

AN ALGORITHM FOR THE PHONOLOGICAL DERIVATION OF ISINAI FROM PROTO-CENTRAL CORDILLERAN

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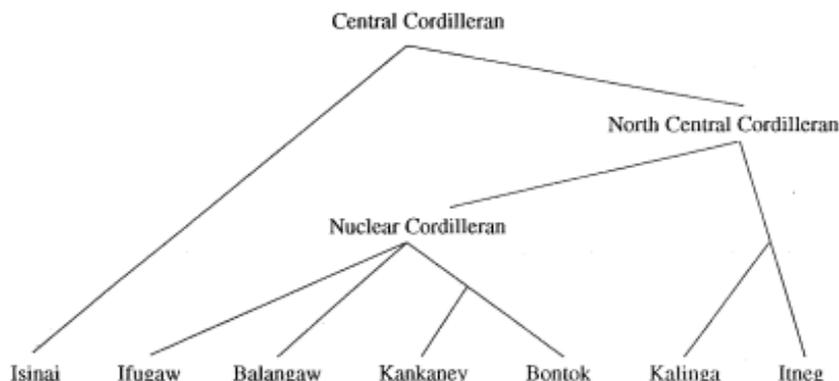
1. BACKGROUND

Isinai is spoken by approximately 8,000 people in the towns of Aritao, Dupax, Bambang, Kayapa, and Santa Fe in the province of Nueva Vizcaya in northern Luzon.¹ The Isinai population is one of several relatively small groups in the Cagayan and Magat Valleys which have a long history of self-identity. Early scholars were unsure of the affiliation of the Isinai language (Keesing 1962). Reid (1974:511) was the first to identify Isinai as a first order member of the Central Cordilleran (CC) family of languages, having separated from the remainder, the North Central Cordilleran (NCC) languages, prior to the dispersal of the latter.² In historical times, Isinai has been in direct contact with only one CC language, Ifugaw (Conklin 1980). Otherwise, it has been surrounded by Southern Cordilleran languages (Kallahan, Pangasinan and Ilongot) and Northern Cordilleran languages (Gaddang, Ibanag and Ilokano). All of these, as well as Tagalog and Kapampangan, have had an influence on Isinai.

¹Isinai data from the municipalities of Aritao and Dupax were collected in 1964 and 1977. The data from Bambang are taken from McFarland (1977). I am indebted to Professor Lawrence A. Reid (1987) for additional data from his translation of Mendiola (n.d.) and for many useful comments on earlier versions of this paper.

²A preliminary estimate of the time depths for the various branches of CC languages, based on lexicostatistical computations of 100 basic lexical items, indicates that Isinai began to diverge from the other CC languages approximately 2,000 years ago.

Figure 1. Internal Relationships of CC Languages
(Reid 1974:512)



2. PHONEMIC INVENTORIES

Reid (1974:513) has reconstructed the following phonemes for Proto-Central Cordilleran:

Consonants				Vowels		
*p	*t	*k	*ʔ	*i	*+	*u
*b	*d	*g		*a		
*m	*n	*ŋ				
	*l					
	*s					
*w	*y					
					Stress	
					*V	

Canonical forms for the syllable included only CV and CVC. The only restrictions on the distribution of the phonemes were that the glottal stop did not occur in word-final position and that the glides did not occur in the same syllables as their corresponding vowels; in other words, the sequences *yi, *wu, *iy, and *uw did not occur.

