In other words, the evidence, arguments, and formulations for Nilo-Saharan reconstruction provided in Chapters 2-8 offer what a strong explanation should provide—interlocking and mutually confirmatory results that generate answers to questions and solutions for issues not conceived of in the initial formulation of problem.

Some languages of the family are well attested indeed, in quality or quantity of evidence or both—it is these that provide the fundamental resources for the overall systematic reconstruction. They make this study possible because they constitute a numerous, representative selection from each distant branch of the family: Uduk from the Koman branch; numerous Central Sudanic languages (usually represented here by proto-Central Sudanic or proto-East Central Sudanic root reconstructions from Ehret MS, available on request); Kanuri from the Saharan group; Kunama, Songay, and For from their respective single-language branches; and Dongolawi, Nobiin, Diling, Gaam, Bertha, Ik, Soo, and many of the Nilotic languages for Eastern Sahelian. This work depends, too, on several existing intermediate reconstructions—of the Eastern and Southern Nilotic, Rub (Kuliak), Daju, and Central Sudanic groups. Several less well-studied languages have been taken into account in the numerous tablings of data and in the findings, providing us a provisional sense of how these languages fit into the history of their various subgroups. But the determinative evidence for the reconstruction comes from the many well-attested languages.

There is perhaps one, fairly specific lesson to be noted here. In historical reconstruction by linguists, one often encounters a confusion about the enduring scientific principle of Ockham's razor. This principle requires us to chose the explanation that most simply accounts for the observed results. But "most simply" is relative. It does not mean that the phonological system we reconstruct should always be simple in some absolute way. The explanation that most simply accounts for the data may necessitate, for instance, a relatively large number of consonants, as the Nilo-Saharan evidence does.

More particularly for Nilo-Saharan, the lesson is this: we cannot assume that simpler consonant inventories are original and that more complicated ones are secondary. Only full, systemic comparison can resolve the matter. To do otherwise is to prejudge the case and foreclose essential avenues of inquiry. In the Nilo-Saharan family, at least one branch, Central Sudanic, did increase the number of its consonants. In most other branches of the family, consonant mergers tended to predominate, shrinking the inherited inventory very little in some languages, such as Uduk, and a lot in some others, most especially in proto-Southern Nilotic, which ended up with just fourteen consonants in all.

CHAPTER 2
THE CONSONANTS OF PROTO-NILO-SAHARAN

Consonant articulations

The consonants of proto-Nilo-Saharan (hereinafter PNS; see Table 1.1 for this and other abbreviations) formed a relatively complex system, but a system the contours of which were apparent even before extensive and detailed comparative work was undertaken (Ehret 1981a and 1981b). The number of consonants in modern-day Nilo-Saharan languages ranges from as few as thirteen (in some Kalenjin dialects) to well over forty (in some Central Sudanic tongues). Recurrent features of the consonant inventories of distantly related and often geographically remote languages made it clear, however, that the dominant drift of Nilo-Saharan phonological history had been toward simplification of an originally numerous array of consonants.

Up to five potential positions of stop articulation—labial, dental, alveolar, prepalatal, and velar—are separately indicated in Koman, Nilotic, and Central Sudanic divisions of the family. The Koman, Central Sudanic, and Rub ("Kuliak")[1] languages had as well at least four manners of stop release: voiced glottalic (implosive), voiced non-glottalic, voiceless glottalic (ejective), and voiceless non-glottalic. Comparative study, once begun, quickly turned up patterns of one-to-one sound correspondence between these features in the languages that had them. Already in Ehret 1981 such patterns could be discerned—i.e., velar ejective /k'/ in Rub words matched up with /k'/ in cognate Koman and Central Sudanic roots, Rub implosive /ɗ/ corresponded to /ɗ/ elsewhere, and so forth. Clearly these features reflected not some early areal influences but fundamental distinctions of PNS phonology. As the comparative reconstruction proceeded, additional consonant distinctions not at first suspected also emerged from the data.

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[1] A new name, Rub, meaning "human being" in the proto-Rub language, had to be chosen for the closely related Ik, Soo, and Nyang'i subgroup of languages, in place of the name formerly used by linguists, Kuliak. That name has the pejorative meaning "paupers" in the Karimojong language of their neighbors.

PNS voiced stops

The most straightforward reconstructions are of the PNS nasal consonants. In nearly all the Nilo-Saharan languages, four nasals occur—/m/, /n/, /ɲ/ (often represented by the digraph *ny*), and /ŋ/—and the one-to-one correspondence of *m* with *m*, *n* with *n*, and so on, from language to language across the family shows that almost everywhere these phonemes preserve the PNS consonant values. PNS *m and *n have, in fact, undergone almost no sound shifts in any environments, and only in a very few languages have *ɲ and *ŋ been lost or become restricted in their occurrence. These few cases involve languages, such as Nara in Ethiopia, the Nile Nubian tongues, and Kanuri, spoken in regions of strong and often ancient areal influence from Afroasiatic languages, in which these two nasals are generally missing or at best very rare.

A fifth nasal, dental /n̪/, has been recorded in Temein and in Majang (Bender 1971), where it appears to be a secondary development (see PNS root 1437), and is found in Naath ("Nuer"), Jyang ("Dinka"), and Ocolo ("Shilluk") of Western Nilotic, where it occurs in a limited number of environments. That it is also a secondary development in Western Nilotic remains to be fully demonstrated. But it cannot at present be traced any further back in Nilo-Saharan as a whole.

The glottalic and non-glottalic voiced stops of PNS have not uncommonly fallen together in the modern languages, most often as normal non-implosive stops, as the considerations of naturalness would lead one to expect. In Maasai and some other Eastern Nilotic languages, on the other hand, their common outcomes are implosive. But wherever the plus- and minus-implosive distinction has been maintained, the reconstructibility of two series of PNS voiced stops is clear. The straightforward cases are those of *ɓ and *ɗ, which consistently produce /ɓ/ and /ɗ/ in the languages that maintain the distinction, whereas *b and *d in those languages yield /b/ and /d/.

The demonstrations of PNS *ƈ and *ɠ are more indirect.

The prepalatal *ƈ has widely fallen together with reflexes of PNS *d or *ɗ in different languages, suggesting that it may have been a prepalatal rather far forward in its position of articulation. It remains a distinctly palatal implosive today only in the Rub languages, but produced non-implosive palatal reflexes in Maba and For. The Songay reflex /z/ of PNS *ƈ surely also derives from an earlier prepalatal with affricate articulation, [ǰ], which in turn would have derived from a previous stop pronunciation, [j]. The equivalent PNS *non-implosive, *ƈ̪, much more generally than *ƈ produced prepalatal and palatal outcomes in the modern languages. But while its prepalatal locus of articulation is clear, its origin as a stop is obscured by the frequency with which its present-day reflexes are fricatives. In the end, it is the systemic patterning of the PNS voiced stops and the considerations of natural directions of sound shift that dictate the postulation of *ƈ and *ƈ̪ as the prepalatal correlatives of *ɓ and *b and *ɗ and *d.

The distinction least preserved is that between PNS *ɠ and *ɡ. Only in Soo and sometimes in Ik, and possibly rarely in Mangbetu of Central Sudanic, does the distinction overtly persist. Proto-Central Sudanic (PCS) maintained *ɠ and *ɡ as separate phonemes, although the two have fallen together in nearly all the modern Central Sudanic languages (Ehret, MS). Distinctive outcomes for the two are also apparent in Nubian, PNS *ɠ producing Nubian *ɡ, but PNS *ɡ palatalizing to Nubian *j. Almost everywhere else in the family, reflexes of *ɠ and *ɡ cannot be distinguished.

The fifth position of voiced stop articulation, dental, appears to have lacked the glottalic/non-glottalic opposition. Only non-implosive PNS *ƈ̪ can be reconstructed. The postulation of this stop rests on the evidence of those subgroups that have maintained distinctive dentals, most notably Uduk of Koman and the Western Nilotic tongues. The one identified case of PNS *ƈ̪ in Maba has /j/ as its reflex of the dental stop (root 179): a quite plausible outcome since there seems to be a recurrent natural connection of palatal and dental positions in the world's languages, as well as elsewhere in Nilo-Saharan. But more data is needed to see if /j/ is the fully regular Maba outcome of PNS *ƈ̪. In a majority of Nilo-Saharan languages, however, PNS *ƈ̪ and *d have fallen together as a regular consequence of the deletion of the feature [+dental] from the phonology.

A further stop series, of PNS prenasalized *mb, *nd, *nƈ̪, and *ŋg, is also required by the comparative evidence. Note that, as for the implosives, no equivalent dental member of the set can be reconstructed (at least as yet). The prenasalized stops are maintained in a quite different scatter of languages from those that preserve the glottalic/non-glottalic opposition. They appear in Kanuri, Maba, Nara, Tama, and almost all Central Sudanic tongues, among others. They are to be interpreted as unit phonemes rather than clusters because they occur in all stem consonant positions, unlike the prenasalized voiceless stops of PNS (considered below among the voiceless stops). In most Nilo-Saharan languages that lack them, the voiced prenasals have fallen together with the equivalent non-glottal, oral voiced stops; in a few cases they have collapsed instead with the equivalent simple nasal, e.g., PNS *mb > proto-Nilotic *m. Uniquely in proto-Rub in non-

initial environments, PNS *NC became the corresponding implosive stop: PNS *mb > Rub *ɓ /V_, for example.

The following sample of the Nilo-Saharan correspondences among the voiced stops (Table 2.1) illustrates the kinds of patterns of sound correspondence that exist in stem-initial environments and provides the diagnostic evidence for the reconstructible etymons of each correspondence set. (The Central Sudanic citations are of the PCS consonants as reconstructed in Ehret, MS).

Table 2.1. Sample of Nilo-Saharan voiced stop correspondences

PNS	Uduk	CSud	Kunama	Kanuri	Songay	Maba	Nara	WNil	Ik
***ɓ**	ɓ	*ɓ	b	b	b	b	b	b	ɓ
***ɗ**	ɗ	*ɗ	d	d	d	d	d	d	ɗ
***ḍ**	d, j	*ḍ	d	d	d	j	d	d	'j, z
***ʄ**	ɡ	*ʄ	ɡ	ɡ	ɡ	ɡ	ɡ	ɡ	ʄ
***b**	b	*b	b	b	b	b	b	b	b
***ḏ**	ḏ	*d	d	d	d	j	d	ḏ	ɗ, d
***d**	d	*d	d	d	d	d	d	d	d
***ḍ**	j	*ḍ	š	z	z	j	s	j	'j, dz
***ɡ**	ɡ	*ɡ	ɡ	ɡ	ɡ	ɡ	ɡ	ɡ	ɡ
***mb**	b	*mb	b	mb	b	mb	mb	m	ɓ, m
***nd**	d	*nd	d	nd	d	nd	nd	d	d
***nḍ**	d	*nẓ	š	nj	z	(?)	(?)	j	'j, ɲ
***ŋg**	ɡ	*ŋg	ɡ	ŋg	ɡ	ŋg	ŋg	ŋ	ɡ, ŋ
***m**	m	*m	m	m	m	m	m	m	m
***n**	n	*n	n	n	n	n	n	n	n

PNS	Uduk	CSud	Kunama	Kanuri	Songay	Maba	Nara	WNil	Ik
***ɲ**	ɲ	*ɲ	ɲ	n	ɲ	ɲ	n	ɲ	ɲ
***ŋ**	ŋ	*ŋ	ŋ	ŋg	ŋ	ŋ	n	ŋ	ŋ

The correspondences of these consonants in non-initial environments are complicated by various kinds of lenition (e.g., *ɓ and *b > [v]~ [w] /V_V in Kanuri), by levelling of voice distinctions in other cases, and by collapsing of glottalic with non-glottalic reflexes in still other instances. These patterns are dealt with in the general tables of consonant correspondences with which this chapter closes (Tables 2.9 and 2.10).

PNS voiceless stops

Although the parallel occurrence of the glottalic/non-glottalic opposition in the PNS voiceless as well as voiced stops was apparent from the first (Ehret 1981a), what was not clear until the detailed investigation had begun was that the voiceless stops in fact partook of a three-way distinction—glottalic, aspirated, and unaspirated. Only one Nilo-Saharan language, Uduk, has fully maintained the PNS voiceless stops, but the distinctive correspondence patterns marking each of these consonants show that the three-way contrast was not a creation of Uduk alone, but an old PNS feature. The Uduk consonant in each case approximates the most plausible source form for each correspondence set and so can be seen as closely resembling, even if not perhaps exactly preserving, the PNS etymon. Where Uduk has a non-aspirated stop, for instance, a not uncommon outcome elsewhere is the equivalent voiced stop; e.g., Uduk /t/ = proto-Nilotic (and WNil) *d. Voicing is a natural direction of change because a non-aspirated /t/ is usually articulated as a tense stop, alike to [d] except in its lack of voicing. In contrast, an Uduk aspirated stop in initial position almost always corresponds to voiceless reflexes in other Nilo-Saharan tongues, as would be expected of a minus-tense consonant; while Uduk ejectives match up with ejectives in any other Nilo-Saharan languages that preserve such consonants.

Table 2.2, a sampling of the key correspondences in word-initial position, using a slightly different set of languages from those in Table 2.1, lays out the diagnostic evidence for the reconstruction of the PNS voiceless stops.

Table 2.2. Sample of Nilo-Saharan voiceless stop correspondences

PNS	Uduk	CSud	Kanuri	Songay	Maba	Gaam	Bertha	WNil	Rub
***p**	p	*p	b	b	b	p	b	b	*b
***p^h**	p^h	*p	f	f	f	f	f	p	*p
***p'**	p'	*p'	b	b	b	b	p'	p	*ɓ
***ʈ**	ʈ	*t	t	t	d	t	d	ʈ	*t
***ʈ^h**	ʈ^h	*t	t	t	d	t	θ	ʈ	*t
***ʈ'**	ʈ'	*t'	t	t	d	t	s'	ʈ	*c'
***t**	t	*t	d	d	t	t	d	d	*t
***t^h**	t^h	*t	t	t	t	t	θ	t	*t
***t'**	t'	*t'	t	d	d	t	s'	t	*c'
***ʦ**	c	*ʦ	t	t	č	c	θ	c	*c
***ʦ^h**	c^h	*c	c	t	č	c	θ	c	*c
***ʦ'**	c'	*ʦ'	s	t	(?)	ʦ	s'	c	*c'
***k**	k	*k	k	g	g	k	h	k	*k
***k^h**	k^h	*k	k	k	k	k	h	k	*k
***k'**	k'	*k'	k	h	k	k,Ø	k'	k	*k'

As with the voiced stops of PNS, a variety of levelling shifts in non-initial environments, especially those collapsing distinctions of voicing, complicate the correspondence patterns of the voiceless stops. For these, see again the full tabling of PNS consonants at the end of the chapter (Tables 2.9 and 2.10).

Prenasalized varieties of the voiceless stops can also be reconstructed for PNS. Found, however, only in post-vocalic contexts in words, and often analyzable into sequences of stem-final nasal consonant plus a suffix composed of a voiceless stop, these have to be treated as clusters of two reconstructible phonemes and not, like PNS *mb, *nd, *nʤ, and *ŋg, as unit phonemes.

An additional, sixth locus of stop articulation, labial velar, is likely to have existed at one time in the *pre*-proto-Nilo-Saharan language (pre-PNS). A full range of phonemic voiced and voiceless stops would have filled that slot: *g^w, *ʤ^w, *ŋg^w, *k^w, *k^{hw}, and *k$^{w'}$. But by PNS times such consonants had been subsumed into a wider set of *Cw sequences that had developed in the PNS language, deriving from uncertain antecedants, and in which *C could be almost any of the PNS consonants. The phonemic distinctiveness of the erstwhile labial velars had therefore been lost in PNS.

