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Scriptinformatics

EXTENDED PHENETIC APPROACH TO SCRIPT EVOLUTION

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To My Family

Contents

Foreword

The book describes an extended phenetic method developed to study scripts' evolution. This phenetic and evolutionary analysis method comes from more than a decade of scriptinformatic research. This data-driven approach reduces the uncertainties inherent in the phenetic model due to many homoplasies in the scripts. It was used to study the origin of scripts as descendant taxa used historically on the Eurasian Steppe (Grassland). Considered as processing operators so-called evaluation procedures, filtered models are created from the initial extended phenetic model of the studied scripts that somehow reduce the uncertainties of the original model due to the lack of available palaeographic data. The studied scripts' spectra could be determined based on the obtained extended phenetic models. The obtained phenograms and spectra can be compared with the most important historical and geographical literature results, so it was possible to conclude the studied scripts' origin.

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Gábor Hosszú

1. Introduction

Scripts are writing systems that are usually adapted to specific languages, and have temporal, geographical and cultural developments. The evolution of scripts has long been the subject of research. This is probably because human thinking's long-term development is reflected in the surviving script relics, many of which are still undeciphered today. The evolution of scripts is examined by mathematical tools known from systematics, phylogenetics and bioinformatics. In doing so, a particular phenetic model is created for each script as evolutionary taxonomic units (taxa). Phenetics classifies the taxa based on their morphological similarity and does not primarily examine genealogical relations. Due to the scarcity of the morphological diversity of scripts' features, random coincidences of independent evolutionary traits often occur in scripts than biological species. Therefore, phenetic modelling based exclusively on morphological features can lead to erroneous results. For this reason, phenetic modelling has been supplemented by evolutionary considerations, thus making it possible to deal with the modelling uncertainties that can be observed in script evolution due to the large number of random coincidences (homoplasies) that characterize each script (Püspöki Nagy 1977: 303–307; Horváth 2007; Róna-Tas 1985b: 237). Thus, to a limited extent, conclusions about the evolution of the studied scripts can be drawn from the extended phenetic model, whose reliability can be verified by further studies.

Scriptinformatics, in other words, scriptological informatics or computational scriptology, as a branch of applied computer science (informatics), deals with the investigation concerning the evolution of graphemes in various scripts and with the exploration of relationships between scripts, where the scripts could be any sequence of symbols of cultural origin, such as historical writing systems or urban graffiti. In a scriptinformatic research, the machine learning, artificial intelligence and bioinformatics tools are used (Hosszú 2010a; Hosszú 2017). It deals with phylogenetic (phyletic) modelling, developing the necessary algorithms and the phenetic, evolutionary and statistical analyses of features of the studied scripts (Hosszú 2014b; Hosszú 2019: 120).

For scriptinformatic calculations, input data comes from palaeography and other humanities disciplines. The extended phenetic model based on evolutionary considerations has been continuously refined during previous research by increasing the available information. New methods are presented to evaluate the extended phenetic model and to compare the evolution of the scripts studied with historical and geographical data. In the present work, a successive elimination algorithm developed for phenetic and evolutionary analyses was used to examine Rovash (pronounced "rove-ash") scripts, which are specific writing systems used by the people of the Eurasian steppe (Grassland). By evaluating the extended phenetic model, the goal is to explore the relationship between the studied scripts and reconstruct their phenetic relationship and their assumed ancestor scripts.

2. Phylogenetic concepts in scriptinformatics

2.1. Scriptinformatic concepts

Semiotics is the science of signs and sign systems (Dyekiss 1993: 102), includes interpretation, prediction and the process by which meaning can be reached. *Sign* in a semiotic sense can be anything that communicates a meaning that is not the sign itself to the interpreter of the sign. Therefore, that can communicate information to someone who interprets or decodes the sign. Its main types based on the relationship between the surrogate and the object are listed in Table 2-1.

Table 2-1: Types of signs in a semiotic sense

Sign in a semiotic sense	*Icon* in semiotics is a sign that resembles or imitates its object (the signified).
	Index in semiotics is a sign that marks its object (the signified) based on the real relationship that affects it. In other words, it shows evidence of what it represents.
	Symbol in semiotics is a sign that denotes its object (the signified) solely because it will be interpreted to do so. It bears no resemblance to its object; their relationship is culturally learned. The following types of the semiotic symbols are used in scriptinformatics: grapheme, tamga and decorative sign (Table 2-2).

Script is a graphical form that can be defined by a set of semiotic symbols (Table 2-1), orthographic rules and layout rules that control the graphemes' arrangement. The terms script and writing system are used interchangeably in the following. A semiotic symbol is called symbol if the context indicates that it belongs to one or more scripts. The scripts can be classified into logographic and phonographic depending on the meaning of their semiotic symbol (Faber 1990: 32–34). A script is logographic if its symbols (called logograms) represent the meaning but not the pronunciation of a morpheme, the smallest meaningful unit of a language. A script is phonographic if its symbols represent the pronunciation of a syllable (syllabic script) or a phoneme (alphabetic or consonantal script). It is worth noting that the scripts are usually mixed type; e.g., the Latin script is fundamentally phonographic; however, it includes also logograms as # or §.

Feature in scriptinformatics is a heritable property of a script; its alternative names: [heritable] trait, character [in a biological sense], variable, attribute or property. Its types are presented in Table 2-2. Scriptinformatic research examines the scripts' evolutionary changes based on changes in the scripts' various features. By comparing biology and scriptinformatics, a correspondence can be established between genes and features and the genome and the whole set of features that determine a script. In order to determine the appropriate features and their occurrence in different scripts, complex descriptions of features are called Similarity Feature

Groups (SFGs, Table 4-7) have been developed. Table 2-2 presents the use of different features in various interactions between scripts, in the role of both ancestor and descendant.

Table 2-2: Types of features used in phylogenetic modelling of scripts

Types of features	Subtypes of features	Use for ancestors	Use for descendants
Symbol (in a semiotic sense, Table 2-1)	*Grapheme*	SFG-1, SFG-2, SFG-3, SFG-4, SFG-5, SFG-6, etc.	SFG-1, SFG-2, SFG-3, SFG-4, SFG-5, SFG-6, etc.
	Tamga	SFG-3, SFG-6, SFG-7, SFG-8, SFG-9, SFG-14, etc.	-
	Decorative sign	-	-
Orthographic rule		SFG-2, SFG-34, SFG-35, SFG-36, SFG-37, SFG-38, SFG-73, SFG-109	SFG-109
Layout rule		-	-

Grapheme ([in the computer science] character) is semantically the smallest (Pulgram 1976: 3; Sukkarieh et al. 2012: 6) or a phonetically distinctive element that has a specific function (such as the representation of sound and punctuation) in a script. This is a kind of semiotic symbol (Table 2-1). A grapheme is an abstract concept behind graphs, defined by attributes distinguished from other graphemes. The grapheme has various attributes (Hosszú 2013b: 7), see Table 2-3. The type of graphemes can be letter, ideogram, logogram, ligature, numerical digit, pseudo-ligature, diacritic, accent, phonogram, determinative, punctuation mark, syllabogram, etc.

Tamga (tamgha, tamğa, tamaga [Ilyasov 2010: 213]) is a symbol (emblem) of a tribe, a clan or a family; it can be an animal brand, brand, carpenters mark, dynastic sign/emblem, gene sign, horse mark, identity mark, livestock mark, master mark, makers' mark, ownership sign, personal mark, property mark, state emblem, tribal mark (Sebestyén 1903c: 318–339; Yatsenko & Rogozhinskii 2019: 10–42; Ilyasov 2019: 90). It is a semiotic symbol (Table 2-1); some of its attributes are listed in Table 2-3.

Decorative sign is an abstraction that is realized in an inscription as a graphic element that cannot be identified by any grapheme; for example, its role can be decoration. It is a semiotic symbol (Table 2-1); some attributes are listed in Table 2-3.

Orthographic rule (orthographical rule, writing rule) is a script feature, see Table 2-2 and Table 2-3. It is worth noting that although orthographic rules apply in a narrow sense to scripts consisting of graphemes, there are rules for other types of semiotic symbols as well (Table 2-1); namely, tamgas and decorative signs.

Layout rule is a script feature that determines the alignment, placement, and overall appearance of the inscription, see Table 2-3.

Table 2-3: Attributes of the features of scripts

<table>
<tr><th>Types of features</th><th>Subtypes of features</th><th>Attributes (example list)</th><th colspan="2">Subattributes</th></tr>
<tr><td rowspan="3">Symbol (in a semiotic sense, Table 2-1)</td><td>Grapheme</td><td>the script to which it belongs;
grapheme name (letter name, e.g., Phoenician letter name);
glyph shapes;
glyph styles;
transliteration values;
sound values in case of phonographic script
meaning in case of logographic scripts</td><td rowspan="5">using period (may differ for each attribute)</td><td rowspan="5">geographical area of distribution (may differ for each attribute)</td></tr>
<tr><td>Tamga</td><td>cultural background;
glyph shapes;
glyph styles;
meaning</td></tr>
<tr><td>Decorative sign</td><td>cultural background;
glyph shapes;
glyph styles</td></tr>
<tr><td colspan="2">Orthographic rules</td><td>the script to which it belongs;
punctuation, e.g., using separators (the lack of separators is the scriptio continua [continuous writing]);
hyphenation;
spelling;
writing direction;
line order;
capitalisation</td></tr>
<tr><td colspan="2">Layout rules</td><td>the script to which it belongs;
rendering rules (e.g., text shaping);
emphasis (strengthening of parts in a text);
text-separation (separating rows or other parts of text with parallel lines)</td></tr>
</table>

Glyph is a pattern of a semiotic symbol used in scriptinformatics that appears on individual inscriptions, often with different topological properties. Different glyphs are called *glyph variants* that express their relationship to each other. The *glyph distribution* (shape distribution) is a set of glyph variants. The term *shape* is used in virtually the same sense as the term glyph; however, the term shape is applied when emphasizing glyph's topological properties, the *glyph shape* is the set of the geometrical properties of the glyph.

Typical glyph is the most frequently used or a designed variant of a glyph (Hosszú 2013b: 7) that combines the visual properties of a graph of one or more inscriptions, while eliminating the uncertainty of the hand-drawn shapes (such as not completely straight, but intended to be straight and irregular arc).

Glyph style refers to specific topological details of the glyph of a semiotic symbol (Table 2-1). Some examples of glyph styles of graphemes: cursive, lapidary, minuscule, monumental and uncial.

Phoneme is an abstract linguistic entity. This unit distinguishes the meaning of a given language, the smallest articulatory unit of a language, a group of allophones (pronunciation variants). Phoneme is not sound, but a linguistic abstraction. Differently pronounced sounds are identified as appropriate phonemes at the phoneme level of speech perception (Gósy 2004: 245).

Letter is a type of grapheme representing one or more phonemes or phoneme pairs and is a member of a grapheme set (alphabet) of a particular script. A *letterform* is a glyph that belongs to a grapheme that is a letter. A letterform is a language-specific, visually processable representation of speech or a phoneme (Gósy 2004: 245).

Pseudo-ligature is a kind of grapheme, which is a graphic representation of a sound cluster, but was not created from combining the glyphs of the graphemes (ligature) or even if it is derived from a ligature, its components are no longer recognizable in the age of the inscription under study. An example of a pseudo-ligature: Turkic Rovash (Table 8-19) 𐰦, 𐰧 <nd> (SFG-28), where SFG represents a similarity feature group, see below.

Diacritic is a kind of grapheme; it is used in conjunction with the glyph of another grapheme, without which the glyph would belong to a grapheme with a different meaning, sound or emphasis. Examples of diacritics are Brāhmī anusvāra (Table 8-15) and Ancient Greek diaeresis (trema), the latter indicating that the vowel should be pronounced separately from the adjacent vowel and not as part of a diphthong.

Complement is a kind of grapheme, applied for describing a word in Anatolian Hieroglyphic script (Table 8-5); in some cases, it was used in addition to the logogram (Payne, A. 2010a: 7).

Signary (abecedary) is an inscription that lists all the graphemes of a script, usually in some specific order (typically in alphabetical order), e.g., the Table of Espanca (Espanca script, Table 8-10) or the Nikolsburg Alphabet (Székely-Hungarian Rovash script, Table 8-30).

The types of the *writing direction,* see Table 2-4. The writing direction types may apply to individual symbols (Table 2-1) and groups of symbols.

Table 2-4: Types of writing direction

Types	Subtypes	Comments
per line	LTR or RTL horizontal (the lines are rows)	e.g., Celtiberian (Table 8-10) script is LTR, Imperial Aramaic (Table 8-12) script is RTL
per line	bottom-up or top-down vertical (the lines are columns)	e.g., Runic (Table 8-17), Thamudic B (Table 8-7), Hismaic and Safaitic scripts
per line	up-right-down	e.g., Ogham (Table 8-17) script
per line	diagonal	
spiral		e.g., Cretan Hieroglyphic (Table 8-3) script, a lead disk from Magliano with the Etruscan script (Table 8-11) and the Duenos inscription with Early Latin script
circle	LTR or RTL	e.g., Thamudic B (Table 8-7), Hismaic and Safaitic scripts
serpentine	LTR or RTL	e.g., Paleo-Umbrian (Table 8-11) script (LTR)
boustrophedon	LTR or RTL horizontal or bottom-up or top-down vertical	the writing direction of the subsequent lines are opposite
reverse boustrophedon	LTR or RTL horizontal or bottom-up or top-down vertical	the writing direction of the rows are identical, but the rows are reversed relative to each other

The types of the *line order,* see Table 2-5.

Table 2-5: Types of line order

Types	Comments
top-down or bottom-up in case of the horizontal per line writing direction	line order is a *row order*
LTR or RTL in case of the vertical per line writing direction	line order is a *column order*

To describe the changes of semiotic symbols in scriptinformatics, a *multilayer semiotic symbol model* (Table 2-6) was developed, consisting of five logical layers from top to bottom, namely, style, semantic, phonetic, visual identity and topology layers. An earlier version was a four-layer grapheme model (Pardede et al. 2012; Pardede et al. 2016).

Table 2-6: The layers of the multilayer semiotic symbol model

Style Layer determines the appearance of the semiotic symbol. E.g., various styles of the Latin H <h>, such as H, *H,* H, **H**, H, H, **H**, **H**, **H** and H.
Semantic Layer defines the context of the semiotic symbol in the inscriptions. In the case of a decorative sign (a kind of semiotic symbol, Table 2-1), it may not be specified. E.g., the semantic description of the Latin H <h> describes how it is used in a particular script, such as alone or only in a word, when used or when its lower case pair.
Phonetic Layer specifies the semiotic symbol's sound values; this layer does not exist in all kinds of semiotic symbols. E.g., a tamga has no phonetic layer. Another example is the phonetic value of the Latin H <h> is /h/.
Visual Identity Layer determines the glyphs' unique identity of a semiotic symbol, based on the human visual perspective when identifying a symbol. E.g., the visual identity of the Latin A <a> is composed of two stems that reach each other at the top, and usually, but not always there is a bar that reaches the two stems between their top and bottom. Differently, the visual identity of the Latin H <h> is composed of two stems with a bar that reaches the stems about their middle. These two semiotic symbols are graphemes, and they belong to a common grapheme set (the abecedary of the Latin script).
Topology Layer describes a glyph of a semiotic symbol with geometric parameters. E.g., the Latin H <h> topology can be described by two vertical stems with serifs on their two ends and a horizontal bar that reaches the two vertical stems at their middle.

An *inscription* is a surviving relic of one or more scripts, regardless of the writing materials (stone, wall, wood, ink and paper/papyrus/parchment, etc.), and can physically be a fragment, manuscript, scroll or codex. In other words, the term inscription is used in the broadest sense as a hyperonym for all kinds of epigraphs, manuscripts and any written records. It should be noted that such use of the term "inscription" may conflict with the usual meaning of the "inscription" in epigraphy.

Scripts (especially those that are now extinct) can also be considered a set of surviving inscriptions. Inscriptions can be classified according to their geographical location (e.g., separation of Greco-Bactrian and Greek scripts, Table 8-13), the language they record (e.g., different variants of the Latin script, Table 8-18), and their age (e.g., separation of Ancient Greek [Table 8-8] and Greek [Table 8-13] scripts).

The *graph* is a formal unit. This individual visual entity makes up the inscription, an element of an inscription. It is also called the *sign of the inscription*. The concept of the graph is practically equivalent to the concept called *graph* by August and Kohrt (August 1986: 27; Kohrt 1986: 90). The graph (a sign of an inscription) can also be understood as a realization of a semiotic symbol (Table 2-1) in an inscription. In other words, graphemes, tamgas and decorative signs are abstractions of various graphs.

Among the semiotic symbols (Table 2-1), this present research deals with graphemes and tamgas. Since layout rules have no role in the following modelling, the features in the present study can be grapheme, tamga or orthographic rule (Table 2-2). This is in line with Bernal's view that the development of a script should not be examined as a whole, but the isographs of each of its graphemes should be tracked (Bernal 1990: Chapter 3). *Isograph* is a curve on a map that separates various features of scripts—individual glyphs, the position of graphemes, writing direction, and so on (Bernal 1987: 9).

2.2. Scientific disciplinary localization

Biosemiotics is the science of the signs of living systems (Kull 1999: 386), denoting all forms of semiosis observed in the living world (the process of creating, sending and receiving signs). It includes all kinds of signs and sign relations in the living world, including the sign vehicle carrying the meaning (Szívós 2016: 190–191). Unlike biosemiotics, *bioinformatics* combines biology and informatics (Luscombe et al. 2001), develops methods for understanding biological data, analyses and interprets biological data using informatics, statistics, mathematics and engineering knowledge. Bioinformatics primarily concentrates on the content and meaning of signs, not with the carriers of meanings or other parts of the sign relationship. Thus, biosemiotics deal with the sign vehicle, meaning the sign and the relationship between the two; bioinformatics only deals with the sign's meaning (Szívós 2016: 191–192).

Different disciplines deal with the processes that describe evolution over time; some are listed: *bioinformatics* model the evolution of species in the living world; *stemmatology* (stemmology) examines the historical development of traditions recorded in manuscripts (Platnick & Cameron 1977; Reeve 1998); *evolutionary analysis* analyses the phylogenetic trees of networks; a separate area is the development of the use of phylogenetic trees in the history of science, i.e. the evolution of the evolutionary tree (Fisler & Lecointre 2013; Podani & Morrison 2017); *computational linguistics* deals with the evolution of languages (Bryant et al. 2005; Cocho et al. 2015); and additional areas (Podani & Morrison 2017: 192). Scriptinformatics also belong to this kind of evolutionary disciplines, as it models the evolution of scripts.

The term *scriptology* was proposed by Blatner to describe the scientific field of writing (Baltner 1989: 415). Scriptinformatics differ from scriptology in that it examines script primarily in terms of its evolution.

Gelb coined the term *grammatology* to study scripts or writing systems, and includes it in the study of the future of writing and the relationship of writing to speech, religion and art (Gelb 1952). It sets out the principles governing the use and evolution of writing on a comparative-typological basis. Like grammatology, *graphematics* (graphemics) deal with the study of writing systems, including their essential elements, graphemes; belongs to linguistics. Graphematics deal with articulatory properties of texts written in a language and their relationship to spoken language. In contrast, scriptinformatics deal with exploring the evolution and interaction of individual scripts; and identifying the graphs of various inscriptions.

The separate part of scriptinformatics is *computational palaeography* (Hosszú 2013b: 7; Hosszú 2017: 181), which deals with the evolution of historical scripts, provides support for deciphering ancient inscriptions, improves phylogenetic algorithms to explore the relationships in palaeographical data, and usually deals with data on written cultural heritage (Hosszú 2010a; Hosszú 2012a; Tóth et al. 2010; Tóth et al. 2015; Tóth et al. 2016a; Tóth et al. 2016b; Hosszú

2019; Tóth & Hosszú 2019; Hosszú 2020; Hosszú 2021; Tóth et al. 2021). Scriptinformatics use engineering modelling methods to handle any written data, spatially (geographically) analyse different graphemes' variants, and explore relationships of historical or current inscriptions and other palaeographic (including epigraphic) information. An example of scriptinformatic research uses cluster analysis of inscriptions to determine the actual version of a script used in an inscription from unknown origin (Tóth et al. 2016a). Another example is applying convolutional neural networks to determine the degree of visual similarity between pairs of glyphs in various scripts (Daggumati & Revesz 2019). However, they generally do not consider the sound values associated with glyphs and the problems arising from evolutionarily independent but similarly shaped graphemes.

Unlike computational palaeography, humanities-like *palaeography* is part of the humanities; studying ancient writing and forms of writing, interpreting and dating historical manuscripts. *Epigraphy* is the study and decipherment of ancient inscriptions. In a broader sense, palaeography is the science of all kinds of historical inscriptions, documents and scripts, including epigraphy.

Digital palaeography (Ciula 2005; Ciula 2009; Azmi et al. 2011; Levy et al. 2012) is also referred to as computerized palaeography (Wolf et al. 2011) or computer-aided palaeography (Stokes 2009). Both computational palaeography and digital palaeography use computer-aided methods, so there is no sharp line between the two disciplines, but they differ in their goals. On the one hand, computational palaeography is to develop machine learning and modelling algorithms applied to palaeographic origin data. On the other hand, digital palaeography's essence is to supplement humanities-like palaeography with computer methods such as digital description and digitization of old codex data, author identification by image recognition methods or categorization of writing patterns (Hassner et al. 2014: 112–113). Therefore digital palaeography is part of the digital humanities, an interdisciplinary field of humanities-like palaeography, computing and artificial intelligence (Aussems & Brink 2009: 296).

2.3. Phenetic and phyletic concepts

Taxon is a group of objects (entities, statistical entities or data points) examined in the same category. The subject's identity constituting a taxon depends on abstraction in the modelling. *Evolutionary object* is an object that includes its evolution; its development over time can be observed. The main properties of evolutionary objects include reproduction, inheritance, variation and interaction (Gould 2002). Such evolutionary objects include biological organisms (such as plants or animals), languages, software products, law and scripts (Rolland 1994: 216; McHugh-Russell 2019). Even genes can be considered as evolutionary objects. *Phylogeny* is the evolutionary history of related taxa.

In biological taxonomy, multiple taxonomic ranks are used at all taxonomic hierarchy levels. In script taxonomy, the following taxonomic ranks are commonly used: *script family*, *script* and *script variant*. The term script family refers to a set of scripts and does not imply any statement about its member scripts' common origin. Sets or subsets of script families are also called script families. A script variant can also be called a script is used in related palaeographic terminology. Variants of script variations are also called script variations. However, taxonomic script variants are sometimes called *scripts, orthographies* or *alphabets*.

Upon investigating their evolution, scripts or script families are classified into larger script groups based on the geographic area of the members of a *script group*. Therefore, the term script group does not imply any genealogical relationship between their member scripts.

A taxon that cannot be reconstructed, but can be studied is a *taxon studied* (Podani 2000: 177) or an *operational taxonomic unit* (OTU, Sneath & Sokal 1973) in numerical taxonomy, and an *evolutionary unit* (Estabrook 1972) in cladistics. In scriptinformatics, a taxon or OTU can be a script variant (e.g., Old English alphabet of the Latin script), a script (e.g., Latin script, Table 8-18) or an entire script family (Italic scripts, Table 8-11). The taxon or OTU is always a script in the research described below.

An example of non-OTU taxa is the South Semitic scripts' putative common ancestor (Table 8-7), separated from the Old Canaanite script (Table 8-4). Because the studies performed cover not only studiable but also reconstructed scripts, the term taxon will be used below instead of OTU concept since the taxon's meaning is broader than the OTU's meaning.

The taxon is described by *feature*s and the similarity of the taxa is measured by the features of taxa (Table 2-2). The existence of a particular feature in a particular taxon is described by the *feature state.* The feature state is a possible value of a feature. Usually, a feature has only two feature states, i.e., a particular feature is present or missing. The comparison of taxa is performed based on examining each feature (Table 2-2).

In biology, living organisms belong to different species, and species are considered taxa. Similarly, individuals in a scriptinformatic taxon are considered inscriptions (cf. living organisms) created using a particular script (cf. a taxon). This concept is consistent with how a script can be interpreted as the set of all inscriptions created with that script. Analogous to traits of an individual member of the species are features (Table 2-2) that the scribe can use when writing a particular inscription. That is, even if an inscription is short, it could have been a complete set of features (symbols and orthographic rules) in the scribe's mind.

The speciation in scriptinformatics refers to the evolutionary process in which populations evolve into different species (scripts, taxa). In this case, the *population* refers to the writing knowledge of the scribes required to make the individual inscriptions, whose summary represents a particular script.

Plesiomorphy is an ancient, original feature state in the common ancestor of a taxa group. Oppositely, *apomorphy,* is a derived feature state (*apomorphic* feature state) that is created during the evolution of a taxon by changing the plesiomorphic feature state. Types of the apomorphy: autapomorphy, synapomorphy and homoplasy (see later).

Autapomorphy is an unshared derived feature state that exists only on one evolutionary branch. Apomorphous features are found in a single taxon not considered for further subdivision (Ashlock 1974: 82).

Synapomorphy (shared derived feature) is a match of derived features that proves the common descent of taxa. It is a uniquely derived apomorphous feature found in two or more taxa under consideration. This term is the same concept as homology since *homology* is the relationship among taxa features that provide evidence for common ancestry.

Oppositely to the homology, *homoplasy* (Hennig 1966) is a shared derived feature of two or more taxa, when this feature is non-synapomorphic. In other words, homoplasy is a type of apomorphy in which the similarity is not the result of a common origin but a function of random or environmental conditions (in scriptinformatics, e.g., writing technology [Table 4-2] or the fashion of a given age). Finding homoplasies usually means avoiding the *apophenia,* the misinterpretation of the relationship between unrelated data. Accidental coincidences should, as far as possible, be ruled out based on the results used in humanities-like palaeography, history, geography and linguistics. Types of homoplasy are given in Table 2-7.

Table 2-7: Types of homoplasy

Types of homoplasy
Convergence (convergent evolution): It is the process in which, under specific environmental effects, the nature of different taxa changes in a similar direction due to the same function. It appears when lineages from a common ancestor first diverge and then become more similar again, or unrelated lineages become more similar (Stewart 2007). In convergence, homoplasy develops in taxa by varying mechanisms, contrasting to parallel evolution. Some examples and related problems of the convergence are listed in Table 2-8.
Horizontal transference: Originally, it described the transfer of genes between different species during non-conventional biological reproduction. Each of today's feature has its history, but this is not necessarily the same as the history of the species involved (Zhaxybayeva & Gogarten 2004: 182). In biology, horizontal transference involves transferring only a few genes, or possibly only a portion of the genes (Sneath 1975: 361). In scriptinformatics, horizontal transfer (borrowing) means borrowing a feature (Table 2-2) between two taxa (scripts) (Hosszú 2017: 185). Mechanisms of the horizontal transference are listed in Table 2-9.
Parallel evolution: The divergence of lineages from the common ancestor stops, does not increase, and does not decrease their differences (Stewart 2007). The evolution of the glyphs of the vernacular orthographies of the Latin script (Table 8-18) can be considered a parallel evolution, as they did not diverge further after their separation. In this case, homoplasy developed in different taxa, with the same mechanism versus convergence (see above). An example of parallel evolution is the phenomenon wherein the Latin (Table 8-18), Greek (Table 8-13) and Aramaic (Table 8-12) scripts, joined glyphs became fashionable instead of the separate glyphs used earlier. It is worth noting that the boundary between convergence and parallel evolution is not always clear; it is sometimes difficult to distinguish the mechanisms used in the evolution of homoplasy in the taxa being compared.
Reversion: During the reversion [of states of features] (reversal, back-mutation), a feature transforms back from an apomorphic state to a plesiomorphic state. It is a spontaneous return of a feature to a previous or ancestral state. An example of this is the evolution of the Székely-Hungarian Rovash (Table 8-30) script, in which the calligraphic glyphs were widespread in the 16th–18th c. However, from the 20th c., several more ancient, angular glyphs returned into use.

Table 2-8: Some examples for the convergence

Examples for the convergence
The evolutions of the South Semitic 𐩣, 𐩣, ꝏ <m> (SFG-68) and the Székely-Hungarian Rovash 𐳘, 𐳘, 8, 8 <m> (SFG-68) are unrelated; however, their sound value is the same, and even their glyph distributions are very similar.
The similarity of the following types of scripts are evolutionary unrelated: Anatolian-Greek Alphabetic scripts (◊, ◇ <k>, ⊕, ⊙ <q>); Rovash scripts (◊ <k>, ◊ <q>); Aegean scripts (⊛ <ka?>, ◊, ◊ <ko?>) and Anatolian Hieroglyphic script (◈, ◊, ◈ <ku> /gu, ku/), see SFG-91 for details; the reason for their similarity could be due to mere coincidence or similar writing technology. Oppositely, the similarity of the following types of scripts may be the result of no convergence but horizontal transference (glyph shape transfer [Table 2-9: 2-2. §]): Anatolian-Greek Alphabetic scripts (◊, ◇ <k>, ⊕, ⊙ <q>); Paleo-Hispanic scripts (◇, ◊, ◈, ◊, ○, ⊙, ◎, ⌗, ▯ <gu/ku>, ○, ⊙ <gu>, ⊙, ◎ <ku>, ◈, ◈, ⊙ <ku>); Italic scripts (Φ, Φ, ◇, ⊙, ◇ <q>), see SFG-91 for details. The Anatolian-Greek Alphabetic scripts (namely, the Ancient Greek script) likely affected the Paleo-Hispanic and Italic scripts. Inside a script family, the similarity is undoubtedly evolutionary and therefore not homoplasy but homology, as in the Paleo-Hispanic script family (Table 8-10), the Celtiberian ◈, ◈, ⊙ <ku> (SFG-91) and the Northeastern Iberian ◇, ◊, ◈, ◊, ○, ⊙, ◎, ⌗, ▯ <gu/ku>, ○, ⊙ <gu>, ⊙, ◎ <ku> (SFG-91) are indeed related.
The formal similarity between Runic ᚦ *thorn/thurs* <þ> /θ/ and Greco-Bactrian Þ <š> (SFG-100) is a random convergence.

Table 2-9: Scriptinformatic mechanisms of horizontal transference

Mechanisms of horizontal transference
2-1. § *Symbol transfer:* One semiotic symbol (Table 2-1) of a script, along with its glyph, was transferred from another script. E.g., Latin script borrowed the letters Y and Z from Greek script. Cf. borrowing (feature evolution principle, Table 4-2). Another example is the adaptation of Runic ᚦ *thorn/thurs* <þ> /θ/ (Looijenga 2003: 6) to—among others—the Icelandic orthography of Latin script: þ *þorn* <þ> /θ/. Naturally, the symbol transfer does not mean a reticulate evolution, as graphemes are transferred from the ancestor scripts to the new script when a new script is born. Cited: Table 7-5: 7-2. §.
2-2. § *Glyph shape transfer:* A semiotic symbol (Table 2-1) with one or more glyphs exists in a script, and a further glyph is borrowed from another script that will belong to this existing symbol. In this process, the acceptor script's symbol was influenced by the donor script's symbol; cf. borrowing (feature evolution principle, Table 4-2). One possible example of this is the evolution of Turkic Rovash 𐰏 <g^2> (SFG-18) and Turkic Rovash 𐰚 <^{I}k^I> (SFG-57), see Table 7-6: 7-4. §.
2-3. § *Orthographic rule transfer:* The orthographic rule of one script is applied to another script. E.g., in the Old Hungarian orthography of Latin script (Table 8-18) it happened that the digraph *aa* denoted /ā/, this orthographic rule appeared in a late Székely-Hungarian Rovash script relic (Patakfalvi): 𐳀 <a> /a/ and 𐳀𐳀 <á> /ā/ (SFG-2). Another example: Sogdian (Table 8-16) and Uyghur (Table 8-20) scripts denoted palatal labial vowels with a ligature formed from the glyphs of <w> and <y> (Erdal 2004: 42). Its effect may have appeared in the Székely-Hungarian Rovash ᛖ <v>, of which the earliest known sound value was /ü/ (SFG-37). Later, the sound value of ᛖ <v> became /u/, then /v/; another external influence also played a role in this development: in the Old Hungarian orthography of Latin script the role of the letters *u* and *v* was practically the same, both represented /u/, /ü/ and /v/ sounds (SFG-38). Cf. external influence (feature evolution principle, Table 4-2).

Mechanisms of horizontal transference
2-4. § *Glyph style transfer* (typeface style borrowing): The glyph style used for a particular symbol (Table 2-1) of a script starts to be used for the glyph of another symbol of the same script or another script, cf. feature evolution principle referred as “becoming similar” in Table 4-2. Its reason could be a particular interaction between scripts when a glyph style used in one script could influence another script’s glyphs. An example of this that in the various scripts of Aramaic origin not later than the 5th c. AD connecting the letters has become increasingly popular. The progress of this process can be demonstrated in the change of the Sogdian script (Table 8-16), in which the Ancient Letters from AD 313–314 (Sims-Williams & Grenet 2006: 95) used distinct letters, but later variants of the Sogdian script applied connected, cursive letters (Skjærvø 1996: 517, 519, 529–530). Similarly, Parthian and the early variant of Middle Persian (Inscriptional Pahlavi) used individual letters; however, the later variants of Middle Persian (Psalter, Early Cursive Pahlavi and Book Pahlavi) used connected graphemes (Schmitt 1989; Skjærvø 1996: 516–517). It is worth noting that only the significant similarities in glyph styles of different scripts can be considered in examining two graphemes’ relationship (in general features). See the similarity threshold for symbol attributes in Table 4-4.

Reticulate evolution (network evolution, anastomosis [Podani 2000: 178]) is a type of evolution in which two taxa on a previously separate genus are connected so that a network describes the lineage instead of a tree. Possible reticulate evolution mechanisms are horizontal transference (Table 2-7 and Table 2-9) and hybridization.

Hybridization (introgression, introgressive hybridization, interbreeding) is new genetic information that is generated when crossing different taxa. In biology, hybridization involves predominantly complete genomes (Sneath 1975: 360–361). In scriptinformatics, hybridization involves a set of features instead of a unique feature. The types of hybridization) are presented in Table 2-10.

Table 2-10: Scriptinformatic cases of hybridization

Types of hybridization
2-5. § *Script-level hybridization:* A script is evolved from more scripts. An example for the script-level hybridization is the evolution of Gothic script (Table 8-8), which is derived from primarily Greek script, but it also borrowed Latin and Runic letters (symbol transfer, Table 2-9: 2-1. §); e.g., Gothic 𐌷 (Marchand 1973: 14) <h> originates from Latin script (Marchand 1973: 19) and Gothic 𐌿 (Marchand 1973: 14) <u> comes from Runic (Marchand 1973: 21). Another example for the script-level hybridization is Early Cyrillic script (Table 8-21), a combination of Greek and Glagolitic scripts (Hosszú 2017: 185). The evolution of Early Cyrillic script is probably not an example of a horizontal symbol transfer (Table 2-9: 2-1. §), as Glagolitic graphemes were not included in a previously formed script, but were present as components from the beginning of the evolution of Early Cyrillic script. According to some researchers, Paleo-Hispanic scripts could be influenced by Aegean syllabaries; this idea occurred in various publications (Tovar 1951, Koch 2013: 541–558 apud Valério 2014a: 452; Koch 2014). In case of Runic script, similar hybridization of the Punic and Italic scripts has been suggested by Vennemann (2015: 295–330).

Types of hybridization
2-6. § *Symbol-level hybridization:* One symbol of a script is formed as a hybrid of the symbols, glyph shapes or glyph styles of two different scripts. An example of this is the likely influence of the Eurasian tamgas (Table 8-34) in Rovash scripts' evolution, see Figure 6-11 and Figure 6-12.

Systematics is studying evolutionary objects' types and diversity. *Classification* is the sorting of objects into taxa based on their relationships. *Taxonomy* is the discipline of classifying taxa by arranging them in a sorted manner; it can be called sorted classification or science of classification. Other definitions of systematics, classification and taxonomy also known, and these concepts often overlap in practice (Gillott 1995: 91).

Approaches to classifications can be phenetic and phyletic. In a phenetic classification of taxa, the groups are measured on an estimate of the degree of overall similarity; it deals with the amount of divergence. Oppositely, the groups of a phyletic classification of taxa are gauged on common ancestry's relative recency (Daly 1961: 176). A phyletic classification is a *hypothesis,* which tries to identify the evolutionary history of taxa, and it is subject to more testing. It is worth noting that the term phylogenetic is used in many ways.

Comparative methods of *phylogenetics (phyletics)* are methods used for comparative analysis of features in the study of the evolution of individuals. Phyletics encompasses the scientific investigation of the descent of organisms in general. Phyletic analyses can be applied to any domain that varies according to general evolutionary processes. The phylogenetics aims to reconstruct the evolutionary paths (Podani 2000: 175). In general, it is not the evolution of individuals, but the evolution of taxa studied. Phylogenetics includes *phylogenetic taxonomy* (phyletic taxonomy), whose methods are phenetics, cladistics and evolutionary systematics .

Phenetics (numerical taxonomy) classifies taxa according to their morphological similarity, ignoring evolutionary relationships. Morphological features refer to the outward appearance and internal structure of taxa elements; morphological similarity usually involves a phyletic relationship, but not always. The purpose of phenetics is exploring the data structure to determine the differences between the taxa to be classified. Phenetics makes no distinction between apomorphies and plesiomorphies. The result of the phenetic analysis is a *phenogram,* which is a tree-like branching diagram (indexed tree, dendrogram) that uses morphological information of taxa. In phenograms, the branch's length represents the similarity among the taxa.

The primary purpose of phenetic modelling is not to explore lineage relationships (Podani 2000: 175). Its fundamental method is the procedure based on comprehensive similarity (Sokal & Sneath 1963), where the classification should be based on as many features as possible, and these features are equally important at the beginning of the analysis. An essential method of phenetics is *clustering* (cluster analysis), which divides the data set to be analysed into homogenous subsets to a certain extent. Clustering is an unsupervised machine learning method, where the clusters are unknown at the beginning of the procedure.

Cladistics (phylogenetic systematics) compares features in related taxa to determine ancestor-descendant kinships. It is a particular method that assumes a kinship relationship between taxa (Hennig 1966). Cladistics uses only apomorphies in reconstructing the phylogenetic relationships. It does not use plesiomorphies From a mathematical point of view, cladistics is a multivariate process, as many taxa participate in the model in several ways. However, in cladistics, in addition to the mathematical basis, the researcher's ideas about evolution also play a significant role (Podani 2000: 175). Cladistics focuses on concluding evolution from the change of each *feature* (character [in a biological sense]) or the change of the *feature states* (character states [in a biological sense]). Its result is a *cladogram,* which is a tree-like branching diagram that uses hierarchical relationships among taxa based upon synapomorphies (see below) of taxa. The cladogram's shape indicates relatedness, and the lengths of branches have no specific meaning.

The peculiarity of cladistics is that individual features are not equally important, and it is usually assumed that if a feature disappears in the course of evolution, it is improbable that it will reappear later (Podani 2000: 175). Cladistics categorize taxa based on their nearest common ancestor and not go back to more distant shared ancestors. The basic assumption of cladistics is that the studied taxa ultimately originate from a common ancestor and look for dichotomies in the study of evolution, i.e., only one taxon emerges from an ancestor taxon at a given point of development, so the lineage can only branch in two directions at each point. While phenetic analysis primarily expresses similarly between taxa, cladistic analysis determines phyletic kinship (Podani 2017: 156).

If there is no apparent ancestor-descendant relationship between the analysed taxa, cladistic methods are insufficient, and a phenetic approach should be used instead (Podani & Morrison 2017). Since cladistics cannot usually handle hybridization (Table 2-10), but always assume a tree, cladistic procedures are suitable for exploring evolutionary pathways in which individual branches have become stable, but are not appropriate when unique taxa are not yet formed (Podani 2000: 178). Cladistics can be applied outside of biology when it comes to objects evolving (evolutionary objects, taxa), as exemplified by the evolution of the languages and the medieval texts (Podani 2010: 1186).

Evolutionary systematics or evolutionary taxonomy reconstructs the evolutionary relationships of (including the timing) of evolutionary objects (taxa), taking the extent of evolutionary change into account. It reconstructs the evolutionary history of taxa. Its result is a *phylogram,* which conveys taxa's genealogical information. In phylograms, lengths of branches represent the amount of inferred evolutionary change: the longer the branch, the greater is the variation between taxa.

2.4. Script formation

In scriptinformatic research, many concepts used in biological evolution modelling have been applied based on the correspondence between biological species and script, as previously described. Considering the *temporality* in biological evolution, species formation models over time include speciation by splitting, speciation by budding and anagenesis (Podani 2017: 159). These models can also be applied in scriptinformatics. During *splitting,* two other species are created instead of the original species. During *budding,* the original species remains, but a new one emerges from it. In case of the *anagenesis* (speciation by phyletic transformation), there is an evolutionary change of a feature within a lineage over an arbitrary period (Futuyma 2017). An example for scriptinformatic splitting is the splitting of Old Canaanite (Table 8-4) script around the 2nd millennium BC into two script families: Northwest Semitic (Table 8-6 and Table 8-12) and South Semitic (Table 8-7) (Macdonald 2008: 207). An example for scriptinformatic budding is the formation of Paleo-Hebrew (Table 8-6) and Old Aramaic scripts from Phoenician script. A case of the anagenesis in scriptinformatics is the evolution of Ancient Greek (Table 8-8) script to Greek (Table 8-13) script.

Taking the *spatiality* of speciation into account, the following speciation models are used in the biogeography: allopatric, peripatric, parapatric and sympatric. These models can also be used in scriptinformatics.

In the case of *allopatric* speciation, the original population splits in two due to a barrier, and a new species is created on the other side of it. An example of this in scriptinformatics is the evolution of Punic (Table 8-6) script from Phoenician.

In the case of *peripatric* speciation, a peripheral group of the original population—in terms of environmental factors critical to the species—is placed into an isolated area. The ecological space defined by environmental factors occupied by individuals of a species (members of a taxon) is called *niche*. The niche refers to the optimal environmental parameter ranges for the given species and the environment's conditions. In scriptinformatics, a niche can be defined as the cultural and geographical space for using a script (taxon). Examples of peripatric species formation in scriptinformatics can be the formation of Geʿez abjad (Table 8-7) script from Ancient South Arabian script or the formation of Libyco-Berber (Table 8-9) script from Phoenician (Table 8-6). Geʿez and Libyco-Berber scripts developed specific African niches. E.g., the desert conditions may be related to the fact that Libyco-Berber script uses extreme simplistic geometric glyphs. As another example, the survival of Székely-Hungarian Rovash (Table 8-30) script was probably based on the specific cultural and legal separation and relative isolation of Székelyland (Szeklerland [Szeklerland], present-day Harghita, Covasna and parts of Mureș Counties in Romania), so the medieval cultural, legal and administrative system of Székelyland (Hosszú 2010b) can be considered as a niche for Székely-Hungarian Rovash script.

The difference between the allopatric and the peripatric speciation is that in the former case individuals from all parts of the original population are transferred behind the barrier, and in the latter case only a specific group of the original population takes a separate direction of development due to spatial isolation. Punic population evolved from the westward migration of a significant portion of the original Phoenician population; hence Punic cannot be considered an isolated group of the entire Phoenician population. Therefore, the evolution of Punic script is allopatric. Users of Geʿez script in East Africa (Table 8-7) and Libyco-Berber script in North Africa (Table 8-9), on the other hand, emerged from a smaller group of users of the ancestor script, and after a while, their relationship with users of the ancestor script was practically lost. Therefore, the evolution of Geʿez and Libyco-Berber scripts is peripatric.

In the case of *parapatric* speciation, a group from the original population enters a new environment (niche) but still contacts the original one. An example of this is Paleo-Hebrew and Old Aramaic (Table 8-6) scripts from the Phoenician script. In these processes, different niches emerged based on linguistic (especially concerning Aramaic script) and political (in case of separate states, e.g., Paleo-Hebrew), but direct geographical and commercial contacts remained. It is worth noting that during the Punic script development, the connection with Phoenician mother cities remained; therefore, Punic script development is partly parapatric.

In *sympatric* speciation, no spatial isolation is created, but different feature states came into being within the original population from which a new species gradually emerges. An example for scriptinformatic analogue of the sympatric speciation is the formation of Parthian (Table 8-16) script from Imperial Aramaic (Table 8-12) script initially used in Middle Iranian language niche.

2.5. The layered script evolution model

Based on glyphs' topological relations analysis, a *layered script evolution model* was developed (Hosszú 2013a: 12–13, 23; Hosszú 2013b: 10). A layer represents a set of borrowed symbols from the same donor script within a given script. This relationship could have been created by hybridization (Table 2-10: 2-5. §) or multiple symbol transfer (Table 2-9: 2-1. §), cf. Table 7-4. The developed model of script evolution fits the probable readings of the archaeological and palaeographic finds' inscriptions, taking the known historical, geographical and linguistic data into account. In contrast to the traditional *tree model* of scripts' evolution, the layered model is similar to the *wave model,* which allows for more satisfactory modelling than tree models used to illustrate the development of languages, taking isoglosses (map lines separating different linguistic phenomena) into account (Schmidt 1872 apud Francois 2014: 184).

3. Scripts involved in the study

3.1. Earlier research of Rovash scripts evolution

The Eurasian nomads used various scripts on the Eurasian Steppe in very different areas (including the Carpathian Basin); their surviving inscriptions date from the second half of the 1st millennium AD; further inscriptions from the Carpathian Basin date from the 7th c. AD. Their possible relationship is the subject of much research (e.g., Hosszú 2017). V. Thomsen deciphered the Turkic runic inscriptions (Thomsen 1893). Moreover, the Székely-Hungarian Rovash script in the Carpathian Basin has remained in use up to this day. However, many inscriptions made with different scripts are known on the Eurasian steppe, and these inscriptions have not yet been deciphered. Several authors have previously confirmed the similarity of the graphs used in these inscriptions to the so-called Turkic runic on the one hand and the Székely-Hungarian Rovash on the other (Nagy 1895, Sebestyén 1915: 143–160; Németh 1917; Ligeti 1925; Vásáry 1973: 45–49; Róna-Tas 1985b: 241; Vékony 1987b; Kyzlasov, I. L. 1994; Vasil'ev 1994).

Unlike previous deciphering attempts limited to one group of inscriptions, an acknowledged scholar, G. Vékony (1944–2004, late Assoc. Prof. at the Eötvös Loránd University, Budapest) comprehensively deciphered a significant part of these inscriptions from the Carpathian Basin, Eastern Europe and Inner Asia. Due to its comprehensive nature, his decipherment, including the identified sound values of the graphs of those inscriptions, is applied in the present analysis. Vékony published his results in numerous publications (Vékony 1981, 1985a, 1985b, 1987a, 1987b, 1987c, 1992a, 1992b, 1992c, 1992d, 1992e, 1993, 1996, 1997a, 1997b, 1999a, 1999b, 2002, 2004a, 2004b); mostly in Hungarian. Since 2008, the author of this book has systematically collaborated with known linguists and archaeologists, who confirmed and improved the interpretations of Vékony. The outcomes of these joint efforts are published in English (Hosszú 2012a, 2013a, 2013c, 2014, 2015, 2017, 2020) and in Hungarian (Hosszú 2010a, 2010b, 2012b, 2013b, 2014a, 2019, 2021; Hosszú & Zelliger 2013, 2014a, 2014b, 2019, 2020; Zelliger & Hosszú 2014).

The very close similarities between some Eurasian Steppe scripts are confirmed by applying the phenetic method (Hosszú 2017); however, there is no widely used category name for these scripts. In literature, mostly the terms runic or runiform are applied (Golden 1992: 152; Nevskaya & Erdal 2015: 8, among others). However, these terms are inappropriate, since these scripts are evolutionarily unrelated to Runic script and its various variants (Table 8-17) used by different Germanic peoples. For more than a century, in the Hungarian scientific literature, these scripts are usually called in Hungarian "rovásírások" 'Rovash scripts' (e.g., Vikár 1903; Sebestyén 1909). The word *rovás* [rovaːʃ] has several meanings in modern Hungarian, e.g. *carving* (related to the ancient writing technique) and *writing* (to record or make a note of). Therefore, this book's author collectively calls these scripts *Rovash* (pronounced "rove-ash"). It is worth noting that changing the script's name based on the research results is not unknown. For example, the Anatolian Hieroglyphic script was previously designated as Luwian hieroglyphic and even earlier as Hittite Hieroglyphic (Payne, A. 2010a: 2; Yakubovich 2015a: 5). Another example is Cypro-Greek script, whose name was suggested by Egetmeyer in 2010 to replace the conventionally used "Cypriot Syllabary" (Egetmeyer 2010).

Vásáry and Vékony referred to non-Turkic Rovash script relics that were found east of the Carpathian Basin as *kazáriai rovásírás* 'Khazarian Rovash script' or simply *kazáriai írás* 'Khazarian script' (Vásáry 1974: 170; Vékony 1987a: 23). Vékony referred to Carpathian Basin Rovash script as the writing system of the most script relics used in the Carpathian Basin from the 7th c. AD and could not be linked to Székely-Hungarian Rovash (Vékony 1987a: 94). Vékony claimed the existence of a common ancestor of Turkic Rovash and Carpathian Basin Rovash (Vékony 1987a: 119). The surviving inscriptions of the script referred to as Khazarian Rovash script by Vékony also include inscriptions from the Eurasian Steppe that cannot be linked to the Khazar Khaganate. Vékony itself drew attention to this fact, e.g., in connection with the inscription of Homokmégy-Halom (Vékony 2004a: 111). The reading of the Inner Asian wooden stick of Achik-Tash (Table 8-32) by Vékony contains the word "Khazar" linked to the Khazar Khaganate. However, in Inner Asia, there are additional inscriptions that include graphs similar to the inscription of Achik-Tash but still undeciphered today. It is unlikely that all of these could be attributed to the Khazar Khaganate, far to the west of its region. One such script relic is the Altin-Asar inscription, which consists of two orthogonal inscriptions on a tile fragment found in 1987 in the building No. 1 of the Altin-Asar fortress No. 4 in the delta of Syr Darya (Jaxartes) River (Kyzlasov, I. L. 1994: 284). Another similar artefact is an undated rock inscription, which Oskin found in 1976 in the Kyzylkum Desert, ca. 100 km north of Bukhara (Kyzlasov, I. L. 1994: 283). At the moment, none of them could have been read, but based on the graphs in them, I. L. Kyzlasov associates both with Achik-Tash inscription (Kyzlasov, I. L. 1994: 61). Based on these, Hosszú applied a slight modification to Vékony's naming system, as Hosszú refers to the Khazarian Rovash script as Steppe Rovash.

Several names are used in Rovash scripts' literature, some of which are mentioned below (see also Hosszú 2013b: 12). There are main categories, as Asiatic runes for Turkic Rovash graphemes, and European runes for Steppe Rovash, Carpathian Basin Rovash and Székely-Hungarian Rovash graphemes (Tryjarski 1997: 367). Another name for European Rovash scripts is East European runic (Klyashtorny & Vásáry 1987: 171). Németh calls Carpathian Basin Rovash script as Pecheneg script (Németh 1934: 29; Németh 1971: 48). Differently, I. L. Kyzlasov calls Carpathian Basin Rovash script as Tisa script. He classifies the script relics of Carpathian Basin Rovash and Steppe Rovash into the Euroasiatic group of runic scripts (Kyzlasov, I. L. 1994: 14, 73, 321); in this group, he distinguishes the following subgroups: Tisa, Don, Kuban (also Balkaria), Don-Kuban, South-Yenisey, Achik-Tash and Isfara; while within the Asiatic group of runic scripts (Kyzlasov, I. L. 1994: 79–104, 321) he separates the following subgroups: Altai, Yenisey, Orkhon, Talas, Turpan (East Turkestan). The Euroasiatic group of runic scripts corresponds to the Carpathian Basin Rovash and the Steppe Rovash scripts, and the Asiatic group corresponds to the Turkic Rovash script.

Püspöki Nagy pointed out that Avars had a script, as it was referred to by St. Cyril in 867 when he listed the Avar among the peoples of own script in Venice (Italy) (Püspöki Nagy 1977: 308). It should be noted that it is not clear whom St. Cyril understood by Avars. Róna-Tas calls the European relics of Carpathian Basin Rovash and Steppe Rovash as Eastern-European runiform scripts (Róna-Tas 2007b: 22–24). The Székely-Hungarian Rovash was also named differently

(Németh 1934: 1; Sándor 1989–1990: 65; Hosszú 2013a: 190). The term Székely-Hungarian Rovash script (in Hungarian *székely-magyar rovásírás*) appeared in several publications (Csallány 1960; Róna-Tas 1985a: 97). It is important to emphasize that the script's name merely identifies that script, but it does not ensure that the population that may appear in the script's name; that the script was created by certain people or even used in a particular era.

The evolution of scripts has been studied before (e.g., Hackh 1927: 98). As for the Rovash scripts, the possible connection between the Székely-Hungarian Rovash and the Turkic Rovash, which had not been deciphered at that time, was raised as early as the 18th c. A scientific manuscript proves this connection on the Székely-Hungarian Rovash script (Ferenczi, G. 1992: 60), which is a more detailed version of the previously known Marosvásárhely Collection (Sebestyén 1915: 114) (Marosvásárhely in Romanian is Târgu Mureș, Romania). The sheets of Pál Bardócz's manuscript include, among other things, a collection of graphs of Turkic Rovash inscriptions that were not deciphered at that time (Tubay 2015b: 225). Comparing the Székely-Hungarian Rovash graphemes and the graphs of undeciphered (Turkic Rovash) inscriptions found in Siberia (Russia) (von Strahlenberg 1730), historian György Pray (1723–1801) found no connection (Tubay 2015a: 186); however, others confirmed their relationship in 1889 (Fischer 1889) and 1890 (Nagy 1890). Donner had the opinion that the Turkic Rovash was derived from the Carian (Table 8-8) and the Lycian scripts, even before deciphering the Turkic Rovash inscriptions (Heikel et al. 1892: XLXXX ff. apud Tekin 1968, cf. Donner 1896). Since Thomsen, many other scholars agreed that one of the principal ancestors of Turkic Rovash was an Aramaic script (Clauson 1970: 74–76). According to I. L. Kyzlasov, traces of an earlier syllabic script can be discovered in Turkic Rovash. He suggested that the ancestor of the Turkic Rovash was a probably Semitic syllabic system (Kyzlasov, I. L. 1994: 131, 2015: 204).

Using Thomsen's decipherment of the Turkic Rovash inscriptions, Nagy elaborated his earlier theory (Nagy 1895). Following Vámbéry, Réthy and then Nagy also pointed out that Hungarian word *betű* 'letter' is of Turkic origin (Vámbéry 1882; Réthy 1888: 54; Nagy 1895: 269). According to them, the Hungarian word *ír* 'he/she writes' is also of Turkic origin. Despite the Turkic traces of the Hungarian language, Réthy rejected the Turkic origin of Székely-Hungarian Rovash script, and he considered it to be a figment from the 16th–17th c. based on Hebrew script due to the RTL writing direction and partly unwritten vowels in Székely-Hungarian Rovash script (Réthy 1888: 54–56). In contrast, Nagy assumed the Turkic origin of the Székely-Hungarian Rovash (Nagy 1895: 270); however, he stated that full correspondence between Székely-Hungarian Rovash and Turkic Rovash is only valid for two graphemes. These are the Székely-Hungarian Rovash) <n> ~ Turkic Rovash) <n^{1}> (SFG-72) and the Székely-Hungarian Rovash ǀ <s> ~ Turkic Rovash ǀ <s^{1}> (SFG-101), but looking at the graphemes for each sound group together, he found far more matches (Nagy 1895: 273).

Earlier Hungarian scholars hypothesized that the Székely-Hungarian Rovash script was of Scythian, Hun or Hebrew origin, or even an original Székely (Szekler) work (Sándor 2014b: 329–330, 333–340). In 1903, Fadrusz found formal similarities between the Etruscan, Egyptian hieroglyphs and Székely-Hungarian Rovash glyphs (Sebestyén 1915: 25). According to Sebestyén, the Székely-Hungarian Rovash and the Turkic Rovash have a shared past, and Rovash scripts' evolution is closely related to Ancient Greek script (Sebestyén 1915: 155–160). He claimed that the origin of the Turkic Rovash is a Mediterranean script (Sebestyén 1904b:

310). Sebestyén found that the Turkic Rovash and the Székely-Hungarian Rovash come from two sources: a Mediterranean script, which denotes all sounds, and the other is one of the Middle-Eastern scripts, which do not denote all sounds (Sebestyén 1906: 269). Galánthay compared Székely-Hungarian Rovash to Middle Eastern scripts and even Egyptian hieroglyphs (Galánthay 1913–1914).

The fact, that there is a relationship between the Turkic Rovash and the Székely-Hungarian Rovash has become clear by several publications (Németh 1917: 31–44 and Ligeti 1925: 50–52 among others). Ligeti pointed out that the Székely-Hungarian Rovash was not a direct takeover of Turkic Rovash due to "insurmountable historical and palaeographical difficulties" (Ligeti 1927: 476). According to Németh, the glyphs of the Székely-Hungarian Rovash are closer to the Yenisey variant of Turkic Rovash than to the Orkhon variant; however, he pointed out that there are even more similar features to the Talas variant of Turkic Rovash (Németh 1934: 27–28). Püspöki Nagy pointed out that if the Turkic Rovash could have been the direct ancestor of the Székely-Hungarian Rovash, letters being different from the Turkic Rovash would have been included in the Székely-Hungarian Rovash only if the Hungarian sound system differs from the Turkic sound system, e.g., for sounds /f/ and /h/. In contrast, glyphs denoting sounds /c/, /ts/, /m/, /p/, /t/, /u/, /v/ and /z/ are completely different in Székely-Hungarian Rovash and Turkic Rovash (Püspöki Nagy 1977: 303–304). According to Róna-Tas, the ancestor of the Székely-Hungarian Rovash is a kind of Semitic script (Róna-Tas 1994). Revesz applied a bioinformatic method to explore the relations between some Mediterranean scripts and the Székely-Hungarian Rovash (Revesz 2015). Examinations conducted by the author of this book covered several scripts in the Mediterranean region, the Middle East and Inner Asia.

Starting now, for the sake of simplicity, abbreviations are used for the various Rovash scripts, see Table 3-1. More abbreviations are in (Table 8-2).

Table 3-1: Abbreviation and pronunciation of Rovash scripts

Abbreviation	Detailed name	Pronunciation (IPA)
TR	Turkic Rovash	[ˈtɜːkɪk rovaːʃ]
SHR	Szekely-Hungarian Rovash	[ˈseːkɛj hʌŋˈgeə.ri.ən rovaːʃ]
CBR	Carpathian Basin Rovash	[ˈkɔːpɑːθɪən ˈbeɪ.sən rovaːʃ]
SR	Steppe Rovash	[step rovaːʃ]

3.2. Spatio-temporal modelling

The search for symbols that are similar to the examined Rovash graphemes in shape and sound value led to the surprising result that graphemes that are very similar to a smaller part of the graphemes of Rovash scripts (TR, SHR, CBR and SR) can be found in scripts used in Asia Minor in the first half of the 1st millennium BC; but the relatives of a larger part of Rovash graphemes are similar to the graphemes of the Aramaic, Middle Iranian and Brahmic scripts.

According to Vasil'ev, TR was formed in the region of the Altai Mountains (Vasil'ev 2005: 328). It is worth noting that there is no evidence that graphemes were transferred from Asia Minor to the Altai before the spread of the Imperial Aramaic script through the Achaemenid Empire; however, it also cannot be ruled out. Namely, in the first half of the 1st millennium BC, there was population migration from Anatolia to Altai, and therefore, it cannot be ruled out that a kind of writing system was carried to Altai from Anatolia, see Table 3-2.

Table 3-2: Some historical and archaeological data on the Cimmerians and the Pazyryk archaeological culture

3-1	§ The Cimmerians *(gimirri, gimirru)* appeared northwest of Urartu in the late 8th c. BC (Dandamayev & Grantovskiĭ 2006–2011: 806–817). In 714 BC, the Cimmerians defeated King Rusa I of Urartu (Marsadolov 2000a: 249). In the first half of 7th c. BC, during the reign of Midas Phrygian king, the Cimmerians seized Phrygia. In 7th c. BC, Caria came under Lydian rule (Adiego 2007b: 758). The Cimmerians around Gordion have there lived for generations. In 679 BC (Dandamayev & Grantovskiĭ 2006–2011: 806–817) or around 700 BC (Delaunay 1987, 2011), the Cimmerians attacked Assyria during the reign of their king Teušpā, but were defeated, then turned against Lydia *(Luddu).* In 668–665 BC, King Gyges of Lydia became an Assyrian vassal to get help from Assyrian King Assurbanipal to fight against the Cimmerians (Payne, A. 2016). In 668–631/629 BC, during the reign of Assurbanipal, Hilakku (Khilakku), a Neo-Hittite state in the western part of Cilicia *(Cilicia Trachea, Κιλικία Τραχεῖα),* placed itself under Assyrian protection because of the Cimmerian threat (Lendering 1998–2016, retrieved on 29 September 2016). Finally, at the end of 7th or beginning of 6th c. BC, King Alyattes of Lydia expelled the Cimmerians from Anatolia (Marsadolov 2000a: 249).
3-2	§ During the 6th–4th c. BC, the Pazyryk *(Пазырык)* culture dominated the Altai region. During this period, the Chinese and the Achaemenid Empire significantly influenced the Pazyryk culture. In the first half of 6th c. BC, several innovations appeared in the Altai region, which, according to Marsadolov, could be explained by the arrival of new militant nomadic groups from Asia Minor in the late 7th c. or early 6th c. BC, presumably descendants of the Cimmerians. Probably nomadic tribal chiefs from Gordion (Anatolia) or the surrounding areas captured the best valleys of the Altai in the Tuekta and Bashadar areas and subjugated the local Pazyryk population. The 4,000 km distance between the two areas was not an insurmountable obstacle, not least because at that time it functioned as a trade route. Nomads could cover this distance in a year or two (Marsadolov 2000a: 247–258, Marsadolov 2000b: 51). The age of the Pazyryk tombs is 5th–3rd c. BC, when the Altai region was part of the Yuezhi Empire (Table 6-3: 6-3 §), and the Pazyryk sites were undoubtedly related to the Yuezhi (Enoki et al. 1994: 171).
3-3	§ According to some data, it seems that a population related to the Cimmerians arrived in Southern Transdanubia (Western Hungary) around 600 BC, as evidenced by a tumulus in Regöly (Tolna County, Hungary) (Szabó, G. & Fekete 2012: 28; Szabó, G. 2015: 321). According to G. Szabó, the descendants of these population were the Pannonians (Kürthy et al. 2013: 121–124; Szabó, G. & Czuppon 2014: 54; Szabó, G. 2015: 323; Szabó, G. 2020: 119–135). Theoretically, this population could carry a kind of script to Southern Transdanubia. Moreover, the earliest SHR script relic was uncovered in Southern Transdanubia (Bodrog-Alsóbű, around 900 or first half of 10th c., Table 8-30). However, there is no evidence that this area's local population had any continuous local writing tradition of Iron Age origin before the 7th c. AD. Furthermore, Rovash scripts in this region from the 7th c. AD can be explained by the waves of the Migration Period.

It should be emphasized that there are not any surviving inscriptions to prove the Anatolian origins of Rovash scripts. This possibility is suggested by comparing graphemes with the same sound values and similar glyphs.

Based on Table 3-2: 3-2 § and Table 6-3: 6-3 § in the 3rd c. BC or earlier in Inner Asia, a transmission of graphemes could happen from Aramaic origin scripts to Rovash scripts. The donor could be the Imperial Aramaic used in the Achaemenid Empire and its descendant states. In the 3rd c. BC, local variants of the Imperial Aramaic script were undoubtedly not yet developed. This statement is supported by the fact that Persian words began to appear in Aramaic inscriptions in the 2nd c. BC, only. This data indicates that the Imperial Aramaic script had already was used in the Persian language by this time (Rogers 1999: 257).

The development of scripts in time and space is often continuous, with a large temporal and spatial extent, such as Imperial Aramaic script (Table 8-12). In other cases; however, evolution took place locally (e.g., the development of the minuscule variant of the Latin script in Carolingian monasteries and the royal court) and over a short period (e.g., the development of the Cyrillic script, Table 8-21). For the development of Rovash scripts, the potential area of Eurasia can be divided into four regions (Table 3-3), which means a four-part spatial quantization.

Table 3-3: Geographic areas associated with the evolution of Rovash scripts

Area and description
3-4. § *Anatolia* (Asia Minor): The Cimmerians occupied the central areas of Asia Minor in the first half of 7th c. BC, and then left Asia Minor in the late 7th or early 6th c. BC. According to the available data, different groups migrated from here to the Altai region, Eastern Europe and the Carpathian Basin, see for details: Table 3-2.
3-5. § *Inner Asia:* The area of TR formation, where SR script relics were also found (Achik-Tash, Table 8-32). Inner Asia is primarily a geography and civilization unit, a part of Asia with ever-changing borders among settled civilizations in the south and the northern taiga belt (Vásáry 2003: 15–16).
3-6. § *Pontus Steppe:* Numerous SR script relics have been found in and around the Khazar Empire.
3-7. § *Carpathian Basin:* SHR, CBR and SR script relics have been found in various parts of the Carpathian Basin. Due to geographical and chronological reasons, the influence of the Greek Alphabetic (Table 8-13), the Latin Alphabetic (Table 8-18) and the Slavic (Table 8-21) scripts can be only expected here.

Based on the known script relics, any Rovash scripts that were ever used in the modelled areas, as well as possible script transmissions in these areas, are presented in Figure 3-1, where in addition to the well-known facts about the Migration Period in the Eurasian Steppe from East to West, the movements of the Cimmerians (as possible script transmitters) have also been taken into account (Table 3-2).

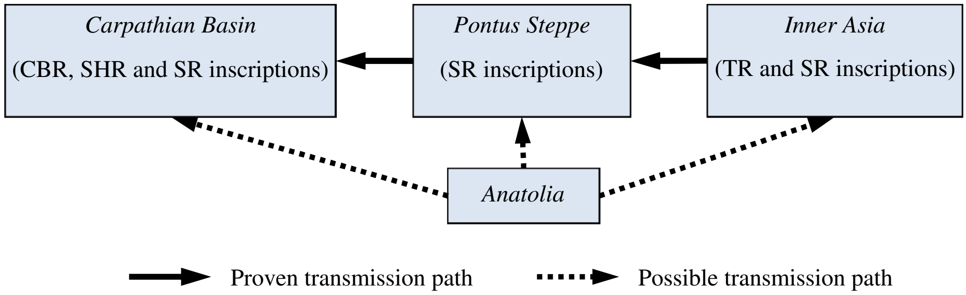


Figure 3-1: Regional divisions to help the investigation of the evolution of Rovash scripts and possible script transmission paths

3.3. *The possibility of acrophony*

According to the hypothesis derived from Thomsen, in addition to graphemes of Aramaic origin, *pictograph*s (pictograms) from the Turkic cultural heritage (tamgas, Table 8-34) appeared in Turkic Rovash (Thomsen 1922). Amanjolov refers to them as *graphic logograms* (Amanjolov 2003: 290). The set of the hypothesized pictographs has changed and were studied in different researchers' works (e.g., Thomsen 1922; Clauson 1970: 70–71; Vékony 1985a: 72, 75; Róna-Tas 1987: 8–9; Kara 1996: 537 and Erdal 2004: 63). Some Rovash graphemes are supposed to originate from pictographs presented in Table 3-4.

Table 3-4: Rovash graphemes that are supposed to be of Turkic pictograph origin, their related Turkic words, and serial numbers of SFGs including these graphemes

Rovash graphemes	Related Turkic words	SFG
TR 𐰋 <b^2>, CBR 𐲂 <b>, SR ᗒ <b^1, b^2>	Old Turkic *äb, äβ*, Uyghur *äv* 'tent, house, home'	SFG-14
TR 𐰓, 𐰔 <d^2>, SHR 𐰔 <d>	Old Turkic *ed* 'property, livestock'	SFG-29
TR 𐱃, 𐱄 <t^1>	Old Turkic *at* 'horse'	SFG-48
TR 𐰍, 𐰎 <g^1>, SR 𐰎 <g^1>	Old Turkic *aγ* 'net'	SFG-22
TR 𐰶, 𐰷 <^{ï}q^ï>, SHR Δ, Δ <k>	Old Turkic *ïq* 'spindle'	SFG-61
TR 𐰸, 𐰹 <^{W}q^W>	Old Turkic *oq,* Uyghur *ok* 'arrow'	SFG-62
TR 𐰤, 𐰥 <n^2>, SR ≁ <n^2>	Old Turkic *en* 'declivity'	SFG-75
TR 𐰞 <l^1, l^2>	Old Turkic *el* 'hand'	SFG-65
TR 𐰖, 𐰗 <y^1>, SHR 0, Ø, θ, ⊘ <Í>, CBR 𐰖 <j>, SR 𐰗, 𐰖 <y^1>	Old Turkic *ya* 'bow' or Old Turkic, Uyghur *ay* 'moon'	SFG-55
TR 𐰼 <r^2>	Old Turkic *er* 'man'	SFG-93

Traditionally, acrophony means using the letter name's first sound like the sound of the letter itself. In this case, the first consonant of the Old Turkic name of a pictograph could be the sound value. In a broader sense, it can be considered as acrophony.

