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

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4 Phonological comparison

In this chapter, the conclusions from the previous two chapters will be considered together to determine whether the developments that took place between Proto-Indo-European and Proto-Tocharian, discussed in chapter 2, can be understood as the result of substrate influence from early Uralic or pre-Proto-Samoyed, of which the sound developments are treated in detail in chapter 3.

4.1 Introduction

The consonant system will be treated first in subsection 4.2; it constitutes the most obvious and long-standing point of comparison between Tocharian and Uralic (e.g., Ivanov 1985, Kallio 2001, Bednarczuk 2015, Peyrot 2019a, although with differing details). The vowel system of pre-Proto-Samoyed was first compared to that of pre-Proto-Tocharian by Peyrot (2019a), and I emended some of his conclusions in an article dedicated specifically to the comparison of pre-Proto-Tocharian and pre-Proto-Samoyed vowel systems (Warries 2022). The comparison provided here in subsection 4.3 is basically in line with my conclusions in that article, which may be consulted for some additional considerations. I argue that pre-Proto-Tocharian vowel system as it would have looked before palatalization took place is particularly similar to the early pre-Proto-Samoyed vowel system, with the important caveat that it remains difficult to confidently date some of the important Samoyed vowel changes.

In order to evaluate whether the phonological systems of pre-Proto-Tocharian and pre-Proto-Samoyed are specifically more similar to one another than to those of other languages spoken in the area, subsections 4.2.2 and 4.3.2 will also briefly highlight the stop systems and vowel systems respectively of Proto-Turkic, Proto-Yeniseian and Proto-Yukaghir. These are the other known language groups that may have been in the region, in addition to early Uralic or early Samoyed. Proto-Yeniseian and Proto-Yukaghir were also involved in the comparison and prehistoric scenario advanced by Peyrot (2019a), with special reference to similarities to pre-Proto-Tocharian and pre-Proto-Samoyed in the vowel systems.

The final subsection of this chapter, subsection 4.4, will provide an overview of the similarities between the pre-Proto-Tocharian and pre-Proto-Samoyed phonological systems, and an interpretation of their potential significance. It is concluded that substrate influence from pre-Proto-Samoyed or a closely related language could explain the more unusual and drastic developments that took place in the development from Proto-Indo-European to Tocharian.

It furthermore turns out that Old Turkic phonology is clearly different from pre-Proto-Tocharian phonology, and so is Proto-Yeniseian in its stop system. The most recent

reconstruction of the Proto-Yeniseian vowel system is not particularly close to that of pre-Proto-Tocharian either, but ongoing research may still change this picture. On the other hand, the consonant system of especially pre-Proto-Yukaghir as recently reconstructed by Zhivlov (2022) is very similar to the pre-Proto-Tocharian and pre-Proto-Samoyed systems. The reconstruction of the pre-Proto-Yukaghir vowel system is not so clear, however. Early Uralic, and perhaps particularly pre-Proto-Samoyed thus remains the most securely reconstructed and therefore most viable comparison for pre-Proto-Tocharian phonology at this point in time.

4.2 Comparison of the consonant systems

The Tocharian lack of the Proto-Indo-European stop contrasts traditionally interpreted as voicing and aspiration is a strong indication of substrate influence, since it is quite a unique development within the Indo-European language family (Peyrot 2019a: 78) and also a relatively unusual feature of languages around the world (Kallio 2001: 226). There are no noticeable compensatory processes that shifted a voicing or aspiration contrast onto adjacent segments. Vowel quality and vowel length remained entirely unaffected. This means that a very meaningful double phonological contrast was given up entirely (on this point particularly Peyrot 2019a: 73).

For these reasons, the stop system has often been the main point of comparison with Uralic. The pervasive palatalization found for almost every Tocharian consonant has also been considered as a potential result of substrate influence (Ivanov 1985, Kallio 2001, Bednarczuk 2015), so this aspect will be addressed as well. The comparison with Proto-Uralic and pre-Proto-Samoyed will be considered first (subsection 4.2.1), and then the stop systems of other ancient languages of the area will be treated as well (subsection 4.2.2), in order to see whether the comparison with Uralic or Samoyed is specific enough to support the contact hypothesis.

