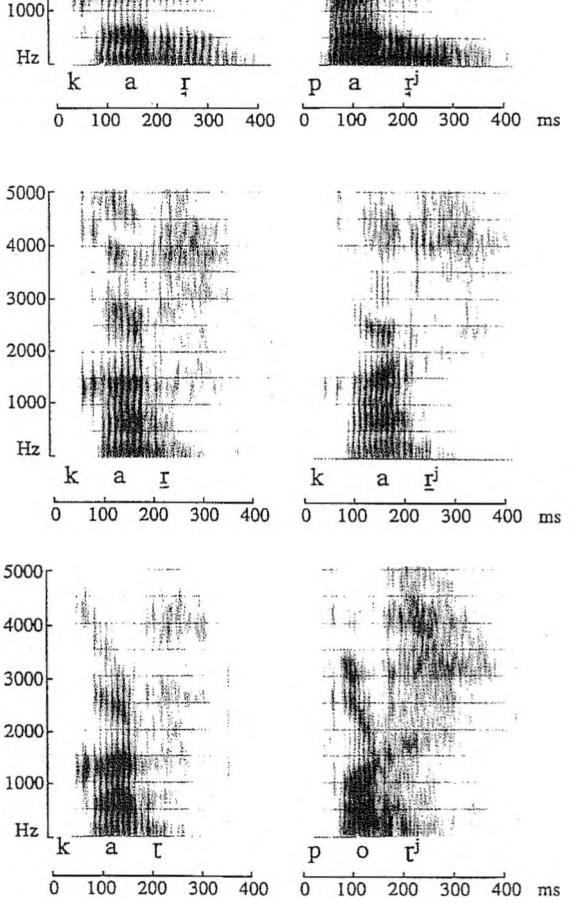

Figure 7.5 Spectrograms of the trills in six Toda words illustrating word-final rhotics. The six words are those in rows one and three of table 7.2. Plain forms are on the left, palatalized forms on the right.

for the palatalized rhotic in Russian. We therefore regard this as a form of palatalized alveolar trill, noting, however, that the sides of the tongue do not make contact with the hard palate in the way that is characteristic of a high front semivowel and typically found in palatalized sounds, including the Russian illustrated in figure 7.4. Emeneau (1984) describes this sound as a dental flap, and it may have been so at the time of his fieldwork in the 1930s, but our video and acoustic recordings show that a trill is the typical pronunciation.

As shown in table 7.2, all three of the Toda trills can also have distinctive palatalization. The spectrograms on the right of figure 7.5 show movements of the formants towards those typical of a high front vowel before each of the three palatalized trills. There is also an offglide with a great deal of energy in the higher frequencies. In this figure the lowering of the frequencies of the higher formants before the retroflex trill is also evident.

The other well-known class of trills is that in which it is the uvula rather than the tongue tip which vibrates. Uvular trills occur in some conservative varieties of Standard French and Standard German, although most speakers of these languages use uvular fricatives or approximants rather than trills. We have also heard uvular trills in Southern Swedish and in some varieties of Italian and Russian where the standard form of these languages would have an apical trill. They are rare outside Western Europe, but do occur at least in Abkhaz and in some varieties of Ashkenazic Hebrew.

Delattre (1971) showed in x-ray studies of several speakers of French and German that the uvular trills are produced by an initial movement of the tongue root backwards followed by an upward movement toward the uvula, which is also moved forward to a position where trilling can occur. These movements can be followed in the series of tracings of successive frames from x-ray films shown in figure 7.9.

There are variations in uvular trills similar to those in apical ones. Spectrograms of the word Ras 'breed' spoken by a male speaker of Southern Swedish are shown in figure 7.10. In the first repetition of this word, four contacts occur; in the second there are only two contacts, including an initial one, but there is then an approximant phase before the vowel begins.

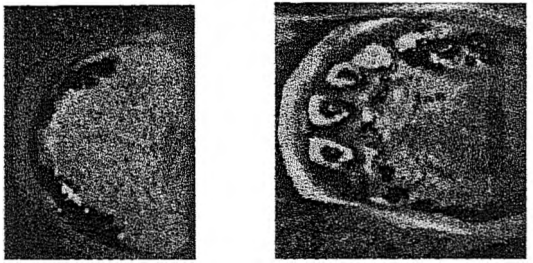

Figure 7.6 Palatogram, linguogram and reconstructed tongue position of the trill in the Toda word kar 'border of doth'. The dark marks on the teeth in this and the following Toda palatograms are stains, and do not reflect tongue contact.