Isinai maintains the same canonical forms. The phonemic inventory of Isinai comprises:

Consonants				Vowels	
p	t	k	ʔ	i	u
b	d	g		e	o
v	s	x			a
	r				
	l				
m	n	ŋ			
w	y				
					Length
					V:

Phonemic /k/ occurs only in borrowed words, and although [v r x] developed as allophones of /b d g/ it is useful to treat them as separate phonemes because of the large number of loan words

in which they appear. Vowel length, rather than stress, is phonemic in Isinai. Long vowels are always stressed. In the absence of a long vowel, or in the few cases where two long vowels occur, stress is predictably on the ultima:

be:yu	'widow'	beyú	'new
ʔa:su	'dog'	ʔasú	'smoke'
li:ma	'hand'	limá	'five'

Isinai vowel length replaces PCC stress unless an otherwise unstressed vowel is compensatorily lengthened via consonant loss (see Rules 9 and 10).

3. Isinai Reflexes of the PCC Phonemes

While all of the modern CC languages, of course, have experienced phonological change to some degree, none has done so to the extent that Isinai has. What follows is an algorithm, a series of rules for the resolution of a specific set of problems, by which Isinai is phonologically derived from PCC. Some of these rules are ordered relative to each other, and some are not. Some also appear to be extremely ad hoc, while others are well motivated. Indication of rule ordering is given below.

3.1. Rules affecting the lateral

Throughout the CC languages the reflexes of PCC *l have shown the widest variation. By using a combination of synchronic and diachronic rules, Reid (1973) has accounted for this variation in Kankanaey. The method used there--indeed, some of the very same rules--helps to explain the Isinai situation. But whereas the Kankanaey vowels faithfully reflect their PCC antecedents, the Isinai vowels do not. Instead, Isinai has experienced a number of changes in the vowels under the influence of *l, necessitating the rule ordering.

In his explanation, Reid proceeds from the allophonic variation of [l] - [r] in Bontok to account for the Kankanaey reflexes of *l. He then corroborates his argument with evidence from Kalinga, Balangaw and Ifugaw in which languages [λ] and/or [r] are allophones of /l/. The conditions under which phonetic [l] is retained in Isinai are virtually identical with those which cause it to remain as such in the NCC languages. The environments in which *l disappears or is merged with the reflexes of other phonemes are similar to those which cause variation in the NCC languages. It is safe to assume, then, that some sort of allophonic variation existed in PCC, although the phonetic nature of the variant cannot be determined. Isinai has neither the retroflex [r] nor the palatal [λ].³ To prevent the rules below from operating inappropriately on those occurrences of [l] retained as such, the symbol L is used for the indeterminate allophone of /l/.

For Bontok-Kankanaey, Reid (1973:56-57) accounts for the retention of non-initial phonetic [l] by first allowing *l to be expressed as [r] (the Bontok allophone), then by having it revert to [l] in certain environments. Substituting [L] for [r] these rules are modified and conflated for PCC as:

$$\text{Rule 1.} \quad *l > L / - \left[\begin{array}{c} \text{V} \\ \text{front} \end{array} \right] ([- \text{coronal}]) \text{ --- } \left\{ \begin{array}{c} \# \\ \text{C} \\ \text{V} \\ - \text{front} \end{array} \right\}$$

By rule 1 any lateral preceded by a non-front vowel, with or without an intervening non-coronal consonant, is manifested as [L], unless it is immediately followed by a front vowel. This

³Although Isinai does have a tapped [r] as a development from /l/, it does not have a retroflex [r].

rule is sufficient to account for nearly all instances of phonetic [l] in Isinai which can be attributed to the level of PCC or higher.⁴ Thus, phonetic [l] is retained in the following forms:

PCC *l ₀ tu	Isi lu:tu	'to cook'
PCC *ʔila	Isi ʔi:la	'to see'
PCC *dalit	Isi dalit	'eel'
PCC *k+ɫab	Isi ʔotlav	'to bite'
PCC *piklat	Isi piʔlat	'scar'

In all other environments the variant must have occurred:

*walu	>	*waLu	'eight'	(weyu)
*lalaki	>	*laLa:ki	'male'	(leya:ʔi)
*d+tʔal	>	*d+tʔal	'floor'	(dotʔe:)
*sakluŋ	>	*sakLuŋ	'ladle'	(se:ʔuŋ)
*ʔalʔu	>	*ʔaLʔu	'pestle'	(ʔe:ʔu)
*ʔ+l+ŋ	>	*ʔ+L+ŋ	'nose'	(ʔeyoŋ).

