Tocharian and Samoyed: on the question of Uralic substrate influence in Tocharian

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3 Relative chronology of Samoyed sound changes

From the previous chapter we have a model of pre-Proto-Tocharian sound developments, and to test the specific hypothesis that pre-Proto-Tocharian was in contact with early Samoyed, we require the same for pre-Proto-Samoyed. This chapter will detail the sound changes that occurred in pre-Proto-Samoyed from Proto-Uralic based on the inherited lexicon that has so far been established for this branch. The further developments to the individual Samoyed languages are left out of consideration to avoid making the matter more complicated than it needs to be for the purpose of comparing pre-Proto-Samoyed and pre-Proto-Tocharian phonology.

3.1 Introduction

The foundations for Proto-Samoyed reconstruction were laid down by Janhunen 1976, with the bulk of etymologies presented in the 1977 publication *Samojedischer Wortschatz* (SW). Janhunen (1981) treated the correspondences with the rest of Uralic. Further work on etymology with minor revisions to the phonological reconstruction are found in, e.g., Helimski (1986, 1992/3, 1997, 2005). The aim is to come to a considered full relative chronology that also takes into account more recent Samoyed historical studies. The numbers that accompany the cited etyma in this chapter correspond to etymological reference list 2, which contains more etymological information and references. It can be found at the end of this dissertation.

3.2 Samoyed and Proto-Uralic phonology

Samoyed is a relatively conservative branch of Uralic, but it still underwent a number of significant phonological changes. The Proto-Uralic consonant inventory is given in Table 3.1 below; this basic information can be found with slight variations in both recent handbook chapters like Aikio (2022a: 5) and Zhivlov (2023: 118), and in older articles as in Janhunen (1981: 249), Sammallahti (1988: 482).

Table 3.1: The Proto-Uralic consonant inventory.

PU	labial	dental	retroflex	palatal	velar
stop	*p*	*t*	*č*	*ć*	*k*
fricative?		*δ*		*δ′*	*γ*/*x*
sibilant		*s*	*š*		
nasal	*m*	*n*		*ń*	*ŋ*
liquid		*l r*			
glide	*w*			*j*	

A few consonants are of uncertain phonetic quality, and their place in the phonological system is tentative. PU *δ may have been a voiced fricative *[ð], which is how it turns up in Saami, although elsewhere this phoneme merged with *t, *l or *r. PU *δ′ is traditionally reconstructed as the palatalized counterpart to *δ, but whether this really was a *[ðʲ] is doubtful. It did merge with *δ in the western branches Saami, Finnic, Mordvin and Mari, and elsewhere it has a palatal reflex *l′*, *ɟ* or *j*. One alternative interpretation of this phoneme in Proto-Uralic is as a palatal lateral *l′ (Zhivlov 2023: 119). The nature of the so-called Uralic "laryngeal", represented in reconstruction by either *γ or *x, is uncertain. It disappeared in many branches, consistent with its interpretation as a weak fricative, but in Saami it became *k, and merged with original PU *k. A velar fricative *ɣ* is found in Mansi and Khanty, but its precise original nature of this phoneme is not fully understood (see Janhunen 1981: 240–246; 2007; Sammallahti 1988: 482; Aikio 2012: 227; 2022a: 7–8; Zhivlov 2023: 119–120). I will use the notation *γ for this phoneme, without the intention of taking a stance on its phonetic value.

Due to various mergers, the Samoyed consonant system was somewhat reduced. PU *δ, *δ′, *γ, *š and *s were either lost or merged with other phonemes. The development of PU *č to PS *c is a purely notational change. Furthermore, PS *s derives from PU *ć in an entirely straightforward manner. There is a possibility that PS *s was actually still palatal *ś (cf. Janhunen 1998: 462), or even retained its affricate pronunciation *ć (Zhivlov 2023: 150), but for the moment, this is of no consequence for our investigation. The Proto-Samoyed consonant system is given here in Table 3.2.

Table 3.2: The Proto-Samoyed consonant inventory.

PU	labial	dental	retroflex	palatal	velar
stop	*p*	*t*	*c*		*k*
sibilant				*s*	
nasal	*m*	*n*		*ń*	*ŋ*
liquid		*l r*			
glide	*w*			*j*	

While the consonant system became smaller, the Samoyed vowel system expanded with the innovation of a few additional distinctions. Most Proto-Samoyed vowels directly continue Proto-Uralic vowel. One important exception is PS *ü, which is almost always innovative in Proto-Samoyed. PS *a, *å and *o will be discussed more extensively in sections 3.6 and 3.7. The exact position of PS *ə̈ and *ə̂ in the vowel space is uncertain, but they are interpreted as reduced vowels (e.g., Janhunen 1998: 463). The Proto-Uralic and Proto-Samoyed vowel systems are presented in Table 3.3.

Table 3.3: The Proto-Uralic (left) and Proto-Samoyed (right) vowel inventories (Janhunen 1981: 247, Helimski 2005; Aikio 2006).

PU	front	central	back	> PS	front	central	back
high	*i ü*		*u*		*i ü*	*į*	*u*
mid	*e*	*ę*	*o*		*e ö*	*ę*	*o*
low	*ä*	*a*			*ä*	*a*	*å*
reduced						*ə ə̂*	

The structure of the Proto-Samoyed phonological system has been slightly revised in recent years. In particular the vowel system has been increased by two extra vowels relative to earlier reconstructions. In 1993, Helimski introduced the idea of the Proto-Samoyed front schwa **ə*[37] in addition to the back schwa **ə̂*. The only difference in the reflexes of these phonemes is in terms of the type of vowel harmony they trigger in Nganasan and, as later discovered by Salminen (2012), in Nenets as well. Etymologically, this front-back contrast is furthermore a continuation of the contrast between PU **i* and **u*, which are understood as having developed into PS **ə* and **ə̂* respectively under certain circumstances (see 3.6.1). It is uncertain whether the two were still phonetically distinct at the Proto-Samoyed level, since the only remaining observable difference between **ə* and **ə̂* in any Samoyed language is the harmonic class they belong to.

Once again based on data from Nganasan, Helimski (2005) furthermore changed the way we understand the development of PU **e* in Samoyed. It was originally thought that PU **e* had merged with **i* as PS **i* (Janhunen 1981: 225; 234; 247). Helimski argued that PU **e* was actually preserved as such, pointing to the notation of Old Nganasan <e> or <ê> in Castrén's data for Modern Nganasan *į* or *i*. The modern reflex *į* can be considered a recent outcome of a raising sound change. Old Nganasan *e* or *ê* developed into Modern Nganasan *į*, but this development is obfuscated by the secondary fronting of this *į* to *i* next to palatal sounds like *ń* (Helimski 2005).

The retention of PU **e* as PS **e* entails a change in notation for some of the other vowels: PS **e* in Janhunen's notation is now rendered as **ä*, identical to its usual Proto-Uralic source, and Janhunen's PS **ä* is written as **a* instead. This latter change renders the consultation of some sources dealing with Proto-Samoyed reconstruction somewhat confusing, since Janhunen's PS **å* was also written as **a* by some scholars (e.g., Helimski 1997; Aikio 2002; see also Aikio 2006a for an overview of the revised reconstruction). I accept Helimski's conclusions and give PS **e* as the reflex of PU **e*, and PS **ä* as the reflex of PU **ä* throughout this dissertation. See Warries (2022) for a more extensive justification and a specific address to the scepticism of Peyrot (2019a).

[37] Alternatively, simply **ə*, see Salminen (2012). I have opted to use **ə* for maximal contrast and clarity.

There are a number of changes that took place between Proto-Uralic and Proto-Samoyed that are rather straightforward on the face of it, such as a merger between PU **δ* and **r* as PS **r* (Janhunen 1981: 250; Sammallahti 1988: 485) and a simplification of clusters containing PU **k* in combination with another obstruent; the **k* in such cases is simply lost (Janhunen 1981: 251). However, most changes show an intricate interplay with other sound laws, attesting to the relative chronology of their occurrence.

In some cases, there are only one or two examples of a change or a conditioning factor, but if the etymologies themselves are reliable and there are no counterexamples, I have decided to take these at face value to come to a workable model of the relative chronology. There are also a number of words that point to irregular developments, going against more generally noticeable trends. These will be mentioned, but for the purposes of this study I have decided to take the majority development as regular, and adopt that in a working hypothesis of the relative chronology.

3.3 Loss of final PU **-i*

The first sound change to address is the development of second-syllable PU **-i* to PS **-ə/ə̂* and its disappearance in certain environments. An intermediate development to **-ə/ə̂* can be assumed for all PU **-i*.[38] This vowel usually disappeared in pre-Proto-Samoyed when it followed a single consonant (Janhunen 1981: 32ff.; Sammallahti 1988: 485). Following a consonant cluster, PS **-ə/ə̂* remains. This distribution is illustrated with some examples below.

Loss of PU final **-i* in Proto-Samoyed	
3.	PU **aŋi* > PS **aŋ* [all] 'mouth'
54.	PU **kari* > PS **kar* [only Ne] 'skin, surface, bark'
98.	PU **lomi* (**lumi*) > PS **jom*(-) [Ng-Sk] 'snow'
114.	PU **nusi-* > PS **nə̂t-* [En-Ne-Sk-Km] 'scrape'
115.	PU **nüδi* > PS **nir* '[no Mt] handle'
154.	PU **sẹni* > PS **cẹn* [all] 'sinew'
193.	PU **weti* > PS **wet* [all] 'water'

Retention of PU final **-i* in Proto-Samoyed	
4.	PU **aŋti* > PS **aŋtə* [all] 'blade'
32.	PU **ẹpti* > PS **ẹptə* [all] 'hair of the head'
77.	PU **kuńći* > PS **kunsə* [Ng-Sk-Km-Mt] 'urine'

[38] It is disputed whether this is a development at all, since one could reconstruct PU **-i* itself as **-ə* instead (Kallio 2012).

95. PU **lẹnti* > PS **lị̈ntə* [only Ng] ‘plain, valley’
177. PU **tumti-* > PS **tumtə-* [no Sk] ‘know, recognize’
200. PU **woŋki* > PS **wåŋkə* [Ng-En-Ne] ‘hole, cave’

There are a number of words that do not behave according to these rules, however. This is due to the fact that any root PU **CVCi* that changed to **CVC* would have continued to alternate with **CVCə* in certain forms of the paradigm. Due to these alternations, final PS **-ə/ə̂* could be analogically added or removed, sometimes in the individual Samoyed languages (cf., e.g., Janhunen 1981: 252 on PS **tə̂ŋ(ə̂)* ‘summer’). For example, gen.sg **ẹptə̂n* is clearly the genitive of a stem **ẹptə̂* ‘hair of the head’, since ***ẹpt* would have an illegal final cluster, but gen.sg. **utə̂n* can be interpreted as the genitive of either **ut* or **utə̂* ‘passage, way’. The latter is the expected regular outcome (see 3.5.2), but the former stem was easily created based on analogy with words like **nir* : gen. **nirən* ‘shaft’, which never contained a consonant cluster and regularly lost the final **-i*. Here are a few examples where the Samoyed languages are in disagreement about the continued presence of final **-ə*:

56. PU **käri-* > PS **kärə-* [Ng-En-Ne] ~ **kär-* [Sk-Km-Mt] ‘dress, put on’
160. PU **suŋi* > PS **tə̂ŋə* [Ng-En-Sk-Km] ~ **tə̂ŋ* [Ne] ‘summer’
181. PU **ukti* > PS **utə* [Ng-NeF] ~ **ut* [EnF-NeT] ‘passage, way’

It should be noted that loss of PU **-i* did not affect the suffix-final *-i* of the personal endings of the possessive declension and the objective conjugation PU 1sg. **-mi*, 2sg. **-ti*, which became PS **-mə* and **-rə* respectively. This makes it difficult to interpret the loss of PU **-i* as a general apocope of word-final PU **-i*, and to my knowledge, this issue has not yet been properly addressed. The adjectival suffix PU **-ji* was not affected either, as this became PS **-jə* (Aikio 2022a: 20). The issue remains to be fully resolved.

3.4 Changes affecting single consonants

A number of consonant changes are relatively straightforward and will be discussed first. In the following subsections, all of them will be woven into the relative chronology more or less firmly, as some of them are involved in further changes affecting the vowels.

