earlier example, an optimal form that lacks an onset is able to violate Ons because faithfulness (I/O correspondence) is more highly ranked. An optimal form that has an epenthetic default consonant as onset is able to violate faithfulness because Ons is more highly ranked.

The second sort of evidence is typological. OT informs a typology of languages. For example, consider the interaction of the following three constraints:

78. Parse: Underlying elements are associated with structure.

79. Fill: Structural positions are filled with underlying elements

80. Ons: Syllables have onsets

Interactions of these constraints support the following inferences (adapted from the "onset theorem" of Prince & Smolensky 1993:91), where $\alpha \gg \beta$ means that α has a higher rank than β, and curly braces delimit constraints for which a ranking is not (yet) specified:

81. If {Parse, Fill} » Ons then the language permits syllables without onsets.

82. If Ons » Parse or if Ons » Fill (or both), then the language requires onsets in syllables. In this case, if Fill » Parse, then Ons is satisfied by phonetic deletion (underparsing); if on the other hand Parse » Fill, then Ons is satisfied by phonetic epenthesis.

These two generalizations suggest a methodology for inferring the ranking of constraints from typological observations:[10]

83. If a language permits syllables without onsets, then {Parse, Fill} » Ons. The rank order of Parse and Fill is still to be determined, which permits three logical possibilities:
    a) Parse » Fill » Ons
    b) Fill » Parse » Ons
    c) {Fill, Parse} » Ons
84. If a language requires onsets in syllables, and achieves them by deleting initial vowels, then Fill, Ons » Parse in one of these logically possible rankings:
    a) Ons » Fill » Parse
    b) Fill » Ons » Parse
    c) {Fill, Ons} » Parse
85. If a language requires onsets in syllables, and achieves them by epenthesis of an initial consonant, then Parse, Ons » Fill, which may later turn out to be any of the following:
    a) Ons » Parse » Fill
    b) Parse » Ons » Fill
    c) {Parse, Ons} » Fill

We will return to this example of constraint interaction after a digression in the interest of a more explicit and precise treatment.

3.2 Primitive constraints

Mnemonic tags like Ons and Parse and *Cor and even such obscure constructs as Id(σ1-place) are coming to constitute a new metalanguage of Optimality Theory, but it is not always obvious how they are related to one another. It would be an advantage if the constraints could all be given definitions commensurate with one another, using the same consistent and simple terms and operations throughout. For example, most of the constraints are quite simple in logical and operational terms, and if they were all defined out of primitive objects and relations those that are more complex would then stand forth, being perhaps worthy of closer scrutiny to see if their greater complexity is truly warranted.

Jason Eisner (1997a) has suggested how constraints may be redefined in terms of local, primitive constraints of two forms:

86. $\alpha \rightarrow \beta$ For every α there is a β that coincides temporally (alignment, licensing).

87. $\alpha \perp \beta$ For every α there is no β that coincides temporally (clash).

In this primitive OT (OTP), the temporal dimension is defined by the sequence of edges of phonological elements (features, segments, morae, etc.) along an implied time line. The edges of elements are represented according to a familiar linguistic convention by labelled brackets. The duration of phonological elements is indicated only by the linear sequence of their edges on this time line, not by actual measurements of time. The only way to specify the temporal location of some element on the time line is by the positions of its edges before, after, or coincident with the edges of other elements. If an edge of one element coincides with an edge of another, the edges that are vertically aligned specify the same point on the time line.[11] The vertical alignment of the edges of elements graphically represents the concidence or overlapping of elements.

GEN freely distributes edges along the timeline.[12] This could afford a very interesting approach to metathesis phenomena, such as e.g. the [nows mæn] “snowman” child-language phenomenon noted in Chapter 1.

Some OTP constraints do not refer to edges. For example, Parse(Feat) says that an underlying feature must be associated with a root node (P&S 181). This constraint may be restated as follows:[13]

88. Parse(Feat)
Feat $\rightarrow$ *Seg*

(The mnemonic tag appears first, followed by its OTP definition. In the OTP expression, underlining marks an underlying element.) A constraint such as (88), which specifies no edges, says that two phonological elements coincide in such a way that the duration of the one specified on the left side of the constraint overlaps the duration of the other, on the right. This constraint cannot specify the edges of ***Feat*** and *Seg* because the duration of a given feature may extend over several segments, or may end in mid-segment. It says only that $[_{\underline{Feat}}$ precedes $]_{Seg}$ and $]_{\underline{Feat}}$ follows $[_{Seg}$ (the feature starts sometime before the end of the root segment, and the feature ends sometime after the beginning of the segment).

One advantage of the OTP representation is that constraints may more easily be compared and related to one another. Often a mere change in mnemonic conventions conceals an underlying similarity or even identity of constraints proposed by different writers. It also becomes more feasible and more interesting to compile a list of constraints

in the literature for comparison, and indeed it was the list in Eisner (1997a) that first drew me to OTP.

OTP does more than introduce notational clarity, however. It limits the set of constraints to those that can be stated in local terms in one of the two forms of primitive definitions. Conjunction and disjunction are permitted reluctantly, and only where they appear to be absolutely necessary. OTP is more fit to survive Ockham's razor than other forms of OT, because it has fewer primitives and explanatory principles.[14]

3.3 Optional onset

To illustrate these ideas, consider the observation that onsets are not required in Pit River syllables:

89. qa áp "the mouth"

90. qá aj·át "the ground squirrel"

According to the generalization in (83), the following ranking of constraints allows onsetless syllables:[15]

91. {Fill(seg), Parse(seg)} » Ons

{*seg* → PL, *seg* → σ} » [$_{\sigma}$ → [$_{C}$

(The first line in constraint ranking (91) shows the ranking of three constraints named with familiar mnemonics. The second line shows the restatement in OTP terms. I will follow this convention hereafter.)

There is, however, a complication in the data. A glottal stop may optionally be inserted, especially if the following syllable is stressed:

92. qa ʔáp ~ qa áp "the mouth"

93. qá ʔas ~ qá as "the water"

94. dáx slaʔám ~ dáx slaám "What shall I eat?"

Stress and pitch are independent, as is shown in (93). A glottal stop can sometimes be heard even before an unstressed syllable, especially in careful pronunciation of isolated citation forms:

95. ʔaj·át ~ aj·át "ground squirrel"

3.4 Variation

Variation, of which this is a simple instance, is pervasive in language. How do we account for variation in an OT grammar? Differences of register, variation by dialect, and

correlated processes of language change, would seem to require multiple, partially intersecting grammars for each speaker. Nagy & Reynolds (1997), citing Reynolds (1994), have shown how we can identify just those constraints whose changes in the ranking account for the variation, and assign to them each a range in the constraint ranking, rather than a single fixed rank position.[16] These constraints are said to "float" between the rank positions that are included in the range.

According to (81), onsetless syllables are possible if Ons is ranked below both Parse and Fill. According to (81), "repair" of onsetless syllables requires that Ons be ranked above either Parse or Fill; and because the "repair" is by epenthesis of an onset consonant /ʔ/ rather than by aphaeresis, Ons must be ranked above Fill and below Parse. To account for the variation of the kind seen in (89–95), Ons must range over two positions in the constraint ranking, one above Fill, the other below Fill. Ons is a "floating" constraint relative to Fill:

96. Parse(seg) » Ons » Fill(seg) » Ons

seg → μ » [$_{\sigma}$ → [$_{C}$ » *seg* → PL » [$_{\sigma}$ → [$_{C}$

The notational convention adopted here uses a dotted line and repetition to indicate a variable rank. The floating constraint appears at either end of the dotted line, which indicates the range over which the constraint can float.[17]

Note that this resolves the relative rank of Parse(seg) and Fill(seg) for Pit River—assuming that neither of them is also a floating constraint. At the high end of its range, Ons intervenes between Parse(seg) and Fill(seg), and Ons is already ranked below Parse(seg), so Fill(seg) must be ranked below Parse(seg).

However, Pit River only allows onsetless syllables word-initially. Ranking (96) permits onsetless syllables word-medially. We need to allow only a limited version of Ons, call it Ons(PrWd), to range below Fill(seg). Here is Ons(PrWd) with its OTP specification:

97. Ons(PrWd)

[$_{PrWd}$ → [$_{C}$

And here is the revised ranking:[18]

98. Parse(seg) » Ons » Fill(seg) » Ons(PrWd)

seg → μ » [$_{\sigma}$ → [$_{C}$ » seg → PL » [$_{PrWd}$ → [C

3.5 Principles for determining underlying forms

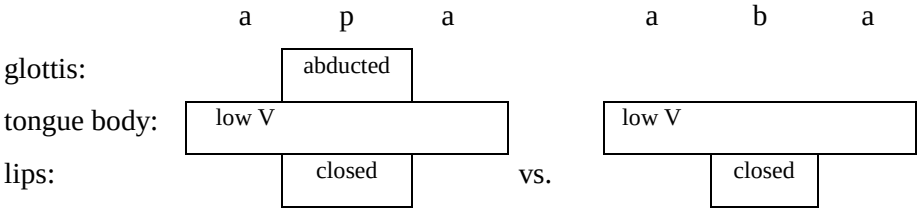
Tesar & Smolensky (1997) discuss the problem of learning the constraint ranking for a given language, assuming that the constraints are universal, and *given the underlying forms* that are to be parsed. On the problem of acquiring underlying forms, they refer to the discussion of "optimality in the lexicon" in P&S (1993:§9). However, in that discussion, knowledge of the constraint ranking is assumed for purposes of determining the underlying forms.

A bootstrap process seems to be required.[19] The induction of input forms probably starts with the assumption that the actual pronunciations heard are faithful representations of their underlying forms. The experience of morphophonemic variation would soon force choices. Which pronunciations are variants of the same input form? Of these, which pronunciation is faithful, and what constraints account for the other pronunciations by dominating the faithfulness constraints?[20]

Although this dissertation is not a study of child language acquisition (alas, it cannot be), nevertheless, some of the same issues concern us. OT studies are typically restatements of previously written grammars. We do not have that luxury for the Pit River language, there being no sound grammar available. As we consider which ranking of constraints accounts for the surface pronunciations of the language, we must also be prepared to ask which of several candidate forms is the underlying form.[21]

3.6 Timeline diagrams

Workers at Haskins Laboratories modelling speech gestures have developed what they call a gestural score, as reported in e.g. Browman and Goldstein (1989). Each line of the score represents states of an articulator, and the vertical alignment of transitions from one state to another represents the coordination and relative timing of gestures. Here is a gestural score for voiceless vs. voiced medial stops (adapted from Kirchner 1998:56):



This gestural score corresponds fairly closely to the articulator-based features that we are using. "Glottis" corresponds to laryngeal features, "lips" corresponds to [labial], and "tongue body" corresponds to any oral cavity feature other than [labial].

These relations can also be displayed on a time line in which labelled brackets represent the beginning and ending points of features (Eisner 1997a, 1997b). Here is a timeline representation of the same [apa] vs. [aba] sequences:

	a	p	a		a	b	a
laryngeal							
[spread]	–[ ]–	+[ ]+	–[ ]–		–[		]–
[constricted]							
[voice]	+[ ]+	–[ ]–	+[ ]+	vs.	+[		]+
[nasal]							
oral cavity							
aperture							
[open]	+[ ]+	–[ ]–+[ ]+	+[ ]+		+[ ]+	–[ ]–	+[ ]+
[open]	+[ ]+	–[ ]–+[ ]+	+[ ]+		+[ ]+	–[ ]–	+[ ]+
[open]	+[ ]+		+[ ]+		+[ ]+	–[ ]–	+[ ]+
[open]	+[ ]+		+[ ]+		+[ ]+	–[ ]–	+[ ]+
[labial]		+[ ]+				+[ ]+	
[dorsal]	+[ ]+		+[ ]+		+[ ]+		+[ ]+

The brackets represent feature transitions not in terms of absolute chronology, but relative to one another, as either coinciding with, preceding, or following one another.

The following shows the timeline representation of contour segments like /j/ and complex segments like /l/, with the simpler representation of /d/ included for comparison:

	l	j	c	t	d
laryngeal					
[spread]	–[ ]–	+[ ]+	+[ ]+	+[ ]+	+[ ]+
[constricted]					
[voice]	+[ ]+	–[ ]–	–[ ]–	–[ ]–	–[ ]–
[nasal]					
oral cavity					
aperture					
[open]	–[ ]–	–[ ]–+[ ]+	–[ ]–+[ ]+	–[ ]–+[ ]+	–[ ]–
	+[ ]+				
[open]	–[ ]–			–[ ]–+[ ]+	–[ ]+
	+[ ]+				
[labial]					
[coronal]					
[anterior]	+[ ]+	–[ ]–	–[ ]–	+[ ]+	+[ ]+
[distributed]	–[ ]–	+[ ]+	+[ ]+	–[ ]–	–[ ]–
	+[ ]+				

In general, all of the left brackets align at the left edge of a segment and all of the right brackets align at the right edge of a segment. For contour segments, there are segment-internal brackets that do not align with segment margins. For example, for the contour segment /j/, the labelled brackets $]_{-open}$ and $_{+open}[$ under the laryngeal node are segment internal. This transition is interior to the segment.

By contrast, for the complex segment /l/, the simultaneity of e.g. [+anterior], [–open] with [–anterior], [+open], is expressed by stacking them vertically, and their pairwise associations are expressed by their parallel ordering.[22]

Phonetically, the aspirates are characterized by delayed onset of voicing of a following vowel or other voiced segment. The above representation takes the delayed onset of voice to be an effect rather than a cause. With the aspirates, exemplified by /c/ and /t/ above, a vocoid articulation (the second [+open] aperture feature) coincides with the latter part of the span of the [spread glottis] feature under the laryngeal node. The drop in supralaryngeal air pressure with the oral release is what delays the onset of voicing for a following [voice] segment and results in a voiceless vocoid (aspiration) at the onset of a following vowel. With the plain series, exemplified by /j/ and /d/ above, there is no vocoid articulation (no second [+open] aperture feature) corresponding to the [spread glottis] feature under the laryngeal node, supralaryngeal air pressure does not drop, and the onset of voicing in a following segment is not delayed.

3.7 Selection theory

Optimality Theory is an application of *selectionist* principles within language (Campbell 1974, 1988, Cziko 1995): a proliferation of blind variations, and survival of only those that meet certain externally imposed criteria of selection. With the advent of works like Dawkins (1983, 1986, 1989) and Cziko (1995), there is growing appreciation for the breadth of phenomena whose origins and development may be elegantly explained—not only phylogenetic evolution, but such matters as

- Origin of instincts
- Brain and nervous system development
- Function and development of the immune system
- Origin and progress of knowledge, culture, science, and technology
- Learning

While these considerations are beyond the scope of this dissertation, they provide a sanguinary context for expecting that something like Optimality Theory will turn out to be the right course for linguistics in the long run.[23]

In the next chapters we will examine particular issues in Pit River phonology.

---

[1] Readers interested in an introduction usually start with Prince and Smolensky (1993), McCarthy and Prince (1993), McCarthy and Prince (1995), and Beckman et al. (1995), and should certainly become familiar with the OT archive at Rutgers, available at http://ruccs.rutgers.edu/roa.html on the World-Wide Web.

[2] Abstractness came to seem almost a meritorious end in itself, and the distinction between generalization and abstraction was neglected if not lost outright as constructs of the serial-rule-application mode of description were reified as elements of Universal Grammar hard-wired in the human genome.

[3] In principle, every output that occurs or could occur in any possible human language, possibly an infinite set. In practice, an infinite set, or even a very large set, could never be processed through the constraint hierarchy in real time. For discussion of alternatives, see Hammond (1997).

[4] That is, within the ranking there may occur subsets of constraints that are not ordered relative to one another. Obviously, members of an unordered set of constraints must not conflict with one another.

[5] Alternatively, they, or some of them, may be considered part of GEN. However, note the discussion of GEN and the OTP timeline later in this chapter.

[6] When a subset of constraints are unranked relative to one another, the candidates must be tested against all of the subset in parallel.

[7] The implication of sequence here is specious, the effect is really a consequence of the ranking.

[8] It is not the surface forms or pronunciations that are optimal, but rather the relationship between underlying and surface forms. (An output form that is identical to its input is optimal only if no constraints affecting the input rank higher than I/O correspondence constraints.) This is evident when we apply the principles of OT to identify the underlying forms from the given surface pronunciations, as in Tesar & Smolensky (1997).

[9] Ideally, the constraints are universal; some language grammars may introduce non-universal constraints.

[10] The possibility of a discovery procedure is implicit in the notion of linguistic universals. Compare Chomsky (1995): "The 'principles and parameters' approach did make it possible to reconstitute something like 'discovery procedures…."