4.2.1 The pre-Proto-Tocharian and pre-Proto-Samoyed stop systems

The Proto-Uralic and (pre-)Proto-Samoyed stop systems consisted primarily of a single series of voiceless stops, providing a good match for the stop system adopted by early Tocharian when the Proto-Indo-European distinctions were abandoned. This is regarded as the strongest indication of Uralic influence on Tocharian (Kallio 2001: 225–226; Bednarczuk 2015: 56, Peyrot 2019a: 78). The difference between Proto-Uralic and Proto-Samoyed is not significant in this regard, so that it is difficult to make any meaningful distinction between these different stages. Table 4.1 shows a comparison of the stop systems. It should be noted that, if the Tocharian stop system is derived from a PIE system without voicing distinctions, as in Kloekhorst's reconstruction (see 2.2, and 2.3.4.4 for a discussion), the transformation of the Tocharian stop system seems less significant.

Table 4.1: A summary of the possible transformation of the (post-)Proto-Indo-European consonant system into an early pre-Proto-Tocharian consonant system under the influence of pre-Proto-Samoyed.

post-PIE	> pre-PT	cf. pre-PS	PU
p, *b*^{h}	*p*	*p*	*p*
t, *d*^{h}	*t*	*t*	*t*
ty, *d*^{h}*y*	*ċ*	*ć*, *č*	*ć*, *č*
ḱ, *ǵ*, *ǵ*^{h} *k*, *g*, *g*^{h}	} *k*	*k*	*k*
k^{w}, *g*^{w}, *g*^{wh}	*k*$^{(w)}$	–	–

The development of the clusters **ty* and **d*^{h}*y* into a monophonemic affricate can be connected with either of the Uralic affricates palatal **ć* or retroflex **č*. Especially the palatal affricate provides an adequate match, since the original cluster **ty*/*d*^{h}*y* contained a palatal glide. Here, pre-PT *ċ* is used rather than *t*^{s} to differentiate the result of **ty*/*d*^{h}*y* from that of word-initial PIE **d*, as these may have remained phonologically distinct until after palatalization (cf. subsections 2.3.4.2 and 2.3.4.3). Changes from palatal affricates like **ć* [tɕ] to [ts] are attested in various languages (see Kümmel 2007: 197–200 for examples), so that a phoneme like PU **ć* may also be an adequate intermediate stage for the development from **ty*/*d*^{h}*y* to PT **t*^{s}.

The palatal affricate PU **ć* eventually became a fricative in the Samoyed languages, but it may have retained its affrication in Proto-Samoyed (Zhivlov 2018; Zhivlov 2023: 150). The time depth of this change is, in any case, unknown, so that it is possible that pre-Proto-Samoyed still had an affricate **ć* at the point in time that it would have come into contact with pre-Proto-Tocharian. It is uncertain if retroflex PU **č*, PS **c*, which definitely retained its affricate character in Proto-Samoyed, can be compared to pre-PT **ċ*, PT **t*^{s} (cf. Peyrot 2019a: 79–80). Within Uralic, a development from PU **č* to *c* [ts] is at least known from Saami (e.g., Korhonen 1988: 273).

The Tocharian development of PIE **d* is problematic, and it is not certain precisely how it changed through time (see 2.3.4.4). Due to the great uncertainties about the development of this phoneme in Tocharian, I think that it cannot be included in a comparison with the early Samoyed or Uralic stop system.

The most straightforward comparison between the pre-Proto-Tocharian and pre-Proto-Samoyed or Proto-Uralic stop systems does not yet contain the palatalization that characterized almost the entirety of the Proto-Tocharian consonant system (cf. Peyrot 2019a: 79 fn. 6). While pre-Proto-Samoyed and Proto-Uralic contained some palatalized consonants, namely **ć*/*ś*, **ń*, and potential **δ́*/*ĺ*, the prevalence of palatalization is not quite comparable to the full system of palatalized consonants in Proto-Tocharian.