In case of some Rovash graphemes, the grapheme's sound value, and the meaning of the related Old Turkic word could affect the grapheme's shape. E.g., TR 𐰋 <b^{2}> resembles a house (yurt) (SFG-14); the glyphs of TR 𐰖, O, 𐰗 <y^{1}> (SFG-55) can be identified with the changing shape of the moon; and TR ↓, ↑ <^{W}q^{W}> (SFG-62) is arrow-shaped, see Table 3-4. In this case, the effect of the acrophony can be considered an external influence (feature evolution principles, Table 4-2).

3.4. Nomadic literacy

According to Macdonald, we can consider those societies as non-literate, in which literacy is not essential to any of the activities, and where memory and oral communication replace the functions that reading and writing occupy within a literate society. In the literate society, the ability to read and write is essential in certain vital aspects, such as the bureaucracy, economic and commercial activities or religious life (Macdonald 2005: 45). An inscription in a non-literate society usually does not serve practical purposes, as exemplified by the Safaitic (Table 8-7) or the Tifinagh (Table 8-9) inscriptions (Macdonald 2005: 54–56, 71–77; Macdonald 2015: 10–12, 28–29). According to him, there is no script development in a non-literate society apart from individual differences, as the reader of the script is not relevant, so there is no external pressure—e.g., the reader's expectations—for the development of the script. Once the script had been adapted to the available written materials, there was no reason to develop further. Moreover, the small, individual variations in glyphs remained personal idiosyncrasies that did not affect anyone else's writing (Macdonald 2015: 12). In general, nomadic societies are characterized by oral-based communication, although there were significant differences between them. This concept is expressed in Cribb's two-dimensional model, which distinguishes nomadic societies based on mobility (endpoints: total nomadism and total settlement) and livelihood (endpoints: agriculture and grazing) (Cribb 1991: 17).

At the beginning of Rovash scripts' evolution, a predominantly oral-based, we can presume an illiterate society, as Macdonald defined. Therefore, it is likely that the glyphs have hardly changed over time. In an illiterate society as defined by Macdonald, communities mostly inherit a version of writing in isolation from each other (in separated niches). This model, results in the long-term invariance of the semiotic symbols (graphemes and tamgas, Table 2-1), making the phenetic analysis comparison of symbols of scripts that are distant from each other in time possible.

Ancient Greek, Paleo-Hebrew, Latin and Arabic are scripts that have been used to produce either sacred books or scholarly and other literary works. These have been read centuries later, and for this reason, these scripts sometimes return to their earlier traditions. However, the knowledge of Rovash scripts passed from father to son. In equestrian-nomadic societies, traditions were preserved orally, so older ages did not play a role in Rovash scripts' evolution.

By the 11th c. AD (13th c. at the latest) knowledge of other Rovash scripts except SHR had ceased. In contrast, SHR embarked on an evolutionary path in which generations read the recorded texts as Christian priests used SHR to write down prayers and feasts' calendar (Stick Calendar, Table 8-30). From the 16th c. textbooks that teach SHR also started to appear (Rudimenta, Bél's book, Table 8-30).

The main field of modelling based on grapheme evolution is the pre-modern evolution of Rovash scripts, where the model developed for script evolution could have prevailed naturally. However, even then, geographical and populational mixing were present, which could mean that the literacy skills of populations with different literacy cultures occasionally interacted. This fact, together with the circumstance that very few script relics can be relied upon, affect phenetic analysis in a way that a complex modelling procedure had to be developed to eliminate uncertainties as much as possible by creating alternative Origin Models (OMs).

4. A phenetic approach to script evolution

4.1. *Identification of different graphemes*

In the phenetic model database, references to the literature are usually followed by glyphs. However, sources are often omitted in glyphs from the following large databases: Hesperia, HoChyMin, LBI, MNAMON, OCIANA, PROEL, TIR; their bibliographic data are explained in the References chapter. In sequencing graphemes, the graphemes are usually separated by a semicolon (;). The repeated identical glyphs or transliteration values are omitted to save space. In the case of an omission, the glyphs are separated by a comma (,), but if there are glyphs from altering sources, they are separated by semicolon (;), e.g., TR (Y) 𐰊 (Thomsen 1893: 9); (O, Y) 𐰉; 𐰉, 𐰉 (Róna-Tas 1987: 13); (T) 𐰉, (Y) 𐰉, 𐰉, 𐰊, (O) 𐰉, 𐰉, 𐰉 (Kairžanov 2014: 17); (O) 𐰉, 𐰉, 𐰉, (O, T) 𐰉, (Y) 𐰊, 𐰊, 𐰊, 𐰊 (von Gabain 1941) <b^1> /b/ in SFG-17. The abbreviations and their meanings are listed in Table 8-1.

The same grapheme can appear in multiple SFGs. In this case, only one (usually the first) occurrence contains the whole specification of all glyph variants of the grapheme with their sources in the literature and the available data related to each glyph variant (inscription, age). Other occurrences of the grapheme include only those glyphs that are important in the given context to avoid unnecessary repetitions. All other data can be found in the first, detailed description of the grapheme. A reference to an SFG containing this detailed description is always included next to incomplete descriptions of the grapheme.

In the phenetic model database, the glyphs of graphemes are listed with the name and age of script relics, where the glyph was used; and the literature source, where the glyph and the sound value of the grapheme were published. In the case of Rovash graphemes; however, in order to avoid unnecessary repetitions, a simpler description was applied. Namely, all SHR, CBR and SR glyphs and a part of TR glyphs are listed in the database of the phenetic model along with the inscriptions, where their shapes were preserved, and the detailed bibliographic data of the inscription is included in Table 8-29 for TR, Table 8-30 for SHR, Table 8-31 for CBR and Table 8-32 for SR.

4.2. *Modelling principles*

Feature engineering processes the raw input data to determine the features that are useful for machine learning algorithms. Table 4-1 presents the theoretical consideration used in feature engineering and modelling.

Table 4-1: Modeling principles and methods

Lex parsimoniae (Ockham' razor, minimum evolution principle, principle of parsimony, parsimony principle): *Pluralitas non est ponenda sine necessitate.* There is no need to introduce surplus unnecessarily. The most probable cladistic tree (cladogram) contains the fewest evolutionary steps (Ashlock 1974: 83). Its other interpretation is minimizing ad hoc explanations. The fewest possible changes are assumed during evolution, thus minimizing the number of homoplasies (Table 2-7). The parsimony is an epistemological approach (Brower 2000: 144).
Minimum Entropy Method (Hosszú 2013a: 12, 41; Hosszú 2013b: 10; Hosszú & Zelliger 2014b: 418–419): Using this, the scripts whose symbols are as close as possible to the symbols of the descendant scripts are assumed to be the closest relatives of the examined descendants. Minimum Entropy Method is a scriptinformatic application of *lex parsimoniae.*
Stability Principle: According to this, a grapheme that represents a sound existing in the acceptor script's language is taken over with its original grapheme glyph and sound value (Boisson 1994: 225 apud Adiego 2007e: 2). This stability principle helps in matching similar graphemes of various scripts.

Based on the study of the evolution of symbols in different scripts, the *feature evolution principles* determining the possible direction of semiotic symbol development (Table 4-2, Hosszú 2013a: 24–25) are elaborated.

Table 4-2: Feature evolution principles

Name and description of the principle
Adaptation: Modification of the sound value or the meaning of a semiotic symbol. If there is no glyph for a certain sound or meaning in a script, but it becomes necessary, an existing glyph is reapplied for the required sound or meaning.
Becoming similar: Transformation of a semiotic symbol similar to existing symbols. Reshaping of a glyph so that it resembles an existing one, e.g., because of fashion. This principle's realisation is the glyph style transfer (Table 2-9: 2-4. §).
Borrowing: Borrowing (adapting) a whole symbol with the needed sound value or only a glyph shape from another script. Cf. symbol transfer (Table 2-9: 2-1. §) or glyph shape transfer (Table 2-9: 2-2. §).
Closer-shape forming: Modifying a glyph in order to reach a more closed glyph. In the following two cases, Macdonald reconstructed the sequence of glyph development: Dadanitic Ѧ > Ѫ > Ѱ > Ѵ <'>, (Macdonald 2010: 12–14) and Dadanitic ⫛ > Ѫ > ⫯ > Ѵ <s[1]> (Macdonald 2010: 13–14). Another (possible) examples: CBR ▯ <r>, SR □ <r[1]> (SFG-95) from TR Ꮧ <r[1]> (SFG-92); TR ◇ <m> (SFG-67) from TR ≪, ≪ <m>.
Different visual identities: As a script evolved, each semiotic symbol evolved to have a different visual identity from each other in order to reach the possible largest topological distance of the visual identities of the symbols (Table 2-6). It is the opposite of merging.

Name and description of the principle
External influence: The effect of a known writing culture (e.g., Latin, Greek, Hebrew, Aramaic, Middle Iranian and Sogdian), tamgas (e.g., Table 8-34), acrophony (e.g., Table 3-4) or a fashion of a given age (e.g., cursivization). Cf. orthographic rule transfer (Table 2-9: 2-3. §) and glyph style transfer (Table 2-9: 2-4. §).
Glyph-variant forming: A variant of the glyph is formed due to the individual differences of a script's users. It is the opposite of unification.
Innovation: The new feature is developed based on the script's users' creativity with no known external influences.
Merging: Formation of *homographs,* that is originally different glyphs of altering graphemes become identical as they develop; however, their associated graphemes remain different in their sound values. It is the opposite of the different visual identities. An example for such evolution is Brāhmī 𑀘 <ca> and 𑀯 <va> to 𑀘 <ca, va> (Maue, Dieter: Personal communication by email, 15 October 2020). Another example is the development of the Old Aramaic (Deir 'Allā, around 800 BC) 𐡅 (Glass 2000: 14) <w> and (Deir 'Allā, around 800 BC) 𐡓 (Glass 2000: 14) <r> into the Middle Persian (inscriptions, 3rd c. AD) 𐭥 (MacKenzie 1971: xi) <w, r>. More examples for homographs: TR ᛚ <I> (SFG-50) and ᛚ <l¹> (SFG-63); SHR ᚺ <γ> (SFG-21) and ᚺ <r> (SFG-92); SHR ǀ <r> (SFG-96) and ǀ <s> (SFG-101); SHR ᚾ <d> (SFG-29) and ᛏ <i> (SFG-54); SR ᒣ <I> (SFG-50) and ᒣ <p> (SFG-78).
Regularity: Shaping the glyphs in a grapheme or tamga set to get regular series of shapes. E.g., SHR ᚺ <r> (SFG-92), ᚺ <č> (SFG-82) and ᚺ <z> (SFG-102); SHR ᒣ <i>, <j> (SFG-50), (reconstructed) *ᒣ <β> (SFG-16) and ᒣ <p> (SFG-80). More examples are in Table 7-7.
Separation: Modifying a glyph of a symbol to differentiate its multiple sound values in case of graphemes or to differentiate its multiple meanings in case of tamgas. E.g., using an existing (or just created) glyph variant of a letter with different sound value. This process happened when the Latin V <v> was separated into U <u> and V <v>.
Simplification: Simplify or modify a glyph for easier drawing or engraving. E.g., *Nabataean* (late) 𐢁, 𐢀 (Macdonald 2008: 218) <'>; *Arabic* (early) ا, (modern) ا (Macdonald 2008: 218) <'ā> /ā/. A possible example: CBR ᛊ <m>, SR ᛊ, ᛊ <m> (SFG-69) from TR ᛯ <m> (SFG-67).
Stability of the visual identity: As a semiotic symbol evolved, its visual identity (Table 2-6) changed much slower than the topological differences of its new glyph variants. E.g., the glyphs of the SHR Ẋ, Ẋ, ⋇, Ẋ <t'> (SFG-106) differ from each other; however, all of them share the common visual identity: two intersecting diagonal lines supplemented at the top and bottom by short lines of symmetrical position. It is worth noting that in some late, calligraphic SHR inscriptions, its visual identity slightly modified, since the short lines became dots, and even disappeared in some cases; e.g., in the alphabet of Szentpéteri (1699–1702), the glyph variety ϰ was used for <t'> (SFG-106), and consequently, the ϰ <t'> became practically homograph with the ɔc <b> (SFG-15) in the same inscription.
Symmetrization: Shaping the glyphs to reach axially or centrally symmetrical forms. E.g., Ancient Greek (Corinth) ᛒ, ᛝ <ε> (Swiggers 1996b: 264); Greco-Bactrian ß, ᛒ, ß <β> (SFG-14), CBR ᛦ, ᛦ <χ> (SFG-44); Southeastern Iberian ᛋ <u> /u/ (Faria 1992: 45; Ferrer i Jané 2013: 447) vs Northeastern Iberian (dual) ↑ <u> (Ferrer i Jané 2014: 244–245). More examples: Table 7-8.
Unification: After the maturation of a script, alternative letters for the same sound or alternative tamgas for the same meaning dropped out of use. It is the opposite of glyph-variant forming.
Vertical emphasis: During the formal changes, the glyph's main stem tends to be vertical.

Name and description of the principle
Writing technology: Modification of a glyph depending on the current writing methods and materials, among others

Different feature evolution principles prevailed in each script's development depending on the circumstances. For example, the ancient Greeks favoured symmetrical glyphs from the beginning (Jeffery 1961: 35), so the Semitic letters they adopted were modified accordingly, meaning that symmetry is a feature evolution principle. Another example of symmetry pursuit is seen in the Carian (Table 8-8) script relics (Adiego 2007a: 206).

The *characteristic feature transformation*s observed in topological changes during feature evolution were identified (Hosszú 2013a: 24–25; Hosszú 2013b: 9–10; Hosszú 2017: 204). Table 4-3 presents the most common characteristic feature transformations.

Table 4-3: Characteristic feature transformations

Name and description of the transformation
Bending or straightening: One of more straight lines of the glyph became curve or one of more curved lines of the glyph became straight. E.g., Raetic ⍖, ⍖, ⟠ <φ> (Marchesini 2014: 206–207); Carian <, >, C, Ↄ <d> (SFG-25); Northeastern Iberian Ϫ, ⸸ <ge/ke> (SFG-18); Northeastern Iberian ᛍ, ☾ <ge/ke> (SFG-18); South Picene ʘ, ⟐ <q> (SFG-91); Northeastern Iberian ⟐, ⊙ <gu/ku> (SFG-91); Libyco-Berber ○, □ <r> (SFG-95); Etruscan 8, ⊟ <fh> (SFG-47); SR ⧗ <$^{W}q^{W}$> vs CBR 8 <q> (SFG-88). Northeastern Iberian ⩔, ȣ <be> (SFG-14); Safaitic ℓ, ℓ, ℓ, ℓ, ⸾, ⸾ <ṯ>, ASA (Hasaitic) ⸾ <ṯ> (SFG-47); Greek (Corinth) ꞵ, ⧗ <ε> (Swiggers 1996b: 264); Greek (cursive, 6^{th} c. AD) ꞵ, ƀ, ß <β> /b/ (Thompson 1912: 194); TR ⩓, ⌒, ⩓ <t^1> (SFG-48); SHR ⧗, ⧗ <e> (SFG-6).
Connecting: Connecting lines of a glyph to form a topology composed of separate parts. E.g., the development of the Old Canaanite (Serabit el-Khadem, ca. 18^{th} c. BC) ═, ═ (Albright 1948: 6–22); (Timna) ═ (Wimmer 2010: 7; Colless 2010: 78–84) <z/ḏ> to Phoenician (Byblos, 11^{th}–10^{th} c. BC) ⌶ (Cross 1989: 82) <z>.
Changing orthographic rule: Modification of an existing orthographic rule.
Duplication: Duplicating the glyph or a part of it to get a new one. E.g., Runic ᛉ, ᛯ (Mees 2000: 50); (Kylver Stone, ca. 5^{th} c. AD [Looijenga 1997: 113]) ᛣ (Vennemann 2015: 292) <z> /z/; more examples: Table 7-8.
Ligature formation: Developing a new glyph from the ligature of existing glyphs. E.g., SHR (Csíkszentmihály) ᛆᚺ <cá> is the ligature of ᛆ <a> and ᚺ <č>.
Line extension, shortening or shifting: Extending, shortening or shifting of a line of the glyph, including the case of creation a +-shape from a T-shape. Its reason could be modifying the glyph to be more symmetrical, to avoid horizontal lines or to change the direction of the slope of lines, among others. E.g., Lydian ⅃, ꟻ, ᚿ, ∃, ∃, ⋿ <e> (SFG-10, SFG-13); Ancient South Arabian (Sabaic) (early zabur) ⧗, (middle zabur) ⅋ (Macdonald 2015: 39) <z>; Umbrian (Etruscan, first half of 4^{th}–1^{st} c. BC) ≠, ≠ (Hempl 1899: 30); ⸸, ᛋ, ⅂ <z> [t͡s] (SFG-39, SFG-41); Elymian ⍖, ⟠ <φ> (SFG-55).

Name and description of the transformation
Line insertion or deletion: Inserting an auxiliary arm or removing a line of the glyph; sometimes, increasing or decreasing the number of repeating lines or curve. E.g., Phoenician 𐤄, 𐤄, 𐤄, 𐤄, 𐤄 <h> (SFG-13, SFG-10); Old Phrygian 𐌄, 𐌄, 𐌄, 𐌄, 𐌄, 𐌄 <e> (SFG-10); Ancient Greek 𐌄, 𐌄, 𐌄, 𐌄 <e> (SFG-13, SFG-10); Carian 𐊼, ▽ <k> (SFG-61); Southeastern Iberian ᚠ, ᚠ, ᚠ, ᚠ, ᚠ, ᚠ <be> (SFG-80); CBR ᚠ, ᚠ, ᚠ <z> (SFG-41); SR ᚺ, ᚺ, ᚺ <č> (SFG-82); SHR ᚼ, ᚼ <ď> (SFG-39); SHR #, # <z> (SFG-102); CBR ᚠ, ᚠ, ᚠ <z> (SFG-41); Runic (Elder Fuþark, Anglo-Frisian Fuþorc, Younger Fuþark) ᛒ, (Oostum) ᛒ (Looijenga 1997: 73); (Elder Fuþark) ᛒ, ᛒ (Looijenga 1997: 6) <b>; Ancient Greek ◇ <o> (SFG-32), Etruscan ◇, ◇ (PROEL: Alfabeto Etrusco. http://www.proel.org/index.php?pagina=alfabetos/etrusco, retrieved in 2015) <o>, Runic ᛟ <o> (SFG-14); Etruscan (Marsiliana d'Albegna, 7th c. BC) 𐌃, 𐌃, (Veias, Caere, 7th c. BC) D (PROEL: Alfabeto Etrusco. http://www.proel.org/index.php?pagina=alfabetos/etrusco, retrieved in 2015) <d>, Oscan 𐌃 <d> (MNAMON: Oscan, retrieved on 22 February 2018); Oscan (Greek-origin, first half of 4th c. e – first half of 1st c. BC) <r>, Oscan (Latin-origin, mid-2nd c. – first half of 1st c. BC) R <r> (MNAMON: Oscan, retrieved on 22 February 2018).
Loop forming or opening: Connecting two lines so as to form a closed loop or transforming a loop by opening it in one or more points. E.g., Ancient South Arabian (Sabaic) (early zabur) 𐩸, (middle zabur) 𐩸 (Macdonald 2015: 39) <z>; Dadanitic 𐪋, 𐪋 <ḏ> (SFG-102); Northeastern Iberian ᛟ, ᛟ <be> (SFG-14). Another (possible) examples: CBR ▯ <r>, SR ☐ <r¹> (SFG-95) from TR ᚺ <r¹> (SFG-92); TR ᚺ <m> (SFG-67) from TR ≪, ≪ <m>; CBR ᛋ <m>, SR ᛋ, ᛋ <m> (SFG-69) from TR ᚼ <m> (SFG-67).
Mirroring or rotating: Mirroring or rotating the glyph or a part of it, e.g., in forming a ligature. E.g., Phoenician I, I <z> (SFG-39); Libyco-Berber H, I (Farrujia de la Rosa et al. 2010: 33) <z/z₁>; Carian I, H <λ> (SFG-105); Carian Φ, ⊖, ⊘ <ś> (SFG-99); Anatolian Hieroglyphic ◉, ◉ (Payne, A. 2010a: 14, 79) *412 <ru>; Libyco-Berber ⌐, ¬, Γ, ˥, 1, ˥ <g> (SFG-18); Ancient Greek ›, < <γ> (SFG-18); Old Aramaic 𐡁 <b> (SFG-17) vs Ancient Greek 𐌁 <b>; Northeastern Iberian ᛘ, ᛘ <be> (SFG-14).
Ornamenting: A geometrically regular glyph is changed to cursive or ornate. E.g., SHR ☼, ☼, ☼, ☼ <mb>; ¤, ¤, ¤ <mp> (SFG-70).
Outlining: Contour forming (contourization); the outline of the original glyph is used, e.g., Ancient South Arabian (Hasaitic) 𐩴 (Macdonald 2004: 496) <g>, cf. Dadanitic 𐪔, 𐪔, 𐪔 <g> (SFG-20).
Parallel lines forming: Move lines so that they become parallel. Northeastern Iberian (Gallia Narbonensis) ↑, ↑, ᛗ, ᛗ, ᛗ, ᛗ (Hesperia: Narbonensis, http://hesperia.ucm.es/en/presentacion_narbonensis.php, retrieved on 24 June 2016) <u>.
Separating: Modification of a glyph by disjoining one or more lines to make the continuous topology discontinuous. E.g., *Phoenician* (Kilamuwa Stele, Samal, ca. 825 BC) 𐤄 (Röllig 1995: 204–205) *hē* <h>; *Old Aramaic* (8th c. BC) 𐡄 (Gibson 1975) <h>.
Use of known glyph: In borrowing a symbol to an acceptor script, the acceptor script users apply a glyph of the donor script they already know. E.g., the ancestor symbol could be SR ᛘ <A> (SFG-8), the descendant symbol is SR ᛗ <A> (SFG-9), and its glyph could be influenced by the ᛘ, ᛗ, ᛗ <tamga> from the Eurasian tamgas (Table 8-34). Another example is descendant symbol TR O, ⊙, ᴗ, ᴗ, ⊙, ⊙, ¤, ė <nd, nt> (SFG-28), its ancestor could be the Greco-Bactrian O <δ> or the Brāhmī 𑀥 <dha>, and the following Eurasian tamgas surely influenced its glyph variants: O, ⊙, ᴗ, ᴗ, ⊙, ⊖ <tamga> (Table 8-34).

In describing the similarity of features, it is important to determine how to measure the degree of similarity in case of attributes of the semiotic symbols, orthographic rules or layout rules (Table 2-2). Therefore, the *similarity threshold* is defined. Namely, the similarity threshold is the desired minimum similarity of features accepted as similar. Using the similarity threshold belongs to the feature engineering phase of the phenetic modelling. Its value depends on the features' types and attributes (Table 4-4).

Table 4-4: Similarity threshold for different types of features

Type	Similarity threshold
Symbol (in a semiotic sense, Table 2-1)	In the case of the symbols, the following attributes are included in the comparison: glyph shape, glyph style, sound value or meaning (Table 2-3). Two symbols are taken to be similar if their glyphs are similar enough, and their sound values or meanings are identical, or the differences in their sound values are linguistically or (in case of comparing their meanings) historically justifiable. The linguistical or historical justification is out of the scope of scriptinformatics; it belongs to the humanities. Considering that the glyphs may be realised vastly differently in inscriptions due to differing calligraphic requirements and altering writing technologies, the comparison of glyph shapes has significant uncertainty, affecting the phenetic analysis. Therefore, in case of doubts, various—often contradictory—aspects are recorded in the comments of the SFGs (Table 4-6). In comparing the glyph styles, only the most significant similarities can be considered in determining the glyph shape or style transfer between two symbols (Table 2-9: 2-2. § and 2-4. §). A possible example of the glyph shape transfer in the evolution is SR and CBR ↄ <I> (SFG-51). In these scripts, the more common glyphs Γ, ᒣ of the letter <I> already existed (SFG-50), but these scripts adapted the glyph style of Middle Persian ↄ <y> (SFG-51). Another example for the glyph shape or style transfer is the SR ٩, ℘ <I> (SFG-52) that was probably influenced by the Middle Persian (Book Pahlavi) و <y> (SFG-51). A counterexample is the glyph style connection of glyphs, which fashion had spread to a great many scripts (e.g., Aramaic) and therefore has no specificity at all.
Orthographic rule	Two orthographic rules are similar enough if identical, or their differences are linguistically or historically justifiable. Only the most characteristic orthographic rules can be taken into account.
Layout rule	Only the most characteristic layout rules can be considered since the applied layout rules were often fashion subjects.

4.3. Descendant, ancestor and witness scripts

The concept of descendant feature, ancestor feature and witness feature (Hosszú 2017: 185) has been developed for the studied, descendant taxa (scripts). The feature can be a symbol (grapheme or tamga) or an orthographic rule (Table 2-2). The whole feature or only one of its attributes (Table 2-3) is borrowed (Table 2-9). A script would be an *ancestor script* of a *descendant script* if it influenced the descendant script, that is, during the evolution of the descendant script, the ancestor script passed some feature state (presence or absence of a feature) to the descendant script. For a given period, a script is considered as a *witness script* if it is not an ancestor, but in a given time and geographical area, the descendant script or its ancestor script shared a certain feature with the witness script, then their evolution diverged, and the witness script retained its feature. An ancestor of an ancestor script can also be a witness script for our study's purposes. E.g., the Ancient Greek <β> (SFG-17) is a descendant feature, the Phoenician <b> (SFG-17) is the ancestor feature, and the the followings are witness features: Espanca <b^e/p^e> (Ferrer i Jané & Moncunill 2019: 81); Southwestern <b^e/p^e> (Rodríguez Ramos 2000: 30, 45; Correia 2009: 321; Koch 2014); Paleo-Hebrew (6th c. BC) (Schniedewind 2006: 140) <b>; Punic (cursive) (Jensen 1969b: 282) <b> and Old Canaanite (Colless 2010: 96; Colless 2014: 103) <b>. The first four originated from the Phoenician <b>, and the last one is the ancestor of the Phoenician <b>. Therefore, if the Phoenician <b> would have been unknown for the present-day research, these witness graphemes could attest the existence of a common relative to the Ancient Greek <β>.

We cannot rule out that the people called Cimmerians carried the knowledge of writing from Anatolia. If it happened at all, it would have happened around 600 BC. Later, there was further transmission of scripts from Anatolia or Levante to Inner Asia, but in those cases, the identity of the involved scripts is well known: the Imperial Aramaic and from 330 BC, the Greek scripts were carried to Inner Asia from the Mediterranean region. It is worth noting that the Anatolian origin depends on the very weak Cimmerian hypothesis, and the gap between the presence of the Cimmerians in Anatolia (7th c. BC) and the date of the earliest Rovash inscriptions is higher than one millennium. Table 4-5 presents some consequences about the possible ancestor and witness scripts of the examined descendants, in our case, Rovash scripts.

Table 4-5: Prerequisites related to witness scripts of examined descendant scripts

4-1. § Except *Cypro-Greek* script, other Aegean scripts should not be considered possible ancestor scripts, as the use of *Cretan Hieroglyphic* (Table 8-3), *Linear A, Linear B and Cypro-Minoan* cannot be detected after the 11th c. BC, which is much earlier than the period under study; namely the 7th c. – beginning of 6th c. BC, Cimmerians' presence in Asia Minor [Table 3-2: 3-1 §] and a few centuries before. The Cypro-Greek script was in use in the 11th–2nd c. BC, and according to Lehmann, in 12th–11th c. BC Syria and Cilicia were influenced by the Aegean culture, partly through Aegean settlers on the coast. Furthermore, at the end of the Bronze Age, the trading relationship between Syria, Libanon, Cyprus, Cilicia and Aegeicum continued (Lehmann 2013: 265, 325, 328). According to Yakubovich, the early Iron Age Cilician elite was of Aegean descent, and the Greeks were present at this time in Cilicia (Yakubovich 2015b: 35–36, 38, 40–41). Although there is no evidence in the literature that Cypro-Greek script in the area of Phrygia or Cilicia around the 7th c. BC had a detectable effect on the other scripts, Cypro-Greek script may still be an ancestor-candidate. It should be noted that some Cypro-Greek graphemes are strikingly similar to certain Rovash graphemes.
4-2. § According to the literature, the use of *Anatolian Hieroglyphic* (Table 8-5) script ceased around 700 BC. Thus, during the Cimmerians' stay in Asia Minor (Table 3-2 and Table 3-3), this script may have affected the scripts—presumably—taken over by the Cimmerians. Therefore, the Anatolian Hieroglyphic script can be considered an ancestor-candidate script.
4-3 § *Old Canaanite* (Table 8-4), *Paleo-Hebrew* (Table 8-6) and *Punic* scripts should be considered witness scripts. The Old Canaanite is a witness script since its using period is much earlier than

the period of Cimmerians' presence (7th c. – the beginning of 6th c. BC) in Anatolia and the few centuries preceding it. The Paleo-Hebrew script was used in Israel's territory, and there are no data on its possible appearance in Asia Minor. Finally, after the period under study, Punic script developed geographically very far away, in North Africa. *Phoenician* (Table 8-6) and *Old Aramaic* scripts can generally be ancestor-candidate scripts. However, in case an examined descendant script is compared to an Anatolian-Greek Alphabetic (Table 8-8) or Greek Alphabetic (Table 8-13) script, as to an ancestor-candidate script, then, Phoenician and Old Aramaic letters can be witness graphemes, since Phoenician and Old Aramaic scripts are presumably the direct or indirect ancestors of Anatolian-Greek Alphabetic and Greek Alphabetic scripts.
4-4 § *South Semitic* (Table 8-7), *Libyco-Berber* (Table 8-9), *Paleo-Hispanic* (Table 8-10) and *Italic* (Table 8-11) script families can be handled as only witness scripts. Its reason is that they come from South Anatolia – Levante region, and they were established around 9th–7th c. BC through Phoenician, Aramaic, South Anatolian and later Greek traders. Although *Runic* script (Table 8-17) evolved much further away, it also indirectly originates from this region through its possible ancestors. Therefore, these script families' members are witness scripts concerning *Anatolian-Greek Alphabetic* graphemes (Table 8-8) in 7th c. BC. They could preserve features that later disappeared in the Levante and Anatolia, where Aramaic and later Greek scripts became dominant.
4-5. § There is no evidence to suggest that *Lemnian* (Table 8-8) script used west of Asia Minor on the island of Lemnos, could have an impact on the interior of Asia Minor until the Cimmerians were expelled from Asia Minor (end of 7th c. – beginning of 6th c. BC), so the Lemnian script can be witness, only.
4-6 § *Carian* script was used in a limited territory in Southwest Anatolia. Carian relics were uncovered from this region from Egypt, where Carian mercenaries lived, in the bordering regions of Lydia and Lycia as well as in Greece (Adiego 2007a: 17–18). However, in Sardis, the Lydian capital, Carian script and language are attested (Adiego 2007a: 29; Payne, A. 2016). The Carian script could affect Cimmerians in Phrygia; however, its chance is very small. Consequently, the Carian script can be handled as an ancestor-candidate for the possible knowledge of any writing system of the Cimmerians.
4-7 § Known relics of the *Lycian* script (Table 8-8) dated from the 5th–4th c. BC, and the inscriptions of *Sidetic* script dated from the 5th–2nd c. BC. These are at least a century later than the Cimmerians' disappearance from Asia Minor (end of 7th c. – beginning of 6th c. BC). Thus, only the ancestors of Lycian and Sidetic scripts might have been sources of a script that might reach the Cimmerians, so Lycian and Sidetic scripts can be considered only possible witness scripts for the presumed writing knowledge of the Cimmerians.
4-8. § The relationship between the *Imperial Aramaic* (Table 8-12) and any Rovash script was generally only possible in Inner Asia (definition of study areas in Table 3-3) due to the chronology of the presence of Cimmerians in Asia Minor. The possible role of Achaemenid Empire using the Imperial Aramaic script is analysed in Table 3-2.
4-9. § *Hebrew* (Table 8-12) script did not exist in the 6th c. BC, so it could not influence the putative writing knowledge of the Cimmerians in Asia Minor (Table 3-2 and Table 3-3). If symbol transfer (Table 2-9: 2-1. §) or glyph shape transfer (Table 2-9: 2-2. §) from Hebrew took place, it was only possible in the Pontus Steppe, in connection with Steppe Rovash used in the Khazar Khaganate.
4-10. § *Hatran* (Table 8-12)*, Palmyrene, Nabataean* and *Elymaic* could be considered witness scripts as they were only locally used. *Armazian* (Table 8-12) script was also used in a narrow area, but it had previously been suggested that the Steppes' peoples had come into contact with it, and thus possibly one of the ancestors of Turkic Rovash (Róna-Tas 1987: 11). Therefore, Armazian script can be considered an ancestor-candidate.

4-11. § *Syriac* (Table 8-12) can be considered an ancestor-candidate script, since before 3rd c. AD the Manicheans used likely the Estrangela variant of Syriac script in Iran and Inner Asia for recording various languages (Skjærvø 2006: 530–533; Skjærvø 2006–2012).
4-12. § *Tibetan* script (Table 8-15) was developed in the mid-7th c. AD and the earliest Rovash inscriptions are from the 7th–8th c. AD. The time slot is small between them; however, the Tibetan can be handled as an ancestor-candidate script.
4-13. § The graphemes of Rovash scripts can be ancestors of each other, the lineage of Rovash scripts has not been clarified. Therefore, if one of the Rovash features is considered an ancestor feature, it only means that the given feature is a suitable ancestor feature, but it is unknown whether it is certainly the ancestor of the studied Rovash feature or whether there is a common ancestor feature of them.

4.4. Similarity Feature Groups (SFGs)

In processing the features in each taxon—called feature engineering—*Similarity Feature Group*s (SFGs) were created for each examined feature. Note that the phenetic analysis does not explore the lineage of features in different taxa, only their similarities. The main sections of SFGs are listed in Table 4-6.

Table 4-6: Main sections of SFGs

Components in an SFG: descendant feature, ancestor feature and witness feature (Table 4-7).
Model parameters in an SFG: changed script, the region of relics, source script family, the period of change, the region of change, glyph fits only with tamgas (Table 4-8).
Comments in an SFG (optional, see below).

The first main section of an SFG lists the components of an SFG, that is, classification of scripts by script family in which the feature that belongs to the given SFG can be found (Table 4-7).

Table 4-7: Components of SFGs

Descendant feature a feature of a descendant script (in the present research, a Rovash script) in a certain SFG. If a feature (Table 2-2) is a grapheme and multiple descendant graphemes can correspond to each other based on their glyphs and sound values, then all of these graphemes are descendant features in the same SFG.
Ancestor feature is the ancestor of the descendant feature according to an Origin Model (OM) in a certain SFG. The descendant features can be ancestor features in another SFG, see Table 4-5: 4-13. §.
Witness feature is an optional feature of an ancestor script or witness script (see Table 4-5), which is not a direct ancestor of the descendant feature, but shares some of its properties with the descendant feature, and this coincidence is not accidental, but of evolutionary origin, i.e. their similarity is not homoplasy (Table 2-7). The witness feature can be *remote ancestor* (not a parent) or *collateral*

relative. E.g., some letters of the Ancient Greek script preserved as witness features of the glyphs of Phoenician script from a certain period. Thus, Ancient Greek script is the witness script of the Phoenician script for that period. However, the Phoenician script is probably one of the ancestor scripts of Ancient Greek script (cf. Table 8-8).

In each SFG, the different, most often mutually exclusive, evolutionary relationship options are *OM1, OM2,* etc. Of these, there are at most $N_O = 5$ in an SFG in the current research. The witness features supporting each OM are listed at the end of that OM. The role of witness features in OMs is important because if more witness features that are similar to the descendant features are included in addition to the ancestor features in an OM, it can increase the reliability of the given OM. Two OMs may have the same ancestor feature, but the putative evolutionary relationships of the ancestor feature are different, and the existence of two OMs expresses this. OMs listed in SFGs are usually listed by order of the beginning of the most probable period of the investigated feature development, rather than by the degree of probability of their validity.

Besides OMs, in several SFGs, there is a possibility for glyph shape (Table 2-9: 2-2. §) or style transfer (Table 2-9: 2-4. §) from tamgas used extensively in the Eurasian Steppe (Table 8-34). This possibility is expressed by $OM+$, which is an optional addition to one or more OMs in a given SFG. The tamgas had no (known) sound value. Therefore, it is uncertain if a tamga affected a grapheme (cf. Table 4-10). The similarity between a descendant glyph and a glyph of a tamga can be the reason of glyph shape or style transfer or a mere coincidence. If the similarity of the glyph of the descendant grapheme to the possible ancestor graphemes is limited, and there was a tamga whose glyph shape or glyph style is almost identical to the glyph shape or style of the descendant grapheme, it is possible that a glyph shape or style can be borrowed from the tamga; this is expressed by the model parameter "glyph fits only with tamgas" in Table 4-8. When the nomadic users of the examined descendant scripts borrowed a new grapheme, they might have used an already known glyph shape or glyph style of a tamga similar to the original shape or style of the borrowing grapheme. This process is a realization of the feature evolution principles referred as "borrowing" or "external influence" (Table 4-2) with the characteristic feature transformation referred as "use of known glyph" (Table 4-3). One reason for this could be that the donor script had different writing technology than the receiving script (e.g., ink and parchment vs carving to wood). Another reason could be that nomadic users might prefer known glyphs of tamgas with high prestige than unknown glyphs of newly borrowing graphemes. It is worth noting that borrowing glyph shapes or styles from tamgas needs more clarification.

Interestingly, the opposite process; namely, the influence of the Rovash scripts on the tamgas could also have happened, as presumed by Tabaldyev, who claimed that some TR graphemes—e.g., TR 𐰼 <r^2> and 𐰋 <b^2>—were used as clan tamga in the Kochkor Valley, in the Issyk-Kul Lake area and the Talas Valley (Tabaldyev 2019: 367, 372–373).

The second main section of an SFG is the *Evaluation,* which can be used for further numerical analysis with the following *model parameters* of the descendant features in a given SFG (Table 4-8). If multiple OMs in an SFG, the model parameters are multiplied accordingly.

Table 4-8: Model parameters in SFGs

Changed script contains all scripts, one of the features of which is listed among the descendant features of the given SFG.
Region of relics contains the regions, where the descendant features that belong to each actual changed descendant script survived. It is worth noting that all surviving Székely-Hungarian Rovash (Table 8-30) inscriptions usually originated from Hungarians, who generally lived in the Carpathian Basin; therefore, in case of the Székely-Hungarian Rovash, the value of this parameter is always the "Carpathian Basin" regardless of where a certain relic was found (cf. Constantinople inscription or Nikolsburg Alphabet, Table 8-30).
Source script family contains all script families, which may be the direct ancestors of the descendant features in the given SFG.
Period of change contains the estimated period of borrowing features (Table 2-2) or the appearance of features created by internal development. This rough approximate period is calculated using periods of the scripts or script variants containing ancestor features in each OM. Suppose the period of use of the probable ancestor feature can be determined more precisely based on the feature examples listed in the first part of the given SFG. In that case, this precise period is used for the model parameter period of change.
Region of change contains the possible geographical areas of the evolutionary step (adaptation or internal development) described in the given SFG. The possible geographical areas are Anatolia, Inner Asia, Pontus Steppe or Carpathian Basin (details: Table 3-3).
Glyph fit only with tamgas indicates whether, in addition to the ancestor graphemes in an OM, it was necessary to borrow the glyphs of the descendant graphemes from tamgas that is described in the OM+ option in a given SFG. Thus, its value is 1 if all three conditions are met: (i) the descendant feature (Table 2-2) is a grapheme or a group of graphemes (not an orthographic rule), (ii) there are tamgas similar to glyphs of descendant graphemes and (iii) in a certain OM, some listed tamgas are more similar to the descendant glyphs than the ancestor glyphs. Note that this is only a probability. The value of 1 for this model parameter means that the descendant glyphs are probably derived from tamgas, but it usually does not mean perfect certainty.

In case of glyph shape transfer (2-2. §), orthographic rule transfer (Table 2-9: 2-3. §) and glyph style transfer (Table 2-9: 2-4. §), there could be a kind of reticulate evolution, since the resulting descendant feature frequently originates from an ancestor feature of another script (borrowing or external influence), and also originates from an internal ancestor, e.g., SFG-2, SFG-35, SFG-36, SFG-37, SFG-38, SFG-52 and SFG-73. In these cases, another script's ancestor feature is considered more significant, and that is included in the numerical calculation. E.g., in SFG-2, the medieval Latin orthographic rule and the descendant grapheme of SFG-1 together are the ancestors of the descendant feature in SFG-2. In numerical calculation, only the medieval Latin orthographic rule is included as the only ancestor.

The third main section of each SFG is the optional *comments,* in which the knowledge and conclusions related to the certain SFG are listed, including the theoretically possible, but unlikely evolutionary relationships as well. It should be noted that with the development of various disciplines (such as palaeography and archaeology) and the discovery of additional script relics, the literature is constantly expanding, which may lead to a refinement of the present phenetic model and even a re-evaluation of previously discarded lineage options.

4.5. Simple phenetic model of taxa

A *simple phenetic model of taxa* containing 66 taxa (scripts) and 186 examined features has been published (Hosszú 2017: 200–222). In this model, each feature with the information about its presence or absence in each taxon is collected into Similarity Feature Groups (SFGs). Based on this model, the presence or absence of their features (Table 2-2) an $N_T \times N_F$ sized two-dimensional (2D) binary taxon–feature data matrix X can be created, where the rows represent the examined taxa (N_T) and the columns mean the examined features (N_F) (Hosszú 2017: 200–201). In the feature engineering phase, paleographic data are transformed into this taxon–feature data matrix X. In doing so, a decision should be made on the presence or absence of each feature in each script, while avoiding homoplasies as much as possible (Table 2-7). The obtained model includes all studied taxa (scripts), and there is no difference between the descendant, ancestor or witness scripts.

In the simple phenetic model of taxa, each SFG was created by evolutionary consideration of the actual features included in the comments of the actual SFG. However, only one of the possible evolutionary possibilities had to be selected in a certain SFG to decide whether each taxon contains the actual feature or not. This deterministic approach increased the number of random coincidences since in many cases, it was not possible to determine whether the presence of a feature in two taxa was due to a common evolutionary origin or only a coincidence (homoplasy, Table 2-7). In the latter case, this feature should have been two distinct features. If they were included into one SFG as one feature, a homoplasy occurred.

4.6. Extended phenetic model of taxa

An economical way to avoid the problem of homoplasies is to exclude all the elementary geometrical figures with low value of Glyph Complexity Parameter (GCP) (Table 8-2), except for those cases where the glyph and value of the grapheme are the same in different scripts. However, homoplasies also occurred in case of more characteristic glyphs; e.g., Norteastern Iberian ᛟ <ba> (SFG-14) vs CBR ᛟ <b>; Norteastern Iberian ᚴ <ki/gi> (SFG-58) vs SHR ᚴ <k> vs Runic ᚴ <k>; Southeastern Iberian ⧖ <kᵒ> (SFG-88) vs SR ⧖ <^{W}q^{W}>; Punic 𐤒 <q> (SFG-88) vs CBR, SR 8 <q>; Libyco-Berber □ <r> (SFG-95) vs CBR ▯ <r>; SR □ <r^{1}> and Northeastern Iberian ᚷ, ✖, ⚹ <da/ta> (SFG-106) vs SHR ᚷ, ⚹, ᚷ <t’>.

In order to solve the problem of homoplasies, in case of each feature, all reasonably evolutionary considerations (geographic, historical, linguistic and palaeographic data) are included in the course of feature engineering by the introduction of Origin Models (OM), and in such a way, the *extended phenetic model of taxa* (P_E) is created. An OM describes the emergence of a particular feature in each script, referring to the underlying evolutionary considerations. In one SFG, multiple OMs can be included, and in each OM, the set of taxa (scripts) being a candidate to be ancestor is usually different. It should be emphasized that the evolutionary concept in a certain OM applies only to the given feature, and does not extend to other features in other SFGs. These evolutionary considerations are presented in the comments following each feature's descriptions in the actual SFG. In several SFGs, there is only one OM; however, more alternatives are included in the majority of SFGs. In the feature engineering phase, it is not possible to decide which OM describes the feature evolutionary step that has taken place in the past. The very unlikely evolutionary considerations do not form OMs, they are described at the most in the comments of the current SFG. By using OMs, the taxa had to be differentiated into descendant, ancestor and witness scripts, and the constructed extended phenetic model is a complete phenetic description of only the descendant taxa (scripts).

The descendant taxa are excluded from the ancestor taxa set; however, many descendant features are present in the model as ancestor features of other descendant features due to the internal developments. A taxon is a witness taxon if it is not a descendant or an ancestor, and there is at least one SFG, where the feature of the actual SFG appears in this taxon. The witness taxon is not included in the phenetic analysis; its role is to support an OM's validity in an SFG.

During the construction of the extended phenetic model of taxa P_E, to minimize the chance of homoplasies, each SFG, where the possibility of the homoplasy appeared were split into more SFGs. Therefore, each SFG includes only those occurrences of a feature, where surely the same feature appeared in different descendant and ancestor taxa.

The extended phenetic model of taxa P_E can be described with an $N_T \times N_F \times N_O$ sized three-dimensional (3D) binary taxon–feature–OM data matrix X_E, where N_O is the maximum number of OMs per SFG in P_E. In the present research the number of taxa $N_T = 31$, the number of features $N_F = 119$ and the maximum number of OMs is $N_O = 5$. The set of taxa includes the descendant scripts ($N_T^d = 4$), the ancestor scripts ($N_T^a = 26$) and an additional taxon, which represents all descendant scripts together, and this is the ancestor if a feature in an SFG is a result of internal development, where the ancestor is any of the descendant taxa. It should be noted that a taxon is called ancestor taxon, if it is not a descendant taxon, and at least one of its features is in at least one SFG as an ancestor feature.

Based on the above, the extended phenetic model of taxa P_E contains evolutionary information below the phenetic information of the descendant taxa. The developed data-driven evaluation algorithm (successive elimination, Figure 4-1) of the extended phenetic model of taxa P_E results phenogram, script spectra and group spectra, where the phenogram is the result of the traditional phenetic analysis, while the script spectra and group spectra result from the evolutionary analysis, and these include information about the origin of the descendant scripts. The algorithm is data-driven because each subsequent step is determined by the data structure, not occasional decisions.

The script spectrum of a descendant script is the number of features (SFGs) which contains only one, unique ancestor script (Hosszú 2019: 374). The group spectrum of a descendant script is the number of features (SFGs) which contains only one, unique ancestor script group. In order to generate script spectrum or group spectrum the extended phenetic model of taxa P_E has to be filtered to get unambiguous so-called filtered phenetic models of taxa, see below.

All features of the descendant taxa have been included in the extended phenetic model of taxa, whereas only those features of the ancestor taxa are in the model, which match the appropriate features of the studied, descendant taxa. Thus—opposite to the simple phenetic model of taxa—the P_e is comprehensive only for the $N_T^d = 4$ examined descendant taxa.

4.7. *Filtered phenetic model of taxa*

The extended phenetic model of taxa P_E is ambiguous for the ancestor taxa. One reason for this is that those SFGs have multiple alternative OMs that describe different evolutionary backgrounds and that OMs in the same SFG usually contain ancestor features belonging to different ancestor taxa. From the N_F=119 different SFGs in the current P_e there are 50 SFGs with one OM per SFG, 40 with two OMs, 16 with three OMs, 11 with four OMs and 2 with five OMs. Thus the number of combinations of OMs from P_e is $1^{51} \times 2^{39} \times 3^{17} \times 4^{10} \times 5^2 \approx 4.96 \times 10^{27}$. Another reason for the diversity of ancestor taxa in some SFGs is that even a unique OM often results in more than one possible ancestor feature belonging to different ancestor taxa (Hosszú 2019: 182). Namely—e.g., in case of graphemes—some graphemes in different scripts can be very similar; therefore, based on the shapes and sound properties, it is often impossible to decide which ancestor script a descendant grapheme comes from.

The extended phenetic model of taxa contains important information about the descendant taxa's evolution. Therefore, its evaluation aims to get unambiguous evolutionary information about the relationship between the descendant and ancestor taxa. It includes the determination of the real ancestor scripts because the $N_T^a = 26$ ancestor scripts in the extended phenetic model of taxa are only candidates for being ancestors.

From the extended phenetic model of taxa, various *taxa's filtered phenetic models* can be extracted by omitting a part of the feature taxa and taking only the unambiguous SFGs into the calculation. In such a way, a less ambiguous or even unambiguous phenetic model can be obtained for the descendant and ancestor taxa. Naturally—as it was earlier noted—the extended phenetic model of taxa does not contain enough information about the phyletic relationships between the ancestor taxa; thus the possible reachable goal is to get phyletic information about the relation of the descendant scripts to the ancestor scripts.

It is worth noting that the ancestor (in fact ancestor-candidate) features in an OM are often so similar to each other, that it is practically impossible to decide which is the real ancestor. Another problem is that it is unsure whether a descendant feature had only one ancestor; a descendant feature may result from a kind of horizontal transference (Table 2-9).

4.8. *Reconfigured filtered phenetic model of taxa*

Based on a phenetic model, it is possible to reconfigure the ancestor scripts' groups' structure. A group spectra of the phenetic model with higher resolution can be obtained in such a way. *Resolution* can be defined as the number of SFGs in a phenetic model (cf. Table 6-4).

4.9. Reduced filtered phenetic model of taxa

The extended phenetic model of taxa P_E contains information about the possible ancestor of each feature of the descendant taxa. If the probable period of the impact of each ancestor script can be estimated, it is possible to create a phenetic model of taxa for a certain age. It can be obtained by removing those SFGs from a phenetic model of taxa, which are related to a certain group of ancestor taxa. E.g., if a descendant taxon was influenced at two different ages, and the ancestors can be classified into two groups depending on when they affected the descendant taxon, those SFGs can be removed from the phenetic model, which are related to those ancestors affected at a certain age. This kind of phenetic model is called the *reduced filtered phenetic model of taxa,* which contains all descendant taxa features, which existed at a certain age.

4.10. Simple phenetic model of descendant taxa

The extended and the various kinds of filtered phenetic models of taxa cannot be evaluated in a usual phenetic analysis, since 2D taxon-feature matrices cannot describe them. Therefore, the *simple phenetic model of descendant taxa* should be constructed from the first $N_T^d = 4$ rows of the matrix of a phenetic model of taxa. The number of columns in the 2D taxon-feature matrix of the simple phenetic model of descendant taxa equals to that of the 3D taxon-feature-OM matrix of a phenetic model of taxa.

The simple phenetic model of descendant taxa has the advantage that it can be evaluated by the usual phenetic analysis methods to obtain a phenogram (e.g., Figure 6-1). Its disadvantage is that it has no information about its relationship with descendant and ancestor taxa.

Theoretically, the simple phenetic models of descendant taxa generated from the extended and the filtered phenetic models of taxa are equivalent, except if in the filtered phenetic model of taxa there are fewer SFGs than in the extended phenetic model of taxa. This situation can occur if some SFGs are removed due to its unlikely OMs or some related ancestor-candidate taxa are merged due to the identical ancestor in the filtered phenetic model. In the present research, the latter case (merging SFGs) is not applied.

4.11. Successive elimination for phenetic analysis

Comparing the different kinds of phenetic models is described in Table 4-9.

Table 4-9: Comparing the types of the various phenetic models

4-14. § The *simple phenetic model of taxa* is the phenetic comparison of taxa (scripts) without differentiation between the descendant and ancestor taxa based on the most probable features by creating Similarity Feature Groups (SFGs). Its advantage is using the most probable features (SFGs); its weakness is the vulnerability to homoplasies. It can be described in a 2D binary taxon–feature data matrix; thus it can be evaluated by the usual phenetic analysis methods, e.g., cluster analysis to obtain a phenogram (Hosszú 2017: 224–227).
4-15. § The *extended phenetic model of taxa* P_E is the phenetic comparison of so-called descendant and ancestor scripts. The selection of the features depends on evolutionary considerations. Its advantage is handling the possibility of homoplasies; its weakness is its ambiguity (for one feature there are multiple possible ancestor features). It can be described in a 3D binary taxon–feature–OM data matrix.
4-16. § The *filtered phenetic models of taxa* (another name: *simplified phenetic model* [Hosszú 2019: 370–392; Hosszú 2020: 53–70; Hosszú 2021]) are derivations of the extended phenetic model by selecting different subsets of the features and ancestor scripts, by applying various assumptions. Their advantage is that they are less ambiguous than the extended phenetic model of taxa or even unambiguous. Their weakness is that they are based on different subsets of the possible SFGs, which limit their accuracy. However, they avoid the errors that would result from an incorrect selection of alternative OMs in each SFG. In other words, the uncertainty arising from multiple evolutionary alternatives in SFGs is eliminated at the cost of eliminating the less probable lineage options.
4-17. § The *reconfigured filtered phenetic model of taxa* is a special filtered phenetic model with modified groups of ancestor scripts in order to maximize the resolution of the phenetic model (cf. Table 6-4).
4-18. § The *reduced filtered phenetic model of taxa* is generated by removing those SFGs from a phenetic model of taxa that are related to a certain group of ancestor taxa.
4-19. § The *simple phenetic model of descendant taxa* is a subset of the extended or one of the various filtered phenetic models of taxa; it includes only descendant taxa.

The flow chart of the developed data-driven evaluation is presented in Figure 4-1.

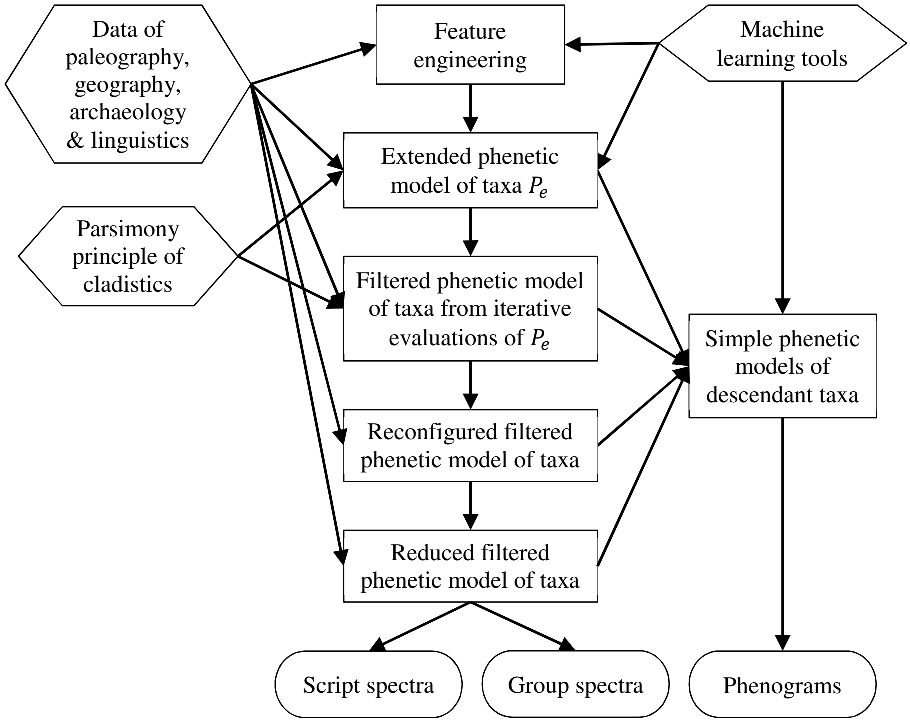


Figure 4-1: The flow of the successive elimination for phenetic and evolutionary analyses

4.12. Methodological limits

A source of uncertainty is the occasional discrepancy between the drawing of script relics by paleographers or archaeologists. Different authors may redraw the glyph used in the same script relic with a greater or lesser variation. Whenever possible, glyphs used in the phenetic analysis come from multiple authors so that individual copy errors can be filtered out to some extent.

Script relics that are described as Phoenician by some literature sources may belong to other Canaanite scripts (Table 8-6) according to other literature sources. This uncertainty is not a problem for our study.

Another problem is the theoretical limit of the phenetic model. E.g., according to Vennemann, the first variant of Runic script (Table 8-17) may indeed have been modelled after the Carthaginian variant of the Punic script (Table 8-6) about 300 BC by applying the principles of semantic and phonetic acrophony, and the Runic script is a hybrid of Punic and Italic (Table 8-11) scripts (Vennemann 2015: 318–330), cf. Table 2-10: 2-5. §. Consequently, in similar cases, the formation of an SFG based on the common phonetic value could lead to an incorrect result.

Regarding the descendant scripts examined in the present research, the accuracy of the phenetic model to be constructed is impaired by specific factors, which can be considered as unwanted modelling disturbances, see Table 4-10.

Table 4-10: Modelling disturbances affecting the phenetic model

The descendant scripts studied (TR, SHR, CBR and SR, Table 8-19) had been used for centuries, while historical events have allowed their users to mix. Therefore, various reticulate evolution types (Table 2-9) could easily occur between them; cf. Table 7-4.
Each descendant script is known to vary degrees; for CBR and SR, this study is based on very few deciphered inscriptions (Table 8-31 and Table 8-32).
The descendant scripts probably lost some symbols during the evolution, whose existence is no longer known. E.g., the following SHR symbols (graphemes) were certainly used in an era, but later they became unknown and are now known only from a manuscript found in the 20th c., the Nikolsburg Alphabet (AD 1490–1526): Ӿ <nd> (SFG-30), ⵅ <nk> (SFG-60); 亍 *tprus* (SFG-81), ↕ <nc> (SFG-86), Ӿ <χ> (SFG-90) and 𐲍 <š> (SFG-99).
When a grapheme was borrowed, it could happen that the sound value of the derived grapheme may have been taken from the donor script, but the glyph shape of the borrowed grapheme could be modified under the influence of a tamga (Table 8-34). In this way, the real origin is obscured. Cf. feature transformation referred to as "use of known glyph" (Table 4-3). Using the glyphs of tamgas could be that the purpose of the users of the descendant scripts may have intended to borrow graphemes from a donor script, but their writing technology or tamga-based visual culture influenced the shapes of the adopted graphemes and may have chosen one of the known tamga shapes that resemble the original glyph of the borrowed grapheme. This phenomenon makes it difficult to trace the origin of the descendant graphemes.

Considering the last item in Table 4-10, this could be the most important theoretical limitation. In some cases, the impact of tamgas is very likely, as there are tamgas whose glyphs are virtually identical to glyphs of the descendant graphemes, e.g., SFG-15, SFG-23, SFG-26, SFG-27, SFG-28, SFG-44, SFG-45, SFG-94, SFG-95, SFG-100 and SFG-105. In especially problematic cases, all ancestor-candidate graphemes (from which the sound values originated) differ significantly from the descendant graphemes, e.g., SFG-22, SFG-26, SFG-40, SFG-66, SFG-67, SFG-95, SFG-101, SFG-105 and SFG-106.

5. The extended phenetic model

In the following, Similarity Feature Groups (SFGs) that form the phenetic model extended by evolutionary considerations are described in detail. Some examples of ligatures found in Rovash inscriptions are also presented.

SFG-1

Descendant feature (grapheme):

SHR (Székelydálya, around 1400) 𐲀; (Nikolsburg, 1490–1526) 𐲀 *a* /ɔ/; (Gelence, 1497) 𐲀 /ɔ, ā/; (Bágy, 15th c.) 𐲀 /ɔ, ā/; (Homoródkarácsonyfalva wall inscription, 1625) 𐲀 /ɔ, ā/; (Gyulafehérvár, 1655) 𐲀; (Marsigli's Alphabet, 1690) 𐲀 *a* /ɔ, ā/; (Szentpéteri, 1699–1702) 𐲀 *a;* (Patakfalvi, 1776–1785) 𐲀 /ɔ/ <a>.

SHR (Bodrog-Alsóbű, around 900 or first half of 10th c.) 𐲀 /βnȧ/ <βna>;

OM1 (SFG-1):

Anatolian-Greek Alphabetic ancestor feature (grapheme):

Ancient Greek (Ipsambul [Abu Simbel, Egypt], 7th c. – the beginning of 6th c. BC, LTR writing direction) Α, Α, Α, Α, Α (Taylor 1883, vol. II: 9–15); (not later than 5th c. BC) Α (Jeffery 1961: 23) *alpha* <α>;

Lydian (Alyattes' coins, RTL writing direction) 𐤠 (Six 1890: 202–215); 𐤠 (Littmann 1916: 1; Melchert 2008b: 57) <a> /a/;

Carian 𐊠 <a> /a/;

Canaanite witness feature (grapheme): *Phoenician* (Nora inscription, Sardinia, ca. 900 BC) 𐤀, (Tell Faḫariyeh [Tell-Fekheriye], 9th c. BC) 𐤀 (Lipiński 1994: 27); (Kilamuwa Stele, Samal, ca. 825 BC) 𐤀, (Cyprus, ca. 880 BC) 𐤀, (Limassol, ca. 750 BC) 𐤀, 𐤀 (Röllig 1995: 204–205); (Karatepe, ca. 700 BC) 𐤀; 𐤀, 𐤀, 𐤀 (Faulmann 1880: 78) *'ālep̄* <'> /ʔ/; *Old Aramaic* (8th c. BC) 𐤀; (Deir 'Allā, around 800 BC) 𐤀 (Glass 2000: 14); (8th–7th c. BC) 𐤀, (7th c. BC) 𐤀 (Gibson 1975) (monumental) 𐤀 (Faulmann 1880: 79); (Nineveh, 7th c. BC) 𐡀 (Taylor 1883, vol. I: 250) *'ālap̄* <'> /ʔ, ā/ (Segert 1997: 118);

Anatolian-Greek Alphabetic witness feature (grapheme): *Lycian* 𐊀, (TL 5) 𐊀, (TL 33) 𐊀 (Kalinka 1901 apud Adiego 2015: 20–21) <a> /a/ (Adiego 2007c: 764; Adiego 2007e: 8; Melchert 2008a: 48);

Paleo-Hispanic witness feature (grapheme): *Southeastern Iberian* 𐌀 (Faria 1992: 45); (Abengibre G.16) 𐌀, 𐌀, 𐌀 (Rodríguez Ramos 2002: 235) <a>; *Northeastern Iberian* P, ᑫ, ᐅ, ᐁ, D (Hesperia: Narbonensis, retrieved on 24 June 2016) <a> (Ferrer i Jané 2014: 244–245); (Gallia Narbonensis) P, P, ᐅ, ᐁ, D (Hesperia: Narbonensis, retrieved on 24 June 2016) <a>; *Celtiberian* (Botorrita) ᐅ (Eska 2008: 166–167), (eastern) P, ᐅ (Cólera 2007: 821), (western) P <a> /a/;

Italic witness feature (grapheme): *Gallo-Greek* (pottery) 𐌀 <a>.

OM2 (SFG-1):

Greek Alphabetic ancestor feature (grapheme):

Greek (uncial, Codex Bezae, Greek text, 5th c. AD) Α (Parker 1992); (medieval uncial) Α, Α, Α, α (Faulmann 1880: 171) *alpha* <α> /a/;

Greek Alphabetic witness feature (grapheme): *Greek* (P46, not later than AD 81) α, α, α

(Kim 1988: 248–257); (medieval cursive) λ, ϑ, α, +, ∂ (Faulmann 1880: 171) *alpha* <α> /a/;

Slavic witness feature (grapheme): *Early Cyrillic* (birchbark [Грамота №109], Novgorod, ca. 1100–1120) А (Рукописные Памятники Древней Руси, http://gramoty.ru/birchbark/document/show/novgorod/109/, retrieved in 2018) *azŭ* <a> /a/.

Evaluation (SFG-1):
Changed script: SHR.
Region of relics: SHR: Carpathian Basin.
Source script family:
OM1: Anatolian-Greek Alphabetic.
OM2: Greek Alphabetic.
Period of change:
OM1: 9th–2nd c. BC, the union of the using periods of Ancient Greek, Lydian and Carian scripts (Table 8-8).
OM2: 1st c. BC – around 900, its lower limit is the age of the earliest relics of the Greek uncial script (Table 8-13), the upper limit is the age of the earliest inscription containing the studied descendant grapheme (Bodrog-Alsóbű, around 900 or first half of 10th c.).
Region of change: OM1: Anatolia. OM2: Pontus Steppe or Carpathian Basin.
Glyph fit only with tamgas: OM1: 0. OM2: 0.

Comments (SFG-1):

(i) According to Sebestyén, SHR 𐲀 <a> is identical to the corresponding glyphs of some Mediterranean scripts, e.g., Pelasgian alphabet (Sebestyén 1906: 272–273). It is worth noting that the Pelasgian was understood as a population before the Ancient Greeks. Sebestyén also tied the Lemnian script to the Pelasgians (Sebestyén 1903a: 22–23).

(ii) Considering OM1, based on the practically identical sound values, the ancestor of SHR 𐲀 <a> must have been the appropriate grapheme of one of the Anatolian-Greek Alphabetic scripts, probably the Ancient Greek.

(iii) Németh supposed the relationship of SHR 𐲀 <a> and the Greek Α *alpha* <α> (Németh 1934: 29; Németh 1971: 39), cf. OM2. Németh published a glyph of the Greek *alpha:* Α without indicating the source. A similar glyph is the Greek medieval uncial *alpha* in the Codex Bezae, 5th c. AD, where the typical *alpha* glyph is Α.

(iv) From the first third of the 20th c. several scholars' opinion was that the ancestor of SHR 𐲀 <a> is the Early Cyrillic *azŭ* <a> (Németh 1917: 31–44; Melich 1925: 153–159; Vékony 1987a: 23). It is worth noting that the stem of SHR 𐲀 <a> is practically always vertical, but the stem of the uncial <a> is mostly slanting. However, the *azŭ* with vertical stem is frequent in the Cyrillic inscriptions (Vékony 1987a: 37). In any case, SHR 𐲀 <a> /à/ found in the Bodrog-Alsóbű inscription (around 900 or first half of 10th c., Table 8-30) makes it unlikely to originate from the Early Cyrillic. Its reason is that the beginning of the Early Cyrillic script developed in Preslav (Shumen Province, Bulgaria) dates back to the period 893–927 (Table 8-21), so there would not have been enough time for the Early Cyrillic А <a> to spread to such an extent that it would be used as an SHR grapheme at an iron smelter in Somogy (a county in Southwestern Hungary) where Bodrog-Alsóbű located. It seems more likely that if—as seen in OM3—SHR 𐳀 <a> is of Greek uncial origin, it is not from a Slavic script but the Greek script. It is worth noting that it can be ruled out that the ancestor of SHR did not have a grapheme denoting *a*. However, the latter argument is weakened by SHR 𐳛 <o>, which is found on the Vargyas inscription, clearly derived from the Glagolitic script (SFG-76). Namely, this is an example for borrowing a grapheme for marking a sound that always existed in Hungarian (in this case *o*). Since other Rovash graphemes denoting *a* and *o* are often also denoted *e*, and *u,* respectively, in other Rovash scripts (cf. SFG-4, SFG-8, SFG-31), it is possible that the reason for borrowing these graphemes denoting vowels was a need for a distinction between *a* vs *e* and *o* vs *u* (borrowing, separation, Table 4-2).

(v) The Greco-Bactrian (Heraüs) ⲁ, (Kaniṣka) ⲁ, ⲁ, (Loulan, 4th c. AD) ⲁ, (Chionites-Hephthalites, Arabo-Hephthalites) ⲁ, ⲁ, ⲁ, ⲁ (Ghirshman 1948: 63) *alpha* <α> could not be an ancestor due to differing shapes.

SFG-2

Descendant feature (grapheme):
SHR (Patakfalvi, 1776–1785) 𐳁 <á> /ā/.

OM1 (SFG-2):
Latin Alphabetic ancestor feature (orthographic rule):
Latin digraph aa often denoted /ā/ in the medieval Old Hungarian orthography.
Rovash ancestor feature (grapheme):
SHR (Patakfalvi, 1776–1785) 𐳀 <a> /ɔ/ (details: SFG-1).

Evaluation (SFG-2):
Changed script: SHR.
Region of relics: SHR: Carpathian Basin.
Source script family:
OM1: Latin Alphabetic (orthographic rule transfer, 2-3. §) and Rovash (internal development) (adaptation, external influence [Table 4-2]; duplication [Table 4-3, Table 7-8]).
Period of change:
OM1: 10th–18th c., the lower limit is the supposed beginning of the Old Hungarian orthography of the Latin script (Table 8-18); the upper limit is the age of the earliest inscription containing the studied descendant grapheme (Patakfalvi, Table 8-30).
Region of change: OM1: Carpathian Basin.
Glyph fit only with tamgas: OM1: 0.

Comments (SFG-2):

(i) Representing /ā/ with a double <a> *(aa)* is a characteristic of the Old Hungarian orthography of the Latin script (Korompay 2003). In the mixed-spelling Érdy Codex of 1526–1527, the /ā/ was also denoted by a double <a> (Dienes 1979; Ludányi 2003).

SFG-3

Descendant feature (grapheme):
TR (Y) 𐰀 (von Gabain 1941), 𐰀 (Thomsen 1893: 9) <A> /ä/ (von Gabain 1941; Tekin 2003: 23; Kyzlasov, I. L. 2015: 199) or /e/ (de Rachewiltz & Rybatzki 2010: Fig. 2);
SHR (Constantinople, 1515, LTR writing direction) 𐳉 <e> /ä, e, ē/.