[11] Alignment of edges is not a statement about precise coordination of phonetic gestures, but there is some correspondence. For example, consider voiceless stop onset before a vowel in e.g. "keep". The right-hand labelled bracket for voicelessness abuts the left-hand labelled bracket for voicing, and that juncture aligns vertically with $]_C$ abutting $[_V$, even though the details of VOT for a voiceless stop onset may vary. Where right and left brackets abut in this way, we may perhaps think of a shift of intention, from one intended gesture to the next. The process of recovering from the preceding gesture and effecting the new intention (e.g. for VOT) may lag or anticipate the implementation of a concurrent shift of intention on a different tier (e.g. a shift from velar stop [k] to front vowel [i]).

[12] "That is, as far as GEN is concerned, brackets may land anywhere. Conditions such as the prosodic hierarchy are enforced by undominated primitive constraints, not by GEN." Eisner (1997a:4, item 17a). This proposal would strictly limit the contrary proposal (noted earlier) that undominated constraints are properly part of GEN.

[13] *Seg* is a segmental root (alternatively, C or V), as distinguished from *Root*, a morphological root (Eisner 1997a:6). Thus, a more explicit statement could give the values of *Seg* as C and V:

Fe*at* $\rightarrow$ C
Feat $\rightarrow$ V

[14] The decomposition of complex constraints into more elementary constraints is carried forward in a different way in Everett and Berent (1997). They argue that the obligatory contour principle (OCP) is an effect of a family of ranked, violable OT constraints on sequences of identical consonants in different positions within Hebrew roots. Molière would have appreciated the irony in Ockham's Nominalist "Law of Parsimony" being often invoked in a field that revels in abstract explanatory principles like the OCP. (A "principe dormitive" is one that purports to explain while merely naming.)

[15] Here, we specify the relevant members of the Fill and Parse families. We may state Fill(seg) more explicitly as Fill(C) and Fill(V), and similarly for Parse(seg):

$\{C \rightarrow PL, V \rightarrow PL, C \rightarrow \sigma, V \rightarrow \sigma\}$ » $[_\sigma \rightarrow [_C$

[16] At some level of analysis, these two views are equivalent. Each of the multiple grammars in the usual view corresponds to one position in the range in Nagy & Reynolds' view.

[17] Nagy & Reynolds (1997) write the floating constraint on the dotted line and mark the ends of its range with large curly braces encompassing the floating constraint, the dotted line, and the range of fixed constraints. This or some other alternative would be preferred if more than one floating constraint were to have overlapping ranges in the same example, but this has not arisen in my work.

[18] A more detailed specification is as follows:

$$\underline{\text{seg}\rightarrow\mu} \gg [_{\sigma}\rightarrow [_{\text{C}}, [_{\underline{\text{PrWd}}} \rightarrow [_{\underline{\text{C}}} \gg \underline{\text{seg}\rightarrow\text{PL}} \gg [_{\underline{\text{PrWd}}} \rightarrow [_{\underline{\text{C}}}$$

Here, Ons is unordered with respect to the high-ranked end of the range for Ons(PrWd). However, the abbreviation used in (98) is a convenient one.

[19] Bootstrapping is a methodological requirement for linguistic analysis, as has been known since the 1930s and 1940s (see Harris 1951[1947], Nevin 1995). It should not be surprising if it is required for a language learner as well.

[20] Hale and Reiss (1997), available after the above was written, propose that acquisition begins with faithfulness constraints ranked above wellformedness constraints; that at first vocabulary (words and short phrases) is stored as unanalyzed wholes; and that synonymy initiates a process of analyzing complex or alternating forms, a process that they call grammar optimization, which results in re-ranking of the constraint hierarchy.

[21] Indeed, this question should be asked even for restatements of existing grammars. The underlying form posited for a system of rules and serial derivations may not be the best choice for an OT grammar, or might not be that selected by a grammar optimization process such as that sketched in Hale and Reiss (1997).

[22] This reflects a limitation of this notation with labelled brackets for complex segments, and has no deeper significance.

[23] Of particular interest is Perceptual Control Theory. For a beginning in the literature, see Powers (1973, 1989, 1992), Marken (1992); http://www.ed.uiuc.edu/csg/ provides an introduction with links to additional information and demonstrations. See also Bourbon et al. (1990), Bourbon (1995), Burnett, *et al*. (in press), Hershberger (1989), Judd (1992), Larson *et al*. (1995, 1996), Robertson & Powers (1990), Runkel (1990). Boersma (1998)

presents interesting developments within linguistics, and in keeping with OT (particularly OTP).

Chapter 4. Laryngeal Features in the Coda

Syllable codas are almost always devoiced in Pit River. The exception is a sequence of two sonorants. We will look now for an OT account for these facts.

4.1. Positional prominence

This is consistent with the observation that codas are not prominent or "privileged" positions (Beckman 1998:1). Beckman (1998) discusses an important generalization, that "segments in prominent positions very rarely undergo phonological processes, *even in cases in which they do not serve as triggers*" for phonological processes (emphasis in original). In other words, faithfulness constraints on segments are less violable – less often outranked by conflicting constraints – in prominent positions such as syllable onsets.

Beckman identifies three bases for prominence. On a functional basis, prominent positions carry a greater informational burden for "lexical storage, lexical access and retrieval, and processing" and therefore a greater range of contrastive potential. Phonetically, prominent positions are marked by various physical cues, "including increased duration or amplitude, pitch extrema, release bursts, etc. […] Positions of phonetic prominence include stressed syllables, syllable onsets, long vowels and possibly final syllables."[1] Of particular interest are phonological asymmetries: contrasts that are neutralized elsewhere, and positionally defined domains in which either phonological processes are either enabled or resisted. In an OT characterization of prominent positions, "[…] *positional faithfulness constraints* crucially dominate context-free faithfulness and markedness constraints."

4.2. Coda devoicing: VdObstr and Ident-Onset

For obstruent devoicing in the coda, Beckman proposes this constraint:

99. *VdObstr: *[voice, –sonorant] "Obstruents must not be voiced."[2]
–sonorant ⊥ voice

This formulation inverts the question in a way that is typical of OT. Instead of asking why obstruents are devoiced in the coda, we ask what more highly-ranked constraint or constraints account for voicing of obstruents in positions other than the coda, that is, in onsets. Beckman proposes the following positional faithfulness constraint for voicing in onsets:[3]

100. Ident-Onset(voice) "Onset segments and their input correspondents must agree in voicing."
($_{\sigma}$[and voice)→ <u>voice</u>

In Pit River, all Laryngeal-node features are faithful in onsets: open (voiceless) and constricted (glottalized), as well as voice. This generalization of (100) is as follows:

101. Ident-Onset(laryngeal)
($_{\sigma}$[and Laryngeal) → <u>Laryngeal</u>

Constraint (101) states a correspondence relation between underlying and surface laryngeal-node features at syllable onset. Indeed, in Pit River all features are faithful in onsets, so, even more generally:

102. Ident-Onset
($_{\sigma}$[and feat)→ <u>feat</u>

Constraint (102) states a correspondence relation between underlying and surface features at syllable onset.[4]

4.3. Sonorant devoicing

The ranking (102) » (99) (faithfulness of onsets ranked above devoicing of obstruents) would suffice if it were only obstruents that were devoiced in syllable codas. However, sonorants can also be devoiced in syllable codas. A sonorant in the coda retains voicing when another sonorant follows, but otherwise has a voiceless offset.[5]

Should we generalize (99) so as to include all segments, not just obstruents? If we did this, we would also have to modify higher-ranked constraint (102) somehow to cover the case sonorant clusters. However, there is no evidence of such a generalization of (99), namely, a universal tendency to devoice sonorants.

It is possible that devoicing of obstruents in the coda results from the ranking (102) » (99), and that some other constraints account for devoiced sonorants. However, before we try that approach, let us continue to search for a unified treatment.

4.4. NoCoda

Hahn (1997) proposes a more direct approach for German final devoicing of obstruents:

103. $\text{NoCoda}_{[+\text{Voice}]}$: No voiced obstruents in codas
(μ_w and obs) $\perp$ voice

This has the same problem as (99), that devoicing in Pit River is not limited to obstruents. If we remove the restriction to obstruents, the effect is to generalize (103) and obtain a simpler constraint:

104. $\text{NoCoda}_{[+\text{Voice}]}$: No voiced segments in codas[6]
$\mu_w \perp$ voice

Constraint (104) says weak morae (codas) are devoiced. It must be outranked by some other constraint or constraints in the cases where a weak mora μ_w is voiced, that is, when a coda sonorant is followed by an onset sonorant, as in:

105. dó·lolmi “all of them”

106. sá·má “I ate.”

Before we consider what those constraints might be, however, there is another issue to examine, lest we miss a potential generalization.

4.5. Spread of laryngeal features

That issue is the spread of laryngealization from a glottalized consonant over a preceding weak mora μ_w. Consider:

107. só·té·wí [sʰóʰté·wiʰ] "I heard."

In (107), the second mora of /ó·/ is devoiced before the underlying voicelessness of /t/ (but the second mora of /é·/ is not devoiced before voiced /w/). We see a parallel spread of a laryngeal feature in:

108. sa·ʔpá [saʔbáʰ] "moss, water weeds"

109. mí·ʔcim [míʔjim] "yesterday"

In parallel fashion the second mora of /a·/ is laryngealized (creaky-voiced) in (108) and the second mora of /í·/ is laryngealized in (109).

This suggests a generalization about features under the Laryngeal node spreading leftward to weak morae.[7] Constraint (115) prevents a coda from having its own Laryngeal features:

115. NoCoda(Laryngeal)
$]_{\mu w} \perp]_{Laryngeal}$

For the Pit River situation, we need the complementary constraint (116), forbidding a Laryngeal span to start immediately after a weak mora:

116. Spread(laryngeal)
$]_{\mu w} \perp [_{Laryngeal}$

This forces a weak mora to share the laryngeal feature of the following onset, if any. The default, if no Laryngeal span follows, is voicelessness (μ_w under no Laryngeal span), neatly capturing word-final and utterance-final devoicing.[8]

However, constraints (115) and (116) are too strong. They also forbid laryngealized consonants in codas unless a laryngealized onset follows.[9]

One possible resolution is to weaken constraint (115) so that it affects only voicing; but that returns us to constraint (104), repeated here for reference:

117. $NoCoda_{[+Voice]}$: No voiced segments in codas
$]_{\mu w} \perp]_{voice}$

Constraint (117) in combination with (116) requires a weak mora to acquire voicing from a following $[_{\underline{voice}}$ onset, or, lacking that, to be voiceless.

However, weakening the constraint to refer to [voice] instead of [Laryngeal] is also too sweeping a move. This would require a separate account of regressive laryngealization of coda sonorants before a laryngealized onset consonant.

It is simpler to say that constraints (115) and (116) are ranked below faithfulness to the underlying laryngeal-node feature [constricted]. This undominated correspondence relation is expressed in (118):

118. constricted → constricted

The ranking 118 »{115, 116} captures the facts about Laryngeal-node spreading, yet permits laryngealized consonants in codas when no laryngealized onset follows. The following tableaux demonstrate the interactions of these ranked constraints. In só·té·wí "I heard, I understood," preaspiration occurs before a voiceless aspirated t, but not before a voiced /w/:

119.	só·té·wí	118 constricted → constricted	115 $]_{\mu w} \perp]_{Laryngeal}$	116 $]_{\mu w} \perp [_{Laryngeal}$
	só·té·wí		*	
☞	só^{h}té·wí			
	só·té^{h}wí		*	*
	só^{h}té^{h}wí			*

In sa·ʔpá "water moss," anticipatory laryngealization (indicated by underscore in the phonetic representation) occurs instead of a voiced mora [a·] or voicelessness [a^{h}] before a glottalized /ʔp/:

120.	sa·ʔpá	118 constricted → constricted	115 $]_{\mu w} \perp]_{Laryngeal}$	116 $]_{\mu w} \perp [_{Laryngeal}$
	sa·ʔpá		*	*
☞	saa̲ʔpá			
	sa^{h}pá	*		

In i·báʔc "strong," underlying laryngealization is preserved, despite the fact that this requires a Laryngeal span to terminate at the right edge of a weak mora, violating

(13). The weak mora in /i·/ is devoiced because plain stops like /b/ are underlyingly voiceless.

121.	i·bá̰c̰	118 constricted → constricted	115 $]_{\mu w} \perp]_{Laryngeal}$	116 $]_{\mu w} \perp [_{Laryngeal}$
	i·bá̰c̰		*	
☞	i^{h}bá̰c̰			
	i^{h}bác	*		

The relationships of constraints (115), (116), and (118) account for allophony of word-final sonorant codas in exactly the same way. For example, the /l/ in ál "trout" has a voiceless offset utterance finally (122) and before voiceless segments whether aspirated and phonetically voiceless (123) or plain and phonetically voiced (124):

122. sá·má qa ʔál "I ate the trout."

123. ál tẘiỷí "He's a trout."

124. ál dám·í·ẘa síuwí "I want to eat trout"

However, the /l/ has a laryngealized offset before a laryngealized onset:

125. ál c̰é sgáw·á "You didn't give me a trout."

The /l/ is fully voiced before a voiced segment :

126. ál ma ál·ís sá·má "I ate trout and salmon."

In this chapter, we have seen how the interaction of a few ranked constraints can account for the devoicing of syllable codas in Pit River, and the exception where a sonorant in the coda precedes an onset sonorant. However, in addition to devoicing, there is the release or aspiration of oral stops in the coda and before consonants. We will take this up in the next chapter.

---

[1] Final syllables in Pit River have a voiceless offset before pause. Under interrogative intonation final syllables are breathy or whispered. There is a similar phenomenon in Yana. This suggests that final syllables are not privileged in these languages, and therefore not universally.

[2] Beckman 1998, citing Lombardi 1996, Alderete 1997, Itô & Mester 1997. I have replaced her detailed definition with a simpler primitive OT (OTP) statement.

[3] Her formal definition is "For all segments *x*, *y*, where $x \in$ Input, $y \in$ Output and *y* is syllabified in onset position, if $x \Re y$, then *y* is [voice] iff *x* is [voice]," where $\Re$ is the correspondence relation (McCarthy & Prince 1995).

[4] The implied relation of underlying features to surface syllabification is made possible by the correspondence relation of underlying and surface features. Correspondence is a transitive relation.

[5] In downriver dialects. I am assuming that μ_w includes C as well as vowel length. De Lacy (1997), reaching for universals, prefers an analysis of heavy syllables with syllable-final C branching from σ, but on equivocal grounds. His second choice (out of four logical possibilities), with syllable-final C branching from μ_w, affords a simpler statement of the Pit River facts.

[6] Notice that the non-OTP specification given by Hahn does not distinguish these two versions of NoCoda.

[7] One way to capture generalizations about laryngeal activity in OTP is by defining spans or intervals as follows:

110. Voiced interval: [Laryngeal]
[voice]

111. Laryngealized interval: [Laryngeal]

112. Voiceless interval:

That is, a [Laryngeal] span specified with the Laryngeal node feature [voice] is voiced; without the feature [voice], a [Laryngeal] span is laryngealized, that is, has a [constricted] feature specification. Features not coincident with a [Laryngeal] span are voiceless. Additional constraints spell out the feature geometry:

113. voice $\rightarrow$ Laryngeal

114. constricted $\rightarrow$ Laryngeal

The undominated constraints (113) and (114) say that voice or laryngealization (glottalization) can only occur in a laryngeal-node span. With constraints (111)-(114) in place (perhaps adding $_{voice}[\perp$Laryngeal and $]_{voice}\perp$Laryngeal as well to make them coextensive), we can express generalizations about laryngeal-node features. An

alternative is a series of parallel constraints, one for each laryngeal-node feature. (This formulation is due to Jason Eisner, p.c.)

[8] This formulation is akin to that of Lombardi (1996).

[9] Word-final laryngealized or glottalized consonants are fairly common. While clusters of laryngealized and plain consonants are not common in Pit River they do occur. Clusters of laryngealized and aspirated oral stops do not occur in the Pit River data that I have put on line so far.

Chapter 5. Aspiration, Voiceless Release, and Gemination

The contrast between aspirated stops and plain stops is neutralized in the syllable coda or before a consonant.[1] The archiphonemes for the neutralization normally have an audible voiceless release. This release is less fortis than that of aspirated stops in syllable onsets.

The archiphonemes could in principle be represented either as aspirated stops or as plain stops. In the first years of my fieldwork, taking my lead from predecessors, I chose the first alternative. In this analysis, aspirates are restricted to syllable onsets (including geminates), and plain stops occur freely not only in onsets but also word finally and preconsonantally in clusters, where they are realized as voiceless released or affricated allophones. Table 127 shows this distribution:

127.