Nevertheless, the palatalization in Tocharian has been compared to Uralic (Ivanov 1985: 413; Kallio 2001: 227–228; Bednarczuk 2015: 56); and similarly, palatalizations in Balto-Slavic and in Indo-Iranian have been connected with Uralic influence as well (Thomason & Kaufman 1988: 247–249; Kallio 2001: 228).

Kallio rightfully remarks that it is unknown whether Proto-Uralic perhaps had phonetic palatalization of consonants before front vowels (Kallio 2001: 228). The main difficulty here lies in the fact that reconstructions primarily concern phonological systems and phonological change, which may lag behind phonetic developments. It is thus entirely possible, perhaps even probable, that pre-Proto-Tocharian consonants were non-phonemically palatalized for a period of time before palatalization was phonemicized (2.4).

It is equally possible, but more difficult to determine, that automatic palatalization of consonants before front vowels was a phonetic feature in early pre-Proto-Samoyed. For example, it is possible that pre-PS **ki* was phonetically realized as palatalized *[kʲi], in opposition to pre-PS **kį* as non-palatalied *[ki]. Phonetic palatalization would have enhanced the contrast between these two phonemically distinct sequences in a natural way, and later in Samoyed the sequences PS **ki*, **ke*, **kä* were independently fully palatalized and assibilated in most Samoyed languages (Janhunen 1998: 467, bearing in mind that **e* in Janhunen's notation is **ä* in the modern notation).

Thus, while it is perhaps plausible that a phonetic palatalization contrast existed in early Samoyed, and that this could have been transferred to Tocharian through contact to become phonologized later, there is no way to establish the presence of this phonetic feature in the source language. Phonological reconstruction alone does not provide us with direct access to such phonetic interactions between the consonants and vowels. Further considerations of the vowel system will be addressed in subsection 4.3.1; first we will turn to the stop systems of other prehistoric languages of the region.

4.2.2 Stop systems of other languages in the region

In this subsection, the general character of the stop systems of Proto-Turkic, Proto-Yeniseian and (pre-)Proto-Yukaghir will be briefly summarized on the basis of the available literature, and compared to the consonant systems of early Tocharian and early Uralic/Samoyed that were discussed more extensively above.

Proto-Turkic had an opposition between strong/fortis stops and weak/lenis stops, as shown in Table 4.2. According to Róna-Tas, both series may originally have been voiceless, with an aspiration contrast (Róna-Tas 1998: 71). In Old Turkic, the weak consonants were voiced and perhaps fricative (Erdal 2004: 61ff.) This does not correspond to the Tocharian single stop series, which is precisely the most conspicuously non-Indo-European feature of the Tocharian phonological system. Substrate influence

from Proto-Turkic therefore clearly cannot explain the loss of Proto-Indo-European stop contrasts.

Table 4.2: The Old Turkic inventory of stops and related obstruents (Erdal 2004: 62).

OTrk.	labial	alveolar	palatal	velar
voiceless	*p*	*t*	*č*	*k*
voiced	*b*	*d*	*y*	*g*

The reconstruction of the Proto-Yeniseian consonant system is an ongoing effort, but both older reconstructions (Starostin 1982) and recent reconstruction (Vajda 2022) agree that Proto-Yeniseian had a phonological voicing opposition in its stops; see Table 4.3. This voicing opposition in Yeniseian does not accord with the pre-Proto-Tocharian development of general voicelessness.

Table 4.3: The Proto-Yeniseian stop inventory as reconstructed by Vajda (2022); the retroflex and labiovelar stops in parentheses are not reconstructed by Starostin (1982).

PYen.	labial	alveolar	post-alveolar	retroflex	palatal	labiovelar	velar	uvular
voiceless	*p*	*t*	*č*	(*ʈ*)	*c*	(*kʷ*)	*k*	*q*
voiced	*b*	*d*	*ǰ*	(*ɖ*)	*ɟ*	(*gʷ*)	*g*	*ɢ*

The Proto-Yukaghir consonant system can also be reconstructed with an opposition between voiceless and voiced stops. Many voiced stops probably developed from earlier consonant clusters like **-nt-* for **-d-*, etc. (Zhivlov 2022; the reconstruction by Nikolaeva (2006: 66) different in the details, interpreting Proto-Yukaghir voiced stops as fricatives instead).