There is a consistent distinction in the spectral domain between uvular and apical trills, with the uvular trills showing a much higher third resonance (between 2500 and 3000 Hz in these examples). There may also be a durational difference: in Lindau's (1985) data intervocalic uvular trills tended to be longer than the apical ones, often consisting of four to six periods.

The uvula might be expected to vibrate somewhat faster than the tip of the tongue, due to its smaller mass, but we cannot show this to be so from the available data. Although Lindau reports that the mean rate of vibration for uvular trills is higher than that for apical trills (her three speakers of Southern Swedish who consistently produced trills had a mean vibration rate of 30.5 Hz), the range (29-33 Hz, s.d. 2.5) is contained within the range observed for apical trills reported earlier. Conversely, Ladefoged, Cochran and Disner (1977) report a mean rate of 26.2 Hz for uvular trills for two speakers (one a Southern Swedish speaker, the other a speaker of a prestige dialect of Italian with uvular trills) compared with 28.6 Hz for apical trills (ten speakers of diverse languages). Trill rates for apical and uvular trills therefore seem to be

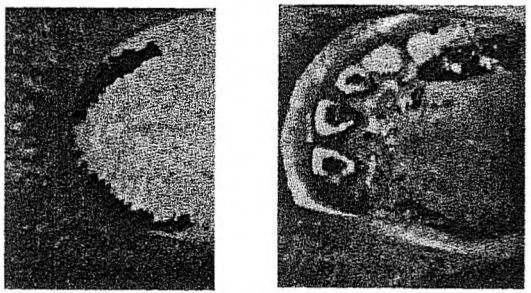

figure 7.7 Palatogram, linguogram and reconstructed tongue position of the trill in the Toda word kar 'juice'.

very similar, with any differences perhaps dependent on speaker characteristics rather than on the use of different articulators. To control for speaker differences it would be necessary to examine a language which uses both apical and uvular trills, although we are not sure that any such language now exists. Older speakers of Eastern dialects of Occitan (Coustenoble 1945, Bouvier 1976) may still maintain a contrast between lingual and uvular trills, deriving from the Latin contrast of single vs geminate r's, in words such as gari 'cured' vs gani 'oak tree'. We do not know of any articulatory or acoustic measurements on such speakers' trills.

It is interesting to note that the bilabial trill releases of prenasalized stops discussed in chapter 4 have a similar rate of vibration to other trills, despite the fact that the lips have a larger mass than either the uvula or the tongue tip. Ladefoged, Cochran and Disner (1977) report a mean rate of 29.3 Hz for prenasalized bilabial trills (five speakers), while Maddieson (1989b) reports a mean rate of 24.8 Hz (four speakers). The range is thus very similar to that observed in apical and uvular trills. As the various non-linguistic uses of

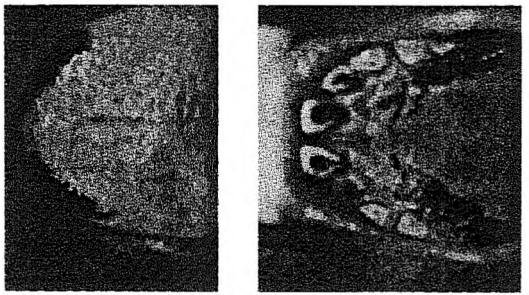

Figure 7.8 Palatogram, linguogram and reconstructed tongue position of the trill in the Toda word kaj 'pen for calves'.

bilabial trills illustrate, the rate of lip vibration can be varied over a wide range. In the English-speaking world both the relatively high frequency labial trill of the disrespectful 'Bronx cheer' or 'raspberry' and the low frequency trill conventionally written 'brrr' and indicating shivering cold are familiar. Frequency variation is controlled by changing the degree of lip spreading and the compression of the lips so that differing amounts of the mass of the lips are actually involved in the vibration. Because bilabial trills in linguistic use are almost always released into high rounded vowels, as noted in chapter 4, lip width is somewhat constricted and the resulting trill rate is intermediate in the potential range.