In these examples, and those which follow, the asterisked form to the right of the arrow contains only those phonological changes created by the rule in question and previous rules; the form in parentheses after the English gloss is the actual Isinai lexeme. Unless otherwise indicated, the forms to the left of the arrow are PCC or derived from PCC by rules previously discussed.

Another rule proposed by Reid (1973:56) changes [r] back to [l] to create the geminate cluster [ll]. Isinai is lacking [ll] forms which can clearly be attributed to PCC, although innovative lexemes, such as /pulla/ 'seed for planting', do occur. One possibility is /bullaŋ/ 'monkey' which can be derived from *bullaŋ+n if gemination occurred before other sound changes. Otherwise, we would expect *[buwa:ŋon] or *[buweŋ].

3.2. Rules affecting the vowels

Isinai shares with Kalinga the development whereby PCC *+ reverts to the earlier /a/ before a final /w/.⁵

Rule 2.	*+ > a / ___ w #		
*pay+w	>	payaw	'field'
*ʔak+w	>	*ʔa:kaw	'to steal' (ʔa:ʔaw)
*pud+w	>	*pudaw	'white' (puraw)
*ʔaLg+w	>	*ʔaLgaw	'day' (ʔe:xaw).

Proximity to [L] causes vowel fronting in several situations. By Rule 3, both *a and *+ are fronted to /e/ when followed by [L], whether or not there is an intervening non-coronal voiceless stop, and whether or not the latter is followed by a vowel.

Rule 3.	$\left[\begin{array}{c} \text{V} \\ + \text{central} \end{array} \right] > e / \text{-----} \left(\left[\begin{array}{c} + \text{stop} \\ - \text{voice} \\ - \text{coronal} \end{array} \right] (\text{V}) \right) \text{L}$
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⁴The PCC and PSCC forms are from Reid (1971, 1973, 1987) and from Himes (1988).

⁵This is interesting since this does not occur before final /y/: both Isinai and Kalinga have /oy/.

The simplest cases are those of intervocalic [L]:

*baL+y	>	*beL+y	'house'	(beyoy)
*ʔ+L+ŋ	>	*ʔeL+ŋ	'nose'	(ʔeyoŋ)
*da:La	>	*de:La	'blood'	(de:ya)
*ba:Lu	>	*be:Lu	'widow'	(be:yu)

Non-coronal voiceless stops intervening between the central vowel and [L], with or without another intervening vowel, also condition the change.

	*dak+L	>	*dekeL	'many'	(deʔe:)
PSCC	*daʔpuL	>	*deʔpuL	'ashes'	(de:pu:)
	*ʔapuL	>	*ʔepuL	'lime'	(ʔepu:)
	*sakLuŋ	>	*sekLuŋ	'ladle'	(se:ʔuŋ)
	*ʔakLaŋ	>	*ʔekLaŋ	'clothes'	(ʔe:ʔeŋ)

Note that in the following forms the vowel immediately preceding final [L] is appropriately affected but that the intervention of a voice stop or a coronal stop causes the first vowel to remain unchanged:

*ʔab+L	>	*ʔabeL	'weave cloth'	(ʔave:)
*d+tʔaL	>	*d+tʔeL	'floor'	(dotʔe:)
*gat+L	>	*gateL	'itch'	(gate:)

Also,

*tagLaŋ	>	*tagLeŋ	'rib'	(taggeŋ)
*d+ŋ+L	>	*d+ŋeL	'to hear'	(doŋe:)
*ʔaŋ+L	>	*ʔaŋeL	'spirit'	(ʔaŋe:)

Rule 4 similarly raises and fronts the low vowel when it is preceded by [L] and is followed by a final consonant, as long as the [L] is not immediately preceded by a front vowel.