OM1 (SFG-3):
Aramaic ancestor feature (grapheme):
Imperial Aramaic (Arachosia [Afghanistan and Pakistan]) , , (Ivantchik & Lurje 2013: 290) *’ālap̄* <’> /ʔ, ā, ē/;
Aramaic witness feature (grapheme): *Imperial Aramaic* (weights, seals and coins, 8th–3rd c. BC) , , (Lidzbarski 1910); (7th c. BC) (Gibson 1975); (Elephantine Papyri, 6th c. BC) (Glass 2000: 14); (satrapies, 5th–4th c. BC) , , (monuments, Egypt, 4th–3rd c. BC) , , (papyrus, Egypt, 2nd c. BC) , (Taylor 1883, vol. I: 250); (6th c. BC) (Schniedewind 2006: 140); (4th c. BC) , (1st c. BC) (Schniedewind 2006: 140); (cursive, 5th–4th c. BC) , ; (monumental) , (Assyrian and Egyptian papyri) , , (Babylonian Bowls) (Faulmann 1880: 79); (Aśoka, around 250 BC) (Glass 2000: 14); (MacKenzie 1971: xi) *’ālap̄* <’> /ʔ, ā, ē/; *Hebrew* (Qumran Manuscripts, 1st c. BC) *’ālef* <’> /ʔ/ [ʔ]; *Hatran* (H 79, soon before AD 240) , , (Beyer 1998: 10, 47–48) <’>.

OM2 (SFG-3):
Middle Iranian ancestor feature (grapheme):
Sogdian (early, Kultobe, before 4th c. AD) , (Sims-Williams & Grenet 2006: colour illustrations without page numbering); (Afrasiyab [Samarkand, Uzbekistan]) (Ivantchik & Lurje 2013: 290) *’ālap̄* <’> /a, ā, ə/.
Middle Iranian witness feature (grapheme): *Sogdian* (Ancient Letters, beginning of 4th c. AD) (Skjærvø 1996: 519); (Ancient Letters, beginning of 4th c. AD) (Harmatta 2004: 186); (sutra) , (Skjærvø 1996: 519) *’ālap̄* <’> /a, ā, ə/.

OM+ (SFG-3):
Tamgas ancestor feature (glyph shapes or styles):
Tamgas (Achaimenid Iran) , ; (Koy-Krylgan-kala) <tamga> (details: Table 8-34).

Evaluation (SFG-3):
Changed script: TR & SHR.
Region of relics: TR: Inner Asia SHR: Carpathian Basin.
Source script family:
OM1: Aramaic.
OM2: Middle Iranian.
Period of change:
OM1: 7th/6th–1st c. BC, the using period of the Imperial Aramaic (Table 8-12) script.
OM2: 2nd–4th c. AD, the lower limit is the use period of the Sogdian script (Table 8-16), the upper limit is the age of the Sogdian glyphs being similar to the descendant glyphs.
Region of change: OM1 & OM2: Inner Asia.
Glyph fit only with tamgas: OM1: 1. OM2: 1.

Comments (SFG-3):
(i) In South Semitic scripts—which cannot be ancestor (Table 4-5: 4-4 §)—there are similar glyphs: Hismaic (Macdonald 2005: 82); , <’> /ʔ/; Safaitic (Macdonald 2004: 496); ; (Macdonald 2015: 37); , (Macdonald 2004: 496) <’> /ʔ/.
(ii) It would be possible that SHR <e> and TR , <A> would have emerged from duplication of CBR, SR <A> (SFG-8). This supposition could be based on the fact that in

the Uyghur (Table 8-20), Manichean Sogdian, Sogdian and Syriac scripts, the glyph of the <’> of the first syllable was duplicated to denote /a/, and when written once, its Turkic sound value could be /e/ (Erdal 2004: 42). In our case, however, the exact opposite would have happened, so this possibility is unlikely and will not be considered.

(iii) Vékony suggested that the ancestor of SHR <e> and TR , <A> is the Parthian <’> (Vékony 1987a: 119); however, glyphs of the Parthian <’> (SFG-8) are far from the shapes of the descendant graphemes.

(iv) It is conceivable that simplification of TR <e> (SFG-6) could have resulted in SHR <e> and TR , <A>. However, TR <e> cannot originate from anywhere, only form TR , <A>. Therefore, the reverse evolutionary path is not taken into account.

SFG-4

Descendant feature (grapheme):

TR (O, Y) (Thomsen 1893: 9); (Y) (Thomsen 1893: 9); (T) (Kyzlasov, I. L. 1994: 71); (manuscripts) (von Gabain 1941); (Toyok) , (O: Ïrq Bitig Manuscript, 930 [Klyashtorny 2002: 42]) , (Dunhuang Letter) (Clauson 1970: 74); (Kalbak-Tash II, 8th c.) ; (Epitaph of Qarï Čor Tegin) (Rybatzki & Wu 2014: 120–121); (Bichiktu-Boom II/1) , <A> /a, ä/ (Tuna 1960: 217; de Rachewiltz & Rybatzki 2010: Fig. 2).

OM1 (SFG-4):
Aramaic ancestor feature (grapheme):
Syriac (Nestorian) (Daniels 1996b: 505) <’> /ʔ/ (Daniels 1996b: 505).

OM2 (SFG-4):
Middle Iranian ancestor feature (grapheme):
Sogdian (early, Kultobe, before 4th c. AD) , (Sims-Williams & Grenet 2006: colour illustrations without page numbering); (Ancient Letters, beginning of 4th c. AD) (Skjærvø 1996: 519); (Ancient Letters, beginning of 4th c. AD) (Harmatta 2004: 186); (Afrasiyab [Samarkand, Uzbekistan]) (Ivantchik & Lurje 2013: 290); (sutra) , (Skjærvø 1996: 519) *’ālap̄* <’> /a, ā, ə/;
Christian Sogdian , (Skjærvø 1996: 519) *’ālap̄* <’> /a, ā/;
Middle Iranian witness feature (grapheme): *Manichean* (Sogdian) (3rd c. AD or earlier) (Skjærvø 1996: 519); (Durkin-Meisterernst 2005: Table 1) *’ālap̄* <’> /a, ā/.

OM+ (SFG-4):
Tamgas ancestor feature (glyph shapes or styles):
Tamgas (Achaemenid Iran) ; (Basins of the Amu Darya and the Syr Darya, 6th–2nd c. BC) <tamga> (details: Table 8-34).

Evaluation (SFG-4):
Changed script: TR.
Region of relics: TR: Inner Asia.
Source script family:
OM1: Aramaic.
OM2: Middle Iranian.

Period of change:

OM1: 5th–8th c. AD, the using period of the Nestorian version of the Syriac script (Table 8-12), its upper limit is the age of the earliest TR inscriptions (Table 8-19).

OM2: 2nd–8th c. AD, the union of the using periods of Sogdian and Christian Sogdian scripts (Table 8-16), its upper limit is the age of the earliest TR inscriptions (Table 8-19).

Region of change: OM1 & OM2: Inner Asia.

Glyph fit only with tamgas: OM1: 0. OM2: 0.

Comments (SFG-4):

(i) According to Sebestyén, TR 𐰀 <A> is of Aramaic origin (Sebestyén 1906: 272–273).

(ii) According to Clauson, the Sogdian <’> is the ancestor of TR <A> (Clauson 1970: 68) (cf. OM1).

(iii) The <’> denoted /a/ in the Sogdian script, and it could also denote *ī/ĭ* or *ē/ĕ* and *ū/ŭ* and *ō/ŏ* in the Middle Iranian (Table 8-16) scripts (Skjærvø 2006–2012).

(iv) The users of TR had intense relationships with the Sogdians.

SFG-5

Descendant feature (grapheme):

SHR (Csíkszentmihály, 1501) 𐳞, 𐳞 <ö> /ö, ő/;

SHR (Wolfenbüttel, 1592–1666) 𐳞 /ö/; (Rudimenta-Giessen, 1598) (page 1) 𐳞, (page 3) 𐳞 /ö, ő/; (István Miskolci Csulyak, 1610–1645) 𐳞 /ő/; (Szegedi, 1655) 𐳞, 𐳞, 𐳞; (Gönczi, 1680 k.) 𐳞; (Hickes, 1705) 𐳞; (Rettegi, 1710) 𐳞; (Bél, 1718) 𐳞 *ö;* (Oertel’s Alphabet, 1719) 𐳞; (Bod’s Rudimenta, 1739) 𐳞; (Oertel’s Album Entry, 1751) 𐳞; (Dési, 1753) 𐳞; (Dobai, 1753) 𐳞; (Szentpéteri, 1699–1702) 𐳞 *ő* <ö> /ö, ő/.

OM1 (SFG-5):

Rovash ancestor feature (grapheme):

SHR 𐳉 <e> /ä, e, ē/ (details: SFG-3).

Evaluation (SFG-5):

Changed script: SHR.

Region of relics: SHR: Carpathian Basin.

Source script family:

OM1: Rovash (internal development) (adaptation [Table 4-2]; ornamenting [Table 4-3]).

Period of change:

OM1: 13th c. AD – 1501, the lower limit is the start of the labialization in the Hungarian language, and the upper limit is the age of the earliest surviving inscription containing the descendant grapheme.

Region of change: OM1: Carpathian Basin.

Glyph fit only with tamgas: OM1: 0.

Comments (SFG-5):

(i) According to Sebestyén, SHR 𐳞 <ö> is the derivation of the Ancient Greek (classical) Υ <υ> /u, ü/ (Sebestyén 1906: 278). However, the direct relationship between SHR 𐳞 <ö> and SHR 𐳉 <e> (SFG-3) is more likely.

(ii) From ca. 13th c. AD in the Hungarian language there a was a labialization (/e/ > /ö/); its consequence: 𐳉 <e> /ä, e, ē/ > 𐳞, 𐳞, 𐳞, 𐳞 <ö> /ö, ő/, cf. SFG-7.

(iii) SHR <ö> (SFG-5) is presumably a glyph variant of SHR <e> (SFG-3). As an example, consider the following glyph variants of TR <ᴵkᴵ>: (SFG-57). This glyph distribution is similar to the glyph distribution SHR (SFG-5).

(iv) The glyph variants of SHR <ö> resulted from late calligraphic development based on the use of ink and paper (writing technology, Table 4-2; ornamenting [Table 4-3]) and the influence of the calligraphic glyph style of the Latin script in that time (external influence [Table 4-2]; glyph style transfer [Table 2-9: 2-4. §]).

SFG-6

Descendant feature (grapheme):

TR (T, Y) (Kyzlasov, I. L. 1994: 71), (Y) (Kairžanov 2014: 17) <e> /e/ (Tekin 2003: 23; de Rachewiltz & Rybatzki 2010: Fig. 2; Kyzlasov, I. L. 2015: 199);

TR (Malov 1951: 17) <A> /a, ä/ (Malov 1951: 17);

SHR (Vargyas, 12th–13th c.) /ē/; (Stick Calendar, ca. 15th c. surviving in a 17th c. copy) /e/; (Csíkszentmihály, 1501) /e/ <e>;

SR (Achik-Tash, 8th c.) <e> /e/.

OM1 (SFG-6):

Rovash ancestor feature (grapheme):

TR <A> /e/ (details: SFG-3);

Rovash witness feature (grapheme): *SHR* <e> /ä, e, ē/ (details: SFG-3).

OM+ (SFG-6):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Kaunchitobe); (Altay) <tamga> (details: Table 8-34).

Evaluation (SFG-6):

Changed script: TR, SHR & SR.

Region of relics: TR: Inner Asia; SHR: Carpathian Basin; SR: Inner Asia.

Source script family:

OM1: Rovash (internal development) (outlining or line extension [Table 4-3]).

Period of change:

OM1: Up to 8th c. AD, the upper limit is the age of the earliest TR, SHR or SR inscriptions (Table 8-19).

Region of change: OM1: Inner Asia.

Glyph fit only with tamgas: OM1: 1.

Comments (SFG-6):

(i) It is a common opinion that SHR <e> and TR <e> are closely related (Ligeti 1925: 52; Németh 1934: Appendix VI; Németh 1971: 38; Püspöki Nagy 1977: 304).

(ii) According to Clauson, TR <e> is not of Iranian origin but is either from Greco-Bactrian <α> (SFG-1) or the result of internal development (Clauson 1970: 68). However, the Greco-Bactrian <α> only had a sound value /a/, therefore, probably not ancestor.

(iii) According to Vékony, the ancestor of TR <e> is Parthian *'ālap̄* <'> (SFG-8) (Vékony 1987a: 94, 119; Vékony 2004a: 154), but it is not probable because of the difference of the glyphs (cf. SFG-8).

(iv) It is conceivable that the putative common ancestor of SHR <e> /ä, ē/ (SFG-11) and

SR 𐳉 <e> (SFG-10) could be the common ancestor of TR, SHR and SR 𐳉 <e>, where the symmetrization and closer-shape forming as feature evolution principles (Table 4-2) could be observed on the development of the glyphs. However, neither SHR 𐳉 <e> nor SR 𐳉 <e> is currently known in Inner Asia, so this lineage is not considered.

(v) The similarity of glyph variants of SHR 𐳉, 𐳉, 𐳉 <e> and SHR 𐳏, 𐳏, 𐳏 <h> (SFG-46) is surely a coincidence.

SFG-7

Descendant feature (grapheme):

SHR (Stick Calendar, ca. 15^{th} c. surviving in a 17^{th} c. copy, page 677 of Marsigli's Manuscript) 𐳬 /ü/; (Kájoni's Ancient, 1673) 𐳬 *ö* /ö, ő/; (Nikolsburg, 1490–1526) 𐳬 *ẅ* /ü/; (Patakfalvi, 1776–1785) 𐳬 /ü/ <Ẅ>.

OM1 (SFG-7):

Rovash ancestor feature (grapheme):

SHR 𐳉 <e> /e, ē/ (details: SFG-6).

OM+ (SFG-7):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Tashkent Oasis) ꭗ; (Basins of the Amu Darya and the Syr Darya, 4^{th}–8^{th} c. AD) ꭗ <tamga> (details: Table 8-34).

Evaluation (SFG-7):

Changed script: SHR.

Region of relics: SHR: Carpathian Basin.

Source script family:

OM1: Rovash (internal development) (becoming similar or borrowing, separation [Table 4-2]; use of known glyph [Table 4-3]).

Period of change:

OM1: 13^{th} c. AD – around 1400, the lower limit is the start of the labialization in the Hungarian language, and the upper limit is the age of the earliest surviving inscription containing the descendant grapheme.

Region of change: OM1: Carpathian Basin.

Glyph fit only with tamgas: OM1: 1.

Comments (SFG-7):

(i) The sound values /ö/ and /ü/ could have been formed so that in the Hungarian language from ca. 13^{th} c. AD occurred an /e/ > /ö/ labialization. Then, in 13^{th}–15^{th} c. AD, as part of becoming more open (e.g., /ü/ > /ö/ sound change) the sound /ö/ resulted. Finally, /ö/ and /ü/ could have evolved into each other, cf. SFG-5. The 𐳬 <Ẅ> is unknown in other Rovash scripts outside of SHR, Hungarian language phenomena can explain its sound values. It likely evolved in the Carpathian Basin.

(ii) An earlier assumption was that SHR 𐳬, 𐳬, 𐳬 <Ẅ> could be developed by doubling one of the graphemes denoting /e/ (Hosszú 2011; Hosszú 2012a: 68). This option would be justified if there were parallels in the Latin script's Old Hungarian variant (Table 8-18). According to Korompay, in the Old Hungarian orthography of the Latin script, the digraph *ee* did not denote /ü/ in any testimonies (Korompay 2012); but there is an example of denoting /ő/

with digraph *ee* (Hegedűs 1989: 96–99). However, SHR <Ẅ> was also used for /ü/, and even the older parts of the Stick Calendar (ca. 15th c.) the <Ẅ> was consequently used for /ü/.

SFG-8

Descendant feature (grapheme):

CBR (Jánoshida, last third of 7th c.) /e/; (Szarvas, first half of 8th c.) /ȧ, e/; (Nagyszentmiklós Bowl No. 6, 8th–11th c.) /a, e/ <A>;

SR (Jitkov, first third of 8th c.) , /a, ā, e/; (Novocherkassk, 8th–10th c.) (with a punctuation mark upper dot, details: SFG-119) /a/; (Kermen Tolga, 8th–10th c.) /a, e/; (Mayatskoe-5, 9th c.) /a/; (Khumara-7, 9th–10th c.) /a/; (Khumara-8 [in copy], 9th–10th c.) /a/ <A>;

SR (Mayatskoe-1, 9th c.) ; (Mayatskoe-10, 9th c.) <<u>dA</u>> /da/ (Table 8-28).

OM1 (SFG-8):

Middle Iranian ancestor feature (grapheme):

Parthian (early, Nisa, 1st c. BC) (Akbarzādeh 2002); (early, Nisa) (Skjærvø 1996: 518); (Ḥājiābād, 3rd c. AD) (Taylor 1883, vol. II: 236); (inscriptional) (Skjærvø 1996: 518); (Akbarzādeh 2002); (inscriptions, 3rd c. AD) (MacKenzie 1971: xi) *’ālap̄* <’> /a, ā/;

Sogdian *’ālap̄* <’> /a, ā, ə/ (details: SFG-4);

Middle Iranian witness feature (grapheme): *Khwarazmian* (coins) , (Vainberg 1977: Table VIII) <’>; *Middle Persian* (Pre-Sasanian) (2nd–1st c. BC) , (Skjærvø 1997: 100); (inscriptional Pahlavi) ; (inscriptional Pahlavi) , (Psalter) , (Early Cursive Pahlavi) , (Book Pahlavi) (Skjærvø 1996: 518) *’ālap̄* <’> /a, ā/ (Skjærvø 1996: 518).

OM+ (SFG-8):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Achaemenid Iran) ; (Chu-Ili interfluve) ; (Basins of the Amu Darya and the Syr Darya, 6th–2nd c. BC) ; (Sarmatia, 2nd half of 1st c. – 1st half of 2nd c. AD) ; (Sidak, 5th – early 8th c. AD) ; (Shaushukumtobe) ; (Mongolia) , <tamga> (details: Table 8-34).

Evaluation (SFG-8):

Changed script: CBR & SR.

Region of relics: CBR: Carpathian Basin; SR: Pontus Steppe.

Source script family:

OM1: Middle Iranian.

Period of change:

OM1: 2nd c. BC – 7th c. AD, the union of the using periods of Parthian and Sogdian scripts (Table 8-16), the upper limit is the age of the earliest CBR or SR inscriptions (Table 8-19).

Region of change: OM1: Inner Asia.

Glyph fit only with tamgas: OM1: 1.

Comments (SFG-8):

(i) According to Vékony, the ancestor of CBR , , <A> is Parthian *’ālap̄* <’> (Vékony 1987a: 119; Vékony 2004a: 154). CBR <A> and SR , , , <A> are surely relatives. Glyphs

ᢰ and ᢱ of SR <A> support Parthian origin. It is worth noting that a straightening had to occur in the glyph 𐲀. Similar straightening can be detected in evolution of Rovash 1 <I> (SFG-50) from Imperial Aramaic 𐡉, 𐡉, 𐡉, 𐡉 <y> (SFG-50) and TR 𐰃 <I> (SFG-53) from Imperial Aramaic 𐡉, 𐡉, 𐡉, 𐡉, 𐡉, 𐡉 <y>. CBR ⋎, Ɏ glyphs are variants of 𐲀.

(ii) According to Sims-Williams, there is no detailed knowledge of Parthian phonology. It is difficult even to say whether a sound such as [e] existed as a phoneme in Parthian. However, in Manichaean Parthian, an initial *ʿayin* is used as an alternative to initial *ʾālap̄* in certain words such as those beginning with short vowel + fricative + stop. The vowel in question was probably a front vowel since initial *ʿayin* otherwise only occurs before *yōḏ*. In such cases, the Parthian script used *ʾālap̄,* e.g., Inscriptional Parthian *ʾstnbk* = Manichean *ʿstmbg*. So it seems that Parthian *ʾālap̄* can at least sometimes indicate a short front vowel (Sims-Williams, Nicholas: Personal communication by email, 11 April 2018).

(iii) According to Skjaervø, Parthian /e/ (if it contrasted with /i/) was written with *yōḏ* only. In the Parthian script, *ʾālap̄* could only represent <a> in initial, not between consonant, where <a> was not written at all. Moreover, there was no <ä> distinct from <a> in Parthian (Skjærvø, Prods Oktor: Personal communication by email, 14 & 16 April 2018).

(iv) In Parthian script, sounds *e* and *ê* were denoted by the digraph *ʿayin* + *yōḏ* <ʿy>, in certain cases denoted by *ʿayin* <ʿ>, only. An unetymological short initial vowel could be denoted facultatively by either *ʾālap̄* <ʾ> or *ʿayin* <ʿ> (Boyce 1975: 15 apud Korn, Agnes: Personal communication by email, 19 April 2018). The prothetic vowel is *i* or *ə* in Parthian (being written with *ʿayin*) and *a* or *ə* in Middle Persian (being written with *ʾālap̄*) (Durkin-Meisterernst 2014 apud Korn, Agnes: Personal communication by email, 19 April 2018). It is essential to distinguish the representation of vowels in a word-initial and internal position. In word-internal position, short vowels (which in Semitic languages are traditionally only *a, i, u*) would not be written at all, and long vowels, as well as diphthongs, would be indicated by one of the followings: *ʾālep̄* <ʾ>, *yōḏ* <y> and *wāw* <w>. Thus <ʾ> denoted *â;* <y> represented *î, ai/ay* and potentially *ê* (if this vowel existed in a language); <w> denoted *û, au/aw* and potentially *ô* (if this vowel existed in a language). In word-initial position (this in Semitic languages normally does not occur, but typical for Middle Persian and Parthian in the Manichean script, but by and large also elsewhere) the following rules existed: *aleph* <ʾ> denoted *a-* and *ə; aleph* <ʾ> or *double aleph* <ʾʾ> represented *â-; ayin* + *yod* <ʿy-> denoted *i-, e-,* and *î-, ê-* and *ai-* and *ı/ə-; aleph* + *waw* <ʾw-> represented *u-, o-,* and *û-, ô-,* and *au-*. According to Korn, the word-initial *aleph* <ʾ> could quite well be used for *ä-,* but the more *i*-like the sound gets, the more likely would it be that one writes: *ayin* <ʿ-> (Korn, Agnes: Personal communication by email, 29 April 2018).

(v) If Sogdian 𐼰 <ʾ> (SFG-3) is the ancestor of SR, CBR <A>, then sound values /a, e/ of CBR, SR <A> would simply result from borrowing Sogdian <ʾ>, since Sogdian <ʾ> denoted /a/, and it could also denote *ī/ĭ* or *ē/ĕ* and *ū/ŭ* and *ō/ŏ* (Skjærvø 2006–2012), cf. SFG-4.

(vi) The strictly geometric shapes of SR 𐲀, ⋎, Ɏ, CBR 𐲀, ⋎ <A> differ from—usually more calligraphic—Middle Iranian glyphs, but the shapes of SR ᢰ, ᢱ <A> probably attest to a transient shape. The angular development of the glyph may be justified by the writing technology (Table 4-2) of the scribes on the Eurasian Steppe; although it should be noted that many CBE and SR graphemes have remained curved. It is conceivable that SR 𐲀, ⋎, Ɏ, CBR 𐲀, ⋎ <A> evolved from the common ancestor of TR 𐰀 <A> and SHR ꓘ <ö> (SFG-5). This supposition could be supported by their partial topological similarity and the fact that there was no form similar to TR 𐰀 <A> and SHR ꓘ <ö> in CBR or SR.

(vii) The (Pre-Sasanian, 2nd–1st c. BC) 𐭠 glyph variant of Middle Persian <’> relates to Persis (Pars, Southwestern Iran); therefore, it cannot be an ancestor due to the temporal and geographical distance.

(viii) The South Semitic <h> has similar glyphs to CBR, SR <A>: Ancient South Arabian (Minaic) (Dadan) ᛉ (Macdonald 2015: 36); (Sabaic) 𐩠, 𐩠; (Hasaitic) Y, Dumaitic V, Taymanitic V, Y, Dadanitic ⅄, 𐪀, Λ (Macdonald 2004: 496); ᛕ (OCIANA-Dadanitic 2017: xiv); Thamudic D Y, ⤙, Thamudic C ⤙, Thamudic B ⅄, Y, Hismaic ⅄, Y (Macdonald 2004: 496); ᛕ (OCIANA-Hismaic 2017: xiv); ᛉ (Macdonald 2005: 82); ⅄ (King 1992: Figure 1 between the pages 5 and 6); Safaitic ᛕ (OCIANA-Safaitic 2017: xv); ⅄, Ⴤ (Macdonald 2004: 496); ⅄; Y, Y, ⅄ (Macdonald 2015: 31, 36); Geʿez abjad V <h> /h/. Moreover, in Old Aramaic script, the word-end <’> and <h> /ā/ represented /-ā/. In the 10th–9th c., the Old Aramaic script’s word-end <h> denoted /ā/ and /ē/ (Segert 1978: 112–113). In Old Aramaic and Paleo-Hebrew scripts, the <h> denoted the word-ending /o/, /a/ or /e/ (Healey 1990a: 35). However, the shapes of South Semitic <h> are unknown out of South Semitic scripts, and the ancestor of CBR or SR scripts was surely not able to accept glyphs directly from South Semitic scripts; therefore, the similar graphemes might be descendants of common ancestors. Moreover, the South Semitic script family (Table 8-7) separated from the Canaanite developmental branch not later than the 10th c. BC (Table 8-6). The Cimmerians—if they have adopted any script—do so only in 7th c. BC in central Asia Minor or in Cilicia, which territories were surely attacked by the Cimmerians (Table 3-2). Thus, based on the temporal and spatial distance, it can be ruled out that there is a relationship between CBR, SR <A> and the South Semitic <h>; therefore, this lineage option is ignored in the following.

(ix) CBR, SR Ⴤ <A> might originate from SHR 𐤀 <a> (SFG-1). Similar development can be observed in Southeastern Iberian ᛧ, Ⴤ (Faria 1992: 45) <ŕ> (Ferrer i Jané 2010: 71), earlier transliteration: <r> (Faria 1992: 45). Another example is the glyph distribution of Ancient Greek ᘓ, ∂, ᒣ, ᖷ, ᖰ, ᛧ *beta* <β> (SFG-17). However, SHR 𐤀 <a> had not /ä/ or /e/ sound value, only /a/ in accordance to any of its possible ancestors (SFG-1). Oppositely, SR <A> has /a, ā, ä/, and CBR <A> has /à, a, ä, e/.

(x) Despite of the morphological similarity, SR ᛘ <A> could not originate from the Linear B 𐀀 AB 08 <a>, since Linear B script became extinct in the 13th c. BC (Table 8-3, Table 4-5: 4-1. §). Moreover, Linear B 𐀀 <a> had no /ä/ or /e/ sound value opposite to Rovash <A>.

(xi) In the majority of TR inscriptions <A> denotes both /ä/ and /e/. However, in some inscriptions written with the Yenisey variant of TR there are special graphemes for /ä/ or /e/ (Erdal 2004: 42), see TR 𐰀, 𐰂 <A> (SFG-3) and TR 𐰅 <e> (SFG-6).

SFG-9

Descendant feature (grapheme):

SR (Achik-Tash, 8th c.) ᛖ <A> /ä/.

OM1 (SFG-9):

Rovash ancestor feature (grapheme):

SR Y, ᛘ <A> (details: SFG-8).

OM+ (SFG-9):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Almaly) ⅋; (South Kazakhstan) ᛗ; (Ancient Turkic tribal tamgas) |Y|; (Zalavár [Hungary]) \Y| <tamga> (details: Table 8-34).

Evaluation (SFG-9):
Changed script: SR.
Region of relics: SR: Inner Asia.
Source script family:
OM1: Rovash (internal development) (becoming similar or borrowing, [Table 4-2]; connecting, use of known glyph [Table 4-3]).
Period of change:
OM1: Up to 8th c. AD, the upper limit is the age of the earliest SR inscriptions (Table 8-19).
Region of change: OM1: Inner Asia.
Glyph fit only with tamgas: OM1: 1.

Comments (SFG-9):
(i) The tamga ᛗ, |Y|, \Y| has separated lines; therefore, in OM1, it is necessary to presume to connect its lines.
(ii) Vékony assumed that SR ᛗ <A> could also denote /a/ (Vékony 2004a: 294–295).

SFG-10
Descendant feature (grapheme):
SR (Mayaki, 8th–9th c.) ϡ /e/; (Khumara-6, 9th–10th c.) ϡ /e/; (Khumara-8 [in copy], 9th–10th c.) ϡ /e/; (Mayatskoe-10, 9th c.) ϡ /e/ <e>.

OM1 (SFG-10):
Greek Alphabetic ancestor feature (grapheme):
Greek (280 BC) ϵ, ϵ, ϵ, ϵ (Thompson 1912: 144); (medieval cursive) ϵ (Faulmann 1880: 171);
Greco-Bactrian (Kaniṣka) ϵ (Ghirshman 1948: 63) *epsilon* <ε>;
Canaanite witness feature (grapheme): *Phoenician* (Kilamuwa Stele, Samal, ca. 825 BC) 𐤄 (Röllig 1995: 204–205); (influenced by cursive formal glyphs, Kition Tariff B, ca. 550 BC) 𐤄 (Healey 1974: 58); 𐤄, 𐤄 (Faulmann 1880: 78) *hē* <h>; *Old Aramaic* (8th c. BC) 𐤄 (Gibson 1975); (Nineveh, 7th c. BC) 𐤄, 𐤄 (Taylor 1883, vol. I: 250) *hē* <h> /h, ā/ (Segert 1997: 118); *Punic* (Carthage, 3rd c. BC) 𐤄 (MNAMON: Phoenician, retrieved in 2015), (end of 3rd c. – beginning of 2nd c. BC) 𐤄 (Amadasi Guzzo 2011: 131) <h>.
Anatolian-Greek Alphabetic witness feature (grapheme): *Old Phrygian* (M-01a – first side of the Midas Tomb) E (MNAMON: Phrygian, retrieved on 9 June 2018); E, E (Young 1969: 262–268) <e> /e/; *Ancient Greek* (8th–5th c. BC) ᴇ (Powell 1991: 8) *epsilon* <ε> /e/; *Lydian* ∃, ∃, E (Adiego 2007e: 7) <e> /e/;
Paleo-Hispanic witness feature (grapheme): *Northeastern Iberian* ϵ, ϵ, E, E, E (Hesperia: Narbonensis, retrieved on 24 June 2016) <e> /e/, (dual) E <e/é> (Ferrer i Jané 2014: 244–245);
Italic witness feature (grapheme): *Camunic* ∃ (Morandi 2004: 476) <e>.

OM2 (SFG-10):
Rovash ancestor feature (grapheme):
TR ϡ <e> (details: SFG-6).

OM3 (SFG-10):
Rovash ancestor feature (grapheme):
SR , <A> /a, ā, ä/ (details: SFG-8).

Evaluation (SFG-10):
Changed script: SR.
Region of relics: SR: Pontus Steppe.
Source script family:
OM1: Greek Alphabetic.
OM2: Rovash (internal development) (glyph variant forming [Table 4-2]; loop opening [Table 4-3]).
OM3. Rovash (internal development) (separation [Table 4-2]; line insertion [Table 4-3]).
Period of change:
OM1: 4thc. BC – 8th c. AD, the union of the using periods of Greek (Table 8-13) and Greco-Bactrian scripts, the upper limit is the age of the earliest SR inscriptions containing the descendant grapheme (Table 8-19).
OM2 & OM3: Before 8th c. AD, the upper limit is the age of the earliest SR inscriptions containing the descendant grapheme (Table 8-19).
Region of change: OM1 & OM2: Inner Asia. OM3: Inner Asia or Pontus Steppe.
Glyph fit only with tamgas: OM1: 0. OM2: 0. OM3: 0.

Comments (SFG-10):

(i) The reason of the formal similarity of SR <e> and the Northeastern Iberian <e> is evolutionary based on OM1, and homoplasy (Table 2-7) based on OM2 and OM3.

(ii) The orientation of the glyph of the Northeastern Iberian <e> is the same as that of the Greek glyph and is opposite to that of SR <e>, which can be explained by the difference in the writing direction of that scripts.

(iii) The graphemes in OM1 of SFG-10 are related not only by indirect kinship but also by a similar glyph style (use of several auxiliary bars in the glyphs): SR <e>; Old Phrygian , , <e>; Ancient Greek <ε>; Lydian , , <e>; Camunic <e>. Based on this, it is conceivable that these graphemes could be formed at a similar age (cf. glyph style borrowing, Table 2-9).

(iv) The basis of OM3 is that the addition of extensions to glyphs is common in the development of Rovash scripts (e.g., SR , , <e>). The reason for the change may have been the need to mark separately the sounds *a* and *e* (separation, Table 4-2).

SFG-11

Descendant feature (grapheme):
SHR (Székelydálya, around 1400) /ä, ē/; (Nikolsburg, 1490–1526) *e*; (Wolfenbüttel, 1592–1666) , /ä, ē/; (Farkaslaki, 1624) /ä, ē/; (Bonyhai-Christmas, 1629) /ä, ē/; (István Miskolci Csulyak, 1610–1645) /ä, ē/; (Csulai, 1644) /ä, ē/; (Gáspár Miskolci Csulyak, 1654) /ä/; (Gyulafehérvár, 1655) , /ä, ē/; (Szegedi, 1655) , /ä/; (Szentpéteri, 1699–1702) *e* /ä/; (Huszti, ca. beginning of 18th c.) /ä, ē/; (Bél, 1718) *e* /ä/; (Patakfalvi, 1776–1785) /ä/ <e>.

OM1 (SFG-11):
Slavic ancestor feature (grapheme):
Glagolitic (Münchener Abecedarium, last sheet of CML 14485, Bayerischen Staatbibliothek, München, second half of 11th–12th c.) (Kempgen 2007); (Codex Zographensis, 10th–11th c.) Ⰵ *jestъ* (*estъ)* <e>.

OM2 (SFG-11):
Rovash ancestor feature (grapheme):
TR <e> (details: SFG-6).

OM3 (SFG-11):
Rovash ancestor feature (grapheme):
SR <e> (details: SFG-10).

Evaluation (SFG-11):
Changed script: SHR.
Region of relics: SHR: Carpathian Basin.
Source script family:
OM1: Slavic.
OM2: Rovash (internal development) (glyph variant forming [Table 4-2]; loop opening [Table 4-3]).
OM3. Rovash (internal development) (glyph variant forming [Table 4-2]; line shifting [Table 4-3]).
Period of change:
OM1: From 9th c. AD before around 1400, the using period of the Glagolitic (Table 8-21) script, the upper limit is the age of the earliest surviving SHR inscription containing the descendant grapheme.
OM2 & OM3: Before around 1400, the upper limit is the age of the earliest surviving SHR inscription containing the descendant grapheme.
Region of change:
OM1: Carpathian Basin.
OM2: Inner Asia, Pontus Steppe or Carpathian Basin.
OM3: Pontus Steppe or Carpathian Basin.
Glyph fit only with tamgas: OM1: 0. OM2: 0. OM3: 0.

Comments (SFG-11):

(i) According to Sebestyén, SHR <e> is ultimately derived from the Phoenician *hē* <h>, and directly from the *epsilon* <ε> of Ancient Greek and related scripts (Sebestyén 1906: 272, 274). Németh hypothesized a relationship between the SHR <e> (SFG-11) and the Glagolitic <e> (Németh 1934: Appendix VI; Németh 1971: 39). The Glagolitic <e> is likely relative to the Greek (cursive, AD 701–718) <ε> (Thompson 1912: 194).

(ii) Vékony pointed out the similarity of SHR <e> (SFG-11), SR <e> (SFG-10) and TR <e> (SFG-6) (Vékony 2004a: 271).

(iii) SHR <e> (SFG-3) is slightly similar to the descendant grapheme.

SFG-12

Descendant feature (grapheme):

SHR (Gáspár Miskolci Csulyak, 1654) ʔ /ē/; (Szentpéteri, 1699–1702) ʕ *Ɛ* /ē/; (Bél, 1718) Ↄ *é* /ē/; (Patakfalvi, 1776–1785) ⁻ /ē/ <é>.

OM1 (SFG-12):

Rovash ancestor feature (grapheme):

SHR ♭; ⌇, ʔ <e> /ä, ē/ (details: SFG-11).

Evaluation (SFG-12):

Changed script: SHR.

Region of relics: SHR: Carpathian Basin.

Source script family:

OM1: Rovash (internal development) (separation [Table 4-2]).

Period of change:

OM1: Not later than 17th c. AD, the upper limit is the age of the earliest SHR inscriptions containing different graphemes for representing the /ä/ and the /ē/.

Region of change: OM1: Carpathian Basin.

Glyph fit only with tamgas: OM1: 0.

Comments (SFG-12):

(i) Gáspár Miskolci Csulyak made the earliest surviving SHR inscription in 1654, where different graphemes were used for representing /e/ (SFG-11) and /ē/ (SFG-12).

SFG-13

Descendant feature (grapheme):

SHR (Dálnok – uncertain shape, 1526) ᛃ; (Rugonfalva, 16th–17th c.) ᚵ <e> /ä/.

OM1 (SFG-13):

Anatolian-Greek Alphabetic ancestor feature (grapheme):

Ancient Greek (Crete, 8th–7th c. BC) ↑, ꟻ, ℷ (Healey 1990a: 37); (Eleutherna, around 528–500 BC) ꟻ (Jeffery 1961: 24, 308); (8th–5th c. BC) ℶ (Powell 1991: 8) *epsilon* <ε> /e/ [e, eː];

Lydian ꟻ (Adiego 2007e: 7; Melchert 2008b: 57); ꟻ, ꟻ (Adiego 2007e: 7) <e> /e/;

Canaanite witness feature (grapheme): *Phoenician* ꟻ (Faulmann 1880: 78); (Sarepta [present-day Sarafand, Libanon], ca. 725 BC) ꟻ (Röllig 1995: 206–207); (Nineveh, 7th c. BC) ꟻ, ꟻ *hē* <h> (SFG-10); *Punic* (cursive) ꟻ, Я, Ħ (Jensen 1969b: 282) <h>;

Anatolian-Greek Alphabetic witness feature (grapheme): *Sidetic* ✕ (Nollé 2001: 629); ꟻ (Adiego 2007e: 14) <e>;

Paleo-Hispanic witness feature (grapheme): *Northeastern Iberian* ⋎ (Hesperia: Narbonensis, retrieved on 24 June 2016); ⊭ (Ferrer i Jané 2014: 244–245); ⊬, ⊧, ⋳, ⋲ (Hesperia: Narbonensis, retrieved on 24 June 2016); (Gallia Narbonensis) ⊭, ⊬, ⊧ (Hesperia: Narbonensis, retrieved on 24 June 2016) <e> /e/; *Celtiberian* (Botorrita) ⊭ (Eska 2008: 166–167); (eastern) ⊭ (Hesperia: Narbonensis, retrieved on 24 June 2016) <e>.

OM2 (SFG-13):

Rovash ancestor feature (grapheme):

SHR ʒ <e> /ä, ē/ (details: SFG-11).

Evaluation (SFG-13):
Changed script: SHR.
Region of relics: SHR: Carpathian Basin.
Source script family:
OM1: Anatolian-Greek Alphabetic.
OM2: Rovash (internal development) (simplification [Table 4-2]; straightening [Table 4-3]).
Period of change:
OM1: 9th–2nd c. BC, the union of the using periods of Ancient Greek and Lydian (Table 8-8) scripts.
OM2: Up to 16th c. AD, the upper limit is the age of the earliest SHR inscriptions containing the descendant grapheme.
Region of change: OM1: Anatolia. OM2: Carpathian Basin.
Glyph fit only with tamgas: OM1: 0. OM2: 0.

Comments (SFG-13):

(i) Based on OM1, SHR grapheme may be derived from Ancient Greek 𐤄 <ε>. Due to the difference in sound value, Canaanite graphemes are only witness graphemes in SFG-13. The glyph variant ᖷ appearing in the Punic script results from a parallel evolution independent of the Ancient Greek 𐤄 <ε>, but both are derived from Phoenician 𐤄 <h>, so Punic is a witness script in this respect.

(ii) OM2 is based on the variability of the glyph of Rovash <e>.

(iii) It is worth noting that the glyph of TR 𐰀 <A> /a, e/ (SFG-4) is also similar to the shape of the descendant grapheme; however, the descendant grapheme did not represent /a/; therefore, this option is ignored.

SFG-14

Descendant feature (grapheme):
TR (O) 𐰉 (Kairžanov 2014: 17) (Y) 𐰊 (Kairžanov 2014: 17) <b¹> /b/;
TR (Y) 𐰋 (Vasil'ev 1983 apud Harmatta 2004: 186); (O) 𐰋, 𐰋 (Thomsen 1893: 9), 𐰋 (Kyzlasov, I. L. 1994: 72); (Y) 𐰌, (Y) 𐰋, (Y) 𐰋, (Y: Begre, 8th–9th c.) 𐰌, 𐰋, 𐰋; (Y) 𐰋, 𐰋, ◊, 𐰋, (O) 𐰋, 𐰋 (Kairžanov 2014: 17); (O) 𐰋, (manuscript) 𐰋 (von Gabain 1941); (Küli Čur, 719–724) 𐰋 (Tekin 2003: 22); (O, T, Y) 𐰋 (Thomsen 1893: 9); (T) 𐰋, (O) 𐰋 (Kairžanov 2014: 17); (Kalbak-Tash I) ◊; (Bichiktu-Boom II/1) 𐰋; (Inegen II) 𐰋 <b²> /b, u̯/;
CBR (Nagyszentmiklós, Bowl No. 6, 8th–11th c.) 𐰋 <b> /u̯/;
SR (Kermen Tolga, 8th–10th c.) ᐳ; (Mayatskoe-1, 9th c.) ᐳ <b¹> /b/;
SR (Jitkov, first third of 8th c.) ᐳ, (Achik-Tash, 8th c.) ᐳ, (Novocherkassk, 8th–10th c.) ᐳ, (Mayatskoe-5, 9th c.) ᐳ, (Khumara-8 [in copy], 9th–10th c.) ᐳ <b²> /b/;
SR (Mayatskoe-10, 9th c.) ᛉ <b²> /b/.

OM1 (SFG-14):
Brahmic ancestor feature (grapheme):
Brāhmī (North Turkestan) 𑀩 (Róna-Tas 1991: 114, Table IV); (Tocharian) 𑀩 (Krause & Thomas 1960: 41); (Standard North Turkestan) 𑀩 (Maue 2010: 9); (alphabet q [Turkestan Gupta]) 𑀩, (alphabets r and s [Early Turkestan]) 𑀩, 𑀩, 𑀩, (alphabet t

[North Turkestan Type A]), (Standard North Turkestan [alphabet u, Type B]), (alphabet v [Khotanese]) (Sander 1968: Tafel 34); (Khotanese) (Leumann 1934: 17); (Cursive Gupta of Central Asia), (Tocharian) (Fischer 2001: 109) <ba>;

Brāhmī (Tumshuqese, TS 31) (Maue 2010: 5) <bi>;

Brāhmī (Gupta, around 6th c. AD), (Gilgit/Bamiyan, from 6th c. AD) (Sander 1968: Tafel 22); (alphabet q [Turkestan Gupta]), (alphabets r and s [Early Turkestan]), (Sander 1968: Tafel 32) <bhi>;

Brāhmī (alphabet q [Turkestan Gupta]), (alphabets r and s [Early Turkestan]), (alphabet t [North Turkestan Type A]), (Standard North Turkestan [alphabet u, Type B]), (alphabet v [Khotanese]) (Sander 1968: Tafel 34) <bu>;

Brahmic witness feature (grapheme): *Brāhmī* (Aśoka, around 250 BC) (Cunningham 1877: Plate XXVII); , (Bühler 1898: Table after p. 123: Comparative Table of the oldest Semitic and the Brāhma alphabets) <ba>; *Tibetan* (Róna-Tas 1991: 117, Table VII) <ba>.

OM+ (SFG-14):
Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Achaemenid Iran); (Kampyrtepa), ; (Kazakhstan and Issyk-Kul Lake Area); (Basins of the Amu Darya and the Syr Darya, 1st c. BC –3rd c. AD); (Coins with double-humped camel, 7th–8th c. AD); (South Kazakhstan and Dzungarian Altai); (Altay); (Almaly) <tamga>; (Novi Pazar), , <stamp>; (Kopeny); (Kuray) <bottom stamp>; (Sharkel); (Kochkor Valley), <shoulder stamp of a pot> (details: Table 8-34).

Evaluation (SFG-14):
Changed script: TR, CBR & SR.
Region of relics: TR: Inner Asia; CBR: Carpathian Basin; SR: Inner Asia & Pontus Steppe.
Source script family:
OM1: Brahmic.
Period of change:
OM1: 4th–7th c. AD, the using period of Brāhmī glyph variants presumed to be the ancestor (Table 8-15), the upper limit is the age of the earliest TR, CBR or SR inscriptions (Table 8-19).
Region of change: OM1: Inner Asia.
Glyph fit only with tamgas: OM1: 1.

Comments (SFG-14):

(i) Some of the tamgas listed in SFG-14 might be not the ancestor of the descendant graphemes, but oppositely, these tamgas might be created from various glyph variants of the descendant graphemes.

(ii) Vékony drew attention to the probability of the relationship between SR <b^2> and TR <b^2> (Vékony 2004a: 252).

(iii) According to Sebestyén, TR , <b^2> originates from Phoenician , , *bēṯ* <b> (SFG-17) supposing the > topological transformation (Sebestyén 1906: 272–273). TR <b^2> may directly have been created from the symmetrization (Table 4-2) of Phoenician ; thus TR <b^2> could refer to the origin of the whole SFG-14. However, it seems more probable that TR ♀ <b^2> originates from the ᛟ glyph with simplification (Table 4-2). Therefore, due to the large topological differences, the ƽ shape is probably not the ancestor of SFG-14.

(iv) Interpreting TR ᛟ, ᛟ, ᛝ <b^2> as Turkic pictograph, its glyph could origin from the shape of the 'house, home,' see Table 3-4. The glyph ᛟ could suggest a yurt-like tent, but the glyphs ♀ and ᛝ do not suggest a tent or house. Perhaps the fact that its sound value with a pronunciation-facilitating vowel meant the Old Turkic *eb, eβ* 'tent, house' word might have played a role in the development of the glyph ᛟ. In fact, it could have been an interpretation-based glyph modification.

(v) According to Mészáros, TR ᛟ <b^2> correspond to the ᛟ on the Treasure of Nagyszentmiklós (Mészáros 1915: 4). This assumption coincides with Vékony's interpretation of the graph ᛟ (Vékony 1987a: 51; 120).

(vi) According to Clauson, TR ᛟ, ᛟ <b^2> originates from Greek <β>, as an example, he cites the glyph of Greco-Bactrian <β> found in Loulan (Clauson 1970: 68). However, the clear majority of the glyph variants of Greco-Bactrian (Kaniṣka) ß, (Vāsudeva III) ß, (Vāsudeva III) ß, ß; (Loulan, 4th c. AD) ♀, ℓ, ℓ (Ghirshman 1948: 63) *beta* <β> significantly differs from the descendant glyphs, despite TR 8 <b^1>, which is presumably a homoplasy (Table 2-7) of the Greek *beta* <β>.

(vii) The shapes of the Brāhmī (alphabet v [Khotanese]) 𑀩 <ba> and 𑀩𑀼 <bu> are similar to SR ᐳ <b^1> (OM1). Based on this, it is conceivable that SR ᐳ <b^2> is not a rotated variant of TR ᛟ <b^2>.

(viii) Based on the geometrical similarity, TR ᛟ <b^2> (SFG-14) could be derived from TR ᛟ, ᛟ, ᐳ, ᐳ, ◇ <m> (SFG-67) by turning the shape ᛟ with 90°, similarly: TR ᛟ <m> and ᛟ <b^2>, cf. Table 7-11. Vékony propounded that based on the /b/ ~ /m/ alternation (Table 7-11) SR ᐳ <b^2> could be relative to TR ᛟ, ᛟ <m> (Vékony 2004a: 252). It is worth noting that the geometrical similarity could result from similar writing technology and style normalization, too; cf. Table 4-2. Cf. SFG-15.

(ix) In principle, it is conceivable that TR 8 <b^1> is a glyph variant of TR ᒍ <b^1> (SFG-17), and its similarity to either SHR 8 <m> (SFG-68) (Hosszú 2017: 216–217) or Ancient Greek 8 <β> is a coincidence. More likely, TR ᛟ, 8 <b^1> is related to TR ᛟ <b^2> (SFG-14). The mere fact that a TR grapheme denoting consonant was used with a velar or a palatal vowel is not conclusive, as there are many examples of fluctuations in this role in TR, see Table 7-3.

(x) The similarity with the following Paleo-Hispanic graphemes is striking (Hosszú 2017: 216): Northeastern Iberian Ω, ᛟ (Hesperia: Narbonensis, retrieved on 24 June 2016) <ba>; ᛟ, ᛟ, ᛟ, ᛟ, ᛟ, ᛟ, ᛟ, ᛟ, ᛟ (Hesperia: Narbonensis, retrieved on 24 June 2016) <be> /be/, (non-dual) ᛟ, (dual) ᛟ, ᛟ; /be/ (Ferrer i Jané 2014: 244–245); (Gallia Narbonensis) ᛟ, ᛟ, ᛟ, ᛟ, ᛟ, ᛟ, ᛟ, ᛟ, ᛟ, ᛟ, ᛟ, ᛟ, Ω (Hesperia: Narbonensis, retrieved on 24 June 2016) <be>; Celtiberian (Botorrita) ᛟ (Eska 2008: 166–167); ᛟ, Ω, ᛟ (Hesperia: Narbonensis, retrieved on 24 June 2016); (eastern) ᛟ; (western) W (Hesperia: Narbonensis, retrieved on 24 June 2016) <be> or <pe>. These may have been created under Greek influence, but another Paleo-Hispanic grapheme could also be their ancestor. To prove the kinship of these Paleo-Hispanic graphemes and the similar Rovash ᛟ, it would be necessary for their common ancestor to appear on some surviving inscriptions in Asia Minor. However, no such data are currently available. It should be noted that the same ᛟ glyph was certainly created in other scripts, certainly in an independent manner: Libyco-Berber ᛟ, ᛟ, ᛟ, ᛟ (Ulbrich 2012: 21); (archaic, Morocco, vertical bottom-up writing direction) ᛟ, ᛟ, ᛟ (LBI: Dougga, retrieved in 2015) <f/p>; Runic (Elder Fuþark) ᛟ (Looijenga 2003: 6) <o> or in a slightly different variant: Glagolitic

(Haskovo Amulet, 10th–11th c. AD) ⴳ *chěrъ (cherъ)* <x>. The development of the listed, ⵅ-type shapes is surely the result of convergence (a kind of homoplasy, Table 2-7), which may stem from scratching into hard objects and the need to be distinguishable from other graphemes.

SFG-15

Descendant feature (grapheme):

SHR (Székelydálya, around 1400) X; (Nikolsburg, 1490–1526) X *eb;* (Bágy, 15th c.) X; (Constantinople, 1515, LTR writing direction) X; (Szegedi, 1655) X; (Szentpéteri, 1699–1702) ⵋ *b* <b> /b/;

CBR (Szarvas, first half of 8th c.) X <b> /b/;

SR (Mayatskoe-2, 9th c.) X; (Homokmégy-Halom, 10th c.) X <b> /b/.

OM1 (SFG-15):

Brahmic ancestor feature (grapheme):

Brāhmī (alphabet q [Turkestan Gupta]) 𑀪, (alphabets r and s [Early Turkestan]) 𑀪 (Sander 1968: Tafel 30) <bha> /bʰ/;

Brāhmī (Gupta, around 6th c. AD) 𑀪𑀻, (Gilgit/Bamiyan, from 6th c. AD) 𑀪𑀻 (Sander 1968: Tafel 22); (alphabet q [Turkestan Gupta]) 𑀪𑀻, 𑀪𑀻, (alphabets r and s [Early Turkestan]) 𑀪𑀻, 𑀪𑀻 (Sander 1968: Tafel 32) <bhī>.

Brahmic witness feature (grapheme): *Brāhmī* (Aśoka, around 250 BC) 𑀪, 𑀪 (Cunningham 1877: Plate XXVII); (North Turkestan) 𑀪 (Róna-Tas 1991: 114, Table IV); (Standard North Turkestan) 𑀪 (Maue 2010: 9) <bha> /bʰ/.

OM2 (SFG-15):

Rovash ancestor feature (grapheme):

TR ⵅ, ⵅ, ⵅ <b^2> (details: SFG-14);

Rovash witness feature (grapheme): *SR* ᐳ <b^1, b^2>; *CBR* ⵅ <b> (details: SFG-14).

OM+ (SFG-15):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Ancient Turkic tribal tamgas) X; (Bactrian sign, northern Afghanistan, Bronze Age) X; (Bayte III) X; (Basins of the Amu Darya and the Syr Darya, 1st c. BC –3rd c. AD) X, (4th–8th c. AD) X, (Sarmatia, 2nd half of 2nd c. – 1st half of 3rd c. AD) X; (Altay) X <tamga> (details: Table 8-34).

Evaluation (SFG-15):

Changed script: SHR, CBR & SR.

Region of relics: SHR, CBR & SR: Carpathian Basin.

Source script family:

OM1: Brahmic (becoming similar, borrowing or simplification [Table 4-2]; use of known glyph [Table 4-3]).

OM2: Rovash (internal development) (becoming similar, borrowing or simplification [Table 4-2]; use of known glyph [Table 4-3]).

Period of change:

OM1: 4th–8th c. AD, the using period of Brāhmī glyph variants presumed to be the ancestor (Table 8-15), the upper limit is the age of the earliest inscription containing SHR, CBR or SR X <b> (Szarvas, the first half of 8th c.).

OM2: Before 8th c. AD, the upper limit is the age of the earliest inscription containing SHR, CBR or SR X <b> (Szarvas, the first half of 8th c.).
Region of change: OM1: Inner Asia. OM2: Inner Asia or Pontus Steppe.
Glyph fit only with tamgas: OM1: 1. OM2: 1.

Comments (SFG-15):

(i) Several hypothesized a relationship between SHR X <b> and TR 𐰉, 𐰉, 𐰉 <b^2> (SFG-14) (Nagy 1895: 274; Sebestyén 1906: 272–273; Németh 1934: Appendix VI Németh 1971: 38; Vékony 1987a: 120). The assumption that Rovash X <b> originated from TR 𐰉 <b^2> (SFG-14) may be supported by the observation that CBR inscriptions do not include X <b> and 𐰉 <b> together, but always just one.

(ii) The Brahmic glyphs in SFG-14: OM1 are not completely closed (e.g., ब, ब, ब, ब), thus, in principle, it would be possible that the descendant graphemes of SFG-14 and SFG-15 evolved simultaneously from the Brahmic ancestor graphemes.

(iii) The feature transformation 𐰉, 𐰉 > X supposed in OM2 may have been created by internal development. It could not have been created in the Carpathian Basin since SR used in the Pontus Steppe also contains the X <b>. Thus the transformation in OM2 could happen in Inner Asia or Pontus Steppe.

(iv) According to Vékony, CBR X <b> is comparable to the Parthian <m> (Vékony 1987a: 120). In addition to the Parthian, the transmission of other Aramaic or Middle Iranian <m> is also possible, that could be followed by an *m > b* sound change (Table 7-11). Ancestor graphemes could be: Armazian 𐡌 (Cereteli 1948–1949 apud Róna-Tas 1987: 14) <m>; Parthian (inscriptions, 3rd c. AD) 𐭌 (MacKenzie 1971: xi); 𐭌 (Skjærvø 1996: 518); (coins of the Parthian kings, 1st–2nd c. AD) 𐭌, 𐭌 (Taylor 1883, vol. II: 236) *mēm* <m> /m/; Sogdian (Ancient Letters, early 4th c. AD) 𐼌 (Skjærvø 1996: 519); (Ancient Letters, beginning of 4th c. AD) 𐼌 (Harmatta 2004: 186); (early) 𐼌 (Clauson 1970: 74); (sutra) 𐼌, 𐼌 (Skjærvø 1996: 519) <m>; Elymaic (Tang-e Sarvak) X, X, (Simbar) X, X (Häberl 2006: 57); (Tang-e Sarvak) X, X, X, X, X (Elymais, coins) X, X, X (Henning 1952: 168) <m>; Khwarazmian 𐾼 <m> (SFG-67). It is against the correctness of the idea that none of Rovash inscriptions has a X-like graph with a sound value of /m/. Moreover, according to Vékony, the development of Rovash <b> based on the *m > b* sound change (cf. Table 7-11) is difficult to prove (Vékony 2004a: 252). Cf. SFG-14.

(v) Rovash X <b> and the following Paleo-Hispanic graphemes are similar to each other: Northeastern Iberian X, X, X, X, X <bo> /bo/, (dual) ✳ <bo> /bo/ (Ferrer i Jané 2014: 244–245), (Gallia Narbonensis) X, X, X, X (Hesperia: Narbonensis, retrieved on 24 June 2016) <bo>, Celtiberian (Botorrita) ✳ (Eska 2008, 166–167), (eastern) X, (western) X <bo> or <po>. These Paleo-Hispanic graphemes are known only in the Northeastern Iberian and the Celtiberian scripts, which differ from the other Paleo-Hispanic scripts show a strong Greek influence. However, it is possible that these Northeastern Iberian and Celtiberian graphemes are not of Greek origin, but the results of internal development and, indirectly, perhaps Phoenician descendants. If there were any kinship between Rovash <b> and Paleo-Hispanic <bo/po>, these graphemes' common ancestor should have been formed in Asia Minor. However, no data are known for this, so contrary to an earlier suggestion (Hosszú 2017: 217), their similarity is certainly a coincidence (Table 2-7).

SFG-16

Descendant feature (grapheme):

SHR (Bodrog-Alsóbű, around 900 or first half of 10th c.) 𐲂 /β<u>nȧ</u>/ <βna> (Table 8-24);

CBR (Környe, end of 7th c.) 𐲂 /β/; (Szarvas, first half of 8th c.) 𐲂 /β/; (Kiskundorozsma, end or last third of 8th c.) 𐲂 /β/; (Nagyszentmiklós, 8th–11th c.) 𐲂 /β, v/ <β>;

SR (Mayaki, 8th–9th c.) 𐲂 /β/; (Kermen Tolga, 8th–10th c.) 𐲂 /β/; (Novocherkassk, 8th–10th c.) 𐲂 /v/; (Mayatskoe-10, 9th c.) 𐲂 /β/ <β>.

OM1 (SFG-16):

Anatolian-Greek Alphabetic ancestor feature (grapheme):

Old Phrygian Ϝ, ꟻ (Adiego 2007e: 3) <v> /w/;

Ancient Greek (Crete, 8th–7th c. BC) ꟻ (Healey 1990a: 37); (Korkyra, 8th–7th c. BC) ϡ, ϡ (Healey 1990a: 37); (Euboia) Ϝ *digamma* <ϝ> /u̯/ (Jeffery 1961: 24–25) [w];

Lydian ꟻ (Melchert 2008b: 57); ꟻ (Littmann 1916: 1; Adiego 2004: 305; Adiego 2007d: 769; Melchert 2008b: 58) <v> /w/ (Adiego 2007e: 7) or /v/ (Adiego 2004: 305; Adiego 2007d: 769; Melchert 2008b: 58);

Anatolian-Greek Alphabetic witness feature (grapheme): *Lemnian* (6th c. BC) ꟻ, ᚴ (MNAMON: Lemnian, retrieved in 2015) <v>; *Lycian* Ϝ (Adiego 2007e: 8) <w> /w/ (Adiego 2004: 305; Adiego 2007c: 764; Adiego 2007e: 8; Melchert 2008a: 48–49);

Italic witness feature (grapheme): *Etruscan* (Marsiliana d'Albegna, 7th c. BC) ꟻ <v> /β, u̯/ [β]; *Raetic* ꟻ, ꟻ <v> /v/ (Marchesini 2014: 206–207); *Lepontic* ꟻ, ꟻ <v>; *Venetic* ꟻ, ꟻ <v>; *Umbrian* (Etruscan, 4th– first half of 1st c. BC) ꟻ <v> [w] (MNAMON: Umbrian, retrieved in 2015); *Oscan* (Etruscan, first half of 4th c.– first half of 1st c. BC) ꟻ <v> [w]; *Messapic* Ϝ, Ϝ <v> /v/; *Early Latin* (archaic, 4th–2nd c. BC) Ϝ <f> /f/;

Runic witness feature (grapheme): *Runic* (Elder Fuþark) ᚠ, ᚠ, ᚠ; (Elder Fuþark, Anglo-Frisian Fuþorc) ᚠ (Looijenga 2003: 6); (Younger Fuþark) ᚠ (Looijenga 2003: 6.) <f> /f/.

OM2 (SFG-16):

Brahmic ancestor feature (grapheme):

Brāhmī (Standard North Turkestan) 𑀩 (Maue 2010: 9); (Standard North Turkestan [alphabet u, Type B]) 𑀩 (Sander 1968: Tafel 34); (Cursive Gupta of Central Asia) 𑀩, (Tocharian) 𑀩 (Fischer 2001: 109) <ba> (more glyphs: SFG-14);

Brāhmī (alphabet t [North Turkestan Type A]) 𑀩𑀼, (Standard North Turkestan [alphabet u, Type B]) 𑀩𑀼 (Sander 1968: Tafel 34) <bu> (more glyphs: SFG-14).

OM+ (SFG-16):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Altay) ꟻ <tamga> (details: Table 8-34).

Evaluation (SFG-16):

Changed script: SHR, CBR & SR.

Region of relics: SHR: Carpathian Basin; CBR: Carpathian Basin; SR: Pontus Steppe.

Source script family:

OM1: Anatolian-Greek Alphabetic.

OM2: Brahmic.

Period of change:

OM1: 9^{th}–2^{nd} c. BC, the union of the using periods of Old Phrygian, Ancient Greek and Lydian scripts (Table 8-8).

OM2: 4^{th}–7^{th} c. AD, the using period of Brāhmī glyph variants presumed to be the ancestor (Table 8-15), the upper limit is the age of the earliest CBR surviving inscriptions (Table 8-19).

Region of change: OM1: Anatolia. OM2: Inner Asia.

Glyph fit only with tamgas: OM1: 0. OM2: 0.

Comments (SFG-16):

(i) Note that the <β> is attested in SHR by a ligature, only. During the Árpádian period (AD 1000–1301, the age of the Árpád dynasty in Hungary), /β/ gradually declined and disappeared from the vast majority of the Hungarian-speaking area (Szathmári 2002: 36–50). As a result, <β> became redundant and disappeared from SHR.

(ii) According to Vékony, the ancestor of Rovash <β> is the Parthian , , *wāw* <w> (SFG-32) extended with an auxiliary arm (Vékony 2004a: 155). The addition of a diacritic (a vertical bar) would significantly change the glyph of Parthian grapheme, that this supposition is very unlikely. Based on cladistics's *lex parsimoniae* (Table 4-1), Parthian provenance as an option can be omitted.

(iii) According to Erdal, [b] is at the word onset, within words, [b] appears only in late texts. Onset [b] could be equally assigned to /v/ as to /p/ (Erdal 2004: 62, 99–100). Based on this, it was possible that Brāhmī , <ba> or <bu> was transmitted for representing Rovash <v> (OM2). Cf. the voiced labio-velar approximant CBR <b> /u̯/ (SFG-14) and the voiced bilabial fricative CBR <β> /β/ (SFG-16). Moreover, there is an example for using SR <β> to denote /b/ (Novocherkassk, see above); therefore, the Brāhmī <ba> or <bu> can be an ancestor.

(iv) In Tibetan script, which is close relative to Brāhmī, <ba> denoted originally a [v] and it stood in some early alphabets in place of <wa> (Róna-Tas 1991: 94).

(v) The name of Bumïn Khagan was in Sogdian *bġ βwmyn ġ'ġ'n* 'Lord Bumïn Khagan' (Golden 1998: 19). According to Yoshida, the Sogdian voiced plosives and affricate **b, *d, *ǰ, *g* have become fricatives *β, δ, ž,* and *γ* even in the initial position; the voiced plosives *b, d, ǰ, g* are found only after nasalized vowels (Yoshida 2009: 286).

SFG-17

Descendant feature (grapheme):

TR (Y) (Thomsen 1893: 9); (O, Y) ; , (Róna-Tas 1987: 13); (T) , (Y) , , , (O) , , (Kairžanov 2014: 17); (O) , , , (O, T) , (Y) , , , (von Gabain 1941) <b^1> /b/;

TR (T) , (Y) , , , (O) , , , (Kairžanov 2014: 17) <b^2> /b/;

SR (Jitkov, first third of 8^{th} c.) /b/; (Mayatskoe-10, 9^{th} c.) /β/ <b^1>.

OM1 (SFG-17):

Aramaic ancestor feature (grapheme):

Imperial Aramaic (satrapies, 5^{th}–4^{th} c. BC) , , (monuments, Egypt, 4^{th}–3^{rd} c. BC) , (papyrus, Egypt, 2^{nd} c. BC) (Taylor 1883, vol. I: 250); (7^{th}–5^{th}/4^{th} c. BC) (Gibson 1975); (Elephantine Papyri, 6^{th} c. BC) (Glass 2000: 14); (MacKenzie 1971: xi);

(6th c. BC), (4th c. BC), (1st c. BC) (Schniedewind 2006: 140); (cursive, 5th–4th c. BC); (Aśoka, around 250 BC) (Glass 2000: 14) *bēṯ* <b> /b, β/;

Syriac (Estrangela) <b, ḇ>;

Aramaic witness feature (grapheme): *Hebrew* (Qumran Manuscripts, 1st c. BC) *bēṯ* <b> /b/; *Nabataean* (late) (Macdonald 2008: 218) <b>; *Hatran* (H 79, soon before AD 240) (Beyer 1998: 10, 47–48) <b>; *Armazian* (Cereteli 1948–1949 apud Róna-Tas 1987: 14) <b>; *Arabic* (early), (modern) (Macdonald 2008: 218) *bā'* <b> /b/.

OM2 (SFG-17):

Middle Iranian ancestor feature (grapheme):

Parthian (early, Nisa, 1st c. BC), (inscriptional) (Skjærvø 1996: 518); (inscriptions, 3rd c. AD) (MacKenzie 1971: xi) <b> /b, u̯/;

Khwarazmian (Chirik-Rabat [Kyzylorda Region, Kazakhstan], 4th–2nd c. BC) (Ivantchik & Lurje 2013: 286–287); (Toprak-kala), (Vainberg 1977: Table VIII) <b>;

Sogdian (Ancient Letters, early 4th c. AD) (Skjærvø 1996: 519); (Ancient Letters, beginning of 4th c. AD) (Harmatta 2004: 186); (sutra), (Skjærvø 1996: 519) <b> /b, β/;

Middle Iranian witness feature (grapheme): *Middle Persian* (Psalter) (Bulayïq, 6th–7th c., a copy of an origin from the 4th c. AD) (Skjærvø 1996: 518) <b> /b, u̯/; *Manichean* (Sogdian) (3rd c. AD or eralier) (Skjærvø 1996: 519) *bēṯ* <b> /b, β/.

Evaluation (SFG-17):

Changed script: TR & SR.

Region of relics: TR: Inner Asia; SR: Pontus Steppe.

Source script family:

OM1: Aramaic.

OM2: Middle Iranian.

Period of change:

OM1: 7th/6th c. BC – 5th c. AD, the union of the using periods of Imperial Aramaic (Table 8-12) and Estrangela Syriac scripts.

OM2: 2nd c. BC – 8th c. AD, the union of the using periods of Parthian (Table 8-16), Khwarazmian and Sogdian scripts; the upper limit is the age of the earliest TR or SR script relics (Table 8-19).

Region of change: OM1 & OM2: Inner Asia.

Glyph fit only with tamgas: OM1: 0. OM2: 0.

Comments (SFG-17):

(i) According to Sebestyén, TR <b^1> is of Phoenician origin (Sebestyén 1906: 272–273). However, the loop of Phoenician , , <b> is always on top, and the loop of the studied Rovash graphemes are always on the bottom, so it is unlikely that they could be in direct descent.

(ii) According to Clauson, TR <b^1> is close to early Sogdian and Middle Persian (Psalter) <b> (Clauson 1970: 68). However, the glyph of Middle Persian <b> is too different from the descendant glyphs.

SFG-18

Descendant feature (grapheme):

TR (O, T, Y) (Thomsen 1893: 9; Kyzlasov, I. L. 1994: 71); (Y: Begre, 8^{th}–9^{th} c.) ; (Y) (Radlovim 1893: Table LXXX 1 a, M. M. I.); (Y: Begre, 8^{th}–9^{th} c.) ; ; (Y) , , , , (Büyük Larousse 9: 4678); (T) , , (Y) , , , , (O) (Kairžanov 2014: 17); (Mendur-Sokkon IV) ; (Kalbak-Tash I) ; (Koytübek) ; (Bichiktu-Boom II/1) ; (Kupchegen) ; (Manyrlu-Koby I) ; (Sary-Koby) ; (O) , (manuscript) , (von Gabain 1941) <g²> /g/;

SHR (Erdőszentgyörgy, 13^{th}–14^{th} c.) /d͡ʒʲ/ or /dʼ/; (Stick Calendar, ca. 15^{th} c. surviving in a 17^{th} c. copy) /g, gy/; (Nikolsburg, 1490–1526) *egh* /g/; (Wolfenbüttel, 1592–1666) /g/; (Gáspár Miskolci Csulyak, 1654) /g/; (Dobai, 1753) /g/ <g>.