The only regularly occurring trill we know of that is made with the blade of the tongue is the Czech 'f'. This trill is typically made with the laminal surface of the tongue against the alveolar ridge. Short (1987) describes this sound as "a rolled post-alveolar fricative (never the sequence of [r] plus [3] attempted by

Figure 7.9 Frames traced from x-ray films of German and French intervocalic uvular trills (after Delattre 1971). The second frame in each row, shows retraction of the tongue, and the third frame in each row shows backward movement of the tongue root followed by tongue body raising and fronting of the uvula.

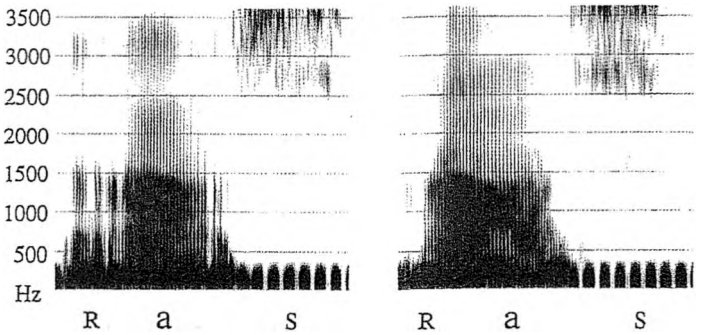

Figure 7.10 Spectrograms of uvular trills in two repetitions of nas 'breed' spoken by a male Southern Swedish speaker from Helsingborg.

non-Czechs ..We agree with his description that it is (often) 'rolled', although we would use the term trilled. He is also correct in noting that the frication is not of the 3 type. But in our observation this sound is usually a sequential combination of a trill and a fricative. The frication is not like that of 3 (with which this sound contrasts) but has a distinctive whistle-type of relatively narrow-band noise. It is often partially voiceless. Some speakers produce just the fricative, without a trill component (this variant will be described below), but others, perhaps most, Czech speakers have a trill at the beginning.

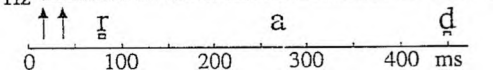

Figure 7.11 A spectrogram of the Czech word rad *rad* 'order'. The closure phases of each of the two vibrations of the blade of the tongue are indicated by arrows.

A spectrogram of the Czech word rad *rad* 'order' is shown in figure 7.11. In this utterance there were two vibrations of the blade of the tongue, which were themselves fairly fricative, followed by a fricative during which voicing commences.

As we have noted, tongue tip trills are by far the most common type of trill, uvular trills are rarer and bilabial trills have a very restricted distribution. Beyond these, it is possible to induce vibratory motions of other vocal organs. For example, a part of the tongue body may vibrate against the palatal or velar surface. Palatal and velar vibrations of the tongue body are sporadically produced, particularly as transitional phenomena in the release phase of Dorsal stops. A 'double burst' is seen particularly often at the release of a velar stop; this could be said to be a brief trill, but it never appears to be a required articulatory target. A good illustration of this kind of velar release is seen in figure 7.2 above, in Speaker B's pronunciation of karro. Other examples can be seen in the Toda spectrograms in figure 7.5. The strident vowels of !X6o, which will be discussed in chapter 9, are produced with trilling of the epiglottis. Trills of the velum or uvula on an ingressive airstream produce one of the major types of sounds in snoring.

7.3 Taps and Flaps

Another class of rhotic sounds are those which invariably have a single short closure. These are called taps and flaps, and are generally apical. Many linguists, including Lindau (1985), do not make any distinction between these two terms. However, Ladefoged (1968) has suggested that it is useful to

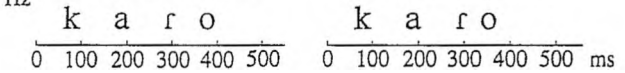

Figure 7.12 Spectrograms showing taps from a female speaker of Peninsular Spanish and a male Spanish speaker from Peru in the word karo 'expensive'.

distinguish between them. The distinction now proposed is that a flap is a sound in which a brief contact between the articulators is made by moving the active articulator tangentially to the site of the contact, so that it strikes the upper surface of the vocal tract in passing; a tap is a sound in which a brief contact between the articulators is made by moving the active articulator directly towards the roof of the mouth. Both types are usually coronal. Thus flaps are most typically made by retracting the tongue tip behind the alveolar ridge and moving it forward so that it strikes the ridge in passing. Taps are most typically made by a direct movement of the tongue tip to a contact location in the dental or alveolar region.