	Onset	Geminate	Before C	Word-final
/p/, etc.	[b], etc.	[pp], etc	[p‘], etc	[p‘], etc
/p^{h}/, etc.	[p^{h}], etc.	[pp^{h}], etc	—	—

According to the second alternative, the one used in this work, plain stops are restricted to syllable onsets (including geminates), and aspirates occur freely not only in onsets but also word finally and preconsonantally in clusters, as follows:

128.

	Onset	Geminate	Before C	Word-final
/b/, etc.	[b], etc.	[pp], etc	—	—
/p/, etc.	[p^{h}], etc.	[pp^{h}], etc	[p‘], etc	[p‘], etc

Here are some of the reasons for choosing the second alternative:

- For a feature to be lost in neutralization is more plausible than for one to be gained.

- Upriver dialects appear to have shifted to a voiced–voiceless opposition, probably under areal influence from Paiute. Under the second alternative, the same representation serves both the downriver and upriver dialect areas (aside from lexical differences, of course).[2]
- Native speakers perceive the neutralization this way.[3]

A disadvantage of this choice is that it complicates the representation of reduplicants of the form CVC. For example, [bóq‘bo·qí] ~ [bóχ̣bo·qí] “brown” is written /bóxbo·qí/ in our phonemic orthography. Under the first alternative, the phonemic representation would be /póqpo·qí/. We will revisit this issue when we discuss reduplication in the next chapter.

The plain and aspirated stops alike are underlyingly voiceless.[4] The constraints described in Chapter 4 account for devoicing in the coda. They cannot account for the voiceless release or aspiration of a segment that is already voiceless. Something more is needed to account for this restriction in the distribution of oral stops.

We will approach a solution through the analysis of more narrowly defined problems in the phonology of aspiration and voiceless release in Pit River.

5.1. Aspirates and clusters

The allophones of the aspirated stops and plain stops are almost in complementary distribution. They only contrast in syllable onsets (including geminates). If the aspirated stops in onsets were represented as clusters of plain stop plus /h/, then we would need only two series of oral stops, plain and laryngealized. Thus púm “beaver” would be written /phúm/. Following Olmsted, I worked with this alternative at one stage of my fieldwork.

One difficulty is that it complicates the phonotactics of consonant clusters.[5] We could no longer say that no more than two consonants occur in a cluster medially, and no more than three initially, and the exceptions would all involve this /h/ of aspiration. For example, (129) would be represented as /wínthalúumi/, with the medial cluster /nth/.

129. wíntalúumi “He has a job. (n- repetitive, habitual)”

It would also complicate the representation of gemination. For example, (130) would be represented as / wít·halúumi/, with a geminate /t·/ followed by aspiration in the medial cluster /t·^{h}/.

130. wít·alúumi “He works.”

The aspirates probably originated historically from clusters, as in neighboring Yana and other Hokan languages (Jacobsen 1976, Langdon 1974, Langdon 1979, Silver 1976). The process is thought to be as follows. First, clusters arise from loss of a syllabic::

131. *CVCV > CCV

As we see synchronically in Pit River, an oral stop that is the first member of a consonant cluster is phonetically voiceless with audible release:

132. *CVCV > *C‘CV

If the following consonant is elided, the stop with voiceless release comes in contrast with syllable-initial plain stops (which are phonetically voiced in the present form of the language):

133. C^hV contrasts with CV, e.g. /ta/ contrasts with /da/

We can see a relic of this process synchronically in the pronominal prefix c-, “first person singular evidential.” Table (134) juxtaposes a fragment of two pronominal paradigms, one with and one without the prefix t- “evidential”:

134.

s–	al·u suwí	“I’m hungry.”	t–s–	it ci̯ýí	“It’s me.”
g–	al·u guwí	“You’re hungry.”[6]	t–g–	m̯i tgi̯ýí	“It’s you.”
ý–	al·u ý̯uwí	“He’s hungry.”	t–ẃ–	qá gac tẃi̯ýí	“It’s him.”

In each case, the evidential t– is prefixed before s–, g–, or ẃ–, the personal pronoun.[7] In combination with s– the result is not [t‘s] as expected, but aspirated /c/, phonetically [c^h].

Certainly, the rephonemicization of such clusters to affricates is not unusual cross-linguistically. However, the change from cluster /ts/ to segment /c/ is not regular in the language. For example, the pronominal cluster is retained when the /t/ falls in the coda of a preceding syllable and another consonant follows the s– prefix:

136. bám·é tsgi̯ýí [bʌ́m·ét‘ ski̯ʔí^h] “You didn’t know me! (evidently)”

It is generally the case that the first member of an initial cluster is pronounced in the coda of a preceding syllable that otherwise would be open. In each of the following examples, a dot is added to show the resyllabification of the first member of a cluster:

137. díním·átsi [dɪ́nɪ́m·ʌ́t‘.si^{h}] “to wake up”

138. yályú tw̉iỷí [yályú t‘.ʔwiʔí^{h}] “He’s a man.”

139. yályú tgiỷí [yályú t‘.giʔí^{h}] “You’re a man.”

In (136), the /t/ is pronounced in the coda of a preceding, otherwise open syllable, and the /s/ is pronounced in the onset of the following syllable, and the cluster is not rephonemicized as /c/. However, if the preceding syllable already has a consonant in the coda, the entire cluster is syllabified in the onset. (Clusters are not permitted in the coda.)

The resyllabification of onset clusters occurs generally in the language, and of course is also common cross-linguistically. For example, the initial cluster of the root –xh̉ot– is retained intact when reduplicated (140), but resyllabified when an open syllable precedes it (141). (Dots are added in the phonetic representations to mark syllable boundaries.)

140. xh̉ot xh̉ot ỷuwí [q^{x}ɦot‘.xɦot‘.ỷu.wí^{h}] “It’s crumbly (like chalk).”

141. diguxh̉ó·di [dɪ.guq^{x}.ɦó^{h}.ti^{h}] “to crumble with the hands”

5.2. A rearticulated cluster

In the case of the first person prefix, however, it is the assimilated /c/ that occurs in the onset of the following syllable, instead of /s/ as expected. And this is so even when the /t/ of the evidential is syllabified with the preceding word (a common alternant pronunciation):

142. yályú ciỷí [yályú^{h} c^{h}iʔí^{h}] ~ [yályút‘ c^{h}iʔí^{h}] “I’m a man.”

It appears that the first person evidential has been rephonemicized as an underlying affricate /c/, even when the evidential prefix t– is separated from it by liaison with a preceding syllable nucleus. Clearly, the underlying syllable-initial cluster ts has given rise to an aspirated /c/ segment with the meaning of the combination of the t– evidential and s– first person prefixes. This provides synchronic evidence for the cluster origin of aspirates.

5.3. OT analysis

To account for the resyllabification of /t/ in (142), we could posit a variant of CodaCond, requiring μ_w to be a consonant (thus preferring closed syllables). This constraint would have to be given lower rank than the coda-devoicing constraints of Chapter 4 that give rise to devoicing of long vowels (preaspiration). Otherwise, our proposed Coda-Cond would prefer candidates in which a syllable is closed by geminating the following onset consonant.

A simpler explanation is a constraint prohibiting clusters in onsets, as follows:[8]

143. *Complex Onset

$_{C}[\rightarrow {}_{\sigma}[$

In this OT formulation *Complex Onset is an alignment constraint that allows no more than one consonant in the onset of a syllable. It may not be obvious that it prohibits onset clusters. Recall the meaning of the $\rightarrow$ symbol. One translation of constraint (143) into ordinary language is "if there is a left edge of a consonant, it must align with the left edge of a syllable." It does not require each syllable to have an onset. After the first consonant, any additional consonants in an onset cluster violate this constraint.[9] Onset clusters are possible if they are present in input and there is no preceding open syllable for them to close. Since clusters do not occur in codas in Pit River, this amounts to a prohibition on all clusters unless a syllable boundary intervenes.

It might appear that we need a CodaCond(*Cluster) constraint, constructed in an exactly parallel way to allow just one consonant in the coda. Together, these constraints would allow syllables such as CV, VC, and CVC, and also V if there is no underlying C. Syllables like CCV(C) and CVCC would incur violations.[10] However, no such constraint is needed here. The universal NoCoda constraint, which prohibits closed syllables CVC, has very low rank in Pit River. A consonant that violates constraint (143) is freely resyllabified. When a cluster follows an open syllable CV, the constraint ranking gives preference to those output candidates in which the initial member of the cluster is syllabified in the coda of that preceding syllable.

Constraint (143) is subordinate to input-output correspondence (faithfulness), so that if no open syllable precedes, the cluster can surface intact in the onset. This ranking also means that the absence of clusters in syllable codas (or, more to the point, the presence of onset clusters) is ultimately a function of historically contingent lexical input.

Example (139) is analyzed in tableau (144).

144.	yályú tgiý̨í	Faithfulness feat → feat	Ons [σ → [C	143 C[→ σ[
	yályú.tgiý̨í			*
☞	yályút.giý̨í			
	yályú tg.iý̨í		*	

In the first candidate, yályú.tgiý̨í, the cluster is in the onset. This incurs one violation of Constraint (143), *Onset Cluster. The third candidate, yályú tg.iý̨í, violates Ons. The second candidate, yályút.giý̨í, incurs no violations of these constraints.

Example (136), bám·é tsgiý̨í, is more complex, with a CCC cluster. It falls out in the tableau as follows:

145.	bám·é tsgiý̨í	Faithfulness feat → feat	Ons [σ → [C	143 C[→ σ[
	bám·é.tsgiý̨í			**
	bám·étsg.iý̨í		*	
	bám·ét.sgiý̨í			*
☞	bám·éts.giý̨í			
	bám·éc.giý̨í	*		

If the underlying cluster /tsg/ is syllabified entirely in the onset, it violates constraint (143) twice, and if it is syllabified entirely in the coda it violates Ons. Splitting the cluster so that only /t/ falls in the coda still violates constraint (143). Since coda clusters are unpenalized (NoCoda has very low rank), the optimal candidate splits the cluster so that /ts/ falls in the coda and /s/ in the onset.[11] The last candidate listed fails on faithfulness because the underlying cluster /ts/ surfaces as affricate /c/. This shows that Example (136) must have the cluster /ts/ and not the affricate /c/ in its underlying form.

Example (142) is the interesting case where the cluster ts surfaces as the affricate /c/, but the underlying t may still surface in the coda of a preceding open syllable. Using an underlying cluster similar to that in Example (139) and Example (136), we get the following tableau:

146.	yályú tsiy̰í	Faithfulness feat → feat	Ons [$_{\sigma}$ → [$_{C}$	143 $_{C}$[→ $_{\sigma}$[
	yályú.tsiy̰í			*
☞	*yályút.siy̰í			
	yályúts.iy̰í		*	
	yályú.ciy̰í	*		
	yályút.ciy̰í	*		

But the predicted form yályút.siy̰í is in fact not acceptable. After the t- evidential, the s- morpheme surfaces as /s/ only if another prefix follows, as in example (136) and tableau (145). The correct forms are the last two candidates listed, yályú.ciy̰í and yályút.ciy̰í. But these both incur a violation of high-ranking I/O correspondence (faithfulness). It appears that the evidential first person pronoun has been reinterpreted as a unitary prefix consisting of the affricate /c/, no longer analyzable into t– plus s– prefixes.

Nevertheless, the t– morpheme still surfaces as /t/ in the coda of a preceding open syllable in the variation yályú ciy̰í ~ yályút ciy̰í that we saw in example (142). This suggests that the prefix c– is an allomorph of s– that occurs after the t– evidential prefix when no other pronominal prefix follows, and that both t– and the reinterpreted c– are underlyingly present, as in the following tableau:

147.	yályú tciy̰í	Faithfulness feat → feat	Ons [$_{\sigma}$ → [$_{C}$	143 $_{C}$[→ $_{\sigma}$[
	yályú.tciy̰í			*
☞	yályút.ciy̰í			
	yályútc.iy̰í		*	
	yályú.ciy̰í	*		

The initial cluster /tc/ violates constraint (143). Syllabifying it in the coda violates Ons. The optimal candidate puts the /t/ in the coda and the /c/ in the onset.

Omitting the /t/, producing yályú ciy̰í, violates faithfulness. But this candidate is in fact also acceptable. For the explanation, we will turn now to another issue in Pit River phonology.

5.4. Lenition of release

The release of a plain stop may be lenited before the onset of a following stop. In consequence of this, both released and unreleased allophones of the plain stops occur as the first member of a cluster. This is more common with a homorganic cluster:

148. batdi [bʌt‘di^{h}] ~ [bʌtdi^{h}] “wild plum”

In (148), the homorganic cluster with first member unreleased is indistinguishable from a geminate plain stop: /bad·i/, [bʌt·i^{h}]. However, this is clearly a special case of a general phenomenon, since the voiceless release may also be lost when the two consonants of the cluster have disparate places of articulation:

149. hápt̰is [hʌ́p‘d̰ɪs] ~ [hʌ́pd̰ɪs] “gall bladder”

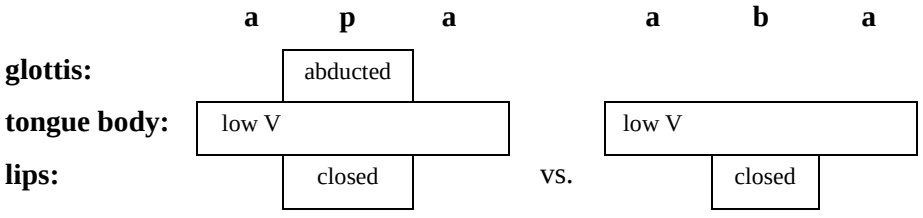
Recall that the aspirates are represented as contour segments, similarly to the affricates:

	j	c	t	d
laryngeal				
[spread]	+	+	+	+
[constricted]				
[voice]	–	–	–	–
[nasal]	–	–	–	–
oral cavity				
aperture				
[open]	–+	–+	–+	
[open]		–+	–+	
[labial]				
[coronal]				
[anterior]			+	+
[distributed]	+	+		

A [–open] feature specification on the first tier represents the oral stop articulation, and a [+open] feature specification on the second tier represents the voiceless vocoid of aspiration. It is the [+open] feature of aspiration that may be lenited in the first member of an oral stop cluster.

Kirchner (1998) proposes an effort-based analysis of lenition. Building on work on speech gestures such as that reported in Browman and Goldstein (1989), he argues that fortition vs. lenition for e.g. medial voicing involves the presence vs. absence of a speech gesture.

In Chapter 3, we saw Kirchner's gestural score for voiceless vs. voiced medial stops. Here it is again (adapted from Kirchner 1998:56):



Of this, Kirchner says:

> [M]edial stop voicing processes can […] be understood as a species of lenition, consistent with the effort-based approach proposed here, in that they plausibly involve the elimination of a glottal abduction (or constriction) gesture. […] Voicing in this context thus affords an effort savings, because the devoicing (glottal abduction) gesture necessarily involves more effort than no gesture at all.

Although voicing is not the salient feature in the lenition process with which we are now concerned, the presence or absence of a gesture is involved.

In Chapter 3, we discussed the correspondence of this gestural score to the articulator-based features that we are using. “Glottis” corresponds to laryngeal features, “lips” corresponds to [open] aligned with [labial], and “tongue body” corresponds to [open] aligned with an oral cavity feature other than [labial]. We saw how these relations can be displayed on a time line in which labelled brackets represent the beginning and ending points of feature spans (Eisner 1997a, 1997b). The brackets represent feature transitions not in terms of absolute chronology, but relative to one another, as either coinciding with, preceding, or following one another.

Recall that the aspirates are represented as contour features. Here is a timeline representation of the medial /td/ cluster of *batdi* in a fortis and lenis pronunciation:

	t‘	d		t	d
laryngeal					
[spread]	$_{+}$[	]$_{+}$		$_{+}$[	]$_{+}$
[constricted]					
[voice]	$_{-}$[	]$_{-}$	vs.	$_{-}$[	]$_{-}$
[nasal]					
oral cavity					
aperture					
[open]	$_{-}$[ ]$_{-+}$[ ]$_{+}$	$_{-}$[ ]$_{-}$		$_{-}$[	]$_{-}$
[open]	$_{-}$[ ]$_{-+}$[ ]$_{+}$	$_{-}$[ ]$_{-}$			
[labial]					
[coronal]					
[anterior]	$_{+}$[	]$_{+}$		$_{+}$[	]$_{+}$

Clearly, there is more gestural complexity in the fortis articulation [t‘d] vs. the lenis articulation [td]. The place of articulation is the same throughout, anterior coronal, but for the fortis articulation the aperture feature must switch from [–open] to [+open] and back to [–open]. Otherwise, the two representations are identical.[12]

For these features, the labelled bracketting for the unreleased homorganic cluster, on the right, is identical to that for a geminate /d·/:

	d	·
laryngeal		
[spread]	$_{+}$[	]$_{+}$
[constricted]		
[voice]	$_{-}$[	]$_{-}$
[nasal]		
oral cavity		
aperture		
[open]	$_{-}$[	]$_{-}$
[labial]		
[coronal]		
[anterior]	$_{+}$[	]$_{+}$

That is, the unreleased pronunciation of the cluster in (150) is phonetically identical to the pronunciation of the geminate stop in (151):

150. batdi [bat·i^{h}] ~ [bat‘di^{h}] “plum”

151. lád·íw [lát·íw‘] “five”

The release of laryngealized stops may also be lenited before a following oral stop. As with the plain stops, both released and unreleased allophones of the laryngealized stops occur as the first member of a cluster:

152. sanák̓da·l̓í [sʌnʌ́k̓‘da·ʔlí^{h}] ~ [sʌnʌ́k̓da·ʔlí^{h}] “I was blinded.”