OM1 (SFG-18):

Aramaic ancestor feature (grapheme):

Imperial Aramaic (satrapies, 5^{th}–4^{th} c. BC) , , (papyrus, Egypt, 2^{nd} c. BC) , (Taylor 1883, vol. I: 250); (Elephantine Papyri, 6^{th} c. BC) (Glass 2000: 14); ; (MacKenzie 1971: xi); (monumental) (Faulmann 1880: 79); (cursive, Egypt, 5^{th}–3^{rd} c. BC) , (Lidzbarski 1910); (Aśoka, around 250 BC) (Glass 2000: 14) *gāmal* <g> /g, γ/;

Aramaic witness feature (grapheme): *Elymaic* (Tang-e Sarvak) , (Simbar) (Häberl 2006: 57) <g>.

OM2 (SFG-18):

Brahmic ancestor feature (grapheme):

Brāhmī (alphabet q [Turkestan Gupta]) , , (alphabets r and s [Early Turkestan]) , , , (alphabet t [North Turkestan Type A]) , (Standard North Turkestan [alphabet u, Type B]) (Sander 1968: Tafel 35) <ge>;

Brāhmī (alphabets r and s [Early Turkestan]) , , , (alphabet t [North Turkestan Type A]) , (Standard North Turkestan [alphabet u, Type B]) (Sander 1968: Tafel 31) <gi>.

OM+ (SFG-18):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Achaemenid Iran) ; (Basins of the Amu Darya and the Syr Darya, 1^{st} c. BC –3^{rd} c. AD) ; (4^{th}–8^{th} c. AD) ; (Sarmatia, 2^{nd} half of 1^{st} c. – 1^{st} half of 2^{nd} c. AD) ; (Altay) <tamga> (details: Table 8-34).

Evaluation (SFG-18):

Changed script: TR & SHR.

Region of relics: TR: Inner Asia; SHR: Carpathian Basin.

Source script family:

OM1: Aramaic.

OM2: Brahmic.

Period of change:

OM1: 7^{th}/6^{th}–1^{st} c. BC, the using period of the Imperial Aramaic (Table 8-12) script.

OM2: 4^{th}–8^{th} c. AD, the using period of Brāhmī glyph variants presumed to be the ancestor (Table 8-15), the upper limit is the age of the earliest TR or SHR inscriptions (Table 8-19).

Region of change: OM1 & OM2: Inner Asia.
Glyph fit only with tamgas: OM1: 1. OM2: 1.

Comments (SFG-18):

(i) The sound values /d͡ʒʲ/ or /ď/ of SHR (Erdőszentgyörgy) <g> are the influence of the Old Hungarian orthography of the Latin script (Zelliger, Erzsébet: Personal communication, 2011–2013).

(ii) Nagy supposed that SHR <g> and TR <^{I}k^{I}> (SFG-57) are relatives (Nagy 1895: 274), cf. Table 7-6: 7-4. §. This presumption would require a voicing (sonorization), which is possible (Table 7-9: 7-6. §), but according to *lex parsimoniae* of cladistics (Table 4-1) descent options with fewer assumptions are worth considering.

(iii) According to Sebestyén, SHR <g> is relative to TR <g^2> and TR <^{I}k^{I}> (SFG-57); furthermore, it is presumed to be of Greek and Phoenician origin, respectively. According to him, the reason of the short slant stroke is the distinction from SHR <l> (SFG-64) and <š> (SFG-98) (Sebestyén 1906: 272–273, 275).

(iv) According to Németh, SHR <g> corresponds to TR <g^2> (Németh 1934: Appendix VI; Németh 1971: 38).

(v) According to Clauson, TR <g^2> is of Greco-Bactrian origin (Clauson 1970: 69). However, Greco-Bactrian (Kaniṣka), (Chionites-Hephtalites, Arabo-Hephtalites), (Ghirshman 1948: 63) *gamma* <γ> significantly differs form the descendant graphemes.

(vi) Both TR <g^2> and ancestor graphemes Brāhmī <ge> and <gi> are used in syllables with front (palatal) vowels, which supports OM2.

(vii) It is homoplasy is the similarity of the following graphemes to the descendant graphemes: Southeastern Iberian ,,, <ga/ka> (Ferrer i Jané 2010: 71, 77; Ferrer i Jané 2013: 447); Northeastern Iberian ,; ,,,,, (Hesperia: Narbonensis, retrieved on 24 June 2016); (dual) /ga/, ; , /ka/ <ka/ga> (Ferrer i Jané 2005: 981; Ferrer i Jané 2014: 244–245); Celtiberian (Botorrita) (Eska 2008: 166–167), ,,,, (Hesperia: Narbonensis, retrieved on 24 June 2016) <ka>; Northeastern Iberian ,,,,,,,,, (Hesperia: Narbonensis, retrieved on 24 June 2016) <ge/ke> /ge, ke/, (dual) , <ge> /ge/, ,,,, <ke> /ke/ (Ferrer i Jané 2005: 981; Ferrer i Jané 2014: 244–245) <ke> /ge, ke/.

SFG-19

Descendant feature (grapheme):
CBR (Szarvas, first half of 8th c.) <g> /g/;
CBR (Jánoshida, last third of 7th c.) <rg> /rg/ (Table 8-26).

OM1 (SFG-19):
Middle Iranian ancestor feature (grapheme):
Parthian (early, Nisa, 1st c. BC) (Skjærvø 1996: 518); (Avroman, 13/12 BC) , (Ivantchik & Lurje 2013: 290); (inscriptional) (Skjærvø 1996: 518); *gāmal* <g> /g, γ/;
Middle Persian (Book Pahlavi) ,, (Skjærvø 1996: 518); (Rosenthal et al. 1986–2011: Table 3) *gāmal* <g> /g, γ/;
Middle Iranian witness feature (grapheme): *Middle Persian* (inscriptional) , (Psalter) (Bulayïq, 6th–7th c., a copy of an origin from the 4th c. AD) (Skjærvø 1996: 518) *gāmal* <g> /g, γ/.

OM+ (SFG-19):
Tamgas ancestor feature (glyph shapes or styles):
Tamgas (Basins of the Amu Darya and the Syr Darya, 1st c. BC –3rd c. AD) ; (Beskepe) ; (Altay) ; (Mongolia) <tamga> (details: Table 8-34).

Evaluation (SFG-19):
Changed script: CBR.
Region of relics: CBR: Carpathian Basin.
Source script family:
OM1: Middle Iranian.
Period of change:
OM1: 2nd c. BC – 7th c. AD, the union of the using periods of Parthian and Middle Persian scripts (Table 8-16).
Region of change: OM1: Inner Asia.
Glyph fit only with tamgas: OM1: 1.

Comments (SFG-19):

(i) Vékony suggested Parthian <g> (SFG-19) (Vékony 2004a: 165) as ancestor. The slant main stem of the glyph makes this lineage possible.

(ii) Due to the direction of the slope of the glyph, neither Phoenician (ca. 700 BC) <g> (SFG-18), nor Ancient Greek (8th–5th c. BC) <γ> (SFG-18) is an ancestor.

(iii) The glyph of CBR <g> is simple, its Glyph Complexity Parameter (GCP) is only 1 (Table 8-2). Therefore, it is difficult to determine from which script it may come.

SFG-20

Descendant feature (grapheme):
SR (Achik-Tash, 8th c.) ; (Kermen Tolga, 8th–10th c.) ; (Mayatskoe-10, 9th c.) ; (Khumara-6, 9th–10th c.) ; (Khumara-7, 9th–10th c.) <g²> /g/;
SR (Homokmégy-Halom, 10th c.) <g¹> /γ/.

OM1 (SFG-20):
Middle Iranian ancestor feature (grapheme):
Middle Persian (inscriptional) (Skjærvø 1996: 518–519) *qōp̄* <q>.

OM2 (SFG-20):
Brahmic ancestor feature (grapheme):
Brāhmī (alphabets r and s [Early Turkestan]) , , , (alphabet t [North Turkestan Type A]) , (Standard North Turkestan [alphabet u, Type B]) , (alphabet v [Khotanese]) (Sander 1968: Tafel 29); (Khotanese) (Leumann 1934: 17) <ga> (more glyphs: SFG-18);
Brahmic witness feature (grapheme): *Brāhmī* (Aśoka, around 250 BC) , (Cunningham 1877: Plate XXVII) <ga>.

OM3 (SFG-20):
Rovash ancestor feature (grapheme):
TR , , <g²> (details: SFG-18).

OM+ (SFG-20):
Tamgas ancestor feature (glyph shapes or styles):
Tamgas (Bayte III) ; (Mongolia) (Yatsenko 2001: 185, Рис. 35) <tamga> (details: Table 8-34).

Evaluation (SFG-20):
Changed script: SR.
Region of relics: SR: Inner Asia, Pontus Steppe & Carpathian Basin.
Source script family:
OM1: Middle Iranian.
OM2: Brahmic.
OM3: Rovash (internal development) (becoming similar or borrowing [Table 4-2, glyph shape transfer, Table 2-9: 2-2. §]; use of known glyph [Table 4-3]).
Period of change:
OM1: 3^{rd}–7^{th} c. AD, the using period of the Middle Persian script (Table 8-16).
OM2: 4^{th}– 8^{th} c. AD, the using period of the Brāhmī script (Table 8-15), the upper limit is the age of the earliest SR inscriptions (Table 8-19).
OM3: Before 8^{th} c. AD, the upper limit is the age of the earliest SR relic (Table 8-32).
Region of change: OM1, OM2 & OM3: Inner Asia.
Glyph fit only with tamgas: OM1: 0. OM2: 1. OM3: 1.

Comments (SFG-20):
(i) According to Agyagási, the /q/ > /γ/ secondary voicing and spirantization is an areal phenomenon of the Western Old Turkic, a process that has already taken place in R-Turkic and Kipchak languages living in the South Russian Steppe (Agyagási 2009: 89), cf. Table 7-9: 7-6. §. Based on this, <g^1, g^2> might be formed by borrowing Middle Persian <q> with /q/ sound value, and then becoming /γ/ by voicing.

(ii) It is worth noting that Middle Persian legend *ḥ'k'n* 'khagan' is *γ'γ'n* in Sogdian orthography (Harmatta & Litvinsky 1996: 368). Due to Sogdian influence, it might be possible that a Middle Persian <q> is borrowed in TR as /γ/.

(iii) SR , , <g^2> may be closed glyph variants of TR , , <g^2> (SFG-18); see some examples for analogue shape development: Northeastern Iberian , , <ge/ke>, <ge> /ge/, , , <ke>; , <ke> (SFG-18).

SFG-21

Descendant feature (grapheme):
TR (Y) (Orkun 1986); (Kyzlasov, I. L. 1994: 118); (Zhalgyz-Tjobe I) <g^1> /γ/;
SHR (Vargyas, 12^{th}–13^{th} c.) <γ> /γ/;
CBR (Környe, end of 7^{th} c.) , ; (Szarvas, first half of 8^{th} c.) ; (Nagyszentmiklós, 8^{th}–11^{th} c.) , , <γ> /γ/;
SR (Jitkov, first third of 8^{th} c.) /γ/, /g/, /γ/ <g^1, g^2>;
SR (Achik-Tash, 8^{th} c.) /γ/; (Mayaki, 8^{th}–9^{th} c.) /γ/; (Mayatskoe-10, 9^{th} c.) /γ/; (Khumara-6, Khumara-8 [in copy], 9^{th}–10^{th} c.) /γ/; (Kievan Letter, 955–961) /γ/ <g^1>.

OM1 (SFG-21):

Middle Iranian ancestor feature (grapheme):

Sogdian (early, Kultobe, before 4th c. AD) (Sims-Williams & Grenet 2006: colour illustrations without page numbering); (Ancient Letters, beginning of 4th c. AD) (Skjærvø 1996: 519); (Ancient Letters, beginning of 4th c. AD) (Harmatta 2004: 186); (sutra) (Skjærvø 1996: 519) *gāmal* <γ> /g, γ/ (Skjærvø 1996: 519, 530).

OM+ (SFG-21):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Achaemenid Iran) ; (Bayte III) ; (Basins of the Amu Darya and the Syr Darya, 6th–2nd c. BC) , ; (1st c. BC –3rd c. AD) ; (Kultobe, 1st–3rd c. AD) ; (Sidak, 5th – early 8th c. AD) ; (Altay) ; (Mongolia) ; (Ancient Turkic tribal tamgas) <tamga> (details: Table 8-34).

Evaluation (SFG-21):

Changed script: SHR, CBR & SR.

Region of relics: SHR: Carpathian Basin; CBR: Carpathian Basin; SR: Inner Asia & Pontus Steppe.

Source script family:

OM1: Middle Iranian.

Period of change:

OM1: 2nd–7th c. AD, the using period of the Sogdian script (Table 8-16), the upper limit is the age of the earliest SHR, CBR or SR script relics (Table 8-19).

Region of change: OM1: Inner Asia.

Glyph fit only with tamgas: OM1: 1.

Comments (SFG-21):

(i) Vékony proposed that CBR <γ> could indirectly originate from an Aramaic origin <ḥ> (Vékony 2004a: 155). However, according to Skjærvø, there is no evidence that the Parthian *ḥē̱t* <ḥ> /h, χ/ could represent /γ/ (Skjærvø, Prods Oktor: Personal communication by email, 23 November 2013). According to Cheung, normally, the voiceless /χ/ would not have been sonorized, except in the segment /*χt/ > /γd/, a development typical for all East Iranian languages (Cheung, Johnny: Personal communication by email, 16 December 2013). Based on this, the Parthian <ḥ> /h, χ/ is certainly not the ancestor of the <γ> /γ/ and related Rovash graphemes. Their ancestor could be of Aramaic origin <g>, denoting /γ/. The Sogdian <ḥ> represented /χ/, the Sogdian <g> denoted /γ/ (Sims-Williams 1989: 176, Table 1). According to Sims-Williams, the glyphs of the Sogdian <ḥ> and <g> remained different until the late Sogdian period in word-final position and the practice of some scribes in both medial and initial position (Sims-Williams 1981a: 194–195). According to Skjærvø, in the cursive form of the Sogdian script, the <γ> and <ḥ> are usually indistinguishable, though kept distinct in final position in some manuscripts (Skjærvø 2006–2012). Of <g> graphemes in Aramaic origin scripts, only Sogdian has a glyph that could be the ancestor of Rovash , , <g^1, g^2, γ>.

(ii) The closest relatives of TR (Y) , <g^1> are possibly not in SFG-21, but in SFG-22.

(iii) In Hungarian and Turkic, the /g, γ/ >/k/ devoicing is unlikely (Table 7-9: 7-6. §). Therefore, Rovash , <k, k^1> (SFG-58) could not develop from a grapheme with /g, γ/ sound values, i.e., SFG-58 could not be derived from SFG-21. However, if Rovash , <k, k^1>

evolved from the Middle Persian 𐭪, 𐭪 *kāp̄* <k> (SFG-58), there was no need for voicing, since Middle Persian <k> had both voiced and voiceless sound values: /g, k/. Nevertheless, the glyph distribution of the Middle Persian <k> (SFG-58) is very different from the descendant graphemes of SFG-21, so it is likely not an ancestor grapheme.

(iv) The descendant graphemes could in principle be derived from voicing of TR И, N <$^{A}q^{A}$>; SHR, CBR ᛸ, ᛸ <k> (SFG-58), but this would be an additional assumption; therefore, this option is omitted.

(v) The glyph distributions of the descendant graphemes of SFG-21 and SFG-58 significantly overlap, but this is probably due to the common writing technology (Table 4-2).

SFG-22

Descendant feature (grapheme):

TR (O, Y) ᛉ, ᛌ, (Y) ᛙ (Thomsen 1893: 9); (Y) ᛘ (Vasil'ev 1983 apud Harmatta 1997b: 163); (Y) ᛘ (Orkun 1986); ᛉ, ᛏ, ᛉ; (Epitaph of Qarï Čor Tegin) ᛉ (Rybatzki & Wu 2014: 118–119); (Khentii, second half of 8th c. – beginning of 9th c.) ᛉ; (Kalbak-Tash IV/VI) ᛙ; (Kalbak-Tash XXX) ᛙ <g^1> /γ/;

SR (Homokmégy-Halom, 10th c.) ᛌ <g^1> /ġ/.

OM1 (SFG-22):

Brahmic ancestor feature (grapheme):

Brāhmī (Steppe Brāhmī, Khüis Tolgoi inscription, after 600, top-down vertical per line writing direction with RTL column order [Maue 2018: 291]) ᚱ (Ölmez & Maue 2019: 76, 81) <γa> (<g_1a>).

Brahmic witness feature (grapheme): *Brāhmī* (North Turkestan, in Turkic texts) ᛞ (Róna-Tas 1991: 114, Table IV); (Standard North Turkestan) ᛞ (Maue 2010: 9) <gha> /g^h/; *Brāhmī* (North Turkestan) ᛏ (Maue 2016b: 143) <g_1a>; *Brāhmī* (North Turkestan) ᛏ (Maue 2016b: 143) <g_2a>.

OM2 (SFG-22):

Rovash ancestor feature (grapheme):

TR ᛝ <g^1> (details: SFG-21);

Rovash witness feature (grapheme): *SHR* ᚺ <γ>; *CBR* И, N <γ>; *SR* ᚺ, И, ᛜ <g^1> /γ/ (details: SFG-21).

OM+ (SFG-22):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Achaemenid Iran) ᛉ; (Bayte III) ᛙ, ᛉ, ᛉ; (South Kazakhstan and Chu-Ili interfluve) ᛙ; (Basins of the Amu Darya and the Syr Darya, 6th–2nd c. BC) ᛙ, ᛏ; (Kanka) ᛉ; (Old Turkic coins of Tokharistan, 7th–8th c. AD) ᛉ; (Altay) ᛙ; (Mongolia) ᛉ; (Almaly) ᛉ, ᛉ <tamga> (details: Table 8-34).

Evaluation (SFG-22):

Changed script: TR & SR.

Region of relics: TR: Inner Asia; SR: Carpathian Basin.

Source script family:

OM1: Brahmic (becoming similar or borrowing [Table 4-2]; rotating or use of known glyph [Table 4-3]).

OM2: Rovash (internal development) (different visual identities [Table 4-2]; line insertion, separating or use of known glyph [Table 4-3]).

Period of change:

OM1: 7th–8th c. AD, the using period of Brāhmī glyph variant presumed to be the ancestor (Table 8-15), the upper limit is the earliest TR or SR inscriptions (Table 8-19).

OM2: Not later than 8th c. AD, the upper limit is the earliest TR or SR inscriptions (Table 8-19).

Region of change: OM1 & OM2: Inner Asia.

Glyph fit only with tamgas: OM1: 1. OM2: 1.

Comments (SFG-22):

(i) Interpreting TR 𐰍, ˈıˈ <g^1> as a Turkic pictograph, its formation from Old Turkic *aγ* 'net' word was supposedly based on its shape (Thomsen 1922; Róna-Tas 1987: 8–9). For an analysis of the issue of Turkic pictographs, see Table 3-4.

(ii) According to Clauson, the glyph of TR ˈıˈ <g^1> may simply have been invented (Clauson 1970: 68–69).

(iii) Vékony suggested the possible relationship between CBR И <γ> (SFG-21) and TR 𐰍, ᛉ, ˈıˈ <g^1> (SFG-22) (Vékony 2004a: 153, 155), see OM2. The purpose of this development may have been to make the shape of the descendant grapheme different from the shape of the TR И, N <^{A}q^A> (SFG-58), so that their visual identities (Table 4-2) became different.

(iv) The Anatolian-Greek Alphabetic Lycian)|(, ͻ|c (Faulmann 1880: 168), ⁎ (Melchert 2008a: 48) <q> /k/ (Melchert 2008a: 48–49) or /q?/ (Adiego 2007e: 8) is similar to TR glyphs ᛉ, ˈıˈ, ˈǀˈ. Their relationship should be presumed to be a /k/ > /γ/ sound change, which might be justified based on Table 7-9: 7-6. §. However, the full glyph distribution of TR <g^1> should also be derived from Lycian <q>, which is cumbersome: Lycian)|(>? TR ᛉ, ˈıˈ, ˈǀˈ >? 𐰍, ϒ, ϒ. Thus despite the formal similarity, Lycian)|(<q>—by modifying a previous presumption (Hosszú 2017: 215)—is not considered a relative of TR ᛉ <g^1>.

SFG-23

Descendant feature (grapheme):

TR (Y) ◊ (Vasil'ev 1983 apud Harmatta 1997b: 163); (T) ✧ (Kyzlasov, I. L. 1994: 70); (Y: Begre, 8th–9th c.) ʘ; (Y) ◈ (Büyük Larousse 9: 4679; Tekin 2003: 23); (Y) O, ⊙, ◊ (Kairžanov 2014: 18) <ṅ> /ŋ/.

OM1 (SFG-23):

Anatolian Hieroglyphic ancestor feature (grapheme):

Anatolian Hieroglyphic ◈; ◈; ◊ *423 <ku> (details: SFG-91).

OM2 (SFG-23):

Brahmic ancestor feature (grapheme):

Brāhmī (Tocharian) 𑀗 (Krause & Thomas 1960: 41); (North Turkestan) 𑀗 (Róna-Tas 1991: 114, Table IV) <ṅa>;

Tibetan ང (Róna-Tas 1991: 117, Table VII) <ṅ> or <ng>.

OM+ (SFG-23):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Bayte III) ◊; (coins with double-humped camel, 7th–8th c. AD) ✧; (Basins of the

Amu Darya and the Syr Darya, 6th–2nd c. BC) ⊙, ◈, (1st c. BC –3rd c. AD) ⊙, (4th–8th c. AD) O <tamga> (details: Table 8-34).

Evaluation (SFG-23):
Changed script: TR.
Region of relics: TR: Inner Asia.
Source script family:
OM1: Anatolian Hieroglyphic.
OM2: Brahmic (adaptation, becoming similar or borrowing [Table 4-2]; use of known glyph [Table 4-3]).
Period of change:
OM1: Around 7th c. BC, the end of the using period of the Anatolian Hieroglyphic (Table 8-5) script.
OM2: 4th–8th c. AD, the using period of Brāhmī glyph variants presumed to be the ancestor (Table 8-15), the upper limit is the age of the earliest TR inscriptions (Table 8-29).
Region of change: OM1: Anatolia. OM2: Inner Asia.
Glyph fit only with tamgas: OM1: 0. OM2: 1.

Comments (SFG-23):

(i) In Anatolian Hieroglyphic, the /n/ before the consonants were not marked in writing (Table 7-10), no distinction was made between voiced and voiceless, and aspirated and unaspirated voices; all of this properties are similar to Aegean syllabic scripts (Fischer 2001: 75). Based on these properties, TR ◊ <ṅ> could be derived from the Anatolian Hieroglyphic ◊ <ku> (SFG-91) (OM1).

(ii) The middle point in glyphs of TR ⊙, ◈, ⊙ <ṅ> supports that the descendant glyphs may originate from tamgas.

SFG-24

Descendant feature (grapheme):
TR (O, J, T) 𐰭 (Thomsen 1893: 9; Kyzlasov, I. L. 1994: 72), 𐰭 (Kairžanov 2014: 18), (Y) 𐰮 (Thomsen 1893: 9), 𐰮 (Kairžanov 2014: 18), (manuscript) ❯ (von Gabain 1941), 𐰭 (Róna-Tas 1987: 13), (Kül Tegin, 732; Bilge Khagan, 735) 𐰭, (Toyok) 𐰭, (Ïrq Bitig Manuscript, 930) 𐰭, (Dunhuang Letter) 𐰭, (Khakassia, Tuva) 𐰭 (Clauson 1970: 75); (Kalbak-Tash I) 𐰭; (Kalbak-Tash II, 8th c.) 𐰭; (Urkosh, 8th–9th c.) 𐰭 (Tugusheva et al. 2014: 78, 81); (Bichiktu-Boom XVI/3) 𐰮 <ṅ> /ŋ/;
SR (Kermen Tolga, 8th–10th c.) Y; (Mayatskoe-10, 9th c.) Y <ṅ> /ŋ/.

OM1 (SFG-24):
Aramaic ancestor feature (grapheme):
Imperial Aramaic ⅄, ⅄, ⅄, ⅄ *gāmal* <g> /g, γ/ (details: SFG-18);
Middle Iranian witness feature (grapheme): *Parthian* (early, Nisa, 1st c. BC) ➤ (Skjærvø 1996: 518); (Avroman, 13/12 BC) ⅄, ⅄ (Ivantchik & Lurje 2013: 290); (inscriptional) ⅄ (Skjærvø 1996: 518); ⅄ *gāmal* <g> /g, γ/.

OM2 (SFG-24):
Brahmic ancestor feature (grapheme):
Brāhmī (alphabet t [North Turkestan Type A]) ञ, (Standard North Turkestan [alphabet u,

Type B]) 𑀗 (Sander 1968: Tafel 29) <ṅā>;
Brahmic witness feature (grapheme): *Brāhmī* (Tocharian) 𑀗; (North Turkestan) 𑀗 <ṅa> (details: SFG-23); *Tibetan* ང <ṅ> (details: SFG-23).

OM+ (SFG-24):
Tamgas ancestor feature (glyph shapes or styles):
Tamgas (Basins of the Amu Darya and the Syr Darya, 6th–2nd c. BC) ᚴ <tamga> (details: Table 8-34).

Evaluation (SFG-24):
Changed script: TR & SR.
Region of relics: TR: Inner Asia; SR: Pontus Steppe.
Source script family:
OM1: Aramaic.
OM2: Brahmic.
Period of change:
OM1: 7th/6th–1st c. BC, the using period of the Imperial Aramaic (Table 8-12) script.
OM2: 4th–8th c. AD, the using period of Brāhmī glyph variants presumed to be the ancestor (Table 8-15), the upper limit is the age of the earliest TR or SR inscriptions (Table 8-19).
Region of change: OM1 & OM2: Inner Asia.
Glyph fit only with tamgas: OM1: 0. OM2: 1.

Comments (SFG-24):

(i) Based on Table 7-10: 7-13. §, the ancestor of SFG-24 might be an Anatolian-Greek Alphabetic <g>. However, the shape of Ancient Greek Ꞁ, ⅂, 〉, ⋀ *gamma* <γ> /g/ [g] (occasionally [ŋ], cf. Table 7-10) (SFG-18) differs from the descendant grapheme. Lycian ⅄, ᚴ, (TL 5) Ɣ (Kalinka 1901 apud Adiego 2015: 21) <g> /g/ (Adiego 2007e: 8) could be more appropriate, but based on the age of the known Lycian script relics, it cannot be ancestor (cf. Table 4-5: 4-7 §).

(ii) According to Clauson, TR 𐰭 <ṅ> was created from other glyphs of TR (Clauson 1970: 69). That seems unlikely.

(iii) It is worth noting that in Uyghur script (Table 8-20), which originated from the Sogdian script, /ŋ/ was denoted by the digraph of <n> and <k> (Clauson 1970: 59).

(iv) For the /n/ + C sound pairs, see Table 7-10.

SFG-25

Descendant feature (grapheme):
CBR (Környe, end of 7th c.) 〉; (Szarvas, first half of 8th c.) 〉; (Kiskundorozsma, end or last third of 8th c.) >; (Nagyszentmiklós, 8th–11th c.) > <d> /d/;
SR (Jitkov, first third of 8th c.) > /δ/; (Achik-Tash, 8th c.) > /δ/; (Mayaki, 8th–9th c.) ≻ /ǰ/; (Kermen Tolga, 8th–10th c.) > /δ/; (Novocherkassk, 8th–10th c.) > /δ/; (Mayatskoe-1, 9th c.) 〉 /δ/; (Mayatskoe-2, 9th c.) 〉 /δ/; (Mayatskoe-10, 9th c.) 〉 /δ/; (Khumara-6, Khumara-7, Khumara-8 [in copy], 9th–10th c.) > /δ/; (Kievan Letter, 955–961) 〉 /δ/ <d>.

OM1 (SFG-25):
Anatolian-Greek Alphabetic ancestor feature (grapheme):
Carian (Kaunos, Kildara, Memphis, Sinuri, Stratonikeia) C, Ɔ, (Memphis, Mylasa) <,

(Memphis) ⟩; (Bronze Lion, ca. 500 BC, E.xx 7, RTL writing direction) ⟩ (Masson 1976: 82–83; Adiego 2007a: 128, 223) <d> /d/ [ð] (Adiego 2007e: 10);

Anatolian-Greek Alphabetic witness feature (grapheme): *Old Phrygian* Λ <d> (details: SFG-26); *Ancient Greek* Λ *delta* <δ> (details: SFG-26); *Lydian* 𐤣 (Littmann 1916: 1; Adiego 2007e: 7; Melchert 2008b: 57) <d> /ð/ (Melchert 2008b: 58) or /d/ (Adiego 2007e: 7).

OM2 (SFG-25):

Aramaic ancestor feature (grapheme):

Imperial Aramaic (satrapies, 5th–4th c. BC) 𐡃, 𐡃, (monuments, Egypt, 4th–3rd c. BC) 𐡃, (papyrus, Egypt, 2nd c. BC) 𐡃, 𐡃 (Taylor 1883, vol. I: 250); (7th–5th/4th c. BC) 𐡃 (Gibson 1975); 𐡃, 𐡃; (Elephantine Papyri, 6th c. BC) 𐡃 (Glass 2000: 14); (Assyrian and Egyptian papyri) 𐡃, 𐡃, (Babylonian bowls) 𐡃, 𐡃 (Faulmann 1880: 79); (cursive, Egypt, 5th–3rd c. BC) 𐡃, 𐡃 (Lidzbarski 1910); (6th c. BC) 𐡃, (4th c. BC) 𐡃, (1st c. BC) 𐡃 (Schniedewind 2006: 140); (Aśoka, around 250 BC) 𐡃 (Glass 2000: 14); 𐡃 (MacKenzie 1971: xi) *dāleṯ* <d> /d, δ/;

Aramaic witness feature (grapheme): *Nabataean* 𐢄, 𐢄 *dāleṯ* <d> /d, δ/; *Hatran* (H 79, soon before AD 240) 𐣣 (Beyer 1998: 10, 47–48) <d>; *Palmyrene* 𐡣, 𐡣, 𐡣 (Harmatta 2000: 181) *dāleṯ* <d> /d, δ/; *Arabic* (early) د, (modern) د (Macdonald 2008: 218) *dāl* <d> /d/.

OM3 (SFG-25):

Middle Iranian ancestor feature (grapheme):

Parthian (early, Nisa, 1st c. BC) 𐭃 (Rosenthal et al. 1986–2011: Table 3); 𐭃, 𐭃; (inscriptional) 𐭃 (Nyberg 1964); (inscriptions, 3rd c. AD) 𐭃 (MacKenzie 1971: xi); (coins of the Parthian kings, 1st–2nd c. AD) 𐭃 (Taylor 1883, vol. II: 236) *dāleṯ* <d> /d, δ/;

Khwarazmian (Chirik-Rabat [Kyzylorda Region, Kazakhstan], 4th–2nd c. BC) 𐾴 (Ivantchik & Lurje 2013: 286–287); (Tok-kala, 7th–8th c. AD) 𐾴 (Vainberg 1977: Table VIII) <d>;

Sogdian (Ancient Letters, early 4th c. AD) ⅃ (Skjærvø 1996: 519) *dāleṯ* <d> /d, δ/.

OM+ (SFG-25):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Chu-Ili interfluve) > <tamga> (details: Table 8-34).

Evaluation (SFG-25):

Changed script: CBR & SR.

Region of relics: CBR: Carpathian Basin; SR: Pontus Steppe.

Source script family:

OM1: Anatolian-Greek Alphabetic.

OM2: Aramaic.

OM3: Middle Iranian.

Period of change:

OM1: 7th–3rd c. BC, the using period of the Carian script (Table 8-8).

OM2: 5th–1st c. BC, the using period of that Imperial Aramaic (Table 8-12) glyph variants presumed to be the ancestor.

OM3: 2nd c. BC – 7th c. AD, the union of the using periods of Parthian (Table 8-16), Khwarazmian and Sogdian scripts; the upper limit is the age of the earliest CBR or SR script relics (Table 8-19).

Region of change: OM1: Anatolia. OM2 & OM3: Inner Asia.
Glyph fit only with tamgas: OM1: 0. OM2: 0. OM3: 0.

Comments (SFG-25):

(i) According to Vékony, the ancestor of CBR > <d> is the straightened shape of the Parthian 𐭃 *dāle*<u>*t*</u> <d> (Vékony 1987a: 120). Besides, Khwarazmian and Sogdian <d> may also be considered an ancestor-candidate. If the glyph ≻ of <d> in the Mayaki SR inscription is not just a simple italicized variant, it reinforces Middle Iranian derivation (OM3).

SFG-26

Descendant feature (grapheme):

SR (Jitkov, first third of 8th c.) ᑎ, ∩ /ǰ/; (Achik-Tash, 8th c.) ∩ /d/; (Novocherkassk, 8th–10th c.) ∩ /d/; (Mayatskoe-10, 9th c.) ∩ /d/; (Khumara-6, Khumara-7, 9th–10th c.) ∩ /d/ <d>;
SR (Mayatskoe-1, 9th c.) ∩; (Mayatskoe-10, 9th c.) ∩ <<u>dA</u>> /da/ (Table 8-28);
SR (Kermen Tolga, 8th–10th c.) ∩; (Mayatskoe-10, 9th c.) ∩ <<u>dI</u>> /de/ (Table 8-28).

OM1 (SFG-26):
Anatolian-Greek Alphabetic ancestor feature (grapheme):
Old Phrygian (M-01a – first side of the Midas Tomb) Λ (Adiego 2007e: 3) <d> /d/;
Ancient Greek (Eltynia [Crete, Greece]) Λ (Jeffery 1961: 24) *delta* <δ> /d/.

OM2 (SFG-26):
Middle Iranian ancestor feature (grapheme):
Parthian 𐭕, 𐭕, 𐭕 *tāw* <t> /t, d/ (details: SFG-103).

OM+ (SFG-26):
Tamgas ancestor feature (glyph shapes or styles):
Tamgas (Achaemenid Iran) ∩; (Bayte III) ∩; (Basins of the Amu Darya and the Syr Darya, 1st c. BC –3rd c. AD) ∩ <tamga> (details: Table 8-34).

Evaluation (SFG-26):
Changed script: SR.
Region of relics: SR: Inner Asia & Pontus Steppe.
Source script family:
OM1: Anatolian-Greek Alphabetic (becoming similar or borrowing [Table 4-2]; use of known glyph [Table 4-3]).
OM2: Middle Iranian (becoming similar or borrowing [Table 4-2]; use of known glyph [Table 4-3]).
Period of change:
OM1: 9th–4th c. BC, the union of the using periods of Old Phrygian and Ancient Greek scripts (Table 8-8).
OM2: 2nd c. BC – 3rd c. AD, the using period of the Parthian script (Table 8-16).
Region of change: OM1: Anatolia. OM2: Inner Asia.
Glyph fit only with tamgas: OM1: 0. OM2: 1.

Comments (SFG-26):

(i) The shape of the descendant grapheme certainly comes from tamgas. So, it is not easy to find the ancestor grapheme from which the descendant grapheme's sound value is derived.

(ii) Vékony propounded that SR ∩ <d> is a descendant of Parthian *tāw* <t> (Vékony 1987a: 120), see OM2.

(iii) Due to differences in sound value, none of the Aramaic or Middle Iranian <t> can be considered the ancestor of SR ∩ <d> except Parthian and Middle Persian <t>. The shapes of Middle Persian 𐭲 *tāw* <t> /t, d/ (SFG-108) and SR ∩ <d> significantly differ from each other; thus they are surely not relatives.

(iv) SR >, ᐳ, ᛡ <d> /d, δ, ǰ/ (SFG-25) is presumably not ancestor, since it was usually used with SR ∩ <d> in the same inscriptions for differentiate between palatal and velar syllables (vowel harmony, Table 7-1).

SFG-27

Descendant feature (grapheme):

TR (Y) 𐰓 (Vasil'ev 1983 apud Harmatta 2004: 186); (Y: Begre, 8th–9th c.) 𐰓; (O, T, Y) 𐰓, (Y) 𐰓, 𐰓, (T) 𐰓 (Kyzlasov, I. L. 1994: 71), (Y) 𐰓 (Jensen 1969a: 424, Fig. 419 apud Bernal 1987: 8, Fig. 6; Bernal 1990: 41, Table 6); (Y) 𐰓 (Büyük Larousse 9: 4678), (Küli Čur, 719–724) 𐰓 (Tekin 2003: 22) <d^1> /d/.

OM1 (SFG-27):
Kharoṣṭhī ancestor feature (grapheme):

Kharoṣṭhī (Aśoka, around 250 BC) 𐨢, (British Library) 𐨢, 𐨢, 𐨢, 𐨢, (Khotan Dharmapada) 𐨢, (Niya) 𐨢, (Schøyen) 𐨢, 𐨢 (Glass 2000: 80–81) <dha> /d^ɦ/.

OM2 (SFG-27):
Aramaic ancestor feature (grapheme):

Armazian ⟩ (Cereteli 1948–1949 apud Róna-Tas 1987: 14); ⟩ (Häberl 2006: 57) *dāleṯ* <d>;
Aramaic witness feature (grapheme): *Hatran* 𐣣 (PROEL: Alfabeto Hatran, retrieved in 2016) <d> (other glyphs: SFG-25); *Elymaic* (Tang-e Sarvak) ⟩, ⟩, (Shimbār) ⟩, ⟩ (Häberl 2006: 57) <d>.

OM3 (SFG-27):
Middle Iranian ancestor feature (grapheme):

Parthian 𐭃, 𐭃, 𐭃 *dāleṯ* <d> /d, δ/ (details: SFG-25);
Middle Persian (inscriptions, 3rd c. AD) 𐭣 (MacKenzie 1971: xi) *dāleṯ* <d> /d, y/ (Skjærvø 1996: 519).

OM4 (SFG-27):
Brahmic ancestor feature (grapheme):

Brāhmī (Aśoka, around 250 BC) 𑀤, 𑀤 (Cunningham 1877: Plate XXVII); (Socotra [Jemen], T 32, LTR inscription, end of 2nd c. AD – 4th c.) 𑀤 (Strauch & Bukharin 2004: 127); (Tocharian) 𑀤 (Krause & Thomas 1960: 41); (North Turkestan) 𑀤 (Róna-Tas 1991: 114, Table IV); (alphabet q [Turkestan Gupta]) 𑀤, 𑀤, (alphabets r and s [Early Turkestan]) 𑀤, 𑀤, 𑀤, (alphabet t [North Turkestan Type A]) 𑀤, (Standard North Turkestan [alphabet u, Type B]) 𑀤, (alphabet v [Khotanese]) 𑀤, (Sander 1968: Tafel 29) <da>;
Brahmic witness feature (grapheme): *Brāhmī* (Tocharian) 𑀟 (Krause & Thomas 1960: 41); (North Turkestan) 𑀟 (Róna-Tas 1991: 114, Table IV); (Standard North Turkestan [alphabet u, Type B]) 𑀟 (Sander 1968: Tafel 29) <ḍa>; *Brāhmī* (Tocharian) 𑀤 (Krause

& Thomas 1960: 41); (North Turkestan) (Róna-Tas 1991: 114, Table IV); (alphabet q [Turkestan Gupta]) , , (alphabets r and s [Early Turkestan]) , (alphabet t [North Turkestan Type A]) , (Standard North Turkestan [alphabet u, Type B]) , (alphabet v [Khotanese]) (Sander 1968: Tafel 29) <ḍha>.

OM+ (SFG-27):
Tamgas ancestor feature (glyph shapes or styles):
Tamgas (Bactrian sign, northern Afghanistan, Bronze Age) ; (Basins of the Amu Darya and the Syr Darya, 1st c. BC –3rd c. AD) , ; (Sarmatia, 2nd half of 1st c. – 1st half of 2nd c. AD) ; (Sidak, 5th – early 8th c. AD) ; (Ancient Turkic tribal tamgas) <tamga> (details: Table 8-34).

Evaluation (SFG-27):
Changed script: TR.
Region of relics: TR: Inner Asia.
Source script family:
OM1: Kharoṣṭhī.
OM2: Aramaic.
OM3: Middle Iranian.
OM4: Brahmic.
Period of change:
OM1: 5th/3rd c. BC – 7th c. AD, the using period of the Kharoṣṭhī (Table 8-14) script.
OM2: 1st–2nd c. AD, the using period of the Armazian (Table 8-12) script.
OM3: 2nd c. BC – 7th c. AD, the union of the using periods of Parthian (Table 8-16) and Middle Persian scripts.
OM4: 4th–8th c. AD, the using period of Brāhmī glyph variants presumed to be the ancestor (Table 8-15), the upper limit is the age of the earliest TR inscriptions (Table 8-29).
Region of change: OM1, OM2, OM3 & OM4: Inner Asia.
Glyph fit only with tamgas: OM1: 1. OM2: 1. OM3: 1. OM4: 1.

Comments (SFG-27):

(i) Róna-Tas derives TR , <d^1> from the Armazian <d> (Róna-Tas 1987: 14), which is described in OM2.

(ii) According to Clauson, TR , <d^1> originated from Middle Persian <d> (cf. OM3). However, Clauson notes that there are no double graphemes in any Iranian script (Clauson 1970: 68).

(iii) The reason of creating duplicated glyph of TR , <d^1> might be the separation from TR , <nč> (SFG-87) (Table 4-2), cf. Table 7-8.

(iv) It is conceivable that the descendant graphemes of SFG-25 and SFG-27 are of the same origin. In this case, the Yenisey variant of TR glyph () could be the more original glyph.

(v) The ~ feature transformation justifies the assumption that a similar one can be observed on the glyph variants of TR <nč>: , , , (SFG-87).

(vi) TR <d^1> might be the descendant of Carian (Euromos, Kaunos, Kildara, Mylasa, Hyllarima, Sakkara, Sinuri) , <δ> /d/ [d] (Adiego 2007e: 10) or /md/d/ or /^{n}t/ (Kloekhorst 2008: 138–139), but the glyph variants of TR <d^1> differ from Carian <δ>, and its sound value is not clarified; therefore, it cannot be taking into account.

SFG-28

Descendant feature (grapheme):

TR (O, T) ○, ⊙ (Kyzlasov, I. L. 1994: 70); (O, T, Y) ⊙ (Kairžanov 2014: 18); (Toñuquq, 726) ◡̇, (Kül Tegin, 732; Bilge Khagan, 735) ◡̈ (Róna-Tas 1987: 11); (O, Y) ⊙ (Kyzlasov, I. L. 1994: 72; Kairžanov 2014: 18); (O) ⊙ (Kairžanov 2014: 18); (Y) ◡̈ (Büyük Larousse 9: 4679); (Küli Čur, 719–724) ⊙ (Tekin 2003: 23); (Kül Tegin, 732; Bilge Khagan, 735) ◡̇ (Clauson 1970: 75); ⊖̇ (Malov 1951: 17) <nd, nt> (Róna-Tas 1987: 11; Róna-Tas 1991: 61–62, 111).

OM1 (SFG-28):

Greek Alphabetic ancestor feature (grapheme):

Greco-Bactrian (Kadphises) δ, δ, (Kaniṣka) δ, δ, (Vāsudeva I) δ, (Kaniṣka II) δ, (Vāsudeva III) ◎, (Sasanian princes Bahrām and Hormizd) δ, ◎, δ, (Kidāra) ◎, ○ (Ghirshman 1948: 63) *delta* <δ>.

OM2 (SFG-28):

Brahmic ancestor feature (grapheme):

Brāhmī (North Turkestan) ◇ (Róna-Tas 1991: 114, Table IV); (alphabet t [North Turkestan Type A]) ◆ (Sander 1968: Tafel 29) <dha>;

Brahmic witness feature (grapheme): *Brāhmī* (Aśoka, around 250 BC) D; (Socotra [Jemen], T 32, LTR inscription, end of 2nd c. AD – 4th c.) ◁ (Strauch & Bukharin 2004: 133) <dha>; *Brāhmī* (Aśoka, around 250 BC) ⊙ (Rogers 1999: 257); (Standard North Turkestan [alphabet u, Type B]) ⊙ (Sander 1968: Tafel 29) <tha> /tʰ/; *Brāhmī* (Aśoka, around 250 BC) ○ <ṭha> /ṭʰ/.

OM+ (SFG-28):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Achaemenid Iran) ○, ⦶; (Chu-Ili interfluve) ○; (Basins of the Amu Darya and the Syr Darya, 6th–2nd c. BC) ◡̈, ◡̈, ⊙, ⊙, (1st c. BC –3rd c. AD) ⊙, (4th–8th c. AD) ○; (Kultobe, 1st–3rd c. AD) ⊖; (Beskepe) ○; (Kanka) ○, ⦶, ⊖; (Mongolia) ○, ⊙, ⊖; (Talas Valley) ⊙ <tamga> (details: Table 8-34).

Evaluation (SFG-28):

Changed script: TR.

Region of relics: TR: Inner Asia.

Source script family:

OM1: Greek Alphabetic.

OM2: Brahmic.

Period of change:

OM1: AD 342–781, the using period of the Greco-Bactrian script (Table 8-13).

OM2: 4th–8th c. AD, the using period of Brāhmī glyph variants presumed to be the ancestor (Table 8-15), the upper limit is the age of the earliest TR inscriptions (Table 8-29).

Region of change: OM1 & OM2: Inner Asia.

Glyph fit only with tamgas: OM1: 1. OM2: 1.

Comments (SFG-28):

(i) Brāhmī anusvāra represents /n/; however, the anusvāra is written in the preceding akṣara (Table 8-15). Therefore, the dots in TR O, ʘ, ⊙ <nd> cannot stem from Brāhmī anusvāra (Table 8-15). The dots in the glyphs (e.g., ῳ, ῳ, ⊙) originates surely from glyphs of tamgas, e.g., ῳ, ῳ, ⊙.

(ii) For the /n/ + C sound pairs, see Table 7-10.

SFG-29

Descendant feature (grapheme):

TR (J, O, T, Turpan, Altai) ×; (O, Y) + (Kairžanov 2014: 17); (Zhalgyz-Tjobe I) +; (Bichiktu-Boom II/1) ×; (manuscript) + (von Gabain 1941) <d^2> /d/;

SHR (Nikolsburg, 1490–1526) + *ed;* (Bágy, 15th c.) +; (Szamosközy's Note, before 1593) +; (Énlaka, 1668) †; (Szentpéteri, 1699–1702) ✝ *d* <d> /d/;

SHR (Constantinople, 1515, LTR writing direction) ‹ <<u>nd</u>> /nd/.

OM1 (SFG-29):

Aramaic ancestor feature (grapheme):

Imperial Aramaic 𐡃, 𐡃, 𐡃 *dālet̠* <d> /d, δ/ (details: SFG-25);

Aramaic witness feature (grapheme): *Hebrew* (Qumran Manuscripts, 1st c. BC) ד, (Text of the Pentateuchus Masoret, 9th c. AD) ד *dālet̠* <d>.

OM2 (SFG-29):

Greek Alphabetic ancestor feature (grapheme):

Greco-Bactrian ✖ (Cunningham 1893) *delta* <δ> (other glyphs: SFG-28).

OM3 (SFG-29):

Middle Iranian ancestor feature (grapheme):

Parthian 𐭃, 𐭃, 𐭃 *dālet̠* <d> /d, δ/ (details: SFG-25);

Khwarazmian 𐾺, 𐾺 <d> (details: SFG-25);

Sogdian 𐼻 *dālet̠* <d> /d, δ/ (details: SFG-25).

OM+ (SFG-29):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Achaemenid Iran) +; (Bactrian sign, northern Afghanistan, Bronze Age) ×; (Bayte III) ×; (Ancient Turkic tribal tamgas) ×; (Kazakhstan and Issyk-Kul Lake Area) +; (Basins of the Amu Darya and the Syr Darya, 1st c. BC –3rd c. AD) ×, +, (4th–8th c. AD) ✖, (Sarmatia, 2nd half of 2nd c. – 1st half of 3rd c. AD) ×; (Kultobe, 1st–3rd c. AD) +; (Gol Mod-2) +, +; (Altay) +, ×; (Mongolia) + <tamga> (details: Table 8-34).

Evaluation (SFG-29):

Changed script: TR & SHR.

Region of relics: TR: Inner Asia; SHR: Carpathian Basin.

Source script family:

OM1: Aramaic.

OM2: Greek Alphabetic.

OM3: Middle Iranian.

Period of change:

OM1: 7th/6th–1st c. BC, the using period of the Imperial Aramaic (Table 8-12) script.

OM2: AD 342–781, the using period of the Greco-Bactrian (Table 8-13) script.

OM3: 2nd c. BC – 8th c. AD, the union of the using periods of Parthian (Table 8-16), Khwarazmian and Sogdian scripts; the upper limit is the age of the earliest TR or SHR script relics (Table 8-19).

Region of change: OM1, OM2 & OM3: Inner Asia.
Glyph fit only with tamgas: OM1: 1. OM2: 0. OM3: 1.

Comments (SFG-29):

(i) Nagy propounded the relationship of SHR 𐳇 <d> and TR ⇕ <t^1> (SFG-48) (Nagy 1895: 274). This is unlikely because SHR 𐳇 <d> is the same as the glyph variant + of TR <d^2>, and TR ⇕ <t^1> had no sound value /d/ (cf. Table 7-9: 7-5. §). According to Sebestyén and Németh, SHR 𐳇 <d> corresponds to TR ✕ <d^2> (Sebestyén 1906: 274; Németh 1934: Appendix VI; Németh 1971: 38).

(ii) According to Sebestyén, TR ✕ <d^2> could be derived from Aramaic <d> (cf. Imperial Aramaic 𐡃 <d>) or Greek <τ> (cf. Ancient Greek T <τ>, SFG-104) (Sebestyén 1906: 272–274), see OM1.

(iii) Interpreting TR ✕ <d^2> as Turkic pictograph, its formation from Old Turkic *ed* 'property, livestock' word was supposed (Róna-Tas 1987: 8–9). For an analysis of the issue of Turkic pictographs, see Table 3-4.

(iv) The weakness of OM2 is that the glyph variant ✖ of Greco-Bactrian <δ> can be found only in the publication of Cunningham.

(v) An analogue of the feature transformation presumed in OM1 and OM3 is attested in the following glyph variants of TR <^{I}k^I>: ϡ and Ӽ (SFG-57).

(vi) The following Paleo-Hispanic and Italic graphemes originate from the Old Canaanite +; ⋌ <t>, and represent /d/ and /t/. However, their sound values /t/ and /d/ are presumably based on the specific property of the acceptor language: Northeastern Iberian X (Hesperia: Narbonensis, retrieved on 24 June 2016) <ta> /da, ta/, (dual) /da/ (Ferrer i Jané 2005: 981; Ferrer i Jané 2014: 244–245); Celtiberian (Botorrita) ✖ (Eska 2008: 166); (eastern, western) X (Hesperia: Narbonensis, retrieved on 24 June 2016) <ta>; Venetic (Padova, end of 6th c. – beginning of 1st c. BC) ⋏, X <t> [d] (MNAMON: Venetic, retrieved in 2016); Umbrian (Etruscan, 4th c. – first half of 1st c. BC) ⋏ <t> /t, d/ (MNAMON: Umbrian, retrieved in 2016); Lepontic (early) X, +, (late) X <t> /t, d/ (MNAMON: Celtic, Lepontic, retrieved in 2016); Gallo-Etruscan (4th–2nd c. BC) X <t> /t, d/ (MNAMON: Celtic, Gaulish). Concerning the possibility of /t/ > /d/ or /d/ > /t/ sound changes, see Table 7-9: 7-5. §.

(vii) According to Clauson, TR ✕ <d^2> was derived from the glyph variant of Greco-Bactrian *kappa* <κ> found in Loulan (Clauson 1970: 68): (Loulan, 4th c. AD) ✘ (Ghirshman 1948: 63). This assumption is very unlikely due to the differences in sound values.

SFG-30

Descendant feature (grapheme):
SHR (Nikolsburg, 1490–1526) Ӿ *and* <nd>.

OM1 (SFG-30):
Rovash ancestor feature (grapheme):
SHR 𐳇 <d> (details: SFG-29).

Evaluation (SFG-30):
Changed script: SHR.
Region of relics: SHR: Carpathian Basin.

Source script family:

OM1: Rovash (internal development) (separation [Table 4-2], duplication [Table 4-3, Table 7-8]).

Period of change:

OM1: Not later than AD 1490–1526, the upper limit is the age of the Nikolsburg Alphabet (Table 8-30).

Region of change: OM1: Inner Asia, Pontus Steppe or Carpathian Basin.

Glyph fit only with tamgas: OM1: 0.

Comments (SFG-30):

(i) SHR ⅹ <nd> is probably derived from a grapheme with a /d/ sound value. This development may have been due to a change in the sound value of one of the glyph variants of SHR <d> (see Table 7-10), but it is more likely to come from the duplication of SHR ƚ <d>.

SFG-31

Descendant feature (grapheme):

TR (Y) ‹ (Vasil'ev 1983 apud Harmatta 2004: 186); (Y) ʌ (Vasil'ev 1983 apud Harmatta 1997b: 163); (Y) ›, ⁄ (Büyük Larousse 9: 4678); (O, Y) ⱶ (Thomsen 1893: 9); (O) ꜫ, Ɛ (Kairžanov 2014: 17); (O, T, Y) › (Thomsen 1893: 9; Kyzlasov, I. L. 1994: 71); (Khentii, second half of 8th c. – beginning of 9th c.) ›; (Bichiktu-Boom XVI/3) ‹; ⱶ, ⱶ, (manuscript) ⱶ (von Gabain 1941) <W> /o, u/ (Tuna 1960: 217);

CBR (Nagyszentmiklós, 8th–11th c.) ⱶ <W> /o/.

OM1 (SFG-31):

Aramaic ancestor feature (grapheme):

Imperial Aramaic (Zinjîrlû [Zenjirli], 8th c. BC) ۲, (weights, seals and coins, 8th–3rd c. BC) ۲, ץ, (Tayma [Teimâ], 5th–4th c. BC) ר, ר, ר, (cursive, Egypt, 5th–3rd c. BC) ר, ו (Lidzbarski 1910); (satrapies, 5th–4th c. BC) ר, ר, (monuments, Egypt, 4th–3rd c. BC) ר, (papyrus, Egypt, 2nd c. BC) ו (Taylor 1883, vol. I: 250); (7th c. BC) ו, ו, ו, ו, ו (Gibson 1975); (Elephantine Papyri, 6th c. BC) ו (Glass 2000: 14); ו; (6th c. BC) ו, ו, ו, ו, (5th–4th c. BC) ו, ו, ו, ו (Gibson 1975); (Aśoka, around 250 BC) ו (Glass 2000: 14); (Leather Documents of the Satrap and Royal Prince Aršāma) ו, (Persepolis) ו, (Daskyleion) ו, (Kandahar) ו (Rosenthal et al. 1986–2011: Table 3); ו (MacKenzie 1971: xi) *wāw* <w> /u̯, ō, ū/;

Aramaic witness feature (grapheme): *Hebrew* (Qumran Manuscripts, 1st c. BC) ו <w>; *Nabataean* (late) ו (Macdonald 2008: 218) <w>; *Hatran* (H 79, soon before AD 240) ו <w> (Beyer 1998: 10, 47–48); *Palmyrene* ו, ו <w> (Harmatta 2000: 181); *Armazian* ו <w> (Cereteli 1948–1949 apud Róna-Tas 1987: 14); *Arabic* (early) و, (modern) و (Macdonald 2008: 218) <w>;

Middle Iranian witness feature (grapheme): *Parthian* ו, ו, ו *wāw* <w> /u̯, ō, ū/ (details: SFG-32); *Khwarazmian* (Chirik-Rabat [Kyzylorda Region, Kazakhstan], 4th–2nd c. BC) ו (Ivantchik & Lurje 2013: 286–287); (Toprak-kala) ו (Vainberg 1977: Table VIII) *(waw)* <w>; *Sogdian* ו, ו, ו, ו, ו *wāw* <w> /u̯, ō, ū/ (details: SFG-32); *Middle Persian* (inscriptions, 3rd c. AD) ו (MacKenzie 1971: xi) *wāw* <w> /u̯, ō, ū/; *Avestan* ו (Hoffmann & Forssman 1996: 41); ו (Hoffmann 1987–2011: Table 2); ו (Taylor 1883, vol. II: 252) <o>; *Avestan* ❯ (Hoffmann 1987–2011: Table 2); ❯ (Taylor 1883, vol. II: 252) <u>.

Evaluation (SFG-31):
Changed script: TR & CBR.
Region of relics: TR: Inner Asia; CBR: Carpathian Basin.
Source script family:
OM1: Aramaic.
Period of change:
OM1: 7th/6th–1st c. BC, the using period of the Imperial Aramaic (Table 8-12) script.
Region of change: OM1: Inner Asia.
Glyph fit only with tamgas: OM1: 0.

Comments (SFG-31):

(i) According to Clauson, TR › <W> is derived from early Sogdian or other Middle Persian *wāw* (SFG-32), and its angle may have been introduced to differentiate it from TR <n^1> (SFG-72) (Clauson 1970: 68). However, TR › <W> is more similar to the earlier, more angular Aramaic glyphs: TR glyph › can be found in the typical glyphs of Imperial Aramaic *wāw*. TR ⱶ, ł glyphs are even more characteristic, the corresponding Aramaic glyphs are from the early period: Imperial Aramaic (7th c. BC) ι, (5th–4th c. BC) ־ו <w>. Consequently, Rovash ⱶ, ł <W> was most probably borrowed from Aramaic in that time.

(ii) In Phoenician script there are similar glyphs: Phoenician (Sidon, 4th c. BC) ⅂ (Taylor 1883, vol. I: 227); ⅂, ⅂ (Faulmann 1880: 78) *wāw* <w> /u̯/ [u̯, w] (SFG-33). Of these, the glyphs for which data are available are from 4th c. BC. Of the areas studied, grapheme transfer from the Phoenician script could, in principle, only occur in Asia Minor. However, this should have happened before the end of 6th c. BC (cf. Table 3-3: 3-4. §), so this descendant grapheme—based on the data currently available—can not be derived from the Phoenician script.

(iii) TR ⱶ, ł, ⱶ <W> and CBR ⱶ <W> have an identical shape; so there is no doubt of their common origin.

(iv) The glyphs of Middle Persian Ⴢ <w> and Armazian ≀ <w> largely differ from the glyphs of TR ⱶ, ł, ⱶ <W> and CBR ⱶ <W>; hence they are listed as witness graphemes.

(v) The Avestan ❯ <u> is likely not the ancestor of the descendant graphemes, since it represents only /u/, whereas the sound values of Rovash <W> are /o/ and /u/.

SFG-32

Descendant feature (grapheme):
SHR (Bodrog-Alsóbű, around 900 or first half of 10th c.) Ͻ /u/; (Székelydálya, around 1400) Ͻ /o, ó/; (Nikolsburg, 1490–1526) Ͻ *o* /o/; (Wolfenbüttel, 1592–1666) Ͻ /o/; (Rugonfalva, 16th–17th c.) Ͻ /ó/; (Szentpéteri, 1699–1702) Ͻ *o* <o>.

OM1 (SFG-32):
Middle Iranian ancestor feature (grapheme):
Parthian (early, Nisa, 1st c. BC) ◢, (inscriptional) ◢ (Rosenthal et al. 1986–2011: Table 3); (inscriptional) Ͻ *wāw* <w> /u̯, ō, ū/ (Häberl 2006: 57);
Sogdian (early, Kultobe, before 4th c. AD) Ͻ (Sims-Williams & Grenet 2006: colour illustrations without page numbering); (Ancient Letters, beginning of 4th c. AD) Ͻ (Skjærvø 1996: 519); (Ancient Letters, beginning of 4th c. AD) Ͻ (Harmatta 2004:

186); (Shatial [Gilgit-Baltistan, Pakistan]) , , (Ivantchik & Lurje 2013: 290); *wāw* <w> /u̯, ō, ū/.

Middle Iranian ancestor feature (grapheme): *Sogdian* (sutra) , (Skjærvø 1996: 519) *wāw* <w> /u̯, ō, ū/.

Evaluation (SFG-32):
Changed script: SHR.
Region of relics: SHR: Carpathian Basin.
Source script family:
OM1: Middle Iranian.
Period of change:
OM1: 2nd c. BC – around 900, the union of the using periods of Parthian (Table 8-16) and Sogdian scripts, the upper limit is the age of the earliest SHR relics (Table 8-19).
Region of change: OM1: Inner Asia.
Glyph fit only with tamgas: OM1: 0.

Comments (SFG-32):

(i) Several have hypothesized that there is a relationship between SHR <o> and TR <W> (SFG-31) (Nagy 1895: 274; Sebestyén 1906: 277).

(ii) According to Sebestyén, both SHR <o> and TR <W> are derived from splitting Ancient Greek <o> into two (Sebestyén 1906: 272, 277), cf. Ancient Greek (Signature of Polykleitos, Olympia, 450–425 BC) (Johnston 2013: 204) *omicron* <o> /o, u/ (Faulmann 1880: 170). However, this idea contains too many assumptions.

(iii) The basis of OM1 is that according to Vékony, SHR <o> originates from Parthian *wāw* <w> (Vékony 1987a: 119; Vékony 2004a: 155). However, it is possible; SHR <o> is also similar to Sogdian , *wāw* <w>.

(iv) The earliest known SHR inscription (Bodrog-Alsóbű, around 900 or first half of 10th c.) contains SHR <o> representing /u/ in a ligature (OM2). In the short text of this inscription, there was no need for representing the sound /o/; therefore, it has no information if SHR <o> also represented/o/ in SHR variant used for this inscription.

(v) SHR <o> could be derived by straightening the upper and lower parts of TR <W> or shifting the top and bottom vertical lines of TR , CBR <W> (SFG-31) inward (OM2), cf. closer shape forming (Table 4-2); line shifting [(Table 4-3). However, such transformations are unlikely and therefore, will be discarded.

(vi) Glagolitic (10th c. AD) , (10th–11th c. AD) *onъ* <o> (SFG-76) cannot be ancestor, since Glagolitic <o> did not represent /u/.

(vii) Kharoṣṭhī (Aśoka, around 250 BC) , (British Library) <u> slightly reminds to the descendant grapheme.

SFG-33

Descendant feature (grapheme):
SR (Novocherkassk, 8th–10th c.) /o/; (Mayatskoe-10, 9th c.) /u/ <W>.

OM1 (SFG-33):
Canaanite ancestor feature (grapheme):
Phoenician (Byblos, 11th–10th c. BC) ; (Tel Zayit Alphabet, late 10th c. or very early 9th c. BC) (Kőszeghy 2010: 57); (around 900 BC) , , (Swiggers 1996b: 262); (Tell

Faḫariyeh, 9th c. BC) 𐤅 (Lipiński 1994: 27; Bordreuil 2005: 24); (Karatepe KAI 26, ca. 700 BC) 𐤅 (Amadasi Guzzo & Zamora López 2013: 187); (Nineveh, 8th c. BC) 𐤅, (Nineveh, 7th c. BC) 𐤅, (Sidon, 5th c. BC) 𐤅, (Sidon, 4th c. BC) 𐤅 (Taylor 1883, vol. I: 227); 𐤅, 𐤅 (Faulmann 1880: 78) *wāw* <w> /u̯/ [u̯, w];

Old Aramaic (Zinjîrlû [Zenjirli], late 9th–8th c. BC) 𐡅 (Jeffery 1961: 18, 24) (Deir ’Allā, around 800 BC) 𐡅 (Glass 2000: 14); (8th c. BC) 𐡅; (8th c. BC) 𐡅, 𐡅 (Gibson 1975); (Nineveh, 7th c. BC) 𐡅 (Taylor 1883, vol. I: 250) *wāw* <w> /w, ū, au/ (Segert 1997: 117–118);

Aramaic ancestor feature (grapheme):

Imperial Aramaic 𐡅, 𐡅, 𐡅 *wāw* <w> (details: SFG-31).

OM2 (SFG-33):

Middle Iranian ancestor feature (grapheme):

Parthian 𐭅,𐭅, 𐭅 *wāw* <w> /u̯, ō, ū/ (details: SFG-32);

Sogdian 𐼹, 𐼹, 𐼹 *wāw* <w> /u̯, ō, ū/ (details: SFG-32).

OM3 (SFG-33):

Rovash ancestor feature (grapheme):

TR 𐰉, 𐰉, 𐰉 <W> (details: SFG-31).

Evaluation (SFG-33):

Changed script: SR.

Region of relics: SR: Pontus Steppe.

Source script family:

OM1: Canaanite or Aramaic.

OM2: Middle Iranian (different visual identities [Table 4-2]; line insertion [Table 4-3]).

OM3: Rovash (internal development) (glyph-variant forming [Table 4-2], line insertion [Table 4-3]).

Period of change:

OM1: 11th c. BC – 2nd c. AD, the union of the using periods of Phoenician (Table 8-6), Old Aramaic and Imperial Aramaic (Table 8-12) scripts; the upper limit is Imperial Aramaic glyph variants presumed to be ancestor (see Comments).

OM2: 2nd c. BC – 8th c. AD, the union of the using periods of Parthian and Sogdian scripts (Table 8-16), the upper limit is the age of the earliest SR inscriptions (Table 8-32).

OM3: Not later than 8th–9th c. AD, the limit is the age of the earliest SR inscription containing the descendant grapheme.

Region of change:

OM1: Anatolia or Inner Asia.

OM2: Inner Asia.

OM3: Inner Asia or Pontus Steppe.

Glyph fit only with tamgas: OM1: 0. OM2: 0. OM3: 0.

Comments (SFG-33):

(i) Concerning OM1, the source of SR ⌠, ⌡ <W> could be a glyph variant of Phoenician 𐤅 <w>, Old Aramaic 𐡅 <w> or Imperial Aramaic <w>. It is worth noting that from Phoenician 𐤅 <w> a glyph was created whose two upper arms became parallel, this is Ancient Greek Ϝ <F> (SFG-16) and related glyphs. Presumably, an example of this development could be the

Volscian (VM 1 lead axe, Satricum, 5th c. BC) (Cornell 1995: 458) ᚨ (Urbanová 2003: 34) <ú>. The Volscian script, of course, has no relationship to Rovash scripts.

(ii) Analogies of the transformation supposed in OM1, OM2 and OM3 have happened in case of SR Ↄ, Ↄ, ϡ, ⁊ <I> (SFG-51) and SR ૭, ℈, ℈ <e> (SFG-10).

SFG-34

Descendant feature (grapheme):

SR (Khumara-8 [in copy], 9th–10th c.) ϡ /u/; (Kievan Letter, 955–961) ⋎ʌ /o/ <W>.

OM1 (SFG-34):

Middle Iranian ancestor feature (orthographic rule):

Manichean script: doubling vowels denoted the long vowels (see Comments).

Rovash ancestor feature (grapheme):

TR ⱶ, ᐳ, ᐳ, ᐟ <W> (details: SFG-31).

OM2 (SFG-34):

Rovash ancestor feature (grapheme):

TR ⱶ, ᐳ, ᐳ <W> (details: SFG-31); *SR* ᚿ <W> (details: SFG-33).

Evaluation (SFG-34):

Changed script: SR.

Region of relics: SR: Pontus Steppe.

Source script family:

OM1: Middle Iranian (orthographic rule transfer, Table 2-9: 2-3. §) and Rovash (internal development) (external influence [Table 4-2]; duplication [Table 4-3]).

OM2: Rovash (internal development) (glyph-variant forming [Table 4-2], line insertion [Table 4-3]).

Period of change:

OM1: 3rd–8th c. AD, the using period of the Manichean (Table 8-16) script, the upper limit is the age of the earliest SR script relic (Table 8-19).

OM2: Before 8th c. AD, the limit is the age of the earliest SR inscription containing the descendant grapheme.

Region of change: OM1: Inner Asia; OM2: Inner Asia or Pontus Steppe.

Glyph fit only with tamgas: OM1: 0. OM2: 0.

Comments (SFG-34):

(i) The Khumara-8 inscription surviving only in copy (Table 8-32). The drawing of the inscription's reliability cannot be verified since it perished.

(ii) Regarding the provenance of SR <W>, it is worth noting that according to Erdal, in each Uyghur sources the /o/ was represented by the duplication of the <w> to be distinguished from /u/ (Erdal 2004: 42; Erdal, Marcel: Personal communication by email, 7 June 2018). However, Erdal pointed out that in Manichean and Uyghur manuscripts, doubling of vowels, according to some authors, meant the long vowels. More researches shared this opinion (von Gabain 1941 §16 apud Erdal 2003: 48; Tuna 1960: 247–252 apud Erdal 2003: 48; Pritsak 1963 §10 apud Erdal 2003: 48; Ščerbak 1961: 34–36 and 1966: 153–154 apud Erdal 2003: 48; Tekin [1975] 1995: 91–94 apud Erdal 2004: 48–49). Erdal took the position that both rules prevailed, but neither was exclusive. Based on this, SR ⋎ʌ <W> could have been created by doubling a glyph similar to TR 𐰇, 𐰆, 𐰆, 𐰈 <W> (SFG-31). This derivation is supported by the existence of the glyphs of TR 𐰆, 𐰈 <W> (SFG-31); the second component of the glyph 𐲈 is a rotated TR 𐰆 <W>, and the glyph variant 𐰈 can give an example for rotation of 𐰆 <W>. However, according to Korn, in the Manichean script, the <w> may be doubled to fill space, i.e. scribes took great care to fill lines nicely, and this independent of the sound value. In Middle Persian script <w> was not doubled (Korn, Agnes: Personal communication by email, 28 June 2018). Based on all of this, the reliability of OM1 is in doubt.