Two features of their PNS occurrence patterns testify, however, that they formerly constituted a separate phonemic set. Firstly, *Cw sequences tend to be notably more frequent when C is velar than when it is not. Over 25% of the voiced-velar-initial stems in the reconstructed Nilo-Saharan vocabulary (over 30% if *ŋ is neglected) are in fact *Cw initial; with one exception, PNS *d, the rest of the voiced stops have an under-20%, and most an under-10%, rate of *Cw shapes in that environment. For the voiceless velar stops, this criterion is less telling; about 11% of voiceless-velar-initial roots begin actually in *Cw. This figure is indeed markedly higher than the proportion of *Cw sequences among the rest of voiceless-stop-initial roots taken as a whole. But three individual non-velars, PNS *t', *ʦ, and *ʦ', do have distinctly higher percentages, at least in the available data, of *Cw occurrences than of *k, *k^h, and *k'.

A second distributional feature consistently sets off the velar cases of *Cw from the rest, however—PNS velar stops can occur followed by *w in stem-final as well as initial position, whereas no other consonant on present evidence can do so. Labialized velars, in other words, could appear in both the regular PNS stem positions, consistent with their having once been phonemes distinct from simple velars; while all other cases of *Cw show a defective, initial-only pattern of occurrence, indicative of their secondary derivation from some other kind of generating conditions in pre-PNS.

PNS fricatives

Fricative phonemes can be reconstructed for only three of the positions of stop articulation, the dental, alveolar, and prepalatal. The dental locus of PNS *θ has been maintained in just one Central Sudanic language, Baledha (Balendru), and in Bertha and Western

Nilotic, but is indirectly implied also by its distinctive outcomes in several other languages, notably in Uduk and Kunama where it produces a palatal or prepalatal fricative. PNS alveolar *s and prepalatal *ṣ are more often retained in forms resembling their probable PNS values. A single voiced fricative, PNS *z, was probably alveolar in its articulation, although in Western Nilotic its reflex is a voiced dental.

A fifth, prenasalized and voiced fricative phoneme, *nð, needs also to be postulated. At the proto-Saharo-Sahelian (PSS) stage in the evolution of the family (see Chapter 4 for demonstration of the subclassification followed here), it had become articulated as *nz, since in the descendant languages of that branching its reflexes consistently run parallel in articulation to those of PNS *z (Table 2.3 below). But in the three language groups—Koman, Central Sudanic, and Kunama—that derive from earlier branchings of the family, the evidence requires a different PNS articulatory positioning for *nð. In Kunama it fell together with PNS *θ as /š/, indicating a pre-Kunama dental locus of articulation, while in PCS it produced a palatal outcome, represented here as *nj. The evidence of Uduk is ambiguous as to its pre-Koman point of pronunciation: there *nð, like *both* PNS *θ and *š, yielded /š/, at least word-initially. What is clear from these data is that in PNS *nð was pronounced as either a prepalatal or a dental but not as an alveolar [nz].

The simplest and therefore preferable history of sound-shift, however, and one nicely in keeping with the subclassification developed in Chapter 4, is that PNS *nð began as a dental prenasal, fricative in its manner of airflow to account for its near universally fricative outcomes in modern Nilo-Saharan tongues, and that it remained thus pronounced throughout the subsequent proto-Sudanic and proto-Northern Sudanic (PNSud) stages. Its Uduk and Kunama outcomes would thus follow simply from the same sound-shifts that affected the other PNS dental fricative, *θ, in those languages. For the PSahSah daughter of proto-Northern Sudanic, only a single sound change, from *nð to *nz, need be postulated, after which its history paralleled that of PNS *z in the various Saharo-Sahelian languages. In PCS again only a single sound shift, moving *nð from dental to palatal articulation, is required.

The articulatory ease of shifts between dental and palatal position is widely attested in the world's languages. The most common direction is from palatal to dental; e.g., the cases of Castilian /θ/, the dental consonants of Swahili and Makua in eastern Africa, and the dental outcomes of PNS *ʈ and *ʈʰ in Bertha in Table 2.2. But as other Nilo-Saharan examples presented in this chapter show, e.g., the Uduk and

Kunama outcomes for PNS *θ above and the Nilotic reflex of PNS *l̪ below, the opposite direction of shift is also possible.

Interestingly, the PNS fricatives all became stops in proto-Nilotic. Thus, *except* in certain limited environments in some Eastern Nilotic languages, any words or morphemes in a Nilotic language that contain /s/ must be considered loans. Proto-Nilotic was, like some modern Western Nilotic tongues, a language without fricatives.

The diagnostic correspondences of the PNS fricatives in word-initial position are illustrated in Table 2.3.

Table 2.3. Sample of Nilo-Saharan fricative correspondences

PNS	Uduk	CSud	Kunama	Kanuri	Songay	Bertha	WNil	Rub
***θ**	š	*θ	š	s	s	θ	t̪	*s
***s**	s	*s	s	s	s	š	t	*s
***ṣ**	s	*ṣ	s	s	s	θ	c	*ṣ
***z**	s	*z	s	z	s	z	d̪	*s
***nð**	š	*nj	š	nz	z	z	d̪	*s

PNS liquids

Of the three liquids reconstructible for PNS, two are uncomplicated postulations. PNS *l must be seen as the etymon of a correspondence set that gives /l/ generally, but not quite universally, across the family. The major exceptions are Rub, in which PNS *l rather unexpectedly produced proto-Rub *ɬ, and Nubian, in which the reflex of *l in initial position was *d. PNS *l also yields flap reflexes non-initially in one branch of the Surmic group and in Nyimang. The flapped consonant of PNS, *r, more commonly produces divergent reflexes in word-initial position than does PNS *l. In that environment *r became /d/ in Kunama and Songay, yielded /d/~ /ɗ/ in Daju, and dropped out entirely in Nubian. But nearly everywhere else it remains simply /r/.

The third liquid, PNS *l̪, is a considerably less straightforward postulation. In a great many Nilo-Saharan languages its reflexes have fallen together with those of *l. Generally in Uduk, Nilotic, and Rub, however, and non-initially in Gaam among others, distinctive out-

comes for *l̪ appear. The representation chosen here for it, with a dental diacritic, aligns it with the similarly marked dental stops and fricatives. Overtly dental reflexes of the consonant appear in Uduk of the Koman branch and in Gaam of the Eastern Sahelian subgroup. In Uduk *l̪ is realized as a dental stop [d̪] word-initially; and word-final in pre-Uduk it probably also formerly produced *[d̪], since its present-day Uduk outcome, [d], is identical to that of PNS *d̪ in the language. Only in old intervocalic contexts in Uduk does it yield the reflex [l] indicative of its originally lateral nature. In Gaam, PNS *l̪ became an interdental voiceless fricative (written ɬ) in most postvocalic environments, but *l word-initially.

Indirect evidence of *l̪'s originally dental pronunciation comes from a variety of other languages in which the consonant produced flapped outcomes, indicative of an originally front-tongue point of articulation: e.g., Kanuri, in which *l̪ > r /_#, and proto-Surmic, where *l̪ > *r /#_, among others. In Nilotic alone (and probably in certain word-initial environments in Daju), it produced a palatal outcome (proto-Nilotic *lʸ, realized as proto-Eastern Nilotic (PEN) *j' and proto-Southern Nilotic (PSN) *lʸ).

A sampling of the word-initial correspondences of PNS *l, *l̪, and *r follows in Table 2.4. For further particulars, one should again turn to the tables at the close of this chapter.

Table 2.4. Sample of Nilo-Saharan word-initial liquid correspondences

PNS	Uduk	CSud	Kunama	Kanuri	Songay	Nubian	Gaam	Nilotic	Rub
***l**	l	*l	l	l	l	*d	l	*l	*ɬ
***l̪**	d̪	*l	l	l	l	*d	l	*lʸ	*l
***r**	r	*r	d	r	d	Ø	r	*r	*r

PNS glides

Four PNS consonants can be placed in the category of glides. The interesting feature of this class in PNS was the recurrence there of the glottalic/non-glottalic distinction: PNS *w paired with a second PNS labial glide *'w, while PNS *y was paralleled by PNS *'y. The articulations of these four proto-phonemes can be presumed to have been similar to those of their modern reflexes /'w/, /'y/, /w/, and /y/ in

the Moru-Madi and Mangbetu languages of Central Sudanic: the first two consonants differ from the latter two by the addition of "a slight glottal 'catch'" (Tucker 1940: 105); they are pre-glottalized glides. Distinctive outcomes for PNS *w and *y have been noted only in Central Sudanic, argued to have preserved the original articulations; in Rub, where PNS *'y became proto-Rub *'j and PNS *'w post-vocalically fell together with proto-Rub *b; in Songay, where both consonants became /h/; and in Maba where PNS *'w may possibly have produced /b/ non-initially. Elsewhere PNS *'y normally fell together with *y, and PNS *'w with *w.

Sample outcomes word-initially for the four consonants are presented in Table 2.5.

Table 2.5. Sample of Nilo-Saharan glide correspondences

PNS	Uduk	CSud	Kanuri	Songay	Nilotic	Rub
***w**	w	*w	w	w	*w	*w
***'w**	w	*'w	w	h	*w	*w
***y**	y	*y	y	y	*y	*y
***'y**	y	*'y	y	h	*y	*'j

The glottal consonant of PNS

One final phoneme, representing a sixth position of consonant articulation, is PNS *h. It may have had two allophones, *[h] word-initially and *[ʔ] in other environments, but the evidence is not conclusive for this allomorphic distribution. A sample of its reflexes in Table 2.6 reveals the limited range of word-initial outcomes PNS *h in the modern Nilo-Saharan tongues.

Table 2.6. Sample correspondences of Nilo-Saharan *h

PNS	Uduk	CSud	Kunama	Kanuri	Songay	Nara	Nilotic	Rub
***h**	h	*' (*ʔ)	h ~ Ø	h/_a,ɑ; y/_i,e; w/_o,u	h	h	Ø	*h

Elsewhere in Nilo-Saharan PNS *h generally became zero (Ø), as it did in Nilotic according to Table 2.6.

At some point in time, in pre-PNS, there probably existed an additional glottal consonant *ʔ. Its postulation is suggested by the existence in PNS of stems shapes VC and CV, differing from the otherwise general PNS *CVC pattern in their lack either of a stem-initial or of stem-final consonant. If such roots derive from earlier *ʔVC and *CVʔ shapes, their non-conformity to pattern would be accounted for by a single sound shift, deleting *ʔ. But such a consonant was clearly lost by the time of emergence of PNS, and modern occurrences of glottal stops in Nilo-Saharan languages can generally be assigned unambiguously to PNS *h or to later epenthesis.

The PNS consonant system

The forty-five PNS consonants revealed by the evidence presented here in Table 2.7 and in the Nilo-Saharan Etymological Dictionary can be arranged in a relatively well-balanced system.

Table 2.7. The consonants of proto-Nilo-Saharan

*ɓ		*ɗ	*ᶑ	*ʄ	
*b	*ᵭ	*d	*ḍ	*g	
*p	*ᵯ	*t	*ṭ	*k	
*pʰ	*ᵯʰ	*tʰ	*ṭʰ	*kʰ	
*p’	*ᵯ’	*t’	*ṭ’	*k’	
	*θ	*s, *z	*ṣ		
*m		*n	*ɲ	*ŋ	
*mb	*nð	*nd	*nḍ	*ŋg	
*w			*y		
*’w			*’y		*h
	*ᶅ	*l, *r			

A still better balanced system might have characterized the consonants of pre-PNS times. One of the two notable gaps in the distribution of the PNS voiced stops (see Table 2.1), the dental prenasalized

slot, can been filled, as it has been above, with a consonant that is best reconstructed for PNS as a dental prenasalized voiced fricative but which, from its systemic fit, can be suggested to have derived from an earlier pre-PNS *nᶑ. Somewhat more adventuresomely, it can be proposed that PNS *ᶅ, the dental lateral, accounts for the unfilled dental implosive slot, deriving thus from pre-PNS *ᶑ, or, alternatively, it may account for the empty dental nasal slot, in that case reflecting pre-PSN *ᶇ.

Nilotic consonant reconstruction

The Nilotic reconstruction followed here takes account both of the comparative work of Rottland (1982) and Vossen (1982) and of the wider correspondence patterns of the Nilotic cognates of older Nilo-Saharan roots. In combination, the data confirm the proto-Nilotic (PN) consonants reconstructed in Ehret 1974, with three significant exceptions: (1) two PN flap/trill consonants, flapped *r and probably trilled *R, must be postulated (following the lead of Rottland 1982), instead of just *r; (2) a voiced equivalent, *j, of PN *c must be added to the inventory; and (3) the dental nasal *ᶇ is a probable Western Nilotic innovation, not traceable to proto-Nilotic. Dimmendaal (1984) proposes an additional PN consonant *s, but its possible existence remains to be adequately substantiated and in any case appears extraneous to the wider Nilo-Saharan consonant correspondences of the Nilotic languages. In general, examples in Eastern and Southern Nilotic of /s/, whenever their origins can be traced, prove to be loanwords.

The existence of distinct /b/ and /ɓ/ and also /d/ and /ɗ/ in Bari of Eastern Nilotic has led Dimmendaal (1984) to propose extending those distinctions also to PEN and by implication to PN. But Bari /d/ is in fact the normal outcome of PEN *’j (PN *lʸ), and non-initial /b/ is a normal reflex of either PEN *p or *ɓ, depending on the environment involved. This situation leaves word-initial /b/ as an isolated item, attributable to word-borrowing, as examples in the Etymological Dictionary show (e.g., Bari entries in roots 62 and 70 versus those in roots 59, 61, 65, and 73, and also the borrowed and non-borrowed Bari forms of the same root noted in root 596). Other comparative work, undertaken by Hieda (1983 and elsewhere), must be treated with some care because it tends to mix together comparisons that are not supportable by rigorous sound correspondences with others that are quite supportable.

The presently substantiatable correspondences among the three branches of Nilotic—proto-Western Nilotic (PWN), PEN, and PSN—are as follows in Table 2.8.

Table 2.8. Nilotic consonant correspondences

PN	PWN	PEN	PSN	PN	PWN	PEN	PSN
***b**	*b	*ɓ	*p	***p**	*p	*p	*p
***ḍ**	*ḍ	*ɗ	*t	***ṭ**	*ṭ	*t	*t
***d**	*d	*ɗ	*t	***t**	*t	*t	*t
***j**	*j	*j’	*c	***c**	*c	*c	*c
***g**	*g	*g	*k	***k**	*k	*k	*k
***m**	*m	*m	*m	***r**	*r	*r	*r
***n**	*n	*n	*n	***ʀ**	*r	*r, *rr	*ʀ
***ɲ**	*ɲ	*ɲ	*ɲ	***l**	*l	*l	*l
***ŋ**	*ŋ	*ŋ	*ŋ	***l**^{y}	*l	*j’	*l^{y}
***w**	*w	*w	*w	***y**	*y	*y	*y

PEN and PSN each possessed separately reconstructible *s; but these, as argued above, entered each branch via loanword activity and cannot be found in words common to languages of the two branches except in cases where borrowing from a language of one branch into a language of the other branch is certain or probable. Vossen (1982) has proposed several additional PEN consonant reconstructions to those allowed here; these all appear explicable in different ways, however, as environmentally conditioned variants of certain of the PEN phonemes identified in Table 2.8.

Using the PNS consonant tables

In the remaining portions of this chapter, an extensive tabling of the observed consonant correspondences of Nilo-Saharan is presented.

Table 2.9 lays out the usual patterns of consonant occurrence in word-initial position through a wide selection of Nilo-Saharan languages, and Table 2.10 provides the most common outcomes for PNS consonants in non-initial environments in much the same set of languages. A slash separating two items of an entry indicates that the two are alternative outcomes in complementary environments, whereas a similarity sign (~) between two items indicates that they are or were at one time free-alternate reflexes. An entry in parentheses is a reflex attributable to one language or one subgroup but not as yet to the whole group to which the entry refers. The sign Ø marks a nil reflex of a consonant. Blank spaces have been left on the charts where no reflexes have yet been identified in the particular languages concerned. Each table is followed by a commentary describing variant or alternative consonant reflexes in more limited environments in the various languages and offering a provisional historical ordering of sound shifts in particular languages.