Even the fricative portion of the affricate /c̓/ may be assimilated to the onset of a following consonant:[13]

153. dí·mac̓ji [dí·mʌt̓^{s}ci^{h}] ~ [dí·mʌt̓ci^{h}] “to learn how (by example)”

This can make it difficult to hear the first member of a cluster, particularly /q̓/:

154. q̓ós·i ál·éq̓da [q̓óšỳál·éq̓dʌ^{h}] “spinney, alluvial fan, draw”[14]

Kirchner (1998) makes a case for an effort-based constraint called LAZY to account for lenition phenomena like these. It is a floating constraint whose rank is keyed to differences of register and dialect. If you expend more effort, Faithfulness dominates LAZY:

155.	batdi dí·maˀcji	Faithfulness feat → feat	LAZY
☞	bat‘di dí·mʌtˀˢciʰ		*
	bat·i dí·mʌtˀjiʰ	*	

If you expend less effort, LAZY dominates Faithfulness:

156.	batdi dí·maˀcci	LAZY	Faithfulness feat → feat
	bat‘di dí·mʌtˀˢciʰ	*	
☞	bat·i dí·mʌtˀciʰ		*

This accounts for the variable presence in the prefix c– of underlying /t/:

157.	yályú tciˀyí	LAZY	Faithfulness feat → feat	LAZY	Ons [σ → [C	143 C[→ σ[
	yályú.tciˀyí					*
☞	yályút.ciˀyí			*		
	yályútc.iˀyí				*	
☞	yályú.ciˀyí		*			

The output form yályút.ciˀyí is optimal when Faithfulness dominates LAZY. The output form yályú.ciˀyí is optimal when LAZY dominates Faithfulness.

5.5. Aspirates in the coda

An oral stop in the coda must be released, which we represent as aspiration. To account for this, we can posit a constraint that requires a $]_{+open}$ feature margin at the right edge of a weak mora:

158. CodaCond(open)
$]_{\mu w} \rightarrow]_{+open}$

If a candidate representation has in a syllable coda a plain stop with its [–open] aperture, constraint (158) prefers an otherwise identical candidate that has the [–+open] contour of an aspirated stop in the coda. This constraint also accepts the [+open] feature specifications of vocoids, just as we wish.

There are two problems with this proposal. First, constraint (158) prohibits geminate plain stops. Compare the timeline representations of CV and moraic specifications for geminates and clusters:

159.

Cluster — batdi “plum”					**Geminate —** lád·íw “five”					
b	a	t	d	i	l	á	d	·	í	w
$_{\mu}s[$	$]_{\mu}s$	$_{\mu}w[\ ]_{\mu}w$	$_{\mu}s[$	$]_{\mu}s$	$_{\mu}s[$	$]_{\mu}s$	$_{\mu}w[\ ]_{\mu}w$	$_{\mu}s[$	$]_{\mu}s$	$_{\mu}w[\ ]_{\mu}w$
$_{c}[\ ]_{c}$	$_{v}[\ ]_{v}$	$_{c}[\ ]_{c}$	$_{c}[\ ]_{c}$	$_{v}[\ ]_{v}$	$_{c}[\ ]_{c}$	$_{v}[\ ]_{v}$	$_{c}[\ ]_{c}$	$_{c}[\ ]_{c}$	$_{v}[\ ]_{v}$	$_{c}[\ ]_{c}$

The geminate /d·/ in lád·íw is linked to two morae, and the cluster /td/ in batdi is also linked to two morae. The difference is that the geminate /d·/ has the two morae linked to one C slot, but the cluster /td/ has one mora for the /t/ and a second mora for the /d/.

The obvious move is to modify constraint (158) to refer to C slots, as follows:

160. CodaCond(open)
$(]_{\mu w}$ and $]_{C}) \rightarrow]_{+open}$

However, there is a second problem with both (158) and (160). They both forbid nasals in the coda. We could complicate constraint (160) by adding a disjunction:

161. CodaCond(open)
$(]_{mw}$ and $]_{C}) \rightarrow (]_{+open}$ or $]_{+nasal})$

This violates an OTP restriction of complex statements (conjunctions or disjunctions) to one side of definitions, and a desire to allow only simple statements if possible.

A simpler solution is to drive notational distinctions down to the level of phonetic specification. In Chapter 2, the nasals were specified as follows:

	m	n
laryngeal		
[voice]	+	+
[nasal]	+	+
oral cavity		
aperture		
[open]	–	–
[labial]	+	
[coronal]		+

Sagey (1986) has a soft palate node connecting to the root node. We can understand [+nasal] to be equivalent to [+open] on the root/soft palate branch, parallel to [+open] on the root/oral cavity/aperture branch. This revision appears as follows:

	m	n
laryngeal		
[voice]	+	+
soft palate		
[open]	+	+
oral cavity		
aperture		
[open]	–	–
[labial]	+	
[coronal]		+

Implications of this move for the sonority ranking are considered in Appendix B.

In this chapter we have developed an OTP account of the neutralization of the contrast between aspirated stops and plain stops in the syllable coda and before a consonant. We have shown how certain exceptions—due to lenition, and due to a relic of the cluster origin of the c– pronominal prefix being preserved after an open syllable—can be accounted for by variable ranking of floating constraints.

[1] An alternative statement of the environments is: before another consonant and word-finally.

[2] Stop allophones with voiceless release are restricted to syllable codas in both dialect regions. If we were to assign the voiceless released allophones to the plain series, it would be the aspirates that were restricted to the onset, but in upriver dialects it is the voiced stops (corresponding to downriver plain stops) that are restricted to onsets.

[3] English orthography is probably not a significant factor with the speakers who worked with me, and almost certainly was not for those who worked with Sapir and Harrington. I have seen only brief word lists recorded by them, but their data in these matters are entirely consistent with mine. While English phonology may be a factor here, interpretation of loan words argues against it. For example, neither Pit River nor neighboring Klamath has an /f/ phoneme. "Coffee" in Pit River is / kó·pi/, with voiceless plain stop after a long, partly devoiced vowel; in Klamath, it is /kó·bi/, with voiced intervocalic /b/ (Barker 1963a, 1963b). For a Pit River speaker, the fricative is analogous to the turbulence and affrication of the fortis aspirate in contrast to a voiceless plain stop. For a Klamath speaker, the fricative is relatively lenis, its "softness" more analogous to the voiced stop than it is to a voiceless stop. Klamath and northern Paiute are regional influences favoring a voiced-voiceless opposition in upriver dialects long antecedent to contact with English.

[4] If they were not underlyingly voiceless, then coda devoicing could not be accounted for by spread of laryngeal features, as in Chapter 4.

[5] It also proved unworkable as a practical orthography, a desideratum at the time.

[6] Although it is grammatically acceptable, this form is pragmatically unacceptable in Pit River. The evidential would be required, since you're speaking to the person, and the irrealis pronoun would be required because the hunger itself is not directly in evidence but must be inferred:

135. al·u tmuwí ~ al·u tə́muwí "You're hungry (I suppose)."

[7] The difference between y̰– and w̰– in the third person reflects a distinction as to stative or durative meaning (pleionastically expressed by the stem –iy̰– vs. –uw–). Hunger is transient, identity is not.

[8] If we use the alternative statement of the environments of neutralization (before another consonant and word-finally) then the constraints must be stated in terms of $_{C}[$ and $]_{PrWd}$. However, this would make it more difficult to account for resyllabification after a short open syllable.

[9] Compare the more general formulations in Eisner (1997a:13):

σ ⊥ ([$_C$ and]$_C$)	*Complex: Only one element can be in onset or coda position.
σ ⊥ [$_C$	NoComplexOnsetOrRhyme.
μ ⊥ [$_C$	*Complex: No complex onset or coda.

The combination of a constituent interior like σ or μ in the same statement with an edge excludes the cases where the named edge aligns with an edge of the named constituent; for example, μ ⊥ [$_C$ means that the edge [$_C$ is disfavored in the interior of the mora, between [$_μ$ and]$_μ$ but aligning with neither. It is this combination of edges with interiors that specifies a greater domain (codas as well as onsets) for the above constraints, as compared with *ComplexOnset, which refers only to edges, and whose range is limited to onsets.

[10] The prohibition against doubly-heavy syllables CV·C does not concern us here.

[11] In an earlier draft, I concluded erroneously that splitting the cluster as /t.sg/ was optimal. I am embarrassed to say that I was persuaded by the formal arrangement of the tableau, which then included CodaCond(*Cluster), and did not carefully re-examine the phonetic facts. Formal considerations can be very seductive, but do not themselves constitute data. It is always important to verify that one's results have a valid relationship to one's observational data.

[12] It is not clear to me that voicing, in Kirchner's example, involves fewer gestures than voicelessness, since there is muscular effort involved in the production and control of voicing. I suspect that the explanation is that the transition from voicing to voicelessness and back in [apa] is more complex than the continuation of voicing in [aba]. Our account here, at any rate, involves gestural complexity in terms of transitions. Note that coda devoicing of sonorants is not lenited because spread of [–voice] is not an aperture change.

[13] In citation forms and in other contexts where the pronunciation is punctiliously emphasized, the laryngealized stop may alternatively be pronounced with fortis release, and may approximate an ejective articulation; but this is true in all environments and not just preconsonantally in a cluster.

[14] From q̓ós·i "juniper" (cf. q̓ós·i·máloo "juniper tree") plus ʔál·éq̓daʔ "liking, desiring" (cf. dálíl·éq̓di "to like, want, desire"). Upriver, junipers grow where there is a bit of water. With suffix –wí "dweller," this is the basis of the upriver band name rendered Kosalektawi by Kniffen and qosaléʔtawí by Olmsted/deAngulo.

Chapter 6. Reduplication

A common type of reduplication is seen in

162. bóxbo·qí "brown"

When a CVC root like –boq– is reduplicated in a word like this, we see an alternation of plain and aspirated stops (here, /q/ alternating with /x/) and an alternation of vowel length. The length alternation can be accounted for by a constraint requiring that weak morae in the input and the output correspond faithfully:

163. I/O Correspondence(μ_w)
$\underline{\mu_w} \rightarrow \mu_w$

Constraint (163) is the formulation given for WeightIdent in Eisner (1997a:10). It must be ranked lower than Ons, the constraint requiring onsets, which is:

164. Ons
$[_\sigma \rightarrow [_C$

In the presence of the suffix –í, the ranking (164) » (163) prefers a candidate in which the final consonant of a CVC reduplicant is pronounced as the onset before /í/.[1]

In addition to constraints (164) and (163), the following tableau includes constraint (161) for releasing obstruents in codas, and constraints (115) and (116) for devoicing codas. By common convention, a dot . represents syllable boundary.

165. bóq–boq–í	164 $[_\sigma \rightarrow [_C$	163 $\underline{\mu_w} \rightarrow \mu_w$	161 $]_{\mu w}$ and $]_C \rightarrow]_{+open}$	115 $]_{\mu w} \perp]_{Laryngeal}$	116 $]_{\mu w} \perp [_{Laryngeal}$
bóq.boq.í	*		*		

	bóq.bo.qí		*	*		
	bóx.bo.qí		*			
	bóx.bo·.qí				*	*
☞	bóx.bo^{h}.qí					

Another type of reduplication involves a verb root in construction with the copula:

166. ɣ̌utɣ̌ut ɣ̌uwí “It's squishy (like fruit).”

167. xh̬otxh̬ot ɣ̌uwí “It's crumbly (like chalk).”

The obvious assumption is that the underlying form of a verb root such as –ɣ̌ut– or –xh̬ot– has low pitch, and that both base and reduplicant are faithful to the underlying form, segment by segment. The relevant faithfulness constraints are:

168. I/O correspondence (seg)
seg → seg

169. I/O correspondence (feat)
feat → feat

However, the form of the verb root changes when it is in a verbal construction with an instrumental prefix such as gu– “with the hand” or c̬i– “with the foot”:

170. diguɣ̌·ú·t̬i “to squash (fruit) with the hand.”

171. dic̬ixh̬ó·di “to crush (chalk) with the foot.”

Comparing e.g. /ɣ̌ut̬/ with /ɣ̌ú·t̬/, we see that we have to account for a mora of vowel length and high pitch.

My analysis assumes that the high pitch is in the input form of the instrumental prefix, so that a progressive LH contour is part of e.g. gu–́ “with the hand,” c̬i–́ “with the foot,” etc. (low pitch on the prefix, high pitch on the verb root).

Tableau (172) shows the interaction of the underlying form di–gu–́xh̬ót–i with these constraints:

172.	di–gu–xɬ̊ót–i	169 feat → feat	163 $\underline{\mu_w} \rightarrow \mu_w$	164 $[_\sigma \rightarrow [_C$	143 $_C[\longrightarrow {}_\sigma[$
	digux.ɬ̊oti	*			
	digu.xɬ̊óti		*		*
	digu.xɬ̊ó·ti				*
☞	digux.ɬ̊ó·ti				
	diguxɬ̊.ó·ti			*	

Candidates like diguxɬ̊oti that fail to assign high pitch to the root syllable fail on faithfulness. If the root begins with a cluster, the initial consonant of the cluster must be in the coda of the prefix syllable. A candidate with the cluster in the onset of the root syllable fails on constraint (143), Onset(*Cluster); a candidate with the cluster in the coda of the prefix syllable incurs a violation of constraint (164) Ons.

Another approach would be to require that syllables be heavy:

173. Coda
$]_\sigma \rightarrow]_{\mu w}$

Any open CV syllable in Pit River violates constraint (173), but because it is ranked lower than Ons, this violation would be suffered blandly if there were no following cluster to resyllabify. However, because NoCoda is a widely attested constraint, albeit low ranking in Pit River, as we saw in Chapter 5, its opposite (while still possible) lacks plausibility.

These roots have two morae in their input forms. What happens to the weak mora of the hitherto closed syllable /ɬ̊ot/, now made an open syllable /ɬ̊o/? Under constraint (163), the correspondence relation of input mora to output mora, it surfaces as vowel length in the syllable /ɬ̊ó·/.

The same construction of instrumental prefix and verb root occurs without an onset cluster in example (170) diguy̓·ú·ʔti “to squash (fruit) with the hand”:

174.	di–gu–́y̓ut–i	Faithfulness feat → feat	163 $\underline{\mu_w} \rightarrow \mu_w$	164 $[_\sigma \rightarrow [_C$	143 $_C[\longrightarrow {}_\sigma[$
	diguy̓útʔi		*		
☞	diguy̓ú·ʔti				
	diguy̓utʔi	*			

A constraint interaction exactly like that in Tableau (172) favors the output form diguy̓ú·ʔti in Tableau (174). This is almost right, but misses the gemination of the root-initial consonant. We have a weak mora $]_{\mu w}$ (the first half of the geminate consonant) where we have postulated an underlying short vowel in the prefix gu–.

If the input for the instrumental prefix were a heavy syllable, we would expect the underlying $]_{\mu w}$ in the coda to surface as vowel length. Instead, we see gemination of the following consonant. My assumption is that the extra mora is historically a reflex of a lost syllable. This is supported by relationships such as the following:[2]

čʔi–	“with the foot”	čʔíg·oh̓	“foot”
h̓i–	“with the head”	láh̓	“head”
ja–	“with the fingers”	duj·i	“finger”
q̓i–	“with the buttocks”	boq̓	“buttocks”
čʔwa–	“with the teeth”	ičʔ·á	“teeth”
ma–	“with fire”	mál·ís	“fire”
plʔa–	“with the tongue”	iplʔí	“tongue”

The underlying form of the instrumental prefixes includes a weak mora μ_w as the underlying carrier for the high pitch that surfaces on the root syllable. If the root begins with a cluster, as in Tableau (172), the first member of the cluster is associated with the empty C-slot.