(iii) The basis of OM2 is that it is possible that the additional strokes of SR 𐲈 <W> were applied on the glyph of TR 𐰆 <W> (SFG-31) due to distinguish from the 𐰣 <n[1]> (SFG-72) or for calligraphic purposes.

SFG-35

Descendant feature (grapheme):

TR (Y) 𐰜 (Vasil'ev 1983 apud Harmatta 2004: 186); (O, T, Y) 𐰝 (Kyzlasov, I. L. 1994: 72); (O, Y) 𐰜, (O) 𐰜, 𐰜; (Kalbak-Tash I) 𐰜; (Khentii, the second half of 8th c. – the beginning of 9th c.) 𐰜; (Bichiktu-Boom II/1) 𐰜; (Tanbaly-Tash, 9th–10th c., LTR writing direction) 𐲈 (Rogozhinskii & Kyzlasov 2004: 42) <Ẅ> /ö, ü/;

SHR (Stick Calendar, ca. 15th c. surviving in a 17th c. copy) ⋜ /ö, ő, ü, ű/; (Nikolsburg, 1490–1526) 𐳞 *eě* /ö/; (Wolfenbüttel, 1592–1666) Z /ü/; (Rudimenta-Giessen, 1598) 𐳟 /ü/; (Farkaslaki, 1624) 𐳟 /ü/*;* (Farkaslaki, 1624) 𐳞, 𐳞 /ö, ő/; (Csulai, 1644) 𐳞 /ü/; (Gyulafehérvár, 1655) 𐳪 /u/; (Kájoni's Ancient, 1673) 𐳟 *ü* /ő, ü, ű/; (Szentpéteri, 1699–1702) 𐳟 *ű;* (Hickes, 1705) 𐳟 /ü/; (Patakfalvi, 1776–1785) 𐳞 /ö/ <Ẅ>.

OM1 (SFG-35):

Middle Iranian ancestor feature (orthographic rule):

Sogdian script: ligature of the <w> and <y> denoted the /ö, ü/ (see Comments).

Rovash ancestor feature (grapheme):

TR 𐰇, 𐰆, 𐰆, 𐰈 <W> (details: SFG-31); *TR* 𐰃, 𐰃, 𐰃 <I> (details: SFG-50); and *TR* 𐰃 <I> (details: SFG-53).

Evaluation (SFG-35):

Changed script: TR & SHR.

Region of relics: TR: Inner Asia; SHR: Carpathian Basin.

Source script family:

OM1: Middle Iranian (orthographic rule transfer, Table 2-9: 2-3. §) and Rovash (internal development) (external influence [Table 4-2]; ligature formation [Table 4-3]).

Period of change:

OM1: 2nd–8th c. AD, the using period of the Sogdian script (Table 8-16), the upper limit is the age of the earliest TR or SHR script relics (Table 8-19).

Region of change: OM1: Inner Asia.

Glyph fit only with tamgas: OM1: 0.

Comments (SFG-35):

(i) Several hypothesized a kinship between SHR 𐳟, ⋜ <Ẅ> and TR 𐰜, 𐰜, 𐰝 <W> (SFG-31) (Nagy 1895: 274; Sebestyén 1906: 273, 280; Németh 1934: Appendix VII; Németh 1971: 38).

(ii) Sebestyén argued that TR 𐰜, 𐰝 <Ẅ> and SHR 𐳟 <Ẅ> are descendants of Ancient Greek (classic) Υ <υ> /u, ü/ (Sebestyén 1906: 273, 278, 280; Sebestyén 1915: 158).

(iii) According to Clauson, TR <Ẅ> was derived from the mirrored glyph of Greco-Bactrian (Loulan, 4th c. AD) ʏ (Ghirshman 1948: 63) *upsilon* <υ> found in Loulan (Clauson 1970: 68). It is worth noting that in the publication of Clauson its glyph is ʏ (Clauson 1970: 74), opposite to the glyph ʏ in the publication of Ghirshman (Ghirshman 1948: 63), which was cited by Clauson; however, their difference is not decisive for the assessment of origin. It is more important that Greco-Bactrian <υ> represented *h* (Harmatta 1994a: 413); therefore, it is unlikely an ancestor.

(iv) Sims-Williams demonstrated the Sogdian tradition of representing front rounded vowels *(ö, ü)* by the combination of <w> and <y> (Sims-Williams 1981b: 359; Sims-Williams 1989: 181; Sims-Williams 1996: 313–314). In Sogdian and Uyghur (Table 8-20) scripts, palatal labial vowels *(ö, ü)* are represented by the ligature of <w>and <y> (Erdal 2004: 42). Based on this, TR ᚴ, ᚠ <Ẅ> can be the result of the ligature of ᛚ, ᛚ <I> (SFG-50) and > <W> (SFG-31), and TR 𐰇, ᚹ <Ẅ> is composed of ᚽ <I> and ᚾ, >, > <W>. Supposing the influence of Sogdian script, TR <Ẅ> could have been constructed of TR ᚽ, ᛚ <I> and >, ᚾ <W> as follows: ᚠ < ᛚ + >; 𐰇 < ᚽ + ᚾ; ᚹ < ᚽ + >. This derivation is the basis of OM1.

(v) Erdal showed (Erdal, Marcel: Personal communication by email, 7 November 2016) the use of graphemes <o> for /ö/ and <u> for representing /ü/ as demonstrated in a Turkic text written with Brāhmī script (Table 8-15) in the IOL Toch 81 inscription (Maue 2008).

(vi) A possible ancestor of TR ᚠ, 𐰇, ᚹ <Ẅ> could be Ancient Greek (Athens, 8th–7th c. BC) ᛉ, (Thera, 8th–7th c. BC) ᛉ, Y, ᛉ, (Crete, 8th–7th c. BC) Y, Y, (Korkyra, 8th–7th c. BC) ᛉ, ᛉ, Y; (Boiotia, 8th–7th c. BC) ᛉ (Healey 1990a: 37); (Thera, 7th c. BC) Y, ᚴ (Haarmann 1990: 287); (Ipsambul [Abu Simbel, Egypt], 7th c. – the beginning of 6th c. BC, LTR writing direction) V, V (Taylor 1883, vol. II: 9–15) *upsilon* <υ> /u, ū/ (Woodard 2008c: 15–17), which could be used for representing /ö, ü/ as happened in Brāhmī script (Hosszú 2017: 210). The glyph variants of TR ᚠ, 𐰇, ᚹ <Ẅ> can be easily derived from Ancient Greek ᛉ, ᛉ <υ>. This solution seems to be very simple (Hosszú 2017: 210). However, if TR 𐰇, ᚹ <Ẅ> would have originated from Ancient Greek ᛉ, ᛉ <υ>, it had had to represent also /u/, as Ancient Greek <υ> did so. Nevertheless, there is no trace of it in the known TR inscriptions (Table 8-29). Moreover, using <υ> to represent /u/ is not an option in case of Greco-Bactrian script – which was nevertheless known in Inner Asia, since in the Greco-Bactrian script, the *upsilon* <υ> represented /h/ (Harmatta 1994a: 413).

(vii) Cf. SFG-36.

SFG-36

Descendant feature (grapheme):

CBR (Szarvas, first half of 8th c.) ʔ /ü/; (Kiskundorozsma, end or last third of 8th c.) ϡ; (Nagyszentmiklós, 8th–11th c.) ϡ, ϡ /ü/ <Ẅ>;

SR (Kermen Tolga, 8th–10th c.) ϡ /ö, ü/; (Mayatskoe-10, 9th c.) ϡ /ü/; (Khumara-8 [in copy], 9th–10th c.) ϡ /ö/ <Ẅ>.

OM1 (SFG-36):

Middle Iranian ancestor feature (orthographic rule):

Sogdian script: ligature of the <w> and <y> denoted the /ö, ü/ (see Comments).

Rovash ancestor feature (grapheme):

TR > <W> (details: SFG-31) and *TR* ᛚ <I> (details: SFG-50).

OM2 (SFG-36):
Rovash ancestor feature (grapheme):
TR , , <Ẅ> (details: SFG-35).

Evaluation (SFG-36):
Changed script: CBR & SR.
Region of relics: CBR: Carpathian Basin; SR: Pontus Steppe.
Source script family:
OM1: Middle Iranian (orthographic rule transfer, Table 2-9: 2-3. §) and Rovash (internal development) (external influence [Table 4-2]; ligature formation [Table 4-3]).
OM2: Rovash (internal development) (glyph-variant forming [Table 4-2]; bending and mirroring [Table 4-3]).
Period of change:
OM1: 2^{nd}–8^{th} c. AD, the using period of the Sogdian script (Table 8-16), the upper limit is the age of the earliest CBR or SR relics containing the descendant grapheme.
OM2: Before 8^{th} c. AD, the upper limit is the age of the earliest CBR or SR relics containing the descendant grapheme.
Region of change: OM1 & OM2: Inner Asia.
Glyph fit only with tamgas: OM1: 0. OM2: 0.

Comments (SFG-36):

(i) According to Vékony, CBR , /ü/ <Ẅ> originated from the ligature of Parthian *wāw* <w> (SFG-32) and *yōḏ* <y> (SFG-50) (Vékony 1987a: 120). Moreover, the ligature of Sogdian *wāw* <w> (SFG-32) and *yōḏ* <y> (SFG-50) could result the SR <Ẅ>, including its special upper part. CBR , , shapes may be simplified variants of the SR . However, it is more likely that components of the ligature were TR graphemes (<W> and <I>), which already existed in TR, and only the rule of forming a ligature-based <Ẅ> came from Sogdian.

(ii) Erdal showed (Erdal, Marcel: Personal communication by email, 7 November 2016) the use of graphemes <o> for /ö/ and <u> for /ü/ as demonstrated in a Turkic text written with Brāhmī script (Table 8-15) in the IOL Toch 81 inscription (Maue 2008). According to Maue, the Turkic part of the IOL Toch 81 manuscript written with Brāhmī script is from the second half of 9^{th} c. AD, or if it non-Uyghur, it dates back to an even earlier period. The Brāhmī variant used in the manuscript differs from Uyghur Brāhmī; its features point to high antiquity (Maue 2008: 59). The scribe of IOL Toch 81 stands in the tradition of Tocharian Brāhmī and this script is in the initial stage in the development of Turkic Brāhmī (Maue 2008: 65–66). The upper part of the glyph in Brāhmī (alphabets r and s [Early Turkestan]) , , , (alphabet t [North Turkestan Type A]) , , (Standard North Turkestan [alphabet u, Type B]) , (Sander 1968: Tafel 33); (Tocharian) (Krause & Thomas 1960: 41) <u> could explain the specific upper part of the glyph of SR <Ẅ>. Nevertheless, the shape of the Brāhmī <u> is significantly different from the descendant graphemes.

(iii) Vékony suggested the derivation of CBR , , SR <Ẅ> from TR , <Ẅ> (SFG-35) (Vékony 2004a: 153), see OM2. Similar shape development: Imperial Aramaic , <r> (SFG-92) and Khwarazmian <r> (SFG-92).

(iv) It is worth noting that the glyph styles of CBR , , SR , <Ẅ> and SR <e> (SFG-11) are the same.

SFG-37

Descendant feature (grapheme):

SHR (Vargyas, 12th–13th c.) 𐳮 /ü/; (Homoródkarácsonyfalva Stone inscription, around 13th c.) 𐳮 /u/; (Nikolsburg, 1490–1526) 𐳮 *ew* /v/; (Szamosközy's Poem, 1604) 𐳮 /u, v/; (Bonyhai's Alphabet, 1627) 𐳮 /u/; (Bonyhai's Example Sentence, ca. 1627) 𐳮 /u, v/; (Patakfalvi, 1776–1785) 𐳮 /v/; (Wolfenbüttel, 1592–1666) 𐳮 /v/ <v>;

SR (Khumara-6, Khumara-7, 9th–10th c.) 𐳮 /ö/ <Ẅ>.

OM1 (SFG-37):

Middle Iranian ancestor feature (orthographic rule):

Sogdian script: ligature of the <w> and <y> denoted the /ö, ü/ (see SFG-35: Comments);

Rovash ancestor feature (grapheme):

TR 𐰆 <W> (details: SFG-31) and *TR* 𐰃 <I> (details: SFG-50).

OM2 (SFG-37):

Rovash ancestor feature (grapheme):

TR 𐰇 <Ẅ> /ö, ü/ (details: SFG-35).

OM+ (SFG-37):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Basins of the Amu Darya and the Syr Darya, 1st c. BC –3rd c. AD) 𐳮; (Beskepe) 𐳮 <tamga> (details: Table 8-34).

Evaluation (SFG-37):

Changed script: SHR & SR.

Region of relics: SHR: Carpathian Basin; SR: Pontus Steppe.

Source script family:

OM1: Middle Iranian (orthographic rule transfer, Table 2-9: 2-3. §) and Rovash (internal development) (external influence [Table 4-2]; ligature formation [Table 4-3]).

OM2: Rovash (internal development) (becoming similar, borrowing or symmetrization [Table 4-2]; use of known glyph [Table 4-3]).

Period of change:

OM1: 2nd–9th/10th c. AD, the using period of the Sogdian script (Table 8-16), the upper limit is the age of the earliest script relics (Khumara-6, Khumara-7, Table 8-32) containing the descendant grapheme 𐳮 <Ẅ>.

OM2: Before 9th–10th c. AD, the upper limit is the age of the earliest inscription containing the descendant grapheme.

Region of change: OM1 & OM2: Inner Asia.

Glyph fit only with tamgas: OM1: 1. OM2: 1.

Comments (SFG-37):

(i) According to Nagy, SHR 𐳮 <v> and SHR 𐳘 <m> (SFG-68) originates from the Greek <β> and <μ>, respectively. Nagy noted that the pronunciation of the Greek <β> begin to be *v* from around 5th c. AD; moreover, the sounds *m* and *v* were interchanged in some Hungarian words. Based on this, SHR 𐳘 <m> originally denoted *v*, and SHR 𐳮 <v> originally denoted *m* (Nagy 1895: 276). However, the latter assumption is not supported by any known data.

(ii) According to Sebestyén, SHR 𐳮 <v> originates from SHR 𐳪 <u> (SFG-38) based on that property of the Latin script (Table 8-18) that the Latin <u> and <v> were often used interchangeably than the bottom lines were omitted from the glyph of SHR ⋈ <u> (Sebestyén 1906: 280–281). From the script relics that have uncovered since Sebestyén's publications (Vargyas, Homoródkarácsonyfalva), it seems probable that SHR ᛖ <v> is earlier than SHR ⋈ <u>, so Sebestyén's caption of derivation is likely incorrect. Nevertheless, Sebestyén may be right that these two graphemes are in a genealogical relation to each other, and the relationship between them is the influence of the Old Hungarian orthography of the Latin script, cf. SFG-38.

(iii) According to Vékony, SHR ᛖ <v> /u, ü, v/ and SR Ϻ <Ẅ> /ö, ü/ are the ligatures of Rovash ⌉, ⌈ <I> (SFG-50) and TR > <W> (SFG-31) (Vékony 1987a: 120), see OM1. Thus its formation is similar to that of SFG-35. An example of rotating <W> is the shape of TR ⌃ <W> (SFG-31). The sound value /u/ may have been created as a result of Old Hungarian orthography of the Latin script (Table 8-18), as the roles of the glyphs, u and v were practically the same, both denoting sounds /u/, /ü/ and /v/. It is worth noting that the glyph of SR Ϻ surviving only in two poorly retained SR inscriptions (Khumara-6 and Khumara-7), and the glyph of SHR ᛖ is observable in many script relics with a consistent writing style. Therefore, it is conceivable that the glyph may have originally been ᛖ and not Ϻ.

SFG-38

Descendant feature (grapheme):

SHR (Stick Calendar, ca. 15th c. surviving in a 17th c. copy) ᛞ /u, ü/; (Nikolsburg, 1490–1526) ᛞ *v* /u/; (Csíkszentmihály, 1501) ᛖ /u/; (Szamosközy's Poem, 1604) ᛞ /u/; (Kájoni's Ancient, 1673) ᛞ *u* /u/; (Rudimenta-Giessen, 1598) (page 3) ᗢ, (page 4) ⋈ /u/; (Szentpéteri, 1699–1702) ⋈ *u;* (Hickes, 1705) ⧗ /u/; (Bél, 1718) ⋈ *u* /u/; (Gönczi, around 1680) ∞ /u/; (Marsigli's Alphabet, 1690) ᛞ *u;* (Dobai, 1753) ∞ /u/; (Patakfalvi, 1776–1785) ᛞ /u/ <u>.

OM1 (SFG-38):

Latin Alphabetic ancestor feature (orthographic rule):

Latin medieval Old Hungarian orthography: the role of the letters *u* and *v* were practically identical; both represented /u/, /ü/ and /v/.

Rovash ancestor feature (grapheme):

SHR ᛖ <v> /u, ü, v/ (details: SFG-37).

Evaluation (SFG-38):

Changed script: SHR.

Region of relics: SHR: Carpathian Basin.

Source script family:

OM1: Latin Alphabetic (orthographic rule transfer, Table 2-9: 2-3. §) and Rovash (internal development) (adaptation, external influence, closer-shape forming [Table 4-2]; duplication or line insertion [Table 4-3, Table 7-8]).

Period of change:

OM1: 10th–15th/16th c. AD, the lower limit is the supposed beginning of the development of the Old Hungarian orthography of the Latin script (Table 8-18); the upper limit is the age of the earliest inscription containing the descendant grapheme ᛞ <u> (Nikolsburg, Table 8-30).

Region of change: OM1: Carpathian Basin.
Glyph fit only with tamgas: OM1: 0.

Comments (SFG-38):

(i) According to Sebestyén, SHR ⋈ <u> was derived from the parts of the Ancient Greek ◇ *omicron* <o> (SFG-32) by reconstruction, then closing its sides with vertical lines (Sebestyén 1906: 273, 280). This concept contains too many assumptions.

(ii) The glyph ᛞ is certainly the result of medieval development, influenced by the Old Hungarian orthography of the Latin script (Table 8-18). According to Vékony, the glyph ᛞ is derived from SHR ᛖ <v> /u, ü, v/ by adding auxiliary bars (Vékony 2004a: 29). It is unknown from the surviving SHR script relics exactly when ᛖ <v> and ᛞ <u> were developed; even in the 17th c. there is an example that the ᛖ <v> denoted /u/ (Bonyhai's Example). On the other hand, it can be observed that in script relics where the ᛞ <u> also existed, the use of ᛖ <v> was limited to the notation of /v/. Using ᛞ <u> as /ü/ makes it probable that the ᛞ <u> is derived from a ᛖ <v> grapheme with /ü/ sound value, see Λᛞ◊ /küs/ 'little' in the Stick Calendar (Sándor 1991).

(iii) A change analogous to the putative SHR ᛖ > ᛞ feature transformation is seen in case of the Runic ᛈ, ᛈ <p> (Looijenga 2003: 6).

SFG-39

Descendant feature (grapheme):

SHR (Nikolsburg, 1490–1526) ⫽ *eǵ* /ď/, ǂ *eng* /ng/ or /nď/; (Csíkszentmihály, 1501) ǂ /ď/; (Szamosközy's Note, before 1593) ǂ /g/; (Rugonfalva, 16th–17th c.) ǂ /ď/; (Bonyhai's Alphabet, 1627) ǂ /g/; (Csulai, 1644) ǂ /ď/; (Gyulafehérvár, 1655) = /ď/; (Szegedi, 1655) ǂ, ǂ /ď/; (Énlaka, 1668) ǂ /ď/; (Kájoni's Ancient, 1673) ǂ *g* /g/; (Hickes, 1705) ⫽ /ď/; (Patakfalvi, 1776–1785) ⫽ /ď/ <ď>;

SHR (Nikolsburg, 1490–1526) ǂ *eng* /ng/ <ng> or /nď/ <nď>.

OM1 (SFG-39):

Anatolian-Greek Alphabetic ancestor feature (grapheme):

Ancient Greek (Crete, 8th–7th c. BC) I; ǂ, ǂ (Hempl 1899: 29); (Athens, 8th–7th c. BC) I (Healey 1990a: 37); (Thera, 7th c. BC) ǂ (Heubeck 1979: 98, Fig. 37 apud Powell 1991: 51; Haarmann 1990: 287); (early) ǂ, (Athens) I, (Milétosz) I, (Corinth) 王 (Doblhofer 1962: 36) *zeta* <ζ> /ds, sd/ (Jeffery 1961: 25–28), /zd/ or /dz/ [d͡ʒ/d͡z] (Hinge 2006);

Italic witness feature (grapheme): *Etruscan* ǂ (Hempl 1899: 30); ǂ, ǂ, ǂ (Haarmann 1990: 297); (late) ǂ <z> /t^s/ (Marchesini 2009: 125); *Faliscan* ǂ (Hempl 1899: 30) <z>; *Lepontic* (6th c. BC) ǂ, ‡, (later) ✗ <z> (Morandi 2004: 476) /t^s/? (tau Gallicum) (Eska 2008: 168, 171); *Oscan* (Etruscan, first half of 4th c. BC – first half of 1st c.) I <z> [z, t͡s, d͡z]; *Raetic* ǂ, I <z> /t?/z?/ (Marchesini 2014: 206–207); *Umbrian* (Etruscan, 4th c. – first half of 1st c. BC) ǂ, ǂ (Hempl 1899: 30), ǂ (MNAMON: Umbrian, retrieved in 2015) <z> [t͡s] (Buck 1904: 24); *Venetic* (Este, end of 6th c. – beginning of 1st c. BC) ✗ <z> [d].

OM2 (SFG-39):

Brahmic ancestor feature (grapheme):

Brāhmī (alphabet q [Turkestan Gupta]) ᛉ, (alphabets r and s [Early Turkestan]) ᛉ <ja> (details: SFG-41);

Tibetan ཛ (van Schaik 2011: 79); ཛ (Róna-Tas 1991: 117, Table VII) <ja> (Róna-Tas 1991: 94).

OM+ (SFG-39):
Tamgas ancestor feature (glyph shapes or styles):
Tamgas (Khumbuztepa, 3rd–1st c. BC) ⧧; (Basins of the Amu Darya and the Syr Darya, 6th–2nd c. BC) ǂ; (Altay) ⧧; (Ancient Turkic tribal tamgas) ⤫ <tamga> (details: Table 8-34).

Evaluation (SFG-39):
Changed script: SHR.
Region of relics: SHR: Carpathian Basin.
Source script family:
OM1: Anatolian-Greek Alphabetic.
OM2: Brahmic (becoming similar, borrowing or symmetrization [Table 4-2], use of known glyph [Table 4-3]).
Period of change:
OM1: 9th–5th c. BC, the using period of the Ancient Greek (Table 8-8) script.
OM2: 4th–9th c. AD, the union of the using periods of Brāhmī and Tibetan graphemes (Table 8-15); the upper limit is the age of the Hungarian conquest of the Carpathian Basin since after this any influences of the Brāhmī or Tibetan scripts were impossible.
Region of change: OM1: Anatolia. OM2: Inner Asia.
Glyph fit only with tamgas: OM1: 0. OM2: 1.

Comments (SFG-39):

(i) The previous sound value of SHR <d'> can be deduced from the sound change of the Ancient Hungarian /d͡ʒʲ/ > Old Hungarian /ď/. The exact time of this sound transition is unknown, but it happened after the 10th c. AD, and it certainly ended by the 15th c.

(ii) According to Sebestyén, SHR ǂ, ǂ <d'> was derived from the ligature of SHR ϯ, + <d> (SFG-29) and †, ‡ <i> (SFG-53) (Sebestyén 1906: 272, 275). It is unlikely since the ligature-based letter creation is presumably the influence of the Old Hungarian orthography of the Latin script (see the development of SHR D <ń> from Ɔ <n> and 1 <j>, SFG-73). However, in the Old Hungarian orthography of the Latin script the digraph gy <d'> was developed from the g <g> and y <y>, and not from <d> and <y>.

(iii) The glyphs of Phoenician (ʿIzbet Ṣarṭah Ostracon, around 1100 BC) ⌷ (Röllig 1995: 204–205); ⧣, ⧣ (Sprengling 1931: 55); (Byblos, 11th–10th c. BC) I (Cross 1989: 82), (Tel Zayit Alphabet, late 10th c. or very early 9th c. BC) ⌶ (Kőszeghy 2010: 57); (Tell Faḫariyeh, 9th c. BC) I (Lipiński 1994: 27); (Limassol [Cyprus], ca. 750 BC) ‡ (Röllig 1995: 204–205); (Karatepe KAI 26, ca. 700 BC) ⌶ (Amadasi Guzzo & Zamora López 2013: 187) *zai* <z> /dz/ (Hackett 2008: 86) are generally far from the descendant grapheme, and their phonetic value also differs. Therefore, it is very unlikely that Phoenician <z> could be the ancestor grapheme.

(iv) SR > <d> (SFG-25) and SR ∩ <d> (SFG-26) had the /ɟ/ sound value, besides the /d/ or /δ/. Therefore, SHR ϯ <d> (SFG-29) could also have had/ɟ/ sound value, and the glyph ǂ of the descendant grapheme could have been developed with a line insertion (Table 4-3) for separation (Table 4-2) from SHR ϯ <d> /d/. However, this is a very unlikely lineage, since there is no example for the /ɟ/ sound value of SHR ϯ <d> (SFG-29).

(v) Cf. SFG-41.

(vi) The similarity between the three-cross-line variant Ancient Greek , <ζ> and SHR (Hickes) <d'> is surely the result of a homoplasy (Table 2-7), only.

SFG-40

Descendant feature (grapheme):

TR (Róna-Tas 1987: 13); (O, Y) , , (Y) , , , (Thomsen 1893: 9); (T) , (Kyzlasov, I. L. 1994: 71); , , , , (Malov 1951: 17); (T) , , , , , (Y) , , , (O) , (Kairžanov 2014: 18), (Yar Khoto N. 21, wall inscription) (Erdal 1993: 91, 104–105); (Mendur-Sokkon IV) ; (Khangyt-khat, end of 7th c. – the beginning of 8th c.) , ; (Kalbak-Tash II, 8th c.) ; (Khentii, the second half of 8th c. – the beginning of 9th c.) ; (Mendur-Sokkon I/1) ; (Tumshuk-Koby) ; (Inegen II) ; (manuscript) (von Gabain 1941), (Toñuquq, 726) (Clauson 1970: 75) <z>;

SR (Khumara-8 [in copy], 9th–10th c.) <z> /z/.

OM1 (SFG-40):

Aramaic ancestor feature (grapheme):

Imperial Aramaic (7th c. BC) , (Gibson 1975); (inscriptions) , (Bühler 1898: Second table after page 124: Comparative Table of the Perso-Aramaic and the Kharoṣṭhī); (satrapies, 5th–4th c. BC) , (monuments, Egypt, 4th–3rd c. BC) , (papyrus, Egypt, 2nd c. BC) (Taylor 1883, vol. I: 250); (cursive, Egypt, 5th–3rd c. BC) , (Lidzbarski 1910); (monumental) , , (Assyrian and Egyptian papyri) , (Babylonian Bowls) , (Faulmann 1880: 79); (Aśoka, around 250 BC) *zayin* <z> /z/;

Armazian (Cereteli 1948–1949 apud Róna-Tas 1987: 14) <z>;

Aramaic witness feature (grapheme): *Syriac* (Estrangela) ; (Nestorian) *zayn* <z> /z/.

OM2 (SFG-40):

Greek Alphabetic ancestor feature (grapheme):

Greco-Bactrian (Loulan, 4th c. AD) (Ghirshman 1948: 63); , , , , (Cunningham 1893: Plate III, before page 93) *zeta* <ζ>.

OM3 (SFG-40):

Middle Iranian ancestor feature (grapheme):

Khwarazmian (coins) , , (Vainberg 1977: Table VIII) <z>;

Middle Persian (inscriptional) (Skjærvø 1996: 518) <z> /z/;

Middle Iranian witness feature (grapheme): *Parthian* (early) (Nisa, 1st c. BC) ; (inscriptional) *zayin* <z> /z, ž/ (Häberl 2006: 57); *Sogdian* (early) (Kultobe, before 4th c. AD) , (Sims-Williams & Grenet 2006: colour illustrations without page numbering); (Ancient Letters, beginning of 4th c. AD) (Harmatta 2004: 186); (sutra) (Skjærvø 1996: 519) *zayin* <z> /z/; Christian Sogdian (Skjærvø 1996: 519) *zayin* <z> /z/.

OM4 (SFG-40):

Brahmic ancestor feature (grapheme):

Brāhmī (North Turkestan, in Turkic texts) (Róna-Tas 1991: 114, Table IV); (Uyghur) (Sander 1968: Tafel 41); (Uyghur) (Maue 2010: 6) <za> /z/.

OM+ (SFG-40):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Achaemenid Iran) , ; (Khumbuztepa, 6th–5th c. BC) ; (Basins of the Amu Darya and the Syr Darya, 1^{st} c. BC –3^{rd} c. AD) , ; (Sarmatia, 2^{nd} half of 2^{nd} c. – 1^{st} half of 3^{rd} c. AD) ; (Kultobe) ; (Issyk-Kul Lake area) <tamga> (details: Table 8-34).

Evaluation (SFG-40):
Changed script: TR & SR.
Region of relics: TR: Inner Asia; SR: Pontus Steppe.
Source script family:
OM1: Aramaic.
OM2: Greek Alphabetic.
OM3: Middle Iranian.
OM4: Brahmic.
Period of change:
OM1: $7^{th}/6^{th}$ c. BC – 2^{nd} c. AD, the union of the using periods of Imperial Aramaic (Table 8-12) and Armazian scripts.
OM2: AD 342–781, the using period of the Greco-Bactrian (Table 8-13) script.
OM3: $1^{st}/2^{nd}$ c. AD – late 7^{th} /8^{th} c. AD, the union of the using periods of Khwarazmian (Table 8-16) and Middle Persian scripts.
OM4: ca. 6^{th}–8^{th} c. AD, the using period of Brāhmī glyph variants presumed to be the ancestor (Table 8-15), the upper limit is the age of the earliest TR or SR inscriptions (Table 8-19).
Region of change: OM1, OM2, OM3 & OM4: Inner Asia.
Glyph fit only with tamgas: OM1: 1. OM2: 1. OM3: 1. OM4: 1.

Comments (SFG-40):

(i) According to Clauson, TR , , , <z> is the completion of the Greco-Bactrian (Loulan, 4^{th} c. AD) (Ghirshman 1948: 63) <ζ> with a vertical line (Clauson 1970: 70), see OM2.

(ii) The > topological change is possible; its analogy is the glyph distribution of the Greco-Bactrian (Loulan, 4^{th} c. AD) (Ghirshman 1948: 63), (Ghirshman 1948 apud Clauson 1970: 74); , , (Cunningham 1893: Plate III, before page 93) *upsilon* (Harmatta 1994a: 413) <υ> /h/ (Harmatta 1994a: 413); where there happened a > , topological change.

(iii) Interestingly, the following Uyghur graphemes are similar to the Khwarazmian ones: Uyghur (beginning), (closing) (Kara 1996: 540) <z>.

(iv) TR glyph variants , , especially remind Brāhmī <za>.

(v) TR , <z> is comparable to Ancient South Arabian (Minaic, Sabaic) <z>; however, the clear majority of Rovash glyphs are open, so it is highly probable that the close-shaped glyph of TR , was developed later, and its similarity to South Semitic <z> is homoplasy (Table 2-7).

SFG-41

Descendant feature (grapheme):
CBR (Szarvas, first half of 8^{th} c.) ; (Kiskundorozsma, end or last third of 8^{th} c.) ; (Nagyszentmiklós, 8^{th}–11^{th} c.) , , <z> /z/.

OM1 (SFG-41):
Brahmic ancestor feature (grapheme):
Brāhmī (Gupta, 4^{th}–6^{th} c. AD) (Salomon 1998: 32); (North Turkestan) (Róna-Tas 1991:

114, Table IV); (alphabet q [Turkestan Gupta]) , , , (alphabets r and s [Early Turkestan]) , , , (alphabet t [North Turkestan Type A]) , (Standard North Turkestan [alphabet u, Type B]) , (alphabet v [Khotanese]) (Sander 1968: Tafel 29); (Khotanese) (Leumann 1934: 17); (Tocharian) (Krause & Thomas 1960: 41) <ja> /ɟ/;

Brahmic witness feature (grapheme): *Brāhmī* (Socotra [Jemen], T 25-b, LTR inscription, end of 2^{nd} c. AD – 4^{th} c.) <ji> (details: SFG-39).

OM2 (SFG-41):

Brahmic ancestor feature (grapheme):

Tibetan (Róna-Tas 1991: 117, Table VII) <za> [zà/sà].

OM+ (SFG-41):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Kanka) <tamga> (details: Table 8-34).

Evaluation (SFG-41):

Changed script: CBR.

Region of relics: CBR: Carpathian Basin.

Source script family:

OM1 & OM2: Brahmic.

Period of change:

OM1: 4^{th}–8^{th} c. AD, the using period of Brāhmī glyph variants presumed to be the ancestor (Table 8-15), the upper limit is the age of the first occurrence of the descendant grapheme.

OM2: From AD 630–648 to 8^{th} c., the lower limit is the creation of the Tibetan script (Table 8-15), the upper limit is the age of the first occurrence of the descendant grapheme.

Region of change: OM1 & OM2: Inner Asia.

Glyph fit only with tamgas: OM1: 1. OM2: 0.

Comments (SFG-41):

(i) Tibetan <za> was originally formed from Tibetan <ja> (SFG-39). Tibetan <za> is mirrored from <ja> (Maue, Dieter: Personal communication by email, 21 January 2020).

(ii) According to Vékony, the possible ancestor of CBR <z> is the straight variant of Parthian *zayin* <z> (SFG-40) with slanting arms, or more likely, the derivation of Rovash <s^1> (SFG-101) (Vékony 1987a: 120). However, these concepts contain too many assumptions.

(iii) A possible ancestor could be Ancient Greek (Thera, 7^{th} c. BC) (Heubeck 1979: 98, Fig. 37 apud Powell 1991: 51; Haarmann 1990: 287); (early) , (Corinth) (Doblhofer 1962: 36) *zeta* <ζ> /ds, sd/ (Jeffery 1961: 25–28), /zd/ or /dz/ [d͡ʒ/d͡z] (Hinge 2006) (further Ancient Greek <ζ> glyphs: SFG-39). This option would require a feature transformation (>) and a sound change. There are examples of both separately: Lemnian (6^{th} c. BC) (MNAMON: Lemnian, retrieved in 2015) <z>; Etruscan (late) <z> /t^s/ (Marchesini 2009: 125); Faliscan (4^{th}–1^{st} c. BC) <z>, Umbrian (Etruscan, first half of 4^{th}–1^{st} c. BC) , <z> [t͡s] (Buck 1904: 24), Early Latin <z>. However, this is only circumstantial evidence, so the Ancient Greek <ζ> could not be considered an ancestor.

(iv) The shape of Khwarazmian (coins) , , (Vainberg 1977: Table VIII) <z> is slightly curved. The straight-line CBR <z> could originate from it, but this requires the addition of further arms. Besides, while Rovash ǀ <s^1> (SFG-101) did not have any arm, to derive from it, one would have to assume that arms were added. Oppositely, the Khwarazmian <z> had an arm so only its multiplication should be presumed. For changing the number of arms and becoming slanting, there are examples in Table 4-3. However, this lineage option seems unlikely due to the number of assumptions. Similar grapheme: Uyghur (beginning), (ending) (Kara 1996: 540) <z>.

(v) Cf. SFG-39 and SFG-40.

SFG-42

Descendant feature (grapheme):
SR (Jitkov, first third of 8th c.) ; (Mayatskoe-10, 9th c.) <χ> /χ/.

OM1 (SFG-42):
Aramaic ancestor feature (grapheme):
Imperial Aramaic (weights, seals and coins, 8th–3rd c. BC) , , (Lidzbarski 1910); (satrapies, 5th–4th c. BC) , , (monuments, Egypt, 4th–3rd c. BC) , , (papyrus, Egypt, 2nd c. BC) , (Taylor 1883, vol. I: 250); (6th c. BC) , , (Gibson 1975); (inscriptions) (Bühler 1898: second table after p. 124: Comparative Table of the Perso-Aramaic and the Kharoṣṭhī); (Elephantine Papyri, 6th c. BC) (Glass 2000: 14); (6th c. BC) (Schniedewind 2006:140); (4th c. BC) , (Schniedewind 2006:140); (6th c. BC) , (4th c. BC) , (1st c. BC) (Schniedewind 2006: 140); (Aśoka, around 250 BC) (Glass 2000: 14); (MacKenzie 1971: xi) *hē* <h> /h/;
Aramaic witness feature (grapheme): *Hebrew* (Qumran Manuscripts, 1st c. BC) *hē* <h> /h/.

OM2 (SFG-42):
Middle Iranian ancestor feature (grapheme):
Parthian (early) (Nisa, 1st c. BC) (Skjærvø 1996: 518) <h>;
Khwarazmian (Toprak-kala) (Vainberg 1977: Table VIII) <h>;
Manichean (Sogdian) (3rd c. AD or earlier) (Skjærvø 1996: 519); , (Durkin-Meisterernst 2005: Table 1) *hē* <h> /a, Ø/;
Middle Iranian witness feature (grapheme): *Parthian* (inscriptional) ; (inscriptional) (Skjærvø 1996: 518) <h>; *Sogdian* (Ancient Letters, early 4th c. AD) , (sutra) (Skjærvø 1996: 519) <h>; *Middle Persian* (inscriptional Pahlavi) , (Psalter) (Bulayïq, 6th–7th c., a copy of an origin from the 4th c. AD) , (Book Pahlavi) (Skjærvø 1996: 518); (coins, 4th–6th c. AD) (Taylor 1883, vol. II: 236) <h>; *Christian Sogdian* (Skjærvø 1996: 519) *hē* <h> /a, Ø/.

Evaluation (SFG-42):
Changed script: CBR & SR.
Region of relics: CBR: Carpathian Basin; SR: Inner Asia & Pontus Steppe.
Source script family: OM1: Aramaic. OM2: Middle Iranian.
Period of change:
OM1: 7th/6th–1st c. BC, the using period of the Imperial Aramaic (Table 8-12) script.
OM2: 2nd c. BC – 7th c. AD, the union of the using periods of Parthian, Khwarazmian and Manichean scripts (Table 8-16), the upper limit is the age of the earliest CBR or SR script relics (Table 8-19).

Region of change: OM1 & OM2: Inner Asia.
Glyph fit only with tamgas: OM1: 0. OM2: 0.

Comments (SFG-42):

(i) It is not problematic that in the ancestor graphemes the sound value is /h/, and the sound value of the descendant grapheme is /χ/. Sounds /h/ and /χ/ are close to each other, e.g., the Aramaic <ḥ> was borrowed by the Middle Iranian languages with sound values /h/ and /χ/ (Skjærvø 1996: 519).

SFG-43

Descendant feature (grapheme):
SR (Mayaki, 8th–9th c.) <χ> /χ/.

OM1 (SFG-43):
Middle Iranian ancestor feature (grapheme):
Parthian (early, Nisa, 1st c. BC) (Skjærvø 1996: 518); (Avroman, 13/12 BC) , (Minns 1915: 62; Ivantchik & Lurje 2013: 286–287) *ḥēṯ* <ḥ> /h, χ/ (more glyphs: SFG-58);
Middle Persian (inscriptional) (Skjærvø 1996: 518) *ḥēṯ* <ḥ> /h, χ/ (more glyphs: SFG-58);
Middle Persian (coins, 4th–6th c. BC) (Taylor 1883, vol. II: 236) <h>.

Evaluation (SFG-43):
Changed script: SR.
Region of relics: SR: Pontus Steppe.
Source script family: OM1: Middle Iranian.
Period of change:
OM1: 2nd c. BC – 7th c. AD, the union of the using periods of Parthian and Middle Persian scripts (Table 8-16).
Region of change: OM1: Inner Asia.
Glyph fit only with tamgas: OM1: 0.

Comments (SFG-43):

(i) The Chu-Ili interfluve and Issyk-Kul Lake Area) ; (Basins of the Amu Darya and the Syr Darya, 1st c. BC –3rd c. AD) , <tamga> (Table 8-34) might affect the descendant grapheme.

SFG-44

Descendant feature (grapheme):
CBR (Békés-Povádzug, second half of 11th c. – beginning of 12th c.) , <χ> /χ/;
SR (Achik-Tash, 8th c.) , <h> /h/.

OM1 (SFG-44):
Aramaic ancestor feature (grapheme):
Imperial Aramaic (weights, seals and coins, 8th–3rd c. BC) , , (Lidzbarski 1910); (satrapies, 5th–4th c. BC) , , (monuments, Egypt, 4th–3rd c. BC) , , (papyrus, Egypt, 2nd c. BC) , (Taylor 1883, vol. I: 250); (6th c. BC) , , (Gibson 1975); (inscriptions) (Bühler 1898: second table after p. 124: Comparative Table of the Perso-Aramaic and the Kharoṣṭhī); (Elephantine Papyri, 6th c. BC) (Glass 2000: 14);

(6th c. BC) (Schniedewind 2006:140); (4th c. BC) , (Schniedewind 2006:140); (6th c. BC) , (4th c. BC) , (1st c. BC) (Schniedewind 2006: 140); (Aśoka, around 250 BC) (Glass 2000: 14); (MacKenzie 1971: xi); (Bactria) , , (Arachosia [Afghanistan and Pakistan]) , (Ivantchik & Lurje 2013: 290) *hē* <h> /h/;

Aramaic witness feature (grapheme): *Hebrew* (Qumran Manuscripts, 1st c. BC) *hē* <h> /h/; *Nabataean* (late) (Macdonald 2008: 218) <h>; *Palmyrene* (Harmatta 2000: 181) <h>; *Arabic* (early) , (modern) (Macdonald 2008: 218) *hā'* <h> /h/.

OM2 (SFG-44):

Middle Iranian ancestor feature (grapheme):

Parthian (early) (Nisa, 1st c. BC) (Skjærvø 1996: 518) <h>;

Manichean (Sogdian) (3rd c. AD or earlier) (Skjærvø 1996: 519) *hē* <h> /a, Ø/;

Middle Iranian witness feature (grapheme): *Parthian* (inscriptional) ; (inscriptional) (Skjærvø 1996: 518) <h>; *Khwarazmian* (Toprak-kala) (Vainberg 1977: Table VIII) <h>; *Middle Persian* (inscriptional Pahlavi) , (Psalter) (Bulayïq, 6th–7th c., a copy of an origin from the 4th c. AD) , (Book Pahlavi) (Skjærvø 1996: 518); (coins, 4th–6th c. AD) (Taylor 1883, vol. II: 236) <h>; *Christian Sogdian* (Skjærvø 1996: 519) *hē* <h> /a, Ø/.

OM+ (SFG-44):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Achaemenid Iran) ; (Bayte, 3rd c. BC –2nd AD) ; (Noin Ula, 2 BC) ; (Basins of the Amu Darya and the Syr Darya, 6th–2nd c. BC) , ; (1st c. BC –3rd c. AD) , ; (Sarmatia, 2nd half of 2nd c. – 1st half of 3rd c. AD) ; (Nagyszentmiklós, inscription No. 17, 8th–11th c. AD) <tamga> (details: Table 8-34).

Evaluation (SFG-44):

Changed script: CBR & SR.

Region of relics: CBR: Carpathian Basin; SR: Inner Asia & Pontus Steppe.

Source script family:

OM1: Aramaic and Tamgas (becoming similar or borrowing [Table 4-2, glyph shape transfer, Table 2-9: 2-2. §]; use of known glyph [Table 4-3]).

OM1: Middle Iranian (becoming similar or borrowing [Table 4-2, glyph shape transfer, Table 2-9: 2-2. §]; use of known glyph [Table 4-3]).

Period of change:

OM1: 7th/6th–1st c. BC, the using period of the Imperial Aramaic (Table 8-12) script.

OM2: 2nd c. BC – 7th c. AD, the union of the using periods of Parthian (Table 8-16) and Manichean scripts, the upper limit is the age of the earliest CBR or SR inscriptions (Table 8-19).

Region of change: OM1 & OM2: Inner Asia.

Glyph fit only with tamgas: OM1: 1. OM2: 1.

Comments (SFG-44):

(i) For the ancestor of CBR , , <χ> (SFG-44) and CBR <χ> (SFG-45), Vékony propounded the following possibilities: Semitic <q> (Vékony 1987a: 120–121), TR <qº> (SFG-62) (Vékony 2004a: 153) or SR <h> (SFG-44) (Vékony 2004a: 293).

(ii) It is not a problem that the glyph has the sound value /χ/ in CBR, and /h/ in SR. The sounds /h/ and /χ/ are close to each other, e.g., the Aramaic <ḥ> was adopted by the Middle Iranian languages with /h/ and /χ/ (Skjærvø 1996: 519).

(iii) It is possible that the SFG-42, SFG-43 and SFG-44 are strongly related.

(iv) Rovash graphemes denoting *k, q* or *χ* are reviewed by Table 7-2.

(v) Imperial Aramaic *hē* <h> (SFG-42) has an early glyph variant (𐡄), which is similar to the descendant grapheme.

(vi) Greco-Bactrian (cursive) ƒ (Kurbanov 2010: Fig. 93) <χ> slightly similar to the descendant glyphs; however, its usual glyph variants (Χ, ϗ, χ, see SFG-46) are different; therefore, it is not considered a possible ancestor grapheme.

(vii) The (Bayte [Mangystau Region, Kazakhstan], 3rd c. BC –2nd AD) ⥼ (Yatsenko 2010b: 140) Sarmatian/Massagetian graph can be compared to the descendant graphemes under study (Table 8-34).

(viii) The Ancient Greek (red) Y, ↓; (Boiotia) Ѱ, Ψ (Swiggers 1996b: 264) *chi* (Jeffery 1961: 36) <kh> /kʰ/ could be an ancestor; however, the descendant glyphs are consequently mirrored and slightly different from the Ancient Greek glyphs. It is worth noting that direct or indirect relatives of the Ancient Greek <kh> have glyphs being more similar to the descendant graphemes: Ancient South Arabian (Sabaic) (ca. 1000 BC) Ѱ (Stein 2013: 194); (Minaic) (Dadan) Ψ; (Sabaic) Ψ, Ψ; (Hasaitic) Ψ, Dispersed Oasis North Arabian, Taymanitic Y, Ѵ, Dadanitic Λ, ሐ, Λ, Dadanitic (Lihyanite) Λ, Λ (Macdonald 2004: 496); Thamudic D m, Thamudic C ሐ, m, Hismaic ⋲ (OCIANA-Hismaic 2017: xiv); ሐ, ϶ (Macdonald 2004: 496); ∃ (King 1992: Figure 1 between the pages 5 and 6); ⋹ (Macdonald 2005: 82); Thamudic B Y, Safaitic ϵ (OCIANA-Safaitic 2017: xv); ϶, Λ (Macdonald 2004: 496); Ⅲ, ∃, m (Macdonald 2015: 31, 33, 37) <ḥ> /ħ/; Lycian Ѱ, V, Y, Y <χ> (Adiego 2007e: 8) or <x> (Melchert 2008a: 48) /k/ (Adiego 2007e: 8–9; Melchert 2008a: 48) (before velar vowels) (Adiego 2004: 243, 306, 318; Melchert 2008a: 48–49); Etruscan (Marsiliana d'Albegna, 7th c. BC) Y, (early) Y, (late) Ѱ, ↓ (Doblhofer 1962: 319) <χ> [kʰ]; Messapic (first half of 6th–4th c. BC) ↑, Y; (second half of 5th–3rd c. BC) Y <h> /h?/ (de Simone 1988: 325–415; Marchesini 2009); Raetic Y, Ѱ (Marchesini 2014: 206–207); ⅄ (Morandi 1982: 199) <χ> /ch/; Lepontic (early) ↓, (late) Ѱ <χ>; Gallo-Etruscan (4th–2nd c. BC) Y, ᚠ <χ>; Venetic (beg. of 6th c. – end of 6th c. BC) Y; (Este, Padova, end of 6th c. – beginning of 1st c. BC) Y <χ> [g]; Camunic (Piancogno) Y, (Foppe di Nadro) ⅄ (TIR: Script, retrieved on 20 February 2018); Y, Y (Morandi 2004: 476) <χ?> [g?]. Some of them reminds specific Rovash glyph. Namely, the glyph variants (ሐ, ϶, Y) of the South Semitic <ḥ> remind some Rovash glyphs (⅄ [SFG-44], ⅁ [SFG-42]). The glyph variants (↑, Y, ⅄, Ѱ) of the Italic <h, χ> are even more similar to Rovash ⅄, ⅄, ⅄, ⅁ glyphs. The existence of Italic <h, χ> glyphs (especially: Y) may support, that they could have indirect relationship to Rovash <χ>.

(ix) The similarities of the descendant grapheme to Old Canaanite (Serabit el-Khadem, ca. 18th c. BC) ᛘ (Albright 1948: 6–22); ᛘ (Sprengling 1931: 55); Ч, Ψ; (Sinai 358) ⅄ (Colless 2010: 96); (15th c. BC) Ч (Cross 1989: 82) <h> /h/ and Anatolian Hieroglyphic ⅄, ⅄ (Payne, A. 2010a: 191) *451 ᴱ*<u>hur</u>,* HUR <hur> are surely homoplasies (Table 2-7).

SFG-45

Descendant feature (grapheme):

CBR (Nagyszentmiklós, 8th–11th c.) ⩚ <χ> /χ/.

OM1 (SFG-45):
Rovash ancestor feature (grapheme):
CBR ᚼ <χ>; *SR* ᛦ, ᛦ <h> (details: SFG-44).

OM+ (SFG-45):
Tamgas ancestor feature (glyph shapes or styles):
Tamgas (Basins of the Amu Darya and the Syr Darya, 6th–2nd c. BC) ᛦ; (Kultobe, 1st–3rd c. AD) ᚼ <tamga> (details: Table 8-34).

Evaluation (SFG-45):
Changed script: CBR.
Region of relics: CBR: Carpathian Basin.
Source script family:
OM1: Rovash (internal development) (becoming similar, borrowing or symmetrization [Table 4-2, Table 7-8]; use of known glyph [Table 4-3]).
Period of change:
OM1: Before 8th–11th c. AD, the upper limit is the age of the earliest CBR inscriptions containing the descendant grapheme.
Region of change: OM1: Inner Asia.
Glyph fit only with tamgas: OM1: 1.

Comments (SFG-45):
(i) The glyph ᚼ developed likely parallel with the more usual ᛦ, ᚼ variants.
(ii) Vékony raised the idea of the relationship between CBR ᚼ <χ> and TR ↑ <ʷqʷ> (SFG-62) (Vékony 2004a: 153); however, their sound values significantly differ.

SFG-46
Descendant feature (grapheme):
SHR (Homoródkarácsonyfalva Stone inscription, around 13th c.) ⵅ; (Nikolsburg, 1490–1526) ⵅ *eh;* (Wolfenbüttel, 1592–1666) ⵅ; (Rudimenta-Giessen, 1598) ⵅ *ah;* (Szamosközy's Poem, 1604) ⵅ; (Kájoni's Ancient, 1673) ⵅ *h;* (Kájoni's Rudimenta-like, 1673) ⵅ *h;* (Gönczi, around 1680) ⵅ; (Dobai, 1753) ⵅ; (Patakfalvi, 1776–1785) ⵅ <h> /h/.

OM1 (SFG-46):
Slavic ancestor feature (grapheme):
Glagolitic (Codex Assemenianus – fol. 138v, second half of 10th c. – first half of 11th c. AD) Ⱈ (Kempgen 2016: 2); (Psalterium Siniaticum – fol. 78r, 11th c. AD) Ⱈ (Kempgen 2016: 4); (Abecenarium Bulgaricum, 12th c. AD or maybe earlier) Ⱈ (Kempgen 2016: 8) *xlъmъ (spidery kh)* <χ> #6000 (Jung 2013: 116; Kempgen 2016: 5)
Greek Alphabetic witness feature (grapheme): *Greek* (uncial) (4th c. AD) Χ, (9th c. AD) Χ (Taylor 1883, vol. II: 154); (medieval uncial) Χ, Χ (Faulmann 1880: 171); (cursive, 2nd c. BC) Χ, (7th c. AD) Χ (Taylor 1883, vol. II: 154); (medieval cursive) χ, χ, χ (Taylor 1883, vol. II: 203); (medieval cursive) χ (Faulmann 1880: 171); (minuscule) (9th c. AD) χ, (12th c. AD) χ (Taylor 1883, vol. II: 154); (medieval minuscular) χ, χ, χ (Faulmann 1880: 171) *chi* <χ> /χ/; *Greco-Bactrian* (Sasanian princes Bahrām and Hormizd) χ, χ, (Loulan, 4th c. AD) χ (Ghirshman 1948: 63); (cursive) χ (Kurbanov 2010: Fig. 93) *chi* <χ> /χ/.

OM+ (SFG-46):
Tamgas ancestor feature (glyph shapes or styles):
Tamgas (Kaunchitobe) ⵅ; (Altay) ⵅ <tamga> (details: Table 8-34).

Evaluation (SFG-46):
Changed script: SHR.
Region of relics: SHR: Carpathian Basin.
Source script family:
OM1: Slavic.
Period of change
OM1: 9th–13th c. AD, the using period of the Glagolitic script (Table 8-21), the upper limit is the age of the earliest SHR inscription containing the descendant grapheme.
Region of change: OM1: Carpathian Basin.
Glyph fit only with tamgas: OM1: 1.

Comments (SFG-46):

(i) In case of SHR ⵅ <h>, Sebestyén presumed that its calligraphic ⵋ glyph variant originates from the glyph H of the Latin <h> (Sebestyén 1906: 272, 275). Others have hypothesized that SHR ⵅ <h> and Greek Χ *chi* <χ> (Németh's notation: <ḫ>) are related (Ligeti 1925: 51; Németh 1934: 29; Németh 1971: 39), which corresponds to OM1. In the earliest surviving inscriptions the angular shape ⵅ of SHR ⵅ <h> is looped, similar to that observed for the Greek <χ> only on some medieval cursive variants: χ, χ, χ (details above); however, most of the Greek <χ> glyph variants are cross-shaped: Χ, Χ. An example of a glyph development that can be linked to this is: TR ጰ, ጰ <b²> ~ TR ⵅ <b²> (SFG-14).

(ii) Vékony proposed the relationship between SHR ⵅ, ⵅ <h> and CBR ⩚ <χ> (Vékony 2004a: 154); however, their topological difference is too large.

(iii) Rovash graphemes denoting *k, q* or *χ* are reviewed by Table 7-2.

(iv) The glyph distributions of SHR ⵅ, ⵅ, ⵅ <e> /e, ē/ (SFG-6) and SHR ⵅ, ⵅ, ⵅ, ⵅ, ⵅ, ⵋ <h> (SFG-46) largely overlap. This similarity is just a coincidence.

SFG-47

Descendant feature (grapheme):
SHR (Bodrog-Alsóbű, around 900 or first half of 10th c.) ⊙; (Vargyas, 12th–13th c.) θ; (Homoródkarácsonyfalva Stone inscription, around 13th c.) θ; (Stick Calendar, ca. 15th c. surviving in a 17th c. copy) θ; (Nikolsburg, 1490–1526) θ *f;* (Csíkszentmihály, 1501) θ; (Wolfenbüttel, 1592–1666) ⊕; (Farkaslaki, 1624) ⊗; (Bonyhai's Example, ca. 1627) θ; (Bonyhai's Alphabet, 1627) ⊗; (Kájoni's Ancient, 1673) θ *f;* (Kájoni's Rudimenta-like, 1673) ⊕ *f;* (Gönczi, around 1680) ⊕; (Marsigli's Alphabet, 1690) θ *f;* (Patakfalvi, 1776–1785) ⊗ <f> /f/.

OM1 (SFG-47):
Slavic ancestor feature (grapheme):
Glagolitic (Old Church Slavonic) ⰿ (Diringer 1948: 477) *fita (thita)* <f>;
Slavic witness feature (grapheme): *Early Cyrillic* ѳ (Kempgen 2015–2016, Vol. 2: 59) *fita* <f>;
Greek Alphabetic witness feature (grapheme): *Greek* (4th c. BC – 2nd c. AD) Θ (McLean 2002:

41); (cursive, 3rd c. BC – 4th c. AD) θ (Thompson 1912: 191–193); (cursive, 2nd c. BC – 9th c. AD) ϑ, (cursive, 3rd c. BC – 9th c. AD) ϑ (Thompson 1912: 191–194); (early minuscule, 9th c. AD) θ, (late uncial, 9th c. AD) θ, (middle minuscule, 10th–11th c. AD) θ (Taylor 1883, vol. II: 154) *theta* <θ> (further glyphs: SFG-28);

Canaanite witness feature (grapheme): *Phoenician* (ʿIzbet Ṣarṭah Ostracon, ca. 1100 BC) ⊕ (Rollston 2008a: 84); ⊕ (Valério 2008: 121); (Byblos, 11th–10th c. BC) ⊕; (Tel Zayit Alphabet, late 10th c. or very early 9th c. BC) ⊗ (Kőszeghy 2010: 57), (Tell Faḫariyeh, 9th c. BC) ⊗ (Lipiński 1994: 27); (Shipitbaal inscription, Byblos, around 900 BC) ϴ (Röllig 1995: 214) *ṭēṯ* <ṭ> /tˁ/; *Old Aramaic* (Zinjîrlû [Zenjirli], late 9th–8th c. BC) ⊘, ⊘, ⊗; (8th c. BC) ⊘; (7th c. BC) ⊘, ⦶, ⊘ (Gibson 1975) <ṭ> /tˁ/ [tˁ, t’, θ’]; *Paleo-Hebrew* (Mesha Stele, 9th c. BC) ⊖ (Rollston 2010: 52) <ṭ>;

Anatolian-Greek Alphabetic witness feature (grapheme): *Ancient Greek* ⊕, ⊗, ⊕ *theta* <θ>, *Lemnian* (6th c. BC) ⊗, ⊞ (MNAMON: Lemnian, retrieved in 2015) <θ>;

Italic witness feature (grapheme): *Etruscan* (Northern, Central-Southern, Cerveteri, early) ⊙, (late) ○, (Marsiliana d’Albegna, 7th c. BC) ⊗, (Veii [Veias], early) ⊗ <θ> [t^h]; *Venetic* (Padova, end of 6th c. – beginning of 1st c. BC) ◊, ⊙ <θ> [t]; *Lepontic* (early) ⊙ <ϑ>; *Camunic* ⊙ (Morandi 2004: 476) <ϑ>; *Messapic* (second half of 5th c. BC – end of 2nd c. BC) ◦, ⊙; (second half of 5th c. BC –3rd c. BC) ⊝; (second half of 5th c. BC –4th c. BC) ⦶, (second half of 5th c. BC – end of 2nd c. BC) ⊖, (first half of 6th c. BC – first half of 4th c. BC) ⊕ <θ> /θ/.

Evaluation (SFG-47):
Changed script: SHR.
Region of relics: SHR: Carpathian Basin.
Source script family:
OM1: Slavic.
Period of change:
OM1: 9th c. AD – around 900, the using period of the Glagolitic script (Table 8-21), the upper limit is the age of the earliest SHR inscription containing the ⊗ <f>.
Region of change: OM1: Carpathian Basin.
Glyph fit only with tamgas: OM1: 0.

Comments (SFG-47):

(i) According to Sebestyén and Németh, the ancestor of SHR ⊗ <f> is the Greek (ca. after 450 BC) ɸ, ɸ (Jeffery 1961: 35–37) *phi* <φ> /f, p^h/ (Sebestyén 1906: 272, 274; Németh 1934: 29). In his publication, Sebestyén includes the glyph variant with the stem that does not extend beyond the loop among the glyphs of the Greek <φ>, but the use of such glyph variant is known only from very early times: Ancient Greek (in Naxos exists from the 7th c. BC, generally used in ca. 525–450 BC) ⦶, (7th–6th c. BC) ɸ, Φ (Jeffery 1961: 35–37) *phi* <φ> /p^h/. Therefore, due to the difference of the glyphs and sound values, the Greek *phi* <φ> cannot be the ancestor of SHR ⊗ <f>.

(ii) Németh supposed the relationship between SHR <f> and Greek <θ> by borrowing the Greek <θ> with sound value /f/ (Németh 1934: Appendix VI; Németh 1971: 39). However, according to Vékony, the Greek *theta* <θ> never denoted /f/ (Vékony 1987a: 37).

(iii) The /f/ voiceless labiodental fricative is pronounced by the upper teeth and lower lip, and the /θ/ voiceless interdental fricative is pronounced by placing the tongue between the upper and lower teeth so that the two sounds are similar to each other. The /θ/ is rare in different languages. E.g., the German language lacks /θ/, in English the *th-fronting* pronunciation (/θ/ becomes /f/) is related. It is usually not uncommon to replace /θ/ with other sounds, including /f/. However, there is not any data that in the evolution of any Rovash script there could be a <θ> > <f> adaptation (Table 4-2). In CBR, the sound /f/ was denoted by a grapheme presumably formed from the <p>: ꓶ <f> (SFG-80), i.e., CBR grapheme denoting /f/ has nothing to do with SHR ⦵, ⊘, ⦻ <f>. It follows from the creation of CBR ꓶ <f> by internal development that no grapheme is denoting /f/ from another script. This observation can be justified if CBR script reached the Hungarians via Turkic transmission, as there was no sound /f/ in the Old Turkic language. Similarly, SHR ⦻ <f> reached the Hungarians through non-Turkic mediation. Based on the available data, this takeover happened in the Carpathian Basin through Slavic mediation, since in Slavic language the Greek <θ> > Glagolitic <f> adaptation occurred (Table 4-2).

(iv) The glyphs ⊗, ⊕ of the Ancient Greek *theta* <θ> were typical back in 7th c. BC (McCarter 1975); however, they no longer appear on the surviving Ancient Greek inscriptions from the 4th c. BC (Thompson 1912: 144–145). Therefore, if a script had borrowed these glyphs from the Ancient Greek *theta* <θ>, this should have happened before 4th c. BC. The Ancient Greek glyph variant ⊙ was used up to the 3rd c. BC (SFG-28).

(v) The glyph variants of SHR <f> before 15th c. AD had a singe slant bar or the intersection of two short bars (⦵, ⊘, ⊘, ⦵). It is conceivable that if two cross lines reaching the edges (⊕, ⦻) had already been formed, there would have been examples of these variants from before 15th c. AD. Based on this, it is imaginable that the glyph variants ⊕ and ⦻ are only the later development results, and their similarity to Ancient Greek ⊕ and ⊗ shapes is homoplasy (Table 2-7).

(vi) The glyph variant ⦵ may have been used to distinguish it from SHR ⊘ <í> (SFG-55), or it was an innovation.

(vii) Phoenician ⊗, ϴ, Old Aramaic ⊘, ⊘, ⦶, ⊘, Ancient Greek ⊕, ⊕, ⊗ and Greek ϴ, ⊙, θ, θ (SFG-28, SFG-47) glyphs demonstrate that the shape transition between them is simple.

(viii) The direct ancestor of Glagolitic ⰿ *fita* <f> and Early Cyrillic ѳ *fita* <f> is the uncial Greek θ <θ> from the 9th c. AD (Taylor 1883, vol. II: 154).

SFG-48

Descendant feature (grapheme):

TR (Y) 𐱃 (Vasil'ev 1983 apud Harmatta 2004: 186); (J, O, T [Kyzlasov, I. L. 1994: 72; Kairžanov 2014: 17], manuscript) 𐱃; (Khangyt-khat, end of 7th c. – beginning of 8th c.) 𐱃; (Y) 𐱃 (von Gabain 1941); (O) 𐱃 (Kyzlasov, I. L. 1994: 72, 148); (O, T) 𐱃 (von Gabain 1941); (Y) 𐱃 (Büyük Larousse 9: 4679); (O) 𐱃 (Tekin 2003: 22); 𐱃, (O, T, Küli čur 719–724) 𐱃 (Tekin 2003: 22); (Kupchegen) 𐱃; (O) 𐱃 (von Gabain 1941); 𐱃 (Thomsen 1893: 9); 𐱃 (Jensen 1969a: 424, Fig. 419 apud Bernal 1987: 8, Fig. 6; Bernal 1990: 41, Table 6); (Manyrlu-Koby II) 𐱃; (Kalbak-Tash I) 𐱃; (Kalbak-Tash II, 8th c.) 𐱃; (O) 𐱃, (O) 𐱃 (von Gabain 1941); (Toñuquq, 726) 𐱃, (Uyghur inscriptions) 𐱃, (Toyok) 𐱃, (Ïrq Bitig Manuscript, 930) 𐱃, (Dunhuang Letter) 𐱃, (Manichean texts) 𐱃, (Khakassia, Tuva) 𐱃, 𐱃 (Clauson 1970: 75) <t¹> /t/.

OM1 (SFG-48):

Brahmic ancestor feature (grapheme):

Brāhmī (alphabet q [Turkestan Gupta]) त, (alphabets r and s [Early Turkestan]) त, त, त,

(alphabet t [North Turkestan Type A]), (Standard North Turkestan [alphabet u, Type B]), , (alphabet v [Khotanese]) (Sander 1968: Tafel 29) <tā>.

OM+ (SFG-48):
Tamgas ancestor feature (glyph shapes or styles):
Tamgas (Achaemenid Iran), , ; (Mongolia); (Kharguaytin belchir); (Bayte III); (Basins of the Amu Darya and the Syr Darya, 1st c. BC –3rd c. AD), , , ; (Sarmatia, 2nd half of 1st c. – 1st half of 2nd c. AD); (Altay), ; (Mongolia), , <tamga> (details: Table 8-34).

Evaluation (SFG-48):
Changed script: TR.
Region of relics: TR: Inner Asia.
Source script family:
OM1: Brahmic.
Period of change:
OM1: 4th–8th c. AD, the using period of Brāhmī glyph variants presumed to be the ancestor (Table 8-15), the upper limit is the age of the earliest TR inscriptions (Table 8-19).
Region of change: OM1: Inner Asia.
Glyph fit only with tamgas: OM1: 1.

Comments (SFG-48):

(i) Interpreting TR , <t^1> as Turkic pictograph, its formation from the Old Turkic *at* 'horse' word was supposed (Thomsen 1922; Róna-Tas 1987: 8–9). For an analysis of the issue of Turkic pictographs, see Table 3-4.

(ii) According to Clauson, the original glyph variant of TR <t^1> is , and it was not borrowed, but the result of own development (Clauson 1970: 70).

(iii) Some glyph varieties of the Brāhmī (Standard North Turkestan [alphabet u, Type B]) (Sander 1968: Tafel 35) <the> and the Brāhmī (alphabet q [Turkestan Gupta]), (alphabets r and s [Early Turkestan]), , (alphabet t [North Turkestan Type A]), (Standard North Turkestan [alphabet u, Type B]) (Sander 1968: Tafel 31) <thī> also have some similarity to the descendant grapheme.

(iv) The Parthian (early, Nisa, 1st c. BC) (Rosenthal et al. 1986–2011: Table 3); (Skjærvø 1996: 518); (inscriptional) (Rosenthal et al. 1986–2011: Table 3); (Skjærvø 1996: 518) *ṭēṯ* <ṭ>; Manichean (Sogdian, 3rd c. AD or earlier) (Skjærvø 1996: 519) *ṭēṯ* <ṭ> /t/ and Christian Sogdian (Skjærvø 1996: 519) *ṭēṯ* <ṭ> /t/ might be considered as ancestor; however, the glyph distribution of the descendant grapheme differs significantly from the glyphs of these graphemes, so it is unlikely that any of them would be the ancestor.

(v) Probably SFG-48 includes TR (Irq Bitig Manuscript, ca. 9th c. AD) <ot> /ot/ (Tekin 1993: 1, 4; Tekin 2003: 23), which is perhaps the cursive variant of , <t^1>.

SFG-49

Descendant feature (grapheme):
SR (Khumara-7, 9th–10th c.) <t^2> /t/.

OM1 (SFG-49):
Brahmic ancestor feature (grapheme):

Brāhmī (alphabet q [Turkestan Gupta]) 𑀞𑁂, (alphabets r and s [Early Turkestan]) 𑀞𑁂 (Sander 1968: Tafel 35) <ṭhe>;

Brāhmī (alphabets r and s [Early Turkestan]) 𑀞𑀺, (Standard North Turkestan [alphabet u, Type B]) 𑀞𑀺 (Sander 1968: Tafel 31) <ṭhi>.

Brahmic witness feature (grapheme): *Brāhmī* (alphabet q [Turkestan Gupta]) 𑀣𑀺, (alphabets r and s [Early Turkestan]) 𑀣𑀺, 𑀣𑀺, (alphabet t [North Turkestan Type A]) 𑀣𑀺, (Standard North Turkestan [alphabet u, Type B]) 𑀣𑀺 (Sander 1968: Tafel 31) <thi>.

Evaluation (SFG-49):
Changed script: SR.
Region of relics: SR: Pontus Steppe.
Source script family: OM1: Brahmic.
Period of change:

OM1: 4th–9th/10th c. AD, the using period of Brāhmī glyph variants presumed to be ancestor (Table 8-15), the upper limit is the age of the attestation of the SR grapheme (Table 8-19).

Region of change: OM1: Inner Asia.
Glyph fit only with tamgas: OM1: 0.

Comments (SFG-49):

(i) Note that SR <t> is attested in only one inscription (Khumara-7, Table 8-32), in the dignity name ⊁ᘔɜ /t^{i}g^{i}n/ (Vékony 1987a: 27), near front vowel /i/.

(ii) It is possible that SFG-48 and SFG-49 are closely related.