Rule 4.	*a > e /	$\left[\begin{array}{c} \text{V} \\ \text{-front} \end{array} \right]$	L	___	C	#
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*buLaŋ	>	*buLeŋ	'moon'	(buwen)
*ʔuLaŋ	>	*ʔuLeŋ	'vein'	(ʔuwet)
*duLaw	>	*duLew	'betel leaf'	(duwew)
			'yellow'	
*tagLaŋ	>	*tagLeŋ	'rib'	(taggeŋ)

Presence of the front vowel /e/ immediately before the [L] causes the low vowel to retain its quality; /i/, of course, cannot immediately precede [L].

*deLaŋ	>	*deLaŋ	'path'	(deyan)
*keLaŋ	>	*keLaŋ	'to bite'	(ʔeyat)
*keLaŋ	>	*keLaŋ	'to climb'	(ʔeyab)
*ʔeLaŋ	>	*ʔeLaŋ	'fence'	(ʔeyar)

When the low vowel is not immediately followed by a final consonant it remains low. In most of these cases the shift is already blocked by a preceding /e/, but one form demonstrates the retention of /a/ which cannot be attributed to that factor.

*buLa:ŋ+n	>	*buLa:ŋ+n	'rainbow'	(ʔasivuwɑ:ŋon)
*ʔabe:La	>	*ʔabe:La	'shoulder'	(ʔave:ya)
*de:La	>	*de:La	'blood'	(de:ya)
*leLa:ki	>	*leLa:ki	'male'	(leyɑ:ʔi)
*teLantag	>	*teLantag	'shore'	(teyantax)

Another rule affecting the vowels fronts the high back vowel to /i/ when followed by [L] and another occurrence of the back vowel, whether or not there is an intervening consonant between the latter. This rule must be applied before Rules 7 and 8, which merge intervocalic [L] with the glottal stop and the latter with the glides.

Rule 5.	*u > i / ___ L (C) u	
*ʔuLu	>	*ʔiLu 'head' (ʔiyu)
*buLuk	>	*biLuk 'rotten' (biyuʔ)
*duLnu	>	*diLnu 'dew' (di:nu)
*ʔuLpu	>	*ʔiLpu 'thigh' (ʔi:pu)

This fronting does not occur if any other vowel follows the [L].⁶

*buLen	>	*buLen	'moon'	(buwen)
*-buLaŋ+n	>	*-buLɑŋ+n	'rainbow'	(-buwɑ:ŋon)
*duLew	>	*duLew	'betel leaf'	(duwew)

Finally, all occurrences of *+ unaffected by the application of Rules 2 and 3 are reflected as /o/.

*ʔ+n+m	>	ʔonom	'six'	
*ʔeLɔ+y	>	*eLɔy	'liver'	(ʔe:toy)
*eLɔŋ	>	*eLɔŋ	'nose'	(ʔeyoŋ)

3.3. The lateral and the glottal stop

At some point after it had influenced the vowel shifts described above, the lateral variant [L] merged with other segments. Intervocalic [L] must have been affected first, then intervocalic [ʔ] and finally syllable- and word-final [L].

⁶Sequences of the type of uL+ are lacking unless the Isinai innovation /biyop/ 'sky' is derived from *bul+p. One dialect of Ifugaw, that of Guinbong in Mayoyaw, has /ʔclap/ 'sky', probably a semantic shift from PPH *ʔulep 'cloud'. If the Isinai case is somehow analogous, then the rule should read:

$$*u > i / _ _ L (C) \begin{bmatrix} \text{V} \\ +\text{high} \\ -\text{front} \end{bmatrix}$$

Application of this rule in Bambang is questionable. IsiB has the forms di:nu 'dew' and ʔi:pu 'thigh', which are expected, but it also has ʔu:yu 'head', which is not. IsiB buyoʔ 'rotten' may be analogous to ʔu:yu or it may be derived from PPH *buyuk. Both *buyuk and *buluk have reflexes in CC languages.