However, if the root begins with a single consonant, as in example (170), diguy̓·ú·t̓i, “to squash (fruit) with the hand,” then that consonant is geminated.

175.	di–gu[́]–y̓ut̓–i	169 feat → feat	163 $\underline{\mu_w} \rightarrow \mu_w$	164 $[_\sigma \rightarrow [_C$	143 $_C[\rightarrow {}_\sigma[$
	di.gu.y̓út̓.i			*	
	di.gu.y̓ú·.t̓i		*		
	di.gu.y̓u.t̓i	*	*		
☞	diguy̓·ú·t̓i [dɪ.gʊʔ.yú·.t̓iʰ]				

A third type of reduplication in Pit River looks like this:

176. č̓ikč̓í·ga “hatchet”

177. qásqá·sa “Stellar’s jay”

178. č̓ayč̓á·ya “California jay”

The reduplicant in (176) also occurs unreduplicated, as a verb root, “chop or chip,” but such alternants have not been identified for the others. The reduplicant in this type of word is typically an onomatopoeic CVC syllable with high pitch. Length of the second syllable can be accounted for as mora preservation under constraint (163) $\underline{\mu_w} \rightarrow \mu_w$. The suffix is simply –a, with low pitch.[3]

We did not account for an alternation of pitch in the first type of reduplication that we examine. Here is example 162 again, for reference, and another of the same type:

179. bóxbo·qí “brown”

180. wál̓wa·l̓í “butterfly”

The reduplicant in (180) is a verb root –wál̓– “flap”; I have not identified –bóq– as a root. The underlying form of the CVC root has high pitch. An obvious explanation for the alternation is that an initial syllable of the suffix, bearing low pitch, has been lost, and the

pitch is retained by the reduplicant. A possible candidate for a morpheme to be reduced to a suffix is the copula –uw–. If the "characterizing" third-person pronominal prefix w̰– were used, the construction underlying (180) would look like this:

181. *wál̰wál̰ w̰uwí "It characteristically goes flap-flap"

The likelihood of eliding the initial syllable of *w̰uwí seems great. The same source might underly the –(w)í suffix of words identifying where a person lives or is from, such as ajúm·á·wí. However, such speculation requires more firm evidence than I have yet identified. It suffices to posit an underlying form for the suffix with an empty C-slot that carries the low pitch feature. Then the selection of the correct candidate for (179) and (180) follows the lines we have seen in tableau (175). Leaving out the constraints that let the length alternation surface, and the constraints for releasing obstruents in codas and for devoicing codas, which were covered at the beginning of this chapter, the tableau is as follows:

182.

	bóq–bóq–[̀]í	169 feat → feat	163 $\underline{\mu}_w \rightarrow \mu_w$	164 $[_\sigma \rightarrow [_C$	143 $_C[\rightarrow {}_\sigma[$
	bóx.bóq.í		*	*	
	bóx.bó.qí		*		
	bóx.bó·.qí	*			
☞	bóx.bóo.qí				
	bóx.bo·.qí	*			

This predicts a reduplicant with a falling tone, such as we saw in Chapter 2 with the suffix –(l)óo in example (50) and the suffix –umá in example (51), repeated below:

183. batdilóo [bʌt`dilóo] "wild plum bush"

184. sí·sá·diníumá [sɪ̰ʰsáʰtɪníimá], [síʰsáʰtɪníʊmá], [síʰsáʰtɪním<u>m</u>á]
"I was told (remote past)" ([<u>m</u>] low pitch)

The candidate that actually surfaces has low tone on both morae of the lengthened reduplicant, rather than falling tone. A possible explanation is a constraint forbidding successive morae to have different tones. I do not yet have sufficient data to formulate the conditions under which it is violable. There are no tautosyllabic rising tone sequences in

Pit River. Falling tone is not common, but does occur, always crossing a morpheme boundary, and it appears that a sonorant or word boundary must follow. A glottalized sonorant, as in wál̓wa·l̓í, does not permit a violation. There may be other conditions.

There are instances of simple reduplication, involving only an alternation in pitch:

185. ẃátẃat "snowshoe rabbit"

There is no evidence here of a pitch-bearing suffix, other than the pitch alternation itself. Until there is internal or historical data to support this, the simpler hypothesis is that the alternation is merely onomatopoeic; but this may apply equally to the alternation in example (180) wál̓wa·l̓í "butterfly."

In this chapter, we have seen how the characteristics of various kinds of reduplication in Pit River fall out of the constraint rankings that we have established for other purposes in earlier chapters.

---

[1] If the final vowel were an epenthetic vowel, the constraints giving rise to epenthesis would be violated in reduplicated forms like poxpox 'yuwí "it's boiling." The -i suffix in words like bóxbo·qí has high pitch and imposes low pitch on the preceding syllable. Contrast the suffix -a in onomatopoeic words like qásqá·sa "Stellar's bluejay," which does not impose low pitch on the syllable preceding it.

[2] There are other instrumental prefixes for which there are no obvious cognate nouns, e.g. gu– "with the hand," and others that appear to be subordinate uses of verb roots, e.g. –ju– "flow" corresponding to ju– "by flowing; with liquid," and –h̓u– "(wind) blow" corresponding to h̓u– "by blowing; with air".

[3] Constraint (163) is superseded by some other constraint in atsugé (Atsugewi or Hat Creek). The cognate for (177) is qásqasa, accent indicating stress (Leonard Talmy, p.c.).

Appendix A. Laryngeal Phonetics

A number of characteristics of the Pit River language that will concern us involve features and relative timing of laryngeal articulation. We will discuss these under two headings: voice onset (voicing and aspiration), and laryngealization.

To describe these articulatory facts will require a brief review of laryngeal anatomy and its configurations for voiceless airflow and for phonation of different types, usually described as phonation registers. The principal sources used here are Gray (1901), Lieberman and Blumstein (1988) and Klatt and Klatt (1990).

A.1. Anatomy

The larynx sits atop the cartilage rings of the tracheum. The palpable component is the thyroid ("shield-like") cartilage, which extends from the front to either side, where it is connected by soft tissue to the cricoid ("ring-like") cartilage, which may be thought of as the topmost and largest of the stack of ring cartilages that make up the tracheum (see Figure 3).

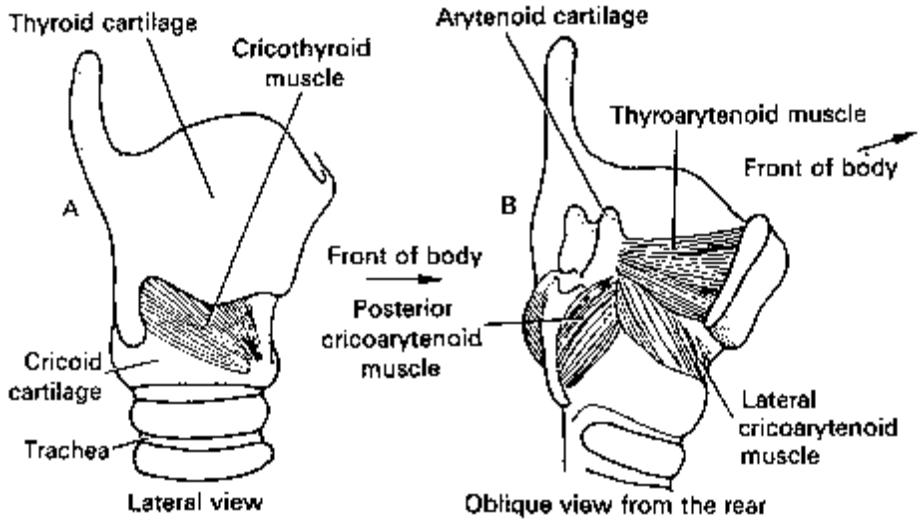


Figure 3. Cartilages and intrinsic muscles of the larynx (Lieberman and Blumstein 1988:98)

The vocal folds are made up of the thyroarytenoid muscles, which make up most of their mass, and vocal ligaments. They have a fixed attachment to the cricoid cartilage at their front or anterior ends. At their posterior ends, however, they are attached to two moveable cartilages, the arytenoid ("ladle-shaped") cartilages. These may be envisioned, in horizontal cross section, as two triangular shapes, each with one apex attached to the posterior end of one of the vocal bands. The most distant apex is connected to the cricoid cartilage by the lateral and posterior cricoarytenoid muscles. In the schematic view shown in Figure 4, these opposing muscles pivot the triangular arytenoid cartilages about their medial apices, which face each other and are connected together by the interarytenoid muscle.

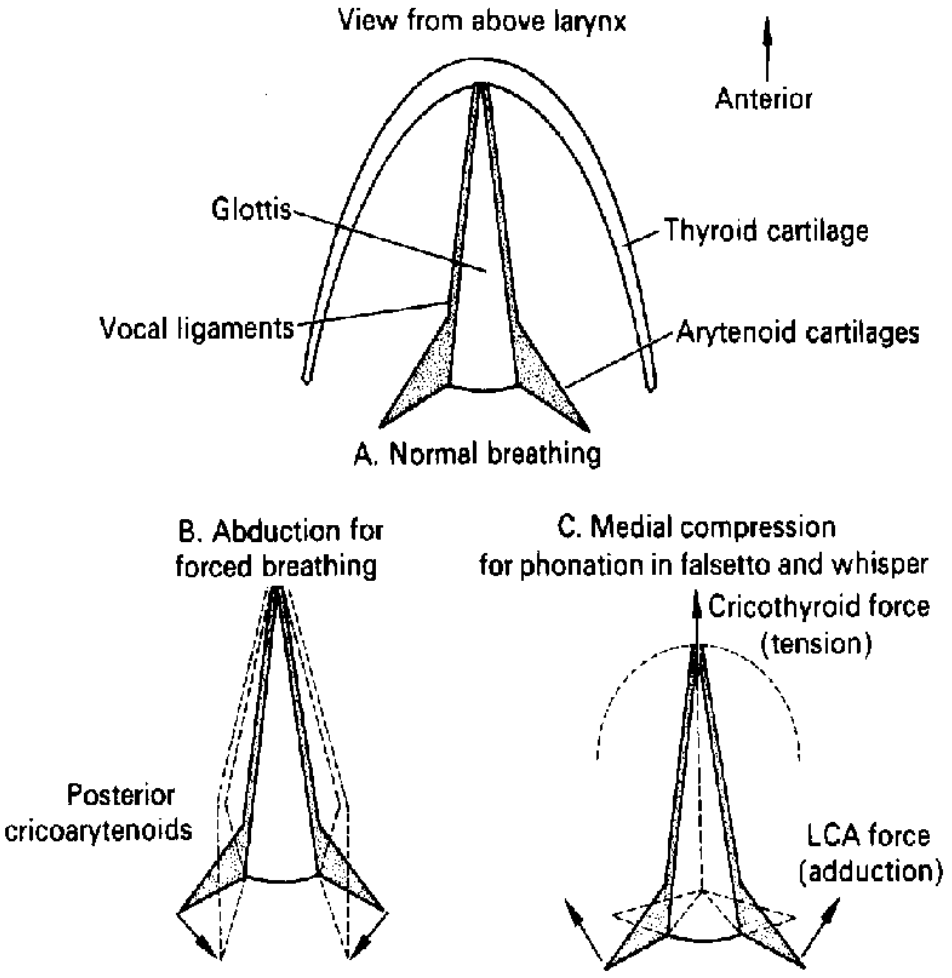


Figure 4. Rotation of arytenoids (Lieberman and Blumstein 1988:99)

The top of the cricoid cartilage curves upward at the back of the larynx, and the bottom of the thyroid cartilage curves downward at the front, so that the vocal bands are streched more or less horizontally between them. A projection (labelled “inferior cornu”) of the thyroid cartilage articulates with a facet on the cricoid cartilage. By rocking the thyroid cartilage backward on this pivot, primarily by contraction of the cricothyroid muscles, which connect posterior points on the thyroid cartilage to anterior points on the cricoid cartilage, and perhaps by contraction of other muscles such as the sternohyoid muscle, the vocal folds are streched more tightly. This movement may be felt by

palpation with the fingers as a raising of the anterior portion of the thyroid cartilage, for example when raising the pitch of the voice.

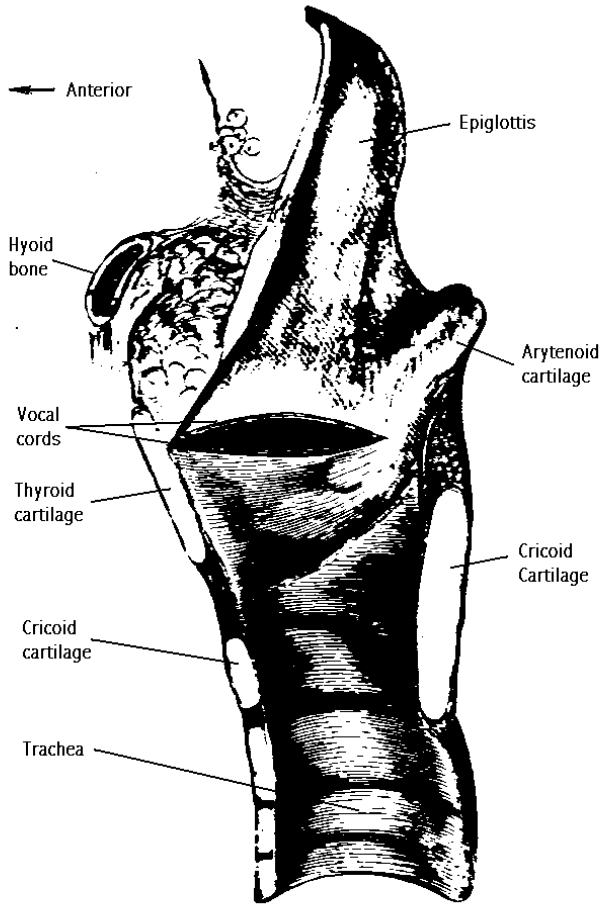


Figure 5. Sagittal section through trachea and upper larynx (Gray 1901:961)

A.1.1. Voiceless sounds

The space between the vocal folds is controlled by manipulation of the arytenoid cartilages (Figure 5). When the lateral cricoarytenoid muscles are contracted, pulling the posterior apices of the arytenoids apart, the vocal bands are pulled together (adducted) by their posterior attachments. This is referred to as medial compression (Figure 4C). If the lateral cricoarytenoid muscles are contracted and nothing else is done, a triangular

aperture remains at the posterior side of the larynx, between the arytenoid cartilages. This is the normal configuration for voiceless sounds.

A.1.2. Voiced sounds

Contracting the interarytenoid muscle brings the arytenoids closer together, closing the remaining triangular aperature between them. This is the configuration for normal phonation in speech (Figure 6).

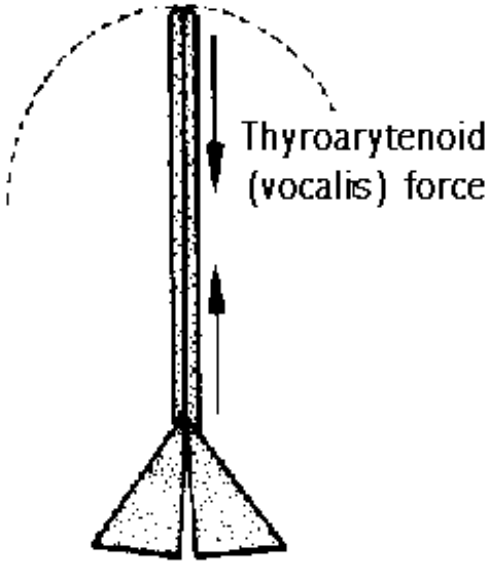


Figure 6. Complete closure for phonation (Lieberman and Blumstein 1988:99)

Contraction of the posterior cricoarytenoid muscles has the opposite affect: as the posterior apices of the arytenoids are pulled together (adducted), the posterior attachments of the vocal folds are pulled apart (abducted). An extreme of this gesture is seen during forceful breathing, especially inhalation (Figure 4B).

Catford (1977) describes a linear scale used by Lindqvist (1969). Starting with voicing in the middle of this scale, abduction of the arytenoids progresses through lax voice and breathy voice to voicelessness; and (starting again from voice) progressive adduction leads through tense voice and creak or laryngealization to glottal stop. Figure 7 illustrates the central part of this scale, contrasting laryngealized or “pressed” voice in column A, modal voice in column B, and breathy voice or murmer in column C.