Table 4.4: Proto-Yukaghir stops and affricates (Zhivlov 2022: 47).

PYuk.	labial	dental	palatal	velar
voiceless	*p*	*t c*	*č*	*k*
voiced	*b*	*d ʒ*	*ǯ*	*g*

Zhivlov has argued that pre-Proto-Yukaghir can be reconstructed entirely without this voicing opposition, and that Proto-Yukaghir voiceless stops can be traced back to earlier geminates and specific changes in consonant clusters (Zhivlov 2022: 53–57). This entails a consonant system for pre-Proto-Yukaghir as in the table below; this is very similar to both the pre-Proto-Tocharian and pre-Proto-Samoyed systems.

Table 4.5: A reconstruction of the pre-Proto-Yukaghir consonant system (Zhivlov 2022: 57).

pre-PYuk.	labial	dental	palatal	velar
stop	*p*	*t*		*k*
affricate		*c*	*č*	
nasal	*m*	*n*	*ń*	*ŋ*
liquid		*l r*	*l´*	
glide	*w*		*j*	

Out of the three early languages of the region, Proto-Turkic, Proto-Yeniseian and (pre-)Proto-Yukaghir, only pre-Proto-Yukaghir may have had the same lack of voicing oppositions as found in Tocharian and Uralic/Samoyed. This means that, aside from early Uralic and Samoyed, early Yukaghir represents another potential source for the lack of voicing oppositions in the Tocharian stop system.

4.3 Comparison of the vowel systems

The Tocharian vowel system was first compared to potential outside sources by Peyrot (2019a), who argued for a significant similarity with the Ket (Yeniseian), Yukaghir and pre-Proto-Samoyed vowel systems. These are all marked by a lack of phonemic vowel length and the presence of two central vowels, in addition to the five cardinal vowels. Peyrot reconstructed an identical seven-vowel system for pre-Proto-Tocharian, allowing for a very neat comparison (Peyrot 2019a: 80–89). Chapter 3 shows that the Samoyed situation was more complicated, however.

4.3.1 The pre-Proto-Tocharian and pre-Proto-Samoyed vowel systems

The comparison of the pre-Proto-Tocharian and pre-Proto-Samoyed vowel systems that Peyrot (2019a) made is very striking. However, it needed to be further informed by a detailed relative chronology of both pre-Proto-Tocharian and pre-Proto-Samoyed. I attempted to further work out the details in my article on the comparison of the pre-Proto-Tocharian and pre-Proto-Samoyed vowels systems, Warries (2022), and the stages of the vowel system as discussed for Tocharian chapter 2 and for Samoyed in chapter 3 derive from this endeavour. The diachronic developments of the pre-Proto-Tocharian and pre-Proto-Samoyed vowel inventories are here repeated in a condensed form in Table 4.6 and Table 4.7 below.

The first of the two tables, Table 4.6, contains the post-PIE vowel system, after laryngeal developments had taken place, and following on this the systems required before palatalization took place ("pre-pal.") and after palatalization took place ("post-

pal."), and finally Proto-Tocharian itself. The second of the two tables, Table 4.7, contains the development of the Samoyed vowel system. The exact chronology of developments is not as clear in this case, so that the relative order of the two intermediate pre-Proto-Samoyed stages is uncertain. Proto-Uralic and Proto-Samoyed vowel systems are given on the far left and the far right of the table respectively.

Table 4.6: An overview of the development of the pre-Proto-Tocharian vowel system.

post-PIE			pre-PT pre-pal.			pre-PT post-pal.			PT		
ī		(*ū*)	*i̯y*		*uw*	*ʸi̯y*		*⁽ʸ⁾uw*	*i*		*u*
i	*R̥*	*u*	*i*	*"i̯"*	*u*	*⁽ʸ⁾i*		*u*		*ə*	
e ē		*o ō*	*e*	*ë*	*o*	*⁽ʸ⁾e*		*o*	*e*		*o*
	a ā			*a*	*å*		*a*	*å*		*a*	*å*

Table 4.7: An overview of the development of the pre-Proto-Samoyed vowel system.