SFG-50

Descendant feature (grapheme):

TR (O, T, Y) ᛚ (Kyzlasov, I. L. 1994: 71); (T, Y) ᛚ (Kairžanov 2014: 17); (Mendur-Sokkon IV) ᛚ; (Epitaph of Qarï Čor Tegin) ᛉ (Rybatzki & Wu 2014: 126–127) *e, i;* (Khentii, second half of 8th c. – beginning of 9th c.) ᛚ; (Tanbaly-Tash, 9th–10th c., LTR writing direction) ᛚ (Rogozhinskii & Kyzlasov 2004: 42); (manuscript) ᛚ (von Gabain 1941); (Y) ᛚ, ᛚ (Büyük Larousse 9: 4678) <I> or <ı/i> (Konkobaev et al. 2015: 41) /i, ï/ and in case of the Orkhon inscriptions, also /ë/ (Kara 1996: 537);

SHR (Vargyas, 12th–13th c.) ᛚ /i/; (Homoródkarácsonyfalva Stone inscription, around 13th c.) ᛚ /i/; (Erdőszentgyörgy, 13th–14th c.) ᛚ /i/; (Stick Calendar, ca. 15th c. surviving in a 17th c. copy) ᛚ /i, j/; (Nikolsburg, 1490–1526) ᛚ *eÿ* /j/; (Constantinople, 1515, LTR writing direction) ᛚ /i, í, j/; (Wolfenbüttel, 1592–1666) ᛚ /i, j/; (István Miskolci Csulyak, 1610–1645) ᛚ /i, j/; (Rugonfalva, 16th–17th c.) ᛚ /j/; (István Miskolci Csulyak, 1610–1645) ᛚ /i/; (Gyulafehérvár, 1655) ᛚ /j/; (Marsigli's Alphabet, 1690) ᛚ *i* /i/; (Marsigli's Alphabet, 1690) ᛚ *ei* /j/ <i>, <j>;

CBR (Szarvas, the first half of 8th c.) ᛚ <I> /i/;

CBR (Ozora-Tótipuszta, last third of 7th c.) ᛗ <I$\underline{\gamma}$> /ïγ/ (Table 8-26);

SR (Jitkov, the first third of 8th c.) ᛚ /i/; (Mayaki, 8th–9th c.) ᛚ /ï/ <I>;

SR (Kermen Tolga, 8th–10th c.) ᛗ; (Mayatskoe-10, 9th c.) ᛗ <$\underline{\text{dI}}$> /de/ (Table 8-28);

SR (Kievan Letter, 955–961) ᛚ <$\underline{\text{Il}}$> /il/ (Table 8-28);

SR (Kievan Letter, 955–961) ᛈ <$\underline{\text{Iq}}$> /ïq/ (Table 8-28).

OM1 (SFG-50):

Aramaic ancestor feature (grapheme):

Imperial Aramaic (satrapies, 5th–4th c. BC) , , (monuments, Egypt, 4th–3rd c. BC) , , (papyrus, Egypt, 2nd c. BC) , (Taylor 1883, vol. I: 250); (7th c. BC) , , , (6th c. BC) , , , , (5th–4th c. BC) , , (Gibson 1975); (monumental) , , (Assyrian and Egyptian papyri) , (Faulmann 1880: 79); (Leather Documents of the Satrap and Royal Prince Aršāma) , (Persepolis) ; (Rosenthal et al. 1986–2011: Table 3); (MacKenzie 1971: xi); (satrapies and Egypt, 4th–3rd c. BC) (Taylor 1883, vol. II: 236); (Aśoka, around 250 BC) (Glass 2000: 14); (Bactria) , , , (Arachosia [Afghanistan and Pakistan]) , , (Ivantchik & Lurje 2013: 290) *yōḏ* <y> /y, ī/;

Aramaic witness feature (grapheme): *Hebrew* (Qumran Manuscripts, 1st c. BC) <y>;

Kharoṣṭhī witness feature (grapheme): *Kharoṣṭhī* (Aśoka, around 250 BC) <ya> /j/ (Bühler 1898: 103; Glass 2000: 14).

OM2 (SFG-50):

Middle Iranian ancestor feature (grapheme):

Khwarazmian (Toprak-kala) (Vainberg 1977: Table VIII) *yodh* <y>;

Middle Iranian witness feature (grapheme): *Parthian* (early) (Nisa, 1st c. BC) (Skjærvø 1996: 518); (Nisa) , , , (Avroman, 13/12 BC) , , (Ivantchik & Lurje 2013: 290); (inscriptional) (Skjærvø 1996: 518); (Rosenthal et al. 1986–2011: Table 3); (inscriptions, 3rd c. AD) (MacKenzie 1971: xi) *yōḏ* <y> /y, ĕ̄, ĭ̄/; *Khwarazmian* (Chirik-Rabat [Kyzylorda Region, Kazakhstan], 4th–2nd c. BC) (Ivantchik & Lurje 2013: 286–287) <y>; *Sogdian* (early, Kultobe, before 4th c. AD) (Sims-Williams & Grenet 2006: colour illustrations without page numbering); (Ancient Letters, beginning of 4th c. AD) , (sutra) , (Skjærvø 1996: 519) *yōḏ* <y> /y, ē, ī/;

Uyghur witness feature (grapheme): *Uyghur* , (beginning), (middle), (ending) (Kara 1996: 539–540) *yōḏ* <y> /y/.

Evaluation (SFG-50):

Changed script: TR, SHR, CBR & SR.

Region of relics: TR: Inner Asia; SHR & CBR: Carpathian Basin; SR: Pontus Steppe.

Source script family:

OM1: Aramaic.

OM2: Middle Iranian.

Period of change:

OM1: 7th/6th–1st c. BC, the using period of the Imperial Aramaic (Table 8-12) script.

OM2: 1st/2nd c. AD – late 7th /8th c. AD, the using period of the Khwarazmian script (Table 8-16).

Region of change: OM1 & OM2: Inner Asia.

Glyph fit only with tamgas: OM1: 0. OM2: 0.

Comments (SFG-50):

(i) The glyphs of the (Basins of the Amu Darya and the Syr Darya, 1st c. BC –3rd c. AD) ; (Sarmatia, 2nd half of 1st c. – 1st half of 2nd c. AD) ; (Mongolia) <tamga> (Table 8-34) are identical to the majority of the descendant glyphs; however, these tamgas are not necessary for creating the descendant glyphs, since the ancestor glyphs are fairly similar to the descendant glyphs.

(ii) According to Nagy and Sebestyén, the relative of SHR 1 <j> is TR 9 <y^2> (SFG-56), and their ancestor could be an Aramaic grapheme, obviously the *yōḏ* <y> (SFG-50) (Nagy 1895: 274; Sebestyén 1906: 272, 275).

(iii) According to Püspöki Nagy, SHR 1 <j> and TR ᛚ <I> are relatives (Püspöki Nagy 1977: 304).

(iv) According to Clauson, TR <I> is most similar to Middle Persian (Pahlavi) <y> (SFG-51). However, it is more similar to the earlier, more angular Imperial Aramaic glyph (Clauson 1970: 68).

(v) According to Németh, SHR ǂ <i> (SFG-53) and 1 <i>, <j> (SFG-50) correspond to TR ᛚ <I> (SFG-50) and <I> (SFG-53) (Németh 1934: Appendix VI; Németh 1971: 38). For the /j/ sound value of the SHR 1 <i>, <j>, see Comments in SFG-54.

(vi) The early glyph variants of the Imperial Aramaic <y>—e.g., (7th c. BC) , , (7th c. BC) , , —are likely not ancestors of TR ᛚ, 1 <I>, and in the later centuries, its possible adaptation could happen only in Inner Asia based on Table 3-2 and Table 3-3.

(vii) It is striking that the Uyghur , , , <y> corresponds exactly to TR ᛚ, 1 <I> and even resembles <I> (SFG-53).

(viii) It is worth noting that TR used the <I> for representing /e/, too. This feature could inherit from the Parthian <y> /y, ē̆, ī̆/ or the Sogdian <y> /y, ē, ī/.

SFG-51

Descendant feature (grapheme):

CBR (Nagyszentmiklós, 8th–11th c.) ⟩ <I> /i, ï/, moreover /ь/ or /e/ in a Slavic inscription (see Comments);

SR (Achik-Tash, 8th c.) ⟩ /i, ï/; (Mayatskoe-2, 9th c.) /ï/; (Mayatskoe-10, 9th c.) , /i, ï/; (Mayatskoe-5, 9th c.) /i/; (Khumara-6, 9th–10th c.) ⟩ /i/ <I>.

OM1 (SFG-51):

Middle Iranian ancestor feature (glyph style):

Middle Persian (inscriptional) , (Psalter) (Bulayïq, 6th–7th c., a copy of an origin from the 4th c. AD) , (Early Cursive Pahlavi) , (Book Pahlavi) , , (Skjærvø 1996: 518) <y> /y, ē̆, ī̆, ǰ/;

Aramaic witness feature (grapheme): *Palmyrene* , (Harmatta 2000: 181); (Palmyra, 2nd c. AD) (Taylor 1883, vol. II: 236) *yōḏ* <y>; *Nabataean* (late) (Macdonald 2008: 218) <y>; *Arabic* (early) , (modern) (Macdonald 2008: 218) *yā'* <y, ī>;

Middle Iranian witness feature (grapheme): *Parthian* (Nisa, 1st c. BC) ; (Nisa) , , , (Avroman, 13/12 BC) , , ; (inscriptional) ; ; (inscriptions, 3rd c. AD) *yōḏ* <y> /y, ē̆, ī̆/ (details: SFG-50); *Khwarazmian* (Toprak-kala) (Vainberg 1977: Table VIII) <y> (other glyph: SFG-50).

Evaluation (SFG-51):

Changed script: CBR & SR.

Region of relics: CBR: Carpathian Basin; SR: Inner Asia & Pontus Steppe.

Source script family:

OM1: Middle Iranian (borrowing [Table 4-2, glyph shape transfer, Table 2-9: 2-2. §]; bending [Table 4-3]).

Period of change:

OM1: 3rd–7th c. AD, the using period of the Middle Persian script (Table 8-16).

Region of change: OM1: Inner Asia.

Glyph fit only with tamgas: OM1: 0.

Comments (SFG-51):

(i) According to Vékony, CBR ↄ <I> and SR ↄ <I> are descendants of the Parthian *yōḏ* <y> (Vékony 1987a: 119). The available literature data do not confirm this similarity: Parthian ❯, ♪, ❙ <y> (SFG-50). In contrast, the glyphs of the Middle Persian <y>, which are closely related to the Parthian script, are the same shape as CBR, SR ↄ <I>.

(ii) Oppositely to OM1, it is also possible that the creation of CBR and SR ↄ <I> was borrowing the Middle Persian ℑ <y>, which could be a symbol transfer (Table 2-9: 2-1. §).

(iii) According to Zoltán, before the 12th c. AD, so in the age of creating the Slavic inscriptions of the Treasure of Nagyszentmiklós, the Slavic pronunciation of the /ь/ was surely short *i* (reduced *i*). Zoltán pointed out that in the Bulgarian language in the 10th c. AD the reduced *i* began to transform: in some positions, it disappeared, and in others, it became /e/. An example for the /ь/ > /e/ sound change is the Bulgarian /чьст/ > /чест/ 'honour' (Zoltán, András: Personal communication, 2012; Zoltán 2012: 383–387; Zoltán, András: Personal communication by email, 28 July 2020). Thus, the sound values /i, ï/ of CBR ↄ <I> were supplemented with the sound value /ь/ or /e/ when applied to Slavic language (adaptation, Table 4-2).

SFG-52

Descendant feature (grapheme):

SR (Kermen Tolga, 8th–10th c.) ꟼ /i/; (Khumara-7, 9th–10th c.) ꟼ /ï/ <I>.

OM1 (SFG-52):

Middle Iranian ancestor feature (glyph style):

Middle Persian (Book Pahlavi) ℑ (Skjærvø 1996: 518) <y> /y, ĕ, ĭ, ǰ/ (details: SFG-51), its glyph style was applied to SR Г, ꓶ <I> (details: SFG-50).

Evaluation (SFG-52):

Changed script: SR.

Region of relics: SR: Pontus Steppe.

Source script family:

OM1: Middle Iranian (external influence [Table 4-2, glyph style transfer Table 2-9: 2-4. §]; loop forming [Table 4-3]).

Period of change:

OM1: 3rd–7th c. AD, the using period of the Middle Persian (Table 8-16) script.

Region of change: OM1: Pontus Steppe.

Glyph fit only with tamgas: OM1: 0.

Comments (SFG-52):

(i) Oppositely to OM1, it is also possible that the creation of SR ꟼ, ꟼ <I> was borrowing the shape of Middle Persian ℑ <y>, which could be a glyph shape transfer (Table 2-9: 2-2. §). In this case, the source of the reticulate evolution (Table 7-6: 7-3. §) seems to be clear, Book Pahlavi variant of Middle Persian script. Therefore, this SFG is a descendant of the Middle

Persian script in the numeric calculation.

(ii) In another Middle Iranian script, in the Manichean, also there is an example for an additional small circle: Manichean (Sogdian) (3rd c. AD or earlier) 𐫃 *gāmal* <g> /g, γ/ and 𐫄 <γ> /γ/ (Skjærvø 1996: 519).

SFG-53

Descendant feature (grapheme):

TR (Y) 𐰄 (Thomsen 1893: 9) <I> /i, ï/;

OM1 (SFG-53):
Aramaic ancestor feature (grapheme):

Imperial Aramaic 𐡉, 𐡉, 𐡉, 𐡉, 𐡉 *yōḏ* <y> /y, ī/ (details: SFG-50).

OM2 (SFG-53):
Rovash ancestor feature (grapheme):

TR 𐰃, 𐰃 <I> (details: SFG-50).

Evaluation (SFG-53):
Changed script: TR.
Region of relics: TR: Inner Asia.

Source script family:

OM1: Aramaic.

OM2: Rovash (internal development) (glyph-variant forming [Table 4-2]; line shifting [Table 4-3]).

Period of change:

OM1: 7th/6th–1st c. BC, the using period of the Imperial Aramaic (Table 8-12) script.

OM2: Before 8th c. AD, the upper limit is the age of the earliest TR relics containing the descendant grapheme (Table 8-29).

Region of change: OM1 & OM2: Inner Asia.
Glyph fit only with tamgas: OM1: 0. OM2: 0.

Comments (SFG-53):

(i) Nagy supposed that SHR † <i> and TR 𐰃 <I> (SFG-50) are relatives (Nagy 1895: 274).

(ii) According to Sebestyén, the relative of SHR †, ‡ <i> is TR 𐰄 <I> and 𐰃 <I> (SFG-50), and its ancestor could be the Aramaic 𐡉, 𐡉 *yōḏ* <y> (SFG-50) (Sebestyén 1906: 272, 275).

SFG-54

Descendant feature (grapheme):

SHR (Székelydálya, around 1400) † /i/; (Nikolsburg, 1490–1526) † *i* /i/; (Bögöz, end of the 15th c. – beginning of 16th c.) † /i/; (Rugonfalva, 16th–17th c.) † /i/; (Rudimenta-Giessen, 1598) † /i/; (Énlaka, 1668) † /i/; (Szentpéteri, 1699–1702) † *i* <i>;

SHR (Csíkszentmihály, 1501) ‡ /i, í/ <i>;

SHR (Gyulafehérvár, 1655) ᚴ /i, í/ <i>.

OM1 (SFG-54):
Rovash ancestor feature (grapheme):

TR 𐰃, 𐰃 <I> /i, ï/; *CBR* 𐰃 <I> /i/; *SR* 𐰃, 𐰃 <I> /i, ï/ (details: SFG-50).

Evaluation (SFG-54):
Changed script: SHR.
Region of relics: SHR: Carpathian Basin.
Source script family:
OM1: Rovash (internal development) (glyph-variant forming [Table 4-2]; line shifting [Table 4-3]).
Period of change:
OM1: Not later than AD 1400, the upper limit is the earliest SHR inscription containing the descendant grapheme.
Region of change: OM1: Carpathian Basin.
Glyph fit only with tamgas: OM1: 0.

Comments (SFG-54):

(i) As an influence of the Old Hungarian orthography of the Latin script (Table 8-18), SHR 1 <i>, <j> (SFG-50) was developed by adapting the /j/ consonantal sound value. In the Old Hungarian orthography of the Latin script (Table 8-18), the Latin i <i> and j <j> graphemes were *allographs* for a long time, i. e., they did not differ in their sound value. In the Old Hungarian orthography of the Latin script the meaning of any of i and j (as well as y) was as follows: /i/, /j/, and the sign of palatalization. From the beginning of 13th c., it can only be observed that the glyph j at the beginning of the word and the end of the word (in all sound values) becomes common, and the glyph i was used inside the word (already in the Tihany Land Survey from AD 1211). Even in the Hungarian codices from of the 15th–16th c., glyphs i and j are not separated into two individual graphemes with different sound values opposite to the today's Hungarian orthography of the Latin script. Based on this, SHR grapheme denoting /i/ and /j/ could not have been differentiated into two graphemes (one for denoting /i/ and another for /j/) due to the Latin or the Old Hungarian orthography of the Latin script (Szentgyörgyi, Rudolf: Personal communication by email, 21 December 2017). Therefore, the glyph † had to happen before adapting the /j/ by SHR glyph variant 1. It seems that SHR glyph variant 1 received the /j/ beside the /i/, but SHR glyph variant † kept its original /i/ sound value. In such a way, two different SHR graphemes were developed: † <i> and 1 <i>, <j>.

(ii) The glyph variants ⸸, ⸸, ⸸ of the Greco-Bactrian *iota* <ι> (SFG-56) are very similar to SHR † <i>; however, its whole glyph distribution is far from the descendant grapheme.

(iii) The similarity between SHR † <i> and the Kharoṣṭhī (Aśoka, around 250 BC) 𐨀𐨁 (Glass 2000: 38) <i> is likely a homoplasy (Table 2-7). Since they have a common ancestor, the Imperial Aramaic 𐡉, 𐡉, 𐡉, 𐡉 <y> (SFG-50), their evolution is a convergence (Table 2-7).

(iv) The glyph variant ‡ of SHR † <i> is a descendant of the glyph †.

(v) The glyph variant ᚴ of SHR † <i> is likely a descendant of the glyph †, and unrelated to TR 𐰃, 𐰄 <I> /i, ï/ (SFG-53).

SFG-55

Descendant feature (grapheme):
TR (Y) 0, O (von Gabain 1941); (Khakassia, Tuva) 0 (Clauson 1970: 75), (O, T, Y) D (Kyzlasov, I. L. 1994: 70), 𐰖 (Róna-Tas 1987: 9, 13), (T) 𐰖, (Y) 𐰖, 𐰖, 𐰖 (Kairžanov 2014: 17) <y^1> /y/ [j];
TR (Y) D (Kairžanov 2014: 17) <y^2> /y/ [j];

SHR (Stick Calendar, ca. 15th c. surviving in a 17th c. copy); (Nikolsburg, 1490–1526) *ely;* (Csíkszentmihály, 1501); (Constantinople, 1515, LTR writing direction); (István Miskolci Csulyak, 1610–1645); (Gyulafehérvár, 1655); (Szegedi, 1655) , ; (Szentpéteri, 1699–1702) *ly* <Í> /j, ʎ/ [j];

CBR (Szarvas, first half of 8th c.); (Kiskundorozsma, end or last third of 8th c.); (Nagyszentmiklós, 8th–11th c.) <j> or <y> /j, i̯/;

SR (Jitkov, first third of 8th c.), (Achik-Tash, 8th c.); (Mayatskoe-1, 9th c.); (Khumara-6, Khumara-8 [in copy], 9th–10th c.) <y^1> /y/.

OM1 (SFG-55):

Aegean ancestor feature (grapheme):

Cypro-Greek (common) , (Valério 2016: 249); (common) (Olivier 2007–2008: 617–618); (common) (Davis 2010: 38–61); (Paphian, 6th c. BC) (Valério 2016: 228) <ja>.

OM2 (SFG-55):

Middle Iranian ancestor feature (grapheme):

Parthian (Nisa) (Ivantchik & Lurje 2013: 290) *yōḏ* <y> /y, ĕ̄, ĭ̄/ (other glyphs: SFG-50);

Khwarazmian (Chirik-Rabat [Kyzylorda Region, Kazakhstan], 4th–2nd c. BC) (Ivantchik & Lurje 2013: 286–287) *yodh* <y> (another glyph: SFG-50);

Manichean (Sogdian) (3rd c. AD or earlier) (Skjærvø 1996: 519); , (Durkin-Meisterernst 2005: Table 1) *yōḏ* <y> /y, ē, ī/;

Middle Iranian witness feature (grapheme): *Middle Persian* (Book Pahlavi) <y> /y, ĕ̄, ĭ̄, ǰ/ (details: SFG-51); *Middle Persian* (Psalter) , (Book Pahlavi) *dāleṯ* <d> /d, y/ (details: SFG-56).

OM+ (SFG-55):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Achaemenid Iran) , ; (Bactrian sign, northern Afghanistan, Bronze Age) ; (Chu-Ili interfluve) ; (Basins of the Amu Darya and the Syr Darya, 6th–2nd c. BC) , ; (1st c. BC –3rd c. AD) , ; (4th–8th c. AD) ; (Kultobe, 1st–3rd c. AD) ; (Kanka) , , ; (Beskepe) ; (Mongolia) , , ; (Talas Valley) <tamga> (details: Table 8-34).

Evaluation (SFG-55):

Changed script: TR, SHR, CBR & SR.

Region of relics: TR: Inner Asia; SHR & CBR: Carpathian Basin; SR: Inner Asia & Pontus Steppe.

Source script family:

OM1: Aegean.

OM2: Middle Iranian.

Period of change:

OM1: 11th–2nd c. BC, the using period of the Cypro-Greek (Table 8-3) script.

OM2: 2nd c. BC – 7th c. AD, the union of the using periods of Parthian, Khwarazmian and Manichean scripts (Table 8-16), the upper limit is the age of the earliest TR, SHR, CBR or SR inscriptions (Table 8-19).

Region of change: OM1: Anatolia. OM2: Inner Asia.

Glyph fit only with tamgas: OM1: 0. OM2: 1.

Comments (SFG-55):

(i) The clear majority of TR inscriptions use the descendant grapheme under study in velar syllables (<y^1>)¸therefore, its use in a palatal syllable (<y^2>) can be considered an exception.

(ii) Interpreting TR D, 0, O, ᗭ <y^1> as Turkic pictograph, its formation from the Old Turkic *ya* 'bow' (Clauson 1970: 70) or *ay* 'moon' was supposed (Róna-Tas 1987: 8–9). There is no evidence for this assumption; however, the development of the glyphs of TR <y^1> was probably influenced by the fact that Old Turkic-speaking users were reminded of the moon by the shape and sound value of the grapheme combined with a pronunciation-facilitating vowel (acrophony in a broad sense). For an analysis of the issue of Turkic pictographs, see Table 3-4.

(iii) According to Mészáros, TR D <y^1> correspond to the symbol D in the inscriptions of the Treasure of Nagyszentmiklós (Mészáros 1915: 4). This assumption is the same as Vékony's interpretation (Vékony 1987a: 49).

(iv) According to Sebestyén, SHR 0 <Í> originates from the duplication of TR 𐰖 <y^2> (SFG-56) (Sebestyén 1906: 272, 276). This idea seems to be unlikely.

(v) TR D <y^1> might be formed from TR P, P <y^2> by leaving the vertical line. Leaving the vertical line out of TR ♀ <y^2> gives the glyph variant TR O <y^1>. It should be noted that there are many examples of omitting the vertical line of glyphs or, conversely, supplementing with a vertical line, e.g., Ancient Greek Φ, Φ <φ> (Jeffery 1961: 35–37); Raetic Φ, Φ <ϕ> (Marchesini 2014: 206–207); Elymian Φ, Φ <ϕ> (Marchesini 2012: 101–103); Carian Y, ∇ <k> (SFG-61); Carian Y, V <n> (Adiego 2007a: 508); Carian Y, V <u> (Adiego 2007a: 508); and Taymanitic Y, V <ḥ> (Macdonald 2004: 496). A comparison of the Lycian Ѵ, Ѵ <ã> (Melchert 2008a: 48) and the Lycian Ѵ, Ѵ <ẽ> (Bryce 1986: 57) shows that leaving the lower vertical line may have had a meaning-modifying role similar to that observed in TR. Cf. TR ∨ <l^1> (SFG-63) and Y <l^2> (SFG-65), which is a close analogue of OM4. TR 𐰖, ♀ <y^2> /j/ (SFG-56) might be ancestor by applying the characteristic feature transformation referred to as "line shortening" (Table 4-3). However, the descendant graphemes under study (TR D <y^1>, SHR 0 <Í>, CBR D <j>, SR D <y^1>) are generally used in every Rovash scripts. Oppositely, TR 𐰖, ♀ <y^2> (SFG-56) is used only in TR. Therefore, it is less probable that TR 𐰖, ♀ <y^2> could be earlier.

(vi) The Brāhmī (alphabet q [Turkestan Gupta]), (alphabets r and s [Early Turkestan]), , (alphabet t [North Turkestan Type A]), (Standard North Turkestan [alphabet u, Type B]), (alphabet v [Khotanese]) (Sander 1968: Tafel 30); (IOL Toch 81) (Maue 2008: 60–61) <ya> might be an ancestor, it would be supported by the fact that TR descendant grapheme generally used near velar vowels, similarly to the Brāhmī <ya>. However, its glyphs are different from the descendant glyphs.

(vii) Regarding the sound value of the <Í>, it should be noted that from the 16th c. AD the sound /ʎ/ began to disappear from the Hungarian language; however, it remained in use in some dialects, including Palóc (Hungarian dialect in Northern Hungary and Southern Slovakia) (E. Abaffy 2003c: 597–598; E. Abaffy 2003d: 711–713; Prószéky 2009: 7–9).

(viii) The development of the 0, 0, 0, 0, ʘ glyph variants of SHR <Í> is comparable to the development of TR O, ʘ, ʘ <nd> (SFG-28) and SHR 0, 0, 0, 0 0 <f> (SFG-47). The goal of the modifications could be to make the glyph more characteristic to obtain different visual identities (Table 4-2) for the different graphemes.

(ix) The shapes of SHR 0, 0, 0, 0 <Í> (SFG-55) are closer to the shapes of TR O, D, ◁ <y^1> than to the shapes of CBR D <j> or SR D <y^1>.

(x) For interactions between multiple descendant grapheme lineages, see Table 7-5: 7-1. §.

SFG-56

Descendant feature (grapheme):

TR (Y) , (O) , (Kairžanov 2014: 17) <y^{1}> /y/;

TR (Y) (Vasil'ev 1983 apud Harmatta 2004: 186); (Y: Begre, 8th–9th c.) (Türik Bitig, http://bitig.org/show_big.php?fn=copies/535.gif, retrieved on 20 March 2015); (O, Y) , ; (O, T, Y) (Kyzlasov, I. L. 1994: 71); (Y) , (Büyük Larousse 9: 4678); (Y) , , , , , , , , (O) , (Kairžanov 2014: 17); (O, T) , (manuscript) (von Gabain 1941); (Róna-Tas 1987: 13); (Khakassia, Tuva) (Clauson 1970: 75); (Epitaph of Qarï Čor Tegin) (Rybatzki & Wu 2014: 126–127); (Kalbak-Tash III) <y^{2}> /y/ [j].

OM1 (SFG-56):

Middle Iranian ancestor feature (grapheme):

Middle Persian (Psalter) (Bulayïq, 6th–7th c., a copy of an origin from the 4th c. AD) , (Early Cursive Pahlavi) , (Book Pahlavi) , , (Skjærvø 1996: 518) *dālet* <d> /d, y/;

Middle Persian (inscriptional) , (Psalter) , (Early Cursive Pahlavi) , (Book Pahlavi) , , <y> /y, ĕ, ĭ, ǰ/ (details: SFG-51);

Middle Iranian witness feature (grapheme): *Middle Persian* (inscriptions, 3rd c. AD) (MacKenzie 1971: xi) *dālet* <d> /d, y/.

Evaluation (SFG-56):

Changed script: TR.

Region of relics: TR: Inner Asia.

Source script family:

OM1: Middle Iranian.

Period of change:

OM1: 3rd–7th c. AD, the using period of the Middle Persian (Table 8-16) script.

Region of change: OM1: Inner Asia.

Glyph fit only with tamgas: OM1: 0.

Comments (SFG-56):

(i) The clear majority of TR inscriptions use the descendant grapheme under study in palatal syllables (<y^{2}>)¸therefore, its use in a velar syllable (<y^{1}>) can be considered an exception.

(ii) According to Clauson, TR <y^{2}> is derived from the Greco-Bactrian , , *iota* <ι> (Clauson 1970: 70); see the glyph variants of the Greco-Bactrian <ι>: Greco-Bactrian (Loulan, 4th c. AD) , , (Ghirshman 1948: 63); (rectangular) , (cursive) , (Kurbanov 2010: Fig. 93); (intaglios) , , , (Ghirshman 1948: 63) *iota* <ι> /i/. Clauson notes that the Greek *iota* <ι> denoted /j/ before a vowel. However, the Greek <ι> is usually a vowel; therefore, it is unlikely as an ancestor.

(iii) The shape of TR <y^{1}> (SFG-55) may have been extended by one stem; they could be analogous to the pair of TR <l^{1}> (SFG-63) and <l^{2}> (SFG-65). However, this is less likely due to the relatively common open shapes (, , ,) among the glyph variants of TR <y^{2}>, which are difficult to derive from <y^{1}>.

(iv) It was earlier pointed out (Hosszú 2017: 210) that there is a striking similarity between TR 𐰘, 𐰙 <y^2> and the following glyphs of the South Semitic <y>: Ancient South Arabian, Dispersed Oasis North Arabian, Taymanitic, Thamudic B 𐩺, Dumaitic, Dadanitic 𐩺, 𐩺, Hismaic 𐪚, 𐪚, 𐪚, Safaitic 𐪚, 𐪚 (Macdonald 2004: 496) <y> /y/ [ç]. However, there is no data to suggest that South Semitic scripts used in desert areas east and south of Asia Minor had a cultural impact on any of the Asia Minor scripts, so this similarity can be considered homoplasy (Table 2-7).

(v) It is worth noting that the glyph of the Greco-Bactrian ι <ι> seems to be outlined (outlining, Table 4-3) only because of the drawing the edge of the intaglios.

SFG-57

Descendant feature (grapheme):

TR (Y) 𐰛 (Vasil'ev 1983 apud Harmatta 2004: 186); (O, T, Y) 𐰚 (Kyzlasov, I. L. 1994: 71); (O, Y) 𐰚, (Y) 𐰛; (T) 𐰚, 𐰚, (Y) 𐰚, 𐰚, 𐰚, 𐰚, (O) 𐰚, 𐰚, 𐰚 (Kairžanov 2014: 18); (Mendur-Sokkon I/1) 𐰚; (Mendur-Sokkon IV) 𐰚, 𐰚; (O) 𐰚, (manuscript) 𐰛, 𐰛 (von Gabain 1941); (Y) 𐰛, 𐰚 (Büyük Larousse 9: 4678) <^{I}k^{I}> /k/;

SR (Kievan Letter, 955–961) 𐰚 <k> /k/.

OM1 (SFG-57):

Aramaic ancestor feature (grapheme):

Imperial Aramaic (satrapies, 5th–4th c. BC) 𐡊, 𐡊, 𐡊, (monuments, Egypt, 4th–3rd c. BC) 𐡊, (papyrus, Egypt, 2nd c. BC) 𐡊, 𐡊 (Taylor 1883, vol. I: 250); (monumental, 6th c. BC) 𐡊, (cursive, 5th–4th c. BC) 𐡊 (MNAMON: Aramaic, retrieved on 26 May 2018); (monumental) 𐡊 (Faulmann 1880: 79); (inscriptions) 𐡊, 𐡊 (Bühler 1898: second table after p. 124: Comparative Table of the Perso-Aramaic and the Kharoṣṭhī); (Elephantine Papyri, 6th c. BC) 𐡊 (Glass 2000: 14); 𐡊, 𐡊; (Aśoka, around 250 BC) 𐡊 (Glass 2000: 14); (Leather Documents of the Satrap and Royal Prince Aršāma) 𐡊, (Persepolis) 𐡊, (Daskyleion) 𐡊, (Kandahar) 𐡊 (Rosenthal et al. 1986–2011: Table 3); 𐡊 (MacKenzie 1971: xi) *kāp̄* <k> /k, χ/;

Canaanite witness feature (grapheme): *Phoenician* (ʿIzbet Ṣarṭah Ostracon, ca. 1100 BC) 𐤊 (Rollston 2008a: 84); 𐤊, 𐤊, 𐤊; (Sprengling 1931: 55); (Byblos, 11th–10th c. BC) 𐤊; (Gezer, 10th c. BC) 𐤊 (Kőszeghy 2010: 57); (Amurru, 11th c. BC) 𐤊, 𐤊, (Aḥīrām's inscription, Byblos, ca. 1000 BC) 𐤊, 𐤊, (Jeḥīmilk's inscription, Byblos, ca. 950 BC) 𐤊, (Tel Zayit Alphabet, late 10th c. or very early 9th c. BC) 𐤊 (Kőszeghy 2010: 57); (Elibaal's inscription, Byblos, ca. 900 BC) 𐤊, (Nora's inscription, Sardinia, ca. 900 BC) 𐤊, (Tell Faḫariyeh, 9th c. BC) 𐤊 (Lipiński 1994: 27); (Kilamuwa Stele, Samal, ca. 825 BC) 𐤊, (Limassol, ca. 750 BC) 𐤊 (Röllig 1995: 204–205); 𐤊, 𐤊, 𐤊, 𐤊, 𐤊, 𐤊, 𐤊 (Faulmann 1880: 78) *kāp̄* <k> /k/ [k]; *Old Aramaic* (Bar-Hadad, 9th c. BC) 𐡊 (PROEL: Alfabeto Arameo, retrieved on 26 May 2018); (10th–5th/4th c. BC) 𐡊 (Gibson 1975); (Deir 'Allā, around 800 BC) 𐡊 (Glass 2000: 14); (Nineveh, 7th c. BC) 𐡊 (Taylor 1883, vol. I: 250) *kāp̄* <k> /k/; *Paleo-Hebrew* (Mesha Stele, 9th c. BC) 𐤊 (Rollston 2010: 52, 54); (Mesha Stele, 9th c. BC) 𐤊, 𐤊 (Faulmann 1880: 78) *kāp̄* <k> /k/;

South Semitic witness feature (grapheme): *Hismaic* 𐪋 (OCIANA-Hismaic 2017: xiv); 𐪋 (Macdonald 2005: 82); 𐪋, 𐪋 (Macdonald 2004: 496); 𐪋 (King 1992: Figure 1 between the pages 5 and 6); *Safaitic* 𐪋 (Macdonald 2004: 496); 𐪋 (Macdonald 2015: 33, 36) <k> /k/;

Aramaic witness feature (grapheme): *Hebrew* (Qumran Manuscripts, 1st c. BC) כ *kaf* <k>;

Hatran (H 79, soon before AD 240) (Beyer 1998: 10, 47–48) <k>; *Armazian* (Cereteli 1948–1949 apud Róna-Tas 1987: 14) <k>.

OM2 (SFG-57):
Middle Iranian ancestor feature (grapheme):
Parthian (Nisa, 1st c. BC) (Skjærvø 1996: 518); (Nisa) , , , (Ivantchik & Lurje 2013: 290) <k> /g, k/;
Khwarazmian (coins) (Vainberg 1977: Table VIII) <k>;
Sogdian (early, Kultobe, before 4th c. AD) (Sims-Williams & Grenet 2006: colour illustrations without page numbering); (Ancient Letters, early 4th c. AD) (Skjærvø 1996: 519); (Ancient Letters, beginning of 4th c. AD) (Harmatta 2004: 186); (sutra) , (Skjærvø 1996: 519) *kāp̄* <k> /k/;
Middle Persian (3rd c. AD) <k> (details: SFG-58);
Middle Iranian witness feature (grapheme): *Parthian* (inscriptional) (Skjærvø 1996: 518) <k> /g, k/;
Uyghur witness feature (grapheme): *Uyghur* (beginning), (middle), (ending) (Kara 1996: 540) *kāp̄* <k> /k, g/ (Kara 1996: 540).

Evaluation (SFG-57):
Changed script: TR & SR.
Region of relics: TR: Inner Asia; SR: Pontus Steppe.
Source script family:
OM1: Aramaic.
OM2: Middle Iranian.
Period of change:
OM1: 7th/6th–1st c. BC, the using period of the Imperial Aramaic (Table 8-12) script.
OM2: 2nd c. BC –8th c. AD, the union of the using periods of Parthian (Table 8-16), Khwarazmian, Sogdian and Middle Persian scripts; the upper limit is the age of the earliest TR or SR script relics (Table 8-19).
Region of change: OM1 & OM2: Inner Asia.
Glyph fit only with tamgas: OM1: 0. OM2: 0.

Comments (SFG-57):

(i) The (Altay) <tamga> (Table 8-34) is very similar to a typical descendant glyph variant; however, it does not seem to be necessary for the development of the descendant glyphs, since the ancestor glyphs are similar to the descendant glyphs.

(ii) According to Clauson, TR , <^{I}k^{I}> is the descendant of the Sogdian *kāp̄* <k> (Clauson 1970: 69). It is worth noting that the glyphs (, ,) of the Uyghur <k> are more similar to the glyphs (, ,) of TR <^{I}k^{I}>.

(iii) The (Mendur-Sokkon I/1) being a glyph variant with three parallel strokes of TR <^{I}k^{I}> was developed applying the feature evolution principle referred as "glyph-variant forming" (Table 4-2) with the characteristic feature transformation referred as "line insertion" (Table 4-3).

(iv) Rovash graphemes denoting *k, q* or *χ* are reviewed by Table 7-2.

(v) The age of Phoenician glyphs similar to the glyphs of the descendant glyphs under study was 10th c. BC that is, too early for the Phoenician script to be considered a direct ancestor.

(vi) Of South Semitic scripts as witness scripts, Hismaic 𐪋 and Safaitic 𐪋, 𐪋 <k> support that the characteristic glyph 𐰚 of TR <^{I}k^{I}> could be evolved from Semitic <k>.

SFG-58

Descendant feature (grapheme):

TR (T) 𐰴, 𐰴, 𐰴, (O, Y) 𐰴, (Y) 𐰴, (O) 𐰴 (Kyzlasov, I. L. 1994: 70–71); (Khentii, second half of 8^{th} c. – beginning of 9^{th} c.) 𐰴; (manuscript) 𐰴 (von Gabain 1941), (O, Y) 𐰴, (Y) 𐰴, 𐰴 (Büyük Larousse 9: 4678) <^{A}q^{A}> or <k^{1}> /q/;

SHR (Nikolsburg, 1490–1526) 𐳓 *ac;* (Csíkszentmihály, 1501) 𐳓; (Constantinople, 1515, LTR writing direction) 𐳓; (Gyulafehérvár, 1655) 𐳓; (Szegedi, 1655) 𐳓; (Énlaka, 1668) 𐳓; (Hickes, 1705) 𐳓 <k> /k/;

CBR (Szarvas, the first half of 8^{th} c.) 𐳓 <k> /k/.

OM1 (SFG-58):

Anatolian-Greek Alphabetic ancestor feature (grapheme):

Ancient Greek (Sikinos [Cyclades]) ↓ *chi* <kh> (Jeffery 1961: 35–37, 39–40, 322);

Paleo-Hispanic witness feature (grapheme): *Northeastern Iberian* ↓, ↓ (Hesperia: Narbonensis, retrieved on 24 June 2016) /gi, ki/, (dual) ↓, ↓ /gi/, ↓, ↓, ↓, ↓ /ki/ (Ferrer i Jané 2005: 981; Ferrer i Jané 2014: 244–245) <ki/gi>; *Northeastern Iberian* (Gallia Narbonensis) И, ᐱ, ↓, ✓, ✓, ᐱᐱ, И, ↓, Z (Hesperia: Narbonensis, retrieved on 24 June 2016) <ki> /gi, ki/; *Celtiberian* (Botorrita) ✓ (Eska 2008: 166–167), (eastern, western) ↓ (Hesperia: Narbonensis, retrieved on 24 June 2016) <ki>;

Runic witness feature (grapheme): *Runic* ᛇ (Mees 2006: 50) <k>.

OM2 (SFG-58):

Aramaic ancestor feature (grapheme):

Imperial Aramaic 𐡊, 𐡊, 𐡊, 𐡊, 𐡊, 𐡊, 𐡊 *kāp̄* <k> /k, χ/ (details: SFG-57);

Syriac (Estrangela) ܟ (Faulmann 1880: 85); (Estrangela) ܟ (Taylor 1883, vol. I: 227) *kōp̄* <k> /k, χ/;

Aramaic witness feature (grapheme): *Nabataean* (late) 𐢔 (Macdonald 2008: 218) <k>; *Arabic* (early) ک, (modern) ك (Macdonald 2008: 218) *kāf* <k> /k/.

OM3 (SFG-58):

Middle Iranian ancestor feature (grapheme):

Middle Persian (inscriptions, 3^{rd} c. AD) 𐭊 (MacKenzie 1971: xi); 𐭊 (Skjærvø 1996: 518), (coins, 4^{th}–6^{th} c. AD) 𐭊, 𐭊 (Taylor 1883, vol. II: 236); (Psalter) (Bulayïq, 6^{th}–7^{th} c. AD, a copy of an origin from the 4^{th} c. AD) 𐮋 (Skjærvø 1996: 518) *kāp̄* <k> /g, k/.

OM4 (SFG-58):

Middle Iranian ancestor feature (grapheme):

Parthian (inscriptional) 𐭇 (Skjærvø 1996: 518) *ḥēṯ* <ḥ> /h, χ/ (more glyphs: SFG-43);

Khwarazmian (coins) ח (Vainberg 1977: Table VIII) <ḥ>;

Sogdian (Ancient Letters, early 4^{th} c. AD) 𐼇, 𐼇, (sutra) 𐼇, 𐼇 (Skjærvø 1996: 519) *ḥēṯ* <ḥ> /χ, h/ (Skjærvø 1996: 519, cf. Sims-Williams 1989: 176, Table 1);

Middle Persian (Pre-Sasanian) (2^{nd}–1^{st} c. BC) 𐭧 (Skjærvø 1997: 100); (Psalter) (Bulayïq, 6^{th}–7^{th} c., a copy of an origin from the 4^{th} c. AD) 𐮇, (Early Cursive Pahlavi) 𐮇, (Book Pahlavi) 𐮇 (Skjærvø 1996: 518) *ḥēṯ* <ḥ> /h, χ/ (more glyphs: SFG-43);

Manichean (Sogdian) (3rd c. AD or earlier) ⲙ (Skjærvø 1996: 519); ⲛ (Durkin-Meisterernst 2005: Table 1) *ḥēṯ* <ḥ> /χ, h/.

OM+ (SFG-58):
Tamgas ancestor feature (glyph shapes or styles):
Tamgas (Achaemenid Iran) H; (Bayte III) ↑; (Basins of the Amu Darya and the Syr Darya, 6th–2nd c. BC) ↑, H; (1st c. BC –3rd c. AD) H; (Altay) N; (Mongolia) H <tamga> (details: Table 8-34).

Evaluation (SFG-58):
Changed script: TR, SHR & CBR.
Region of relics: TR: Inner Asia; SHR & CBR: Carpathian Basin; SR: Inner Asia.
Source script family:
OM1: Anatolian-Greek Alphabetic.
OM2: Aramaic.
OM3 & OM4: Middle Iranian.
Period of change:
OM1: 9th–5th c. BC, the using period of the Ancient Greek (Table 8-8) script.
OM2: 7th/6th–1st c. BC or 1st–7th c. AD, the union of the using periods of Imperial Aramaic (Table 8-12) and Syriac scripts, the upper limit is the age of the earliest TR, SHR, CBR or SR inscriptions (Table 8-19).
OM3: 3rd–7th c. AD, the using period of the Middle Persian (Table 8-16) script.
OM4: 2nd c. BC – 8th c. AD, the union of the using periods of Parthian (Table 8-16), Khwarazmian, Sogdian, Middle Persian and Manichean scripts, the upper limit is the age of the earliest TR, SHR or CBR script relics containing the descendant grapheme (Table 8-31).
Region of change: OM1: Anatolia. OM2, OM3 & OM4: Inner Asia.
Glyph fit only with tamgas: OM1: 0. OM2: 1. OM3: 0. OM4: 0.

Comments (SFG-58):

(i) Nagy and Németh supposed the relationship between SHR ↑ <k> and TR N <^{A}q^{A}> (Nagy 1895: 274; Németh 1934: Appendix VI; Németh 1971: 38).

(ii) According to Sebestyén, SHR ↑ <k> is of the same origin as SHR ◊ <k> (SFG-91), and is ultimately derived from Phoenician Ӿ, ⊣, Ч <k> (SFG-57) assuming multiple feature transformations (Sebestyén 1906: 272, 276).

(iii) According to Clauson, TR N, N, Ⅎ <^{A}q^{A}> is a descendant of Sogdian ⲙ, ⲙ <ḥ> (SFG-43) (Clauson 1970: 69), see OM4.

(iv) SHR ↑ <k> has been used near /a/ according to some traditions, and even in the Nikolsburg alphabet its letter name is *ac;* these data confirms that SHR ↑ <k> is a relative of TR N, N, Ⅎ <^{A}q^{A}>.

(v) SHR, CBR ↑ <k> was probably formed from TR N, N, Ⅎ <^{A}q^{A}> to be distinguishable from SHR H, N, N <r> (SFG-92) and SHR H, CBR И, N <γ> (SFG-21). The easy shape transition between the ↑ and И is demonstrated by a glyph variant of CBR <γ> in the Treasure of Nagyszentmiklós: ✓.

(vi) Rovash graphemes denoting *k, q* or *χ* are reviewed by Table 7-2.

(vii) Greco-Bactrian (Heraüs) И, Ʞ, (Vāsudeva I) И, Ʞ, (Kaniṣka II) K, И, (Sasanian princes Bahrām and Hormizd) И, И, K, И, (Loulan, 4th c. AD) ✗ (Ghirshman 1948: 63) *kappa*

<κ> /k/ has some glyphs being similar to the descendant grapheme(И, И, И); however, there is not any Rovash glyph variant, which is similar to the typical ꝁ glyph of Greco-Bactrian <κ>. Therefore, it is unlikely that the Greco-Bactrian <κ> is the ancestor.

(viii) The earliest glyph variant of Kharoṣṭhī (Aśoka, around 250 BC) 𐨑 (Bühler 1898: 106–107; Glass 2000: 14); (British Library) ς, ɾ, ϱ; (Khotan Dharmapada) ϱ; (Niya) ς; (Schøyen) ɾ (Glass 2000: 53–56) <kha> /k^h/ might be ancestor. Interestingly, both Kharoṣṭhī 𐨑 <kha> and TR И <^{A}q^A> were used in syllables containing /a/. Concerning some traditions, SHR ᛋ <k> has also been used near /a/. However, the archaic 𐨑 glyph variant of Kharoṣṭhī <kha> was regularly used in inscriptions until the beginning of 1st c. AD, occasionally in later records (Glass 2000: 53–54). Therefore, in the later time, when Kharoṣṭhī was used North to India, this glyph variant (𐨑), characterized by the straight head and leg, was not in use. Consequently, this could not be the ancestor of the descendant graphemes.

SFG-59

Descendant feature (grapheme):
SR (Achik-Tash, 8th c.) ζ, ζ <q> /q/.

OM1 (SFG-59):
Rovash ancestor feature (grapheme):
TR И <^{A}q^A> (SFG-58).

Evaluation (SFG-59):
Changed script: SR.
Region of relics: SR: Inner Asia.
Source script family:
OM1: Rovash (internal development) (glyph-variant forming [Table 4-2]; bending [Table 4-3]).
Period of change:
OM1: Not later than the 8th c. AD, the limit is the age of the only one deciphered inscription containing the descendant grapheme (Table 8-32).
Region of change: OM1: Inner Asia.
Glyph fit only with tamgas: OM1: 0.

Comments (SFG-59):

(i) Regarding the shape of SR ζ, ζ <q>, it could be the mirrored pair of TR ⅄, ᚴ, ᚠ <^{I}k^I> (SFG-57). However, based on its sound value, it is rather the bending (Table 4-3) variant of TR И <^{A}q^A> (SFG-58). In the latter case , the possible parallels of this shape development: TR 1 <I> (SFG-50) and SR ⊃ <I> (SFG-51); TR ϒ, И <Ẅ> (SFG-35) and SR ʃ <Ẅ> (SFG-36).

(ii) Rovash graphemes denoting *k, q* or χ are reviewed by Table 7-2.

SFG-60

Descendant feature (grapheme):
SHR (Nikolsburg, 1490–1526) Ӿ *vnc* <nk>.

OM1 (SFG-60):
Rovash ancestor feature (grapheme):
SHR ᛋ <k> (details: SFG-21).

OM+ (SFG-60):
Tamgas ancestor feature (glyph shapes or styles):
Tamgas (Sarmatia, 2nd half of 2nd c. – 1st half of 3rd c. AD) ᛝ; (Achaemenid Iran) ᛝ; (Sarmatia, 2nd half of 2nd c. – 1st half of 3rd c. AD) ᛝ <tamga> (details: Table 8-34).

Evaluation (SFG-60):
Changed script: SHR.
Region of relics: SHR: Carpathian Basin.
Source script family:
OM1: Rovash (internal development) (becoming similar, borrowing or symmetrization [Table 4-2]; duplication or use of known glyph [Table 4-3]).
Period of change:
OM1: Before AD 1490–1526, the limit is the age of the Nikolsburg Alphabet (Table 8-30).
Region of change: OM1: Inner Asia, Pontus Steppe or Carpathian Basin.
Glyph fit only with tamgas: OM1: 1.

Comments (SFG-60):
(i) It is possible that SHR ᛝ <nk> could be derived from the duplication of SHR ᛀ <k> (cf. Table 7-8). Its sound value may refer to the Ancient Greek script tradition that *ng* was denoted by a double <γ> (Table 7-10: 7-14. §).

SFG-61
Descendant feature (grapheme):
TR (O, Y) ◁, (T, O, J) ▷, (Y) ▽ (Kairžanov 2014: 18); (manuscript) ◀ (von Gabain 1941); (Toñuquq, 726) ⊲, (Kül Tegin, 732; Bilge Khagan, 735) ◁ (Clauson 1970: 75) <^{ı}q^{ı}>;
SHR (Homoródkarácsonyfalva Stone inscription, around 13th c.) Δ, Δ; (Erdőszentgyörgy, 13th–14th c.) Δ <k> /k/.

OM1 (SFG-61):
Anatolian-Greek Alphabetic ancestor feature (grapheme):
Carian (Kaunos, Kildara, Memphis, Mylasa) ∇, (Euromos, Hyllarima, Memphis, Sakkara, Stratonikeia) Y; (Memphis, E.Me 37) ∇; (Masson 1978: 38; Adiego 2007a: 62–63), (coins) Δ <k> /k/ (Adiego 2007a: 32, 250).

OM2 (SFG-61):
Brahmic ancestor feature (grapheme):
Brāhmī (alphabets r and s [Early Turkestan]) 𑀔, (alphabet t [North Turkestan Type A]) 𑀔 (Sander 1968: Tafel 31); (Turkestan Gupta, 4th–5th c. AD) 𑀔, 𑀔 (Sander 2005: 136) <kha> /k^h/;
Brāhmī (alphabets r and s [Early Turkestan]) 𑀔𑀺, (alphabet t [North Turkestan Type A]) 𑀔𑀺, (Standard North Turkestan [alphabet u, Type B]) 𑀔𑀺 (Sander 1968: Tafel 31) <khi>;
Brahmic witness feature (grapheme): *Brāhmī* 𑀔, 𑀔 (Bühler 1898: Table after p. 123: Comparative Table of the oldest Semitic and the Brāhma alphabets); 𑀔, (Aśoka, around 250 BC) 𑀔; (Socotra [Jemen], T 44-c, LTR inscription, end of 2nd c. AD – 4th c.) 𑀔 (Strauch & Bukharin 2004: 130) <kha>; *Tibetan* ཁ (Róna-Tas 1991: 117, Table VII) <kha>.

OM+ (SFG-61):
Tamgas ancestor feature (glyph shapes or styles):
Tamgas (Achaemenid Iran) △; (Bayte III) △; (Basins of the Amu Darya and the Syr Darya, 6th–2nd c. BC) △; (1st c. BC –3rd c. AD) ◬; (Kanka) △, △ <tamga> (details: Table 8-34).

Evaluation (SFG-61):
Changed script: TR & SHR.
Region of relics: TR: Inner Asia; SHR: Carpathian Basin.
Source script family:
OM1: Anatolian-Greek Alphabetic.
OM2: Brahmic.
Period of change:
OM1: 7th–3rd c. BC, the using period of the Carian script (Table 8-8).
OM2: 4th–8th c. AD, the using period of Brāhmī glyph variants presumed to be the ancestor (Table 8-15), the upper limit is the age of the earliest TR or SHR relics (Table 8-19).
Region of change: OM1: Anatolia. OM2: Inner Asia.
Glyph fit only with tamgas: OM1: 0. OM2: 1.

Comments (SFG-61):
(i) Interpreting TR ◁, ▷ <^{ï}q^{ï}> as a Turkic pictograph, its formation from the Old Turkic *ïq* ‘spindle’ was supposed (Róna-Tas 1987: 8–9). For an analysis of the issue of Turkic pictographs, see Table 3-4.
(ii) Rovash graphemes denoting *k, q* or *χ* are reviewed by Table 7-2.

SFG-62
Descendant feature (grapheme):
TR (J, O, T [Kyzlasov, I. L. 1994: 72]) ↓, (Y) ↑ (Büyük Larousse 9: 4678; Kyzlasov, I. L. 1994: 72; Kairžanov 2014: 17); (Toñuquq, 726) ↓ (Clauson 1970: 75) <^{W}q^{W}> /q/.

OM1 (SFG-62):
Aegean ancestor feature (grapheme):
Cypro-Greek ↥ (Davis 2010: 38–61), (common) ⇡, (Paphian) ⇞ (Olivier 2007–2008: 617–618) <ka> /ga, ka, k^{h}a/.

OM2 (SFG-62):
Brahmic ancestor feature (grapheme):
Brāhmī (Gupta) † (PROEL: Silabario Siddham, retrieved in 2018); (alphabet l [Late Gupta], ca. 6th c. AD) ⍑, ⍖ (Sander 1968: Tafel 21); (alphabet q [Turkestan Gupta]) ⍑, (alphabets r and s [Early Turkestan]) ⍑ (Sander 1968: Tafel 29); (Turkestan Gupta, 4th–5th c. AD) ⍑, ⍑ (Sander 2005: 136); (Gupta, ca. AD 380) ✝, (Cursive Gupta of Central Asia) ⸘ (Fischer 2001: 109) <ka> (further glyphs: SFG-91);
Brahmic witness feature (grapheme): *Brāhmī* (Aśoka, around 250 BC) +; † (Bühler 1898: Table after p. 123: Comparative Table of the oldest Semitic and the Brāhma alphabets); (Socotra [Jemen], T 23-a, LTR inscription, end of 2nd c. AD – 4th c.) ✝ (Strauch & Bukharin 2004: 128); (alphabet v [Khotanese]) ⍑ (Sander 1968: Tafel 29) <ka>;
Kharoṣṭhī witness feature (grapheme): *Kharoṣṭhī* (Aśoka, around 250 BC) ϡ (Salomon 1998: 49); (Schøyen) ϡ <ka> /k/.

OM+ (SFG-62):
Tamgas ancestor feature (glyph shapes or styles):
Tamgas (Khumbuztepa, 4th c. BC) ↓; (Bactrian sign, northern Afghanistan, Bronze Age) ↑; (Basins of the Amu Darya and the Syr Darya, 6th–2nd c. BC) ↑; (1st c. BC –3rd c. AD) ↑; (Sarmatia, 2nd half of 2nd c. – 1st half of 3rd c. AD) ↑ <tamga> (details: Table 8-34).

Evaluation (SFG-62):
Changed script: TR.
Region of relics: TR: Inner Asia.
Source script family:
OM1: Aegean.
OM2: Brahmic.
Period of change:
OM1: 11th–2nd c. BC, the using period of the Cypro-Greek script (Table 8-3).
OM2: 4th–8th c. AD, the using period of Brāhmī glyph variants presumed to be the ancestor (Table 8-15), the upper limit is the age of the earliest TR inscriptions (Table 8-29).
Region of change: OM1: Anatolia. OM2: Inner Asia.
Glyph fit only with tamgas: OM1: 0. OM2: 0.

Comments (SFG-62):
(i) Interpreting TR ↓, ↑ <^{W}q^{W}> as Turkic pictograph, its formation from the Old Turkic *oq* 'arrow' word was supposed (Clauson 1970: 71; Róna-Tas 1987: 8–9; Kara 1996: 537). Perhaps the fact that its sound value with a pronunciation-facilitating vowel meant the Old Turkic *oq* 'arrow' word might have played a role in developing the glyphs ↓ and ↑ or vice versa, in keeping these glyphs unchanged. The possible effect of the shape of the arrow in the glyph formation is an external influence (Table 4-2, glyph style transfer Table 2-9: 2-4. §). For an analysis of the issue of Turkic pictographs, see Table 3-4.
(ii) Rovash graphemes denoting *k, q* or *χ* are reviewed by Table 7-2.
(iii) A possible ancestor could be Ancient Greek (red) Ү, ↓; (Boiotia) ᛉ, Ψ *chi* <kh> /k^{h}/ (SFG-44). These could be borrowed only in Asia Minor and only by the Cimmerians if they have adopted any script (Table 3-2). For the Asia Minor variant of Ancient Greek (blue), the sound value of Ancient Greek Ү *chi* <kh> was /ps/ and not /k^{h}/ (Young 1969: 254; Swiggers & Jenniges 1996: 282; Tzitzilis 2007: 753; Woodhouse 2009: 167). There are further scripts with graphemes being similar to the descendant graphemes: Lycian ᛉ, V, Y, Ү <χ> or <x> /k/ (before velar vowels) (SFG-44); Etruscan (Marsiliana d'Albegna, 7th c. BC) Y, (early) Y, (late) ᛉ, ↓ (Doblhofer 1962: 319) <χ> [k^{h}]; Runic (Elder Fuþark) (Lindkœr-C) ↓ (Looijenga 1997: 121) <k>; however, these cannot be ancestors of TR ↓ <^{W}q^{W}>, see Table 4-5.
(iv) Phoenician Ү, ᛉ, Ӳ, ᛉ *kāp̄* <k> is likely not an ancestor of TR ↓, ↑ <^{W}q^{W}>, since the possible Phoenician glyphs were used not later than 9th c. BC (SFG-57).

SFG-63

Descendant feature (grapheme):
TR (T) ↲ (Kyzlasov, I. L. 1994: 71); (O, Y) ↲ (Thomsen 1893: 9); ↳ (Róna-Tas 1987: 13); (Y) ┛ (Büyük Larousse 9: 4678); (T) ↳, (Y) ↾, ✓, ↳ (Kairžanov 2014: 18); (Y) ∨ (Thomsen 1893: 9); (Khentii, second half of 8th c. – beginning of 9th c.) ↲; (Toyok) ⫞, (Dunhuang Letter) ↲, (Manichean texts) ┻ (Clauson 1970: 75) <l^{1}> /l/;

CBR (Környe, end of 7th c.) ⑊, \, ⌋, |, / <l> /l/;
SR (Achik-Tash, 8th c.) ⟩; (Mayatskoe-10, 9th c.) ⅃ <l> /l/;
SR (Kievan Letter, 955–961) 𐰞 <I̲l> /il/ (Table 8-28).

OM1 (SFG-63):
Canaanite ancestor feature (grapheme):
Phoenician (Byblos, 11th–10th c. BC) 𐤋; 𐤋, 𐤋 (Sprengling 1931: 55), (Gezer, 10th c. BC) 𐤋 (Kőszeghy 2010: 57); (Karatepe KAI 26, ca. 700 BC) 𐤋 (Amadasi Guzzo & Zamora López 2013: 187) <l> /l/;
Old Aramaic (8th c. BC) 𐡋; (Deir ʼAllā, around 800 BC) 𐡋 (Glass 2000: 14); (7th c. BC) 𐡋, 𐡋, 𐡋, (6th c. BC) 𐡋 (Gibson 1975); (Nineveh, 7th c. BC) 𐡋 (Taylor 1883, vol. I: 250) *lāmaḏ* <l>;
Canaanite witness feature (grapheme): *Paleo-Hebrew* (end of 8th c. BC) 𐤋 (MNAMON: Hebrew, retrieved in 2015) <l>;
South Semitic witness feature (grapheme): *Ancient South Arabian* (Minaic, Sabaic, Hasaitic) 𐩡; *Dispersed Oasis North Arabian* 𐪁, *Dumaitic* 𐪁 (Macdonald 2004: 496); *Taymanitic* ᛚ (OCIANA-Taymanitic 2017: xiii); 𐪁 (Macdonald 2004: 496); *Dadanitic* ᚴ (OCIANA-Dadanitic 2017: xiv); 𐪁, *Thamudic D* ⇁, *Thamudic C* 𐪁 (Macdonald 2004: 496); *Hismaic* 𐪁 (OCIANA-Hismaic 2017: xiv); *Thamudic B* 𐪁 (Macdonald 2004: 496); *Geʿez abjad* ለ <l> /l/.

OM2 (SFG-63):
Anatolian-Greek Alphabetic ancestor feature (grapheme):
Old Phrygian (M-01a – first side of the Midas Tomb) ᛚ (Young 1969: 267–268) <l> /l/;
Ancient Greek (Athens, Thera, Naxos, Korkyra, 8th–7th c. BC) 𐌋, (Crete, 8th–7th c. BC) ⌝, 𐌋, (Boiotia, 8th–7th c. BC) V (Healey 1990a: 37); (Iónia, Corinth) ᛚ, (Athens, Euboea) ⅃ (Cook 1990: 264); (Ipsambul [Abu Simbel, Egypt], 7th c. – the beginning of 6th c. BC, LTR inscription) ᛚ (Taylor 1883, vol. II: 9–15); (8th–5th c. BC) ⊣ (Powell 1991: 8); (Signature of Polykleitos, Olympia, 450–425 BC) ⊢ (Johnston 2013: 204); (Argos) ⊢ (Cook 1990: 264) *lambda* <λ> /l/;
Lydian 𐤠 (Littman 1916: 1; Adiego 2007e: 7; Melchert 2008b: 57) <l> /l/;
Anatolian-Greek Alphabetic witness feature (grapheme): *Lemnian* (6th c. BC) 𐌋 (MNAMON: Lemnian, retrieved in 2015) <l>;
Paleo-Hispanic witness feature (grapheme): *Espanca* 𐌋 <l>; *Southwestern* 𐌋, ᛚ <l>; *Southeastern Iberian* 𐌋 <l> (Faria 1992: 45; Ferrer i Jané 2013: 447); *Northeastern Iberian* (dual) ᛚ <l> (Ferrer i Jané 2014: 244–245); *Celtiberian* (Botorrita) ʌ (Eska 2008: 166–167); (eastern, western) ᛚ (Hesperia: Narbonensis, retrieved on 24 June 2016) <l>;
Italic witness feature (grapheme): *Etruscan* (Marsiliana d'Albegna, 7th c. BC) 𐌋 <l>; *South Picene* ᛚ <l>; *Lepontic* (early) 𐌋, 𐌋, (late) 𐌋 <l>; *Venetic* (beg. of 6th c. – end of 6th c. BC) 𐌋, 𐌋 <l>; *Oscan* (Etruscan, first half of 4th c. – first half of 1st c. BC) 𐌋, (Capua, just after mid-3rd c. BC) 𐌋 <l> /l/; *Umbrian* (Etruscan, 4th c. – first half of 1st c. BC) 𐌋, (Iguvine Tablets, ca. 300–90 BC) 𐌋 (Britannica: Umbrian language) <l>; *Raetic* (Magrè) 𐌋, (Sanzeno) ᛚ; (Pfatten/Vadena) 𐌋 <l> (Marchesini 2014: 206–207; MNAMON); *Faliscan* (7th–5th c. BC) ᛚ, (4th–1st c. BC) ᛚ, L <l>; *Camunic* (Piancogno) ᛚ, (Foppe di Nadro) 𐌋 (TIR: Script, retrieved on 20 February 2018); ᛚ, 𐌋 (Morandi 2004: 476) <l>; *Gallo-Etruscan* ᛚ, L <l>; *Messapic* (first half of 6th c. – 4th c. BC) ʌ <l> /l/; *Early Latin* (4th–2nd c. BC) ᛚ <l>;

Runic witness feature (grapheme): *Runic* (Elder Fuþark) (Kylver Stone, ca. 5th c. AD) ᛚ; (Hesselagergårds Skov-C) ᛚ, ᛚ, (Hammenhög-C) ᛚ, ᛚ, (Griesheim) ᛚ (Looijenga 1997: 73) <l>.

OM3 (SFG-63):

Aramaic ancestor feature (grapheme):

Imperial Aramaic (satrapies, 5th–4th c. BC) 𐡋, 𐡋, (monuments, Egypt, 4th–3rd c. BC) 𐡋 (Taylor 1883, vol. I: 250); (Elephantine Papyri, 6th c. BC) 𐡋 (Glass 2000: 15); 𐡋 (MacKenzie 1971: xi) *lāmaḏ* <l> /l/;

Syriac (Estrangela) ܠ; (Western) ܠ (middle, ending, individual), ܠ (beginning); (Nestorian) ܠ <l> /l/;

Aramaic witness feature (grapheme): *Nabataean* (late) 𐢓 (Macdonald 2008: 218) <l>; *Arabic* (early) ل, (modern) ل (Macdonald 2008: 218) *lām* <l> /l/.

OM4 (SFG-63):

Middle Iranian ancestor feature (grapheme):

Khwarazmian (coins) ل (Vainberg 1977: Table VIII) <l>;

Middle Persian (Book Pahlavi) 𐭫 (Skjærvø 1996: 518–519); (Psalter) (Bulayïq, 6th–7th c., a copy of an origin from the 4th c. AD) 𐮋 (Skjærvø 1996: 518) *lāmaḏ* <l> /l/.

Evaluation (SFG-63):

Changed script: TR & SR.

Region of relics: TR: Inner Asia; SR: Inner Asia & Pontus Steppe.

Source script family:

OM1: Canaanite.

OM2: Anatolian-Greek Alphabetic.

OM3: Aramaic.

OM4: Middle Iranian.

Period of change:

OM1: 11th c. BC – 2nd c. AD, the union of the using periods of Phoenician (Table 8-6) and Old Aramaic scripts.

OM2: 9th–2nd c. BC, the union of the using periods of Old Phrygian, (Table 8-8) Ancient Greek and Lydian scripts.

OM3: 7th/6th c. BC – 7th c. AD, the union of the using periods of Imperial Aramaic (Table 8-12) and Syriac scripts, the upper limit is the age of the earliest TR, CBR or SR inscriptions (Table 8-19).

OM4: 1st/2nd–7th c. AD, the union of the using periods of Khwarazmian (Table 8-16) and Middle Persian scripts, the upper limit is the age of the earliest TR, CBR or SR inscriptions (Table 8-19).

Region of change: OM1 & OM2: Anatolia. OM3 & OM4: Inner Asia.

Glyph fit only with tamgas: OM1: 0. OM2: 0. OM3: 0. OM4: 0.

Comments (SFG-63):

(i) According to Clauson, the close parallels of TR 𐰞, 𐰠 <l^1> can be found in the glyphs of both early Sogdian and Psalter <l> (Clauson 1970: 69).

(ii) Due to the difference in the sound values the following scripts used for Sogdian language cannot be ancestor: Sogdian 𐼹, 𐼹, 𐼹, 𐼹 <l, δ> /δ/ (SFG-105); Manichean (Sogdian)

(3rd c. AD or earlier) 𐼹; 𐼹, 𐼹 (Skjærvø 1996: 519) <l, δ> /δ/; Christian Sogdian 𐼹, 𐼹 (Skjærvø 1996: 519) <l, δ> /δ/. It is worth noting that in loanwords, there were /l/ in Sogdian language.

SFG-64

Descendant feature (grapheme):

SHR (Székelydálya, around 1400) Λ; (Nikolsburg, 1490–1526) Λ *l* <l>; (Székelyderzs, 1490s) Λ; (Gelence, 1497) Λ; (Rugonfalva, 16th–17th c.) Λ; (Constantinople, 1515, LTR writing direction) Λ; (Wolfenbüttel, 1592–1666) Λ; (Szamosközy's Poem, 1604) Λ; (István Miskolci Csulyak, 1610–1645) Λ, Λ; (Farkaslaki, 1624) Λ; (Bonyhai's Example, ca. 1627) Λ; (Bonyhai's Alphabet, 1627) Λ; (Gáspár Miskolci Csulyak, 1654) Λ; (Gyulafehérvár, 1655) Λ; (Patakfalvi, 1776–1785) Λ <l> /l/;

SR (Homokmégy-Halom, 10th c.) Λ <l> /l/.

OM1 (SFG-64):

Aegean ancestor feature (grapheme):

Cypro-Greek (Ofeltas/Opheltau inscription, 1050–950 or beginning of 1st millennium BC) 𐠩; (Perna 2010: 148, 154); (Paphian) 𐠩, 𐠩, 𐠩, 𐠩; (Valério 2016: 266); (Paphian) 𐠩 (Olivier 2007–2008: 617–618); (Paphian, 6th c. BC) 𐠩, 𐠩 (Valério 2016: 228) <le> /le/.