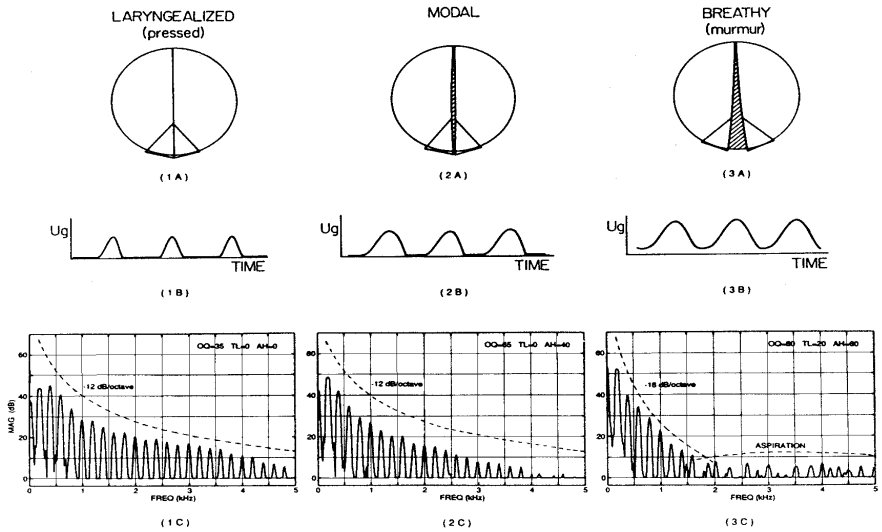


Figure 7. Glottal configurations, volume velocity waveforms, and source spectra[1]

With the arytenoids holding the vocal folds nearly approximated for laryngealized voice (1A), the interruptions due to medial compression are lengthened, and the glottal pulses are shortened (1B). There is also muscular involvement in the pulses of modal voicing, where the arytenoids are adducted without medial compression (2A), so that the vocal folds are brought close together but not closed (2B). With lung pressure, the vocal folds vibrate, being open 50% to 60% of the time. Closure is more rapid than opening due to active participation of the arytenoids. The resulting volume velocity waveshape is slightly skewed (2B).

It is the muscular efforts involved in voicing that make questionable Kirshner's (1998) interpretation of medial voicing, a form of lenition, as a lessening of effort. (See Chapter 5 for an alternative interpretation in terms of gestural complexity.)

A.1.3. Laryngealization and glottalization

Laver (1980) describes laryngealization

> In this type of phonation the arytenoids are pressed inward so that the posterior portions of the vocal folds are held together and only the anterior (ligamental) portions are able to vibrate. The result is often a harsh sound with a comparatively low pitch. It is also known as vocal fry and creaky voice (Ladefoged 1970:14–15).

In laryngealization, the interarytenoid muscle draws the arytenoids together, and perhaps the lateral crycoarytenoid muscles apply medial compression to the vocal bands. The effect is to close off the glottis. With lung pressure, the vocal bands vibrate, but due to the more active closure by the arytenoids the periods of closure are perhaps twice as long as the periods of opening, resulting in a narrow glottal pulse of less amplitude than that of ordinary voice.

The same gesture is involved in the glottal stop and in glottalized sounds.

A.1.4. Breathy or murmered sounds

In breathy or murmered voice, the posterior ends of the arytenoids are well separated, but they bring the vocal folds close enough to vibrate with the passage of air due to lung pressure. The noise of aspiration turbulence is mixed with the periodic pulse of voicing. For ordinary voicing and laryngealized voice, between each pair of glottal pulses there is complete closure of the glottis more or less simultaneously along the full length of the vocal bands. The abrupt cessation of the air flow has the effect of a square wave, relatively strong excitation of higher harmonics at the instant of closure. With breathy or murmered sounds, however, there is never complete closure. The vocal folds close first at the front, then progressively further back toward the arytenoids. There is no sharp cutoff of the glottal pulse. The result is a rounded waveform approximating a sine wave (albeit having no negative phase), with rounded curves at closure and reopening. Because of the sinusoidal waveform, the fundamental component is stronger. Because closure is gradual rather than simultaneous, higher harmonics are weak, allowing the aspiration noise to be audible.

A.1.5. Anatomical detail

The schematic drawings above are adequate for a very simple model of the larynx—for example, to explain the aerodynamic factors involved in phonation. The anatomical facts are considerably more complex.

Figure 8 shows the pyramidal, crescent shape of the arytenoids, with their articulation points on top of the cricoid cartilage. The arytenoid muscle attaches to the smooth, concave posterior surface, which is facing you in the drawing. The vocal bands, including the thyroarytenoid muscle, attach to the rough, convex anterior surface of the crescent.

Also shown clearly is the “articular facet for the inferior cornu of the thyroid cartilage,” the joint around which the cartilage pivots or rocks as the anterior shell of this “voicebox” cartilage is raised and lowered. This movement plays an important role in changing voice pitch and in other articulations.

The muscles of the larynx are shown in Figure 9. The arytenoids are attached to the cricoid cartilage by the posterior and lateral cricoarytenoid muscles and to the thyroid

cartilage by the vocal cords (ligaments) and the cricothyroid muscles, which together make up the vocal folds. The attachments of the interarytenoid muscle and the posterior cricoarytenoid muscles are at very near the same point on the outer ends of the crescent shapes of the arytenoid cartilages. The interarytenoid muscle pulls the posterior sides of the arytenoids together; the lateral cricoarytenoides pull forward on the opposite side from this attachment.

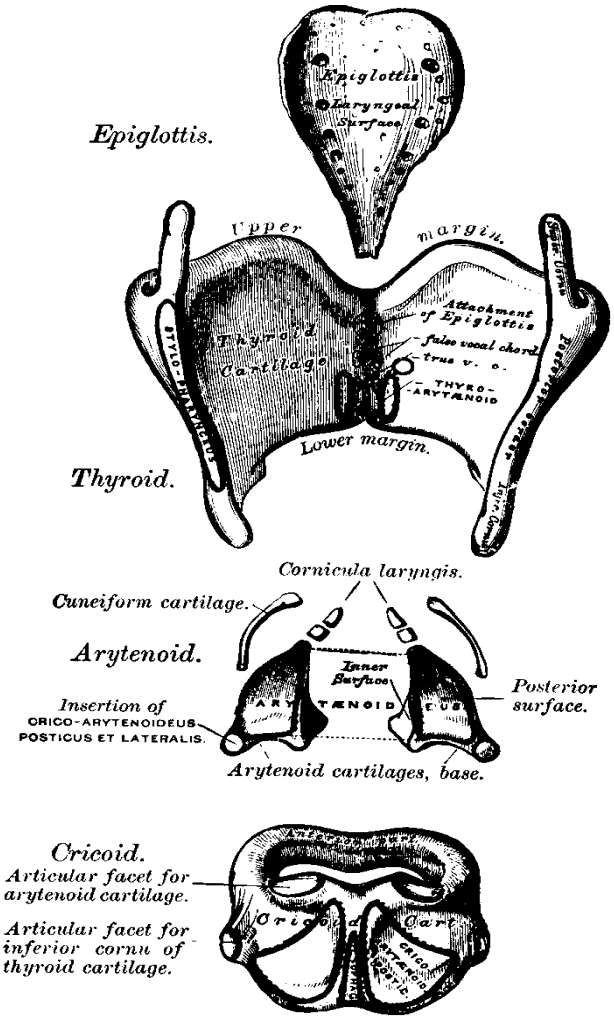


Figure 8. Cartilages of the larynx, seen from the rear (Gray 1901:957)

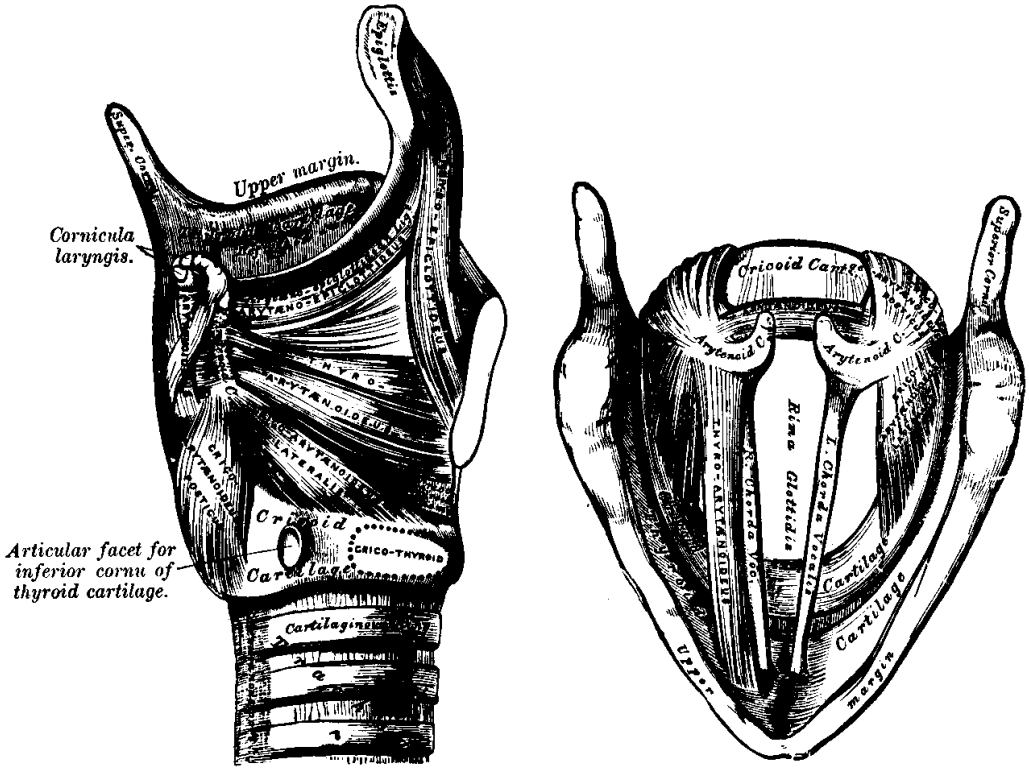


Figure 9. Muscles and cartilages of the larynx, seen from right side and from top (Gray 1901:962)

Although the reproduction of Gray's drawings in the reprint from which I have extracted these illustrations is poor, it may still be seen that the opposing cricoarytenoid muscles (posterior and lateral) act to swing the arytenoid cartilage rather like a gate to which the vocal folds are attached. As in the schematic drawings, contraction of the posterior cricoarytenoid muscles rocks the crescent-shaped arytenoids back and to the sides, and thereby abducts the posterior ends of the vocal folds, even if the interarytenoid muscle is contracted; and contraction of the lateral cricoarytenoid muscles rocks the arytenoids forward and thereby adducts the posterior ends of the vocal folds, especially if the interarytenoid muscle is contracted.

When the pitch of phonation is raised, and even more with other laryngeal articulations to be discussed presently, the thyroid cartilage rocks upward, pivoting on the cricothyroid joint, indicated in Figure 8 as the "articular facet for the inferior cornu of the thyroid cartilage." This movement may be felt by palpating the thyroid cartilage as it moves under the skin of the neck.

A.2. Epiglottal articulation

In this representation, it becomes evident how pressure from above upon the arytenoids could affect their position and that of the vocal folds. This is important because, as it turns out, movement of the epiglottis is involved in the articulation of certain consonants of the Pit River language.

Until quite recently, the epiglottis has been assumed to have no role in speech.[2] Its function is commonly said to be limited to closing off the air passage during the act of swallowing,[3] although it has been known at least since the turn of the century that

> the entrance to the larynx is closed, not, as was formerly supposed, by the folding backward of the epiglottis over it, but, as Anderson Stuart has shown, by the drawing forward of the arytenoid cartilages toward the cushion of the epiglottis—a movement produced by the contraction of the external thyro-arytenoid, the arytenoid, and aryteno-epiglottidean muscles. (Gray 1901:331-2)[4]

Laufer and Condax (1979) showed that the epiglottis, and not the root of the tongue, is the active articulator in pharyngeal spirants and stops. Using a fiberscope, a device employing a fiber-optic bundle to transmit light to and from a field of view including, in this case, the pharynx, tongue radix, epiglottis, and larynx, they documented approximation of the epiglottis to the anterior wall of the pharynx during the production of pharyngeal continuants by a number of speakers of Hebrew and of Arabic. They also showed that the epiglottis is involved in whisper.[5] During these productions, the tongue rarely even enters the field of vision.[6]

Using flashlight and a dental mirror (warmed to body temperature to prevent fogging), with a facing mirror, I have observed my own articulation of the Pit River pharyngeal spirant. Movement of the epiglottis toward the wall of the pharynx is clearly visible. The tongue, being protruded to facilitate inspection, is quite obviously not involved in the occlusion, although the tensing of muscles to raise the larynx and lower the epiglottis is felt in the tongue radix, mediated by their attachments to the hyoid bone and perhaps the interimplication of some nearby muscles and connective tissues.

By detailed examination of cadavers, Laufer and Condax determined that the arytenoepiglottideus, thyroepiglottideus, and thyroarytenoideus (together with smaller muscles) can pull the epiglottis down and position the arytenoids under it. The relationship to the arytenoids is important because the production of a pharyngeal fricative appears to involve constriction between the base of the epiglottis and the arytenoids (Laufer and Condax 1979:67). In the most common articulation of pharyngeal spirants, including my own and those of Pit River speakers whom I observed, the larynx is raised by the stylo-pharyngeus (and palato-pharyngeus). The visible tensing and approximation of the faucal pillars is mostly a side effect,[7] but one result is to close the walls of the pharynx around the sides of the epiglottis, so that the only aperture is anterior, not lateral (Laufer and Condax 1979:67). Another observed effect, which appears to be at least in part due to action of these muscles, is a raising of the larynx. These movements of the larynx and the faucal pillars are also seen, albeit in much lesser degree, as the pitch of the voice is elevated.

Direct observation of the position and movements of the vocal folds has not been possible. However, there is indirect evidence that tension of the vocal folds also contributes to the turbulence heard as frication in the socalled pharyngeal spirant.[8] The muscles that pull the epiglottis and the arytenoids together apply pressure from the epiglottis on the arytenoids, and adduct the arytenoids more tightly than they would be if the epiglottis were not involved (Laufer and Condax 1979:75). The result is laryngealization or an involuntary glottal stop associated with pharyngeal consonants. This is heard as a glottal stop at the onset of voicing of a following resonant in Pit River words like aseʔhlá “sky”, jéʔnaˀ “lizard” (compare déʔdaˀ “acorn”, laʔ·a “with the head” [laʔ “head,” –ẘa ~ –wa instr.]). There is a tendency for this laryngealization to spread to non-adjacent resonants in the same word.

A well known characteristic of pharyngeal and pharyngealized consonants is a modification of adjacent vowels. This has been assumed to be an assimilation to [a] due to a retracted tongue root for both the vowel [a] and for pharyngealized sounds. Citing X-ray studies by Russell (1931) and their own work with the fiberscope, Laufer and Condax show (1979:78-81) that the position of the tongue is irrelevant as well for articulation of /a/, and that the acoustically significant constriction is produced by the epiglottis as the active articulator. The “flattening” of vowels adjacent to pharyngeal sounds is primarily due, then, to the position of the epiglottis.

The epiglottis is an integral part of the larynx, both anatomically and functionally. In this description, I account the phonetic contribution of the epiglottis as an active articulator among the laryngeal features.

A.3. Laryngealization

Glottalized stops are ordinarily described as ejectives, with a characteristic "popping" articulation produced by increasing air pressure in the oral cavity by raising the closed glottis, prior to release of the oral stop closure. The following description may be taken as typical:

> [T]he opening of the glottis is delayed until after the [oral] release [...]. Such sounds, made while the glottis is closed, are produced without the direct involvement of air from the lungs. Air is compressed in the mouth of PHARYNX above the glottal closure, and released while the breath is still held: the resultant sounds produced in the *glottalic* AIRSTREAM MECHANISM are known as EJECTIVE sounds. (Crystal 1985:138, small caps in original for cross references)

The series of oral stops in Pit River that I have termed laryngealized are not ejectives. They are not produced by a glottalic airstream mechanism. The salient feature is not a characteristic ejective release, but rather laryngealization of adjacent vowel segments.

Glottal closure is complete only in syllable-final position or as the culmination of laryngealization of a preceding long vowel. Prevocalically, these might be thought of as voiced stops with laryngealized voice.

A.4. Laryngealized aspirate

There are two aspirates in Pit River. The first is a typical [h] segment. The second has been described as a pharyngeal spirant (Uldall 1933, de Angulo 1931, Voegelin 1945).

This sound is produced in the manner of a certain form of stage whisper. In ordinary whisper, as described above, the arytenoid cartilages are adducted by the lateral cricoarytenoid muscles, resulting in medial compression which closes the anterior portion of the vocal folds. However, the interarytenoid and posterior cricoarytenoid muscles are not contracted, so that the arytenoid cartilages are separated at the posterior end of the vocal folds. This creates a triangular aperture through which subglottal air pressure is shunted. It is the turbulence of air flow through this constriction that is heard as whisper. In a stage whisper, subglottal air pressure is increased, and turbulence is greater. The Pit River sound being described here can be observed (by laryngeoscope) to involve partial occlusion by the epiglottis, which is pressed down against the arytenoids as described above. Simultaneously, the thyroid cartilage is raised. This gesture raises the vocal folds and the arytenoids in closer proximity to the epiglottis. It also presumably increases tension on the vocal bands, as it does when pitch is raised with ordinary phonation.

