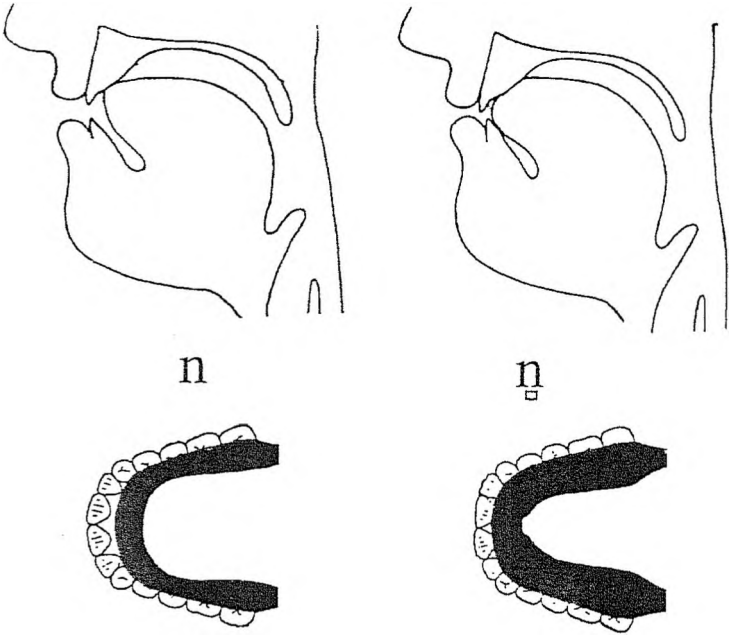


Figure2.7 Tracings from x-ray photographs and palatograms of apical and laminal alveolar nasals in Bulgarian (after Stojkov 1961).

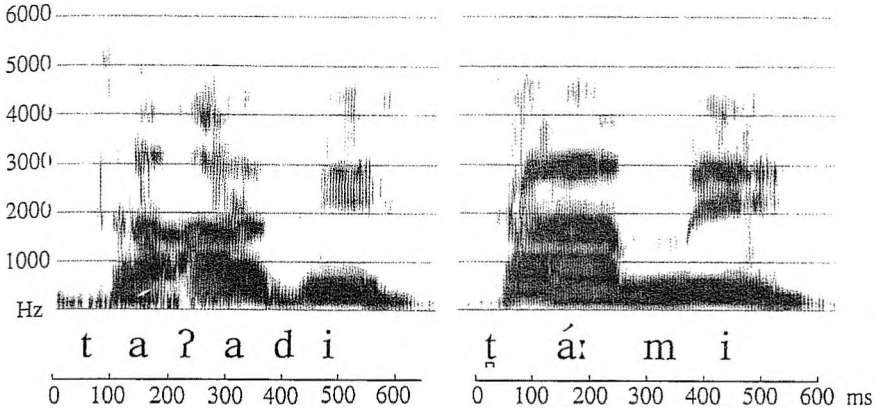


Figure 2.9 Spectrograms of Dahalota?adi 'fruit *of shitinke'* and ta:mi 'grass, thatch', illustrating longer and noisier release for alveolar than for dental plosives.

occurred in a number of utterances of this word by this speaker. Dart (1991, 1993) also found a significantly higher F2 prior to closure and lower F3 and F4 at both closure and release of apical alveolar stops in 'O'odham, in comparison with the laminal dentals.

An exception to the generalization that laminal consonants are likely to be more affricated is provided by Dahalo. The contrast between the laminal dental stops and the apical alveolar stops in this language is illustrated by the spectrograms in figure 2.9. The noisy part of the release of the alveolars is roughly three times as long as that of the dentals. In having greater affrication in the alveolar stops, Dahalo is unlike most of those languages of India, Australia and the Americas in which dental / alveolar contrasts are found.