In most instances the consonant correspondences are those of individual modern languages, but in five cases the reconstructed consonants of the proto-language of a particular Nilo-Saharan subgroup are presented: for Central Sudanic (Ehret MS), for Daju (modified by the writer from Thelwall 1981), for Surmic (the writer’s very tentative proposals only), for Nilotic (Ehret 1974, revised by reference to Rottland 1982 and Vossen 1982), and for Rub (Heine 1976; Ehret 1981b). Also, in two instances where the modern Tama reflex of a PNS consonant differs from its reflex in earlier proto-Taman, the reconstructible proto-Taman root (marked with an asterisk) has been given. When a capital letter is offered as the reconstructed phoneme, the phonetic value of the etymon is unclear. Relatively minor adjustments of the published Daju reconstructions had to be made, and these are noted under the appropriate entries in the Nilo-Saharan Etymological Dictionary.

One significant correction of the published Rub reconstruction should be noted here, however. Ik /dz/ is usually a reflex of proto-Rub non-glottalic *j (PNS *ḍ), and its /z/ derives from proto-Rub *’j (PNS *ɗ) in underlying front-vowel environments. Ehret (1981b) mistakenly suggested the opposite alignment.

Table 2.9. Word-initial consonant correspondences of Nilo-Saharan

	*ɓ	*b	*ɖ̪	*ɗ	*d	*ɗ̣	*ɖ	*ʄ	*g	*mb	*nd	*nɖ	*ŋg	*n ð
Uduk	ɓ	b	ɖ̪	ɗ	d	d/j	j	g	g	b	d	d	g	š
PCS	*ɓ	*b	*d	*ɗ	*d	*ɗ̣	*ɖ	*ʄ	*g	*mb	*nd	*nz̧	*ng	*nj
Kunama	ɓ	b	d	d	d	d	š	g	g	b	d	š	g	š
Kanuri	ɓ	b	d	d	d	d	z	g	g	mb	nd	nj	ŋg	nz
For	ɓ	b	d	d	d	j	j	g	g	b	d		g	s
Songay	ɓ	b	d	d	d	z	z	g	g	b	d	z	g	z
Maba	ɓ	b	j	d	d	j	s	g	g	mb	nd		ng	
Dongolawi	ɓ	b	d	d	d	d	j	g	j	b	d	d	g	j
Tama	ɓ	b	d			j	j	g	g	*mb		j	*ŋg	
Nara	ɓ	b		d	d	d		g	g	mb	nd		ng	
Gaam	ɓ	b	d	d	d	ɖ	ɖ	g	g	b	d	ɖ	g	j
Bertha	ɓ	b		ɗ	d	ɗ	z	g	g		nd?	z	ŋg?	z
Temein				d/r		j				mb				
Nyimang	b	b	ɖ̪	d	d	d	ɖ̪	g	g	(*mb)			(*ŋg)	
Daju	*ɓ	*b		*ɗ	*d	*ɗ	*j	*g	*g	*mb	*nd	*nd	*ŋg	*ɲj (?)
Surmic	*ɓ	*b		*ɗ	*d	*d		*g	*g	*m	*d		*ŋ	
Nilotic	*b	*b	*ɖ̪	*d	*d	*d	*j	*g	*g	*m	*d	*j	*ŋ	*ɖ̪
Rub	*ɓ	*b	*ɗ	*ɗ	*d	*'j	*j	*ʄ	*g	*b/*m	*d	*'j/*ɲ	*g̣/*ŋ	*s (?)

Table 2.9. Word-initial consonant correspondences of Nilo-Saharan (continued)

	*p	*p^h	*p'	*ʈ̪	*ʈ̪^{h}	*ʈ̪'	*t	*t^h	*t'	*ʈ	*ʈ^h	*ʈ'	*k	*k^h	*k'
Uduk	p	p^h	p'	ʈ̪	ʈ̪	ʈ̪'	t	t^h	t'	c	c^h	c'	k	k^h	k'
PCS	*p	*p	*p'	*t	*t	*t'	*t	*t	*t'	*ʈ	*c	*ʈ'	*k	*k	*k'
Kunama	b	f	f	t	t	t/d	t/d	t/d	t/d	t/d	š	t/d	k	k	k/g
Kanuri	b	f	b	t	t	t	d	t	t	t	c	s	k	k	k
For	f	f	f	t	t	t	t	t	t	t	t	t	k	k	k
Songay	b	f	b	t	t	t	d	t	d	t	t	t	g	k	h
Maba	b	f	f	d	d?	d	t	t	d	c	c		g	k	k
Dongolawi	b	Ø	b	t	(t)	t	d	t	t	t	t	t	k	k	k
Tama		f		t	t	t	t	t	t	t	t	t	k	k	k
Nara	b	f	f	t	t	t	d	t	t	t	s	s	k	k	k
Gaam	p	f	b	t	t	t	t	t	t	c	c	ʈ	k	k	k/Ø
Bertha	b	f	p'	d	θ	s'	d	θ	s'	θ	θ	s'	h	h	k'
Temein	p	p		ʈ̪	ʈ̪	ʈ̪								k	k
Nyimang		f		ʈ̪	ʈ̪	ʈ̪	ʈ̪	ʈ̪		t	ʈ̪	d	k	k	k
Daju	*p	*p	*p	*t	*t	*t	*t	*t	*t	*s	*c	*c	*k	*k	*k/Ø
Surmic	*b	*p	(b)	*ʈ̪		*ʈ̪'	*t	*t/*c	*t/*c	*T	(c)	(š)	*k	*k	*k'
Nilotic	*b	*p	*p	*ʈ̪	*ʈ̪	*ʈ̪	*d	*t	*t	*c	*c	*c	*k	*k	*k
Rub	*b	*p	*ɓ	*t	*t	*c'	*t	*t	*c'	*c	*c	*c'	*k	*k	*k'

Table 2.9. Word-initial consonant correspondences of Nilo-Saharan (continued)

	*h	*θ	*s	*ṣ	*z	*r	*l	*l̪	*w	*'w	*y	*'y	*m	*n	*ɲ	*ŋ
Uduk	h	š	s	š	s	r	l	d̪	w	w	y	y	m	n	ɲ	ŋ
PCS	*'	*θ	*s	*ṣ	*z	*r	*l	*l̪	*w	*'w	*y	*'y	*m	*n	*ɲ	*ŋ
Kunama	h~Ø	š	s	s	s	d	l	l	w	w	y	y	m	n	ɲ	ŋ
Kanuri	h	s	s	s	z	r	l	l	w	w	y	y	m	n	n	ŋg
For	Ø	s	s	s	s	r	l	l	w	w	y	y	m	n	ɲ	ŋ
Songay	h	s	s	s	s	r	l	l	w	h	y	h	m	n	ɲ	ŋ
Maba	Ø	s	s	s	s	r	l	l	w	w	y	y	m	n	ɲ	ŋ
Dongolawi	Ø	s	s	š	s	Ø	d	d	w	w	Ø	Ø	m	n	n	n
Tama	Ø	s	s	s		r	l	l	w	w	y	y	m	n		ŋ
Nara	h	s	s	s		d	l	l	w	w	Ø	Ø	m	n	n	n
Gaam	Ø	s	s	s	j	ṛ	l	l	w	w	y	y	m	n	ɲ	ŋ
Bertha	Ø	θ	š	θ	z	r	l	l	w				m	n		ŋ
Temein	Ø						l	l	w	w	y, j	y	m	n̪ (n/_Vn)		ŋ
Nyimang	Ø	s	s (š/_ε)	s	s	d	l	l	w	w	j	y	m	n	ɲ	ŋ
Daju	Ø	*š	*s	*s	*š	*d/ɗ	*l	*l	*w	*w	*y	*y	*m	*n	*ɲ	*ŋ
Surmic	Ø	*c	*s	*š	*j	*r	*l	*r	*w	*w	*y	*y	*m	*n	*ɲ	*ŋ
Nilotic	Ø	*t̪	*t	*c	*d̪	*r	*l	*l^y	*w	*w	*y	*y	*m	*n	*ɲ	*ŋ
Rub	*h	*s	*s	*ṣ	*s	*r	*ɬ	*l	*w	*w	*y	*'j	*m	*n	*ɲ	*ŋw

Commentary to Table 2.9

Uduk

1. PNS *ɗ̪ > j /#_[-round]; PNS *ɗ̪ > d elsewhere.
2. PNS *t̪^{h} > c^h /#_i.
3. PNS *w, *'w sometimes > Ø /#_[+round].
4. PNS *y > Ø /#_e# and /#_eNC.
5. PNS *y, *'y sometimes > h~y /#_VC, V = [+high], especially *i.
6. PNS *n, *ŋ > ɲ /#_[+front] (before rule 9 in Commentary to Tables 3.1-3.4).

PCS

1. PNS *ɗ > pre-PCS *r /V_ (preceded shift 2).
2. a. PNS *(N)DVL > *(n)drV (D = PNS *d̪, *d, or *ɗ, L = PNS *l, *l̪, or *r, including *r < PNS *ɗ, for which see shift 1);
   b. PNS *TVL > *trV, T = all PNS dental, alveolar, and prepalatal voiceless stops except possibly *t̪^{h} (> PCS *c); L = as in 2.a.
3. PNS $*C_vVC_l > C_{lv}V$, where C_v = [+velar], C_l = [+labial], in the following varieties:
   (a) *ɠVB > gɓV;
   (b) *ɠVP, *gVB, *kVB, and *kVp > *gbV;
   (c) *gVP, *k^{h}VB, *k'VB, and *KVP > *kpV (B = *b or *ɓ, P = *p, *p^h, or *p', and K = *k, *k^h, or *k').
4. PNS *(N)DVS > *(n)zV if both D and S = dental or alveolar, > *(n)ẓV if one of D or S is prepalatal (D = *d̪, *ɗ, *d, *ɗ̪, or *ḍ, S = sibilant).
5. PNS [+tense/-voice] > pre-PCS [+voice] /N(V)_ (preceded shift 7).
6. PNS [+contin./-voice] > [+contin./+voice] /N(V)_ (preceded shift 7).
7. pre-PCS *NV(N)C > *NCV, C = [+voice] (not = PNS *l̪).
8. PNS *hVNC > *NCV.
9. PNS *waN > *Nwa.
10. *C > Ø /#CV_# (this shift came last and removed all remaining stem-final C not previously resituated by shifts 1-9).

Kunama

1. PNS *e, *o > pre-Kunama *a; PNS *ε > pre-Kunama e, *ɔ >

pre-Kunama *o; which was followed by:
2. PNS *e: > pre-Kunama *i:, *o: > pre-Kunama *u:; and:
3. *ʈ > *ʈʰ; after that:
4. *ʈ' > ʈ'; then:
5. *ʈ' > *c' /_i; and then:
6. *ʈ > t, *ʈ' > t', *ɗ > *ɗ, *ʂ > s; after which:
7. *t > pre-Kunama *d, *t' > *ɗ /#_VS, where V = [-high], S = sibilant; and in addition:
8. *t > pre-Kunama *d, *t' > *ɗ /#_VS(S)V(-)#, V = pre-Kunama *o(:) [< PNS *ɔ(:)], *u(:), S = sonorant. These shifts along with:
9. *k' > ɠ /#_il-; and:
10. PNS *ʈʰ >pre-Kunama *č, PNS *(n)ɖ > pre-Kunama *(n)ǰ—as well as two shifts deleting the distinction between dentals and alveolars:
11. NS *θ > š, *nð > pre-Kunama *nǰ; and:
12. PNS *ɖ > ɗ; *ʈʰ, *tʰ > t; *ɭ > l; the latter of which itself preceded:
13. *ɗ > r /V_—all came before:
14. deletion of the feature [+glottal] (collapsing the ejectives and implosives with their non-glottalic equivalents); and also before:
15. *ǰ > *č, *z > s; after which:
16. *č (created by shifts 11, 15, and 16) > š; and finally:
17. *NS > *S, where S = sibilant. Also, the shifts:
18. a. PNS *We, *Wi > u /#_C,
    b. PNS *Wa, *Wɛ > o /#_C, C not = l (?), and:
    c. PNS *Wa:, *Wɛ: > u /#_C, C = obstruent—this last shift preceding Kunama shifts 2 and 5 of the Commentary to Table 2.10 below— along with:
19. a. PNS *Yi(:) > i /#_,
    b. PNS *Yɛ(:), *Ya(:) > i /#_C, and
    c. PNS *Y > Ø /#_[+round]C; can all be placed after PNS *'w > w and *'y > y, which itself would have been brought about by shift 15 above.

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20. /d/ > sporadic d ~ ǰ alternations; rarely also /t/ > t ~ č.
21. *h > h ~ Ø /#_, > Ø elsewhere.

Kanuri

1. PNS *ʈ > pre-Kanuri *ʈʰ /V_; was followed by:
2. PNS *ʈ' > *č', *ʈʰ > *č in pre-Kanuri; which preceded:
3. pre-Kanuri *č' > *s'. Shift 2 along with:

4. PNS *t > d; and
5. PNS *VN > *V: /_Cʰ#, came before:
6. deletion of feature [±aspirated]. Another shift:
7. PNS *Vh > *V:, together with shift 3, operated before:
8. deletion of feature [glottal] (collapsing the ejectives and implosives with their non-glottalic equivalents). This shift and:
9. pre-Kanuri *č > *š > s /V_, both preceded:
10. V-raising/lengthening /#C_s/z# and /C_S#, S = alveolar sonorant, (i.e., PNS *ɛ(:) > *e:, *ɔ(:) > *o:, *e(:) > *i:, *o(:) > *u:). This shift (or, probably, composite of two shifts) along with shift 3 above and:
11. PNS *o > pre-Kanuri *ɔ: /#k_L, /#L_k, and /#k_k, L = liquid; all preceded:
12. PNS *e: > *i, *o: > *u in pre-Kanuri; followed by:
13. pre-Kanuri *i, *e, *o, and *u > ə, *ɛ and *ɔ > a, *a > ɑ /_C and /C_C_#. This shift was followed by:
14. *V: > V (*i: > i, *u: > u, *ɛ: > e, *ɔ: > o, *a: > a); which preceded:
15. /a/ > [ɑ] /_#. Shift 14 also came before:
16. PNS *g > j, *k > *c /_i and /#_i- (verb-stem-final) in pre-Kanuri; which was followed by:
17. pre-Kanuri *c > š; which came before:
18. *s > š /_i (and probably *(n)z > (n)j /_i); and:
19. pre-Kanuri *ɖ (< PNS *ɗ) > d ~ j /#_iC, > d elsewhere; PNS *ʈ > t; and:
20. PNS *g > j, *k > c /_ [+front] (only /e/ left in this category).

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21. PNS *#NCV# verbs > -VNC- in Kanuri class 1.
22. PNS *#VC > #wVC, V = [+round], > #yVC, V = [+front].
23. PNS *h >w /#_[+round], >y /#_[+front], > Ø /V_, > h elsewhere.

For

1. PNS *WV > o, u /#C- + __C (*Wa, *Wɛ, *We > o; *WV: and *Wi > u).
2. PNS *YV > i, e /#_V, V = [-round] (Ya > ya /#_#, > e /#__y; other YV > i);
3. PNS *Y > Ø /#_[+round].
4. PNS *Y > Ø /#C- + _aC.
5. PNS *g, ɠ > j, *D > r /verb-stem initial (D as in PCS shift 4).
6. PNS *y, *'y > j /verb-stem initial.

7. pre-For #wi# verb stems > iw- (this shift surely has some kind of wider generality, still to be determined, and probably derives from the effects of synchronic verb morphology).