PU			pre-PS (uncertain relative order)						PS		
i ü		*u*	*i ü*	*i̯*	*u*	*i ü*		*u*	*i ü*	*i̯*	*u*
e	*e̯*	*o*	*e*	*e̯*	*o*	*e*	*e̯*	*o*	*e ö*	*e̯*	*o*
ä	*a*		*ä*	*a*	*å*	*ä*	*a*	*å*	*ä*	*a*	*å*
							ə ə̂			*ə ə̂*	

Since the comparison of the consonant systems pointed to a stage of pre-Proto-Tocharian without pervasive phonological palatalization, it follows that we should ideally also compare the pre-Proto-Tocharian vowel system as it looked before palatalization with pre-Proto-Samoyed. The vowel system represented here as "pre-PT pre-pal." is the minimal vowel system necessary before palatalization (cf. 2.4 and Warries 2022). Diphthongs like pre-PT **ey* and **ew* (PT **ʸi* and **ʸu*) are left out of the table to conserve space. The pre-Proto-Tocharian vowel inventory before palatalization is nearly identical to that of pre-Proto-Samoyed, apart from the three-way contrast between the low vowels **ä*, **a* and **å* and the presence of a rounded high front vowel **ü*. Here it should be borne in mind that Proto-Uralic and early Samoyed had sequences of a vowel and a glide **j* or **w*, which may correspond to the pre-Proto-Tocharian diphthongs written here as **i̯y* and **uw*, as well as the type **ey* and **ew* (cf. 2.4 and Warries 2022: 198-200).

While the pre-PS **ü* really has no convincing pre-Proto-Tocharian counterpart, a plausible counterpart to pre-PS **ä* can be found. The two pre-Proto-Tocharian front vowels **i* and **e* as they are represented in Table 4.8 derive from three Proto-Indo-European sources: PIE **i* and **e* can be theoretically merged as pre-PT **i* (after some **i*

had changed into *$i̇$, see 2.4.2), while PIE *$\bar{e}$ ends up as a short vowel like pre-PT *e. It is not strictly necessary to keep these vowels distinct for palatalization to take place normally (again, see 2.4.2 for the differences between etymological PIE *i and *e with regards to palatalization), but it is also possible that the merger of the short front vowels happened later. If PIE *i and *e were kept separate, we may imagine that PIE *$\bar{e}$ initially became a vowel like pre-PT *$æ$, differentiated from short PIE/pre-PT *e by vowel quality. This would then entail the earlier presence of a more direct counterpart to the third front vowel pre-PS *$ä$ in pre-Proto-Tocharian as well. This is illustrated in the Table 4.8, where the full comparison between the pre-Proto-Tocharian and pre-Proto-Samoyed vowel systems is provided with the corresponding vowels side by side.

Table 4.8: A summary of the possible transformation of the (post-)Proto-Indo-European vowel system into an early pre-Proto-Tocharian vowel system under the influence of pre-Proto-Samoyed.

post-PIE	> pre-PT	pre-PS
i	i	i
–	–	$ü$
e	e	e
a	a	a
o	$ë$	$ę$
u	u	u
$\underset{\circ}{R}$	$i(R)$	$i̯$
$\bar{e}$	$æ$	$ä$
$\bar{a}$	$å$	$å$
$\bar{o}$	o	o
$\bar{\imath}$	$i̯y$	$i̯j$
$(\bar{u})$	uw	uw

Pre-Proto-Tocharian innovated a system without Proto-Indo-European vowel length, and with various new vowel oppositions. The types of oppositions, especially with the inclusion of central vowels, is very similar to the Proto-Uralic and early pre-Proto-Samoyed systems. Here the pre-Proto-Samoyed system is an especially close match due to the contrast between high *$i̯$ and *$ę$ that is not reconstructed for Proto-Uralic itself. Similarly, the presence of three low vowels *$ä$, *a and *$å$ is a pre-Proto-Samoyed innovation that can be matched quite well with pre-Proto-Tocharian if PIE *i and *e merged later.

4.3.2 Vowel systems of other languages in the region

In this subsection, the vowel systems of Proto-Turkic, Proto-Yeniseian and (pre-)Proto-Yukaghir will be briefly summarized, and compared to those of early Tocharian and Uralic/Samoyed that were discussed more extensively in the previous subsection.