The next question that we should consider is the nature of retroflex articulations. We illustrated a retroflex articulation in Toda in figure 2.6, but there is considerably more to be said about such articulations. The term 'retroflex' has

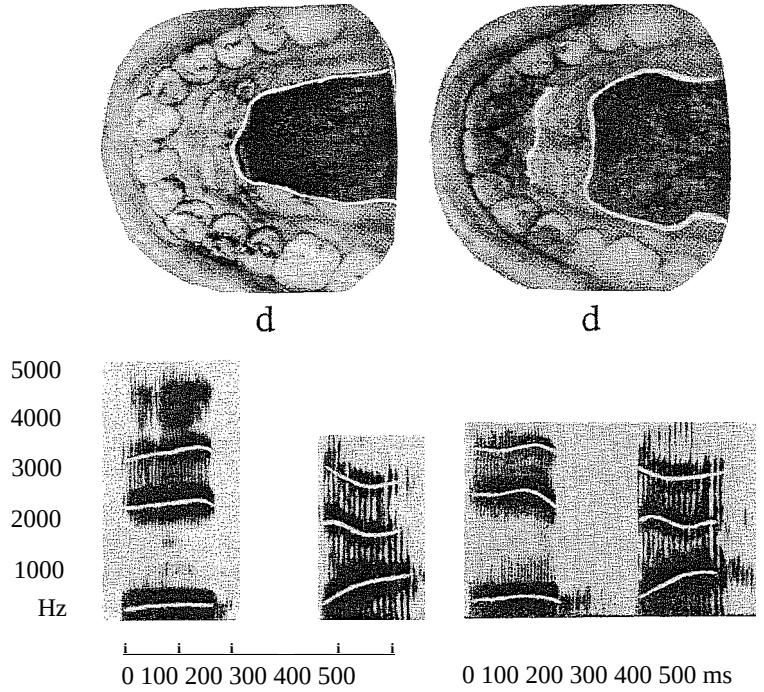


Figure 2.10 Spectrograms and palatograms illustrating the difference between laminal denti-alveolar d and apical retroflex d in Ewe in the phrases e da 'he throws' and e da 'he cooks', based on Ladefoged (1968).

We examined the contrast between d and d in two dialects of Ewe (Kpando and Peki) and in some of the neighboring Central Togo languages. Instrumen-

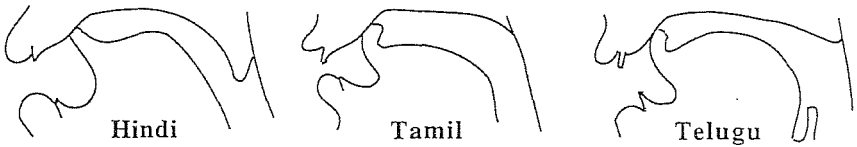


Figure 2.11 X-ray tracings of the apical retroflex d in Hindi and the sub-apical retroflex 4.in Tamil and Telugu (after Ladefoged and Bhaskararao 1983.)

long in the sagittal plane had touched the roof of the mouth. As the area of contact on the roof of the mouth is longer than 5 mm the tip of the tongue must have moved as it made contact, an action that we find typical of retroflex sounds. Spectrograms for these words are shown in the lower part of tire figure. The acoustic difference produced by these slightly different articulations is very small, consisting mainly of a greater lowering of F2 and F3 before the closure in e da.

Ladefoged (1968) suggested that the Ewe retroflex d might not be the same as the similarly symbolized sound in Hindi, a suggestion that still seems likely to us. Ewe d does not sound as retroflex as Hindi d. We do not have comparable data on the two languages, so we have no way of deciding this issue. But Ladefoged and Bhaskararao (1983) have shown that languages can differ in the kind of retroflexion that they employ. Figure 2.11 shows typical tongue positions for the retroflex consonants in Tamil and Telugu, two Dravidian languages, and Hindi, an Indo-Aryan language. The Dravidian languages typically have sub-apical consonants in which the underside of the tongue contacts the anterior part of the hard palate, whereas Hindi speakers do not usually have the tongue tip curled so far back and therefore the contact is on the apical edge of the tongue. We use the approved IP A retroflex symbols such as 4, for