Acoustically, there can be a low-frequency, irregular flutter, probably of the epiglottis, with the effect of a croupy cough.

This segment is accordingly transcribed /ʰ̰/, as a laryngealized aspirate.

A.5. Assimilation of glottalization

The facts of assimilation of glottalization support this analysis.

Glottalization or laryngealization tends to spread, so that a preceding continuant may be glottalized. A number of prefixes w-, y-, m-, n-, l- have glottalized alternants ẘ-, ỷ-, m̰-, n̰-, l̰- which tend to occur (are normal alternants) when a glottalized or laryngealized consonant or ʰ̰ follows in the same word.

In particular, in a cluster ʰ̰R, where R is a resonant consonant /m, n, l, w, y/, voicing of the resonant typically begins with glottal closure. This would be difficult to explain if ʰ̰ were a pharyngeal spirant. Klatt and Stevens (1969) give no evidence for laryngealization being associated with a pharyngeal spirant.

A.6. Pharyngealization

Klatt (1986) found some evidence for association of some degree of pharyngealization with laryngealized vowel onsets. There is pharyngealization associated with the /ʰ̰/ segment. Uldall, Voegelin, and others assumed that pharyngealization is the salient feature distinguishing /ʰ̰/ from ordinary /h/. They may have been led to this conclusion by the description of similar sounds found in other languages, such as Arabic and Hebrew.

However, contrary to the assessment of earlier workers, pharyngealization of the /ʰ̰/ segment in Pit River appears rather to be a side effect of raising (rocking) the thyroid cartilage so as to approximate the vocal bands and arytenoids to the epiglottis.

Vowel allophony similar to that associated with pharyngealization is also associated, though not as strongly, with the back velar stops /q, x, q̰/. In this case, the shifting of vowel quality is a side effect of raising the posterior portion of the dorsum into proximity to the uvula and soft palate. There may be some contraction of the pharynx as well, but this can scarcely be more than a side effect of the raising of the posterior dorsum of the tongue. It is clear that the tongue radix is not moved back toward the pharynx for these sounds, as they can easily be produced while the tongue body is fully extended from

the mouth, and no retraction of the tongue is observed. The raising of the dorsum is clearly visible in a mirror even if the tongue is protruded past the lips while pronouncing the article /qa/, or even while pronouncing the deictic /xé/ with its mid vowel.

Klatt and Klatt (1990:823) observe that in a study (Klatt 1986) of one speaker "laryngealized vowel onsets were accompanied by some frication noise before [a low central vowel], implying the existence of a pharyngeal constriction accompanying the laryngeal adduction gesture. [... The] acoustic pattern is consistent with spectral data on pharyngeal fricatives in Arabic." This evidence supports the expectation that pharyngealization would be associated with the laryngeal gesture observed for the /h̊/ of the Pit River language.

---

[1] Klatt & Klatt 1990:822. The source spectrum plots amplitude against frequency, noting the fall-off of amplitude per octave. Note that row B and row C do not align with each other, as the horizontal dimension in row B is time and that in row C is increased frequency at the glottal source.

[2] For example, Heffner (1964:152), Chapman (1973:6-29), O'Connor (1973:42), Catford (1977:163, 193), cited in Laufer and Condax (1979); Crystal (1987:130). Laufer and Condax (1979) first demonstrated the role of the epiglottis, which has since become more generally accepted. When I was arguing in 1974 that the Pit River spirant written /h̊/ was not a pharyngeal spirant, and that retraction of the tongue root was not the salient feature, this was unheard of. Tongue root features are still given credence which in my opinion is not warranted.

[3] For example, the definition of the word in *Webster's Ninth New Collegiate Dictionary* says it is "a thin plate of flexible cartilage in front of the glottis that folds back over and protects the glottis during swallowing". Hardcastle (1976:60) says "The primary function of the epiglottis is to close off the entrance to the larynx during swallowing, to prevent food passing into the trachea."

[4] In a footnote, Gray cites a suggestion "that the epiglottis is not essential to the deglutition even of liquids." Gray describes the process of swallowing as follows (1901:332):

> The morsel of food after leaving the tongue passes on to the posterior or laryngeal surface of the epiglottis, and glides along this for a certain distance; then the Palato-glossi muscles, the constrictors of the fauces, contract behind the food; the soft palate is slightly raised by the Levator palati, and made tense by the Tensor

> palati; and the Palato-pharyngei, by their contraction, pull the pharynx upward over the morsel of food, and at the same time come nearly together, the uvula filling up the slight interval between them. By these means the food is prevented from passing into the upper part of the pharynx or the posterior nares [the nasal passage-—BN]; at the same time the latter muscles [the Palato-pharyngei-—BN] form an inclined plane, directed obliquely downward and backward, along the under surface of which the morsel descends into the lower part of the pharynx. The Salpingo-pharyngeus raises the upper and lateral part of the pharynx—*i.e.* that part which is above the point where the Stylo-pharyngeus is attached to the pharynx.

[5] "During the production of whisper we observed that the epiglottis was generally farther back than during normal voice, but in this more retracted position, it continued to make the same kinds of motions it did during normally voiced speech" (65). Occlusion of the air passage above the vocal folds apparently increases the turbulence that is heard as whisper, and it is this which is exaggerated in a stage whisper. I am not yet prepared to develop the implications of this for the phonological status of whispered vowels and syllables word-finally in Pit River and in Yana.

Also of interest is the fact that the epiglottis is elevated and the pharynx is widened for falsetto register, but not for ordinary phonation (Arnold 1980:481).

[6] They also showed that the epiglottis is involved in articulation of low central and back (rounded) vowels, narrowing the rear of the oral cavity even farther back than is done for labiovelars.

[7] Catford (1977:163) describes this movement in what he terms a faucal articulation of pharyngeal consonants, mistakenly attributing the turbulence for the fricative to the contraction of the pharyngeal walls and/or approximation of the tongue radix. He states that there is also another, less common articulation of pharyngeal consonants without this faucal movement.

[8] Among the intrinsic laryngeal muscles, tension of the cricothyroid is the primary factor in raising pitch, with help from the lateral cricoarytenoids adducting the vocal folds and the vocalis tensing the vocal folds themselves. The cricothyroid is inactive below about 150 Hz (Arnold 1980).

Appendix B. Sonority Revisited

In Chapter 5, to account for nasality, we proposed a feature [open] on the root/soft palate branch, parallel to [+open] on the root/oral cavity/aperture branch. With this change, it becomes interesting to re-examine sonority ranking in terms of degrees of openness.

Recall how in Chapter 2 we reconstructed the sonority hierarchy with the [open] feature as follows:

136.

	[sonorant]	[approximant]	[open]	Sonority Rank
Obstruent	–	–	–	0
Nasal	+	–	–	1
Liquid	+	+	–	2
Vocoid	+	+	+	3

The [open] feature has to refer to the second tier under the aperture node, since the first degree of openness for fricatives and affricates is not distinguished in the sonority rank as presented. Here is the specification of aperture features for the four major classes, Obstruent, Nasal, Liquid, and Vocoid. The new [open] feature under the soft palate node is distinguished by the gray shade in the column. The four tiers under the aperture node are in unshaded columns.

137.

	[open]	[open]	[open]	[open]	[open]	Sonority Rank
Obstruent	– or +	–	–	–	–	0
Nasal	–	+	–	–	–	1
Liquid	–,+		–,+	–	–	2
Vocoid	+		+			3

Unspecified features may be either [+open] or [–open]. For vocoids, this represents vowel height. Liquids and vocoids are unspecified here for nasality.

We can see some correspondence of sonority to the degree of openness of a segment, as measured by a count of [+open] features.

- A [+open] specification on the soft palate node moves the nasals up one notch in sonority rank.
- The combination of [+open] and [–open] specifications on the second tier under the oral cavity node moves liquids up to rank 2. The notation "–,+" is for a complex segment, where each feature value has a different place of articulation.
- The [+open] specification on the second tier under the oral cavity node raises vocoids to rank 3. Low or open vowels are not considered more sonorous than high vowels.

It seems intuitively obvious that sonority (and prominence in syllable contours) should correlate closely with how widely open the vocal tract is to the egress of sound. However, the correspondence of openness to this sonority ranking is not complete:

- Contour segments (for affricates and fricatives) are omitted here as they are not differentiated in this sonority ranking.
- The first-tier [open] feature under the oral cavity node is not a differentiator in the sonority scale, which is to say that fricatives are not considered more sonorous than oral stops.

The sonority ranking given in Clements and Hume (1995) is incomplete. The now well-known data of Imdlawn Tashlhiyt Berber from Dell & Elmedlaoui (1988, 1989), as summarized in Prince & Smolensky (1993), show how it can be more finely differentiated. The sonority scale given there can be represented with a numeric ranking as follows:

138.

Voiceless Stop	0
Voiced Stop	1
Voiceless Fricative	2
Voiced Fricative	3
Nasal	4
Liquid	5
High Vowel	6
Low Vowel	7

Obstruents, which are all 0 in the Clements & Hume ranking, are spread over rank numbers 0–3 for voiced and voiceless stops and fricatives; vocoids, which all rank 3 for Clements & Hume, are separated by vowel height. Stops and affricates are not distinguished.

Table (139) shows the correlation of degrees of openness with the Dell & Elmedlaoui ranking just as Table (137) did for the Clements & Hume ranking:

139.

	[open]	[open]	[open]	[open]	[open]	Sonority Rank
Vcls Stop	– –+	–	– –	– –	– –	0
Vcd Stop	– –+	– –	– –	– –	– –	1
Vcls Fricative	+	–	–	–	–	2
Vcd Fricative	+	–	–	–	–	3
Nasal	–	+	–	–	–	4
Liquid	–, +		–, +	–	–	5
High Vowel	+		+	+	–	6
Low Vowel	+		+	+	+	7

Bibliography

The following abbreviations are used in citations:

AA American Anthropologist
AL Anthropological Linguistics
BAE-B Bureau of American Ethnology, Bulletin
BAE-R Bureau of American Ethnology, Report
BC Boas Collection, Library of the American Philosophical Society, Philadelphia
ICA-P International Contress of Americanists, Proceedings
IJAL International Journal of American Linguistics
JAF Journal of American Folklore
JASA Journal of the Acoustic Society of America
JSAP Journal de la Société des Américanistes de Paris
Lg Language
ROA Rutgers Optimality Theory Archive http://ruccs.rutgers.edu/roa.html
SJA Southwestern Journal of Anthropology
UCAR University of California Anthropological Records
UCAS-R *University of California Archaeological Survey, Reports*
UCB *Archives of The Survey of California and Other Indian Languages, U. C. Berkeley.*
UCPAAE *University of California Publications in American Archaeology and Ethnology*
UCPL *University of California Publications in Linguistics*
VFPA *Viking Fund Publications in Anthropology*

Alderete, John. 1997. Dissimilation as local conjunction. In *Proceedings of the North East Linguistics Society*, ed. by Kiyomi Kusumoto, 17–32. Amherst: GLSA.

Anderson, Stephen R. 1985. Phonology in the Twentieth Century: Theories of rules and theories of representations. Chicago: Univ. of Chicago Press.

Arnold, Godfrey E. 1980. Speech, physiology of. *Encyclopedia Britannica*, 15th Edition, 477-492. Chicago: The University of Chicago Press.

Barker, M. A. R. 1963a. *Klamath Texts.* UCP-AAE 30.

Barker, M. A. R. 1963b. *Klamath Grammar.* UCP-AAE 31.

Barker, M. A. R. 1964. *Klamath Grammar.* UCP-AAE 32.

Bauman, James, with Ruby Miles and Ike Leaf. 1979. *Pit River Teaching Dictionary*. Anchorage: National Bilingual Materials Development Center.

Bauman, James, and the Pit River people. 1980. *Introduction to Pit River Language and Culture*. Anchorage: National Bilingual Materials Development Center.

Beckman, Jill N. 1998. *Positional Faithfulness*. PhD dissertation, UMass Amherst.

_____, L. Dickey, & S. Urbanczyk. 1996. *Papers in optimality theory*. U. of Mass. Occasional Papers 18. GLSA, UMass, Amherst.

Berko-Gleason, Jean. 1982. Insights from child language acquisition for second language loss. In Lambert and Freed (1982:13-23).

Bourbon, W. T., Copeland, K. E., Dyer, V. R., Harman, W. K., & Mosely, B. L. (1990). On the accuracy and reliability of predictions by control-system theory. Perceptual and Motor Skills, 71, 1990, 1331-1338.

Bourbon, W. Thomas. (1995). Perceptual control theory. In: H. L. Roitblat & J.-A. Meyer (eds.). Comparative approaches to cognitive science. Cambridge, MA: MIT Press.

Boysson-Bardies, Bénédicte de, and Marilyn May Vihman. 1991. Adaptation to language: evidence from babbling and first words in four languages. *Lg*. 67.2:297-319.

Bright, William. 1965. Review of A history of Palaihnihan phonology, by D.L. Olmsted. *Lg* 41:175-8.

Boersma, Paul. 1998. *Functional Phonology: Formalizing the interactions between articulatory and perceptual drives*. The Hague: Holland Academic Graphics

Browman, Catherine, and Louis Goldstein. 1989. Articulatory gestures as phonological units. *Phonology* 6:201-251.

_____. 1992. Articulatory phonology: An overview. *Phonetica* 49:155-180.

Burnett, T. A. , Senner, J.E. & Larson, C.R. (In Press). Voice F0 responses to pitch-shifted auditory feedback: A preliminary study. *J. Voice*.

Campbell, D. T. 1974. Evolutionary epistemology. In P. A. Schilpp (Ed), *The philosophy of Karl Popper* (Vol. 1, pp. 413–463). La Salle, IL: Open Court.

_____. 1988. A general "selection theory," as implemented in biological evolution and in social belief-transmission-with-modification in science. *Biology and Philosophy*, 3, 171–177.

Campbell, Lyle, and Marianne Mithun, eds. 1979. The Languages of Native America: Historical and Comparative Assessment.

Carrithers, Michael *et al* (eds). 1985. *The category of the person: anthropology, philosophy, history*. Cambridge: Cambridge University Press.

Catford, J. C. 1977. *Fundamental problems in phonetics*. Bloomington: Indiana University Press.

Chapman, W. H. 1973. *Introduction to practical phonetics.* Summer Institute of Linguistics.

Chafe, Wallace, ed. 1976. American Indian languages and American linguistics: papers of the Second Golden Anniversary Symposium of the Linguistic Society of America. Lisse: The Peter de Ridder Press.

Chase-Dunn, Christopher, S. Edward Clewett, and Elaine Sundahl. 1992. A very small world-system in northern California: the Wintu and their neighbors. Draft of March 27 1992 as presented to the 57th annual meeting of the Society for American Archaeology.

Chase-Dunn, Christopher & Kelly M. Mann. 1998. *The Wintu and their neighbors: A small world-system in northern California*. University of Arizona Press.

Clements, G. N. 1990. The role of the sonority cycle in core syllabification. In J. Kingston and J. Beckman (eds.), *Papers in laboratory phonology 1: Between the grammar and physics of speech* (pp. 283-333). New York: Columbia University Press.

Clements, G. N., and Elizabeth V. Hume. 1995. The internal organization of speech sounds. In Goldsmith (1995:245-306).

Cook, Eung-Do. 1989. Is phonology going haywire in dying languages? Phonological in Variations Chipewyan and Sarcee. *Language in Society*18:235-255.

Crystal, David. 1985. *A dictionary of linguistics and phonetics*. Cambridge: Basil Blackwell.

Crystal, David. 1987. *The Cambridge encyclopedia of language*. Cambridge: Cambridge University Press.

Cziko, Gary. 1995. Without miracles: Universal selection theory and the second Darwinian revolution. Cambridge, MA: MIT Press.

de Angulo, Jaime. 1953. Indian Tales. New York: Hill and Wang. Reprint 1974 by Ballantine Books, Inc.