The Proto-Turkic and Old Turkic vowel system is markedly different from that of (pre-)Proto-Tocharian, with a length distinction and a very systematic, symmetrical oppositions between front and back vowels, and rounded and unrounded vowels (Róna-Tas 1998: 69–70; Erdal 2004: 45). This is shown in Table 4.9. The loss of vowel length with the creation of more vowel contrasts in pre-Proto-Tocharian thus does not look like the result of influence from Proto-Turkic.

Table 4.9: The Proto-Turkic vowel inventory (Róna-Tas 1998: 69–70).

PTrk.	front	round	back	round
high	*i ī*	*ü ǖ*	*ï ī*	*u ū*
mid		*ö ō*		*o ō*
low	*ä ǟ*		*a ā*	

The exact nature of the Proto-Yeniseian vowel system is more contentious. The inventory reconstructed by Starostin (1982: 185) is very similar to the pre-Proto-Tocharian and the pre-Proto-Samoyed system in both its lack of opposition in vowel length, and in its relatively high number of quality contrasts; cf. Table 4.10.

Table 4.10: Starostin's reconstruction of the Proto-Yeniseian vowel system (1982: 185).

PYen.	front	central	back
high	*i*	*ɨ*	*u*
mid	*e*	*ə*	*o*
low	*ä*	*a*	*ɔ*

On the other hand, Vajda's most recent reconstruction is significantly different, with a reduction of the vowel system from nine vowels to five vowels (Vajda 2022: 266). The additional contrasts in the later Ket branch of Yeniseian are derived by Vajda from earlier combinations with the glides **j* and **w* (Vajda 2022: 262-273); cf. Table 4.11. It is this Proto-Ket vowel system that provides the close match to the pre-Proto-Tocharian and pre-Proto-Samoyed vowel systems in Peyrot's (2019a) comparison, but the time depth is unclear.

Table 4.11: Vajda's reconstructions of the Proto-Yeniseian (left) and Proto-Ket (right) vowel systems (2022: 262, 266).

PYen.	front	central	back	> PKet	front	central	back
high	*i ij iw*		*u uj uw*		*i*	*ɯ*	*u*
mid	*e ej ew*		*o oj ow*		*e*	*ɤ*	*o*
low		*a aj aw*				*a*	

The Proto-Yukaghir vowel system is reconstructed by Nikolaeva as in Table 4.12, but many details of the developments still need to be worked out (see Maslova 2008: 258), and the reconstruction will likely change upon further research. Long vowels in Yukaghir are usually dependent on syllable structure, or derive from contractions of earlier diphthongs (Nikolaeva 2006: 64–65, Zhivlov 2022: 55–56). The few long vowels that do not transparently derive via such processes may also be secondary, so that Nikolaeva hypothesises that the pre-Proto-Yukaghir vowel system originally lacked distinctive vowel length (Nikolaeva 2006: 65). This would entail a further similarity between the phonological systems of (pre-)Proto-Yukaghir, pre-Proto-Tocharian and pre-Proto-Samoyed, in line with the comparison by Peyrot (2019a). It should be borne in mind, however, that the reconstruction of the Proto-Yukaghir vowel system is still insecure, not to mention the pre-Proto-Yukaghir vowel system.

Table 4.12: A reconstruction of the Proto-Yukaghir vowel system (Nikolaeva 2006: 57).

PYuk.	front	central	back
high	*i* (*ü*)	*y*	*u*
mid	*e*	*ö*	*o*
low		*a*	

Between Proto-Turkic, Proto-Yeniseian and Proto-Yukaghir, Proto-Turkic provides the worst match with the pre-Proto-Tocharian vowel system. Especially the presence of distinctive vowel length does not accord well with the fact that vowel length was lost in pre-Proto-Tocharian. Proto-Yeniseian (especially Proto-Ket) and Proto-Yukaghir show a closer correspondence with both pre-Proto-Tocharian and pre-Proto-Samoyed. Uncertainties concerning the time depth of the Proto-Ket system, derived from a more dissimilar Proto-Yeniseian system according to Vajda (2022), and concerning the general reconstruction of Yukaghir vowels, render a proper comparison with pre-Proto-Tocharian rather insecure.