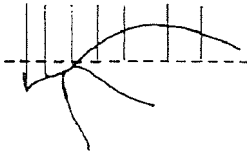
sounds lowers F4 so that it comes close to F3; but a retroflex modification of palatal sounds modifies F3 so that it comes close to F2. Stevens and Blumstein (1975) remark that "the overall acoustic pattern is characterized by a clustering of F2, F3 and F4 in a relatively narrow frequency region." The latter point is confirmed by Dave (1977), who also notes that in both his data and that of Stevens and Blumstein (1975) there are much greater formant transitions going from a vowel into a retroflex consonant than going from a retroflex consonant into a following vowel. This effect, which is also evident in our data, indicates that the tongue tip first bends back into the retroflex position, and then, during the closure phase, straightens out somewhat, so that by the time of the release of the closure it is in a less extreme position.

We have now considered all the articulatory gestures required for stops made in the dental and alveolar regions, and those made with the tip and the underside of the tongue in the post-alveolar region (the apical and sub-apical retroflex sounds). Laminal sounds made with the upper side of the tongue in the post-alveolar region are usually called palato-alveolar.

Australian languages are particularly well known for the large number of contrasting coronal articulations they use. Many Australian languages contrast laminal dental, apical alveolar, apical post-alveolar (retroflex), and laminal post-alveolar (palato-alveolar) stops. In the Australianist literature, sounds made with this last articulation are usually referred to as 'palatal', but as we will show, the articulation is further forward than the sounds traditionally called palatal. Words illustrating the four coronal places for stops and nasals in Eastern Arremte are given in table 2.5.

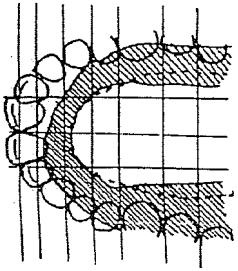
Palatograms of the words in the first row of table 2.5, made available to us by Andrew Butcher, are shown in figure 2.12. Above each palatogram is a sketch of the articulatory position in the sagittal plane inferred by Butcher from a combination of palatographic and linguographic evidence. Gridlines on the palatograms and sagittal sections correspond. The laminal dental involves a contact over the entire denti-alveolar region. The apical alveolar articulation is made directly on the alveolar ridge. The articulation here designated apical post-alveolar, conventionally called 'retroflex', involves a sub-apical contact

Apical alveolar

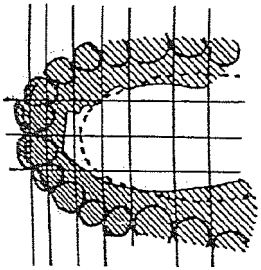


Laminal dental

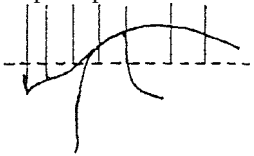
(1)



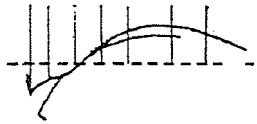
(2)



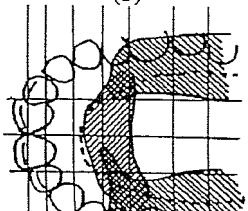
Apical post-alveolar



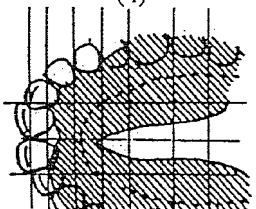
Laminal post-alveolar



(3)



(4)