Rule 7. *L > ʔ / V ___ V

*buLen	>	*buʔen	'moon'	(buwen)
*keLat	>	*keʔat	'to bite'	(ʔeyat)
*kuLen	>	*kuʔen	'worm'	(ʔuwen)
*deLom	>	*deʔom	'deep'	(deyom)

The disposition of the intervocalic glottal stop, whether inherited directly from PCC or a reflex of the lateral, depends upon the placement of stress and the height of the vowels in the sequence. If both of the vowels are of the highly contrastive pair /i a/ and the first is stressed, the glottal remains.

*ʔaʔaw	>	ʔa:ʔaw	'shadow'
*siʔit	>	si:ʔit	'to pour'
*saʔil	>	sa:ʔil	'to push aside'

In all other cases the glottal is deleted. Between like vowels this results in a single, long vowel.

Rule 8. *ʔ > ø / V ___ V

*buʔuk	>	*buuk	'hair'	(bu:ʔ)
*luʔum	>	*luum	'ripe'	(lu:m)
*soʔod	>	*sood	'to wait'	(so:r)
*maʔatuj	>	ma:tuj	'hot'	
*maʔagas	>	ma:gas	'pungent'	

Between unlike vowels (other than those dealt with above) a glide is inserted to preserve the canonical form CV(C). The character of the glide is determined, again, by the vowel height and order in the sequence. If one of the vowels is low, the other vowel determines the point of articulation of the glide:

*ligaʔu	>	*liga:wu	'winnowing basket'	(lixa:wu)
*daʔun	>	da:wun	'leaf'	
*-buʔa:ŋon	>	-buwa:ŋon	'rainbow'	
*paʔit	>	payit	'bitter'	
*be:ʔa	>	be:ya	'lungs'	
*i-ʔapʔap	>	ʔiyapʔap	'to hide'	

If both of the vowels are non-low, then the first vowel determines the nature of the glide.

*ʔiʔu	>	ʔiyu	'head'
*ʔuʔet	>	ʔuwet	'vein'
*ʔeʔoŋ	>	ʔeyoŋ	'nose'
*bituʔon	>	bituwon	'star'

At this point all remaining instances of [L] assimilate to the preceding sound creating a geminate cluster or vowel length.

Rule 9. *L > :

*tabLek	>	*tabbek	'mud'	(tavveʔ)
*ʔamLaki	>	*ʔammaki	'big'	(ʔammaʔi)

*mabLes	>	*mabbes	'good'	(mavves)
*tagLeŋ	>	taggeŋ	'rib'	
*sekLuŋ	>	*sekkuŋ	'ladle'	(se:ʔuŋ)
*ʔekLeŋ	>	*ʔekkeŋ	'clothes'	(ʔe:ʔeŋ)
*saŋLe:	>	*saŋpe:	'to roast'	(saŋpe:)
*ʔeLʔu	>	ʔe:ʔu	'pestle'	
*ʔepuL	>	ʔepu:	'lime'	
*eLgaw	>	*ʔe:gaw	'day'	(ʔe:xaw)
*tuLʔeŋ	>	tu:ʔeŋ	'bone'	

Earlier application of this rule would generate the non-occurring forms *tu:weŋ 'bone' and *ʔe:yu 'pestle'.

Unlike the other CC languages Isinai inherited a few forms (Reid 1974:520) which contained syllable-final glottal stop. In all such cases the glottal is deleted and the preceding vowel is compensatorily lengthened:

Rule 10. *ʔ > :	/	V	___	C
PSCC *baʔba	>	*ba:ba	'tooth'	(ba:va)
PSCC *guʔgu	>	*gu:gu	'to scratch'	(gu:xu)
PSCC *daʔpul	>	de:pu:	'ashes'	
PSCC *siʔpuk	>	*si:puk	'to blow'	(si:puʔ)

3.4. The voiceless stops

Isinai in general reflects PCC *p and *t as such, and it shares with some dialects of Kalinga and Ifugaw the general rule whereby *k is reflected as a glottal stop in all environments.