3.4.1 PU **δ*, **s* and **š*

PU **δ* is reflected in Proto-Samoyed as **r*, which means that it merged with already existing PU **r* (Janhunen 1981: 250; Sammallahti 1988: 485; Zhivlov 2023: 150). Examples include the following:

58. PU **käwδi* > PS **kürə* [der. Ng-En-Ne] 'band (for tightening something)'
71. PU **kuδa* > PS **kârâ* [Sk-Km] 'morning'
93. PU **lęδi-* > PS **lęr-* [der. Ne-Sk] 'be frightened'
115. PU **nüδi* > PS **nir* '[no Mt] handle'
134. PU **piδi* > PS der. **pirə* [Ng-En-Ne-Sk] 'height'
135. PU **piδkä* > PS **pirkä* [no Ng] 'high'
166. PU **täγ/wδi* > PS **tärə* [Ng-Ne-Sk] 'full'

A number of PU **t* in suffixes also changed to **r*, chiefly in the 2sg. possessive suffix PU **-ti*, which became PS **-rə*, and in one of the Proto-Uralic causative suffixes PU **-tA*, which developed into PS **-rA* (Janhunen 2002: 82; Aikio 2022a: 20; Zhivlov 2023: 150). It could be assumed that this happened via an intermediate stage **-δV* (Zhivlov 2023: 150), in which case this development could be taken together with the general rhotacization of PU **δ*.

With that assumption, the change from PU **δ* to PS **r* can receive a tentative place in the relative chronology. If the intervocalic environment after the second syllable is an important trigger for the change from PU **t* to PS **r*, as seems to be the case since postconsonantal **t* is preserved as such (e.g., Zhivlov 2023: 150), it can be tentatively dated before the loss of second-syllable **-i*. Forms like PU **tuliti* 'your fire' may have developed via **tulâδâ* to **tulârâ* to PS **tujrâ* (cf. Fi. *tulesi*, also from PU **tuliti*). If PU **t* in this position first merged with **δ* before the loss of second-syllable **-i*, the development may also have taken place via an intermediary stage of the type pre-PS **tulδâ* or **tujδâ*.

The development as a whole has to be dated before a notable change of two other consonant phonemes, namely those of PU **s* and **š*. At some point in the development of Samoyed, both **s* and **š* became PS **t* (Janhunen 1981: 150; Zhivlov 2023: 150). This can be seen in the examples below.

PU **s* > PS **t*
69. PU **kosi-* (**kusi-*) > PS **kot-* [all] 'cough'
70. PU **koska* > PS **kåtå* [Ng-En-Ne] 'grandmother'
78. PU **kupsa-* > PS **kâptå-* [all] 'extinguish'
91. PU **läsi-* > PS **jät-* [Ng-En-Ne-Sk] 'near'
100. PU **lupsa* > PS **jâptå* [all] 'dew'
103. PU **męksa* > PS **mįtâ* [no Mt] 'liver'
114. PU **nusi-* > PS **nât-* [En-Ne-Sk-Km] 'scrape'
140. PU **poski* > PS **påtâ* [all] 'cheek'
148. PU **sala-* > PS **tålä-* [all] 'steal'
149. PU **sarka* > PS **tårkå* [En-Ne] 'branch'
153. PU **sęksa* > PS **tįtå-jŋ* [no Ng] 'Siberian pine'

156. PU **soski-* > PS der. **tåtu-* [Sk-Km] 'chew'
158. PU **suδ′a* > PS **tâjå* [only Mt] 'finger'
159. PU **suksi* > PS **tutâ* [Ng-En] 'ski'
161. PU **süli* > PS **tij* [Sk; der. Ng-En-Ne-Mt] 'fathom'

PU **š* > PS **t*

48. PU **kajši-*; noun *kajšo* > PS **kåjtâ-*; noun **kåjto* [Ng-En-Ne-Sk] 'be sick; sickness'
163. PU **šęra* > PS **tįrå-* [En-Ne-Sk?; der. Mt] 'dry (itr.)'
162. PU **šelki-* > PS **tej-* ~ ?**teə-* [no Km] 'fly'

The **t* from PU **s* never developed further to **r* in any suffix; cf. the third person singular possessive suffix PS **-tA* from PU **-sA*. The completion of the development from **s*/**š* to PS **t* can thus be placed after the change from **δ* to **r*, although the initial merger of the two sibilants and developments through intermediary stages (such as **[θ]*) cannot be further pinned down at present.

3.4.2 PU **l*, **δ′* and **j*

The changes to PU **l*, **δ′* and **j* are best treated together, since they share a reflex PS **j* in many environments. PU **δ′* is relatively straightforward, since it is always reflected as PS **j* (Janhunen 1981: 250; Sammallahti 1988: 485; Zhivlov 2023: 150), as illustrated by the following list.

12. PU **ćoδ′a-* > PS **såjå-* [Ng-Ne] 'wage war'
17. PU **ćüδ′i* > PS **sijə* [En-Sk-Km-Mt] 'charcoal'
23. PU **δ′ęmi* > PS **jęm* [Sk-Km] 'bird cherry'
24. PU **δ′ümä* > PS **jimä* [all] 'glue'
45. PU **kaδ′a-* > PS **kåjä-* [all] 'leave'
62. PU **koδ′ka* > PS **kåjkâ* [Ng-En-Ne-Sk] 'idol; ghost'
106. PU **muδ′a* > PS **mâjå* [Ng-Sk-Km-Mt] 'earth, land, terrain'
122. PU **oδ′a* > PS **åjå* [no Ng] 'raw'
142. PU **puδ′a-* > PS **pâjä-* [no Km] 'chop wood'
158. PU **suδ′a* > PS [only Mt] **tâjå* 'finger'

PU **l*, on the other hand, underwent a split development in Samoyed. It is either preserved as **l* or changed into **j* (Janhunen 1981: 250). Word-initially the general development was into **j*, except when followed by PU **ę* (Aikio 2014b: 86).

PU *l- > PS *j-	
87.	PU *lapta > PS *jåptå [no Km] ‘flat, thin’
88.	PU *läćä- > PS *jäsä- [En-Ne-Sk] ‘cover the tent’
89.	PU *lämi > PS der. *jämVjə [Ng-Ne] ‘broth’
90.	PU *lämpi ‘warm’ > PS *jämpə [Ng-En-Ne-Sk] ‘clothes’
91.	PU *läsi- > PS *jät- [Ng-En-Ne-Sk] ‘near’
98.	PU *lomi (*lumi) > PS *jom(-) [Ng-Ne-Sk] ‘snow’
100.	PU *lupsa > PS *jâptå [all] ‘dew’

PU *l- = PS *l- before PU *ę	
93.	PU *lęδi- > PS *lęr-, der. *lęrö- [der. Ne-Sk] ‘be afraid’
94.	PU *lęmpi > PS *lį̈mpâ [Ng-En-Ne-Sk] ‘swamp, bog’
95.	PU *lęnti > PS *lį̈ntâ [Ng] ‘lowland’
97.	PU *lęwi > PS *lę [all] ‘bone’

PU *l > PS *l- ~ *j-	
96.	PU *lepći > PS *lępsâ [Ng-En] ~ *jępsâ [Ne-Sk-Km-Mt] ‘cradle’

In one instance, initial *l shifted to *j before *ę in only part of Samoyed, namely in PU *lępći ‘cradle’, PS *lępsâ. This has a reflex with initial *l-* in EnF *l'ičᴜ* and Ng. *labsə*, but initial *j-* in NeT *jebc°*, PSk. **ťopsə*, Km. *ďepsü*, Mt. *čĕpsë*, as if from PS **jępsâ* instead (Aikio 2014b: 86). Salminen reconstructs this as PS **l'ępsâ*, with a unique palatal **l'*, and projects this back to a PU **l'ępćâ* with the same phoneme, arguing that the developments of an initial sequence PU **lę* with both *l* and *j* in the Samoyed languages would otherwise be impossible (Salminen 2023: 383–384). Rather than reconstructing an additional Proto-Uralic phoneme, perhaps in this case assimilation occurred with the following **ć* or **s* (when it was still palatal **ś*) to cause a secondary palatalization. An intermediary stage in the development from **l* to **j* may have been a palatal lateral **l'* in pre-Proto-Samoyed. However, the problem of the correspondence *l* and *j* within Samoyed is also found in different words of non-Uralic origin, and the situation is not at all straightforward (see Kaheinen 2023: 88).

The word-internal developments are different. Before consonants, and potentially also word-finally after the first syllable, the reflex is **j* (Janhunen 1981: 250). Between vowels the development could go further, depending on the type of stem: in *i*-stems **l* changed to **j* and even disappeared in intervocalic position, while in *A*-stems it was retained as PS **l* (ibid.). After the second syllable, **l* was also retained, as seen in in PU **aćkal* ‘step (n.)’ > PS **asâl-* ‘step (v.)’ and certain suffixes like the verb suffix PU **-li-* > PS

*-*l*(*ə*)- (Aikio 2012: 244). The list of examples below shows how, normally, PU **j* and PU **l* merged in *i*-stems.

PU **Vji* and **Vli* > PS **Vj* (no vowel sequence)	
13.	PU **ćoji-* > PS **soj-* [En-Ne] 'be heard, be audible'
132.	PU **peli-* > **pẹj-* [Sk; der. in rest] 'fear'
161.	PU **süli* > PS **tij* [Sk; der. in Ng-En-Ne-Mt] 'fathom'
170.	PU **toli-* (**tuli-*)> PS **toj-* [all] 'come'
175.	PU **tuli* > PS **tuj* [all] 'fire'
182.	PU **ulki* > PS **uj* [no Km] 'pole'

PU **Vj*(*k*)*i* and **Vl*(*k*)*i* > PS **Və* (vowel sequence)	
18.	PU **ćülki-kći-* > PS **siə-sə-* [En-Sk-Km] 'spit'
47.	PU **kaji* > PS **kåə̂* [Sk] 'slender object'
51.	PU **kali-* > PS **kåə̂-* [all] 'die'
74.	PU **kulki-*[39] > PS **kuə̂* [Ne-Sk] 'float downstream'
143.	PU ?**puji* > PS **puə̂* [all] 'back, behind'
180.	PU ?**uji-* > PS **uə̂-* [Ne–Sk–Mt] 'swim'
188.	? PU **wali-* > PS **wåə̂-* [Ng-En-Ne-Mt] 'speak'

PU **Vli* > PS **Vj* and **Və*	
198.	PU **woli-* 'be' > PS **åj-*, **åə̂-* [paradigmatic alternation in En-Ne; all] 'be'

PU **Vl*(*k*)*i* > PS **Vj* or **Vj* (ambiguous cases)	
55.	PU **käli* > PS ?**käj* [Mt] or ?**käə* [Ng-Sk]; [Ne ambiguous] 'tongue'
162.	PU **šelki-* > PS **tej-* or ?**teə̈-* [potentially in EnT; rest ambiguous] 'fly'

PU **Vli* > PS **V* (exceptional example)	
183.	PU **üli-* > PS **i-* [no Mt] 'on; space above'

The variability in the reflexes of **Vj* and **Və* most likely result from paradigmatic alternations between, e.g., nom.sg. **tuj* : gen.sg. **tujə̂n*, which regularly became **tuə̂n*

[39] Connected with PS **kəj-* 'go' rather than **kuə̂-* by Aikio (2002: 26). One could consider a paradigmatic split, with **kəj-* from forms like the aorist pre-PS **kuj-ŋå-* with the vowel change to **kə̂j-ŋå-* (NeT *xəya*), cf. 3.6.1. However, the particularly common palatalization of suffixes attached to this stem in Tundra Nenets, like in fut.ptc. *xæw°ntya*, ipfv.vn. *xæbya*, and ipfv.ptc. *xænya* next to *xæna* (Salminen 1997: 66, 83–84), might suggest that it originally was front vocalic PS **käj-* rather than the back vocalic **kə̂j-* that would be expected from PU **kulki-*.