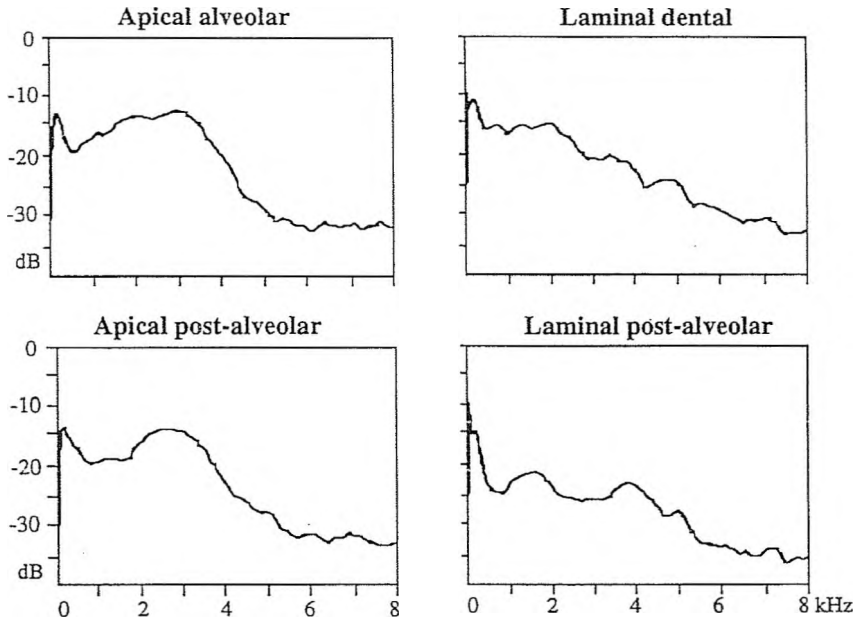


Figure 2.13 Mean spectra of the release bursts of the four Coronal stops of Eastern Arremte. Each panel of the figure is calculated from ten tokens of words containing the stop in question in varied contexts.

according to the active articulator shape, rather than place of articulation, is apparent in these data. The spectra of the two laminal stops show a general tendency for amplitude to decrease monotonically as frequency increases. In contrast, the spectra of the two apical stops show a strong mid-frequency peak. This is narrower in bandwidth for the post-alveolar (retroflex) than for the alveolar. Further differences also appear when the time-course of the articula-

affrication. These sounds are therefore laminal post-alveolar affricates tc. dz. or palatal stops c, j or palatal affricates cc, dj. In most of the West African languages in which these sounds occur there is a contrast between non-labialized and labialized counterparts (written 'dw' and 'tw' as in the name of the Akan dialect 'Twi'). But the labialized and non-labialized sounds do not necessarily have the same tongue gesture. Thus our main speaker of the Fante dialect of Akan had the same mid-point of articulation in the voiced labialized consonant in 5d^{w}e 'he calms' as in the voiceless non-labialized consonant in 5tce 'he catches'; but the extent of the contact was greater during the labialized consonant. Our main speaker of the Akwapem Twi dialect of Akan had very little affrication in the corresponding sounds, and had the same center point of articulation in oc^a 'he cuts' and caca 'mattress'; but in this case the contact was greater in the non-labialized consonant. In Nzima we found the articulations to be affricated palatal stops in both accs 'he divides' and occ"e 'he pulls'.

Some of the variations noted above may not be differences among dialects of Akan, as we have been implying, but simply differences among individual speakers. The problem is further complicated by the fact that there are large individual anatomical differences in the coronal region, making it hard to make precise remarks about articulation. Keating and Lahiri (1993), who have summarized articulatory descriptions based on x-rays of speech sounds in the palatal and velar regions, note that different sources provide quite different articulatory pictures of what are claimed to be the same sound.

As we have noted in the case of the West African languages the actual area of contact in sounds of this type may vary over a wide range, so that it is often hard to decide whether a given sound should be classified as a palato-alveolar or a palatal. Languages seldom distinguish between sounds simply by one being a palatal and the other a palato-alveolar, preferring instead either to have affricates in the one position and stops in the other, or in some other way to supplement the contrasts in place of articulation with additional variations in the manner of articulation. For example Ngwo has palatal stops and laminal post-alveolar affricates in a stop system which includes d, dz, ds, j, g. The middle three terms in this series are illustrated in Figure 2.14, which shows that