Songay

1. PNS *ɖ > *ɖ, was followed by:
2. *ɖ > pre-Songay *ǰ; which along with:
3. PNS *ʈ, *ʈ^{h} > *[č], *ʈ' > *[c'] /V_ in pre-Songay; came before:
4. pre-Songay prepalatals were removed, probably by a shift to dental position (*ʂ > *θ, *ǰ (> *ž?) > *ð, *ɖ > *d̪, *ʈ > *t̪, *ʈ^{h} > *t̪^{h}, and *ʈ' > *t̪', with the allophones *[č] > *θ, *[c'] > *[θ']). This shift and:
5. PNS *[-voice/+glottal/-cont] > pre-Songay *[-voice/+tense/-cont] /N_, preceded:
6. *t̪, *t̪' > pre-Songay *t̪^{h}, except /N_, which came before:
7. deletion of feature [dental]. Shift 6, along with:
8. PNS *p > p^{h} /#_Vmp (one example, no counter-examples) also preceded:
9. [+tense/-voice/-cont] > [+voice/-cont] (remaining *p > *b, *t > *d, *k > *g). Shift 6, together with:
10. PNS *k' > h (*h later > Ø /V_), both preceded:
11. deletion of feature [+glottal] in three steps:
    a. [-voice/+glottal/-cont] > [+voice/+glottal/-cont]; followed by:
    b. [+voice/+glottal] > [+voice/-glottal]; and finally:
    c. pre-Songay *s' > *s*. Shifts 9 and 11, as well as the sequence of shifts 12 and 13—
12. PNS *yɛ(h)# > i (one example; no counter-example); followed by:
13. PNS *ɛ(:) > *e(:), *ɔ(:) > o(:) /#(C_)C_(N)#; > *a(:) elsewhere in pre-Songay—all operated before:
14. pre-Songay *g > j, *k > c, *ŋ > ɲ /_[+front] (this shift came after PNS *k and *ɠ > *g and *k' > h); which was itself followed by:
15. early Songay *a(:) > e(:), *e(:) > i(:), *o(:) > u(u) /#C_(N)C- + -V[+high]#.

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16. PNS *ɲ > n /#_o# and /o_#.
17. PNS *mb > *m /#_Vl- (just one example); after which:
18. PNS *NC > C /#_.
19. PNS *we(:) > o(o) /#__# and /#__L, L = liquid.

Maba

1. PNS *ŋ > ɲ /_[+front] (for palatalization of other velars, see commentary to Table 2.10, Maba shifts 14 and 15).
2. PNS *Wi, *We > o /#__l; *We (and presumably *Wi) > u /#__C, C not = *l; *Wɛ > o /_#.
3. PNS *YV > [+front] (examples: *yi > i; *yay > i /#CV__#; *ya > e /#__C; *'ye > e /#a__#).

Dongolawi

1. a. PNS *WV$_1$ > [+round] /#(a)__S(VC)(V)#, V$_1$ = [+front], sonorant; varieties: *Wɛ(:) > o(:), *Wa'y (> presumed pre-Dongolawi *We), *We(:), *Wi(:) > u(:);
   b. PNS *Wa(:), *Wɛ(:) > u /#__rC.
2. PNS *We (and *Wi ?) > u /#__s.
3. PNS *Yi(:), *Ye(:) > i(:), except for #'ye# > ɛ; followed by:
4. PNS *Y > Ø elsewhere.

Tama

1. PNS *WV > [+round] /#__f, /#__luw-, and /#__#.
2. PNS *Wi > i /#_k- (one example).
3. PNS *YV > i /#_#, V not = [+round].
4. PNS *Y > Ø /#_i.

Nara

1. pre-Nara *t > š /#_i (for sources of pre-Nara *t, see Table 2.9).
2. pre-Nara *s > [š] /#_i (pre-Nara *s < PNS *θ, *s, *š, and *z). For where these two shifts fit in the Nara ordered sound shifts, see Table 4.6, Nara shifts 9 and 10.

Gaam

1. PNS *We, *Wɛ > əə /#__L-#, > ə /#_LVC, L = liquid; *We:, *Wi > ɔ ~ u, *Wa > ɔ /#_S(C)-#, S = sonorant.
2. PNS *y > Ø /#_[+front].

Bertha

1. PNS *Yi > i:, *'ye(:) > i(:), *Wi > u /#_C.

2. PNS *#(V_1)CV_2# > #NCV#, V_1 = V_2, C = plain voiced stop, after Bertha shifts 7 and 10 in Commentary to Table 2.10.

Temein

1. PNS *ɗ > r /verb-stem-initial.
2. PNS *W > Ø /#_iCVC.
3. PNS *b > m /#_VN.

Nyimang

1. PNS *y > j /_e#.
2. PNS *ye > e /#_C, *yi > i.

Daju

1. PNS *wi > *(w)u, *we > *o /#_CV, C = [+contin].
2. PNS *'we > *u, *aWa > *o /#__d.
3. PNS *Wi > *i /#_CC.
4. PNS *wa(:) > o /#_SVC, S = sonorant.
5. PNS *ye > *i /#_y/
6. PNS *'y > *j /#_e (one example; no counter-examples).
7. PNS *ŋ > pre-Daju *ɲ /#_[+front] (before some PNS *ɛ > *a in pre-Daju).
8. PNS *l̰ > *'j /u.

Nilotic

1. PNS *we: > Nilotic *o: /#_CVC, V = [+round] (one example; no counter-examples as yet).

Rub

1. PNS *NC > *N /#_VC, C = [+sonorant] or [+contin]; > *C otherwise; and:
2. PNS *a:y > Rub *e, *ɛy > *i; both preceded:
3. PNS *#CV# > Rub *#VC#, V not = *wɛ; after which:
4. PNS *e > Rub *ɪ, *ẹ, *i, PNS *a > Rub *e /#Y_C (variant outcomes apparently depending on following C); which came before:
5. PNS *y > Ø /#_i.

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6. PNS *we, *wɛ, *(a)Wa > *o /#_C(V)# and /#_CVC-; and:
7. PNS *h > Ø /i- + #_V.

Wider distributed shared sound shifts

I. Northern Sudanic: PNS stem shape *#WV_1C# > -V_2C#, V_1 = [-round], V_2 = [+round], with addition of a prefix. The common outcomes were *Wa > /ɔ/ or /o/, *We > /o/ or /u/, and *Wi > /u/ in such instances. Examples of this rule are known throughout Nilo-Saharan except in Koman and PCS. It appears therefore to be in origin a long-lived synchronic morphophonemic innovation of the proposed Northern Sudanic branch (see Chapter 4).

II. Saharo-Sahelian: PNS *nð > *nz.

III. Sahelian: PSahSah *nz (< PNS *nð) > *z.

IV. Eastern Sahelian: PNS *#ŋg(w)V# > *ŋV in nominals. This shift is rarely attested because its environment is a rare one, but the evidence is consistent. It has been noted for the Kir-Abbaian languages and for Nara of Astaboran (evidence from Rub and Western Astaboran languages has not been found as yet: see roots 478 and 499 in the Etymological Dictionary), and thus appears to be an innovation of the Eastern Sahelian subgroup.

V. Possible Kir-Abbaian: PNS *h > Ø. This shift recurs commonly enough elsewhere; so it may have arisen separately in the Jebel and Kir branches of Kir-Abbaian or separately in still later subgroups of those two. The simplest hypothesis, though—since *h was still retained in early Rub and Astaboran (see Nara) of Eastern Sahelian, but nowhere in Kir-Abbaian—is that its deletion was a proto-Kir-Abbaian shift.

VI. Possible Kir-Abbaian: PNS *ɠ > *g. This shift recurs so widely that it may have been separately innovated since proto-Kir-Abbaian, but again the evidence for its earlier presence in Rub and Astaboran (see Nubian reflexes of the two consonants) and its complete lack of indication in Kir-Abbaian tongues make it most probably a Kir-Abbaian innovation.

VII. Jebel subgroup of Kir-Abbaian: PNS *ʈ̰' > probable proto-Jebel *[ɖ̰] /#_iC, yielding Gaam /j/ and falling together in Bertha with PNS *ɗ to produce modern-day Bertha /ɗ/.

VIII. Jebel subgroup of Kir-Abbaian: PNS *ʈ, *ʈ^h > *ʈ^h > proto-Jebel *č. Nowhere else in Nilo-Saharan do just these two particular consonants alone fall together.

Table 2.10. Non-initial consonant correspondences of Nilo-Saharan

	*ɓ	*b	*ɖ̤	*ɗ	*d	*ḍ	*ḍ	*ʄ	*g	*mb	*nd	*nḍ	*ŋg	*n ð
Uduk	ɓ	b/ɓ	ɖ̤/ɗ	ɗ	r	j/r	j	g~k’	g/k^h	b	d/ɗ		g/k^h	
Kunama	b	b	r	r	d	d/r	š	g	g	b	d	d	g	
Kanuri	v~w	v~w	r	r/l	r/l	r	z	g	g	mb	nd	z	ŋg	
For	b	b	r	r	r	j/r	j	g/Ø	g/Ø		nd		ŋg	s
Songay	b/w	b/w	r	r	r	r	r	g	g	mb	nd	nd	ŋg	nz
Maba	b	b		r	r	j	s				nd		ng	
Dongolawi	b	w	r	r	r	r (*d^y)	š	g	j	mb			ŋg/j/n	
Tama	b	b		l/r	r			g	g					*c
Nara	b	b	d	r	d			g		mb	nd		ng	
Gaam	b/w	w	ɬ	r	r	ḍ/r	ḍ	g	Ø	b			g/Ø	
Bertha		b	r	ɗ/r	d/rr	ɗ/r	d				nd			
Temein					d									
Nyimang	b	b	ɖ̤	r	d/r	ɖ̤		g	g					
Daju			*d	*ɗ/*r	*d/*r		*d	*g	*g	*mb	*nd		*ŋg	
Surmic	*b	*b	(r)	*r	*r	(r)		*g			*r		*ŋ	
Nilotic	*b	*b	*ɖ̤	*d	*r	*r	*j	*g	*g	*m	*r	*ɲ	*ŋ	
Rub	*ɓ	*b	*d	*ɗ	*d	*’j	*j	*ʄ	*g	*ɓ	*ɗ	*’j	*ʄ	

Consonants of Proto-Nilo-Saharan

Table 2.10. Non-initial consonant correspondences of Nilo-Saharan (continued)

	*p	*p^h	*p’	*ʈ	*ʈ^h	*ʈ’	*t	*t^h	*t’	*ʦ	*ʦ^h	*ʦ’	*k	*k^h	*k’
Uduk	p/p^h	p^h	p’/p	ʈ^h	ʈ^h	ʈ’/ʈ	t/t^h	t^h	t’/t	c/c^h	c^h	c’/c	k/k^h	k^h	k’/k
Kunama	b	f	f	t/d	t	t/d	d	t	t	t	š	t	g/k	k	k
Kanuri	p/v~w	p/f	p/v~w	t/d	t/d		r	t	t/d	s	s	s	k/g	k	k
For	b/f	f	b/f	t				t	t	s			g	g	g
Songay	b/w	f	b/w	r	t	t	r	t	r	s	s	s	g	k	Ø
Maba	f			d	r	r			t	s	s	s	k	k	k
Dongolawi	b	w	b				d	d			(*j)	š(*j)	k/g	k/g	k/g
Tama	b	f					t	t				c		k	k
Nara	b	f				t						s	g	h (?)	
Gaam	b/w	f/w	b/w	d/ɬ	d/ɬ	d/ɬ	d	d	r	s		s	Ø	Ø	Ø
Bertha		f	p’	d		s’	d	ɵ			ɵ	s’	g	h	k’
Temein				ʈ				t						k	
Nyimang	b	f		ɖ̤	ɖ̤		d		ɖ̤			ɖ̤?		k	
Daju	*b	*b	*b		*d	*ɗ	*d	*d			*c/*j		*g/*k	*g/k/x	*g/x
Surmic		*p	*b		*t								*k	*k	*k’
Nilotic	*b	*p	*p	*ʈ	*ʈ	*ʈ	*d	*t	*d	*c	*c	*c	*k	*k	*k
Rub	*b	*p	*ɓ		*t	*c’	*t	*t	*c’	*c	*c	*c’	*k	*k	*k’

Table 2.10. Non-initial consonant correspondences of Nilo-Saharan (continued)

	*mp	*mp^h	*mp'	*nʈ	*nʈ'	*nt	*nt^h	*nt'	*nʈ	*nʈ'	*ŋk	*ŋk^h	*nk'	*ns	*nʂ
Uduk	mp/p	p^h	mp	ʈ^h	ʈ'			ɗ			ŋk/k^h	k^h	ŋk~ŋk'		
Kunama	mb	nf		nt	nd	nd	nt	nd	t	nt	ng/g	nk/k	nk/k	ss	s
Kanuri	mb/p	w~v	mb	nd,n/_#	t		nt				ŋg/k	ŋg/k	ng/k		
For		b	b	nt							ŋ	g	g		
Songay	mb		mb	nd	nd	nd	nt	nd	nd	ns	ŋg/ŋ	ŋk	ŋg	ns	ns
Maba				nt							ng/ŋ	ng/ŋ	ng	s	
Dongolawi	mb/b	b	b	nd		d					ŋg/k/g	g/k	ŋg/g	ss	šš
Tama	(b)				d		t				k			s	
Nara	b			t								ng		s	
Gaam	b/w	f/w	b/w	ɬ	ɬ					j	ŋ	Ø	Ø ~ g	s(s)	s
Bertha		f	p'								ŋ			s	
Temein	m	p		ʈ	ʈ						ŋ				
Nyimang				ɖ							ŋ	g	g		
Daju		*b						*ɗ		*ɗ	*ŋ	*g/*k		*s	s
Surmic	*m			*t	*T							*k?		*s	*s
Nilotic	*m	*p	*p	*ʈ		*n	*t		*c	*c	*ŋ	*k	*k	*t	*c
Rub	*b		*ɓ	*t		*t	*t					*k	*k	*k'	(z)

Consonants of Proto-Nilo-Saharan

Table 2.10. Non-initial consonant correspondences of Nilo-Saharan (continued)

	*h	*θ	*s	*ʂ	*z	*r	*l	*ɭ	*m	*n	*ɲ	*ŋ
Uduk	'	s~ʈ^h	s	š	s	r	l	l/ɗ	m	n	ɲ	ŋ
Kunama	Ø	š	s	s	s	r~ll	l	l	m	n	ɲ	ŋ
Kanuri	Ø	s	s	s	z/s	r/l	l/r	l/r	m	n	n	ŋg
For	Ø	s	s	s	s	r	l	l	m	n	ɲ	ŋ
Songay	Ø	s	s	s	s	r	l	l	m	n	n/y	ŋ
Maba	Ø	s	s	s	s	r	l	l	m	n	ɲ	ŋ
Dongolawi	Ø	s	s	š	s	r	l	l	m	n	ɲ	ɲ/n
Tama	Ø	s	s			r/l	l	l	m	n	ɲ	ŋ
Nara	Ø	s		s		r	l	l	m	n		n/g
Gaam	Ø	z	s	s	d/j	r	l	ɬ/Ø	m	n	ɲ	ŋ
Bertha	Ø/ʔ	θ	š	θ	z	l/r	l	r	m	n	n	ŋ
Temein	Ø	s	s			r	l		m	n/ɳ	ɲ	ŋ
Nyimang	Ø		s	s		r	l	r/l	m	n	ɲ	ŋ
Daju	Ø	*š	*s	*s	*š	*R	*l	*R, *l	*m	*n	*ɲ	*ŋ
Surmic	Ø	[s]	*s	*š	(s)	*R	*l	*L	*m	*n	*ɲ	*ŋ
Nilotic	Ø	*ʈ	*t	*c	*ɖ	*ʀ	*l	*l^y	*m	*n	*ɲ	*ŋ
Rub	*h	*s	*s	*ʂ	*s	*r	*ɬ	*l	*m	*n	*ɲ	*ŋ

Commentary to Table 2.10

Uduk

1. PNS *mp > m /_#, was followed by:
2. pre-Uduk *N > NC /#CV_+ -Vl; and by:
3. PNS *NC > C /_#, C = [-voice] (*mp^{h} > p^{h}, *mp' > p', *ⱡ > ⱡ^{h}, etc.; except that *nt' > ɗ); this shift 3, along with:
4. pre-Uduk *g (< PNS *g, *ŋg) > k /_#; and:
5. pre-Uduk [+glottal/-voice] > [+tense/-voice] /V(N)_V (*p'>p, *ⱡ'> *ⱡ, etc.; ejection is retained in a few as yet undefined instances); and:
6. pre-Uduk *k^{h} > k^{h}~ h, *k' > k'~ ʔ (written ') /#C$_1$V_(VC)#, C$_1$ usually = velar; were all followed by:
7. pre-Uduk [+tense/-voice] > [-tense/-voice]/_# (*p > p^{h}, *ⱡ > ⱡ^{h}, etc.).