'fire', and could be levelled in either direction, i.e., either **tuj* : **tujân* or **tuâ* : **tuân* (Aikio 2012: 246–247). The verb 'to be' still shows such an alternation in Tundra Nenets: the present participle NeT *ŋæda* regularly derives from PS **åjtå*, with the regular consonant stem PU ±**wol-* 'be' suffixed with **-(n)ta*, while the imperative and connegative NeT *ŋaq* can be derived from PS **åâk*, from PU ±**wolik* (cf. SW: 16–17 with a reconstruction of **åâ-* ~ **åâ-j-* ~ **åj-* for Nenets). A similar distribution of allomorphs is found in Forest Enets, with *ŋa-* in the aorist, imperative, jussive and connegative and *ɛ-* elsewhere (Khanina & Shluinsky 2023: 827). The imperative/connegative PS **åâk* is also reflected in Nganasan with the (suppletive) connegative *ŋuəʔ* (Wagner-Nagy 2019: 272). Similar to the preservation of PU **l* after the second syllable, suffixal PU **-ji* was able to preserve its **j* in the suffix PU **-ji* > PS **-jə*.

There are no examples containing PU **δ′* that show that this consonant was ever lost in the same way as many PU **l* and **j* in intervocalic position before **-ə*, but this may simply be a coincidence due the general lack of words that show this phoneme in the relevant environment. The clearest instance of PU **Vδ′i* reflected in Samoyed seem to be PS **sijə* from PU **ćüδ′i* 'charcoal' (17). While this could suggest that PU **δ′* only became **j* after **Vjə* from both **Vji* and **Vli* had developed into vowel sequences, PS **sijə* could also represent a development from earlier **sij* (type PU **tuli* > PS **tuj*) with an analogical **-ə* added at the end after the sound law removing **j* in intervocalic position had ceased to operate (cf. section 3.3).

3.4.3 PU **w* and **γ*

Proto-Uralic **γ* (alternatively written as **x*) is lost in Samoyed (Janhunen 1981: 245–246; Sammallahti 1988: 485; Zhivlov 2023: 150). Generally, the sequence PU **Vγi* yields a simple vowel in Samoyed. The only known instance of **Vki* behaves in the same way, so that **Vki* may be routed through **Vγi*. The examples are given together here.

PU **Vγ/ki* > PS **V* (no vowel sequence)
39. PU **jęγi-* > PS der. **ęr-* [Ne-Sk-Mt] 'drink', **ękâl-* [En-Ne] 'gulp'
64. PU **koki-* > PS **ko-* [no Ng] 'see'
102. PU **meγi-* > PS **mi-* [all] 'give, sell'
130. PU **peγi-* > PS **pi-* [no Mt] 'cook'
169. PU **toγi-* > PS **tå-* ~ **tâ* [all?] 'bring'
192. PU **weγi-* > PS **i-* [Sk-Km] 'take, grab'
195. PU **wiγi-* > PS **ü-* [Sk; der. Ne] 'take, carry'

PU **Vγi* > PS **V* or **Və* (ambiguous example)
120. PU **ńoγi-* (**ńuγi-*) > PS **ńo-* or perhaps **ńoâ-* [Ne-Sk-Mt] 'pursue'

PU **Vγi* > PS **Və* (vowel sequence)	
157.	PU **suγi-* > PS **suə̂-* [Sk; der. Ng] 'row'

Only PU **suγi-* 'row' unambiguously yielded a vowel sequence **uə̂* on account of Ng. *tuobsa* 'oar' (PS ±**tuə̂-psåń*); SkTym *tū-* and SkKet *tū-* are suggestive of a vowel sequence, but not probative, and this verbal root is not attested in the other Samoyed languages. Since this is the only example of a sequence **Vγi* being reflected as a vowel sequence in Samoyed, alternative explanations may also be imagined. For instance, this verb may have been influenced by the semantically close verbs PS **uə̂-* 'swim' and PS **kuə̂-* 'drift downstream'.

The reflexes of PU **Vwi* are normally also PS **V*, same as for PU **Vγi*. There are only a few ambiguous cases, as can be seen in the examples below.

PU **Vwi* > PS **V*	
97.	PU **lẹwi* > PS **lẹ* [all; der. Ng] 'bone'
126.	PU **pawi* > PS **pa* [all; der. Ng] 'tree'
151.	PU **sewi-* > PS der. **tima* [all] 'tooth'
152.	PU **sewi-* > PS der. **titü* [Ng-En-Sk] 'bait'
167.	PU **täwiw* > PS ?**tä/ew* [Sk-Km-Mt; ders. Ng, En, Ne] 'lung'
174.	PU **towi* (**tuwi*) > PS **to* [all; der. Ng] 'lake'

PU **Vwi* > PS **V* or **Və* (ambiguous example)	
16.	PU **ćowi* (**ćuwi*) > PS der. **so-j* or perhaps ?**soə̂-j* [no Ng] 'throat'

PU **Vwi* > PS **Və* (uncertain example)	
155.	PU ?**si/äwi* > PS *tiə̈* [Ng-En-Ne-Sk] 'year ring (of tree)'

PU **Vwi* > PS **Vw* or **Və* (uncertain ambiguous example)	
92.	PU ?**lewi-* > ? PS **jew-* or **jeə̈-* [only Sk] 'shoot'

On account of PU **sewi-* 'eat' to PS **ti-* (in derivations), the development of **eγi* to PS **i* appears to have been shared with **ewi*. It seems that word-final **-w* was preserved in Proto-Samoyed (Gusev 2008), so that perhaps loss of the **-w-* in these roots should have applied in intervocalic position, before loss of final **-i*. However, the potential Selkup reflex of putative PU **lewi-* 'shoot', Sk. **t́ǖ-* 'shoot' (Aikio 2002: 53 fn. 5; Salminen 2023: 392) could imply preservation of the **-w-* at least in this root: PS **je-* would not yield the front rounded vowel Sk. **ǖ*. None of the other roots with the structure **CVwi* show effects of the **-w-*, so that it is difficult to determine what vowel effects, if any, should have been

expected if the **-w-* was preserved until a late stage. A vowel sequence **jeə-* might also yield Sk. *ćīī-*, however, as it is expected to merge with the regular development from PS **iə* to Sk. *īī* (PS **i* and **e* merge in Selkup). Loss of intervocalic **-w-* might also be dated before the loss of intervocalic **j* in **Vjə*, since such sequences yield a vowel sequence in Proto-Samoyed, which is not atteetd with certainty for PU **Vwi*. This distribution may be accidental, however, owing to the low number of examples.

The reflex of *A*-stem sequences like PU **uwa* are often given as uniformly resulting in **uə̂* in Proto-Samoyed, with a preservation of the original disyllabic structure, but not of the second-syllable vowel. In some words, a reconstruction of **uå* is now preferred: for instance, PS **puə̂* 'back' (143) gives Ng. *huo* while PS **puə̂l-* 'blow' yields Ng. der. *hüoltə-*, with no other way to account for the difference; thus Ng. *hüoltə-* may be derived from PS **puål-* instead (Kaheinen 2023: 68–73; Zhivlov 2023). Compare the split development of PU second-syllable *-a* discussed in subsection 3.7.1 below.

82. PU **kuwakka* > PS **kuə̂kå-nå* [only Ng] 'long ago'
150. PU **puwa-* > PS **puå-* [Sk; der. all] 'blow', der. **puål-* 'blow'
201. PU **(w)uwa* > PS **wuə̂-* [only Ng] 'current'

The similar sequence apparently **üwä* ends up as PS **iə* 'belt', with the regular change from **ü* to **i* (on which see 3.6.1) and a prothetic consonant. The disappearance of the **-w-* in this position before PU **A* might be later than before PU **i*, on account of the completely reliable preservation of the original disyllabic structure in these examples, as opposed to the apparent reduction to monosyllables in all cases of **Vwi*.

3.4.4 Summary

The simple consonant changes are now briefly summarized. PU **δ* merged with **r* most likely before loss of second-syllable **-ə*. The development of PU **s* and **š* took place after the change of PU **δ* and some suffixal **t* to **r*. PU intervocalic **-l-* before **-ə* merged with PU **-δ'-* and PU **-j-* as **-j-*, and was eventually lost in this position. In word-final position **-j* from all sources was preserved, so that the intervocalic elision of **-j-* cannot be dated before apocope of final **-ə*. Intervocalic PU **-w-*,**-γ-* and **-k-* disappeared in original *ə*-stems most likely before both loss of intervocalic **-j-* in the same environment, and before the apocope of **-ə* after open syllables. This is summarized in Table 3.4.

Table 3.4: An overview of the changes discussed in this section and their relative chronology as far as can be determined.

Sound changes		Chronology	Treated in
A *-i*	> *-ə*	a notational change	3.3
B1 *CVCVtV*	> *CVCVδV*	before B2, C1.	3.4.1
B2 *δ*	> *r*	before E.	3.4.1
C1 *CVCə*	> *CVC*	before C5.	3.3
C2 *Vγ/kə*	> *V*	**eγi* > **i*;	3.4.3
C3 *Vwə*	> *V(w)*		3.4.3
C4 *uwa*	> *uə̂/uå*		3.4.3
C5 *Vjə*	> *Və*		3.4.2
D1 *Vli*	> *Vjə*	before C5	3.4.2
D2 *δ´*	> *j*	possibly with D1 before C5.	3.4.2
E *s/š*	> *t*		3.4.1

3.5 Changes affecting consonant clusters

A number of Proto-Uralic consonant clusters were reduced in Samoyed, and these reductions are relevant for the relative chronology of a number of vowel developments. Aside from the specific change of **lC* to **jC*, already discussed above (3.4.2) together with the general development of **l*, the remaining changes each involve the loss of a segment.

3.5.1 PU **rk* and **lk*

The sequences PU **rki* and **lki* were reduced to pre-PS **rə* and **lə*. This change could well have occurred before **lC* had become **jC*, allowing for an abstraction to **Rkə* > **Rə* (Aikio 2002: 26).

10. PU **ćęrki* > PS **sęr* [Ng-En-Ne-Sk; der. Km-Mt] 'ice; white; salt
18. PU **ćülki-kći-* > PS **siə-sə-* [En-Sk-Km] 'spit'
74. PU **kulki-* > ? PS **kuə̂-* [ders. Ne-Sk] 'float downstream'
146. PU **purki* > PS **pur* [der. Ne-Sk?] 'smoke'
162. PU **šelki-* > PS **tej-* (or **teə-*?) [all] 'fly'
182. PU **ulki* > PS **uj* [no Km] 'pole'

Most of these words behave in Samoyed exactly as though the **k* was never there. In particular, apocope in PU **ulki* > ** uli* > PS **uj* pole', PU **šelki-* > **šeli-* > PS **tej-* (or **teə-*?) 'fly', and PU **ćęrki* > **ćęri* > PS **sęr* 'ice; white; salt' should have occurred when the **k* had already disappeared. We can thus date this change before the development **CVCə* > **CVC* in the relative chronology.

The cluster **rk* was not affected before **-A*, as evident from PU **sarka*, which became PS **tårkå* 'form, bifurcation, branch' (149). There are, however, some words that possibly show a loss of **lk* even before **-A*, namely PU **tulka* > PS **tuå* 'feather' (176), PU **ülkä* > PS ?**ij* 'boy' (184), and PU **pälkä* > PS ?**pea* 'thumb' (128) (Aikio 2020: 95). The developments of these words are difficult to understand, especially next to PU **wolka* > PS **wajk* 'shoulder' (199) with the more expected change from **lk* to **jk*. It is also problematic that the **lk*-cluster would have completely disappeared from PU **tulka*, since in *a*-stems the expected intermediary of **j* should not have been lost (cf. 46. PU **kaja* > PS **kåjå* 'sun'). This would force us to set up a sound development that avoids an intermediary step **j* in some way, such as a speculative **tulka* > **tulγa* > **tujγa* > **tuwå* > **tuå*. An intermediate stage like **tuwå* would also seem to be necessary to account for the lack of reduction in the sequence **u-a* > PS **ə̂-å*, which is otherwise only known to be blocked by an intervening **-w-* (the development of **u* is discussed in subsection 3.6.1). This remains highly speculative, but the development of **-lk-* needs to be resolved if this etymology of PS **tuå* is to be accepted.

PU **δ′k* is not lost in a similar way in PU **koδ′ka* > PS **kåjkə̂* 'idol; ghost' (62), so that the change of **lk* should perhaps be dated before the merger of **l* and **δ′*, if this example is reliable. If a cluster **lγ* is posited as an intermediary stage in the development of PU **tulka* > PS **tuå*, the different reflex PS **ij* of PU **ülkä* may be accounted for by positing a change of **lγ* or later **jγ* to either **j* or **w* depending on the surrounding vowels: **j* in a front environment, and **w* in a back environment. This remains difficult, however: while pre-stage **tuwa* would yield PS **tuå*, an earlier **üjä* to **ijä* should be expected to yield Sk. **ićə* rather than **ī* if the final vowel was not lost in some way.