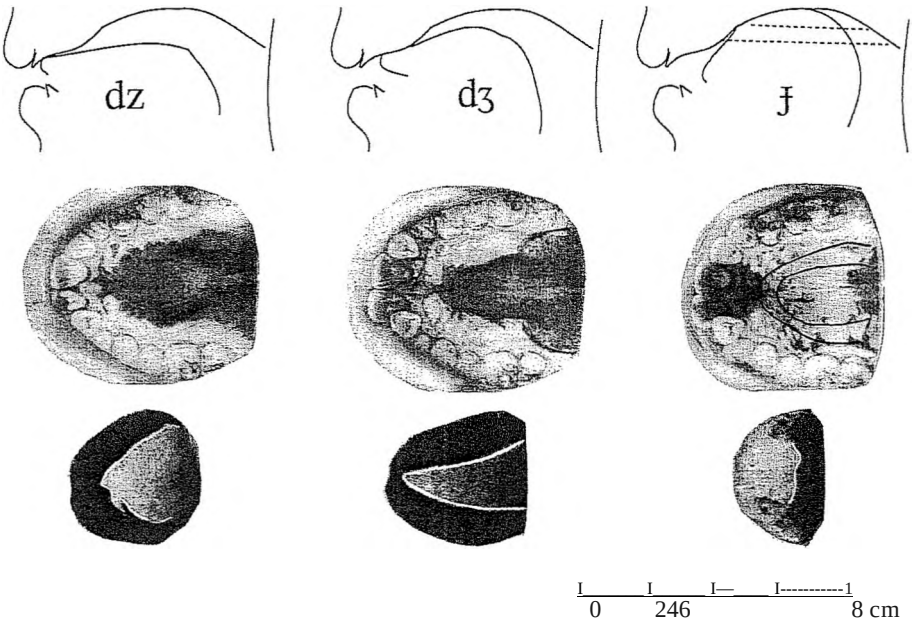


Figure 2.14 Palatograms, linguagrams, and inferred articulatory positions of lamina! denti-alveolar, laminal palato-alveolar, and palatal stops in the Ngwo words edzS 'dance', dje (a species of fruit), ejl 'postpone' (based on Ladefoged, 1968). The contact area on the roof of the mouth is the area from which the marking medium has been wiped away. The dotted lines on the palatal sagittal section correspond to the (solid) contour lines superimposed on the palatogram.

wide contact area on the tongue front. In the tracing based on cineradiography, the contact on the upper surface is on the sloping area of the palate. Comparing this figure with the laminal post-alveolar from Arremte illustrated in figure 2.12 above, both the active and passive surfaces involved are distinct in the two cases. Thus, among articulations that have loosely been called 'palatal' there are two quite distinct types involved, as well as a number of intermediate cases, such as some of the Akan types and perhaps the palatals of Czech (see the discussion in Keating and Lahiri 1993).

Lahiri and Blumstein (1984) have argued that phonological theories need not recognize the distinction between palato-alveolars and palatals, because the differences are always, as in Ngwo, supplemented by differences in manner of articulation. However, there are counterexamples. According to both Bubrikh (1949) and Lytkin (1966), Komi has both post-alveolar and palatal affricates (as well as palatal stops). So in this case differences in place of articulation are not supplemented by differences in manner. In addition, some dialects of Malayalam contrast laminal post-alveolar, palatal, and velar nasals. Although the more well-known dialects of this language contrast only six places of articulation, Mohanan and Mohanan (1984) note that there is a dialect that distinguishes seven places on the surface by having both n and ɲ.

It is customary to distinguish three places within the Dorsal region, as indicated in figure 2.2. We have already illustrated the palatal place, and will discuss the contrast between velar and uvular sounds below. The central member of the Dorsal class is the velar place. Virtually every language has velar stops. By definition, these involve a contact on the velum, or soft palate. However, since the active articulator involved is the body of the tongue and this is also involved in the production of front/back contrasts in vowels, the effect of vowel environment on velar stops is different from that seen with other places. Rather than primarily modifying the shape of the tongue behind or in front of the constriction, the location of the constriction itself is affected. In view of this it is possible to distinguish front, central and back velars. Fronted velars may actually make contact on the hard palate. Figure 2.16 illustrates the different location of the constriction in the Ewe words aka 'sand' and eke 'charcoal'.