Rule 11. *k > ʔ		
*kutu	>	ʔutu 'louse'
*ʔanak	>	ʔanaʔ 'child'
*kutkut	>	ʔutʔut 'to dig'
*bokon	>	boʔon 'not'
*makpe:	>	maʔpe: 'thick'

Application of this rule at this point, of course, prevents the loss of the glottal stop in the environments specified in Rules 8 and 10.

3.5. The voiced stops

By and large the Isinai voiced stops have fricative reflexes in postvocalic position.⁷

Rule 12.	$\begin{bmatrix} b \\ d \\ g \end{bmatrix}$	>	$\begin{bmatrix} v \\ r \\ x \end{bmatrix}$	/	V	___
*guwab	>	guwav	'below'			
*ʔibaga	>	ʔivaxa	'to say'			
*tadom	>	tarom	'sharp'			
*ʔigid	>	ʔixir	'left'			
*bonog	>	bonox	'back'			

⁷McFarland (1977) has at least partially phonemicized the Isinai data from Bambang which show [b d g] in final position and [v r k] intervocally.

This appears to be a classic case of lenition, one in which certain sounds (such as stops) are weakened in 'weak' environments (such as intervocallically or finally).

3.6. Parochial rules

3.6.1. Aritao

There are minor dialect variations in the Isinai-speaking community. For example, in Aritao (IsiA) it is common for [v] to be pronounced [w] between two occurrences of the low vowel.

Rule 13. In IsiA, v > w / a ___ a		
ba:va	>	ba:wa 'tooth'
bava:yi	>	bawa:yi 'female'

IsiA also degeminate clusters of consonants which are [+ back], while concomitantly lengthening the preceding vowel. This rule is ordered after Rule 11, which merges the voiceless velar stop with the glottal stop, since forms with a geminate glottal stop, such as IsiB ʔuʔʔuʔ 'to cough,' would not otherwise occur.

Rule 14. In IsiA, [+ back] _a > : / ___ [+ back] _a		
taggeŋ	>	ta:xeŋ 'rib'
*seʔʔŋ	>	se:ʔŋ 'ladle'
*ʔeʔʔeŋ	>	ʔe:ʔeŋ 'clothes'
ʔuʔʔuʔ	>	ʔu:ʔuʔ 'to cough'
*saŋŋe:	>	sa:ŋe 'to roast'

3.6.2. Bambang

Isinai of Bambang (IsiB) exhibits sound shifts which affect the voiceless coronal consonants.

Rule 15. In IsiB, s > t / ___	$\left. \begin{array}{c} \# \\ C \\ V \\ \text{-front} \end{array} \right\}$
saʔon > taʔon	'T'
ʔasa:wa > ʔata:wa	'spouse'
pogson > pogton	'to squeeze'
susu > tutu	'breast'
ʔisbu > ʔitbu	'urine'
ʔa:pos > ʔa:pot	'cotton'
masde: > matde:	'thick'
ʔu:nas > ʔu:nat	'sugarcane'

Rule 16. In IsiB, t > s / ___	$\left[\begin{array}{c} V \\ \text{+high} \\ \text{+front} \end{array} \right]$
bitil > bisil	'hunger'
tinoy > sinoy	'frog'
ti:run > si:run	'to push'

Curiously, there are a considerable number of forms which do not have the expected reflex in IsiB:

ʔosaʔ	'one'	(expected *ʔota)
pu:su	'heart'	(expected *pu:tu)
li:nis	'clean'	(expected *li:nit)
ti:laʔ	'lost'	(expected *si:laʔ)

These rules also operate in the Southern Cordilleran language Ilongot (Reid 1971), but they are much more common in the Northern Cordilleran languages of the Cagayan Valley (Tharp 1974). As such, this provides an interesting example of areal, as opposed to genetic, linguistics.