All of these changes remain very tentative, but it should be clear that if (part of) these etymologies are correct, some chain of developments needs to be set up that somehow does not interfere with either **Vja*, **Vδ′a*, **Vla*, or, for that matter, **Vka*, and that also blocks the development of **u-a* to **ə̂-å*. An intermediate **lγ* with further changes specific to that cluster is the best option I currently see short of positing an entirely new phoneme such as **ɬ* or the like.

3.5.2 PU **kC*, **Ck* and geminates

Original **k* in consonant clusters was not preserved in several other clusters either. Not only did it disappear in the sequences **rki*, **lki* and possibly even **lkA*, it was eliminated from all clusters of the type **kC* and **Ck* where *C* was an obstruent (Janhunen 1981: 251). This development is seen in a good number of examples, given in the lists below.

PU **Ck* > PS **C* (loss of **k*)	
1.	PU **aćkal* > PS **asVl-* [Sk-Km] 'step'
22.	PU **čočki* (**čučki*) > PS **cocə̂* [Sk] 'log'

57. PU **kätki-* > PS **kätə* [Ng-Ne-Mt] 'wrap up, swaddle'
61. PU **koćki-* > PS **kåsə̂-* [no Mt] 'dry (itr.)'
70. PU **koska* > PS **kåtå* [Ng-Ne-En; Sk?, Mt?] 'grandmother'
105. PU **moćki-* > PS **måsə̂-* [no Ng] 'wash'
140. PU **poski* > PS **påtə̂* [all?] 'cheek'
156. PU **soski* > PS der. **tåtu-* [Sk-Km] 'chew'

PU **kC* > PS **C* (loss of **k*)

28. PU **ękta-* > PS **i̯tå-* [all] 'hang'
103. PU **męksa* > PS **mi̯tə̂* [no Mt]'liver'
131. PU **peksä-* > PS **pet-* [Ng-Ne-Sk-Km] 'beat'
141. PU **pučki* > PS **pucə̂* [all] 'hollow stalk'
153. PU **sęksa* > PS **ti̯tå-jŋ* [no Ng] 'Siberian pine'
159. PU **suksi* > PS **tutə̂* [Ng-En] 'ski'
173. PU **totki* > PS der. **tåtu* [Sk] 'tench'
181. PU **ukti* > PS **ut(ə̂)* [Ng-En-Ne] 'passage, way'

Janhunen interprets these developments in terms of assimilation and subsequent degemination (on which see below); e.g., **ks*, **kt*, **sk* > **tt* > **t* and **ck* > **cc* > **c* (Janhunen 1981: 251). This may indeed have been an intermediate step before the cluster was fully lost, but whether it really occurred cannot be properly verified. Contrary to the development of **rki* and **lki*, final **-ə* generally did not disappear due to apocope after these original consonant clusters, even if those stems had only a single intervocalic consonant in Proto-Samoyed after losing the **k*. This indicates that this specific type of *k*-loss is to be dated after the general development of stems of the type **CVCə* to **CVC* (see 3.3).

Geminate stops show a similar interaction with apocope. There are not many examples of Proto-Uralic geminate consonants, and only a very few are known to be reflected in Samoyed, listed here.

30. PU **ęna-ęppi* > PS [Ng-En-Ne-Km] **i̯nə̂pə̂*
60. PU **kęčči-* > PS **kęcə̂-* [Sk] 'bad smell, stench'
113. PU **nokki* > PS der. **nåku* [Sk] 'neck'

If the development of PU **kęčči-* to PS **kęcə̂-* represents a regular development, the simplification occurred after *ə*-apocope. On account of PU **nokki* to PS der. **nåku* 'it was also after the disappearance of simple **-k-* in stems of the type **CVki* like PU **koki-* > **ko-*. Fittingly, this latter change was already dated before the former in the discussion above, but the available evidence remains slim.

Thus, if the loss of **k* in the clusters described above went through an intermediary stage of assimilation to geminates (Janhunen 1981: 251), that change should be dated before degemination itself. Such a middle step cannot be dated relative to any other changes, however, as it cannot be confirmed in the first place.

3.5.3 PU pre-consonantal glides

The final type of consonant cluster to discuss is the type starting with the labial glide **w*. This glide was lost in Samoyed in preconsonantal environment, but seemingly only at a relatively late date. The three examples are provided here.

38. PU **jäwji* > PS **jüjə* [Ng-Ne] 'lichen (on trees)'
58. PU **käwδi* > PS **kürə* [ders. Ng-Ne] 'band (for tightening something)'
166. PU ?**täwδi* or **täγδi* > PS *tärə* [Ng-En-Ne-Sk] 'full'

Final **-ə* was apparently shielded from apocope by the original cluster **wC*, so that the simplification seems to have happened after the loss of **-ə* after open syllables (Aikio 2002: 33). On account of the development from PU **jäwji* to PS **jüjə* 'lichen (on trees)' rather than to ***jüə*, this cluster simplification also seems to have happened after the loss of intervocalic **j* in sequences of the type **Vjə* (cf. 3.4.2).

Clusters of the type **jC* seem to have behaved differently, as both examples show a loss of the final PU **-i*.

136. ? PU **pijri* > ? PS **pijr* [Ne] 'inner bark of birch'
186. PU **wajŋi* > PS **wajŋ* [all] 'spirit, soul, breath'

Some vowel changes seem to have been involved with the disappearance of preconsonantal **w*, most clearly a change from **äwC* to **üC*. The lack of a vowel-change in PS **tärə* 'full' (not ***türə*) has been explained by Zhivlov with a reconstruction as PU **täγδi* rather than **täwδi* (Zhivlov 2023, cf. Aikio 2002: 31–34). This would imply the continued presence of PU **γ* in the pre-Proto-Samoyed consonant system until after apocope, since otherwise PU **täγδi* would be expected to yield PS ***tär* instead. Naturally, since it is only a single example, the final **-ə* may have been added secondarily in Proto-Samoyed as well, so that we must remain cautious.

3.5.4 Summary

To summarize this section, a number of Proto-Uralic consonant clusters were simplified in Samoyed. These simplifications can be dated relative to a number of other developments, in particular the loss of **-ə* after open syllables. The reduction of PU **rki*

and **lki* happened before **CVCə* changed to **CVC*, but every other cluster simplification happened after **CVCə* had become **CVC*. For structural reasons, we may suppose that **lC* had not changed to **jC* yet, since it patterned with the resonant **r* in the sequence **Rki*; there are no original sequences PU **jki* to strictly corroborate this, however. For the relative chronology, we may conclude:

1) **rki*, **lki* > **ri*, **li*
2a) **l* > **j*; 2b) **CVCə* > **CVC*
3a) *Vjə* > *Və*; 3b) **kC*/*Ck* > **C* or **CC*; 3c) **CC* > **C*
4) **wC* > **C*

A development **γC* > **C* might be added on the basis of only PS **tärə* 'full' if from PU ?**täγδi* rather than ?**täwδi*. Table 3.5 gives a summary.

Table 3.5: An overview of the changes discussed in this section and their relative chronology as far as can be determined.

Sound changes		Chronology	Treated in
A *-Rkə*	> *-Rə*	before B1, B4, C1	3.5.1
B1 *CVCə*	> *CVC*	before B2, C1, C2	3.3
B2 *w*/*γC*	> *C*		3.5.3
B3 *Vγ*/*kə*	> *V*	before C2, C1?	3.4.3
B4 *Vjə*	> *Və*		3.4.2
C1 *kC*/*Ck*	> *C* or *CC*	if via *CC*, before C2	3.5.2
C2 *CC*	> *C*		3.5.2
D1 *l*/*δ´*	> *j*	before B4	3.4.2

3.6 Changes affecting non-low vowels

In this section we will go through the changes that affected the non-low vowels **u*, **i*, **ü*, **ę*, and **o*. They are all very important for the development of the pre-Proto-Samoyed vowel system. A more thorough discussion focussing on PU **a* is given in the next subsection.

3.6.1 PU **u*, **i* and **ü*

The Proto-Uralic high vowels **i* and **u* both show a double reflex in Proto-Samoyed. They are either preserved as such, or reduced to "front" **ə̈* and "back" **ə̂* respectively. We will start with a look at PU **u*, which changed into PS **ə̂* before a following PU **-a* (Janhunen 1981: 223-224).

41. PU **juka* > PS **jə̂kå* [no Ng] ‘small river’
42. PU **jupta-* > PS **jə̂ptə̂-* [Sk; der. Ng] ‘say, speak’
71. PU **kuδa* > PS **kə̂rə̂* [Sk-Km] ‘morning’
75. PU **kuma-* > PS **kə̂mə̂-* [no Km] ‘fall over’
76. PU **kuńa-* > PS **kə̂ńə̂-* [all] ‘close eyes’
78. PU **kupsa-* > PS **kə̂ptå-* [all] ‘extinguish’
79. PU **kura-* > PS **kə̂rå-* [Ng-En-Ne-Km; der. Sk] ‘bend; crooked, bent’
80. PU **kura* > PS der. **kə̂ru* [En-Ne-Mt] ‘knife’
100. PU **lupsa* > PS **jə̂ptå* [all] ‘dew’
106. PU **muδ′a* > PS **mə̂jå* [Ng-Sk-Km-Mt] ‘earth, land, terrain’
107. PU **muja-* > PS **mə̂jə̂-* [Ne] ‘become happy’
108. PU **muka* > PS **mə̂kå* [all; der. Km] ‘back’
109. PU **muna* > PS **mə̂nå* [Ng-En-Sk; der. Km] ‘egg’
110. PU **mura* > PS der. **mə̂rVŋkå* [Ng-En-Ne] ‘cloudberry’
142. PU **puδ′a-* > PS **pə̂jä-* [Ng; der. En-Ne-Sk-Mt] ‘chop wood’
144. PU **puna-* > PS **pə̂n-* [Ng-Sk-Km; der. En-Ne] ‘braid, weave’
158. PU **suδ′a* > PS **tə̂jå* [only Mt] ‘finger’
178. PU **tunta-* > PS **tə̂ntå-* [En-Sk; der. Ne] ‘teach, accustom to’

In some examples, like in PU **kuma-* > PS **kə̂mə̂-* ‘fall over’, the PU **-a* was changed into PS **-ə̂* (see also subsection 3.7.1), which must have happened later. The exceptions, in which PU **u* was not reduced before a second-syllable **-a*, all contained an intervocalic **w* in Proto-Uralic. The rule can thus be formulated as “**u-a* > **ə̂-å/ə̂* except in the sequence **uwa*” (Zhivlov 2023: 152). Whether this is due to a true retention of **u* in this environment or a reversal of the change from **ə̂w* to **uw* is difficult to tell.

82. PU **kuwakka* > PS **kuə̂kå-nå* [only Ng] ‘long ago’
147. PU **puwa-* > PS **puå-* [Sk; der. all] ‘blow’, der. **puål-* ‘blow’
201. PU **(w)uwa* > PS **wuə̂-* [only Ng] ‘current’

There are a few examples where **u* was reduced, even though the conditioning environment as described so far did not apply.

81. PU **kurki* > PS der. **kə̂rö* [no Ng] ‘crane’
114. PU **nusi-* > PS **nə̂t-* [En-Ne-Sk-Km] ‘scrape’
160. PU **suŋi* > PS **tə̂ŋ* [all] ‘summer’

For some of these aberrant cases, paradigmatic alternations could be assumed. For example, PU **nusi-* ‘scratch’ would originally have formed a verbal noun based on the

consonant stem **nus-*, thus **nus-ma*, and an aorist stem **nus-ŋa-*, from which an expected allomorph **nâs-* may have been levelled to other forms of the paradigm, so that the expected imperative **nutâ-k* changed to PS **nâtâ-k*. PU **suŋi* 'summer' may have undergone the vowel change in certain case forms like the old locative **suŋna* > **tâŋnå* 'in summer', or in other, similar formations. The same might have applied for PU **kurki* 'crane', but it is more difficult to imagine that a locative pre-PS **kur(k)na*, or an ablative pre-PS **kur(k)ta*, or the poss.3sg. pre-PS **kur(k)sa* would have been common enough to spread via analogy. The suffix **-ö* (or **-V w*, see Salminen 2012: 341, Kaiheinen 2023: 64) could theoretically have had some influence, depending on its age in this word and the precise origins of the suffix.