4.4 Overview and conclusions

The pre-Proto-Tocharian phonological system, both in the stops and the vowels, probably went through a stage that bears a great likeness to pre-Proto-Samoyed. The Tocharian developments are striking and, in some cases, entirely unique among the known Indo-European languages and thus suggestive of substrate influence. As illustrated throughout this chapter the Proto-Uralic and early Samoyed phonological systems provide appropriate matches.

Tocharian more closely resembles this language group than it does most of the other known old languages of the area. It is clear that both Proto-Turkic and Proto-Yeniseian constitute an inadequate comparison for the pre-Proto-Tocharian phonological system, especially with regards to voicing oppositions in the case of Proto-Yeniseian. The earlier stages of pre-Proto-Yukaghir have not yet been reconstructed in detail, so that any comparison remains unreliable for the present. However, at least the consonant system seems to have been similar to that of (pre-)Proto-Samoyed, so that it could provide an adequate comparison for pre-Proto-Tocharian as well. There may have been early contact between Proto-Samoyed and pre-Proto-Yukaghir with both lexical exchange (Aikio 2014, J. Häkkinen 2012) and perhaps also structural convergence (suggested by Peyrot 2019a). It should be borne in mind that the time depth of Proto-Yukaghir is perhaps at most around 2000 years (Maslova 2003: 2), which is younger than Proto-Tocharian estimated around 2500 to 3000 years ago, and thus too late for a comparison with pre-Proto-Tocharian. The earlier stages of especially the vowel systems are uncertain, and the time depth that needs to be reached for a comparison with pre-Proto-Tocharian is a great obstacle.

Based on current knowledge, early Uralic, and possibly specifically pre-Proto-Samoyed, provides a good model for the changes observed in the Tocharian phonological system. The Table 4.13 and Table 4.14 below repeat the most adequate comparisons of the consonant systems and the vowel systems.

Table 4.13: A summary of the possible transformation of the (post-)Proto-Indo-European consonant system into an early pre-Proto-Tocharian consonant system under the influence of pre-Proto-Samoyed.

PIE	> pre-PT	pre-PS	~ PU
p, b^h	*p*	*p*	*p*
t, d^h	*t*	*t*	*t*
ty, d^{h}y	*ć*	*ć, č*	*ć, č*
ḱ, ǵ, ǵ^h *k, g, g^h*	*k*	*k*	*k*
k^w, g^w, g^{wh}	*k$^{(w)}$*	–	–

Table 4.14: A summary of the possible transformation of the (post-)Proto-Indo-European vowel system into an early pre-Proto-Tocharian vowel system under the influence of pre-Proto-Samoyed.

post-PIE	> pre-PT	cf. pre-PS <	PU
i	*i*	*i*	*i* (*ü*)
–	–	*ü*	*ü*
e	*e*	*e*	*e*
a	*a*	*a*	*a*
o	*ë*	*ę*	*ę*
u	*u*	*u*	*u*
R̥	*i̇*(*R*)	*į*	*ę*
ē	*æ*	*ä*	*ä*
ā	*å*	*å*	*a* (*o*)
ō	*o*	*o*	*o*
ī	*i̇y*	*ij*	*ij*
(*ū*)	*uw*	*uw*	*uw*

In terms of the phonological comparison, both the consonant and the vowel system of pre-Proto-Samoyed may be more closely matched to a pre-Proto-Tocharian system without pervasive phonemic palatalization. Tocharian palatalization has been considered as another aspect of Tocharian phonology influenced by Uralic substrate influence (Ivanov 1985: 413; Kallio 2001: 227–228; Bednarczuk 2015: 56), but in a phonological sense, this is difficult to substantiate beyond a general plausibility. Phonetic, automatic palatalization before front vowels may already have been a feature at the time in early Samoyed, so that it may still have been contact with a Uralic language that set Tocharian on its path toward palatalization. Unfortunately, the nature of phonological comparison makes it difficult to properly test this particular aspect of the contact hypothesis.