OM2 (SFG-64):

Anatolian-Greek Alphabetic ancestor feature (grapheme):

Ancient Greek (Ionia, Corinth) Λ (Cook 1987: 8); (Ipsambul [Abu Simbel, Egypt], 7th c. – the beginning of 6th c. BC, LTR writing direction) Λ, Λ (Taylor 1883, vol. II: 9–15) *lambda* <λ> /l/;

Anatolian-Greek Alphabetic witness feature (grapheme): *Carian* (Kaunos, Mylasa, Sinuri, Stratonikeia) Δ; (Memphis, E.Me 37) Δ (Masson 1978: 38; Adiego 2007a: 62–63) <l> /l/ (Adiego 2007e: 10); *Lycian* Λ (Melchert 2008a: 48), (TL 29) Λ (Kalinka 1901 apud Adiego 2015: 14, 21); (TL 5) Λ (Kalinka 1901 apud Adiego 2015: 14, 21) <l> /l/ (Adiego 2007e: 8);

Paleo-Hispanic witness feature (grapheme): *Northeastern Iberian* Λ (Hesperia: Narbonensis, retrieved on 24 June 2016) <l> (Ferrer i Jané 2014: 244–245);

Italic witness feature (grapheme): *Elymian* (5th c. BC) Λ, Λ, Λ <λ> (Marchesini 2012: 101–103); *Oscan* (Greek, first half of 4th c. – first half of 1st c. BC) Λ <λ, l>; *Messapic* (first half of 6th c. – end of 2nd c. BC) Λ, (4th c. – end of 2nd c. BC) Λ, *Gallo-Greek* (3rd c. BC – 1st c. AD) (engraving) Λ, Λ, Λ, (pottery) Λ, Λ, Λ, Λ <l>.

OM3 (SFG-64):

Greek Alphabetic ancestor feature (grapheme):

Greco-Bactrian (Kadphises) Λ, (Kaniṣka) Λ, Λ, (Sasanian princes Bahrām and Hormizd) Λ, Λ, (Chionites-Hephthalites, Arabo-Hephthalites) Λ, Λ, Λ, Λ, Λ (Ghirshman 1948: 63) *lambda* <λ>;

Greek (medieval uncial) λ, (medieval cursive) λ, λ, λ, (medieval minuscular) λ, λ, λ, λ (Faulmann 1880: 171) *lambda* <λ>.

OM4 (SFG-64):

Rovash ancestor feature (grapheme):

TR ↾, ⌄ <l1> /l/ (details: SFG-63).

OM+ (SFG-64):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Achaemenid Iran) Λ, ꟼ; (Basins of the Amu Darya and the Syr Darya, 1st c. BC – 3rd c. AD) Λ; (4th–8th c. AD) ʌ, Ϟ; (Sarmatia, 2nd half of 1st c. – 1st half of 2nd c. AD) Λ, Λ <tamga> (details: Table 8-34).

Evaluation (SFG-64):

Changed script: SHR & SR.

Region of relics: SHR: Carpathian Basin; SR: Carpathian Basin.

Source script family:

OM1: Aegean.

OM2: Anatolian-Greek Alphabetic.

OM3: Greek Alphabetic.

OM4: Rovash (internal development) (separation or symmetrization [Table 4-2]; mirroring, line extension or line insertion [Table 4-3]).

Period of change:

OM1: 11th–2nd c. BC (Table 8-3).

OM2: 9th–5th c. BC, the using period of the Ancient Greek (Table 8-8) script.

OM3: 4th c. BC – 10th c. AD, the union of the using periods of Greek (Table 8-13) and Greco-Bactrian scripts, the upper limit is the age of the earliest inscription containing the descendant grapheme.

OM4: Up to 10th c. AD, the upper limit is the age of the earliest inscription containing the descendant grapheme.

Region of change: OM1 & OM2: Anatolia. OM3 & OM4: Inner Asia.

Glyph fit only with tamgas: OM1: 0. OM2: 0. OM3: 0. OM4: 1.

Comments (SFG-64):

(i) Several hypothesized a kinship between SHR Λ <l> and the Ancient Greek Λ <λ> (Sebestyén 1906: 272, 276; Németh 1917: 36; Németh 1934: 29; Ligeti 1925: 51; Németh 1971: 39), as expressed by OM1.

(ii) The development of the Lycian Λ <l> and SHR Λ, Λ <l> from a glyph like the Ancient Greek Λ <λ> may have been analogous to the shape evolution of the Southeastern Iberian Λ, Λ, Λ <ka/ga> (SFG-18) from the Ancient Greek Λ <γ> or Phoenician Λ <g>.

(iii) The basis of OM4 is that SR Λ, SHR Λ, Λ, Λ, Λ <l> could be derived by mirroring (∨ > Λ) or line extending (↾ > Λ) from TR ↾, ∨ <l^1>, then in the case of SHR by adding auxiliary bars. An example of mirroring and line extension is the glyph distribution (⇃, Ꞁ, ↾, ∨) of TR <l^1> itself, and examples of adding strokes are presented in Table 4-3. The relationship between TR ʕ, ʕ, Ⴈ <g^2> (SFG-18) and SHR Λ <g> is analogous to this.

(iv) Of the glyphs of the Parthian <l> (SFG-65), the variant ɺ could also be the ancestor of SHR Λ <l> when rotated 90° in the positive direction and mirrored vertically. Nevertheless, this lineage makes many assumptions, so the Parthian origin is unlikely based on cladistics's *lex parsimoniae* (Table 4-1).

SFG-65

Descendant feature (grapheme):

TR (O, Y) Ƴ <l^1> /l/ (Kairžanov 2014: 18);

TR (Y) ᛉ (Vasil'ev 1983 apud Harmatta 2004: 186), (O, T, Y) ᛉ, (Y) ᛉ, (manuscript) ᛉ (von Gabain 1941); (Kalbak-Tash II, 8th c.) ᚴ; (Urkosh, 8th–9th c.) ᚿ (Tugusheva et al. 2014: 78, 81) <l^2> /l/.

OM1 (SFG-65):
Anatolian-Greek Alphabetic ancestor feature (grapheme):
Ancient Greek ⊣, ⊢ *lambda* <λ> /l/ (details: SFG-63);
Runic witness feature (grapheme): *Runic* ᚠ, ᚿ, ᚳ <l> (details: SFG-63).

OM2 (SFG-65):
Greek Alphabetic ancestor feature (grapheme):
Greco-Bactrian ✂, ⊧, ⊧, ⊦ *lambda* <λ> (details: SFG-64).

OM3 (SFG-65):
Middle Iranian ancestor feature (grapheme):
Parthian (Ḥājiābād, 3rd c. AD) 𐭋, 𐭋, (Taylor 1883, vol. II: 236) *lāmaḏ* <l> /l/;
Middle Iranian witness feature (grapheme): *Parthian* (early) (Nisa, 1st c. BC) 𐭋 (Rosenthal et al. 1986–2011: Table 3); (coins of the Parthian kings, 1st–2nd c. AD) l, ʃ, ɩ, ɩ (Taylor 1883, vol. II: 236); (inscriptional) 𐭋; (inscriptional) 𐭋 (Skjærvø 1996: 518) *lāmaḏ* <l> /l/.

OM4 (SFG-65):
Kharoṣṭhī ancestor feature (grapheme):
Kharoṣṭhī (Aśoka, around 250 BC) 𐨫, (British Library) 𐨫, 𐨫, 𐨫, (Khotan Dharmapada) 𐨫, 𐨫, (Niya) 𐨫, (Schøyen) 𐨫, 𐨫 (Glass 2000: 95) <la>.

OM5 (SFG-65):
Rovash ancestor feature (grapheme):
TR ∨ <l^1> (details: SFG-63).

OM+ (SFG-65):
Tamgas ancestor feature (glyph shapes or styles):
Tamgas (Achaemenid Iran) Y; (Chu-Ili interfluve) Y; (Basins of the Amu Darya and the Syr Darya, 6th–2nd c. BC) ᚠ; (Sarmatia, 2nd half of 1st c. – 1st half of 2nd c. AD) Y; (Sidak, 5th – early 8th c. AD) Y; (Shaushukumtobe) Y; (Mongolia) Y, Y <tamga> (details: Table 8-34).

Evaluation (SFG-65):
Changed script: TR.
Region of relics: TR: Inner Asia.
Source script family:
OM1: Anatolian-Greek Alphabetic.
OM2: Greek Alphabetic.
OM3: Middle Iranian.
OM4: Kharoṣṭhī.
OM5: Rovash (internal development) (separation [Table 4-2]; line insertion [Table 4-3]).
Period of change:
OM1: 9th–5th c. BC, the using period of the Ancient Greek script (Table 8-8).
OM2: AD 342–781, the using period of the Greco-Bactrian script (Table 8-13).
OM3: 2nd c. BC – 3rd c. AD, the using period of the Parthian script (Table 8-16).
OM4: 5th/3rd c. BC – 7th c. AD, the using period of the Kharoṣṭhī script (Table 8-14).

OM5: Up to 8th c. AD, its upper limit is the age of the earliest TR script relic (Table 8-19).
Region of change: OM1: Anatolia. OM2, OM3, OM4 & OM5: Inner Asia.
Glyph fit only with tamgas: OM1: 0. OM2: 1. OM3: 1. OM4: 1. OM5: 1.

Comments (SFG-65):

(i) Interpreting TR **Y** <l²> as Turkic pictograph, its formation from Old Turkic *el* 'hand' word was supposed (Thomsen 1922; Róna-Tas 1987: 8–9). For an analysis of the issue of Turkic pictographs, see Table 3-4.

(ii) The basis of OM2 is that according to Clauson, TR **Y** <l²> (SFG-65) is derived from Greco-Bactrian <λ>, and TR **⅄** <č, ğ> (SFG-83) originates from the Semitic *ṣāḏē* <ṣ>. Additionally, Clauson supposed also that the inventor of TR intentionally wanted to mistify the origin of TR, and therefore swapped the glyphs of TR **⅄** <č, ğ> and TR **Y** <l²> (SFG-65) (Clauson 1970: 68). So the ancestor of TR **⅄** <č, ğ> is the Greco-Bactrian <λ>, and TR **Y** <l²> is derived from the early Sogdian <ṣ, c> /č, ǰ/ (SFG-83) or the Middle Persian <ṣ> /č, ǰ, z/ (SFG-83). However, the assumption of intentional swapping is too strong. In another part of his publication, Clauson modified his former assumption and referred to the varied appearance of the Greek <λ> (Clauson 1970: 69).

(iii) TR **Y** <l²> and TR 𐰽, 𐱁 <s¹, š¹> (SFG-97) might be relatives based on the lambdacism (Table 7-9: 7-7. §) (Róna-Tas 1987: 7). However, it seems to be a too strong assumption.

(iv) The background of OM5 is the presumed relationship of TR ∨ <l¹> (SFG-63) and **Y** <l²>. Note that an analogous pair is the TR D <y¹> (SFG-55) and 9 <y²> (SFG-56): in both pairs, the glyphs of graphemes that are used near velar or palatal vowels differ by a vertical line.

SFG-66

Descendant feature (grapheme):
CBR (Szarvas, first half of 8th c.) 𐳖, 𐳖 <l> /l/.

OM1 (SFG-66):
Rovash ancestor feature (grapheme):
TR (Y) Y, Y <l²> /l/ (details: SFG-65).

OM+ (SFG-66):
Tamgas ancestor feature (glyph shapes or styles):
Tamgas (Achaimenid Iran) Ҳ, Ҳ; (Koy-Krylgan-kala) Ҳ <tamga> (details: Table 8-34).

Evaluation (SFG-66):
Changed script: CBR.
Region of relics: CBR: Carpathian Basin.
Source script family:
OM1: Rovash (internal development) (becoming similar, borrowing or glyph variant forming [Table 4-2]; line insertion or use of known glyph [Table 4-3]).
Period of change:
OM1: Before 8th c. AD, the upper limit is the age of CBR inscription containing the descendant grapheme.
Region of change: OM1: Inner Asia, Pontus Steppe or Carpathian Basin.
Glyph fit only with tamgas: OM1: 1.

SFG-67

Descendant feature (grapheme):

TR (T) O (Kononov 1980: 58–59); (T) (von Gabain 1941); (Y) , , (Kyzlasov, I. L. 1994: 94); (Y) (Tekin 2003: 23); (Y) , (Kairžanov 2014: 17) <m> /m/;

TR (Mendur-Sokkon IV) ; (Y) , (Vasil'ev 1983 apud Harmatta 2004: 186); (O, Y) (Thomsen 1893: 9); (O, T, Y) ; (Y) ; (Doblhofer 1962: 309); (T) (Tekin 2003: 22); (O) ; (T) , (Y) , , , , (O) (Kairžanov 2014: 17); (Kalbak-Tash I) ; (Kalbak-Tash IV/VI) ; (T) , , (Kairžanov 2014: 17); (Khentii, second half of 8th c. – beginning of 9th c.) ; (Kupchegen) ; (Bichiktu-Boom II/1) ; (O) , (Büyük Larousse 9: 4679); (T) (von Gabain 1941) <m> /m/;

SR (Novocherkassk, 8th–10th c.) O <m> /m/.

OM1 (SFG-67):

Middle Iranian ancestor feature (grapheme):

Middle Persian (inscriptional) (coins, 4th–6th c. AD) (Taylor 1883, vol. II: 236); (inscriptions, 3rd c. AD) (MacKenzie 1971: xi); (Rosenthal et al. 1986–2011: Table 3); (Skjærvø 1996: 518); (Psalter) (Bulayïq, 6th–7th c., a copy of an origin from the 4th c. AD) (Skjærvø 1996: 518); (Psalter) (MacKenzie 1971: xi); (Psalter) (Rosenthal et al. 1986–2011: Table 3); (Early Cursive Pahlavi) (Skjærvø 1996: 518); (Book Pahlavi) (Skjærvø 1996: 518); (Book Pahlavi) (MacKenzie 1971: xi); (Book Pahlavi) (Rosenthal et al. 1986–2011: Table 3) *mēm* <m> /m/;

Aramaic witness feature (grapheme): *Imperial Aramaic* (satrapies, 5th–4th c. BC) , (monuments, Egypt, 4th–3rd c. BC) , (papyrus, Egypt, 2nd c. BC) , (Taylor 1883, vol. I: 250); (7th–5th/4th c. BC) (Gibson 1975); (Elephantine Papyri, 6th c. BC) (Glass 2000: 15); (MacKenzie 1971: xi); ; (Aśoka, around 250 BC) (Benveniste & Dupont-Sommer 1966: fig. 2; Glass 2000: 15); (Babylonian Bowls) , , (Faulmann 1880: 79) *mēm* <m> /m/; *Syriac* (Estrangela) (ending), (beginning, middle); (Nestorian) (ending), (beginning, middle) *mīm* <m>; *Nabataean* (late) (Macdonald 2008: 218) <m>; *Arabic* (early) , (modern) (Macdonald 2008: 218) *mīm* <m>;

Middle Iranian witness feature (grapheme): *Parthian* , , , *mēm* <m> /m/ (details: SFG-69); *Khwarazmian* (coins) , , , (Vainberg 1977: Table VIII) <m>; *Sogdian* (Ancient Letters, early 4th c. AD) (Skjærvø 1996: 519); (Ancient Letters, beginning of 4th c. AD) (Harmatta 2004: 186); (early) (Clauson 1970: 74); (sutra) , (Skjærvø 1996: 519) <m>; *Manichean* (Sogdian) (3rd c. AD or earlier) , (Skjærvø 1996: 519); (ending), (von Gabain 1974: 17) <m>; *Avestan* (Hoffmann 1987–2011: Table 2); (Hoffmann & Forssman 1996: 41) <m>; *Christian Sogdian* , (Skjærvø 1996: 519) *mēm* <m> /m/;

OM2 (SFG-67):

Brahmic ancestor feature (grapheme):

Brāhmī (Standard North Turkestan) (Maue 2010: 9); (Archaic Tocharian) (Maue 2010: 10); (Tocharian) (Krause & Thomas 1960: 41); (alphabet t [North Turkestan Type A]) (Sander 1968: Tafel 30); (Tumshuqese, TS 31) (Maue 2010: 5); (Cursive Gupta of Central Asia) , (Tocharian) (Fischer 2001: 109) <ma>;

Brahmic witness feature (grapheme): *Brāhmī* (Aśoka, around 250 BC) , (Cunningham

1877: Plate XXVII) <ma>; *Tibetan* མ (Róna-Tas 1991: 117, Table VII) <ma>; *Brāhmī* (alphabet q [Turkestan Gupta]) (Sander 1968: Tafel 30) <me>; *Brāhmī* (alphabet q [Turkestan Gupta]) , (alphabet t [North Turkestan Type A]) , (Standard North Turkestan [alphabet u, Type B]) (Sander 1968: Tafel 32) <mi>; *Brāhmī* (Standard North Turkestan [alphabet u, Type B]) (Sander 1968: Tafel 32) <mī>;

Kharoṣṭhī witness feature (grapheme): *Kharoṣṭhī* (early) (Glass 2000: 16); (Aśoka, around 250 BC) , , (1st c. AD) (Salomon 1998: 43) <ma>.

OM+ (SFG-67):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Achaemenid Iran) O; (Bayte III) ʊ, ◇, ⌗; (Basins of the Amu Darya and the Syr Darya, 6th–2nd c. BC) ⊙, (1st c. BC –3rd c. AD) ⊙, (4th–8th c. AD) O; (Altay) 8, ⚲; (Beskepe) O, , , , , , ; (Mongolia) H, , O, ⊙, , , , , 8, ∞, 8, , , ; (Talas Valley) ⊙; (Tashkent Oasis) ; (Coins with double-humped camel, 7th–8th c. AD) ✧ <tamga> (details: Table 8-34).

Evaluation (SFG-67):

Changed script: TR & SR.

Region of relics: TR: Inner Asia; SR: Pontus Steppe.

Source script family:

OM1: Middle Iranian.

OM2: Brahmic.

Period of change:

OM1: 3rd–7th c. AD, the using period of the Middle Persian (Table 8-16) script.

OM2: 4th–8th c. AD, the using period of Brāhmī glyph variants presumed to be the ancestor (Table 8-15), the upper limit is the age of the earliest TR or SR inscriptions (Table 8-19).

Region of change: OM1 & OM2: Inner Asia.

Glyph fit only with tamgas: OM1: 1. OM2: 1.

Comments (SFG-67):

(i) Clauson considered the modified glyph of the Sogdian <m> to be the ancestor of TR , <m> (Clauson 1970: 69).

(ii) The middle dot in the glyphs of TR ⊙, <m> is surely the effect of tamgas.

(iii) I. L. Kyzlasov pointed out the evolutionary relationship between the glyph variants of TR , , <m> (Kyzlasov, I. L. 1994: 90).

(iv) Brāhmī <ma> could be the ancestor of some glyphs of TR <m> (OM2). A feature transformation analogous to the > transformation presumed in OM2 (albeit in the reverse direction) can be seen in the example of the Brāhmī (Archaic Tocharian) , (Standard Tocharian) (Maue 2010: 10) <n̲a̲> (SFG-75).

(v) A TR <b2> (SFG-14) ~ <m> (SFG-67) correspondence could be envisaged, which may be related to the Old Turkic word onset *b* > *m* change (Table 7-11). The glyph distributions of TR <b2>, SR <b2> (SFG-14) and TR , , , <m> (SFG-67) overlap, although this may stem from stylistic convergence (Table 2-7), the ultimate reason for which is that the shape style of graphemes in a script may also be unified for aesthetic reasons (feature evolution principle referred as “becoming similar”, Table 4-2). Without any further data supporting this sound change-based grapheme adaptation (Table 4-2), this possibility is omitted.

SFG-68

Descendant feature (grapheme):

SHR (Vargyas, 12th–13th c.) ; (Homoródkarácsonyfalva Stone inscription, around 13th c.) ; (Székelydálya, around 1400) ; (Székelyderzs, 1490s) ; (Nikolsburg, 1490–1526) *m* , ; (Constantinople, 1515, LTR writing direction) ; (Wolfenbüttel, 1592–1666) ; (Rugonfalva, 16th–17th c.) ; (Gyulafehérvár, 1655) ; (Énlaka, 1668) ; (Kájoni's Ancient, 1673) *m;* (Berekeresztúr, 14th–15th c.) <m> /m/.

OM1 (SFG-68):

Brahmic ancestor feature (grapheme):

Brāhmī (Standard North Turkestan) (Maue 2010: 9); (Archaic Tocharian) (Maue 2010: 10); (Tocharian) (Krause & Thomas 1960: 41); (alphabet t [North Turkestan Type A]) (Sander 1968: Tafel 30) <ma> (further glyphs: SFG-67);

Brāhmī (Tocharian) (Krause & Thomas 1960: 41); (Tocharian) (Róna-Tas 1991: 114, Table IV); (Tocharian) (Sander 1968: Tafel 41); (Standard Tocharian) (Maue 2010: 10) <m̠a̠>;

Brahmic witnes feature (grapheme): *Brāhmī* (alphabet q [Turkestan Gupta]) , (Standard North Turkestan [alphabet u, Type B]) (Sander 1968: Tafel 30); (Tumshuqese, TS 31) (Maue 2010: 5) <mā>.

OM+ (SFG-68):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Achaemenid Iran) ; (Basins of the Amu Darya and the Syr Darya, 1st c. BC –3rd c. AD) <tamga> (details: Table 8-34).

Evaluation (SFG-68):

Changed script: SHR.

Region of relics: SHR: Carpathian Basin.

Source script family:

OM1: Brahmic.

Period of change:

OM1: 4th–9th c. AD, the using period of Brāhmī glyph variants presumed to be the ancestor (Table 8-15), the upper limit is the Hungarian conquest of the Carpathian Basin since after this any influence of the Brāhmī script was impossible

Region of change: OM1: Inner Asia.

Glyph fit only with tamgas: OM1: 1.

Comments (SFG-68):

(i) According to Sebestyén, SHR <m> is from the Ancient Greek , <μ> (SFG-69), and it was rotated with 90° for space-saving reasons (Sebestyén 1906: 272, 277). Sebestyén emphasized that despite the complete formal identity, SHR <m> and Ancient South Arabian <m> are unrelated (he mentioned the Himyarite variant of Ancient South Arabian script [Table 8-7], Sebestyén 1903a: 28). Moreover, according to Sebestyén, SHR <m> is unrelated to TR <m> either.

(ii) SHR <m> (SFG-68) and TR (Y) , <m> /m/ (details: SFG-67) might be relatives.

(iii) The Manichean (Sogdian) (3rd c. AD or earlier) , , (ending) <m> (SFG-67) might be an ancestor supposing a rotating with 90° in the positive direction. However, this lineage seems to be unlikely.

(iv) The basis of a possible TR 𐰉 <b[1]> (SFG-14) ~ SHR ɘ <m> correspondence would be the Old Turkic word onset *b* > *m* sound change (Table 7-11). Nevertheless, the similarity of their glyphs can be mere coincidence.

(v) SHR ɘ <m> could originate from CBR ξ; SR ξ, ⦚ <m> /m/ (SFG-69) by internal development (closer-shape forming [Table 4-2] and line insertion [Table 4-3]); however, but it seems too strong assumption.

(vi) SHR ɘ <m> is completely similar to the followings: Ancient South Arabian (Minaic) 𐩃, 𐩃, 𐩃, (early musnad Sabaic) 𐩃, (early zabur Sabaic) 𐩃 (Macdonald 2015: 39); (Hasaitic) 𐩃, 𐩃, 𐩃, 𐩃, Dispersed Oasis North Arabian 𐪃, 𐪃, Dumaitic 𐪃 (Macdonald 2004: 496); Taymanitic 𐪃 (OCIANA-Taymanitic 2017: xiii); 𐪃, 𐪃; Dadanitic 𐪃 (Macdonald 2004: 496); 𐪃, 𐪃; 𐪃 (O'Connor 1996: 99); Thamudic B 𐪃, 𐪃, 𐪃 (Macdonald 2004: 496); Hismaic 𐪃 (Macdonald 2005: 82); Geʿez abjad መ, ሠ <m> /m/. However, no historical data is known to support their relationship.

SFG-69

Descendant feature (grapheme):

CBR (Szarvas, first half of 8th c.) ξ; (Nagyszentmiklós, 8th–11th c.) ξ <m> /m/;

SR (Achik-Tash, 8th c.) ξ, ⦚; (Mayaki, 8th–9th c.) ξ; (Kermen Tolga, 8th–10th c.) ξ; (Mayatskoe-2, 9th c.) ξ; (Mayatskoe-10, 9th c.) ξ; (Khumara-6, Khumara-8 [in copy], 9th–10th c.) ξ <m> /m/.

OM1 (SFG-69):

Canaanite ancestor feature (grapheme):

Phoenician (ʿIzbet Ṣarṭah Ostracon, ca. 1100 BC) 𐤌, (arrowheads, mid-11th c. BC) 𐤌 (Rollston 2008a: 84); 𐤌 (Cross 1989: 88); (Byblos, 11th–10th c. BC) 𐤌; (Gezer, 10th c. BC) 𐤌 (Cross 1989: 88); (Tell Faḫariyeh, 9th c. BC) 𐤌 (Lipiński 1994: 27; Bordreuil 2005: 23); (Kilamuwa Stele, Samal, ca. 825 BC) 𐤌, 𐤌 (Lemaire & Sass 2013: 125); (Karatepe, ca. 700 BC) 𐤌, (Byblos, 5th–4th c. BC) 𐤌 (MNAMON: Phoenician, retrieved in 2014) *mēm* <m> /m/;

Old Aramaic (8th c. BC) 𐡌; (Deir 'Allā, around 800 BC) 𐡌 (Glass 2000: 15); (8th–3rd c. BC) 𐡌; (10th–7th c. BC) 𐡌 (Gibson 1975); (Nineveh, 7th c. BC) 𐡌, 𐡌 (Taylor 1883, vol. I: 250) *mēm* <m> /m/ [m].

OM2 (SFG-69):

Anatolian-Greek Alphabetic ancestor feature (grapheme):

Ancient Greek (Thera, 8th–7th c. BC) Ϻ, (Crete, Naxos, 8th–7th c. BC) Ϻ, Ϻ, (Korkyra, Boiotia, 8th–7th c. BC) Μ (Healey 1990a: 37); (Athens, 8th–7th c. BC) Μ, (Crete, 8th–7th c. BC) Μ, (Naxos, 8th–7th c. BC) Μ (Healey 1990a: 37); (8th–5th c. BC) Ϻ, Μ, Μ, Ι (Powell 1991: 8); (Ipsambul [Abu Simbel, Egypt], 7th c. – the beginning of 6th c. BC, LTR writing direction) Μ, Μ, Μ (Taylor 1883, vol. II: 9–15) *mu* <μ>;

Italic witness feature (grapheme): *Paleo-Umbrian* (Tolfa, ca. 530–525 BC) ξ, ξ (Urbanová 2003: 33; Bakkum 2009: 380) <m>; *Proto-Campanian* (Oinochoe in Bucchero, Vico Equense, second half of 6th c. BC) ξ (MNAMON: Oscan, retrieved on 11 March 2018) <m> /m/.

OM3 (SFG-69):
Middle Iranian ancestor feature (grapheme):
Parthian (inscriptions, 3rd c. AD) 𐭌 (MacKenzie 1971: xi); (Skjærvø 1996: 518); (coins of the Parthian kings, 1st–2nd c. AD) , (Taylor 1883, vol. II: 236) *mēm* <m> /m/.

OM4 (SFG-69):
Greek Alphabetic ancestor feature (grapheme):
Greco-Bactrian (intaglios) (Ghirshman 1948: 63) *mu* <μ>;
Greek Alphabetic witness feature (grapheme): *Greco-Bactrian* (Kadphises) , (Kaniṣka) , , (Ghirshman 1948: 63) *mu* <μ>.

OM5 (SFG-69):
Rovash ancestor feature (grapheme):
TR <m> (details: SFG-67).

OM+ (SFG-69):
Tamgas ancestor feature (glyph shapes or styles):
Tamgas (Bactrian sign, northern Afghanistan, Bronze Age) ; (Bactrian sign, Sapalli Culture, Bronze Age) , ; (Bayte III) ; (Kultobe, 1st–3rd c. AD) ; (Kanka) <tamga> (details: Table 8-34).

Evaluation (SFG-69):
Changed script: CBR & SR.
Region of relics: CBR: Carpathian Basin; SR: Inner Asia & Pontus-Steppe.
Source script family:
OM1: Canaanite.
OM2: Anatolian-Greek Alphabetic.
OM3: Middle Iranian.
OM4: Greek Alphabetic.
OM5: Rovash (internal development) (simplification [Table 4-2]; use of know glyph [Table 4-3]).
Period of change:
OM1: 11th c. BC – 2nd c. AD, the union of the using periods of Phoenician (Table 8-6) and Old Aramaic scripts.
OM2: 9th–5th c. BC, the using period of the Ancient Greek script (Table 8-8).
OM3: 2nd c. BC – 3rd c. AD, the using period of the Parthian script (Table 8-16).
OM4: AD 342–781, the using period of the Greco-Bactrian script (Table 8-13).
OM5: Up to the 8th c. AD, the limit is the age of the earliest CBR and SR script relics containing the descendant grapheme.
Region of change: OM1 & OM2: Anatolia. OM3, OM4 & OM5: Inner Asia.
Glyph fit only with tamgas: OM1: 0. OM2: 0. OM3: 1. OM4: 1. OM5: 1.

Comments (SFG-69):
(i) It is worth noting that the earlier glyph variants of Old Aramaic grapheme (𐡌 from the 8th c. BC or from the 10th–7th c. BC) may be ancestor, the later variants may not.
(ii) In OM3, the 𐭌 > > transformation or the use of tamga is assumed.

SFG-70

Descendant feature (grapheme):

SHR (Rudimenta-Giessen, 1598) *amb;* (Stick Calendar, ca. 15th c. surviving in a 17th c. copy) /mb/; (Constantinople, 1515, LTR writing direction) /mb/; (Kájoni's Rudimenta-like, 1673) *Omb*; (Marsigli's Alphabet, 1690) *enb;* (Szegedi, 1655) *emb;* (Bod's Rudimenta, 1739) *umb* <mb>;

SHR (Nikolsburg, 1490–1526) *emp;* (Rudimenta-Giessen, 1598) *tpru;* (Szegedi, 1655) *ptrű;* (Kájoni's Rudimenta-like, 1673) *Rhru;* (Bod's Rudimenta, 1739) *tptrü* <mp>.

OM1 (SFG-70):
Rovash ancestor feature (grapheme):
TR , <b^2> (details: SFG-14).

OM2 (SFG-70)*:*
Rovash ancestor feature (grapheme):
TR (T) , , , <m> (details: SFG-67).

OM+ (SFG-70):
Tamgas ancestor feature (glyph shapes or styles):
Tamgas (Kanka) ; (Tashkent Oasis) <tamga> (details: Table 8-34).

Evaluation (SFG-70):
Changed script: SHR.
Region of relics: SHR: Carpathian Basin.
Source script family:
OM1 & OM2: Rovash (internal development) (adaptation, becoming similar or borrowing [Table 4-2]; ornamenting or use of known glyph [Table 4-3]).
Period of change: OM1 & OM2: Up to around 900, the limit is the age of the earliest SHR script relic (Bodrog-Alsóbű, around 900 or first half of 10th c.).
Region of change: OM1 & OM2: Inner Asia, Pontus Steppe or Carpathian Basin.
Glyph fit only with tamgas: OM1: 1. OM2: 1.

Comments (SFG-70):

(i) OM1 and OM2 are related to the effect of C_{nasal}+C_{stop} sound pair, see Table 7-10.

(ii) The basis of OM2 is that SHR , <mb> and TR <m> (SFG-67) can be relatives based on their glyph and sound value (Németh 1934: Appendix VII; Németh 1971: 38; Vékony 2004a: 251).

(iii) In the Nikolsburg Alphabet, graphemes denoting certain nasal-plosive sound pairs (C_{nasal}+$C_{plosive}$) are consistently presented as if they were ligatures created from doubling the grapheme denoting the consonant in question: *ecz* (SFG-85) and *encz* (SFG-86), *ed* (SFG-29) and *and* (SFG-30), *ac* (SFG-21) and *vnc* (SFG-60), *ep* (SFG-80) and *emp* (SFG-70), *t* (SFG-104) and *enth* (SFG-107), cf. Table 7-8. Strikingly, these grapheme pairs in the Nikolsburg Alphabet are always listed one after the other, kind of suggesting that the <C_{nasal}+$C_{plosive}$> digraphs were created by duplicating the corresponding <$C_{plosive}$> grapheme. Some examples are known from the evolution of scripts that a plosive also marked the nasal before it, see Table 7-10. Perhaps as a result of intellectual analysis, these graphemes <$C_{plosive}$>

and <C_{nasal}+$C_{plosive}$> were placed one after the other in the signary of the Nikolsburg Alphabet. This derivation may be indicated by the *emp* letter name of the grapheme because the *emp* letter name refers to the creation of the grapheme from the duplication of the <p> (SFG-80). However, the *emp* grapheme may not have been necessary, since in the Hungarian language in the medieval Old Hungarian linguistic period there was essentially no word containing the consonant pair /mp/. It follows that the sound value of the *emp* was originally not /mp/. Based on this, the *emp* was likely not created from the doubling <p>. It is more likely that the -shaped grapheme came from a grapheme of /mb/ (cf. SHR *enb,* , /mb/ and TR /b/ [SFG-14], , /m/ [SFG-67]). The assumption that the shape of <mp> resembles <p> based on conscious analysis is supported by the observation that, apart from the Nikolsburg alphabet, not all legs of the glyph of <mp> are inclined downwards in any SHR script relic, but always radial, cf. , , , . Oppositely, the shape of the (Nikolsburg) <mp> suggests its relationship with the <p>. In the context of the same notation for /mb/ and /mp/, it should be noted that in the Manichean Sogdian, voiced and voiceless plosives were not distinguished after a voiced consonant.

SFG-71

Descendant feature (grapheme):

CBR (Nagyszentmiklós, Bowl No. 8, 8th c.) ; (Nagyszentmiklós, Jug No. 6, 8th–11th c.) <n> /n/;

SR (Achik-Tash, 8th c.) <n^1, n^2> /n/;

SR (Novocherkassk, 8th–10th c.) (with a punctuation mark upper dot, SFG-119); (Mayaki, 8th–9th c.) ; (Mayatskoe-1, 9th c.) <n^1> /n/.

OM1 (SFG-71):

Canaanite ancestor feature (grapheme):

Phoenician (ʿIzbet Ṣarṭah Ostracon, ca. 1100 BC) (Rollston 2008a: 84); , , (Byblos, 11th–10th c. BC) , (Sprengling 1931: 55); , (Tell Faḫariyeh, 9th c. BC) (Lipiński 1994: 27); (Karatepe, ca. 700 BC) , (Byblos, 5th–4th c. BC) ; (cursive, Kition Tariff A, ca. 550 BC) (Healey 1974: 58); (influenced by formal cursive glyphs, Kition Tariff B, ca. 550 BC) (Healey 1974: 58); (cursive, Sakkara Papyrus, ca. 525 BC) (Healey 1974: 58); (Egypt, Elephantine Ostraca, 5th c. BC) , , ; (Sidon, Saïda Ostraca, 5th–4th c. BC) , , , (Cairo Papyrus, ca. 300 BC) , , (Röllig 1995: 208–209); (cursive, Elath Ostracon 2070, 400–350 BC) (Healey 1974: 58); (cursive, Shiqmona Jar, ca. 350 BC) (Healey 1974: 58) *nūn* <n> /n/;

Old Aramaic (8th c. BC) ; (Deir ʼAllā, around 800 BC) (Glass 2000: 14); (Nineveh, 7th c. BC) (Taylor 1883, vol. I: 250) *nūn* <n> /n/;

Canaanite witness feature (grapheme): *Paleo-Hebrew* (end of 8th c. BC) (MNAMON: Hebrew, retrieved in 2015) <n>.

OM2 (SFG-71):

Aramaic ancestor feature (grapheme):

Imperial Aramaic (satrapies, 5th–4th c. BC) , (monuments, Egypt, 4th–3rd c. BC) , (papyrus, Egypt, 2nd c. BC) , (Taylor 1883, vol. I: 250); (MacKenzie 1971: xi); (Elephantine Papyri, 6th c. BC) (Glass 2000: 14); (7th c. BC) , , , (6th c. BC) , , , , , (5th–4th c. BC) (Gibson 1975); (satrapies and Egypt, 4th–3rd c. BC) (Taylor 1883, vol. II:

236); (Leather Documents of the Satrap and Royal Prince Aršāma) 𐡍, (Persepolis) 𐡍, (Daskyleion) 𐡍, (Kandahar) 𐡍 (Rosenthal et al. 1986–2011: Table 3); (monumental) 𐡍, (Babylonian Bowls) 𐡍, 𐡍, 𐡍 (Faulmann 1880: 79); (Aśoka, around 250 BC) 𐡍 (Glass 2000: 14) *nūn* <n> /n/.

OM3 (SFG-71):
Kharoṣṭhī ancestor feature (grapheme):
Kharoṣṭhī (Aśoka, around 250 BC) 𐨣 (Glass 2000: 14); (1st c. AD) 𐨣 (Salomon 1998: 43) <na>.

OM4 (SFG-71):
Middle Iranian ancestor feature (grapheme):
Parthian (early, Nisa, 1st c. BC) 𐭍, 𐭍 (Rosenthal et al. 1986–2011: Table 3); (early, Nisa, 1st c. BC) 𐭍 (Skjærvø 1996: 518) *nūn* <n> /n/;
Middle Iranian witness feature (grapheme): *Parthian* (coins of the Parthian kings, 1st–2nd c. AD) 𐭍, (Ḥājiābād, 3rd c. AD) 𐭍 (Taylor 1883, vol. II: 236); (inscriptional) 𐭍 (Skjærvø 1996: 518); (inscriptions, 3rd c. AD) 𐭍 (MacKenzie 1971: xi); 𐭍 (Rosenthal et al. 1986–2011: Table 3) *nūn* <n> /n/.

Evaluation (SFG-71):
Changed script: CBR & SR.
Region of relics: CBR: Carpathian Basin; SR: Inner Asia & Pontus Steppe.
Source script family:
OM1: Canaanite.
OM2: Aramaic.
OM3: Kharoṣṭhī.
OM4: Middle Iranian.
Period of change:
OM1: 9th c. BC – 2nd c. AD, the union of the using periods of Phoenician (Table 8-6) and Old Aramaic scripts.
OM2: 7th/6th–1st c. BC, the using period of the Imperial Aramaic script (Table 8-12).
OM3: 5th/3rd c. BC – 7th c. AD, the using period of the Kharoṣṭhī script (Table 8-14).
OM4: 2nd c. BC – 3th c. AD, the using period of the Parthian script (Table 8-16).
Region of change: OM1: Anatolia. OM2, OM3 & OM4: Inner Asia.
Glyph fit only with tamgas: OM1: 0. OM2: 0. OM3: 0. OM4: 0.

Comments (SFG-71):

(i) Anatolian Hieroglyphic (POTOROO) 𔐱, 𔐱 (Hawkins 2010: 184, 188–189), 𔐱 (Payne, A. 2010a: 132) *35 <na> reminds to SR 𐰣, 𐰤, 𐰣 <n1> (Hosszú 2017: 218). However, the assumption is obvious that CBR 𐲙 <n> and SR 𐰤 <n1> are close related, whereas CBR 𐲙 <n> is undoubtedly of Semitic origin, so SR 𐰤 <n1> is certainly. Based on these, the similarity of Anatolian Hieroglyphic *35 <na> and SR <n1> is surely homoplasy (Table 2-7).

(ii) Ancient Greek (Athens, Crete 8th–7th c. BC) 𐌍, Ͷ, (Thera, Naxos, Korkyra, Boiotia, 8th–7th c. BC) 𐌍 (Healey 1990a: 37) *nu* <ν> /n/; Lydian 𐤭 (Littman 1916: 1; Adiego 2007e: 7; Melchert 2008b: 57); 𐤭 (Swiggers & Jenniges 1996: 283) <n> /n/; Lycian 𐊏; 𐊏, 𐊏 (Adiego 2007e: 8) <n> /n/ are reminiscent of the descendant graphemes, but while these Anatolian-Greek Alphabetic graphemes are always rectangualar in shape, the glyphs of the descendant graphemes are always curved (CBR 𐲙, SR 𐰣, 𐰣 <n>); therefore, they are probably not related.

SFG-72

Descendant feature (grapheme):

TR (Y) ᑕ (Vasil'ev 1983 apud Harmatta 2004: 186); (O, T, Y) ᑐ (Thomsen 1893: 9; Kyzlasov, I. L. 1994: 71); ↄ (Kairžanov 2014: 18); (Y: Begre, 8th–9th c.) ᑕ; (T, Y) ᑕ (Kairžanov 2014: 18) <n^1> /n/;

SHR (Vargyas, 12th–13th c.) ᑐ; (Homoródkarácsonyfalva Stone inscription, around 13th c.) ᑐ, ᑐ, ᑐ; (Bágy, 15th c.) ᑐ; (Nikolsburg, 1490–1526) ᑐ *en* <n> /n/;

SHR (Bonyhai's Example, ca. 1627) ᑐ <n> /n, ny/;

SHR (Constantinople, 1515, LTR writing direction) ᐸ <<u>nd</u>> /nd/;

CBR (Környe, end of 7th c.) ∖ /ń/, ∣ /n/; (Szarvas, first half of 8th c.) ᑐ /n/; (Nagyszentmiklós, 8th–11th c.) ᑐ /ń/ <n>, <ń>;

SR (Jitkov, first third of 8th c.) ᐳ; (Mayatskoe-10, 9th c.) ᑐ; (Khumara-6, 9th–10th c.) ᑐ; (Homokmégy-Halom, 10th c.) ᑐ <n^1> /n/.

OM1 (SFG-72):

Canaanite ancestor feature (grapheme):

Phoenician (5th c. BC) /, /, /; (5th–4th c. BC) /, /, /; (5th–4th c. BC) /; (ca. 350 BC) /; (ca. 300 BC) /, /, / <n> (details: SFG-71).

OM2 (SFG-72):

Anatolian Hieroglyphic ancestor feature (grapheme):

Anatolian Hieroglyphic (POTOROO) ᐳ, ᐳ (Hawkins 2010: 184, 188–189); ᑐ (Payne, A. 2010a: 132); ᘓ (Payne, A. 2010a: 14); ᘓ (Payne, A. 2010a: 116); ᘓ (Payne, A. 2010a: 119); (MARAŞ 1) ᘓ (Yakubovich 2015a: 12) *411 <ni>.

OM3 (SFG-72):

Aramaic ancestor feature (grapheme):

Imperial Aramaic (7th c. BC) /, /, /, (6th c. BC) /, /, /, /, /, (5th–4th c. BC) ו (Gibson 1975) <n> (details: SFG-71);

Armazian ⸮, / (Cereteli 1948–1949 apud Róna-Tas 1987: 14) <n>;

Aramaic witness feature (grapheme): *Hebrew* (Qumran Manuscripts, 1st c. BC) ן <n>; *Hatran* (H 79, soon before AD 240) ן (Beyer 1998: 10, 47–48) <n>.

OM4 (SFG-72):

Middle Iranian ancestor feature (grapheme):

Parthian (early, Nisa, 1st c. BC) / (Skjærvø 1996: 518); (early, Nisa, 1st c. BC) /, ∣ (Rosenthal et al. 1986–2011: Table 3); (inscriptional) ب (Skjærvø 1996: 518); (inscriptions, 3rd c. AD) ﻝ (MacKenzie 1971: xi); ب (Rosenthal et al. 1986–2011: Table 3); (coins of the Parthian kings, 1st–2nd c. AD) ب, (Ḥājiābād, 3rd c. AD) ﻝ (Taylor 1883, vol. II: 236) *nūn* <n> /n/;

Khwarazmian (Tok-kala, 7th–8th c. AD) ﻝ (Vainberg 1977: Table VIII) <n>;

Sogdian (early, Kultobe, before 4th c. AD) ﻝ (Sims-Williams & Grenet 2006: colour illustrations without page numbering); (Ancient Letters, early 4th c. AD) ﻝ (Skjærvø 1996: 519); (Ancient Letters, beginning of 4th c. AD) ﻝ (Harmatta 2004: 186); (sutra) ᒪ, • (Skjærvø 1996: 519) <n>;

Avestan ر (Hoffmann 1987–2011: Table 2) <n>.

Evaluation (SFG-72):
Changed script: TR, SHR, CBR & SR.
Region of relics: TR: Inner Asia; SHR & CBR: Carpathian Basin; SR: Pontus Steppe & Carpathian Basin.
Source script family:
OM1: Canaanite.
OM2: Anatolian Hieroglyphic.
OM3: Aramaic.
OM4: Middle Iranian.
Period of change:
OM1: 11th c. BC – 2nd c. AD, the using period of the Phoenician script (Table 8-6).
OM2: Around 7th c. BC, the end of the using period of the Anatolian Hieroglyphic script (Table 8-5).
OM3: 7th/6th c. BC – 2nd c. AD, the union of the using periods of Imperial Aramaic (Table 8-12) and Armazian scripts.
OM4: 2nd c. BC – 7th c. AD, the union of the using periods of Parthian (Table 8-16), Khwarazmian, Sogdian and Avestan scripts, the upper limit is the age of the earliest TR, SHR, CBR or SR script relics (Table 8-31).
Region of change: OM1 & OM2: Anatolia. OM3 & OM4: Inner Asia.
Glyph fit only with tamgas: OM1: 0. OM2: 0. OM3: 0. OM4: 0.

Comments (SFG-72):

(i) The glyph of the (Achaemenid Iran) ⟩ <tamga> (Table 8-34) is identical to the descendant glyphs, but the ancestor glyphs are also identical to the descendant shapes, so it is unlikely that this tamga was borrowed.

(ii) Several pointed out that SHR 𐳙 <n> and TR 𐰣 <n¹> match (Nagy 1895: 274; Sebestyén 1906: 277; Mészáros 1915: 4; Németh 1934: Appendix VII; Németh 1971: 38; Püspöki Nagy 1977: 304).

(iii) According to Sebestyén, SHR 𐳙 <n> originates from Ancient Greek *nu* <ν> (Sebestyén 1906: 272, 277), cf. Ancient Greek 𐌍, И, 𐌍, *N* *nu* <ν> (SFG-71). This derivation is unfounded due to the large topological difference.

(iv) According to Clauson, TR 𐰣 <n¹> is the same as early Sogdian ↄ <n>, so TR grapheme originates from the Sogdian (Clauson 1970: 69). However, the match is beyond dispute since the glyph ⟩ is not characteristic—its Glyph Complexity Parameter is only 2 (Hosszú 2014a: 66–67; Hosszú 2015: 2022)—the complete match alone is not decisive.

(v) A weakness of OM2 is that Anatolian Hieroglyphic <ni> denoted palatal syllable, while Rovash <n¹> was used in velar syllable.

(vi) The earliest relic of SHR 𐳙 <n> is the ligature <<u>βna</u>> /βnȧ/, which is a ligature surviving in the Bodrog-Alsóbű inscription (around 900 or first half of 10th c.) (Hosszú & Zelliger 2014b: 428). Another ligature, which contains SHR <n> is 𐳚 <nj> (SFG-73).

SFG-73

Descendant feature (grapheme):
SHR (Nikolsburg, 1490–1526) 𐳚 *nÿe* <nj> /nj/ or /ń/;
SHR (Wolfenbüttel, 1592–1666) 𐳚 <nj> /ń/;

SHR (Nikolsburg, 1490–1526) 𐳚 *enÿ;* (Gyulafehérvár, 1655) 𐳚; (Szegedi, 1655) 𐳚 *eny;* (Marsigli's Alphabet, 1690) 𐳚 *onj;* (Szentpéteri, 1699–1702) 𐳚 *ny;* (Patakfalvi, 1776–1785) 𐳚 <ń> /ń/ [ɲ].

OM1 (SFG-73):
Latin Alphabetic ancestor feature (orthographic rule):
Latin digraph *ny* denoted /ń/ in the medieval Old Hungarian orthography of the Latin script
Rovash ancestor feature (grapheme):
SHR 𐳙 <n> /n/ (details: SFG-72) and *SHR* 𐳒 <j> /j/ (details: SFG-50).

Evaluation (SFG-73):
Changed script: SHR.
Region of relics: SHR: Carpathian Basin.
Source script family:
OM1: Latin Alphabetic (orthographic rule transfer, Table 2-9: 2-3. §) and Rovash (internal development) (external influence [Table 4-2]; ligature formation [Table 4-3]).
Period of change: OM1: 9th–16th c. AD (see Comments).
Region of change: OM1: Carpathian Basin.
Glyph fit only with tamgas: OM1: 0.

Comments (SFG-73):

(i) According to Sebestyén, SHR 𐳚 <ń> originates from the ligature of SHR 𐳙 <n> (SFG-72) and 𐳐 <i> (SFG-53) (Sebestyén 1906: 277).

(ii) At the end of the Marsigli's Alphabet, there is the 𐳚 *onj* <ń> /ń/. Its last place in Marsigli's Alphabet probably indicates that originally this letter did not appear in an earlier alphabet, but was later added to it. This observation confirms that in the first period of SHR, there was no separate grapheme to denote /ń/, but the 𐳙 <n> denoted /ń/ as well. This may have been an old tradition because CBR 𐳙 <n> also denoted both /n/ and /ń/ (SFG-72). Although the use of SHR 𐳙 <n> as /ń/ is only attested from ca. 1627 (Bonyhai's Example, Table 8-30), it may reflect previous use. The sound /ń/ existed as a phoneme in Hungarian, so some SHR grapheme had to be marked. If there had been a unique SHR grapheme for /ń/, there would certainly have been no need to create a new SHR grapheme. The reason for creating the new SHR glyph (𐳚) to denote /ń/ may have been that they wanted to distinguish the glyph of /ń/ from another sound. Based on their phonetic similarity, the latter could not have been other than /n/ sound. In the Old Hungarian orthography of the Latin script (Table 8-18), the digraph *ny* may have evolved from the end of the 12th c. AD, so that in many words, the /ń/ sound evolved from the consonant pair /n/+/j/ (A. Molnár 2003: 199). The sound value of *y* was /j/ (Korompay 2003: 286). In accordance with Old Hungarian orthography of the Latin script SHR 𐳚 /nj/ evolved from the ligature of 𐳙 <n> /n/ (SFG-72) and 𐳒 <j> /j/ (SFG-50) and then simplified: 𐳚 /nj/ > 𐳚 <ń> /ń/. Undoubtedly, the 𐳚 ligature had to be used to denote the sound /ń/ based on the *ny* digraph of the Old Hungarian orthography of the Latin script. The use of 𐳙 <n> to denote /ń/ has probably been ceased, the last—albeit only certain—example of its use as /ń/ is from ca. 1627 (Bonyhai's Example). Based on these, the period of creation of SHR <ń>: *terminus a quo:* 9th c. AD, the emergence of the Old Hungarian orthography of the Latin script (with gradual development), *terminus ante quem:* 1490–1526, the time of creating the Nikolsburg Alphabet.

(iii) In Uyghur script (Table 8-20) the /ń/ was represented by the digraph of the <n> and

<y> (Clauson 1970: 59). However, this should not be related to the formation of SHR 𐲙 <ń>, as all early data support that as one of the components of the ligature SHR 𐲙 /n̲j̲/, the original sound value of 𐲑 <j> (SFG-50) was not /j/, but /i/ or /ï/.

(iv) The descendant glyphs are very similar to the (Basins of the Amu Darya and the Syr Darya, 1st c. BC –3rd c. AD) 𐲙 <tamga>; however, based on the Nikolsburg inscription, it is clear that the descendant grapheme was created by a ligature. Therefore, supposing the influence of any tamga is superfluous.

SFG-74

Descendant feature (grapheme):

TR (O, Y) 𐰪 (Kyzlasov, I. L. 1994: 72), (Y) 𐰫; (manuscript) 𐰪, 𐰪 (von Gabain 1941), (Toñuquq, 726) 𐰪 (Clauson 1970: 75) <ń> /ń/.

OM1 (SFG-74):

Brahmic ancestor feature (grapheme):

Brāhmī (Standard North Turkestan) 𑀜 (Maue 2010: 9); (Standard North Turkestan [alphabet u, Type B]) 𑀜, 𑀜 (Sander 1968: Tafel 29); (Khotanese) 𑀜, 𑀜 (Leumann 1934: 17) <ña>;

Brahmic witness feature (grapheme): *Brāhmī* (Aśoka, around 250 BC) 𑀜 (Cunningham 1877: Plate XXVII) <ña>; *Brāhmī* (Standard North Turkestan [alphabet u, Type B]) 𑀜𑀸 (Sander 1968: Tafel 29) <ñā>; *Tibetan* ཉ (Róna-Tas 1991: 117, Table VII) <ña> /ɲa/;

Kharoṣṭhī witness feature (grapheme): *Kharoṣṭhī* (Khotan Dharmapada) 𐨙 (Glass 2000: 67); (Niya) 𐨙; (Schøyen) 𐨙 (Glass 2000: 67) <ña> (other glyphs: SFG-75).

Evaluation (SFG-74):

Changed script: TR.

Region of relics: TR: Inner Asia.

Source script family:

OM1: Brahmic.

Period of change:

OM1: 4th–8th c. AD, the using period of Brāhmī glyph variants presumed to be the ancestor (Table 8-15), the upper limit is the age of the earliest TR inscriptions (Table 8-29).

Region of change: OM1: Inner Asia.

Glyph fit only with tamgas: OM1: 0.

Comments (SFG-74):

(i) According to Clauson, the descendant grapheme TR 𐰪 <ń> came from the duplication of TR 𐰤, 𐰣 <n1> (SFG-72); however, he also raised the idea that it was created by the simplification of the ligature of TR 𐰣 <n1> and TR 𐰖, 𐰗 <y1> (SFG-55) (Clauson 1970: 69). However, these presumptions suppose a very conscious creation of graphemes with some linguistic knowledge, for which there is no evidence. Therefore, based on the cladistics' *lex parsimoniae* (Table 4-1), these lineage options are omitted.

(ii) The supposed ancestor and the descendant graphemes have the same sound value and similar shapes. Compared to Brāhmī glyphs, the lines were crossed out in the middle of the descendant glyph. This modification of the glyph may have happened because the Brahmic glyph resembled the duplicated shape of TR 𐰤, 𐰣 <n1>, and this phenomenon may have had a repercussion on the shape of TR 𐰫, 𐰪 <ń> descendant grapheme.

SFG-75

Descendant feature (grapheme):

TR (O, T, Y) ; (Y) , (Thomsen 1893: 9); (Küli Čur, 719–724) , ; (O, T, Y) , (Y) (Kyzlasov, I. L. 1994: 41, 72, 118); (Y) , (O) (Kairžanov 2014: 18); (Toñuquq, 726) , (Kül Tegin, 732; Bilge Khagan, 735) , (Uyghur inscriptions) , (Khakassia, Tuva) , (Clauson 1970: 75); (Mendur-Sokkon IV) ; (Epitaph of Qarï Čor Tegin) (Rybatzki & Wu 2014: 122–123); (Khentii, second half of 8th c. – beginning of 9th c.) ; (Bichiktu-Boom II/1) ; (Tanbaly-Tash, 9th–10th c., LTR writing direction) (Rogozhinskii & Kyzlasov 2004: 42); (O) , (Y) (Büyük Larousse 9: 4679); (Y) (von Gabain 1941) <n²> /n/;

SR (Khumara-6, Khumara-7, Khumara-8 [in copy], 9th–10th c.) <n²> /n/.

OM1 (SFG-75):

Brahmic ancestor feature (grapheme):

Brāhmī (Aśoka, around 250 BC) (Maue, Dieter: Personal communication by email, 15 October 2020); (alphabet l [Late Gupta], ca. 6th c. AD) , (alphabet m [Gilgit/Bamiyan-Typ II], ca. 6th c. AD) (Sander 1968: Tafel 24); (alphabets r and s [Early Turkestan]) , , (alphabet t [North Turkestan Type A]) , (Standard North Turkestan [alphabet u, Type B]) (Sander 1968: Tafel 36); (Tumshuqese, TS 31) (Maue 2010: 5); (Tumshuqese, THT86a2) (Maue 2016a: 111) <ne>.

OM+ (SFG-75):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Achaemenid Iran) ; (Basins of the Amu Darya and the Syr Darya, 1st c. BC –3rd c. AD) ; (Sarmatia, 2nd half of 2nd c. – 1st half of 3rd c. AD) <tamga> (details: Table 8-34).

Evaluation (SFG-75):

Changed script: TR & SR.

Region of relics: TR: Inner Asia; SR: Pontus Steppe.

Source script family:

OM1: Brahmic.

Period of change:

OM1: 3rd BC – 8th c. AD, the using period of the Brāhmī script (Table 8-15), the upper limit is the age of the earliest TR or SR inscriptions (Table 8-19).

Region of change: OM1: Inner Asia.

Glyph fit only with tamgas: OM1: 1.

Comments (SFG-75):

(i) Based on its sound value, perhaps the Brāhmī <ne> may have been an ancestor grapheme; however, rotation by 60° and an axial mirroring would be required for this in case of same late glyph variants. It is more likely that the Brāhmī <ne> was borrowed with its sound value, but the glyph used in Rovash was a similar tamga: . It is worth noting that the descendant grapheme is used with palatal vowels, similarly to the Brāhmī <ne>. Other nasal Brāhmī graphemes are not eligible due to the large topological difference.

(ii) Interpreting TR , , <n²> as Turkic pictograph, its formation from the Old Turkic *en* ‘declivity’ word was supposed (Thomsen 1922; Róna-Tas 1987: 8–9). For an analysis of the issue of Turkic pictographs, see Table 3-4.

(iii) According to Sebestyén, TR 𐰤 <n^2> is derived from the Ancient Greek Ч, *N* *nu* <ν> (SFG-71) (Sebestyén 1906: 272, 277) by conscious redesigning and duplication (Table 4-3). The shape evolution Ancient Greek *N* > SR ⋠, TR 𐰤 > TR 𐰤 could also be imagined, even from the following glyphs: Greek (early minuscular, 9th c. AD) ᴦ, ᴦ (Taylor 1883, vol. II: 154); (cursive, AD 701–718) ν (Thompson 1912: 194) *nu* <ν> /n/. Clauson suggested that the ancestor of TR 𐰤 <n^2> /n/ was the glyph variant ∼ of the Greco-Bactrian (Kaniṣka II) ᴎ, ᴎ, (Vāsudeva III) ᴎ, ᴎ, ᴎ, (Loulan, 4th c. AD) ∼ (Ghirshman 1948: 63) *nu* <ν> found in Loulan supplemented by a vertical spine for symmetry (Clauson 1970: 69). However, given the mostly geometric glyphs of TR <n^2>, the glyph variants of Greco-Bactrian <ν> ᴎ, ᴎ, ᴎ could be considered a starting point, and then doubling or elongation of the cross line could be presumed. However, all of these make many assumptions, so the Greco-Bactrian origin is unlikely.

(iv) The Kharoṣṭhī (Schøyen) 𐨙 (Allon & Salomon 2000; Schøyen Collection: Fragment 44 e, Part A, Line 3, Syllable 10; Glass 2000: 67) <ña> /ɲ/ (SFG-74) is similar to the descendant grapheme; however, their sound values are different.

SFG-76

Descendant feature (grapheme):
SHR (Vargyas, 12th–13th c.) ⌉ <o> /o/.

OM1 (SFG-76):
Slavic ancestor feature (grapheme):
Glagolitic (right side of page 7 of the Kiev Missal, 10th c. AD) Ⱁ (Nimčuk 1983); (Codex Zographensis, 10th–11th c. AD) Ⱁ (Jagić 1879) *онъ* <o>;
Greek Alphabetic witness feature (grapheme): *Greek* (cursive, 3rd c. AD) ∂ (Thompson 1912: 193); (cursive, AD 302–359) ϑ (Thompson 1912: 193) *omicron* <o> /o, ō/.

Evaluation (SFG-76):
Changed script: SHR.
Region of relics: SHR: Carpathian Basin.
Source script family:
OM1: Slavic.
Period of change:
OM1: 9th–12th c. AD, the age of the Glagolitic script (Table 8-21), the upper limit is the age of SHR inscription containing the descendant grapheme.
Region of change: OM1: Carpathian Basin (Table 3-3: 3-7. §).
Glyph fit only with tamgas: OM1: 0.

Comments (SFG-76):
(i) The ancestor of the Glagolitic Ⱁ *онъ* <o> can be the Greek (early minuscular, 9th c. AD) ꙍ (Taylor 1883, vol. II: 154) *omega* <ω> /ō/.

SFG-77

Descendant feature (grapheme):
CBR (Nagyszentmiklós, 8th–11th c.) ᛟ <ọ> /ọ/.

OM1 (SFG-77):
Slavic ancestor feature (grapheme):
Early Cyrillic (Samuil's inscription, AD 992–993) Ѫ *onsъ (жсъ)* <ǫ>.

OM+ (SFG-77):
Tamgas ancestor feature (glyph shapes or styles):
Tamgas (Achaemenid Iran) ᛟ, ᛟ; (Bayte III) ᛟ; (South Kazakhstan) ᛯ; (Chu-Ili interfluve, Central and East Kazakhstan) ᛯ; (Mongolia) ᛟ, ᛟ, ᛟ; (Alans, medieval) Ѫ <tamga> (details: Table 8-34).

Evaluation (SFG-77):
Changed script: CBR.
Region of relics: CBR: Carpathian Basin.
Source script family:
OM1: Slavic.
Period of change:
OM1: 10th–11th c. AD, the using period of the Early Cyrillic script (Table 8-21), the upper limit is the latest possible date of creating the Treasure of Nagyszentmiklós.
Region of change: OM1: Carpathian Basin (Table 3-3: 3-7. §).
Glyph fit only with tamgas: OM1: 0.

Comments (SFG-77):
(i) CBR ᛟ <ǫ> is preserved in the two Slavic inscriptions of the Treasure of Nagyszentmiklós (Vékony 1987a: 37–38, 48; Hosszú & Zelliger 2014a: 186–187).

SFG-78
Descendant feature (grapheme):
TR (O, T, Y) 𐰯 (Kyzlasov, I. L. 1994: 71), (Y) 𐰯 (Büyük Larousse 9: 4679); (Dunhuang Letter) 𐰯 (Clauson 1970: 75) <p>;
SHR (Farkaslaki, 1624) ᒥ <p>;
CBR (Kiskőrös-Vágóhíd, last third of 7th c.) 𐰯 <p> /p/;
SR (Jitkov, first third of 8th c.) 𐰯 <p> /p/.

OM1 (SFG-78):
Canaanite ancestor feature (grapheme):
Phoenician 𐤐 (Valério 2008: 133); (Byblos, 11th–10th c. BC) 𐤐; 𐤐, 𐤐, 𐤐 (Sprengling 1931: 55); (Tell Faḫariyeh, 9th c. BC) 𐤐 (Lipiński 1994: 27); (Karatepe, ca. 720 BC) 𐤐, (Yeheumilk's inscription, Byblos, mid-5th c. BC) 𐤐, (Bodashtart's inscription, Sidon, second half of 5th c. BC) 𐤐 (Röllig 1995: 204–205) *pē* <p> /p/ [p] (Gutman & Avanzati 2013);
Old Aramaic (Zinjîrlû [Zenjirli], late 9th–8th c. BC) 𐤐; (8th c. BC) 𐤐; (Deir 'Allā, around 800 BC) 𐤐 (Glass 2000: 14); (10th–5th/4th c. BC) 𐤐, 𐤐 (Gibson 1975); (Nineveh, 7th c. BC) 𐤐 (Taylor 1883, vol. I: 250) *pē* <p> /f, p/.

OM2 (SFG-78):
Anatolian-Greek Alphabetic ancestor feature (grapheme):
Ancient Greek (Athens, 8th–7th c. BC) 𐌐, 𐌐, (Thera, 8th–7th c. BC) 𐌐, 𐌐, (Crete, 8th–7th c. BC) 𐌐, 𐌐, 𐌐, (Boiotia, 8th–7th c. BC) 𐌐, 𐌐 (Healey 1990a: 37); (Boiotia) 𐌐 (Jeffery 1961: 33);

(Thera, 7th c. BC) 𐌐 (Haarmann 1990: 287); (Crete) 𐌐, (Gortys, Lyttos [Lyktos], Eltynia, 5th c. BC) 𐌐 (Jeffery 1961: 33) *pi* <π> /p/;

Anatolian-Greek Alphabetic witness feature (grapheme): *Lemnian* (6th c. BC) 𐌐 (MNAMON: Lemnian, retrieved in 2015) <p>; *Lycian* 𐊓 (Adiego 2007e: 8; Melchert 2008a: 48); 𐊓 <p> /p/ (Adiego 2007e: 8);

Italic witness feature (grapheme): *Etruscan* (northern, early) 𐌐; (central, south, Cerveteri, Veii [Veias], early) 𐌐, (late) 𐌐 <p> /p/ [p]; *Faliscan* (7th–5th c. BC) 𐌐, (7th–1st c. BC) 𐌐 <p>; *Lepontic* (early, late) 𐌐 <p> /b, p/; *Umbrian* (Etruscan, 4th c. – first half of 1st c. BC) 𐌐 <p> [p]; *Gallo-Etruscan* (4th–2nd c. BC) 𐌐, 𐌐 <p> /b, p/; *Raetic* (Sanzeno) 𐌐, (Pfatten/Vadena) 𐌐 <p> /p/ (MNAMON).

OM3 (SFG-78):

Aramaic ancestor feature (grapheme):

Imperial Aramaic (satrapies, 5th–4th c. BC) 𐡐, 𐡐, (monuments, Egypt, 4th–3rd c. BC) 𐡐, (papyrus, Egypt, 2nd c. BC) 𐡐 (Taylor 1883, vol. I: 250); (inscriptional, 7th c. BC) 𐡐, 𐡐, 𐡐, (from 6th c. to 5th or beginning of 4th c. BC) 𐡐 (Gibson 1975); (6th c. BC) 𐡐; (Kandahar) 𐡐 (Rosenthal et al. 1986–2011: Table 3); (papyri) 𐡐, 𐡐 (Bühler 1898: second table after p. 124: Comparative Table of the Perso-Aramaic and the Kharoṣṭhī); (Elephantine Papyri, 6th c. BC) 𐡐 (Glass 2000: 14); (cursive) (5th–4th c. BC) 𐡐; (satrapies and Egypt, 4th–3rd c. BC) 𐡐 (Taylor 1883, vol. II: 236); (Aśoka, around 250 BC) 𐡐 (Glass 2000: 14); (Babylonian Bowls) 𐡐 (Faulmann 1880: 79); 𐡐 (MacKenzie 1971: xi); (Bactria) 𐡐, 𐡐 (Ivantchik & Lurje 2013: 290) *pē* <p> /f, p/;

Middle Iranian witness feature (grapheme): *Parthian* (early, Nisa, 1st c. BC) 𐭐 (Rosenthal et al. 1986–2011: Table 3); (Nisa) 𐭐, 𐭐, 𐭐, 𐭐, (Avroman, 13/12 BC) 𐭐, 𐭐 (Ivantchik & Lurje 2013: 290); (inscriptional) 𐭐 (Rosenthal et al. 1986–2011: Table 3) *pē* <p> /p, b/; *Sogdian* (Ancient Letters, early 4th c. AD) 𐼾, (sutra) 𐼾 (Skjærvø 1996: 519) <p> /p/.

OM+ (SFG-78):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Basins of the Amu Darya and the Syr Darya, 1st c. BC –3rd c. AD) 𐡐; (Sarmatia, regional signs, 2nd half of 1st c. AD – 1st half of 2nd c.) 𐡐; (Mongolia) 𐡐 <tamga> (details: Table 8-34).

Evaluation (SFG-78):

Changed script: TR, SHR, CBR & SR.

Region of relics: TR: Inner Asia; SHR & CBR: Carpathian Basin; SR: Pontus Steppe.

Source script family:

OM1: Canaanite.

OM2: Anatolian-Greek Alphabetic.

OM3: Aramaic.

Period of change:

OM1: 11th c. BC – 2nd c. AD, the union of the using periods of Phoenician (Table 8-6) and Old Aramaic scripts.

OM2: 9th–5th c. BC, the using period of the Ancient Greek script (Table 8-8).

OM3: 7th/6th–1st c. BC, the using period of the Imperial Aramaic script (Table 8-12).

Region of change: OM1 & OM2: Anatolia. OM3: Inner Asia.

Glyph fit only with tamgas: OM1: 0. OM2: 0. OM3: 0.

Comments (SFG-78):

(i) According to Sebestyén, TR 𐰯 <p> (SFG-78) is of Semitic origin (Sebestyén 1906: 272, 278), that corresponds to OM1 and OM3.

(ii) SHR (Farkaslaki, 1624) Γ <p> is the only data on the survival of single-branched 𐰯 <p> in SHR. Although it is conceivable that SHR (Farkaslaki, 1624) Γ <p> is a variant of the usual three-branched SHR ᚬ <p> (SFG-80), it occurs in a relatively long text, where the author of the inscription, Mátyás Farkaslaki, consistently used the graphemes that occur several times with the same glyph. For instance, the also uniquely shaped Ѧ <l> (SFG-64) four times, and the # <z> (SFG-102) appears three times in this script relic. Moreover, Farkaslaki makes a clear distinction even between /ö/ and /ü/: ʃ <Ẅ> /ü/ and ⺄, ᒪ <Ẅ> /ö, ő/ (SFG-35), respectively; these are apparently the calligraphic variants of ᚿ and ᐸ. Consequently, the author of the inscription (Mátyás Farkaslaki) was an experienced writer.