A tap, usually described as dental, occurs in intervocalic position in most varieties of Spanish in words such as karo 'expensive'. Quilis (1981) measured the mean closure duration of this segment as 20 ms. Two productions of karo are illustrated by the spectrograms in figure 7.12, the one on the left spoken by a female Peninsular Spanish speaker and the one on the right by a male Peruvian Spanish speaker. In the first of these, there is a marked rise in the second formant as the consonant is formed, but no comparable rise occurs in the second utterance, suggesting that the place of articulation may differ somewhat between the two. Note that in the second of these utterances, although the sound is described as voiced, there is no vocal fold vibration during the short closure. This is a not unusual feature of this type of sound, and parallels the observation made concerning trills.

Most speakers of American English produce similar brief closures for the well-known flap allophone of post-stress pre-syllabic alveolar stops in words such as *city*, *latter* and *ladder*. A clear difference between this American English flap and the Spanish tap can be seen in the x-ray films of Monnot and Freeman

Figure 7.13 X-ray tracings of the articulation of American English alveolar flap and Spanish dental tap, in the words *water* and *Iberica* respectively (after Monnot and Freeman 1972). The direction of movement is indicated by arrows.

(1972). Tracings from the closure phase of these sounds are shown in figure 7.13. The English speaker has a preparatory raising and retraction of the tongue tip during the preceding vowel, which is apparent in earlier frames of the film (not reproduced here). The tongue is then moved forward to make the contact which is captured in the frame illustrated here, after which it returns to the floor of the mouth. The Spanish tap does not involve any substantial anticipation, but instead has a quick upward and downward movement confined to the tongue tip. (Monnot and Freeman do not state where the speakers used in this study were from. It was carried out in California but the Spanish speaker was probably Iberian.) Recasens (1991) shows that the tap in Catalan has similar formant transitions going into and out of the consonant. English flaps often have detectably different transitions before and after the contact.

A considerable proportion 6f the linguistic literature does not make the distinction between tap and flap that is illustrated here, hence it is often uncertain which of these two types of movements occur in particular languages.

7.4 Fricative and Approximant /r/'s

The family of rhotics also includes members in which there is no contact, but instead only an approximation between the articulators. In some instances the typical production is accompanied by friction, in others an approximant is produced. A fricative alveolar rhotic occurs in the KiVunjo dialect of KiChaka (Davey, Moshi and Maddieson 1982), and a fricative uvular rhotic is the most common production of 'r' in French, as shown in the x-ray films by Simon (1967). A spectrogram of this typical French pronunciation is shown in figure 7.14.

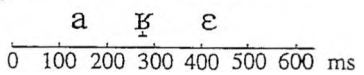

Figure 7.14 Spectrogram of the word *arret* 'stop' pronounced with a uvular fricative by a female speaker of Standard French.

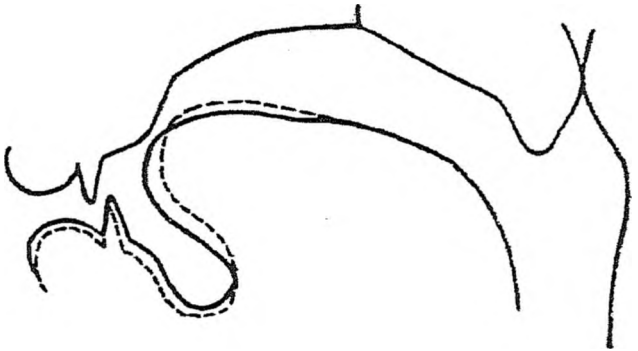

Figure 7.15 Mid-saggital section of the Czech rhotics in the words paja and maja based on palatographic and linguographic data (after Hala 1923). Solid line indicates ɹ, dashed line ɹ̝.

As noted above, some speakers of Czech have a trill with a fricative component whereas others have only a fricative. Palatograms and linguograms of j published by Hala (1923) show a narrow open channel at the center of the mouth which is narrower and formed further forward than that for the contrasting approximant j which also occurs in Czech. Based on this data, Hala infers that for speakers of this type the mid-saggital shape for the two Czech rhotics is as in figure 7.15.

An alveolar approximant rhotic is typical of Southern British English; this segment may appear only in prevocalic positions. A uvular approximant is common in Standard German, especially in non word-initial positions (a uvu-