4. Summary and Conclusions

The rules presented here allow us to predict the expected Isinai forms derivative from reconstructed PCC lexemes. For example, the IsiB form /matde:/ is seen to be derived from PCC *s+d+l 'strong,' which is itself derived from Proto-South-Central Cordilleran *s+d+l 'thick.' Likewise, /duwew/ 'betel leaf' represents a semantic shift in being derived from PCC *dul+w 'yellow.' The utility of this algorithm is immediately apparent when efforts are made to winnow borrowed items from inherited ones, whether or not semantic change has occurred in the process of diffusion. For instance, Isinai has the kin term /ʔa:lom/ 'brother-in-law', which is less likely to be an innovation than it is to be taken from Ilokano ʔarem 'to court' (Constantino 1971:52). The PCC form *ʔal+m does mean 'to court', but its reflex in Isinai ʔe:yom means 'enemy' (Mendiola n.d.). Further application of the Isinai algorithm allows us to assign more and more reconstructed forms to PCC and to higher level reconstructions. We can posit Proto-Philippine *balibaR 'to throw' on the basis of Botolan Sambal, Tagalog and Cebuano balibag and Isinai ʔivali:ve:, and since Inibaloi of Trinidad has ʔan+l and Isinai has ʔane:, both meaning 'soul, spirit', *an+l can be assigned to PSCC, the common parent of Central and Southern Cordilleran languages. It is not expected that the rules provided here will account for all contemporary Isinai lexemes, but they are intended as a first approximation to such an account. As with many of these process in historical linguistics the use of this algorithm must be applied from the lower levels to the higher and back again to fill in the voids in our knowledge of the ancestral language.

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Table 1. Summary of Rules

Rule 1. $*l > L / \left[\begin{array}{c} V \\ \text{-front} \end{array} \right] [+coronal] \rightarrow \left\{ \begin{array}{c} \# \\ C \\ V \\ \text{-front} \end{array} \right\}$

Rule 2. $*+ > a / _ w \#$

Rule 3. $* \left[\begin{array}{c} V \\ \text{+central} \end{array} \right] > e / _ \left(\begin{array}{c} \text{+stop} \\ \text{-voice} \\ \text{-coronal} \end{array} (V) L \right)$

Rule 4. $*a > e / \left[\begin{array}{c} V \\ \text{-front} \end{array} \right] L _ C \#$

Rule 5. $*u > i / _ L (C) u$

Rule 6. $*+ > o$

Rule 7. $*L > ? / V _ V$

Rule 8. $*? > \emptyset / V _ V$

Rule 9. $*L > :$

Rule 10. $*? > : / N _ C$

Rule 11. $*k > ?$

Rule 12. $\left[\begin{array}{c} b \\ d \\ g \end{array} \right] > \left[\begin{array}{c} v \\ r \\ x \end{array} \right] / V _$

Rule 13. In IsiA, $v > w / a _ a$

Rule 14. In IsiA, $[+back]_a > : / _ [+back]_a$

Rule 15. In IsiB, $s > t / \text{---}$ $\left\{ \begin{array}{l} \# \\ C \\ V \\ [- \text{front}] \end{array} \right\}$

Rule 16. In IsiB, $t > s / \text{---}$ $\left[\begin{array}{l} V \\ + \text{high} \\ + \text{front} \end{array} \right]$