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8. PNS *ɭ > l /#ɭV_#, and:
9. PNS *ɭ > l /V_V; preceded:
10. PNS *ɭ > ɖ elsewhere. These three shifts, along with:
11. PNS *d > r /V_, were followed by;
12. a. pre-Uduk *ɓ > ɓ /_#, > b /V_V;
    b. pre-Uduk *ɖ > [ƈ]/_#, > ɖ /V_V;
    c. PNS *ƈ (> pre-Uduk *d) > r /_#, > j /V_V;
    d. PNS *ɠ > g~ k' /_#; which was followed by:
13. pre-Uduk *#moɖ#> #mutⱡ'# and *#moƈ# > *#mut'# + -a > #mut^{h}a# (after vowel shifts of PNS *ɔ > o and V: > V in pre-Uduk: rules 1 and 11 in Commentary to Tables 3.1-3.4); which was followed by:
14. pre-Uduk *[ƈ] > ƈ.

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15. PNS *ŋ > n /#nV_.

---

16. PNS *ɲ > n /#(C)a_(aŋa)#, C = PNS palatal.

---

17. PNS *nk^{h} > nk (*NC^{h} > NC ?) /#CV_Vl.

Kunama

1. PNS *ⱡ, *ⱡ' > T^{h}; /#C^{h}V(N)_V(-)# in pre-Kunama (after PNS *p' > *p^{h}, = modern Kunama /f/; and presumably after Kunama shift 3 in the Commentary to Table 2.9, by which PNS *ⱡ became also an ejective). This shift along with:
2. PNS *NC > C, C = [+voice]; were followed by:
3. PNS *k > k^{h} /#C^{h}VN_V(-)# ; after which:
4. PNS *ⱡ, *ⱡ', and *t > d, *k > ɡ /#(C)V(N)_; after which:
5. pre-Kunama *V(ŋ)k^{h} > *V(:)k^{h}, *nt > *t /#C$_1$V_V(C$_2$V), C$_1$ = pre-Kunama *t, *š, or *p^{h}), C$_2$ = l, n; > *nk elsewhere; which came before Kunama shift 15 of the Commentary to Table 2.9 (by which PNS *t > t) and also before:
6. pre-Kunama *k^{h} > k ~ g /#CV_V-#, C = [-voice/+cont]. Shift 6 probably preceded Kunama shift 14 in the Commentary to Table 2.9, since shift 6 is not yet known to cause PNS *k', changed to /k/ by shift 14, to produce any /g/ (remaining *k > /k/).

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7. PNS *p^{h}, *p' > pre-Kunama *p /#C(V)V$_2$_, V$_2$ = [+high] (i, u, w); examples are known of C = l, *w, *y, t, and s; the full environment of this shift remains to be worked out; took place before *p > Kunama /b/;
8. pre-Kunama *d (PNS *d, *ɖ) > r /#(C)V_(V)CV, > d elsewhere.
9. *r > l /#lV_.

Kanuri

1. PNS *ɖ > pre-Kanuri *ǰ (> Kanuri /z/); was followed by:
2. the collapsing of PNS *ɖ and *ƈ, probably by a shift of the form PNS *ɖ > pre-Kanuri *ƈ, and then by:
3. pre-Kanuri *ƈ > r /V_, > *ɖ elsewhere. This latter shift, along with:
4. PNS *p' > pre-Kanuri *ɓ; preceded the Kanuri shift 7 of the Commentary to Table 2.9. Another shift:
5. PNS *p > pre-Kanuri *b, *t > pre-Kanuri *d; came before the shift 5 of the Commentary to Table 2.9, deleting the distinction [±aspirated]. These several shifts all preceded:
6. pre-Kanuri *d (< PNS *d, *t, and *ƈ) > l /#CV_#, > r /V_V. Two other shifts:
7. PNS *l > r /V_C; and:
8. PNS *ɭ > r /#CV_(CV)#, both preceded:
9. deletion of feature [dental] (inter alia, collapsing pre-Kanuri *ɭ and *l as /l/). These thirteen shifts—along with the sequence:
10. PNS *ŋ > ŋg; followed by:
11. PNS *NC > C /_#, C = [-voice] or [+cont], > N /_#, C = [+voice/-cont]; > NC elsewhere—all came before:

12. pre-Kanuri *ŋ > n /_#; and:
13. pre-Kanuri [+voice/+obstruent] > Kanuri [-voice]/_# > [+voice] elsewhere (labials > [v]~[w] /V_V); and:
14. pre-Kanuri [-voice/-cont] > Kanuri [-voice/-cont] /#_ and /_#; > Kanuri [+voice] elsewhere (thus pre-Kanuri *p, like *b, > [v]~[w] /V_V); the rest > [+voice/-cont]); which itself was followed by:
15. remaining pre-Kanuri *p > /f/ (/#_ and verb-stem-final in class 1 verbs).

For

1. Some *ŋg (< PNS *ŋg, *ŋk) > ŋ (environment still to be worked out). This shift preceded:
2. deletion of feature [+glottalic]; after which:
3. pre-For *g > Ø /#CV_VC. Shift 1 also came before:
4. deletion of feature [±tense] in voiceless stops; after which came:
5. deletion of feature [dental] (pre-For *t̪ > t, PNS *d̪ > d, *l̪ > l, *nð > *nz). This shift in turn variously preceded:
6. pre-For *d (< *d̪, *ɗ, and *d by shifts 2 and 5) > r /V_; and:
7. pre-For *p > f /#_ and /_C, > b elsewhere; *b > f /_C, elsewhere > b; and:
8. pre-For *k > g /V_, which also followed shift 3; as well as the pair of shifts:
9. pre-For *ṭ > *č, PNS *nḍ > *nǰ /V_ ; and:
10. pre-For *ṭ > t /#_; after which, first:
11. pre-For *nz > *ns, *nǰ > *nč (devoicing affricative nasal clusters; and then:
12. pre-For *ns > s; and finally:
13. pre-For *š > s, *nč > ns.

---

14. [-contin/+voice] > $CC_{[-voice]}$ /#CV_V# in adjectives (/b/ > [pp], /g/ > [kk], etc.; probable source: CVC- stem + assimilated form of *t^h adj. suff., i.e., *CVCtV > *CVCCV).

Songay

1. pre-Songay *h > Ø /V_ (after Songay shift 10 of Commentary to Table 2.9).
2. PNS *k' > y /V_#, V = [-front].
3. PNS *t 2 > t /V_V (before Songay shift 9 of Commentary to Table 2.9).

Maba

1. PNS *k > g (> ng /#V_Vn#). This shift preceded:
2. deletion of feature [± aspirated].
3. PNS *ḍ > *ǰ > pre-Maba *ž; after which came:
4. PNS *z > s, pre-Maba *ž > *š (devoicing of fricatives); followed by:
5. PNS *ḍ > j. Following this shift, as well as shift 2, came:
6. pre-Maba *t̪ (< PNS *t̪, *$t̪^h$ by shift 2) > pre-Maba *ḍ; which preceded:
7. deletion of feature [dental]; after which:
8. pre-Maba *t' (< PNS *t̪', *t' by shift 7) > pre-Maba *ɗ; which in turn operated before:
9. deletion of feature [glottal]; after which:
10. /d/ (< PNS *d, *ɗ, *t̪', and *t' by shifts 7, 8 and 9) > r /V_; which came before:
11. r > n /#N(C)V_-# or /#(V)NV_#. Also following shift 9 came:
12. pre-Maba *c (< PNS *ṭ, *$ṭ^h$, *ṭ' by shifts 2 and 9) > pre-Maba *š /V_; followed by:
13. pre-Maba *š > s.

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14. (N)g > (n)j /V_i; and more generally:
15. *ŋ > ɲ /_[+front].

---

16. *$NC_{[-voice]}$ > $NC_{[+voice]}$ (limited range of examples is known so far); after which:
17. /ŋg/ > [ŋ] /V_(-)#.

Dongolawi

1. PNS *ŋg > pre-Nubian *ŋ /_#, > *g /_-# (verb-stem-final), > *ŋg /V_V; was followed by:
2. PNS *g > *j /#_; which preceded:
3. PNS *NC > pre-Nubian *C /#_; and:
4. [+ glottal] > Ø, removing implosive C; after which:
5. pre-Nubian *d > r. This shift also arose after one other major sound change deleting the dental/alveolar distinction (see Western Astaboran section of Table 4.6). Shift 5 was then followed by:
6. *t > d;
7. remaining PNS *NC > C; and then by:
8. *k, *k^h > k; after which:
9. pre-Nubian *k > g /V_.

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10. pre-Dongolawi *ŋ (from PNS *ŋ and *ŋg by shift 3) > n /_-#, > ɲ elsewhere; after which:
11. pre-Dongolawi *ɲ (< *ŋ and *ɲ) > n /#_.

---

12. pre-Dongolawi *f > Ø /#_, > w /V_V.

---

13. pre-Dongolawi *NC$_{[-voice]}$ (remaining after shift 7) > NC$_{[+voice]}$ /V_V, > C /_#, > CC /V_(i)#; prior to:
14. pre-Dongolawi [-voice/-contin] > CC /V_(i)#, > [+voice] [-contin] /V_#.

Tama

1. PNS *d > r /V_# (sometimes /V_V, presumably where a suffix was added since the sound shift), > l /V_ elsewhere (see wider distributed shift 2 below).
2. proto-Taman *r (< PNS *r) > l /_-# (verb).
3. proto-Taman *NC (PNS *mb and *ŋg) > N /#_.
4. PNS *[-voice/-contin] > [+voice/-contin] /_# (provisional).

Nara

1. *ʂ > š /#i_V.
2. *d > r /V_#, > d /V_ elsewhere.

Gaam

1. PNS *p^h > f, except in /V_C-, was followed by:
2. deletion of feature [±aspirated] (*[p^h] > *p, *ʈ^h > *ʈ, *t^h > *t, and *k^h > *k). This shift preceded:
3. *ʈ' > *[c'] /V_. Shift 3 along with:
4. PNS *ʈ' > pre-Gaam *ɗ /V_; and:
5. PNS *p' > ɓ; each preceded:
6. PNS *C' > C /V_ , C' = ejective; after which:
7. pre-Gaam *c > *š /V(N)_V, *ʂ [š] > c /_-# verb-stem final; which itself was followed by:
8. pre-Gaam *š > s. Also apparently predating shift 11—because PNS *nʂ and *ns in the available data give different recorded outcomes in Gaam—was:
9. PNS *NC > C. Shift 7 and:
10. PNS *k' > Ø /_[+front]; operated before:
11. a. deletion of feature [+glottal] (by which the implosives dropped out and remaining *ʈ' > *ʈ, *t' > *t , *ʈ' > *ʈ, and *k' > k);

with the leftover defectively distributed allophones of *ʈ' removed by:

b. *[ɖ] (allophone /#_i; see Commentary to Table 2.9) > j; and:
c. [*ʈ] (allophone /#_VC') > t. Postdating shift 12 came:

12. pre-Gaam *ɖ (< *ɗ and *ɖ by shift 12) > [d] /_-# (verb-stem-final); followed by:
13. pre-Gaam *d (< PNS *ɗ, *d, *ɗ, and *ɖ by shifts 12-13) > r /V_. Operating subsequent to shifts 8 and 12 came:
14. deletion of distinction [±voice] /C(V)_ (/p/ > [b], /t/ > [d], /c/ > [j]); which preceded:
15. lenition of [+voice/-contin] /V_V and /V_-#, specifically [b] > w, [ɖ] > ɬ [ɬ], [j] > i, [g] > Ø ([b], [j], and [g] are preserved regularly in some morphological contexts and sporadically in intervocalic environments not yet accounted for); after which:
16. /ɬ/ + suff. in /t/ > [d] /_# (probably still productive). Three other shifts followed shift 9 above. First came:
17. *s > z /N_ (where *s was a suffix added since shift 9); and then:
18. PNS *z > j; followed, after shift 14 but before shift 16, by:
19. /j/ > /d/ in some /V_VC; and then:
20. deletion of feature [dental] /#_. An additional, probably quite recent shift created new /j/ in Gaam:
21. pre-Gaam *g > j, *k > c, *ŋ > ɲ /_[+front/+vocalic].

Bertha

1. PNS *k > *k^h /#_; as well as:
2. PNS *t^h > t in certain stem final environments, as yet unsatisfactorily defined; and also:
3. PNS * ɖ > ǰ (for pre-Bertha *ʈ^h (< PNS *ʈ and *ʈ^h) > *č, see Jebel rules 1 and 2 in Table 4.6); preceded:
4. PNS (and pre-Bertha) *p^h > f, *ʈ^h and *t^h > ϴ, *č > *š, *k^h > *x; followed by:
5. *x > h; and then by:
6. h > Ø /_#. Shifts 1 and 2 also preceded:
7. [+tense/-voice/-cont] > [+voice/-cont] (PNS *p > b, *ʈ > *ɖ, *t > d, *k > g); which came before:
8. [palatal] > [dental] (pre-Bertha *ɗ > *ɗ, *ʈ > *ʈ, *ǰ > *ð, *š > *ϴ). This shift preceded:
9. /ɗ/ (< pre-Bertha *ɗ and *ɗ) > r, /d/ > rr, /V_# and /V_(V)C. This shift as well as:
10. *ɭ > r /V_, preceded:
11. [+voice/dental] > [+voice/alveolar] (pre-Bertha *ɗ > ɗ, *ɖ > d, *ð > z, *ɭ > l); which was followed by:

12. *ŋ > Ø /_C, C = [-voice] or [+cont].

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13. PNS *r > r /#CV_#, > l /V_ elsewhere.
14. pre-Bertha *g > k /V_-# (only examples derived from PNS *k are known so far, however, so this formulation remains to be tested).

Nyimang

1. /r/ > [ɽ] /_i.
2. *d > r /_#.
3. *k > g /C_V.

Daju

1. PNS *ṭ' > *$ṭ^h$, *ṭ > *ṣ /#_; after which:
2. PNS *$ṭ^h$ > *c, *ḍ > *j; then:
3. [+palatal/-affricate] > [+alveolar/-affricate] (remaining PNS *ṭ > t, *ṭ' > *t', *ṣ > s, *ḍ' > ɗ); after which:
4. PNS *θ > *š, *nð > *nj; subsequently:
5. *C^h > C; and:
6. PNS [+dental] > [+alveolar]; after that:
7. levelling of voicing distinctions in non-initial environments took place, by which *t > *d, *t' > *ɗ (the full determinants and consequences of this rule in the modern Daju languages remain to be fully worked out; also:
8. *ɗ, *d > *r in as yet insufficiently defined non-initial environments (including /_# ? See the wider distributed shift 2 below.); and:
9. pre-Daju *N < PNS *N and *$NC_{[-voice/+tense]}$ (see "wider distributed share sound shifts" VII below) > *$NC_{[+voice]}$ /#CV_VC-; and:
10. *k' > *k or Ø /#_ (determinants of alternants outcomes as yet unclear); > *k/*g /V_.

Nilotic

1. PNS *r > proto-Nilotic *ʀ /V_; cases of *ʀ /#_ may principally have been added via loanwords (e.g., root 1254); after which:
2. PNS *d > proto-Nilotic *r /V_. In addition:
3. proto-Southern Nilotic *l > proto-Kalenjin *ʀ /#_V(C), V = ɛ or ɔ.
4. pre-proto-Southern Nilotic *g > PSN *ŋ /#_VL, L = *l, *r (< PNS *d), and *ɲ.

5. PNS *ŋ > early Western Nilotic *ɲ /#_ɛL only (L = *r, *l), but not, interestingly, before *i or *e.
6. A levelling of voicing distinctions in non-initial environments characterizes the obstruents of the Western Nilotic languages. The original patttern was probably voicing in intervocalic contexts and devoicing word-final, but changing stem-final morphology or recording conventions may sometimes obscure these results.