For completeness, the remaining words in which PU **u* did not change to PS **â* are listed below. It is indeed clear that all these examples have a second-syllable PU **-i* and not **-a* (cf. Janhunen 1981: 233).

43. PU **juri-* > PS **ju/ürâ-* [En-Ne-Sk-Km] 'get lost; forget'
77. PU **kuńći* > PS **kunsâ* [Ng-Sk-Km-Mt] 'urine'
141. PU **pučki* > PS **pucâ* [all] 'hollow stalk'
146. PU **purki* > PS **pur* [ders. Ne-Sk?] 'smoke'
159. PU **suksi* > PS **tutâ* [Ng-En] 'ski'
157. PU **suγi-* > PS **tuâ-* [Sk; der. Ng] 'row'
175. PU **tuli* > PS **tuj* [all] 'fire'
177. PU **tumti-* > PS **tumtâ-* [no Sk] 'know'
181. PU **ukti* > PS **utâ* [Ng-En-Ne] 'passage, way'
182. PU **ulki* > PS **uj* [no Km] 'pole'

PU **i* similarly changed to PS **ə* in some cases, although the circumstances are not as clear due to a smaller number of examples (Janhunen 1981: 225, 237). The majority of reliable examples do show a second-syllable **-ä*, however.

PU **i-ä* yielding a PS **ə*
11. PU **ćilmä* > PS **səjmä* [all] 'eye'
34. PU **ipsä-* > PS **əptä-* [Ne] 'smell'
36. PU **itä-* > PS der. ?**əti/u-* [all] 'appear'
104. PU **minä* > PS **mən* [all] '1sg.'
168. PU **tinä* > PS **tən* [no Ne] '2sg.'

PU **i-i* yielding a PS **ə*
33. PU **imi-* > PS der. **əmmä(-)* [Ne] 'suckle; breast'
35. PU **ipsi* > PS **əptə* [Ng-En-Ne-Sk] 'smell'

Examples where PU **i* is continued as PS **i* are even more scarce (Janhunen 1981: 234). Moreover, they contain some instances where PU **i* is apparently preserved unchanged before **-ä*, namely in PS **ńimsä* 'breast' and **pirkä* 'high'. In both cases we are dealing with derivations from original PU *i*-stems, which are preserved regularly in PS **ńim-* 'suck' and **pir* 'high'. These most likely exerted analogical pressure to change the vowel in otherwise expected PS ***ńəmsä* and ***pərkä*.

PU **i-i* yielding a PS **i*
112. PU **nimi* > PS **nim* [all] 'name'
119. PU **ńimi-* > PS **ńim-* [Sk; ders. all] 'suck'
134. PU **piδi* > PS der. **pirə* [Ng-En-Ne-Sk] 'height'

PU **i-ä* yielding a PS **i*
119. PU **ńimćä* > PS **ńimsä* [Sk] 'breast'
135. PU **piδkä* > PS **pirkä* [no Ng] 'high'

The remaining Proto-Uralic high vowel **ü* changed to PS **i*, except in PU **ćüńćä* > PS **sünsə* 'breast' and PU **künti* > PS **küntə* 'smoke, vapour'. In both cases, the **ü* precedes a cluster with a nasal, which could potentially be significant.

PU **ü* > PS **i* (majority development)
17. PU **ćüδ′i* > PS **sijə* [En-Sk-Mt-Km] 'coal'
18. PU **ćülki-kći-* > PS **siə-sə-* [En-Sk-Km] 'spit'
24. PU **δ′ümä* > PS **jimä* [all] 'lime'
115. PU **nüδi* > PS **nir* [no Mt] 'handle'
161. PU **süli* > PS **tij* [no Km] 'fathom'
179. PU **tütki-* > PS **titə-* 'open' [Sk-Km]
183. PU **üli-* > PS **i-* [no Mt?] 'space above'
185. PU **üwä* > PS **(n|j)iə* [all] 'belt'

PU **ü* = PS **ü* (exceptional cases)
19. PU **ćüńćä* > PS **sünsə* [Ng-En-Ne?-Mt] 'breast'
85. PU **künti* > PS **küntə* [all] 'smoke, vapour'

Pystynen (2017) has suggested that the neighbouring **k* may have been of some influence in **küntə*, with the additional etymologies PU **kütki-* 'tie' to PS **küt-* 'tie' and PU **ńüktä-*

'pull' to PS **n^{l}üt^{l}-*[40] 'pull', but neither of these etymologies seem to be compelling. As far as I can tell, Pystynen's PS **küt-* refers to **ket^{l}-* in SW, which is only reflected as a verb in Km. *šüʔ-/šöʔ-* 'tie, sew'. However, this may also derive from PS **såjtə-* 'sew' (SW 135; see KSz 1081), and the derivatives meaning 'thread', under SW **ketâj*, could plausibly be derived from the root PS **kätə-* 'wrap up' instead; in any case, only Kamas allows for PS **ü*. As for PS **n^{l}üt^{l}-* 'pull', the long vowel of NeT *nyúcy°* requires a different Proto-Samoyed reconstruction, such as PS **n^{l}üət^{l}-* or **n^{l}üjt^{l}-*, which cannot regularly be provided by PU **ńüktä-*.

There are two etymologies where PU **ü* may have developed into PS **ə*, similar to **i* and **u*, but neither involves a following vowel **-A*:

84. PU **külki* > ? PS **käj*, der. **käjwä* [Ng-En-Ne-Sk] 'side'
86. PU **küńil* > PS **käńäli* [all] 'tear'

After the development from **l* to **j*, the **ü* in both words would have followed **k* and preceded a palatal, which in combination may have had a particular effect. Otherwise, the reason for this development remains, at present, unknown. Analogical influence from the verb **kuńa-* 'close eyes', PS **kâńâ-* has been assumed to explain the vowel of PS **käńälį* 'tear' (Pystynen 2014), but since the verb is back vocalic while the noun is front vocalic (Ng. *kəəlï-ðï* 'his/her tear' rather than ***kəəlï-ðu*), this may be difficult.

On account of PU **ð'ümä* > PS **jümä* 'lime' it seems that the change from **ü* to **i* happened after the development from **i-ä* to **ə-ä* discussed above (Sammallahti 1990: 8), although, as Pystynen cautions (2014, and p.c. 2023), the **j* could potentially have had some assimilatory effect as well.

Since additional PS **ü* were created with the developments of PU **käwδi* > PS **kürə* 'rope' and PU **jäwji* > PS **jüjə* 'lichen (on trees)' (see subsection 3.5.3 above), the change from **ü* to **i* can be dated before the simplification of clusters with an initial *w*-component.

Word-initial PU **wi-* also yielded PS **(w)ü-* in at least two examples. The development of PU **wiγi-* 'drag', is separate from that of PU **weγi-* 'take', which did not develop a rounded front vowel, but seeing as the initial **w-* of the latter word was lost, it is difficult to connect this to the development of PU **eγi* to PS **i* in the relative chronology.

195. PU **wiγi-* > PS **ü-* [Ne-Sk] 'drag'
194. PU ±**wijit(t)i* > PS **wüət* [all] 'ten (10)'

[40] **n^{l}* is used when the attestations do not allow differentiation of PS **n* and **ń*, and **t^{l}* is used when the attestations do not allow for a differentiation of PS **t* and **c* (Janhunen 1977).

3.6.2 PU **ę* and PS **ę* and **į*

The Proto-Uralic back unrounded vowel **ę* underwent a phonemic split into two distinct Proto-Samoyed vowels: PS **ę* and **į*. This can be seen in the following lists of examples.

PU **ę* > PS **į* (before original **-a*)	
31.	PU **ęńa* > PS **įńâ* [Ne-Sk] 'tame'
103.	PU **męksa* > PS **mįtâ* [no Mt] 'liver'
153.	PU **sęksa* > PS **tįtå-jŋ* [no Ng] 'Siberian pine'
163.	PU **šęra* > PS **tįrå-* [En-Ne-Sk-Mt] 'dry out (itr.)'

PU **ę* > PS **ę* (before original **-i*)	
10.	PU **ćęrki* > PS **sęr* [all] 'ice; white; salt'
23.	PU **δ´ęmi* > PS **jęm* [Sk-Km] 'bird cherry'
26.	PU **ęćiw-* > PS **ęso-* [En-Ne] 'camp'
32.	PU **ępti* > PS **ęptâ* [all] 'hair of the head'
39.	PU **jęyi-* 'drink' > PS der. **ęr-* 'drink' [Ne-Sk-Mt], der. **ękâl-* 'id.' [En-Ne]
59.	PU **kęčči-* > PS **kęcâ* [Sk] 'spoiled'
96.	PU **lępći* > PS **lępsâ* [Ng-En] ~ **jępsâ* [Ne-Sk-Km-Mt] 'cradle'
117.	PU **ńęli* > PS **ńęj* [Ne-Sk-Km-Mt] 'arrow'
118.	PU **ńęri* 'wetness' > PS **ńęr* 'cartilage' [Ng-En-Ne-Sk]
133.	PU **pęni-* > PS **pęn-* [all] 'put'
154.	PU **sęni* > PS **cęn* (irregular **c-*) [all] 'sinew'

This change is difficult to date, since it did not interact very strongly with other sound laws. Janhunen (1981: 233–234) and Sammallahti (1988: 484) inferred that the syllable structure influenced the reflex of PU **ę*, with a reflex as PS **į* being found only in open syllables. On the other hand, Aikio (Aikio 2015: 34) and recently also Zhivlov (2023: 151) take the vowel in the second syllable as the decisive conditioning factor: a sequence PU **ę-a* yielded a PS **į* while PU **ę-i* yielded PS **ę*. This accounts neatly for the majority of examples. In the relative chronology this should have happened before any PU **-a* had changed into **-â*.

The consistency of these developments is greater than in the case of the development from **u* and **i* to **â* and **ä* before **-A*, even though here, too, some paradigmatic alternations might be expected. For example, the aorist stem of pre-PS **pęnâ-* or already **pęn-* 'put' should have been **pęnŋå-*, whence perhaps regular ***pįnŋå-*. There are only two examples where PU **ę* changed to **į* before **-i*, both with a very similar phonological environment (Aikio 2015: 34; Zhivlov 2023: 151).

94. PU **lęmpi* > PS **lį̈mpə̑* [Ng-En-Ne-Sk] ‘pond, swamp’
95. PU **lęnti* > PS **lį̈ntə̑* [Ng] ‘lowland’

This is interpreted as an additional condition for raising to **į̈* before a nasal cluster (Aikio 2015: 34; Zhivlov 2023: 151). If not only coda nasals in a cluster but also word-final coda nasals should in principle have effected this phonological change, it could be dated before PU **δ́ęmi* ‘bird cherry’, **pęni-* ‘put’ and **sęni* ‘sinew’ developed into **jęm*, **pęn-* and **cęn* respectively. Paradigmatic alternations between otherwise expected **jęm* : gen.sg. **jęmə̑n*, etc., might also have eliminated this change by analogy if it did apply in these words, so that this is not a hard *terminus ante quem*, but it is simpler to avoid including them in the scope of the sound law by preservation of the final **-ə̑* at that point in time.

Zhivlov describes the raising of **ę* to **į̈* as taking place only after **l-*, which works for the two clearest and most straightforward examples (**lį̈mpə̑* and **lį̈ntə̑*; Zhivlov 2023). This would disconnect the development from other sound laws like apocope. However, this could complicate the development of PU **joŋsi* > PS **(j)į̈ntə̑* ‘bow’, this likely happened via an intermediary **jęŋsi*, which then developed further with the rule of raising before a nasal. If that development is restricted to **l_NC*, it implies a direct shift from **o* to **į̈* in **joŋsi* ‘bow’. Since **o* is two steps removed from **į̈*, and the environment **NC* applies in this word, it seems to me more economical to generalize pre-nasal raising in such a way as to include also **(j)į̈ntə̑*, i.e., as **_NC*.