Table 2. Examples of Applications

PCC	*?alg+w	*?+l+ŋ	*taglaŋ	*bulaŋ	*kulaŋ
Rule 1	?aLg+w	?+L+ŋ	tagLaŋ	buLaŋ	kuLaŋ
Rule 2	?aLgaw	DNA	DNA	DNA	DNA
Rule 3	?eLgaw	?eL+ŋ	DNA	DNA	DNA
Rule 4	DNA	DNA	tagLeŋ	buLeŋ	kuLeŋ
Rule 5	DNA	DNA	DNA	DNA	DNA
Rule 6	DNA	?eLoŋ	DNA	DNA	DNA
Rule 7	DNA	?e?oŋ	DNA	bu?eŋ	ku?eŋ
Rule 8	DNA	?eyoŋ	DNA	buweŋ	kuweŋ
Rule 9	?e:gaw	DNA	taggeŋ	DNA	DNA
Rule 10	DNA	DNA	DNA	DNA	DNA
Rule 11	DNA	DNA	DNA	DNA	?uweŋ
Rule 12	?e:xaw	DNA	DNA	DNA	DNA
Isinai	?e:xaw 'day'	?eyoŋ 'nose'	taggeŋ 'rib'	buweŋ 'moon'	?uweŋ 'worm'
PCC	*bu?uk	*?+d+g	*da?puL	*gu?gu	*duL+w
Rule 1	DNA	DNA	da?puL	DNA	duL+w
Rule 2	DNA	DNA	DNA	DNA	duLaw
Rule 3	DNA	DNA	de?puL	DNA	DNA
Rule 4	DNA	DNA	DNA	DNA	duLew
Rule 5	DNA	DNA	DNA	DNA	DNA
Rule 6	DNA	?odog	DNA	DNA	DNA
Rule 7	DNA	DNA	DNA	DNA	du?ew
Rule 8	buuk	DNA	DNA	DNA	duweŋ
Rule 9	DNA	DNA	de?pu:	DNA	DNA
Rule 10	DNA	DNA	de:pu:	gu:gu	DNA
Rule 11	buu?	DNA	DNA	DNA	DNA
Rule 12	DNA	?orox	DNA	gu:xu	DNA
Isinai	bu:? 'hair'	?orox 'back'	de:pu: 'ashes'	gu:xu 'scratch'	duweŋ 'betel leaf'

PCC	*?apuL	*dal+m	*pag+w	*d+t?aL	*dak+l
Rule 1	?apuL	daL+m	DNA	d+t?aL	dak+L
Rule 2	DNA	DNA	pa:gaw	DNA	DNA
Rule 3	?e:puL	deL+m	DNA	d+t?eL	dekel
Rule 4	DNA	DNA	DNA	DNA	DNA
Rule 5	DNA	DNA	DNA	DNA	DNA
Rule 6	DNA	deLom	DNA	dot?eL	deke:
Rule 7	DNA	de?om	DNA	DNA	DNA
Rule 8	DNA	deyom	DNA	DNA	DNA
Rule 9	?e:pu:	DNA	DNA	dot?e:	deke:
Rule 10	DNA	DNA	DNA	DNA	DNA
Rule 11	DNA	DNA	DNA	DNA	de?e:
Rule 12	DNA	DNA	pa:xaw	DNA	de?e:
Isinai	?e:pu: 'lime'	deyom 'deep'	pa:xaw 'chest'	dot?e: 'floor'	de?e: 'many'
PCC	*ba?ba	*taglaŋ	*p+gs+n	*kap+s	*?ituldun
Isinai	ba:va	taggeŋ	pogson	?a:pos	?iti:run
Rule 13	ba:wa	DNA	DNA	DNA	DNA
Rule 14	DNA	ta:geŋ	DNA	DNA	DNA
Rule 15	DNA	DNA	pogton	?a:pot	DNA
Rule 16	DNA	DNA	DNA	?a:pot	?isi:run
IsiA	ba:wa	ta:xeŋ	pogson	?a:pos	?iti:run
IsiB	ba:va 'tooth'	taggeŋ 'rib'	pogton 'squeeze'	?a:pot 'cotton'	?isi:run 'push'