Wider distributed shared sound shifts

I. Northern Sudanic (or Sudanic ?): PNS *b > *m /#rV_#.
II. Eastern Sahelian: PNS *d > *r /#CV_# (word-final). This shift is visible in those Eastern Sahelian languages that did not collapse all non-initial *d with *r (it has been noted for Nara, Taman, Bertha, Nyimang, and apparently Daju). The former presence of this sound shift rule would of course be obscured in cases where subsequently the rest of non-initial *d became /r/. The shift may conceivably date back to proto-Sahelian, since PNS *d has become /r/ generally also in the For, Maban, and Songay languages, but it is specifically counterindicated for Saharan.
III. Possible Eastern Sahelian: PNS *ns > *ss, *nṣ > *ṣ. The attestations of this proposed shift remain few as yet, however.
IV. Kir-Abbaian: PNS *mp > *m, *ŋk > *ŋ, consistently in all contexts. Replications of parts of this outcome turn up in some other Nilo-Saharan languages, but the environments, scope, and consequences of such shift are in each case different. Note that in Daju, the Kir-Abbaian *m < *mp and *ŋ < *ŋk reverts to a proto-Daju cluster *mb and *ŋg /#CV_VC- by the more general Daju rule 1 noted above. See also Kir-Abbaian sound shift in Commentary to Tables 3.1-3.4 for more on this sound shift.
V. Kir-Abbaian: PNS *#iC# > *-Ci-, C = [-voice/+obstruent], with addition of any affixation (see roots 963, 1142, 1143).
VI. Surma-Nilotic: PNS *ŋg > *ŋ in all environments. Only in the Surmic and Nilotic subgroups does this specific outcome for PNS *ŋg appear.
VII. Surma-Nilotic: (1) PNS *nd > *d; followed by:
VIII. Surma-Nilotic: (2) PNS *r > *R /V_ (*R = flap/trill of uncertain articulation, > Surmic *L, Nilotic *ʀ); and then:
IX. Surma-Nilotic: (3) Surma-Nilotic *d > r /V_.

CHAPTER 3
VOWELS AND TONE IN PROTO-NILO-SAHARAN

The proto-Nilo-Saharan (PNS) language is reckoned here to have had seven vowels, occurring both long and short, and provisionally to have had three tones.

PNS Vowels

The seven short vowels can be represented as *i, *e, *ɛ, *u, *o, *ɔ, and *a. Their long equivalents are *i:, *e:, *ɛ:, *u:, *o:, *ɔ:, and *a:. Vowel length is retained in Songay, For, Bertha, Nubian, and Southern Nilotic, among others. That length is original to PNS is shown by the regular correspondence of long and short vowels among these languages and the existence of consistent qualitatively distinct outcomes for long and short vowels in a number of Nilo-Saharan languages that lack the length distinction today. For example, in proto-Central Sudanic (PCS) the long mid vowels produced high vowel reflexes—*e: of Southern Nilotic or Nubian corresponds to PCS *i, in other words, while *o: matches up with PCS *u.

An interim reconstruction of PCS with seven simple vowels—*i, *e, *ɛ, *u, *o, *ɔ, and *a—along with a variety of diphthong-like vowel sequences, has been followed here (Ehret MS). Whether this system is sufficient to explain all the vowel outcomes in all the various Central Sudanic languages remains to be determined. But it does accord well with the correspondences between its distantly-related Moru-Madi, Mangbetu, Aja, and Bongo-Bagirmi subgroups, and it accounts very well indeed with the observed correspondences of Central Sudanic roots with cognate forms outside that branch.

In a number of modern Nilo-Saharan tongues, such as Songay, For, and the Nubian, Daju and Koman languages, this system has simplified to five vowels, in Daju and Koman with additionally the loss of vowel length. For Songay as well as proto-Nubian, the seven vowels became five through the collapsing of the three low vowels, *ɛ(:), *ɔ(:), and *a(:), as *a(:). In Uduk of Koman, in contrast, an asymmetric merging of *ɛ(:) with *a, but of *ɔ(:) with *o, accounts for the outcome. Daju and For show a third pattern, in which *ɔ(:) and *o(:) fall

together as do *ɛ(:) and *e(:). Still a fourth course of simplification to five vowels can be perceived in Kunama. There the short mid vowels, *e and *o, became one with *a, while long *e: and *o: were raised to *u: and *i: respectively, leaving PNS *ɔ(:) and *ɛ(:) to fill the vacated slots of *o(:) and *e(:).

Whether phonemic vowel length in the Kunama language perdures from PNS remains to be worked out. Bender (1971 and elsewhere) records long vowels for it, but the evidence in the Kunama dictionary (Castelnuovo 1950) seems to account quite well for the Kunama correspondences without distinguishing vowel quantity. It appears from Thompson's (1989) materials that vowel length, like consonant length in Kunama, may most often reflect the coalescence of underlying or formerly distinct segments, such as a vowel and a glide.

For another Nilo-Saharan language, Kanuri, the disappearance of vowel quantity distinctions eventuated in a seven-vowel patterning quite unlike that of PNS, namely, **i**, **u**, **e**, **o**, **ə**, **a**, and **ɑ**, and unusual in its sources. The four non-central members of the set all normally derive from PNS long vowels, respectively *i:, *u:, *ɔ:, and *ɛ:, whereas the high central vowel **ə** conflates several PNS vowels, both long and short, namely *u, *e, *e:, *o, and *o:. The low vowel **ɑ** reflects in most environments just PNS *a; its counterpart **a** derives from the falling together of one long and two short PNS segments, *a:, *ɔ, and *ɛ. The comparative data, in other words, confirm Jarrett's (1978) conclusions for Kanuri, reached using the methods of internal reconstruction.

These correspondences and their bases in the PNS vowels can be seen with greater clarity in Table 3.1. The possibility that Kunama maintains phonemic vowel length from its earlier PNS ancestry is denoted by queried long vowels in parentheses (vowel length is not marked in Castelnuovo 1950).

Table 3.1. Sample of PNS vowel correspondences

PNS	Uduk	PCS	Kunama	Kanuri	Songay	Dongolawi
***u**	u	*u	u	ə	u	u
***u:**	u	*u	u (u: ?)	u	uu	u:
***o**	o	*o	a	ə	o	o
***o:**	o	*u	u (u: ?)	ə	oo	o:

Table 3.1. Sample of PNS vowel correspondences (continued)

PNS	Uduk	PCS	Kunama	Kanuri	Songay	Dongolawi
***ɔ**	o	*ɔ	o	a	a	a
***ɔ:**	o	*ɔ	o (o: ?)	o	aa	a:
***i**	i	*i	i	ə	i	i
***i:**	i	*i	i (i: ?)	i	ii	i:
***e**	e	*e	a	ə	e	e
***e:**	e	*i	i (i: ?)	ə	ee	e:
***ɛ**	a	*ɛ	e	a	a	a
***ɛ:**	a	*ɛ	e (e: ?)	e	aa	a:
***a**	a	*a	a	ɑ	a	a
***a:**	a	*a	a (a: ?)	a	aa	a:

In Songay *ɔ(:) and *ɛ(:) became respectively /o(o)/ and /e(e)/ (instead of usual /a(a)/ in one set of environments, /#(C_)C_(N)# (see Songay rule 13 in Commentary to Table 2.9). Additional Songay /e(e)/ were also recreated in many cases in the language by the raising of pre-Songay *a(a)—including instances of *a(a) deriving from PNS *ɛ(:) and *ɔ(:)—in the environment of a historically more recent high-vowel suffix, either in -i or in -u. The shift was not limited to pre-Songay *a(a), but also raised the mid vowels, *e(e) > i(i) and *o(o) > u(u) (see Songay rule 15 in Commentary to Table 2.9). It apparently ceased to be productive early in the development of Songay because in other instances *a(a) persisted despite the addition of -i or -u suffixes. The persistence of pre-Songay *a(a) in these cases shows that the suffixes were added after the sound change no longer operated. Finally, at a still more recent point in time, Songay developed a general word-final CV syllabic structure, requiring final vowel in all words not ending in /w/, /y/, or a nasal. This structure required the adding a word-final V

that replicated the preceding stem vowel, whenever the word in question did not already end in a vowel.

Contrasting with the reduction of the PNS vowel system in such disparate languages as Songay, Human, Uduk, and Kanuri, an expansion of the array of vowel distinctions took place in Rub and also in Nilotic and some of its cousin subgroups in Eastern Sahelian (formerly Eastern Sudanic). For Rub and Nilotic, these changes seem certainly attributable to the phonological histories of the language groups involved, although many aspects of those histories remain as yet obscure.

Eleven proto-Rub vowels—*u, *ʊ, *o̜, *o, *ɔ, *i, *ɪ, *e̜, *e, *ɛ, and *a—have been given interim status in Heine's (1976) reconstruction, but future work may well show some of these distinctions to be allophonic. In addition, proto-Rub had several diphthongs, among them *iu, *eo, *uo, *ɛɔ, and *uɔ, created by deletion of nasality in a following erstwhile nasal cluster, i.e., *CVNC$_2$ > proto-Rub *CVVC$_2$, at least where C$_2$ = [-voice] (see proto-Rub sound shift in Commentary to Tables 3.1-3.4).

Proto-Nilotic (PN) possessed apparently a system of nine, or perhaps ten, vowels, each one occurring both short and long. For proto-Southern Nilotic ten vowel qualities, each with a long and a short version, have been reconstructed on the morphophonemic level (Rottland 1982). The ten vowels consist of five ±ATR pairs, *u and *ʊ, *o and *ɔ, *i and *ɪ, *e and *ɛ, and *ɑ and *a. (Rottland 1982 represents the first member of the last pair as *a and the second as *ɑ; in Rottland 1989, however, they are revised to respectively *a and *ʌ. The segment /ɑ/ is actually heard as [ɔ]; hence it seems better here to reserve the symbol *a* for its -ATR mate, Rottland's *ɑ or *ʌ.)

The beginnings of the development of the Nilotic systems probably go back to what were originally allophonic variants in the early Kir-Abbaian period. Specifically, [ʊ] and [ɪ] emerged initially as allophones respectively of *ɔ and *ɛ in the environment of a following nasal cluster (see Kir Abbaian shift V in the Commentary to Tables 3.1-3.4). The deletion of these governing environments (see Kir-Abbaian shift IV in the Commentary to Table 2.10), along with the possible regular realization of short *i as [ɪ] and short *u as [ʊ] (cf. the Gaam and Eastern Nilotic outcomes in particular), could have produced phonemic *ɪ and *ʊ already by the end of the proto-Kir-Abbaian period. The subsequent development of vowel harmony rules, along with the appearance of ±ATR category shifts in singular-plural formations in nouns—these latter shifts very possibly deriving from earlier Kir-Abbaian distinctions of vowel quantity between singulars and plurals (cf. the Gaam and Bertha plural formation pattern seen, for instance, in root

649 among several others)—and then the spreading of this phenomenon to other morphological alternances, completed the phonemicization of the vowel distinctions evident in PN.

The diphthongization so common in Western Nilotic languages, and the still more complex vowel array in Jyang of Western Nilotic, probably reflect all of the following: syllable loss, consonant deletions, dropping of vowel quantity distinctions, and umlaut and ablaut effects of lost vowel suffixes, during the pre-proto-Western and proto-Western Nilotic stages. The shifts of PN *o > *u and *ɔ > *ʊ evident in several Western Nilotic instances in the Etymological Dictionary were consequences of grammatical processes as yet unexplored; and cases of unexplained *o > *u and *ɔ > *ʊ in Eastern Nilotic languages again probably reflect such processes or, in some instances, perhaps unusual vowel harmony effects. The details of these developments should be of major interest to future scholarship, but cannot be resolved here.

Diphthongs and sequences of glide plus vowel in PNS roots

The PNS vowels could co-occur with adjacent glides in two different formats in the PNS language. One took the shape #CwV(C)# in which PNS *w preceded a vowel medially in a root. The other had the shape #CVG(C)#, where G could be any of the four glides, *w, *'w, *y, or *'y, and followed the vowel.

In the first of these two formats, V seems most commonly to have been PNS *a(:) or a front vowel, but there appear also to have been a few examples of *ɔ(:) and *o(:), almost but not quite wholly restricted to cases of a velar or labial as the preceding consonant. The shape #CwV- was preserved in very few languages, most notably in the Western Nilotic and to some extent the Southern Nilotic languages, in certain of the Eastern Nilotic languages, in the Hill Nubian tongues, and in Uduk of the Koman branch. In PCS, *w apparently persisted in conjunction with some velar C and in a few other limited instances, but not elsewhere. Almost everywhere else in Nilo-Saharan, *wV- /#C_ simplified to a vowel, most often back rounded. The reconstructions for some of these medial sequences, especially *wa and *wa:, are strongly based; other sequences, less often attested in the available data, must be considered much more provisional postulations, at least as to their specific realization in PNS. For a laying out of these data, see Table 3.3 and the Commentary to Tables 3.1-3.4, both at the end of the chapter.

Similar comments can be made about the second pattern of glide-vowel occurrence, #CVG(C)#. Although a number of languages main-

tained such sequences as diphthongs or, in the case of the glottalic glides, sometimes as vowel-plus-consonant, again the more common result was for the sequence to simplify to a vowel, usually back rounded when G was *w or *'w and, contrastively, front unrounded when G was *y or 'y. On the other hand, the correspondence patterns for the particular reconstructed vowel-plus-glide sequences, as depicted in Table 3.4 at the end of the chapter, tend more often than not to be fairly solidly identified.

PNS Tones

PNS can be provisionally reconstructed to have had three phonemic tones, high, mid, and low. The reconstruction for now must be based on the few Nilo-Saharan languages for which good tonal marking and a sufficient body of evidence exists. The primary data for tone reconstruction come therefore from Uduk of Koman, Kanuri of the Saharan group, Songay, and Gaam of Kir-Abbaian. Several other languages, among them For, Bertha, and Maasai, provide some additional useful tonal data.

All three proposed tones seem to be preserved in Gaam, as high, mid, and low; and it appears from the Southern Nilotic evidence that proto-Southern Nilotic also had three tones, although differently distributed, probably as high, low, and falling. Unfortunately, the tonal reconstruction of particular Southern Nilotic roots has not been systematically undertaken, so it remains uncertain what the specific correspondences of the Nilotic tones to the PNS system are and whether the three tones have actual one-to-one correspondences to the proposed three PNS tones or not. The Uduk evidence highlights this latter concern. Uduk has in fact three phonemic level tones (Thelwall 1983), but they derive from rephonemicization of what was in pre-Uduk a two-tone system, the high tone collapsing the proposed PNS high and mid tones in single-syllable stems and the low tone preserving the PNS low tone.

A layout of the diagnostic tonal correspondences in one-syllable words and verb stems appears in Table 3.5. A number of morphological operations, however, apparently could cause tone shift in stems. These, where they can so far be recognized, along with tone shifts occasioned by phonological factors are noted for the diagnostic languages in the Commentary to Table 3.5.