Zhivlov (2023: 152) has proposed an additional, minor source of PS **į̈* from PU **u* in the specific environment **k_j* on account of two potential examples:

72. PU **kuji-* > ? PS der. **kį̈jtV* [Sk-Mt] ‘lie’
83. PU ±**kuwi-* > PS **kį̈j* [Ng-Km-Mt] ‘moon’[41]

The origin of the **j* in PS **kį̈j* ‘moon’ is uncertain, and while Mt. *kistə* ‘lie’ can go back to PS **kij-tə-*, the Sk. **kučal-* ‘lie down’, only attested in Ket Selkup, points to a vowel **u* (Helimski 1997: 280–281). Due to the great uncertainties involved, it will not be possible to draw any conclusions on the basis of this potential sound change.

[41] The original internal consonant of this word is difficult to accurately reconstruct in the absence of a Saami cognate. PU ±**kuwi* should have regularly become PS ***ku*; the **-j* in the Samoyed form might thus also be a derivational suffix of the same kind as seen in PS **soj* from PU **ćowi* ‘throat’ (Aikio 2020: 145).

3.6.3 PU **o*

In a number of words, Proto-Samoyed **o* is a puzzling entity from the Finno-Ugric perspective. The problem is that in a number of words a **o* in Samoyed corresponds to a **u* in the Finno-Ugric languages. This was first discussed by Janhunen (1981: 231), who explained it as a change in all other Uralic branches except Samoyed, which would then preserve the archaic situation. The conditioning would be PU **oCi* > FU **uCi*, as there are plenty of examples of PS **uCCə̂* = FU **uCCi*, such PU **kuńći* 'urine' > PS **kunsə̂*, FU **kuńći* and PU **pučki* > PS **pucə̂*, FU **pučki*. There are also two words where FU **oCi* corresponds to PS **o*, however.

FU **u* ~ PS **o*	
18.	FU **ćuwi* ~ PS der. **so-j* (or ?**soə̂-j*) [no Ng] 'throat'
22.	FU **čučki* > PS **cocə̂* [Sk] 'log'
69.	FU **kusi-* ~ PS **kot*(-) [all] 'cough (noun and verb)'
98.	FU **lumi* ~ PS **jom-* [Ng-Ne-Sk] 'snow'
120.	FU **ńuγi-* ~ PS **ńo-* [Ne-Sk-Mt] 'pursue'
139.	FU **puri* ~ PS **por-* [Mt; der. Ng-En-Ne-Sk] 'bite'
170.	FU **tuli-* ~ PS **toj-* [all] 'come'
174.	FU **tɯwi* ~ PS **to* [all; der. Ng] 'lake'
197.	FU **wuδ'i* ~ PS **oj-* [der. Sk] 'again, anew'

FU **o* ~ PS **o*	
13.	FU **ćoji* ~ PS **soj-* [En-Ne] 'be heard, be audible'
64.	FU **koki* ~ PS **ko-* [no Ng] 'look'

The sound change posited by Janhunen has also been inverted, with the Finno-Ugric languages retaining an original **u* that changed to **o* in Samoyed in *i*-stems with an open syllable. This is the position taken by Zhivlov, who does add the exceptional position before **l* as retaining **u* (Zhivlov 2023: 152). This seems to be mainly on account of the example PU/FU **tuli* > PS **tuj* 'fire' (not ***toj*), but it yields an incorrect result for FU **tuli-* ~ PS **toj-* (~**tu-*) 'come'.

In either direction, the sound laws as suggested should have led to paradigmatic alternations between the vowel stems and the consonant stems: if an original **pori-* : **porma*, for example, developed with a sound law changing **CoCi* into **CuCi* (Janhunen 1981: 231), the result should have been **puri-* : **porma*. Conversely, **puri-* : **purma* should have regularly become **pori-* : **purma* with a change from **CuCi* to **CoCi* (Zhivlov 2023: 152). Such alternations should have been resolved in either Finno-Ugric or Samoyed in a

remarkably consistent way to result in the attested distribution between FU **u* and PS **o*.

There are two etymologies that favour Janhunen's interpretation. First, the opposition in Samoyed between PS **tuj* 'fire' and **toj-* 'come' as opposed to homophony in FU **tuli* 'fire' and **tuli-* 'come' is easier to understand if an earlier opposition of **tuli* 'fire' vs. **toli-* 'come' merged in Finno-Ugric, rather than if earlier **tuli* 'fire' and **tuli-* 'come' split in Samoyed. Second, the assumption that PS **ńo-* 'pursue' and FU **ńuɣi-* 'id.' derive from **ńoɣi-* rather than **ńuɣi-* allows for the derivation of PU **ńoma* 'hare' from this verb (Janhunen 2007: 221). Only **ńoɣ-ma* could yield PU **ńoma*, not ***ńuɣ-ma*.

At this point it does not seem possible to decide exactly how the differentiation of original **o* to PS **o* and FU **u* took place. However, we can see that the great majority of PU **o* became PS **å*, but that this did not happen to any PS **o* that corresponds to FU **u*.[42]

12. PU **ćoδ′a-* > PS **såjå-* [ders. Ng-Ne] 'war'
14. PU **ćojma* > PS **såjmå* [Ng-Sk] 'sound'
62. PU **koδ′ka* > PS **kåjkâ* [Ng-En-Ne-Sk] 'spirit, god, idol'
65. PU **kompa* > PS **kåmpå* [Ng-En-Ne-Sk] 'wave'
66. PU **konta* > PS **kåntâ-* [Ng-En-Ne-Mt] 'hunt; kill; sacrificial animal'
70. PU **koska* > PS **kåtå* [Ng-En-Ne-Sk?] 'grandmother'
68. PU **korpi* > PS **kårpâ* [En-Ne] 'blaze'
61. PU **koćki-* > PS **kåsâ-* [no Mt] 'dry (itr.), be dry'
105. PU **moćki-* > PS **måsâ-* [no Ng] 'wash'
117. PU **ńoma* > PS **ńåmå* [Ng-En-Ne-Sk] 'hare'
122. PU **oδ′a* > PS **åjå* [no Ng] 'meat, body'
123. PU **ojwa* > PS **åjwå* [Ng-En-Ne-Mt] 'head'
138. PU **ponči* 'tail' > PS **påncâ* [all] 'hem, lower edge'
156. PU **soski-* > PS der. **tåtu-* [Sk-Km] 'chew'
172. PU **tora-* > PS **tåro* [Ng-En-Ne-Mt] 'fight'
173. PU **totki* > PS der. **tåtu* [Sk] 'crucian carp'
169. PU **toɣi* > PS **tå-* ~ **tâ-* [all] 'bring'
196. PU **woča* > PS **wåc* [Ng-En-Ne-Sk] 'enclosure'
198. PU **woli-* > PS **åâ-*, **åj-* [all] 'be'
200. PU **woŋki* > PS **wåŋkâ* [Ng-En-Ne] 'hole'

[42] Notice the near complete absence of **oCi* in the following list, only **toɣi-*, ?**woli-* and **ćoji-* are reconstructed with this structure and have reflexes in Samoyed. Especially **toɣi-* > PS **tå-* (next to also **tâ-*) is puzzling besides PS **ńo-* 'pursue' from **ńoɣi-* and PS **tuâ-* from **suɣi-*: three different vowel reflexes apparently need to come from an original binary opposition.

This change, too, has a few exceptions, characterized by a retention of **o* "after **k* in an open syllable", according Zhivlov (2023: 151–152); but also **ćoma* 'good' and **ćoji-* 'be heard' retain the **o* despite not having initial **k* (see Aikio 2020: 135; Salminen 2023: 380–385). It cannot be said that **k* and **ć* fully patterned together in this regard, since PU **ćoδ'a* 'war' did become PS **såjå-* rather than ***sojå*. If Zhivlov's conditioning is otherwise correct, the developments of PU **koćki-* > PS **kåsə̂-* 'dry (itr.)' and PU **koska* > PS **kåtå* indicate that this change happened before the simplification of their internal clusters. It should also be borne in mind that, although the verb **ko-* 'look' looks like a clear open syllable in its citation form, it would practically always have been suffixed in some way, creating forms with both open and closed syllables; e.g., in the connegative **ko-k*, and the aorist stem **ko-ŋå-*. Any resulting alternations between **ko-* and ***kå-* expected to have resulted from regular sound change could have been levelled in favour of **ko-*. Similar alternations might have existed for PU **ćoji-*, PS **soj-* 'be heard, be audible', since the derivation PU **ćojma*, PS **såjmå* 'sound' does show a development from PU **o* to PS **å*.

13. PU **ćoji-* > PS **soj-* [En-Ne] 'be heard'
15. PU **ćoma* > PS **somå* [Ng-En-Ne-Sk] 'good'
63. PU **kojra* > **kora* > PS **korå* [no Mt] 'male reindeer'
64. PU **koki-* > PS **ko-* [no Ng] 'look'
67. PU **kopa* > PS **kopå* [all] 'skin'

It seems most economical to say that, assuming a shape PU **CoCi* for the type PS **por-* ~ FU **puri* (etc.) at the time, pre-PS **CoCi* did not change to **CåCi* while **CoCCi* and **CoC(C)a* did get a pre-PS **å*, and that PS **tå-/tə̂-* from PU **toγi* is an irregular exception. The sound law then took place before loss of final **-ə* and before simplification of clusters in PU **moćki-* > PS **måsə̂-* (etc.).

Not only **o*, but also PU **a* underwent a split development, namely into PS **a* and **å*, thus partly merging with the **o* that developed into PS **å*. This change is discussed in more detail in its own subsection directly after this one, but the basic premise is necessary for the understanding of a final change involving PU **o*. Namely, there are two examples in which PU **o* is reflected as PS **a* rather than **å*, in the specific environment PU **olC* (Zhivlov 2023: 152). The **l* in this position is later changed to **j*, but on account of the different development in PU **ojwa* > PS **åjwå* 'head' and PU **ćojma* > PS **såjmå* 'sound', the shift from **olC* to **alC* can be dated before **l* had merged with **j*. The examples below show how syllable-final **l* and **j* both became PS **j*.

14. PU **ćojma* > PS **såjmå* [Ng-Sk] 'sound, noise'
49. PU **kajwa* > PS **kajwå* [no Mt] 'spade'

123. PU **ojwa* > PS **åjwå* [no Ng] 'head'
165. PU **talwa-* > PS **tåjwå-* [no Sk] 'reach'
171. PU **tolwa* > PS **tajwå* [En-Ne-Mt] 'wedge'
199. PU **wolka* > PS **wajk* [Sk; der. in all] 'shoulder'

This development did not affect PU **alC* on account of PU **talwa-* > PS **tåjwå-* 'reach', which shows the general development of PU **a* to **å* instead (discussed in more detail in the next subsection). The only way to get PU **talwa-* to PS **tåjwå-* and PU **tolwa* to PS **tajwå*, assuming that both words underwent regular developments, is to date **a* to **å* before **o* to **å* and directly change **tolwa* to **talwa* in between these developments. With the reverse chronology, **tolwa* would first become **tålwå*, which leaves no room at all for it to cross with **talwa-* before that becomes **tålwå-* as well. This entails a relative chronology of 1) **a* > **å*; 2) **olC* > **alC*; 3a) **o* > **å*; 3b) **lC* > **jC*.

3.6.4 Summary

The relative chronology of the changes discussed in this section is summarized in Table 3.6. All vowel changes discussed happened before any PU **-a* became PS **-ə̂*, which leads us neatly to our next subsection.

Table 3.6: An overview of the changes discussed in this section and their relative chronology as far as can be determined.

Sound changes		Chronology	Treated in
A1 *u/i-A*	> *ə̂/ə̈-A*	before A2?	3.6.1
A2 *ü*	> *i*	before C1	3.6.1
C1 *äwC*	> *ü*	before C2	3.6.1
C2 *w/γC*	> *C*		3.4.3
C3 *CC,kC,Ck*	> *C*		3.5.2
D1 *oC(C)a*	> *åC(C)å*	before E2	3.6.3
D2 *oCCi*	> *åCCə̂*	before C3	3.6.3
D3 *ę-a*	> *į-å*	before E1?	3.6.2
E1 *CVCə*	> *CVC*	before C1, C2, C3	3.3
E2 *-A*	> *-ə̂*		3.7.1

3.7 Changes affecting PU **a*

There are a number pre-Proto-Samoyed developments that are sometimes considered to be irregular. Most prominent among these is the split development of both first-syllable and second-syllable PU **a*.