_____. ms.(a). Non-technical description of Achumawi. BC.

_____. ms.(b). Does Achumawi belong in the Hokan family? BC. Cited in Gursky (1987).

_____. ms.(c) A comparison between the semasiologies of two languages of the so-called Hokan family (Pomo and Achumawi). *BC.* (A 230-page handwritten ms. including phonology, morphological elements, and a 174-page list of English words with Achumawi and Pomo translations.) Cited in Gursky (1987).
_____, and L. S. Freeland. 1930. The Achumawi language. *IJAL* 7:77-120.
_____, and L. S. Freeland. ms.(a) Appendix of addenda and corrigenda to the grammar of the Achumawi language. *BC.*
_____, and L. S. Freeland. ms.(b) Achumawi Texts. *BC.*
Dawkins, R. 1983. Universal Darwinism. In D.S. Bendall (Ed.), *Evolution from molecules to men* (pp. 403-425). Cambridge: Cambridge University Press.
_____. 1986. *The blind watchmaker.* New York: Norton.
_____. 1989 [1976]. *The Selfish Gene* (rev. ed.). Oxford: Oxford University Press.
de Lacy, Paul. 1997. Prosodic Categorisation. M.A. Thesis, University of Aukland. ROA-236-1297.
Dell, François and Mohamed Elmedlaoui. 1988. Syllabic consonants and syllabification in Imdlawn Tashlhiyt Berber. *Journal of African Languages and Linguistics* 7, 105–130. Summarized in Prince & Smolensky (1993).
_____. 1989. Syllabic consonants in Berber: some new evidence. *Journal of African Languages and Linguistics* 10, 1–17. Summarized in Prince & Smolensky (1993).
Dorian, Nancy C. 1981. *Language death: the life cycle of a Scottish Gaelic dialect*. Philadelphia: University of Pennsylvania Press.
_____. 1991. Review of Hornberger (1988), in *Lg*. 67.2:339-341.
Eisner, Jason. 1997a. What constraints should OT allow? LSA handout, Chicago, 4 January 1997, corrected 9 January. ROA-204-0797.
_____. 1997b. FootForm Decomposed: Using primitive constraints in OT. MIT Working Papers in Linguistics (to appear in 1997); Proceedings of SCIL VII. ROA-205-0797.
Everett, Daniel L. and Iris Berent. 1997. The Comparative Optimality of Hebrew Roots: An Experimental Approach to Violable Identity Constraints. ROA-235-1297
Ferguson, Charles A. 1964. Baby talk in six languages. *In* John J. Gumperz and Dell Hymes (eds.), *The ethnography of communication*. *AA* 66.6.II:103-114.
Gifford, E. W. 1922. Californian kinship terminologies. *UCPAAE* 18:1-285.
_____, and A. L. Kroeber. 1937. Culture element distributions. *UCPAAE* 37.
Goldsmith, John (ed.). 1995. *The handbook of phonological theory*. Cambridge, MA: Blackwell Publishers.
Gray, Henry. 1901. *Anatomy, descriptive and surgical.* Reprint 1974. Philadelphia: Running Press.

Gursky, Karl-Heinz. 1987. Achumawi und Pomo: eine besonder Beziehung? *Abhandlungen der Völkerkundlichen Arbeitsgemeinschaft*, Heft 57. Nortorf: 1987.

Haas, Mary R. 1968. Notes on Chipewyan dialect. *IJAL* 34:165-75.

Hahn, Axel. 1997. Variation, grammars, and the power of the optimal: German obstruent devoicing. Unpublished ms. ROA-241-0198

Hale, Kenneth. 1976. Theoretical linguistics in relation to American Indian communities. *In* Chafe (1976:35-50).

Hale, Mark, and Charles Reiss. 1997. Grammar Optimization: The simultaneous acquisition of constraint ranking and a lexicon. Unpublished ms. ROA-231-1197

Hammond, Michael. 1997. Parsing syllables: modeling OT computationally. Unpublished ms. ROA-222-1097.

Hardcastle, W. J. 1976. Physiology of Speech Production: An introduction for speech scientists. New York: Academic Press.

Harrington, J. P. ms. (a). Achumawi field notes. *UCB*. (Accessed at Berkeley in 1970 and 1972.)

_____. ms (b). Ethnographic and linguistic notes on Achumawi, Atsugewi, Wintu, and Yana. On microfilm: BAE 690510-026, BAE 690510-025 (also SCOIL ZZHarrington.m002, ZZHarrington.m001, numbered in reverse order).

Harris, Randy A. *The linguistic wars: Chomsky, generative semantics, and the rhetoric of science*. New York: Oxford University Press.

Haugen et al., eds. 1981. *Minority languages today*,

Heffner, R-M. S. 1964. *General phonetics.* Madison: The University of Wisconsin Press.

Hershberger, Wayne. (Ed.). (1989). Volitional action: Conation and control. (Advances in Psychology No. 62). NY:North-Holland.

Hornberger, Nancy H. 1988. *Bilingual education and language maintenance: a southern Peruvian Quechua case*. Topics in Sociolinguistics, 4. Dordrecht: Foris.

Hymes, Dell F. 1964. Language in culture and society: a reader in linguistics and anthropology. New York: Harper and Row.

Itô, Junko & Armin Mester. 1997. Sympathy Theory and German truncations. In *University of Maryland Working Papers in Linguistics* 5, *Proceedings of the Hopkins Optimality Workshop/Maryland Mayfest 1997*, ed. by Viola Miglio & Bruce Morén. College Park, MD.

Jacobsen, William H., Jr. 1976. Observations on the Yana stop series in relationship to problems of comparative Hokan phonology. *In* Langdon and Silver (1976) pp. 203-236.

Jacobsen, William H., Jr. 1979. Hokan inter-branch comparisons. *In* Campbell and Mithun (1979) pp. 545-591.

Jakobson, Roman. 1941. *Kindersprache, Aphasie, und allgemeine Lautgesetze*. Uppsala Universitets Aarskrift.

Jakobson, Roman, Gunnar Fant, and Morris Halle. 1952. *Preliminaries to speech analysis*. Cambridge, MA: MIT Press.

Judd, Joel. (1992). *Second language acquisition as the control of nonprimary linguistic perception: A critique of research and theory.* Unpublished doctoral dissertation, University of Illinois at Champaign-Urbana. Dissertation Abstracts International, 53(7), #9236495.

Kingston, John, and Randy L. Diehl. 1994. Phonetic knowledge. *Lg* 70:3.419—454.

Kirchner, Robert M. 1998. An Effort-Based Approach to Consonant Lenition. Ph.D. dissertation, UCLA. ROA-276-0898.

Klatt, Dennis H. 1986. Representation of the first formant in speech recognition and in models of the auditory periphery. In *Proceedings of Montreal Symposium on Speech Recognition*, edited by P. Mermelstein (McGill University, Montreal, 1986), pp. 5—7.

Klatt, Dennis H., and Laura C. Klatt. 1990. Analysis, synthesis, and perception of voice quality variations among female and male talkers. *JASA* 87:2.820-857.

Klatt, Dennis H., and Kenneth N. Stevens. 1969. Pharyngeal consonants. Research Laboratory of Electronics Quarterly Progress Report 93, MIT, Cambridge, Massachusetts, 207-216.

Klar, Kathryn, Margaret Langdon, and Shirley Silver, eds. 1980. American Indian and Indo-European Studies: Papers in Honor of Madison S. Beeler. Trends in Linguistics, Studies and Monographs 16, Werner Winter, Editor. The Hague: Mouton.

Kniffen, Fred B. 1928. Achumawi geography. *UCPAAE* 23.5:297-332.

Kroeber, Alfred E. 1925. *Handbook of the Indians of California.* BAE-B 78. Reprinted 1953 by California Book Company, Berkeley, CA.

Labov, William. 1963. The social motivation of a sound change. *Word*, 19:273–309. Reprinted in Labov (1972:1–42).

_____. 1972a. *Sociolinguistic Patterns*. Philadelphia: University of Pennsylvania Press.

_____. 1972b. On the mechanism of linguistic change. In Labov (1972:160–182).

Ladefoged, Peter. 1964. *A phonetic study of West African languages*. West African Language Monographs, 1. Cambridge: Cambridge University Press.

_____, 1989. Representing phonetic structure. UCLA Working Papers in Phonetics 73.

_____, and Ian Maddieson. 1995. *The sounds of the world's languages*. Cambridge, MA: Blackwell Publishers.

Lamb, Sidney M. 1964. Linguistic diversification and extinction in North America. *XXXV Congreso Internacional de Americanistas,* Mexico, pp. 457-64.

Lambert, Richard D., and Barbara F. Freed. 1982. *The Loss of Language Skills*. Rowley, MA: Newbury House Publishers, Inc.

Langdon, Margaret. 1974. *Comparative Hokan-Coahuiltecan studies: A survey and appraisal.* Janua Linguarum, Series Critica 4. The Hague: Mouton.

_____. 1976. Discussion of Hale (1976), *in* Chafe (1976:51-58).

_____. 1979. Some thoughts on Hokan with particular reference to Pomoan and Yuman. In Campbell & Mithun (1979:592-649).

_____ and Shirley Silver. 1976. *Hokan Studies: Papers from the First Conference on Hokan Languages, held in San Diego, California, April 23-25, 1970*. The Hague: Mouton.

Larson, C.R., Carrell, T.D., Senner, J.E., Burnett, T.A., and Nichols, L.L. 1995. A proposal for the study of voice Fo control using the pitch shifting technique. *Proceedings of Vocal Fold Physiology: Voice Quality Control* (Eds.O. Fujimura and M. Hirano), Singular, San Diego.

Larson, C.R., White, J.P., Freedland, M.B. & Burnett, T.A. 1996. Interactions between voluntary pitch modulations and pitch-shifted feedback signals: Implications for neural control of voice pitch. *Proceedings of Vocal Fold Physiology: Controlling Chaos and Complexity*. (Eds. N. Fletcher & P.J. Davis), Singular, San Diego.

Laufer, Asher, and I. D. Condax. 1979. The epiglottis as an articulator. UCLA Working Papers in Phonetics 45:60-83.

Laver, J. 1980. The phonetic description of voice quality.

Lieberman, Philip, and Sheila E. Blumstein. 1988. *Speech physiology, speech perception, and acoustic phonetics*. Cambridge: Cambridge University Press.

Lock, John L. 1983. Phonological acquisition and change. New York: Academic Press.

Lombardi, Linda. 1996. Positional faithfulness and voicing assimilation in Optimality Theory. Ms., University of Maryland, College Park.

_____. 1996. Laryngeal neutralization and alignment. *In* Beckman, Dickey & Urbanczyk (1996:225-247).

McCarthy, John and Alan Prince. 1993. *Prosodic Morphology I: constraint interaction and satisfaction*. Ms. University of Massachusetts, Amherst, and Rutgers University, New Brunswick, NJ. To appear as Linguistic Inquiry Monograph, MIT Press, Cambridge, MA.

_____. 1996. Faithfulness and reduplicative identity. *In* Beckman, Dickey & Urbanczyk (1996:249-384).

McLendon, Sally. 1980. How languages die: a social history of unstable bilingualism among the Eastern Pomo. *In* Klar, Langdon, and Silver, eds. (1980:137-150).

Marken, Richard S. 1992. *Mind Readings: Experimental studies of purpose*. Gravel Switch, KY: The Control Systems Group.

Merriam, C. Hart. 1926. The Classification and Distribution of the Pit River Indian Tribes of California. Smithsonian Miscellaneous Collections 78.3 (Publication 2874). Washington, D.C.: The Smithsonian Institution.

Nagy, Naomi, and Bill Reynolds. 1997. Optimality Theory and variable word-final deletion in Faetar. *Language Variation and Change*, 9:37-55.

Nevin, Bruce E. 1976. Transformational analysis of some `grammatical morphemes' in Yana. In Langdon and Silver (1976:237-250).

_____. 1991. Obsolescence in Achumawi: Why Uldall Too? Papers from the American Indian Languages Conferences, held at the University of California, Santa Cruz, July and August 1991. Occasional Papers on Linguistics 16:97-127. Department of Linguistics, Southern Illinois University at Carbondale.

_____.*To appear*. How My Father Found the Deer, by Lela Rhodes. Text in English for the *California Reader* (a volume of California Indian stories in English), edited by Herb Luthin, originally planned for publication by the Smithsonian Institute, currently in search of a publisher.

O'Connor, J. D. 1973. *Phonetics*. New York: Penguin.

Olmsted, D. L. 1956. Palaihnihan and Shasta I: Labial stops. *Lg.*32, 73–77.

_____. 1957. Palaihninan and Shasta II: Apical Stops. *Lg.*33, 136–138.

_____. 1959. Palaihnihan and Shasta III: Dorsal stops. *Lg.*35, 637–644.

_____. 1964. *History of Palaihnihan Phonology. UC-PL* 35.

_____. 1966. *Achumawi Dictionary. UCPL* 45.

Padgett, J. 1991. Stricture in feature geometry. Ph.D. dissertation, MIT.

_____. 1996. Feature classes. In Beckman et al. (1996:385-420).

Park, Susan. 1986. Samson Grant, Atsuge shaman. Redding Museum Occasional Papers number 3.

Piggott, Glyne. 1988. Prenasalization and Feature Geometry. In *Proceedings of NELS 19*, (pp. 345-352). Amherst, MA: Graduate Linguistic Student Association.

Powers, William T. 1973. *Behavior: The control of perception.* Greenwood, NY: Aldine/deGruyter.

_____. 1989. *Living control systems: Selected papers of William T. Powers.* Gravel Switch, KY: The Control Systems Group.

_____. 1992. *Living control systems II: Selected papers of William T. Powers.* Gravel Switch, KY: The Control Systems Group.

Prince, Alan S., and Paul Smolensky. 1993. *Optimality Theory: Constraint interaction in generative grammar*. Technical Reports of the Rutgers University Center for Cognitive Science, RuCCS TR-2. . To appear as Linguistic Inquiry Monograph, MIT Press, Cambridge, MA.

Radin, Paul. ms.(a). Brief grammatical sketch of Achomawi (intended to accompany the dictionary). *UCB.* (Two draft ms. versions accessed at Berkeley in 1970.)

_____. ms.(b). Unpublished ms notes on Achumawi, including a brief text (appears on internal evidence to be in a downriver dialect_BEN). *UCB.*

Reynolds, Bill. 1994. *Variation and phonological theory*. PhD dissertation, University of Pennsylvania.

Rhoades, Lela, and Molly Curtis. 1973. A Pit River woman's story. Unpublished ms. submitted as senior study at Goddard College.

Rice, K.D. 1978. A note on Fort Resolution Chipewyan. *IJAL* 44:144–45.

Rosenthal, Sam. 1988. The representation of prenasalized consonants. In H. Borer (ed.), *Proceedings of the West Coast Conference on Formal Linguistics, 7* (pp. 277-291). Stanford: Stanford Linguistics Association.

Robertson, Richard J. and Powers, William T. (Eds.). (1990). *Introduction to modern psychology: The control theory view*. Chapel Hill,NC: New View.

Runkel, Philip J. (1990). Casting nets and testing specimens. New York: Praeger. [Order]

When statistics are appropriate; when models are required.

Russell, O. G. 1931. *Speech and voice.* New York: Macmillan.

Sagey, Elizabeth. 1986. *The representation of features and relations in nonlinear phonology*. PhD. dissertation, MIT. New York: Garland Press.

Schane, Sanford A. 1995. Diphthongization in particle phonology. In Goldsmith (1995:586-608).

Schmidt, Annette. 1985. *Young People's Dyirbal: an example of language death from Australia.* Cambaridge Studies in Lingustics, Supplemental Vol. New York: Cambridge U. Press.

Selkirk, Elizabeth. 1990. A two-root theory of length. MS, University of Massachusetts, Amherst.

Silver, Shirley. 1966. Review of A history of Palaihnihan phonology by D.L. Olmsted, *IJAL* 32(2):210-212.

_____. 1976. Comparative Hokan and the northern Hokan languages. *In* Langdon and Silver (1976:193-202).

Steriade, D. 1994. Underspecification and markedness. In Goldsmith, ed. (1995: 114-174).

Stoel-Gammon, Carol, and Judith A. Cooper. 1984. Patterns of early lexical phonological development. *Journal of Child Language* 11:247-271.
Swadesh, Morris. 1948. Sociologic notes on obsolescent languages. *IJAL* 14:226-35.
Tesar, Bruce, and Paul Smolensky. 1997. The Learnability of Optimality Theory: An algorithm and some basic complexity results. Unpublished ms.
Trubetzskoy, Nikolai. 1939. *Grundzüge der phonologie*. Güttingen: Vandenhoek and Ruprecht.
Uldall, H. J. 1933. A sketch of Achumawi phonetics. *IJAL* 8:73-77.
van der Hulst, Harry. 1989. Atoms of segmental structure: components, gestures and dependency. *Phonology* 6:253-284.
_____ & Jeroen van de Weijer. 1995. Vowel harmony. In Goldsmith (1995:495-534).
Voegelin, C. F. 1946. Notes on Klamath-Modoc and Achumawi dialects. *IJAL* 12:96-101.

Index