Table 3.2. Basic vowel correspondences of Nilo-Saharan

	*a	*a:	*ɛ	*ɛ:	*e	*e:	*i	*i:	*ɔ	*ɔ:	*o	*o:	*u	*u:
Uduk	a	a	a	a	e	e	i	i	o	o	o	o	u	u
PCS	*a	*a	*ɛ	*ɛ	*e	*i	*i	*i	*ɔ	*ɔ	*o	*u	*u	*u
Kunama	a	a	e	e	a	i	i	i	o	o	o	u	u	u
Kanuri	ɑ	a	a	e	ə	ə	ə	i	a	o	ə	ə	ə	u
For	a	aa	e	ɛɛ	e	ɛɛ	i	ii	o	oo	o	oo	u	uu
Songay	a	aa	a	aa	e	ɛɛ	i	ii	a	aa	o	oo	u	uu
Maba	a	a	e	e	e	e	i	i	o	o	o	o	u	u
Dongolawi	a	a:	a	a:	ɛ	ɛ:	i	i:	a	a:	o	o:	u	u:
Tama	a	a:	ɛ	ɛ:	e	e:	i	i:	ɔ	ɔ:	o	o:	u	u:
Nara	a	a	e	e	e	e	i	i	o	o	o	o	u	u
Gaam	a	a	ə	ə	ɛ	ɛ	ɪ	i	ə	ə	ɔ	ɔ	ʊ	u
Bertha (M)	a	a:	ɛ	ɛ:	e	e:	i	i:	ɔ	ɔ:	o	o:	u	u:
Daju	*a	*a	*e	*e	*ə	*ə	*i	*i	*o	*ɔ	*o	*ə	*u	*u
Nilotic	*a	*a:	*ɛ	*ɛ:	*e	*e:	*i	*i:	*o	*ɔ:	*o	*o:	*u	*u
PENil	*a	*a	*ɛ	*ɛ	*e	*e	*ɪ	*i	*ɔ	*ɔ	*o	*o	*ʊ	*u
PSNil	*a/ɑ	*a:/ɑ:	*ɛ	*ɛ:	*e	*e:	*ɪ/*i	*i:/ɪ:	*ɔ/ɑ	*ɔ:/ɑ:	*o	*o:	*ʊ/u	*u:/ʊ:
Shilluk	a	á	ɛ	ɛ	e/ɪɛ	e/ɪɛ	ɪ/ɪɛ	i/ie	ɔ/ʊa	ɔ/ʊa	o/ʊɔ	o/ʊɔ	ʊ/ʊɔ	u/uo
Rub	*a	*a	*ɛ	*ɛ	*e	*e	*ɪ	*i:	*ɔ	*ɔ	*o	*o	*ʊ	*u

Table 3.3. Medial glide-plus-vowel correspondences of Nilo-Saharan

	***wa**	***wa:**	***wɛ**	***wɛ:**	***we**	***we:**	***wɔ**	***wɔ:**	***wo**	***wi**	***wi:**
Uduk	wa	wa	wa	wa	wa	wa		wo	oo	i	u
CSud	*ɔ	*a	*o	*u		*wi	*o	*u	*u	*i	*u
Kunama	o	u	o	a	u	u	o	u	u	u	u; i/_-#
Kanuri	o	a	o	ə	ə	ə	u	ə	u	ə	u
For	o	o		oo	e	ii	o	uu	o	i	uu
Songay	o	oo	u	oo	e	oo	u	aa	o	u	i
Maba	u	u	u	u	e					i	i:
Dongolawi	a:	o:	o:	o:	u:	u:	u:	u:		u:	
Diling	wa	wa	wa	wa	u			o		wo	e
Tama	ɔ			a:	i		o	o:	u	i	
Nara	o									u	
Gaam	ə	ɔ	ɔ	ɔ	ə̈	ə̈				u	
Bertha			u	e:	u	u:		o		i	ʊ:
Daju						i, ii					
Nilotic	*wa	*wa:		*wɛ:	*we	*we	*wɔ	*wɔ:		*wɪ	*wi:
Ik (Rub)	ɔ	ɔ	ɔ		o	u	ʊ		o	*ʊ	*i
Rub /C[velar]_	*wa	*wa	*wɛ	*wɛ	*wɛ					*u	*i

Table 3.4. Vowel-plus-glide correspondences of Nilo-Saharan

Section 1: *VW sequences

	***aw**	***a:w**	***a'w**	***a:'w**	***ɔw**	***ɔ:w**	***ɛw**	***ew**	***iw**	***i:w**
Uduk	a	a	a	aa			aw		i	
PCS	*a/ɔ	*ɔ/*o	*ɔ	*ɔ		*ɔ			u	*wi
Kunama	o/au	au	au	au	u		ew	eu		u
Kanuri	ə	au	o	a			aw		ə	
For	a	oo			u	u	u, uu	u	i	u
Songay	u	aa	u	aa			aw		i	
Maba	o	a	ab						u	
Dongolawi	o:									i:w
Tama	aw	aw	a:							
Nara	u	u	aw							
Gaam	ə, ɔ	aw		ɔɔ						
Bertha	o	a:								
Nilotic	*ɔ	*ɔ:	*ɔ	*ɔ:	*o	*o:		*u:		
/_-#	*aw	*a:w	*aw	*a:w						
Rub	*ɔ	*ɔ	*ab						*i	iw

Table 3.4. Vowel-plus-glide correspondences of Nilo-Saharan (continued)

Section 2: *VY sequences

	*ay	*a:y	*a'y	*a:'y	*ɛy	*ɛ:y	*ey	*e:y	*oy
Uduk	a, aa	ee, e	a	e	i	ii, i	e, i	ii	
PCS	*ɛ	*ɛ	*ɛ	*a	*i	*e	*i	*i	*oi
Kunama	e, ei	ai	ai		i	i	e	i	
Kanuri	e, ai	i, ai, a	ai	i /_#	ə	e	ə	i	
For	ai	e	aa	ii	ee		i	ii	
			a /_CC						
Songay	e	aa	e	e /_#	i	ii	i	ii	oy
/_#	ey	ey	ey		ey				
Maba		e	a		i,e	e:	i	e	
Dongolawi	ɛ:	ɛ:	ɛ:	i:	i:	ɛ:	ɛ:		
Tama				ɪ:					e,o
Nara	a, ai	e	e		e		e		
Gaam	ə, əi	e	ee, ii /_a		ɛ	ɛ		ee	uu
Bertha	e:		e:				i		
Daju	a		a		i	e		e, ee	
Nilotic	*ɛ	*ɛ:	*ɛ:	*a:y	*e	*e:	*i	*i:	*o
/_-#	*ay	*a:y	*ay	*a:y	*ey				
Rub	*ɛ	*e			*i	*e	*e	*ẹẹ	

Commentary to Tables 3.1-3.4

Uduk

1. PNS *ɔ > pre-Uduk *o; followed by:
2. pre-Uduk o > a /#kʰ_C(VC)#, V not = u; followed by:
3. pre-Uduk *o > u /#C_1_C_2, C_1 = [-voice], C_2 = palatal or *θ (and also /#C_1_la' in root 818?); and by:
4. pre-Uduk *o > u /#C_(N)K, K = k, kʰ, or k'; and by:
5. pre-Uduk *o > u /#N_ t̪'. Also, the three shifts:
6. PNS *e(:) > pre-Uduk *ɛ(:) /#Cw_; and:
7. PNS *ɛ(:) > pre-Uduk *e(:) /#C_(h)#; and:
8. PNS *ɛ > e /#C_1_C, C_1 = [palatal/-voice/-cont]; and:
9. PNS *ɛ(:) > e(:) /#b_b (one example, no counter-example); each preceded:
10. PNS *e > i, *ɛ > e /#t̪'_C and /#t_C (but not *e: or *ɛ:); after which:
11. PNS *V: > pre-Uduk *V; after which:
12. pre-Uduk *ɛ > a; and also:
13. pre-Uduk *e > i /#ɗ̪_C and /#C_(n)D (examples of D = *d and *ɗ are known); as well as:
14. pre-Uduk *e > o, *i > u /C_1_C, C_1 = [+velar]; followed by:
15. pre-Uduk *o > u /#W_C, C = labial; and by:
16. V_1 > V_2 /#C_NCV_2S, one V = i or e, other V = o or u, S = sonorant. Shift 11 took place before Uduk shift 1 in the Commentary to Table 2.9, since it is counterindicated for PNS *ḍ.
The shifts *o > *a* , noted for /#ɗ_ŋk_l and /#c'_p' (roots 200 and 948), if regular, preceded shift 1.

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17. PNS *ay > aa, *a:y > ee, *ɛ:y > i /#C_C; elsewhere *ay > a, *a:y > e.

PCS

1. PNS *a(:)y > pre-PCS *ɛ; was followed by:
2. PNS *ɛ > PCS *e, *ɔ > *o /#c_ (< PNS *T_ʂ) and #ʂ_; which along with:
3. PNS *o > pre-PCS *ɔ, PNS *e > pre-PCS *ɛ /#N_N and /NC_C, NC < PNS *NC; and:
4. PNS *ɔ > PCS *o, *ɛ > *e /#C_NC; each preceded the collapsing of PNS *CV(N)C stems to PCS *CV by the PCS shifts 1-9 of the

Commentary to Table 2.9, because their governing environments all included final consonants deleted by those shifts 1-9. Three further vowel shifts:

5. PNS *ɔ > PCS *o, *ɛ > *e /#GB_ (GB = PCS *gɓ, *gb, or *kp); and:
6. PNS *ɔ > PCS *o, *ɛ > *e /#ndr_; and:
7. PNS *o > PCS *ɔ /#C_#, C = PCS affricates *dr, *tr, *ts, *c, *dz, or *j, could well, in contrast, have followed the shifts depicted in the Commentary to Table 2.9; but they and also:
8. PNS *o: > pre-PCS *u:, *e: > i:, both preceded:
9. PNS *V: > PCS *V, collapsing long and short vowels.

Kunama

1. PNS *ɛ > i /#m_l-; may have preceded:
2. PNS *e > pre-Kunama *ɛ /#l_l, which came after Kunama shift 9 in Commentary to Table 2.10, by which *r > l /#lV_; but it, as well as:
3. PNS *o > u /*#ɓ_ɓ (one example, no counter-examples) preceded Kunama shift 4 in Commentary to Table 2.9, by which PNS *e and *o > a.

---

4. PNS *u > i /#r_K.
5. #Cih/y- + -aC > #CiC.
6. PNS *ay > ei /_-#.

For the remaining Kunama vowel outcomes, see shifts 1, 2, 18, and 19 of the Commentary to Table 2.9.

Kanuri

1. PNS *ɛ(:) > *a(:), *e > ɛ /#S_ in pre-Kanuri, S = sibilant (examples of *ʂ and *s are known); as well as:
2. PNS *o > pre-Kanuri *ɔ: /#k_(C) and also:
3. PNS *o: > pre-Kanuri *u: /#C_r, before Kanuri shift 13 of Commentary to Table 2.9.
4. Pre-Kanuri *a (< *ɔ and *-ɛ) > ɑ /#C_C_#, came after Kanuri shift 13 of Commentary to Table 2.9.
5. V > Ø /#_CVC.
6. PNS *ay > *e*, *a:y > *ai* /_#.

Songay

1. PNS *ɔ > u /#C_- + -na#.

2. *V: > V /#C_C(_)CV. (See also Songay rules 13 and 15 from Commentary to Table 2.9)

For

1. PNS *o > *ɔ /#j_C; after which:
2. Pre-For *ɔ > a /#C_1_(C)- verb, C_1 = [+voice/-contin/ +obstruent]; then:
3. PNS *ɛ(:) > *e(e), *ɔ: > *o(o); followed by:
4. *VV (PNS *V:) > V /#C_C(V)C; followed by:
5. pre-For *o > u, *e > i /C_L(_)C, L = liquid.

---

6. PNS *o > a /#j_C (j < *G).
7. PNS *ay > e /_-#.

Maba

1. PNS *V: > V apparently preceded:
2. pre-Maba *e > a /#C_m (also *o > a ?), which itself may have preceded shift 3; and:
3. pre-Maba *o > u, *e > i /#C_S(C), S = sonorant, other than *m; and:
4. pre-Maba *e > i /#C_(w/ya)(-)# (some /#C_h ?); and:
5. pre-Maba *e > a /#C_h, C probably = subset of Maba consonants still to be defined; and:
6. pre-Maba *o > u /#k_s.

---

7. a, i > u /#C_C- + -u(C)- v. extension.

Dongolawi

1. PNS *ɔh > o /#_#; after which:
2. PNS *ɛ(:), *ɔ(:) > a(:) (already in proto-Nubian).

---

3. *V: > V /_C, came before:
4. CwV > CV: /#_C. This shift took place after the proto-Nubian period. Dongolawi outcomes: PNS and PNub *wa > a:, PNub *wa: (< PNS *wa:, *wɛ, and *wɛ:) > o:, while other PNS/PNub *wV > u: (see Diling data in Table 3.3 for evidence of PNub retention of a number of medial *w).

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5. PNS *e > i, *o > u /#C_L, L = liquid.
6. PNS *o > u /*C_ŋk.

7. PNS *i > ɛ /#_rC.
8. PNS *i > ɛ /#d,ɖ_s (after shifts 4 and 6 of the Commentary to Table 2.10, by which PNS *ɖ and *t became pre-Nubian *d).
9. pre-Nubian *sVk > Vsk /#_, V = [+front] (*s < PNS *s and possibly *θ; counterindicated for other V and other sibilants).

Tama

1. V > V: /#C_r(V)n (also /#w_s-? See root 1416).

Gaam

1. pre-Gaam *u > *u, *i > *i /C_(C_)r, *u > *ʊ, *i > *ɪ elsewhere; and:
2. PNS *ɛ(:) > *e(:) /#C_L, L = liquid; and:
3. PNS *e: > *i: /#b_ɬVn (one example, no counter-examples); and:
4. PNS *o(:) > *u(:) /#C_r, C = d, ɖ, t; and:
5. PNS *o > *u /#c_l (for pre-Gaam *c, see proto-Jebel rule in Commentary to Table 2.9, under "Wider distributed shared sound shifts," VIII); and:
6. PNS *o(:) > *u(:) /#C_CuC; all followed Gaam shift 1 in Commentary to Table 2.9 and Gaam shift 13 in Commentary to Table 2-10, and all preceded:
7. PNS *ɔ > a: /C_wn-; and:
8. PNS *e > *ɛ, *o > *ɔ /#C_L, L = liquid; which came before:
9. pre-Gaam *ɔ(:), *ɛ(:) > ə(ə), *o(:) > ɔ(ɔ), *e(:) > ɛ(ɛ). These shifts, along with:
10. PNS *a > ə /#C_S, S = sonorant (some *a: > ə /#C_w/f, but determinants unclear); and:
12. PNS *e: > pre-Gaam *i: > i /_h, or pre-Gaam *e: > i: /_h; all preceded the shift:
13. a. V: > V, removing most cases of distinctive vowel length, except for:
    b. V: > VV /#C̀_S(V)#, S = sonorant (reconstructible low tone environment); and also:
    c. V: > VV /#k_s(V)#; and also:
    d. V: > VV /_G (where G = PNS *y, *'y, *w, or *'w. After these sound shifts, new /e/, /ee/, and /ɔɔ/ were created in Gaam by rules affecting VY and VW diphthongs. The specific outcomes of the cases so far identified appear in sections 1 and 2 of Table 3.4.

Bertha

Note that, although Bender (1989a: 272) says that "lax vowels are not distinctive," the comparative data of Table 3.1 indicate the opposite for two of those vowels, short /ɛ/ and /ɔ/, although not for their long equivalents or for any other members of that category, long or short.

1. PNS *ɔ: > o:, *ɛ: > e:, came before:
2. *o: > u /#(V)Ĺ(-)#.

---

3. *o > ɔ, *e > ɛ /k'_l; followed by:
4. *ɛ > [ɪ] ~ [i] /#C_l (lacking in cases of C = sibilant, because of Jebel rule VII cited in Commentary to Table 2:10). Also:
5. *e > ɛ /#C_h#.

Daju

1. PNS *ɔ > *o, *ɛ > *e; and:
2. pre-Daju *o > *a /ɓ_g (after Daju shift 3 of Commentary to Table 2.10 ?); and:
3. pre-Daju *o > *a /#C_L, C = *c, *s, L = *l, *r; and:
4. pre-Daju *o > *a /#L_ŋ and /#ɗ_C_ŋ (full environment is still to be worked out); and:
5. pre-Daju *e > *a /#C_L, C = voiced labial (cases of *b and *m are known); and:
6. pre-Daju *e > *a /#ɲ_b (after Daju shift 7 of Commentary to Table 2.9). Also:
7. pre-Daju *i, *u > *ə /T_S, S = sonorant; and:
8. PKA *i > proto-Daju *e /T̀_C (T = *t̪^{h}, *t̪').

Nilotic

1. PNS *e > *ɪ /#r_D#, after PNS *d > pre-PNil *ʀ; D = *ɗ, ɖ, and *ɖ.
2. PNS *VN > V: /C_C (Surma-Nilotic shift?).
3. PNS *i > *ɛ/*e /p_L (L = *l, *ɬ) after PNS *p' > PNil *p.

The most common vowel outcomes for the Nilotic branches are noted in the table. The determinants of particular reflexes, especially in the Western and Southern branches, remain generally still to be discovered. For Western Nilotic the loss in pre-Western Nilotic of earlier suffixal vowel morphemes and of vowel length probably account for most of the variety. In addition, there may

be other still-to-be-identified, common Nilotic shifts like shift 1 above, of restricted phonological distribution.

Rub

1. PNS *o > *u, *ɔ > *ʊ /#C_C, C not = voiced stop; possibly followed by:
2. PNS *ɛN > *ɛɔ, *eN > *eo, *uN > *uɔ /#C_C (and probably others still to be discovered).
3. PNS *o > *u /#C_B, B = labial obstruent; and also:
4. PNS *o > *u /#t_d (/t/ and /d/ are Rub outcomes).