3.7.1 PU second-syllable *-*a* to *-*å* and *ə̂*

We will begin our discussion with the second-syllable *-*a*, which underwent a reduction to PS *-*ə̂* in some cases (Janhunen 1981: 226–230). This happened in at least the following etyma:

2. PU **aŋa*- 'open' > PS **ńaŋə̂*- [Ng; der. Sk] 'take off (clothes)
7. PU **ćala*- > PS **sålə̂*- [Ng-Ne-Mt] 'lighten, flash'
29. PU **ęla* > PS **įlə̂* [no Mt] 'below (relational noun)'
31. PU **ęńa* > PS **įńə̂* [Ne-Sk] 'tame'
42. PU **jupta*- > PS **jə̂ptə̂*- [Ng-Sk] 'speak'
52. PU **kama* > PS **kamə̂* [Ne-Sk] 'scale'
62. PU **koδ'ka* > PS **kåjkə̂* [Ng-En-Ne-Sk] 'spirit, god; idol'
66. PU **konta* > PS **kåntə̂* [Ng-En-Ne; der. Mt] 'hunt, kill; sacrificial animal'
75. PU **kuma*- > PS **kə̂mə̂*- [no Km] 'fall'
76. PU **kuńa*- > PS **kə̂ńə̂*- [all] 'close eyes'
103. PU **męksa* > PS **mįtə̂* [no Mt] 'liver'
107. PU **muja*- > PS **mə̂jə̂*- [only Ne] 'smile'
125. PU **pata* > PS **patə̂*- [no Mt] 'put something in a pot'
164. PU **taka*- > PS **takə̂*- [no Mt] 'behind (relational noun)'

In a few instances, the PU *-*a* was lost. This probably happened via an intermediate stage pre-PS *-*ə̂*, which could be removed by analogy.

144. PU **puna*- > PS **pân*- [no Mt] 'weave'
191. PU **watka*- > ? PS **wåt*- [only Ne] 'debark (a tree)'
196. PU **woča* > PS **wåc* [Ng-En-Ne-Sk] 'enclosure'
199. PU **wolka* > PS **wajk* [Sk; der. in all] 'shoulder'

In a few rare instances PU *-*ä* was also affected by a similar reduction. In the pronouns, this could be easily understood as an irregular reduction. (The change in PU **üwä* > PS **iə* 'belt' (185) may be connected with the disappearance of the *-*w*- and the creation of a vowel sequence, and could thus be a separate phenomenon.)

19. PU **ćüńćä* > PS **sünsə̈* [Ng-En-Ne-Mt] 'breast'
104. PU **minä* > PS **mən*- [all] '1sg'
131. PU **peksä*- > PS **pet*- [Ng-Ne-Sk-Km] 'hit, soften a hide'
168. PU **tinä* > PS **tən*- [no Ne] '2sg'

Janhunen explained some of these by reference to the development of the sequences **-åj|äj* to PNe. **-ə*. This is seen in the oblique plural of, e.g., NeT *xoba* < **kopå* 'skin' obl.pl. *xob°* < **kopåj*. The Nenets form for 'eye' NeT *sæw°*, NeF *xäm°* < PNe. **sæmə* can also be explained by this, with an earlier paradigmatic alternation between PNe. **səjmä* : *səjmə*, the latter from PS **səjmäj* (Janhunen 1981: 228–229). However, PS **-Aj* does not seem to have become **-ə* in the other Samoyed languages, meaning that this type of development is possible only for Nenets; cf., e.g., Ng. acc.pl. *kubuj* < PS **kopåj* 'skin' and Ng. acc.pl. *śejmij* < PS **səjmäj* 'eye'. For the development of PU **-A* to **-ə* in Proto-Samoyed itself, another explanation has to be found.

To give a more complete picture, the list below contains examples of PU second-syllable **-a* becoming PS **-å*. With 29 examples as opposed to 19 in the list above, this is the majority development.

6. PU **ćaδa-* > PS **sårå-* [Ng-En-Ne-Sk] 'rain'
14. PU **ćojma* > PS **såjmå* [Ng-Sk] 'sound'
15. PU **ćoma* > PS **somå* [En-Ne-Sk; der. Ng.] 'good'
20. PU **čaŋa-* > PS **cåŋå-* [Ne-Km] 'rub, wear out (tr.)'
28. PU **ękta-* > PS **įtå-* [all] 'hang up'
41. PU **juka* > PS **jôkå* [no Ng.] 'river'
46. PU **kaja* > PS **kåjå* [all] 'sun'
49. PU **kajwa* > PS **kajwå* [Ng-En-Ne-Km] 'spade'
63. PU **kojra* > PS **korå* [no Mt.] 'male, male reindeer'
65. PU **kompa* > PS **kåmpå* [Ng-En-Ne-Sk] 'wave'
70. PU **koska* > PS **kåtå* [Ng-En-Ne-?Sk-Mt*] 'grandmother'
78. PU **kupsa-* > PS **kôptå-* [all] 'extinguish, put out'
79. PU **kura* > PS **kôrå* [Ng-En-Ne-Sk] 'bend'
87. PU **lapta* > PS **jåptå* [no Km] 'thin'
100. PU **lupsa* > PS **jôptå* [all] 'dew'
106. PU **muδ´a* > PS **môjå* [Ng-Sk-Km-Mt] 'earth, land, terrain'
108. PU **muka* > PS **môkå* [all] 'back'
109. PU **muna* > PS **mônå* [Ng-En-Sk-Km] 'egg'
121. PU **ńoma* > PS **ńåmå* [Ng-En-Ne-Sk] 'hare'
122. PU **oδ´a* > PS **åjå* [no Ng] 'meat, body'
123. PU **ojwa* > PS **åjwå* [Ng-En-Ne-Mt] 'head'
149. PU **sarka* > PS **tårkå* [En-Ne] 'fork, bifurcation, branch'
158. PU **suδ´a* > PS **tôjå* [only Mt] 'finger'
163. PU **šęra-* > PS **tįrå-* [En-Ne-?Sk; der. Mt] 'dry out (intr.)'
165. PU **talwa-* > PS **tåjwå-* [no Sk] 'reach'
171. PU **tolwa* > PS **tajwå* [En-Ne-Mt] 'nail, wedge'

178. PU **tunta-* > PS **tânt̊å-* [En-Ne-Sk] 'teach'
190. PU **wara* > PS **wårå* [Ng-Sk-?Km] 'mountain, ridge'

It is clear from the examples that the change to **-ə̂* in the earlier list looks late: both the changes of **ę* to **į* before **-a* (3.6.2) and of **u* to **ə̂* before **-a* (3.6.1) occurred in all instances, regardless of whether the **-a* in question ended up as PS **-å* or PS **-ə̂*. The resulting **-ə̂* is furthermore generally preserved after open syllables (5 cases of preservation vs. 2 of loss, which could be analogical), so that we may suppose that it was still **-a* at the time when **-ə* from original PU **-i* was removed in that environment (3.3). It can thus be dated as a late development in the relative chronology of Samoyed sound changes.

3.7.2 PU first-syllable **a* to **å* and **a*

There is another vowel change connected to the split of the second-syllable PU **-a* into **-ə̂* and **-å*, namely the development of first-syllable PU **a* into **a* or **å* (Aikio 2002: 50; Zhivlov 2014). The examples with PS **a* are here given first.

1. PU **aćkal* > PS **asVl-* [Sk-Km] 'step'
2. PU **aŋa-* 'open' > PS **ńaŋə̂-* [Ne-Sk] 'take off (clothes)'
3. PU **aŋi* > PS **aŋ* [all] 'mouth'
4. PU **aŋti* > PS **aŋtə̂* [all] 'blade, point'
37. PU **jasi* > PS **jat(ə̂)* [Sk] 'chilly weather'
52. PU **kama* > PS **kamə̂* [Ne-Sk] 'scale'
54. PU **kari* > PS **kar* [Ne] 'skin, surface, bark'
125. PU **pata* > PS **patə̂-* [no Mt] 'put something in a pot, in water'
126. PU **pawi* > PS **pa* [all] 'tree'
164. PU **taka-* > PS **takə̂-* [no Mt] 'behind (relational noun)'
186. PU **wajŋi* > PS **wajŋ* [all] 'breath'

The distribution appears to be a development of PU **a-a* > **a-(ə̂)* next to PU **a-a* > PS **å-å* (Zhivlov 2023: 151). The following examples show a development of PU **a-a* to PS **å-å*.

6. PU **ćaδa-* > PS **sårå-* [all] 'rain'
8. PU **ćaŋka-* > PS **såŋkå-* [Sk] 'stick into', der. *såŋkə̂* [En-Ne] 'penis'
20. PU **čaŋa-* > PS **cåŋå-* [Ne-Km] 'rub, wear out (tr.)'
44. PU **kaća-* 'give (as a gift)' > PS der. **kåso* (or ?**kåsåw*) [En-Ne-Sk] 'gift'
46. PU **kaja* > PS **kåjå* [all] 'sun'
53. PU **kanta-* > PS **kåntå-* [all] 'carry'

87. PU **lapta* > PS **jåptå* [no Km] 'thin'
111. PU **nataw* > PS **nåto* (or ?**nåtåw*) [Ne-Km] 'brother-in-law'
149. PU **sarka* > PS **tårkå* [En-Ne] 'fork, bifurcation, branch'
165. PU **talwa-* > PS **tåjwå-* [no Sk] 'reach'
189. PU **wančaw* > PS **wånco* (or ?**wåncåw*) [all] 'root'
190. PU **wara* > PS **wårå* [Ng-Sk-?Km] 'mountain, ridge'

Exceptions to the general distribution are PU **watka-* > **wåt-* 'debark (a tree)' rather than either ***wat(ə̂)* or ***wåtå-* and PU **ćala-* > PS **sålə̂-* 'lighten, flash' rather than expected ***sålä-*. The development of PU **kani-* > PS **kån-* rather than PS ***kan-* can be understood as a result of analogical influence from the causative PU **kanta-* > PS **kåntå-* (Zhivlov 2023: 160). Additionally, the aorist stem could have been a potential factor, since that should probably have regularly developed into PS **kånŋå-*. Similarly, PS **kåjtə̂-* 'be sick' could have been influenced by the derived noun PU **kajšaw* > PS **kåjto* 'sickness', where the second-syllable vowel may have facilitated rounding of the **a* to **å*. It is noteworthy that PU **kaji* and **kali-* developed into PS **kåə̂(-)* rather than ***kaə̂(-)*.

If interpreted as a development from pre-PS **å-ə̂* > PS **a-(ə̂)*, this change has to be dated before PU **o* had become **å*, since original PU **o* is never affected; cf. PU **woča* > PS **wåc* not ***wac*, PU **ponči* > PS **påncə̂* not ***pancə̂*, etc. A true exception seems to be PS **kajwå* 'spade' from PU **kajwa*, where the tautosyllabic palatal may have had some unexpected effect (Aikio 2002: 40).

The causation is somewhat circular here, as it makes about as much sense to say that second-syllable **-a* changed to **-ə̂* in those **a-a*-stems where the first **a* did not become PS **å*. A reverse development could also be posited as being the actual sound change, with PU **a-a* developing to both pre-PS **a-ə̂* and **a-å*, with the latter changing further to PS **å-å*. The same exceptions would of course still apply.

Since there is no known conditioning factor due to which PU second-syllable **-a* become PS **-å* and which become PS **-ə̂*, it seems expedient to set up two different *a*-phonemes at the pre-Proto-Samoyed level already, before one of them merged with PS **-ə̂* from PU **-i*. If a rounding from PU **a* to PS **å* is the sound change at hand, it makes sense to reconstruct one of these **a*'s as pre-PS **-å*, as opposed to pre-PS **-a* that ends up as PS **-ə̂*. A difference in development between, e.g., PU **taka-* and PU **čaŋa-* can then be written as developments from **taka-* to **takə̂* vs. **čaŋå-* to **čåŋå-*. Such a solution is posited for Proto-Uralic by Zhivlov, and may have reflexes in other Uralic branches as well (Zhivlov 2014). At the same time, it has to remain tentative. It would certainly make it easier to understand the Samoyed changes, which otherwise constitute an unmotivated split development.