Wider distributed shared sound shifts

I. Sahelian: PNS *u > *i /#Y_C#, C undefined as yet.
II. Eastern Sahelian: PNS *ɛ, *e > e ~ a /#N_S(V), S = *l or nasal, V not = i, u ? This shift occasionally does not appear in a particular language's reflex, or else in one instance alternative words with *e and *a respectively turn up (root 260, Kalenjin reflexes). Why such variants occur is generally not overtly apparent; but some kind of elided suffixation containing a high vowel, for example, the *i andative or *-uh venitive, is a possible candidate (as in the Kalenjin example in root 260).
III. Kir-Abbaian (or Eastern Sahelian?): PNS *#Vŋ(g)# > #ŋ(g)V# (roots 517, 554).
IV. Kir-Abbaian: PNS *ɛ(:) >*ɪ(:), *ɔ(:) > *ʊ(:) /#C_N(C_2)#, C_2 = [-voice]; followed by:
V. Kir-Abbaian: PNS *NC > N /#CV_, NC = PNS *mp or *ŋk (for this shift see also Commentary to Table 2.10, wider distributed shift IV); followed by:
VI. Kir-Abbaian: remaining PNS *NC > C, where C = [-voice].
VII. Kir: PNS *e > i /#C_d(-)#. Examples of C = *p' and *k have been noted, suggesting that C = some portion of PNS voiceless stops.
VIII. proto-Jebel: PNS *i(:) > *ɛ(:) /#S_l, S = sibilant.
IX. proto-Jebel: PNS *ɔ > *a, *o > ɔ /#K_C_2, C_2 = [-voice].

Table 3.5. Selected tonal correspondences in Nilo-Saharan

	Uduk	Kanuri	Songay	For	Gaam	Bertha	Ik
high	´	´	´	´	´	´	´
mid	` or ¯	´	`	´	¯	`	´
low	` or ¯	`	`	`	`	`	`

Commentary to Table 3.5

The tonal correspondences shown in Table 3.5 obtain in unmodified #CV(C)# stems. With morphological additions, a variety of tonal shifts can be charted in the different languages. The shifts of Gaam and For appear to be few; in the case of For, but possibly not for Gaam, this situation is surely an artifact of insufficient data.

In general, observed occurrences have been noted in this commentary, rather than systematic tone-shift rules. Clearly there are deep-level rules at work here; and some of these, judging from the recurrent effects, for example, of certain suffixes in raising the tone of low-tone stems, or lowering high stem tones, are anciently productive synchronic rules. The establishment of such rules will have to await future studies and, in particular, the wider development of systematic tonal grammars of particular Nilo-Saharan languages.

But their consequences are often widely visible now. Among them are rules that are apparently of PNS provenance; e.g., the raising of low and mid stem tone, and lowering of high tone, upon addition of the PNS *a- attributive noun/adjective prefix (Chapter 6, affix 54), and the parallel effects of adding a suffix in *-Vh (Chapter 6, affixes 49-52). These environments of tonal shift are attested not only in PNS and in Sahelian roots, but separately evinced right across the family—in Uduk (Uduk rules 6 and 7 below), Kanuri (Kanuri rules 1.d, 2.a3, and 3.d), Songay (Songay rules 1-3), For (For rules 1 and 3.a), and Ik (Ik rules 1.b and d, 2.b, and 3). As well, the addition of a variety of sonorants and obstruents suffixes (for which see Chapters 5-7) seems from an early period to have effected other kinds of shifts in stem tone. The range so far attested of examples of this latter sort are listed below for the PNS, Northern Sudanic, Saharo-Sahelian, and Sahelian stages of the evolution of the family (see Chapter 4 for this clas-

sification), and from individual languages (see below Uduk rules 1-5, Kanuri rules 1-3, Songay rules 4 and 5, Gaam rules 1-3), Bertha, and Ik rules 1-2).

In pre-Uduk the PNS mid and low tones fell together in #(C_1)V(C) syllables (Uduk rules 1 and 2), both producing a low-tone reflex where C_1 was a voiced, minus-glottal consonant, and a mid-tone result elsewhere. Derivational processes then led to rephonemicization of this new three-tone distribution. The derivationally extended Uduk words in which tone-lowering took place can thus show either a low or a mid tone in the tone-shifted syllables, depending on the preceding consonantal environment.

PNS

1. a. *Cv́ + (V)h > Cv̀h.
   b. *Cv̀ + (V)h > Cv́h.
2. a. *Cv̀(C) + s > Cv́(Cv́)s.
   b. *Cv́C + r > Cv̀Cv̀r.
   c. *Cv́C + m > Cv̀C(v̀)m.

Uduk

1. * ˉ > * ˋ; followed by:
2. *(C_1)v̀(C) > (C_1)v̀(C), where C_1 = [+voice/-glottal]; > (C_1)v̄(C) elsewhere; which also followed Uduk shifts 3 and 4 of Commentary to Table 2.9.

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3. stem plus suffixes -Vɗ, -Vš, -Vs, -Vl, -ila('), -ira', -u$t_{\underline{}}$':
   a. high-tone stem: *Cv́(C)+ Vɗ > Cv̀(Cv̀)ɗ/Cv̄(Cv̄)ɗ; *Cv́C(v́C)(v́C) + Vɗ > Cv̀C(v̀C)(v̀C)v́ɗ/Cv̄C(v̄C)(v̄C)v́ɗ, etc.;
   b. mid-tone stem: *Cv̄C + Vɗ > Cv̄Cv́ɗ; *Cv̄C + Vl > Cv̀Cv́l/ Cv̄Cv́l, etc.;
   c. low-tone stem: *Cv̀(C)(v̀C)(v̀C) + Vɗ > Cv́(C)(v́C)(v́C)v́ɗ; *Cv̄NC + ira' > Cv́NCírá'.
4. high-tone stem plus suffixes -Vn: *Cv́C + Vn > Cv̄Cv́n/Cv̀Cv́n (> Cv́Cv̀n also has been noted in one case).
5. high-tone stem plus suffix -Vr: Cv́C + Vr > Cv̄Cv̄r /Cv̀Cv̀r.
6. mid-tone stem plus suffix -Vm: Cv̄C + Vm > Cv̀Cv̀m /Cv̄Cv̄m.
7. mid-tone stem plus suffix -(V)y: Cv̄ + y > *Cv́y (*Cay > *Cé).
8. low-tone stem plus suffix -(V)h: Cv̀ + h > *Cv́'.

9. *a- attributive prefix plus stem:
   a. *a- + Cv́C(v́C) > a̰Cv̀C(v̀C)/ à Cv̄C(v̄C) + Cv́Cvn > à Cv̄Cv́n/ à Cv̀Cv́n);
   b. *a- + Cv̄C or Cv̀C > à Cv́C.
10. reduplication in high-tone roots:
   a. *Cv́C > Cv́CCv́C, > Cv́CáCv̀C, Cv́Cà Cv́C > Cv̄NCv̄C/ Cv̀NCv̀C.
   b. *Cv́Cv C > Cv́Cv̀CCv̀Cv̀C/ Cv̄Cv̄CáCv̄Cv̄C.
11. reduplication in mid-tone roots:
   a. *Cv̄C > Cv̄CCv̄C/ Cv̀CCv̀C, Cv̄CáCv̄C/ Cv̀CáCv̀C.
   b. *Cv̄Cv C > Cv̀Cv̀CáCv̀Cv̀C/ Cv̄Cv̄CáCv̄Cv̄C.
12. reduplication in low-tone roots:
   a. *Cv̀C > Cv́CCv̀C, Cv̀CáCv̀C;
   b. *Cv̀Cv N > Cv̄Cv̄NáCv̄Cv̄N/ Cv̀Cv̀NáCv̀Cv̀ (N = nasal).

Northern Sudanic

1. *Cv̀ + *$t_{\underline{}}$ > *Cv́$t_{\underline{}}$.

Saharo-Sahelian

1. *Cv̄ + *t^h > *Cv̀t^h.

Kanuri

1. high-tone stem:
   a. plus suffix in -Vm, -Vk, -as, -t(V), or -k(V): Cv́C + (V)C > Cv̀C(v̀)C(v̀);
   b. plus suffix in -Vl or -Vs (Vs not = as): Cv́C + V > Cv̀Cv́C;
   c. plus suffix in -ta, -ak, -Vp, -Vm:
      (1) *Cv́C + ta or VC > Cv̀Ctá, Cv̀Cv́C;
      (2) *Cv́CVC + Vm > Cv́Cv́Cv̀m;
   d. plus suffix in -uh, -ah: Cv́C + -u/a > Cv̀Cú/á.
2. mid-tone stem:
   a. plus suffix in -Vt, -k, -Vk, -V:
      (1) *Cv̄C + (V)C > Cv́Cv́C;
      (2) *Cv̄C + Vk > Cv̀Cv̀k;
      (3) *Cv̄C + Vh > Cv́Cv̀; + -a > Cv́Cá;
      (4) *k^h- prefix plus mid-tone CV stem: *Cv̄ > kv́Cv̀;
      (5) *Cv̄C + Vl/r > Cv̀Cv̀l/r.
3. low-tone stem:
   a. plus suffix in -Vm, -Vs, -Vk, -Vt: Cv̀C + VC > Cv̀Cv́C;
   b. plus suffix in -Vl, -Vr: Cv̀C + VC > Cv́Cv́C;

c. plus suffix in -Vi: CV̀C + Vi > CV́CV̀ì;
d. plus suffix in -V: CV̀C + uh > CV́Cú; + ih > CV́Cì; CV̀C + -à, sometimes > CV̀Cá.

4. reduplication:
   a. in high-tone roots: *CV́ > CV́CV̀; elsewhere tone remains high throughout; exception: CV́C reduplicated plus -ah > CV̀CCV̀Cá (i.e., rule 1.d above follows this rule);
   b. in mid-tone roots: CV̄C > CV́CCV̀C; CV̄CV > CV́CV́CV̀CV̀; CV̄ > CV̀CV́;
   c. in low-tone roots: CV̀ > CV́CV̀; elsewhere remains low throughout.

Sahelian

1. *CV̀yn + ah > *CV́ynàh.
2. *CV̀(C) + s > CV́(CV́)s.

For

1. in high-tone stem:
   a. *a- + *CV́ > àCV̀;
   b. *CV́C + Vh > CV̀CV̀.
2. in mid-tone stem:
   a. *CV̄C + Cv > CV̀CCV́ (in adj.);
   b. *CV̄C + ah > CV̀Cà.
3. in low-tone stem:
   a. *a- + *CV̀C- > àCV́C-;
   b. *CV̀C + Cv > CV̀CCV́;
   c. *CV̀C + Vh > CV́CV́;
   d. *CV̀ + t > CV́t.

Songay

1. tone shift in #Cvh# stems:
   a. *CV́h# > CV̀# in nouns;
   b. *CV̀h# > CV̂# in verbs. These shifts preceded Songay shift 1 in Commentary to Table 2.10.
2. stem plus *-ah, *-eh suffixes:
   a. *CV́(n)C, *CV̄(n)C + a, e > CV̀(n)Cà/è; some *CV́C + a > CV́Cà;
   b. *CV̄C + a > CV̀Cà;
   c. *CV̀C + a > CV́Cà, sometimes CV̀Cà.

3. stem plus *-i, *-u suffixes (*-i'y, *-ih, *uh ?):
   a. *CV́C + V > CV́Cú/í; also > CV́CV̀; some CV́v + i > CV̀vCí;
   b. *CV̄C + V > CV̀Cù/ì;
   c. *CV̀C + V > CV́Cù/ì; some CV̀vC + i > CV́vCí.
4. stem plus -ow, -ey suffixes:
   a. *CV́C + Vw/y > CV̀CV́ŵ/ŷ; also sometimes > CV́CV́y;
   b. *CV̄C + Vw/y > CV́CV́w/y, CV́CV́ŵ/ŷ;
   c. *CV̀C + Vw > CV́CV̀w, + Vy > CV̀CV́y; also sometimes > CV̀CV̀y; *CV̀ + y > CV́y.
5. stem plus -(V)CV, -VC:
   a. *CV́C + Vn(V), VrV > CV̀CV́C(V̀); *CV́ + tV > CV̀tV́; *CV́C + (Vn)gV> CV̀C(V̀n)gV̀; *CV́C + Vm > CV́CV̀m; *CV́C + kV > CV̀CkV́;
   b. *CV̄C + Vr > CV́CV̀rV̀; CV̄C + -Vm, -nV > CV̀C(V̀)m/n(V̀); *CV̄ + tV > CV́tV́; *CV̄C + VntV > CV̀CV́ntV̀;
   c. *CV̀C + (V)CV, VC > CV́C(V́)CV́, CV́CV́C(V́); + Vm > CV̀CV́m.
6. reduplication:
   a. in high- and mid-tone roots: all high;
   b. low-tone roots: *C_1V̀C > C_1V́CC_1V̀C (*CV̀y > CV̀yCV́ỳ), > C_1V́C_1V́CV̀, C_1V́C_1V́CV́; *CV̀CVN > CV̀CV̀NCV́CV̀N.

Gaam

1. in high-tone stems:
   a. *CV́ɬ + Vm > CV́(ɬ)Vm;
   b. some CV́g + Vn > CV̀V̀n-.
2. in mid-tone stems:
   a. *CV̄ɬ + Vm > CV́(ɬ)Vm;
   b. *CV̄ + n > CV́n;
   c. *CV̄C + -a > CV̀Cá.
3. in low-tone stems:
   a. *CV̀(CV̀) + -j > CV́CV́j; *CV̀ + i > CV̄ì; *CV̀g + -i- > CV̄i-;
   b. *CV̀(gV)N > CV̄N;
   c. *Cày + t + Vl > Cɛ́ɛ́dV́l.

Bertha

1. in mid-tone stems: CV̄C + Vn > CV́CVn.
2. CV́l- + *-ah > CV̀Cà(').

Ik

1. in high-tone stems:
   a. *CV́C + Vn > CVCV́n;
   b. *CV́C + Vh, -i > *CV̀CV́h/í;
   c. *(C)V́C + Vr > *(C)V̀CV́r; + VC_3, C_3 = [-voice], > (C)V̀CV̀C_3;
   d. *a- + *CV́C > àCV̀C;
   e. some *k- + wV́C > kwV̀r;
   f. *CV́ + w > CV̀w.
2. in mid-tone stems:
   a. *CV̄C + Vr/Vd > CVCV́r/V́d; + VsVt > CVCVsV́t;
   b. *CV̄C + Vh > *CV̀CV́h.
3. in low-tone stems:
   a. *a- + *CV̀C > aCV́C (?);
   b. *CV̀C + Vh > CV́CV́.

CHAPTER 4

THE SUBCLASSIFICATION OF NILO-SAHARAN

Subclassificatory schemes

The Nilo-Saharan family has relatively complex internal relationships. Attempts at subclassification of its languages began with Greenberg's (1963) initial formulation of the family. His breakdown of the family had six divisions:

1. Koman
2. Saharan ("Central Saharan")
3. Songay
4. For ("Fur")
5. Maban
6. Chari-Nile

To the last of these, Chari-Nile, were attributed four sub-branches:

a. Central Sudanic
b. Kunama
c. Bertha
d. Eastern Sudanic

Eastern Sudanic, in turn, was composed of ten subgroups, treated as if coordinate—Nubian, Tama, Nara ("Barea"), Temein, Nyimang, Gaam ("Ingessana" or "Tabi"), Daju, Surmic, Nilotic, and Rub ("Nyangiyan").

Bender long ago drew attention to Chari-Nile's weakness as a putative genetic division of th e family and has recently offered an alternative classification (Bender 1989a). His layout has five "peripheral" units of uncertain interrelationship—(1) Songay; (2) Saharan and Rub; (3) Maban and For; (4) Bertha; and (5) Kunama—along with a "Core" Nilo-Saharan comprising Eastern Sudanic, Central Sudanic, and Koman. His Eastern Sudanic divides into two sub-branches, one consisting of Nubian, Taman, Nara, and Nyimang, and the other of Nilotic, Surmic, Temein, and Jebel. He also includes Kadugli-Krongo, a group of doubtful connection to the Nilo-Saharan family at all (Ehret 1995), in this core set.