3.7.3 PU second-syllable *-*a* to *-*ä*

Aside from the specific shift of **olC* to **ajC* to the exclusion of **ojC* to **åjC* discussed at the end of the previous subsection, there is another vowel change that seems to only have been caused by **l* and **δ′*, but not by **j*. This is the fronting of PU **-a* to **-ä* (Janhunen 1981: 221–222). It is noteworthy that the internal **a* still changed to **å* in these cases (cf. 3.7.2), so that it may have happened in a sequence from PU **kala* to *kålå* and PS **kålä* 'fish'. The examples and counterexamples are listed below.

PU **-a* > PS **-ä* (special development in this environment)	
45.	PU **kaδ′a-* > PS **kåjä-* [all] 'leave'
50.	PU **kala* > PS **kålä* [all] 'fish'
124.	PU **pala-* > PS **pålä-* [Ne-Sk] 'swallow'
142.	PU **puδ′a-* > PS **pə̂jä-* [Ng; ders. En-Ne-Sk-Mt] 'chop wood'
148.	PU **sala-* > PS **tålä-* [Ng-En-Ne-Sk; der. Km-Mt] 'steal'
187.	PU **wala* > PS **wålä* [Ng-En-?Ne] 'song'

PU **-a* > PS **-å* (standard development)	
12.	PU **ćoδ′a-* > PS **såjå-* [ders. Ng-Ne] 'war'
106.	PU **muδ′a* > PS **mə̂jå* [Ng-Sk-Km-Mt] 'earth, land, terrain'
122.	PU **oδ′a* > PS **åjå* [no Ng] 'meat, body'

PU **ćala-* to PS **sålə̂-* 'lighten, flash' does not show this development, in addition to its unexpected vocalism **å-ə̂* (expected would be either ***sålä-* or ***salə̂-*). The one available example indicating that **j* did not have the same effect is PU **kaja*, which became PS **kåjå* 'sun', not ***kåjä*. In a sequence **oδ′a*, the stem-final **-a* was not affected in this way, and developed as expected; e.g., PU **oδ′a* 'wet, raw' > PS **åjå* 'meat, body', PU **ćoδ′a* > PS **såjå-* 'war'. The sequence PU **uδ′a* shows a contradictory development in PU **puδ′a-* to PS **pə̂jä-* 'chop wood' next to PU **muδ′a* to PS **mə̂jå* 'earth', so that perhaps some levelling of earlier paradigmatic alternations was involved.

3.8 Information from language contact: Yukaghir

There are various theories on the relationship between Yukaghir and Uralic, or Yukaghir and Samoyed. According to some scholars, Yukaghir is a distant relative of the Uralic languages (e.g., Collinder 1940; Piispanen 2013; Nikolaeva 2020). However, it would be prudent to wait until our knowledge of historical changes in Yukaghir and pre-Proto-Yukaghir reconstruction has advanced further, as this is still an underresearched topic (cf. Zhivlov 2022). An alternative account of especially lexical similarities between Yukaghir and Samoyed in particular has been to consider an early exchange of

borrowings (Rédei 1999; J. Häkkinen 2012; Aikio 2014d). The phonological nature of these proposed borrowings may give us some potential insights into Samoyed sound changes, similar to how Iranian borrowings could inform us on early Tocharian developments. I base the following on Aikio's (2014d) evaluation of the most likely loanword material.

Unfortunately, the proposed Yukaghir borrowings paint a somewhat confusing picture, with a number of contradicting correspondences. This is especially true as regards the sound **l*. On the one hand, there are instances of a correspondence of PU **l* to pre-PY **l*, as in PU **mälki* (would-be-PS **mäə*/*mäj*) ⇒ PYuk. *mel* 'breast', and PU **lańća* (would-be-PS **jåńćå*) ⇒ PYuk. **lančə* 'calm, quiet'. On the other hand, the correspondence between PS **lâmto* 'low' (no PU etymology) and PYuk. **lamtə* 'low' indicates that this word at least entered Samoyed after **l-* had already changed to **j-*; otherwise, this word should have taken part in that change and become PS ***jâmto* (cf. PU **lupsa* > PS **jâptå* 'dew'). At such a point in time, PU **lańća* should already have become pre-PS **jańća*, making borrowing as pre-PYuk. ±**lančə* difficult. These correspondences could be saved by positing that Samoyed **l* had already become palatalized (i.e., PU **lupsa* had changed into **Ĺupså* and PU **lańća* into **Ĺåńćå*), but that this **Ĺ* was borrowed as pre-PYuk. **l*. Borrowings in the other direction (such as PS **lâmto*) could then have been rendered with pre-PS **l* without danger of this being later palatalized to **Ĺ* and eventual PS **j* (as in potential pre-PS **Ĺupså* to PS **jâptå*).

Further interesting examples are PU **ćoδ'ka* (would-be-PS **såjkå* 'goldeneye'), potentially borrowed as PYuk. *so*/*aľqə* 'loon' (both are diving birds), where Yukaghir could show an earlier stage of the development of PU **δ'* before it became PS **j*; conversely, in PU **puδ'a*, which became PS **pâjä-* 'strike, hit; chop wood' and was potentially borrowed as PYuk. **paj-* 'strike, hit', this development appears to have been completed already. PYuk. **paj-* may thus point to a relatively later stage of Samoyed at the time of borrowing than PYuk. *so*/*aľqə*, if both Yukaghir words are correctly etymologized

The comparison between PS **sâppâ-* 'hit, chop' and PYuk. **sapa-* 'hit' (possibly pre-PYuk. **sappa-* vel sim; cf. Zhivlov 2022 on a reconstruction of Proto-Yukaghir voiceless stops as pre-Proto-Yukaghir geminates) indicates a stage of Samoyed after geminate simplification had run its course (3.5.2); that is to say, a rather advanced stage of late pre-Proto-Samoyed. This word could also be of onomatopoeic origin, however, and very similar words are found in other Uralic languages, such as SaaN *čuohppat* 'chop, cut' and Hu. *csap-* 'strike'. The Samoyed word cannot regularly be related, since it should then be PS ***sapâ-* with different vocalism and a singleton stop, and Saami *č-* normally corresponds to Hu. *sz-* [s] rather than to *cs-* [tʃ].[43] PYuk. **weg-* 'lead', if compared to PU

[43] TB *t*^{s}*apa-* 'hit' is also very similar, perhaps especially to Yukaghir *sapa-* 'hit', but it might equally be sound-symbolic.

**wiγi-* > PS **ü-* 'take (somewhere), lead', on the other hand, would again suggest an early stage of Samoyed, before intervocalic **-γ-* had been lost, and before **ü* had become *i* or **wi* changed to **ü*.

These issues may be understood in two ways: either the period of contact between pre-Proto-Samoyed and pre-Proto-Yukaghir was long, allowing for continued borrowing as sound changes occurred on both sides, or some of these etymologies are mistaken and should be left aside. It may also be the case that both statements are true. At the current state of knowledge as regards pre-Proto-Yukaghir sound developments, it is impossible for me to draw a well-founded conclusion fit as an instrument to test further hypotheses, and more research in that area is definitely needed.

3.9 Overview of Samoyed relative chronology

This final section will give an overview of how the changes altered the Samoyed phonological system through time, providing us with a relative chronology that can be compared with the Tocharian phonology of the pervious chapter. The starting point for Samoyed was the Proto-Uralic system, repeated here in Table 3.7 and Table 3.8.

Table 3.7: The Proto-Uralic consonant inventory.

PU	labial	dental	retroflex	palatal	velar
stop	*p*	*t*	*č*	*ć*	*k*
fricative?		*δ*		*δ′*	*γ*/*x*
sibilant		*s*	*š*		
nasal	*m*	*n*		*ń*	*ŋ*
liquid		*l r*			
glide	*w*			*j*	

Table 3.8: The Proto-Uralic vowel inventory.

PU	front	central	back
high	*i ü*		*u*
mid	*e*	*ę*	*o*
low	*ä*	*a*	

An early change seems to be that PU **a* became differentiated into pre-PS **a* and **å*, although the exact mechanism remains elusive (3.7.2). More difficult to date is the split of PU **ę* into pre-PS **ę* and **į* (3.6.2). This is because the precise conditioning is quite complicated, and only potentially interacts with a number of other shifts. It definitely pre-dated the reduction of some PU second-syllable **-a* to PS **-ə̂*, but that itself appears

to be a late development (3.7.1). Another conditioning for a change from PU **ę* to **į* concerns a pre-nasal environment, where it may have applied at a relatively early stage, before apocope of PU **-i* (3.3). An intermediate pre-Proto-Samoyed phonological system that resulted from these changes is provided in Table 3.9 and Table 3.10.

Table 3.9: A representation of a possible intermediate, pre-Proto-Samoyed consonant inventory.

pre-PS 1	labial	dental	retroflex	palatal	velar
stop	*p*	*t*	*č*	*ć*	*k*
fricative		*s* > *ϑ?*	(*š*)		(*γ*)
nasal	*m*	*n*		*ń*	*ŋ*
liquid		*l r*		(*ĺ?*)	
glide	*w*			*j*	

Table 3.10: Potential early changes in the pre-Proto-Samoyed vowel system.

PU	front	central	back		front	central	back
high	*i ü*		*u*		*i ü*	*į*	*u*
mid	*e*	*ę*	*o*	>	*e*	*ę*	*o*
low	*ä*	*a*			*ä*	*a*	*å*

The shift from PU **s* and **š* to PS **t* is difficult to date, but it probably happened after PU **δ* had become **r*, or at least after PU **-t-* after a second-syllable vowel had merged with PU **δ* (3.4.1). The change from PU **s* and **š* to PS **t* possibly took place via an intermediate stage like **ϑ*. The complete disappearance of PU **γ* from the system may have been after apocope, but this is only supported by a single example: PU **täγri* 'full' > PS **tärə* (3.5.3). PU **i* and **u* became split to create two additional vowels **ə* and **ə̂*, potentially before most PU **ü* had become PS **i*, since the latter was apparently not affected (3.6.1). The simplification of certain consonant clusters and geminates seems to have happened at a late date (3.5.2). It is entirely uncertain when the marginal Proto-Samoyed vowel **ö* arose, since it is not known to regularly reflect any Proto-Uralic vowel. The Proto-Samoyed phonological system is repeated in Table 3.11 and Table 3.12.

Table 3.11: The Proto-Samoyed consonant inventory.

PS	labial	dental	retroflex	palatal	velar
stop	*p*	*t*	*c*		*k*
sibilant				*s*	
nasal	*m*	*n*		*ń*	*ŋ*
liquid		*l r*			
glide	*w*			*j*	

Table 3.12: Developments from a possible pre-Proto-Samoyed vowel system (left) to the Proto-Samoyed vowel system (right).

pre-PS	front	central	back	PS	front	central	back
high	*i ü*	*ɨ*	*u*		*i ü*	*ɨ*	*u*
mid	*e*	*ę*	*o*	>	*e ö*	*ę*	*o*
low	*ä*	*a*	*å*		*ä*	*a*	*å*
lax?						*ə ə̂*	

The relative dating of some changes remains impossible due to their lack of interaction, and the two stages of the vowel system presented here could also be inverted, as illustrated in Table 3.13.

Table 3.13: Two alternative sequences of vowel developments from Proto-Uralic to Proto-Samoyed.

	PU			pre-PS			PS		
high	*i ü*		*u*	*i ü*	*ɨ*	*u*	*i ü*	*ɨ*	*u*
mid	*e*	*ę*	*o*	*e*	*ę*	*o*	*e ö*	*ę*	*o*
low	*ä*	*a*		*ä*	*a*	*å*	*ä*	*a*	*å*
lax?								*ə ə̂*	
	PU			pre-PS			PS		
high	*i ü*		*u*	*i ü*		*u*	*i ü*	*ɨ*	*u*
mid	*e*	*ę*	*o*	*e*	*ę*	*o*	*e ö*	*ę*	*o*
low	*ä*	*a*		*ä*	*a*	*å*	*ä*	*a*	*å*
lax?					*ə ə̂*			*ə ə̂*	

Future research into Samoyed etymology and sound change will surely still improve our understanding, but hopefully the present scheme can provide a starting point for more detailed comparison with other languages with which early Samoyed has come into contact, such as (pre-)Proto-Yukaghir. I furthermore hope that the particular difficulties that plague Samoyed historical phonology are made more explicit with this overview.