(iii) According to Clauson, TR 𐰯 <p> is identical to the Imperial Aramaic glyphs from 5th–3rd c. BC, but he sees this only as a coincidence (Clauson 1970: 69). Instead, he considers early Sogdian or late Sasanian- (i.e., not Parthian, but Middle Persian) <p> as its ancestor and assumes that it has been simplified to avoid confusion with TR 𐰘, 𐰙 <y^2> (SFG-56). However, due to the different glyph of the Middle Persian (inscriptional) 𐭯 (Skjærvø 1996: 518) <p> /p, b, f/ (Skjærvø 1996: 518) or /p, (f), β/ (Hoffmann 1987–2011), it cannot be the ancestor of TR 𐰯 <p>. Moreover, it would not have made sense to simplify into a grapheme which thus became identical in shape to TR 𐰃, 𐰄 <I> /i, ï/ (SFG-50).

SFG-79

Descendant feature (grapheme):

TR (Ïrq Bitig Manuscript, 930) ᛒ (Tekin 1993: 1, 4); (Ïrq Bitig Manuscript) ᛒ, ᛒ (Tekin 2003: 23); ᛒ; ᛒ (von Gabain 1941); (Ïrq Bitig Manuscript) ᛒ, (Manichean texts) ᛒ (Clauson 1970: 75) <$^{W/\ddot{W}}$p> /p/ (after /u/) or /up, üp/ (von Gabain 1941).

OM1 (SFG-79):

Brahmic ancestor feature (grapheme):

Brāhmī (alphabets r and s [Early Turkestan]) 𑀧𑀽, 𑀧𑀽 (Sander 1968: Tafel 34) <pū>.

OM+ (SFG-79):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Basins of the Amu Darya and the Syr Darya, 1st c. BC –3rd c. AD) ᛒ <tamga> (details: Table 8-34).

Evaluation (SFG-79):
Changed script: TR.
Region of relics: TR: Inner Asia.
Source script family:
OM1: Brahmic.
Period of change:
OM1: 4th–8th c. AD, the using period of Brāhmī glyph variants presumed to be the ancestor (Table 8-15), the upper limit is the age of the earliest TR inscriptions (Table 8-29).
Region of change: OM1: Inner Asia.
Glyph fit only with tamgas: OM1: 1.

Comments (SFG-79):

(i) A TR <$^{W/\ddot{W}}$p> in the Ïrq Bitig Manuscript denotes /p/ six times after the letter <W> /u/, twice /up/ and once /üp/ (Tekin 1993: 4).

(ii) The glyph of TR , <$^{W/\ddot{W}}$p> used in RTL writing direction is reversed of the Turkestan glyph variant of the Brāhmī <pū> used in LTR writing direction.

(iii) Brāhmī <pū> and TR <$^{W/\ddot{W}}$p> were used near similar vowels, which supports the correctness of OM1.

(iv) Likely, SFG-79 and SFG-80 are closely related.

SFG-80

Descendant feature (grapheme):

SHR (Székelyderzs, 1490s) ; (Nikolsburg, 1490–1526) *ep;* (Gelence, 1497) ; (Rudimenta-Giessen, 1598) , , ; (Szamosközy's Poem, 1604) ; (Gyulafehérvár, 1655) <p> /p/;

CBR (Szarvas, the first half of 8th c.) <f> /f/;

SR (Achik-Tash, 8th c.) (Turčaninov 1971: XXVII–XXVIII, Табл. XXXIX) <p> /p/.

OM1 (SFG-80):

Aramaic ancestor feature (grapheme):

Imperial Aramaic (Babylonian Bowls) , (papyrus, Egypt, 2nd c. BC) <p> /f, p/ (details: SFG-78);

Armazian (Cereteli 1948–1949 apud Róna-Tas 1987: 14) <p>;

Canaanite witness feature (grapheme): *Phoenician* *pē* <p> (details: SFG-78);

Aramaic witness feature (grapheme): *Hebrew* (Qumran Manuscripts, 1st c. BC) *pē* <p> /p/; *Nabataean* , , (late) (Macdonald 2008: 218) *pē* <p>; *Hatran* , , (PROEL: Alfabeto Hatran, retrieved in 2016) <p>; *Palmyrene* (Harmatta 2000: 181); (Palmyra, 2nd c. AD) (Taylor 1883, vol. II: 236) *pē* <p>; *Syriac* (Estrangela) ; (Nestorian) *pē* <p, p̲>; *Arabic* (early) , (modern) (Macdonald 2008: 218) *fā'* <f>;

Middle Iranian witness feature (grapheme): *Parthian* (early, Nisa, 1st c. BC) (Rosenthal et al. 1986–2011: Table 3); (Nisa) , , , , (Avroman, 13/12 BC) , (Ivantchik & Lurje 2013: 290); (inscriptional) (Rosenthal et al. 1986–2011: Table 3) *pē* <p> /p, b/; *Manichean* (Sogdian) (3rd c. AD or earlier) <p>; <f> (Skjærvø 1996: 519); *Christian Sogdian* (Skjærvø 1996: 519) <p>; <f> (Skjærvø 1996: 519).

OM2 (SFG-80):

Brahmic ancestor feature (grapheme):

Brāhmī (alphabets r and s [Early Turkestan]) , <pū> (details: SFG-79).

OM+ (SFG-80):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Achaimenid Iran) ; (Basins of Amu Darya and Syr Darya, 4th–8th c. AD) , ; (Kok-Mardan) ; (Altay) <tamga> (details: Table 8-34).

Evaluation (SFG-80):

Changed script: SHR, CBR & SR.

Region of relics: SHR: Carpathian Basin; CBR: Carpathian Basin; SR: Inner Asia.

Source script family:
OM1: Aramaic.
OM2: Brahmic.
Period of change:
OM1: 7th/6th c. BC – 2nd c. AD, the union of the using periods of Imperial Aramaic (Table 8-12) and Armazian scripts.
OM2: 4th–7th c. AD, the using period of Brāhmī glyph variants presumed to be the ancestor (Table 8-15), the upper limit is the age of the earliest CBR inscriptions.
Region of change: OM1 & OM2: Inner Asia.
Glyph fit only with tamgas: OM1: 1. OM2: 1.

Comments (SFG-80):

(i) The CBR ℷ <f> survives on a single script relic, the Szarvas inscription, which is a worn bone needle case. Based on different researchers' altering drawings (Róna-Tas 1985b: 231; Harmatta 1990: 256; Fehér 2020a: 135), it may be conceivable that the ℷ <f> found on the Szarvas inscription has not two but three arms.

(ii) Derivation from the Aramaic ℶ <p> is conceivable, as addition of extensions is known for other Rovash graphemes, e.g., CBR ⅃, ⅃, ⅃ <z> (SFG-41), SHR ↑, ‡ <i> (SFG-53), SR ⅂, ⅂, ⅂, ⅂ <I> (SFG-51). The glyph of CBR ℷ <f> may have been an intermediate stage in a similar process, see Table 7-7.

(iii) According to Sebestyén, the ancestor of SHR ∃ <p> is the Ancient Greek <π> (Sebestyén 1906: 272, 278), cf. Ancient Greek (Ipsambul [Abu Simbel, Egypt], 7th c. – the beginning of 6th c. BC, its writing direction is LTR) Π, Π (Taylor 1883, vol. II: 9–15) *pi* <π> its glyph is turned to its side and adding a distinctive arm. This idea contains several assumptions; therefore, according to the cladistics' *lex parsimoniae* (Table 4-1) it is less likely.

(iv) According to several researchers, SHR ꓶ, ⅃, ∃ <p> and TR ꓶ <p> (SFG-78) are relatives (Nagy 1895: 274; Ligeti 1925: 51; Németh 1934: 28; Németh 1971: 38). However, the extension of TR, SHR, CBR, SR Γ, ꓶ <p> (SFG-78) with two slanting arms means two assumptions, which reduces the likelihood of relatedness of these graphemes.

(v) It is possible that SFG-79 and SFG-80 are closely related.

(vi) The closest to SR ⅃ <p> are Imperial Aramaic ℶ <p> and the Armazian ʔ <p>. The sound values of the Imperial Aramaic <p> (/f, p/) correspond to the sound values of SR ⅃ <p> and CBR ℷ <f>. The creation of SR ⅃ <p> and SHR ⅃, ⅃, ∃ <p> could serve the separation (Table 4-2) from Rovash ꓶ <β> (SFG-16).

(vii) SHR (Gyulafehérvár, 1655) ꓶ <p> could be a glyph variant of the (Rudimenta-Giessen, 1598) ∃ <p>. The similarity of SHR ꓶ <p> and CBR ℷ <f> (SFG-80) is surely homoplasy (Table 2-7). It can be seen from SHR ꓶ <p> that the topological transition between the glyph variants ∃ and ꓶ was easy.

SFG-81

Descendant feature (grapheme):
SHR (Wolfenbüttel, 1592–1666) ≠; (Bonyhai's Alphabet, 1627) ‡; (Szegedi, 1655) ≠ <p> /p/;

OM1 (SFG-81):
Aegean ancestor feature (grapheme):

Cypro-Greek (common) ǂ; (Paphian, 6th c. BC) ǂ (Valério 2016: 228); (Paphian, 6th c. BC, late) ǂ (Davis 2010: 38–61); (common) ǂ, (Paphian) ‡ (Olivier 2007–2008: 617–618) <pa> /ba, pa/.

OM2 (SFG-81):
Rovash ancestor feature (grapheme):
SHR 𐳠, 𐳠, 𐳠, 𐳠, 𐳠, 𐳠 <p> (details: SFG-80).

OM+ (SFG-81):
Tamgas ancestor feature (glyph shapes or styles):
Tamgas (Sidak, 5th – early 8th c. AD) ǂ <tamga> (details: Table 8-34).

Evaluation (SFG-81):
Changed script: SHR.
Region of relics: SHR: Carpathian Basin.
Source script family:
OM1: Aegean.
OM2: Rovash (internal development) (becoming similar, borrowing or symmetrization [Table 4-2], line shifting or use of known glyph [Table 4-3]).
Period of change:
OM1: 11th–2nd c. BC, the using period of the Cypro-Greek (Table 8-3) script.
OM2: Not later than 16th c. AD, the age of the first appearance of SHR glyph variant ≠.
Region of change: OM1: Anatolia. OM2: Inner Asia, Pontus Steppe or Carpathian Basin.
Glyph fit only with tamgas: OM1: 0. OM2: 1.

Comments (SFG-81):

(i) SHR ≠, ǂ, ǂ <p> is probably a glyph variant of SHR 𐳠, 𐳠, 𐳠 <p> with overdrawn crossbars; the formation of which is analogous to the formation of SHR 𐳉 <e> (SFG-11) and SHR † <i> (SFG-53).

(ii) The earlier letter names of some SHR graphemes *(tpru, ptrű, Rhru, tptrü)* are probably the distorted variants of the Latin word's abbreviation *temperius* 'previously, formerly'. This letter name can be found in the Nikolsburg Alphabet (1490–1526, Table 8-30), where the name of the graph ǂ in the script relic is *tprꝰ* (Table 8-33). Its reading is *tprus* (Németh 1934). Above the name *tprꝰ* in a row with the letter names, a wave sign indicates an abbreviation. In the medieval Latin orthography, this indicated that the letter of a nasal sound was omitted, which could have been the *m* (Máté 2001: 188–189). Máté suggested the Latin *temperius* 'previously, formerly' solution to the abbreviated word *tprꝰ* as the *adverbium gradus comparativus* (comparative of the adverb *temperi* 'in time') of the word tempus. The (Nikolsburg, 1490–1526) ǂ *tprus* (Table 8-33) is likely an ornate glyph variant of SHR ǂ <p> and the (Kájoni's Ancient) ǂ <nap> is a ligature of 𐳙 <n> and ǂ <p>. If the glyph (Nikolsburg) ǂ is considered an older variant of SHR 𐳠 <p>, the name *tprꝰ* in the Nikolsburg Alphabet becomes justified. The names *tpru, ptrű, Rhru, tptrü* are distortions of the name *tprꝰ*. The shape of the ǂ *tprus* is somewhat reminiscent of the (Minguriuk hillfort, 1st c. BC – 3rd c. AD) ⋇ <tamga>, but perhaps not related.

SFG-82

Descendant feature (grapheme):

SHR (Nikolsburg, 1490–1526) 𐲆 *ecź, ech* /tʃ/; (Bágy, 15th c.) 𐲆 /tʃ/; (Constantinople, 1515, LTR writing direction) ᑭ, ☐ /tʃ/; (Gyulafehérvár, 1655) ꓤ /ts/; (Gönczi, around 1680) ꓤ /ts/; (Dobai, 1753) И /ts/; (Szentpéteri, 1699–1702) 𐲆 *cs* <č>;

SR (Achik-Tash, 8th c.) Ꞩ, Ꞩ /s/; (Mayatskoe-10, 9th c.) N /tʃ/ <č>.

OM1 (SFG-82):

Brahmic ancestor feature (grapheme):

Brāhmī (Tocharian) 𑀘 (Krause & Thomas 1960: 41); (Tocharian) 𑀘 (Róna-Tas 1991: 114, Table IV) <t<u>sa</u>>;

Brahmic witness feature (grapheme): *Brāhmī* (Tocharian) 𑀲 (Krause & Thomas 1960: 41); (Tocharian) 𑀲 (Róna-Tas 1991: 114, Table IV) <tsa>.

OM+ (SFG-82):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Bayte III) ⊟; (Kanka) ꟼ, ⊟ <tamga> (details: Table 8-34).

Evaluation (SFG-82):

Changed script: SHR & SR.

Region of relics: SHR: Carpathian Basin; SR: Inner Asia & Pontus Steppe.

Source script family:

OM1: Brahmic.

Period of change:

OM1: 4th–8th c. AD, the using period of Brāhmī glyph variants presumed to be the ancestor (Table 8-15), the upper limit is the age of the earliest SHR or SR inscriptions (Table 8-19).

Region of change: OM1: Inner Asia.

Glyph fit only with tamgas: OM1: 1.

Comments (SFG-82):

(i) Regarding the /s/ sound value of SR (Achik-Tash) Ꞩ, Ꞩ <č>, Vékony presumed that there was a sound change in the language of Achik-Tash inscription /č/ > /s/ (Vékony 2004a: 292, 294). Vásáry gave an example of the Old Turkic /č/ > Bashkir /s/ sound change: Old Turkic /üčün/ > Bashkir өсөн /ösön/ 'for' (Vásáry, István: Personal communication, 2010–2011). According to Vékony, the Achik-Tash inscription's language could be the Bashkir language's ancestor (Vékony 2004a: 296).

(ii) According to Sebestyén, SHR 𐲆 <č> was created from the ligature of two TR 𐰾 <s1> (SFG-97) graphemes (Sebestyén 1906: 274). This assumption is too strong and therefore omitted.

(iii) The transliteration value of the *ṣāḏē* in the Iranist literature is <c> or <č> instead of <ṣ> (Skjærvø 1996: 516).

SFG-83

Descendant feature (grapheme):

TR (Y) λ, (O, T, Y) 𐰲; (Küli Čur, 719–724) 𐰲 (Tekin 2003: 23); (Kalbak-Tash II, 8th c.) ᛚ;

(Sary-Koby) ; (Khentii, the second half of 8th c. – the beginning of 9th c.) ; (manuscript) (von Gabain 1941) <č>, <ǧ> /č, ǰ/ or <çi/či> (Tekin 2003: 23).

OM1 (SFG-83):
Kharoṣṭhī ancestor feature (grapheme):
Kharoṣṭhī (Aśoka, around 250 BC) , (British Library) , , , (Khotan Dharmapada) , (Niya) , (Schøyen) , (Glass 2000: 115) <kṣa> /ṭṣ/.

OM2 (SFG-83):
Kharoṣṭhī ancestor feature (grapheme):
Kharoṣṭhī (Aśoka, around 250 BC) , (British Library) , , , (Khotan Dharmapada) , (Niya) , (Schøyen) , (Glass 2000: 64–65) <ja> /ɟ/.

OM3 (SFG-83):
Middle Iranian ancestor feature (grapheme):
Sogdian ; (Ancient Letters, beginning of 4th c. AD) (Skjærvø 1996: 519); (early) (Clauson 1970: 74); (sutra) (Skjærvø 1996: 519) *ṣāḏē* <ṣ, c> /č, ǰ/ (Skjærvø 1996: 519);
Middle Persian (Psalter) (Bulayïq, 6th–7th c., a copy of an origin from the 4th c. AD) (Rosenthal et al. 1986–2011: Table 3); (Psalter) (Clauson 1970: 74) *ṣāḏē* <ṣ, c> /č, ǰ, z/ (Skjærvø 1996: 518);
Avestan (Hoffmann & Forssman 1996: 41) <c> /č/ (Hoffmann & Forssman 1996: 43);
Aramaic witness feature (grapheme): *Imperial Aramaic* (papyrus, Egypt, 2nd c. BC) , *ṣāḏē* <ṣ> (details: SFG-82); *Hebrew* (Qumran Manuscripts, 1st c. BC) *ṣāḏē* <ṣ, c> /ts/; *Syriac* (Nestorian) *ṣōḏē* <ṣ>;
Middle Iranian witness feature (grapheme): *Parthian* , *ṣāḏē* <ṣ, c> /č/ (details: SFG-82); *Middle Persian* (inscriptional) (Rosenthal et al. 1986–2011: Table 3); (Book Pahlavi) (Rosenthal et al. 1986–2011: Table 3) *ṣāḏē* <ṣ, c> /č, ǰ, z/ (Skjærvø 1996: 518); *Manichean* (Sogdian) , *ṣāḏē* <ṣ, c> /č, ǰ/ (details: SFG-82).

OM4 (SFG-83):
Rovash ancestor feature (grapheme):
TR , <š1> (details: SFG-97).

OM+ (SFG-83):
Tamgas ancestor feature (glyph shapes or styles):
Tamgas (Basins of the Amu Darya and the Syr Darya, 1st c. BC –3rd c. AD) , (Western Turkestan) <tamga> (details: Table 8-34).

Evaluation (SFG-83):
Changed script: TR.
Region of relics: TR: Inner Asia.
Source script family:
OM1 & OM2: Kharoṣṭhī.
OM3: Middle Iranian.
OM4: Rovash (internal development) (adaptation [Table 4-2] based on the /š/ ~ /č/ alternation [Table 7-9: 7-8. §]).

Period of change:

OM1 & OM2: 3rd c. BC – 7th c. AD, the using period of the Kharoṣṭhī (Table 8-14) script.

OM3: 2nd–8th c. AD, the union of the using periods of Sogdian (Table 8-16), Middle Persian and Avestan scripts, the upper limit is the age of the earliest TR script relics (Table 8-19).

OM4: Up to 8th c. AD, the upper limit is the age of the earliest TR script relics (Table 8-19).

Region of change: OM1, OM2, OM3 & OM4: Inner Asia.

Glyph fit only with tamgas: OM1: 1. OM2: 1. OM3: 1. OM4: 1.

Comments (SFG-83):

(i) The lineage of TR ⅄ <č, ğ>, according to Clauson (Clauson 1970: 68), is described in the Comments of SFG-65.

(ii) OM4 is based on the Old Turkic /š/ ~ /č/ alternation (Table 7-9: 7-8. §).

SFG-84

Descendant feature (grapheme):

TR (O) ᛉ, ⅄ (Kyzlasov, I. L. 1994: 118); (Y) ᛉ, ⅄ (Kairžanov 2014: 17); (Kalbak-Tash II, 8th c.) ᛚ (Kubarev 2016: 94–95) <^{i}č^{i}>, <^{i}ğ> /č, ǰ/.

OM1 (SFG-84):

Rovash ancestor feature (grapheme):

TR ⅄, ⅄, ⅄ <č, ğ> (details: SFG-83).

OM+ (SFG-84):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Achaemenid Iran) ⅄; (Basins of the Amu Darya and the Syr Darya, 4th–8th c. AD) ⅄, ⅄; (Kultobe, 1st–3rd c. AD) ⅄ <tamga> (details: Table 8-34).

Evaluation (SFG-84):

Changed script: TR.

Region of relics: TR: Inner Asia.

Source script family:

OM1: Rovash (internal development).

Period of change:

OM1: Before 8th c. AD, the limit is the age of the earliest TR inscriptions (Table 8-29).

Region of change: OM1: Inner Asia.

Glyph fit only with tamgas: OM1: 1.

Comments (SFG-84):

(i) According to Clauson, TR ᛉ, ⅄ <^{i}č^{i}, ^{i}ğ> was derived from the Sogdian ⅄, ⅄, ⅄ <ṣ, c> /č, ǰ/ (SFG-83) or the Middle Persian ⅄, ⅄ <ṣ, c> /č, ǰ, z/ (SFG-83) by adding an auxiliary arm (Clauson 1970: 68). Undoubtedly, the Sogdian and Middle Persian <ṣ> have the same sound value as TR ᛉ, ⅄ <^{i}č^{i}, ^{i}ğ>.

(ii) It is worth noting that opposition to the transliteration value of TR ᛉ <^{i}č^{i}>, it can stand near not only /i/, see the inscription TR ⅄ᛉ⅄⅄ /bašča/ (Kyzlasov, I. L. 1994: 117–119).

(iii) It is difficult that the borrowed grapheme has become more similar to TR ᛉ, ⅄, ⅄, ⅄, ⅄ <š^{1}> (if it already existed), which contradicts the feature evolution principle referred as "different visual identities" (Table 4-2). Interestingly, the glyph variant ᛉ exists in SR with /š/

sound value, and in SHR with /ž/ (which had to be /š/ formerly, the reason of its change was the development of the Hungarian language in the medieval Old Hungarian linguistic period), but the glyph ϒ exists in TR with sound values /č, ǰ/, only. Its reason could be that borrowing the grapheme ϒ, ⅄ <^{i}č^{i}, ^{i}ğ> into TR happened after separation of TR from SR and SHR scripts, and the later scripts preserved the ϒ <š>, but in TR the ϒ, ⅄ <^{i}č^{i}, ^{i}ğ> displaced the ϒ <š> from use due to different visual identities principle (Table 4-2).

(iv) Based on the Old Turkic /š/ ~ /č/ alternation (Table 7-9: 7-8. §), TR ϒ, ᚴ, ϒ, ᚠ, ¥ <š^{1}> (SFG-97) could be the ancestor. However, the glyph distribution of the descendant grapheme differs from TR <š^{1}>; therefore, it is unlikely an ancestor.

SFG-85

Descendant feature (grapheme):

SHR (Stick Calendar, ca. 15th c. surviving in a 17th c. copy) ↑; (Nikolsburg, 1490–1526) ↑ *ecz;* (Rudimenta-Giessen, 1598) ↑; (Bonyhai's Alphabet, 1627) ↑; (Szentpéteri, 1699–1702) ↑ *c* <c> /ts/;

SHR (Gyulafehérvár, 1655) ↑, ↑; (Szegedi, 1655) ↑, ↑; (Kájoni's Ancient, 1673) ↑ *c;* (Gönczi, around 1680) ↑; (Dobai, 1753) ↑ <c> /tʃ/.

OM1 (SFG-85):

Anatolian-Greek Alphabetic ancestor feature (grapheme):

Old Phrygian ↑, Ͳ, φ <↑> (Adiego 2007e: 3; Simon 2015: 382) or <c> /tʃ/ (Adiego 2004: 302–303; Valério 2008: 130; Nikolaev 2017: 219–226) or /ts/ (Young 1969: 295) or one of its variants (Brixhe 2008: 73);

Lydian ↑ <c> /z/dz/dzs/ (Melchert 2004: 602–603; Melchert 2008b: 58) or /t^{s}/ (Valério 2008: 130) or /dz/? (Adiego 2007e: 7);

Carian ↑ (Ray 1982: 182) <τ> /tš/ (Adiego 2007a: 32, 250; Adiego 2007e: 10);

Aegean witness feature (grapheme): *Linear B* ↑ (Woodard 2008e: 54) <zo> [t͡s, d͡z] (Valério 2016: 216);

Anatolian Hieroglyphic witness feature (grapheme): *Anatolian Hieroglyphic* (Bronze Age) ↑ (Payne, A. 2010a: 14), ↑ (Hawkins 1986: 370–371), (Bronze Age) ↑ (Yakubovich 2015a: 12) *376 (Bronze Age) <zi/a> /tsi/a/, (late) <zi> /tsi/ (Yakubovich 2015a: 10); (KARKAMIŠ A14b, 10th c. BC) ↑, ↑ (Hawkins 2000: 83–86) <zi+a>; ↑ (Payne, A. 2010a: 14); ↑ (Payne, A. 2010a: 80); (BABILON 1) ↑, ↑, ↑ (Payne, A. 2010a: 122); ↑ (Hawkins 1986: 370–371); ↑ (Yakubovich 2015a: 12) *377 <za>;

Anatolian-Greek Alphabetic witness feature (grapheme): *Ancient Greek* (Ionic alphabet) (6th–5th c. BC) (Jeffery 1961: 38–39) Ͳ (Galien 1821–1823: 525) *sampi* <σσ> /ss, ts/ #900 (Jeffery 1961: 39);

Greek Alphabetic witness feature (grapheme): *Greek* ↑, Ͳ, (4th c. AD) ↑ *sampi* <σσ> #900 (Foat 1902: 135–173).

OM2 (SFG-85):

Rovash ancestor feature (grapheme):

TR ϒ, ⅄ <^{i}č^{i}, ^{i}ğ> /č, ǰ/ (details: SFG-84).

OM+ (SFG-85):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Khumbuztepa, 4th c. BC) ↓; (Bactrian sign, northern Afghanistan, Bronze Age) ↑;

(Basins of the Amu Darya and the Syr Darya, 6th–2nd c. BC) ↿; (1st c. BC –3rd c. AD) ↑; (Sarmatia, 2nd half of 2nd c. – 1st half of 3rd c. AD) ↑ <tamga> (details: Table 8-34).

Evaluation (SFG-85):
Changed script: SHR.
Region of relics: SHR: Carpathian Basin.
Source script family:
OM1: Anatolian-Greek Alphabetic.
OM2: Rovash (internal development) (glyph variant forming [Table 4-2]; line shifting [Table 4-3]).
Period of change:
OM1: 9th–2nd c. BC, the union of the using periods of Old Phrygian (Table 8-8), Lydian and Carian scripts.
OM2: Before 15th c. AD, the limit is the age of the earliest surviving inscription containing the descendant grapheme.
Region of change: OM1: Anatolia. OM2: Inner Asia, Pontus Steppe or Carpathian Basin.
Glyph fit only with tamgas: OM1: 0. OM2: 1.

Comments (SFG-85):

(i) Due to historical linguistic reasons, SHR ↑ <c> in Hungarian mush have originally denoted only /tʃ/ (voiceless postalveolar affricate), and later became /ts/ (voiceless alveolar affricate). Therefore, all descendant graphemes' original sound values had to be voiceless postalveolar affricate.

(ii) According to Melchert, the sound value of the Lydian ↑ <c> could be any voiced coronal or fricative sound (Melchert 2008b: 57–58).

(iii) Referring to Melchert, Valério suggested a relationship between the Anatolian Hieroglyphic ↾ <zi> and Old Phrygian ↑ <↑/c> (Valério 2008: 130–131). Since the sound value of the Anatolian Hieroglyphic ↾ <zi> is alveolar affricate and not postalveolar, it is handled as a witness and not as ancestor grapheme of the studied descendant grapheme SHR ↑ <c>.

(iv) According to Adiego, the Lydian ↑ <c> and the Carian ↑ <τ> are relatives (Adiego 2004: 302–303).

(v) It is possible that the Sidetic (S2 Sidetic-Greek bilingual) ↑ (Nikolaev 2017: 219) <↑>, <ts> (Nollé 2001: 629), <t> or <t̲> (Adiego 2007e: 14) /*ʃ/ (Nikolaev 2017: 219) also belongs to SFG-85.

(vi) Concerning OM3, TR ⅄ <ⁱčⁱ, ⁱğ> (SFG-84) can be the ancestor of SHR ↑ <c> (Sebestyén 1906: 273–274, 281). The glyph distribution of Messapic <h> ↥, Ұ, Ү (SFG-44) is analogous to the presumed glyph change ⅄ > ↑ here.

SFG-86

Descendant feature (grapheme):
SHR (Nikolsburg, 1490–1526) ↕ *encz* <nc>.

OM1 (SFG-86):
Rovash ancestor feature (grapheme):
SHR ↑ <c> (details: SFG-85).

OM+ (SFG-86):
Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Achaemenid Iran) ⇕; (Basins of the Amu Darya and the Syr Darya, 4th–8th c. AD) ⇕ <tamga> (details: Table 8-34).

Evaluation (SFG-86):
Changed script: SHR.
Region of relics: SHR: Carpathian Basin.
Source script family:

OM1: Rovash (internal development).

Period of change:

OM1: 10th–15th/16th c. AD, the lower limit is the supposed beginning of the emergence of the Old Hungarian orthography of the Latin script, the upper limit is the age of the earliest inscription (Nikolsburg, Table 8-30) containing the studied SHR ↑ <c>.

Region of change: OM1: Anatolia, Inner Asia, Pontus Steppe or Carpathian Basin.
Glyph fit only with tamgas: OM1: 1.

Comments (SFG-86):

(i) In various scripts, the nasals before the stops were often not written out, and in some cases marked with a double letter (Table 7-10). Thus, it is easy to imagine that SHR ⇕ <nc> resulted from doubling SHR ↑ <c>, cf. Table 7-8.

(ii) It is possible that ⇕ <nc> was originally meaning /ts/ or /tʃ/, then its origin could be the same to the origin of SHR ↑ <c> (SFG-85), and ⇕ <nc> could be created as a glyph variant of ↑ <c> by adding slanting bars.

SFG-87

Descendant feature (grapheme):

TR (Y) 𐰨 (Vasil'ev 1983 apud Harmatta 2004: 186); (O, J, T) 𐰨, (Y) 𐰩, 𐰩, 𐰩, 𐰩, (O) 𐰨, 𐰨 (Büyük Larousse 9: 4679); 𐰨 (Róna-Tas 1987: 13); (Khentii, second half of 8th c. – beginning of 9th c.) 𐰨; (Ïrq Bitig Manuscript, 930) 𐰨, (Dunhuang Letter) 𐰨, (Manichean texts) 𐰨, (Khakassia, Tuva) 𐰨, 𐰨 (Clauson 1970: 75) <nč> /nč/ (Thomsen 1893: 9), /nǰ/ [Róna Tas 1991: 111, Table I].

OM1 (SFG-87):
Brahmic ancestor feature (grapheme):

Brāhmī (North Turkestan) 𑀚; (alphabet q [Turkestan Gupta]) 𑀚, 𑀚, 𑀚, (alphabets r and s [Early Turkestan]) 𑀚, 𑀚, 𑀚, (alphabet t [North Turkestan Type A]) 𑀚, (Standard North Turkestan [alphabet u, Type B]) 𑀚, (alphabet v [Khotanese]) 𑀚; (Khotanese) 𑀚; (Tocharian) 𑀚 <ja> /ɟ/ (details: SFG-41);

Brāhmī (Socotra [Jemen], T 25-b, LTR inscription, end of 2nd c. AD – 4th c.) 𑀚𑀺 (Strauch & Bukharin 2004: 131) <ji>;

Brāhmī (Standard North Turkestan [alphabet u, Type B]) 𑀛 (Sander 1968: Tafel 33) <jha> /ɟʱa/;

Brahmic witness feature (grapheme): *Brāhmī* 𑀚 (Bühler 1898: Table after p. 123: Comparative Table of the oldest Semitic and the Brāhma alphabets); 𑀚, (Aśoka, around 250 BC) 𑀚 <ja>.

OM+ (SFG-87):
Tamgas ancestor feature (glyph shapes or styles):
Tamgas (Bactrian sign, northern Afghanistan, Bronze Age) ⸮; (Bactrian sign, Sapalli Culture, Bronze Age) ⸾, ⸮; (Bayte III) ⸾; (Kultobe, 1^{st}–3^{rd} c. AD) ⸾; (Kanka) § <tamga> (details: Table 8-34).

Evaluation (SFG-87):
Changed script: TR.
Region of relics: TR: Inner Asia.
Source script family: OM1: Brahmic.
Period of change:
OM1: 4^{th}–8^{th} c. AD, the using period of Brāhmī glyph variants presumed to be the ancestor (Table 8-15), the upper limit is the age of the earliest TR inscriptions (Table 8-29).
Region of change: OM1: Inner Asia.
Glyph fit only with tamgas: OM1: 0.

Comments (SFG-87):
(i) Interestingly, in the word 𐰇𐰕𐰤𐰨𐰇 <Ẅ <u>nč</u> n^2 z Ẅ> *öz^ö^nčü* (Klyashtorny 1978: 157–158) of the Khentii inscription, the consonant cluster /nč/ was written with 𐰤𐰨 <n^2><nč>.
(ii) The sound value of the Brāhmī (Khotanese) <ja> is more-or-less [d͡ʒ] (Maue, Dieter: Personal communication by email, 21 January 2020).
(iii) According to Róna-Tas, TR <nč> originated from the duplication of TR ❨, ↄ <n^1> (SFG-72) (Róna-Tas 1987: 11). The doubling theory is reinforced by the glyphs » and ʒ, as they suggest a doubling of two identical glyphs (cf. Table 7-10). However, the glyph of TR ❩ <n^1> (SFG-72) is always curved, so it is unlikely that <nč> has the angled glyph variant (») that best shows its putative components. It should be noted that a significant part of the glyphs of TR <nč> are angled.

SFG-88
Descendant feature (grapheme):
CBR (Nagyszentmiklós, 8^{th}–11^{th} c.) 8 <q> /q/;
SR (Mayatskoe-1, 9^{th} c.) 8 <q> /q/ (near /a/);
SR (Achik-Tash, 8^{th} c.) ⪥, ⪥ /q/ (near /u/); (Homokmégy-Halom, 10^{th} c.) ⧖ /q/ (near /o/) <^{W}q^{W}> /q/.

OM1 (SFG-88):
Canaanite ancestor feature (grapheme):
Phoenician (ʿIzbet Ṣarṭah Ostracon, ca. 1100 BC) 𐤒 (Rollston 2008a: 84); 𐤒, 𐤒, 𐤒 (Sprengling 1931: 55); (Tell Faḫariyeh, 9^{th} c. BC) 𐤒 (Lipiński 1994: 27); (Tyre, 10^{th} c. BC) 𐤒, (Ninive, 8^{th} c. BC) 𐤒, 𐤒, (Ninive, 7^{th} c. BC) 𐤒, 𐤒, (Sidon, 5^{th} c. BC) 𐤒, (Sidon, 4^{th} c. BC) 𐤒 (Taylor 1883, vol. I: 227); 𐤒, 𐤒, 𐤒, 𐤒, 𐤒, 𐤒, 𐤒, 𐤒, 𐤒 (Faulmann 1880: 78); (Ipsambul [Abu Simbel, Egypt], 590 BC) 𐤒 (Powell 1991: 7); (Sidon, 5^{th} c. BC) 𐤒 (Taylor 1883, vol. I: 204) *qōp̄* <q> /q/ [$k^{ʕ}$];
Canaanite witness feature (grapheme): *Punic* 𐤒, 𐤒; (Carthage, 3^{rd} c. BC) 𐤒 (MNAMON: Phoenician, retrieved on 24 February 2018); (cursive) 𐤒, 𐤒, 𐤒 (Jensen 1969b: 282); (Neo-Punic) (El Hofra, Lepcis Magna, 2^{nd}–1^{st} c. BC) 𐤒 (MNAMON: Phoenician, retrieved on

24 February 2018); (Guelma, 1st c. BC – 1st c. AD) ⱃ (Amadasi Guzzo & Zamora López 2013: 192) <q>;

Paleo-Hispanic witness feature (grapheme): *Espanca* ⋈ <go/kᵒ>, *Southwestern* ⋈, ⧖ <kᵒ> /g/, /k/ (before /o/), *Southeastern Iberian* (Obulco coins) ⋈, (G.15.1) ⧖, (Nuevo de Mogente) ⋈, (G.7.2b) ⋈, ⋈, ⋈, (Abengibre G.16) ⋈ (Rodríguez Ramos 2002: 237) <ko/go> (Ferrer i Jané 2010: 76, 92, Vidal 2014: 5) or <ko> (Rodríguez Ramos 2002: 237); *Northeastern Iberian* ⧗, ⋈ /go, ko/, (dual) ⧗ /go/, ⧖, ⧖, ⧖ /ko/ <ko/go> (Ferrer i Jané 2005: 981; Ferrer i Jané 2014: 244–245); *Celtiberian* (Botorrita) ⧗ (Eska 2008: 166–167), (eastern, western) ⧗; ⧖ (Hesperia: Narbonensis, retrieved on 24 June 2016) <ko>.

OM2 (SFG-88):

Anatolian-Greek Alphabetic ancestor feature (grapheme):

Carian (Memphis) ⧗; (Memphis, E.Me 30) ⋄ (Masson 1978: 34; Adiego 2007a: 58); (Kaunos) ⧖? (Adiego 2007a: 509) <γ> /g/.

OM3 (SFG-88):

Brahmic ancestor feature (grapheme):

Brāhmī (Tocharian) 8 (Krause & Thomas 1960: 41); (Tocharian) 8 (Róna-Tas 1991: 114, Table IV); (Tocharian) 8 (Sander 1968: Tafel 41); (North Turkestan) 8 (Róna-Tas 1991: 73); (North Turkestan) 8 (Maue 2016b: 143) <k̲a̲>.

OM+ (SFG-88):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Bactrian sign, northern Afghanistan, Bronze Age) ⋈; (South and East Kazakhstan, Chu-Ili interfluve, Dzungarian Altai and Issyk-Kul Lake Area) ⋈; (Basins of the Amu Darya and the Syr Darya, 1st c. BC –3rd c. AD) 8, 8, ⧗; (4th–8th c. AD) ⧗; (Sarmatia, 2nd half of 1st c. – 1st half of 2nd c. AD) ⧗; (2nd half of 2nd c. – 1st half of 3rd c. AD) ⧗; (Kanka) ⧗; (Issyk-Kul Lake area) ϟ <tamga> (details: Table 8-34).

Evaluation (SFG-88):

Changed script: CBR & SR.

Region of relics: CBR: Carpathian Basin; SR: Inner Asia, Pontus Steppe & Carpathian Basin.

Source script family:

OM1: Canaanite.

OM2: Anatolian-Greek Alphabetic.

OM3: Brahmic.

Period of change:

OM1: 11th c. BC – 2nd c. AD, the using period of the Phoenician script (Table 8-6).

OM2: 7th–3rd c. BC, the using period of the Carian script (Table 8-8).

OM3: 4th–7th c. AD, the using period of Brāhmī glyph variants presumed to be the ancestor (Table 8-15), the upper limit is the age of the earliest CBR or SR inscriptions (Table 8-19).

Region of change: OM1 & OM2: Anatolia. OM3: Inner Asia.

Glyph fit only with tamgas: OM1: 0. OM2: 0. OM3: 0.

Comments (SFG-88):

(i) Taylor makes the transition between the earlier ϙ and later ϙ glyphs of the Phoenician <q> to 8th–7th c. BC. Phoenician (590 BC) ⱃ dates from the early 6th c. BC (Taylor 1883, vol.

I: 204), Consequently, there is no temporal impediment to the Cimmerians borrowing Phoenician 𐤒 <q> (cf. Table 3-2) if the Cimmerians had anything to do with the evolution of Rovash scripts at all.

(ii) Rovash graphemes denoting *k, q* or *χ* are reviewed by Table 7-2.

SFG-89

Descendant feature (grapheme):

TR (Y) 𐰛 (Vasil'ev 1983 apud Harmatta 2004: 186); (O) 𐰚 (Harmatta 2004: 186); (O, Y) 𐰚, (O) 𐰚 (Thomsen 1893: 9); 𐰚 (Róna-Tas 1987: 13); (Y) 𐰛, 𐰛, 𐰛, 𐰛, (O) 𐰚, 𐰚, 𐰚, 𐰚 (Kairžanov 2014: 18); (Y) 𐰛 (Büyük Larousse 9: 4678); (Küli Čur, 719–724) 𐰚 (Tekin 2003: 23); (Toñuquq, 726) 𐰚, (Kül Tegin, 732; Bilge Khagan, 735) 𐰚, (Uyghur inscriptions) 𐰚, (Khakassia, Tuva) 𐰛 (Clauson 1970: 75) <^{W}k^{W}> /k/;

CBR (Nagyszentmiklós, 8th–11th c.) 𐰚 <k> /k/.

OM1 (SFG-89):

Brahmic ancestor feature (grapheme):

Brāhmī (alphabet q [Turkestan Gupta]) 𑀓𑀼, 𑀓𑀼, (alphabets r and s [Early Turkestan]) 𑀓𑀼, 𑀓𑀼, 𑀓𑀼, (alphabet t [North Turkestan Type A]) 𑀓𑀼, (Standard North Turkestan [alphabet u, Type B]) 𑀓𑀼, (alphabet v [Khotanese]) 𑀓𑀼 (Sander 1968: Tafel 38); (Tocharian, THT 1020) 𑀓𑀼 (Maue 2010: 4) <ku>;

Brāhmī (alphabet q [Turkestan Gupta]) 𑀓𑀽, (alphabets r and s [Early Turkestan]) 𑀓𑀽, (alphabet t [North Turkestan Type A]) 𑀓𑀽, (Standard North Turkestan [alphabet u, Type B]) 𑀓𑀽 (Sander 1968: Tafel 38) <kū>;

Brāhmī (Standard North Turkestan [alphabet u, Type B]) 𑀔𑀽 (Sander 1968: Tafel 33) <khū> /k^{h}/.

OM2 (SFG-89):

Rovash ancestor feature (grapheme):

CBR 8 <q> /q/; *SR* 8 <q> /q/; *SR* ⧖, ⧗ <^{W}q^{W}> /q/ (details: SFG-88).

OM+ (SFG-89):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Achaemenid Iran) ꟻ; (Basins of the Amu Darya and the Syr Darya, 1st c. BC –3rd c. AD) 𐰚 <tamga> (details: Table 8-34).

Evaluation (SFG-89):

Changed script: TR & CBR.

Region of relics: TR: Inner Asia; CBR: Carpathian Basin.

Source script family:

OM1: Brahmic.

OM2: Rovash (internal development) (becoming similar, borrowing or vertical emphasis [Table 4-2], use of known glyph [Table 4-3]).

Period of change:

OM1: 4th–7th c. AD, the using period of Brāhmī glyph variants presumed to be the ancestor (Table 8-15), the upper limit is the age of the earliest TR or CBR inscriptions (Table 8-19).

OM2: Not later than 7th c. AD, the upper limit is the age of the earliest TR or CBR inscriptions (Table 8-19).

Region of change: OM1 & OM2: Inner Asia.
Glyph fit only with tamgas: OM1: 1. OM2: 1.

Comments (SFG-89):

(i) According to Mészáros, TR ᚱ, ᛒ <$^{\ddot{W}}$k$^{\ddot{W}}$> corresponds to the ᛒ graph of the two identical ᛒᛟᛇ>ᚿ inscriptions on the flat-shallow ladles of the Treasure of Nagyszentmiklós (Mészáros 1915: 4). Consistent with this, Vékony interpreted the ᛒ graph as /ük, kü/ in his decipherment of the ᛒᛟᛇ>ᚿ inscriptions (Vékony 1987a: 48–49). According to him, the transcription of the inscriptions is /β^{a}d^{i} et$\underline{\text{ük}}^{ü}$/, its meaning in Ancient Hungarian language is 'forest food' (forest fruit). It is worth noting that based on the readings of other CBR inscriptions created by Vékony (Vékony 1987a), in CBR there is not vowel harmony (Table 7-1); therefore, it is not sure that the grapheme ᛒ was used near sound *ü*. Zelliger modified Vékony's reading at several points. According to Zelliger, at the end of the word ᛒᛟᛇ there is an unwritten vowel, which is more probably /i/ than /ü/. Thus the reading of the word is /et^{e}k^{i}/ 'food'; and the reading of the whole ᛒᛟᛇ>ᚿ inscription is /β^{å}d^{u} et^{e}k^{i}/ 'forest food' (forest fruit) (Zelliger, Erzsébet: Personal communication, 2010–2011 apud Hosszú 2013a: 160).

(ii) Rovash graphemes denoting *k, q* or *χ* are reviewed by Table 7-2.

SFG-90

Descendant feature (grapheme):
SHR (Nikolsburg, 1490–1526) Ꭓ *echech* <χ> /χ/.

OM1 (SFG-90):
Rovash ancestor feature (grapheme):
CBR 8 <q>; *SR* 8 <k>; *SR* Ꭓ <^{W}q^{W}> (details: SFG-88).

Evaluation (SFG-90):
Changed script: SHR.
Region of relics: SHR: Carpathian Basin.
Source script family:
OM1: Rovash (internal development) (adaptation [Table 4-2], line shortening [Table 4-3]).
Period of change:
OM1: Before AD 1490–1526, the upper limit is the age of the Nikolsburg Alphabet (Table 8-30), which contains the descendant grapheme.
Region of change: OM1: Carpathian Basin.
Glyph fit only with tamgas: OM1: 0.

Comments (SFG-90):

(i) The glyph style of the Nikolsburg Alphabet (Table 8-30) is that certain glyphs were written with shorter lines than the usual SHR glyphs: ꟾ *ecź, ech* <č> (SFG-82); ⸗ *eǵ* <ď> (SFG-39); ⁑ *eh* <h> (SFG-46); ◇ *ek* <k> (SFG-91); ꟾ *r* <r> (SFG-92) and ꟾ *eʒ* <z> (SFG-102), so it is likely that the original shape of SHR (Nikolsburg) Ꭓ <χ> was Ꭓ. The sound value of SHR Ꭓ <χ> may have been developed with a /q/ > /χ/ sound change, which is characteristic of R-Turkic Ogur language; therefore, it is conceivable that this grapheme was taken over from Ogur language environment by Hungarian users of SHR (Vékony 2004a: 108–109).

(ii) Rovash graphemes denoting *k, q* or *χ* are reviewed by Table 7-2.

SFG-91

Descendant feature (grapheme):

SHR (Bodrog-Alsóbű, around 900 or first half of 10th c.) ◊; (Vargyas, 12th–13th c.) ◊; (Székelydálya, around 1400) ◊; (Stick Calendar, ca. 15th c. surviving in a 17th c. copy) ◊; (Székelyderzs, 1490s) ◇; (Nikolsburg, 1490–1526) ◊ *ek;* (Bágy, 15th c.) ◊; (Rugonfalva, 16th–17th c.) ◊; (Marsigli's Alphabet, 1690) ◊ *ek;* (Patakfalvi, 1776–1785) ◊ <k> /k/;
SR (Mayatskoe-5, 9th c.) ◊; (Mayatskoe-10, 9th c.) ◊ <q> /q/;
SR (Kievan Letter, 955–961) ꟼ <Iq> /ïq/ (Table 8-28).

OM1 (SFG-91):
Canaanite ancestor feature (grapheme):
Phoenician (7th c. BC) ⚲; ⚲, ⚲ *qōp̄* <q> (details: SFG-88);
Anatolian-Greek Alphabetic ancestor feature (grapheme):
Ancient Greek (Thera, 8th–7th c. BC) ϙ, (Crete, 8th–7th c. BC) Ϙ (Healey 1990a: 37); (up to 5th c. BC) φ (Jeffery 1961: 33–34); (Naxos, 8th–7th c. BC) ϙ (Healey 1990a: 37); (Ipsambul [Abu Simbel, Egypt], 7th c. – the beginning of 6th c. BC, LTR writing direction) ϙ (Taylor 1883, vol. II: 9–15); (mid-6th–5th c. BC) ϙ (Jeffery 1961: 33–34) *koppa* <q> guttural *k* before /o/ and /u/ (Jeffery 1961: 33–34);
Anatolian-Greek Alphabetic witness feature (grapheme): *Carian* (Kaunos, Memphis) ⊕, (Kildara, Mylasa, Stratonikeia) ⊙; (Thessaloniki, pot fragment, first third of 5th c. BC) ⊕ (Tzanavari & Christidis 1995: 13–17; Adiego 2007a: 164–165) <q> /q/; *Lycian* ◊, ◊ (MNAMON: Lycian, retrieved on 12 April 2016); ◇ (Adiego 2007e: 8) <κ?> (Adiego 2007e: 8) ≈/k</? (Melchert 2008a: 48) or /gh?/ghe?/ (Bryce 1986: 57 by citing the conference paper of Prof. Tritsch in 1975);
Paleo-Hispanic witness feature (grapheme): *Northeastern Iberian* ☐ (Hesperia: Narbonensis, retrieved on 24 June 2016); ⊚, ◈, ◇ <gu/ku> /gu, ku/, (dual) O, ⊙ <gu>, ⊙, ◎ <ku> (Ferrer i Jané 2014: 244–245); *Northeastern Iberian* (Gallia Narbonensis) ◈, ◊, ◇, ◊, ⌗, ⌷ (Hesperia: Narbonensis, retrieved on 24 June 2016) <ku> /gu, ku/; *Celtiberian* (Botorrita) ◈ (Eska 2008: 166–167); (eastern) ◈; (western) ⊙ (Hesperia: Narbonensis, retrieved on 24 June 2016) <ku>;
Italic witness feature (grapheme): *South Picene* φ, ◈, ◇, ◈, ⊙ (MNAMON: South Picene, retrieved on 9 April 2018) <q>; *Camunic* (Piancogno, Foppe di Nadro) Φ (TIR: Script, retrieved on 20 February 2018) <q>.

OM2 (SFG-91):
Anatolian Hieroglyphic ancestor feature (grapheme):
Anatolian Hieroglyphic (KARKAMIŠ A31) ◈ (Hawkins 2000: 141); ◈ (Payne, A. 2010a: 14); (SÜDBURG) ◊ *423 <ku>;
Aegean witness feature (grapheme): Cypro-Minoan ◊ (Valério 2016: 430, 442); ◊ CM 15 <ko?> (Valério 2016: 430, 442).

OM3 (SFG-91):
Brahmic ancestor feature (grapheme):
Brāhmī (Tocharian) ⚲ (Krause & Thomas 1960: 41); (alphabet t [North Turkestan Type A]) ⚲, (Standard North Turkestan [alphabet u, Type B]) ⚲; (Sander 1968: Tafel 29); (Tocharian) ⚲ (Fischer 2001: 109) <ka> (further glyphs: SFG-62).

Brahmic witness feature (grapheme): *Brāhmī* (alphabets r and s [Early Turkestan]) 𑀔, (alphabet t [North Turkestan Type A]) 𑀔; (Turkestan Gupta, 4th–5th c. AD) 𑀔, 𑀔 <kha> /k^{h}/ (details: SFG-61); *Tibetan* ཁ <kha> (details: SFG-61).

OM+ (SFG-91):
Tamgas ancestor feature (glyph shapes or styles):
Tamgas (Bayte III) ◊; (coins with double-humped camel, 7th–8th c. AD) ⟡ <tamga> (details: Table 8-34).

Evaluation (SFG-91):
Changed script: SHR & SR.
Region of relics: SHR: Carpathian Basin; SR: Pontus Steppe.
Source script family:
OM1: Canaanite or Anatolian-Greek Alphabetic.
OM2: Anatolian Hieroglyphic.
OM3: Brahmic.
Period of change:
OM1: 11th–5th c. BC, the union of the using periods of Phoenician (Table 8-6) and Ancient Greek (Table 8-8) scripts.
OM2: Around 7th c. BC, the end of the using period of the Anatolian Hieroglyphic (Table 8-5) script.
OM3: 4th c. AD – around 900, the using period of Brāhmī glyph variants presumed to be the ancestor (Table 8-15), the upper limit is the age of the earliest SHR or SR inscriptions containing the descendant grapheme.
Region of change: OM1 & OM2: Anatolia. OM3: Inner Asia.
Glyph fit only with tamgas: OM1: 1. OM2: 0. OM3: 1.

Comments (SFG-91):

(i) According to Sebestyén SHR ◊ <k> is ultimately derived from Phoenician 𐤊, 𐤊, 𐤊 <k> (SFG-57); however, he presumed multiple feature transformations, from which his derivation is unlikely (Sebestyén 1906: 272, 276).

(ii) Rovash graphemes denoting *k, q* or *χ* are reviewed by Table 7-2.

(iii) Several researchers supposed the relationship of TR ◁, ▷, ▽, ◀, ⊲, ⊲ <^{ï}q^{ï}> (SFG-61) and SHR ◊ <k> (SFG-91) (Nagy 1895: 274; Sebestyén 1906: 276; Németh 1934: Appendix VI; Németh 1971: 38). A ◁ > ◊ or a ◊ > ◁ feature transformations had to occur in this case. Some examples for the feature transformation ◁ > ◊ (similarly in OM3 of SFG-23: ◊ > ⟐ > ⊙): Brāhmī (Aśoka, around 250 BC) 𑀥; (Socotra [Jemen], T 32, LTR inscription, end of 2nd c. AD – 4th c.) ◁ (Strauch & Bukharin 2004: 133); (North Turkestan) ◊ (Róna-Tas 1991: 114, Table IV); (Turkestan Gupta) 𑀥, (alphabets r and s [Early Turkestan]) 𑀥, 𑀥, (alphabet t [North Turkestan Type A]) 𑀥, (Standard North Turkestan [alphabet u, Type B]) 𑀥, (alphabet v [Khotanese]) 𑀥 (Sander 1968: Tafel 29) <dha> and Brāhmī (North Turkestan) 𑀣 (Róna-Tas 1991: 114, Table IV); (Turkestan Gupta) 𑀣, 𑀣, (alphabet t [North Turkestan Type A]) 𑀣, (Standard North Turkestan [alphabet u, Type B]) 𑀣, (alphabet v [Khotanese]) 𑀣 (Sander 1968: Tafel 29) <tha>. However, in TR, the use of the triangular shape is consequent, and it is characteristic; therefore, the ◁ ~ ◊ feature transformation is less likely.

(iv) The rectangle-shaped Syriac (Estrangela) ܩ; (Nestorian) ܩ *qūp̄* <q> [k'] #100 and the Christian Sogdian ܩ (Skjærvø 1996: 519) *qōp̄* <q> /k/ might be ancestor; however, the shape of the descendant glyphs are always rhombus, and they consistently stand on one of their vertices rather than on one of their edges.

SFG-92

Descendant feature (grapheme):

TR (Y) 𐰺 (Vasil'ev 1983 apud Harmatta 1997b: 163); (O, Y) 𐰺, (O, T, Y) 𐰺, (Y) 𐰺, (T) 𐰺 (Kyzlasov, I. L. 1994: 71); (T) 𐰺, (Y) 𐰺, 𐰺, 𐰺, 𐰺 (Kairžanov 2014: 18); (Epitaph of Qarï Čor Tegin) 𐰺 (Rybatzki & Wu 2014: 122–123); (Khentii, second half of 8th c. – beginning of 9th c.) 𐰺; (Toñuquq, 726) 𐰺, (Uyghur inscriptions) 𐰺, (Khakassia, Tuva) 𐰺, 𐰺 (Clauson 1970: 75) <r^{1}> /r/;

SHR (Bágy, 15th c.) 𐲢; (Nikolsburg, 1490–1526) 𐲢 *r;* (Constantinople, 1515, LTR writing direction) 𐲢, 𐲢, 𐲢; (Rudimenta-Giessen, 1598) 𐲢; (Gyulafehérvár, 1655) 𐲢; (Hickes, 1705) 𐲢, (Patakfalvi, 1776–1785) 𐲢 <r> /r/;

SR (Mayaki, 8th–9th c.) 𐰺, 𐰺; (Mayatskoe-2, 9th c.) 𐰺; (Mayatskoe-10, 9th c.) 𐰺 <r> /r/.

OM1 (SFG-92):

Aramaic ancestor feature (grapheme):

Imperial Aramaic (satrapies, 5th–4th c. BC) 𐡓, 𐡓, (monuments, Egypt, 4th–3rd c. BC) 𐡓, (papyrus, Egypt, 2nd c. BC) 𐡓, 𐡓 (Taylor 1883, vol. I: 250); (mid-7th c. BC) 𐡓, (7th–5th/4th c. BC) 𐡓, 𐡓, 𐡓 (Gibson 1975); (Elephantine Papyri, 6th c. BC) 𐡓 (Glass 2000: 14); 𐡓; (satrapies and Egypt, 4th–3rd c. BC) 𐡓 (Taylor 1883, vol. II: 236); (Aśoka, around 250 BC) 𐡓 (Glass 2000: 14); 𐡓 (MacKenzie 1971: xi) *rēš* <r> /r/.

OM2 (SFG-92):

Middle Iranian ancestor feature (grapheme):

Parthian (Nisa) 𐭓, 𐭓, 𐭓, 𐭓 (Ivantchik & Lurje 2013: 290) *rēš* <r> /r/;

Khwarazmian (Chirik-Rabat [Kyzylorda Region, Kazakhstan], 4th–2nd c. BC) 𐭓 (Ivantchik & Lurje 2013: 286–287); (coins) 𐭓 (Vainberg 1977: Table VIII) <r>;

Sogdian (early, Kultobe, before 4th c. AD) 𐼘 (Sims-Williams & Grenet 2006: colour illustrations without page numbering); (Ancient Letters, early 4th c. AD) 𐼘, (sutra) 𐼘, 𐼘 (Skjærvø 1996: 519) *rēš* <r> /r/;

Middle Iranian witness feature (grapheme): *Parthian* (inscriptional) 𐭓 (Skjærvø 1996: 518) <r>; *Armazian* 𐡓 (Cereteli 1948–1949 apud Róna-Tas 1987: 14) <r>.

Evaluation (SFG-92):

Changed script: TR, SHR & SR.

Region of relics: TR: Inner Asia; SHR: Carpathian Basin; SR: Pontus Steppe.

Source script family:

OM1: Aramaic.

OM2: Middle Iranian.

Period of change:

OM1: 7th/6th–1st c. BC, the using period of the Imperial Aramaic script (Table 8-12).

OM2: 2nd c. BC – 8th c. AD, the union of the using periods of Parthian, Khwarazmian and Sogdian (Table 8-16) scripts, the upper limit is the age of the earliest TR, SHR or SR inscriptions (Table 8-19).

Region of change: OM1 & OM2: Inner Asia.

Glyph fit only with tamgas: OM1: 0. OM2: 0.

Comments (SFG-92):

(i) Several pointed out that SHR H, И <r> and TR 𐰺 <r[1]> match (Nagy 1895: 274; Sebestyén 1906: 273, 278; Németh 1934: Appendix VII; Németh 1971: 38).

(ii) According to Sebestyén, the ancestor of TR 𐰺 <r> is the square-shaped Ancient Greek *rho* <ρ> (Sebestyén 1906: 273, 278), cf. Ancient Greek (Athens, Naxos, Korkyra, 8th–7th c. BC) ᑫ (Healey 1990a: 37) *rho* <ρ>. However, the opening feature transformation required for this lineage is unlikely.

(iii) According to Clauson, the ancestor of TR 𐰺, 𐰺 <r[1]> is the early Sogdian <r> (OM2) (Clauson 1970: 70).

(iv) Presumably, Rovash glyphs H and И are results of internal development, cf. TR (Epitaph of Qarï Čor Tegin) H <r[1]>.

SFG-93

Descendant feature (grapheme):

TR (O, Y) 𐰼 (Kairžanov 2014: 18) <r[1]> /r/;

TR (Y) 𐰼 (Vasil'ev 1983 apud Harmatta 2004: 186); (O, J, T [Kyzlasov, I. L. 1994: 72]) 𐰼; (Mendur-Sokkon IV) 𐰼; (manuscript) 𐰼, 𐰼, 𐰼, 𐰼 (von Gabain 1941); (Y) 𐰼 (Büyük Larousse 9: 4679); (Küli Čur, 719–724) 𐰼; (Toyok) 𐰼, (Ïrq Bitig Manuscript, 930) 𐰼, (Dunhuang Letter) 𐰼, 𐰼 (Clauson 1970: 75); (Kalbak-Tash I) 𐰼, 𐰼; (Urkosh, 8th–9th c.) 𐰼 (Tugusheva et al. 2014: 78, 81); (Bichiktu-Boom II/1) 𐰼, 𐰼; (Kochkor, first half of 8th c.) 𐰼 (Klyashtorny 2001: 203–206); (Tanbaly-Tash, 9th–10th c., LTR writing direction) 𐰼 (Rogozhinskii & Kyzlasov 2004: 42) <r[2]> /r/.

OM1 (SFG-93):

Brahmic ancestor feature (grapheme):

Brāhmī (alphabet q [Turkestan Gupta]) 𑀭𑁄, (alphabets r and s [Early Turkestan]) 𑀭𑁄, 𑀭𑁄, 𑀭𑁄, (alphabet t [North Turkestan Type A]) 𑀭𑁄, (Standard North Turkestan [alphabet u, Type B]) 𑀭𑁄 (Sander 1968: Tafel 38) <ro>.

OM+ (SFG-93):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Achaimenid Iran) ϒ; (Bayte III) ϒ; (Basins of Amu Darya and Syr Darya, 6th–2nd c. BC) ϒ; (Kochkor Valley) ϒ <tamga> (details: Table 8-34).

Evaluation (SFG-93):

Changed script: TR.

Region of relics: TR: Inner Asia.

Source script family:

OM1: Brahmic.

Period of change:

OM1: 4th–8th c. AD, the using period of Brāhmī glyph variants presumed to be the ancestor (Table 8-15), the upper limit is the age of the earliest TR inscriptions (Table 8-29).

Region of change: OM1: Inner Asia.

Glyph fit only with tamgas: OM1: 1.

Comments (SFG-93):

(i) Interpreting TR 𐰼 <r[2]> as Turkic pictograph, its formation from the Old Turkic *er* ‘man’ word was supposed (Thomsen 1922; Róna-Tas 1987: 8–9). For an analysis of the issue of Turkic pictographs, see Table 3-4.

(ii) According to Clauson, TR 𐰼 <r²> comes from the Greco-Bactrian *rho* <ρ>, and its ancestor could be the glyph ϼ of the Greco-Bactrian (Chionites-Hephthalites, Arabo-Hephthalites) ϼ, ϼ (Ghirshman 1948: 63) *rho* <ρ>; Clauson uses the glyph ϼ (Clauson 1970: 70, 74). However, derivation of the TR 𐰼 from the glyph ϼ needs many assumptions.

(iii) It may arise that TR 𐰼 <r²> (in case of Kairžanov, TR ϒ <r¹>, too) is the derivation of TR 𐰺 <r¹>. In the case of the presumed 𐰺 > 𐰼 feature transformation, the aim could be to achieve symmetry and to add short slanting bars at the upper vertices, but this makes many assumptions; therefore, based on the cladistics’ *lex parsimoniae* (Table 4-1), this lineage option is omitted.

(iv) It might be conceivable that TR 𐰼 <r²> evolved from TR 𐰽, 𐱁 <s¹, š¹> (SFG-97) under the influence of rhotacism (Table 7-9: 7-7. §). However, in addition to significant sound change, changes in shape should also be presumed; therefore, this lineage option is left out.

SFG-94

Descendant feature (grapheme):
SR (Achik-Tash, 8th c.) ∩ <r²> /r/.

OM1 (SFG-94):
Middle Iranian ancestor feature (grapheme):
Middle Persian (inscriptions, 3rd c. AD) 𐭥 (MacKenzie 1971: xi) *rēš* <r> /r/;
Aramaic witness feature (grapheme): *Hebrew* (Qumran Manuscripts, 1st c. BC) ר, (Text of the Pentateuchus Masoret, 9th c. AD) ר *rēš* <r> /r/;
Middle Iranian witness feature (grapheme): *Parthian* (inscriptional) 𐭓 (Skjærvø 1996: 518) *rēš* <r> /r/.

OM+ (SFG-94):
Tamgas ancestor feature (glyph shapes or styles):
Tamgas (Achaemenid Iran) ∩; (Bayte III) ∩; (Basins of the Amu Darya and the Syr Darya, 1st c. BC –3rd c. AD) ∩; (Beskepe) ∩ <tamga> (details: Table 8-34).

Evaluation (SFG-94):
Changed script: SR.
Region of relics: SR: Inner Asia.
Source script family:
OM1: Middle Iranian.
Period of change:
OM1: 3rd–7th c. AD, the using period of the Middle Persian (Table 8-16) script.
Region of change: OM1: Inner Asia.
Glyph fit only with tamgas: OM1: 1.

Comments (SFG-94):

(i) The descendant grapheme appears on only one script relic, the Achik-Tash inscription found in the Talas Valley, located in Inner Asia; so this grapheme probably developed there.

(ii) The weakness of OM1 is that the glyph of the Middle Persian 𐭥 <r> is only partially similar to the glyph of SR ∩ <r²>.

(iii) TR (Y) ᛁ, ᛁ <r^{1}>; SR ዞ, ዞ <r> (SFG-92) are not similar to the descendant graphemes.

SFG-95

Descendant feature (grapheme):

CBR (Szarvas, first half of 8th c.) *(bottom edge worn)* ⊓; (Nagyszentmiklós, Jug No. 6, 8th–11th c.) ▯; (Nagyszentmiklós, Cup No. 23, 8th–11th c.) ▯ <r> /r/;

SR (Achik-Tash, 8th c.) □; (Jitkov, the first third of 8th c.) ▢; (Khumara-7, 9th–10th c.) ⌑ <r^{1}> /r/.

OM1 (SFG-95):

Anatolian-Greek Alphabetic ancestor feature (grapheme):

Ancient Greek (8th–5th c. BC) ◁ (Powell 1991: 8); (Crete, 8th–7th c. BC) ◀, ◁, ◁, ◠, (Athens, Naxos, Korkyra, 8th–7th c. BC) ◁, (Thera, 8th–7th c. BC) ◁, ◁, (Boiotia, 8th–7th c. BC) ◁ (Healey 1990a: 37); (Thera, 7th c. BC) ᚹ, ᚹ (Haarmann 1990: 287); ᚹ; (Ipsambul [Abu Simbel, Egypt], 7th c. – the beginning of 6th c. BC, LTR writing direction) ▷, ᚹ (Taylor 1883, vol. II: 9–15) *rho* <ρ> /r/;

Anatolian-Greek Alphabetic witness feature (grapheme): *Greco-Iberian* (La Serreta) ᚹ, ᚹ <r>; ▷, ▯ <r’>;

Berber witness feature (grapheme): *Libyco-Berber* (Lanzarote) (vertical and horizontal writing direction) □, ▯, ○, (vertical writing direction) ▭, ◇ (Ulbrich 2012: 21); (Dougga, RTL horizontal writing direction) ○, (archaic, Morocco, bottom-up vertical writing direction) ○, □; (archaic, El Hierro) ○, □, (classic, Fuerteventura, Lanzarote) ○, □ (Farrujia de la Rosa et al. 2010: 33) <r>;

Paleo-Hispanic witness feature (grapheme): *Espanca* ⟫, ⟫ <r?>; *Northeastern Iberian* ◁, ▷ (Hesperia: Narbonensis, retrieved on 24 June 2016) <r>, (dual) ◁, D <r> (Ferrer i Jané 2014: 244–245); *Northeastern Iberian* ○, ◇, ◇, ⍑, ♀, ◇, ⍑, ♀ (Hesperia: Narbonensis, retrieved on 24 June 2016) <ŕ>, (dual) ⍑, Φ, ♀ <ŕ>, ♀, ⍑ <ř> (Ferrer i Jané 2014: 244–245); *Celtiberian* (Botorrita) ♀ (Eska 2008: 166–167); ○, ◇, ◇, ♀, ⍑, ⍑ (Hesperia: Narbonensis, retrieved on 24 June 2016); (eastern) ◇; (western) Φ <r> or <ŕ>;

Italic witness feature (grapheme): *Etruscan* (early, late) ◁ <r> /r/; *Proto-Campanian* (Oinochoe in Bucchero, Nuceria, second half of 6th c. BC) ◁ <r> (MNAMON: Oscan, retrieved on 22 February 2018); *Raetic* ◁, ◁, ▷ <r> (Marchesini 2014: 206–207); *Lepontic* (early) ◁, ◁, (late) ◁, ◁, ◁ <r>; *Venetic* (beg. of 6th c. – end of 6th c. BC) ◁; (Este, Padova, end of 6th c. – beginning of 1st c. BC) ◁, ◁ <r>; *Camunic* (Piancogno) D, (Foppe di Nadro) ◁ (Morandi 2004: 476; TIR: Script, retrieved on 20 February 2018) <r>; *Oscan* (Etruscan, first half of 4th c. – first half of 1st c. BC) ◀, ◁; (Capua, just after mid-3rd c. BC) ◁ <r> [r]; *Umbrian* (Etruscan, 4th c. – first half of 1st c. BC) ◁, ◁, ◁ <r> [r]; *Gallo-Etruscan* (4th–2nd c. BC) D <r>.

OM2 (SFG-95):

Greek Alphabetic ancestor feature (grapheme):

Greco-Bactrian (rectangular) P (Kurbanov 2010: Fig. 93) *rho* <ρ>;

Greek Alphabetic witness feature (grapheme): *Greco-Bactrian* (Heraüs) ρ, ρ, ρ, (Loulan, 4th c. AD) ρ, (Chionites-Hephthalites, Arabo-Hephthalites) ρ, ρ, (Kings of Zabol and Turkic princes) ρ, ρ, ρ (Ghirshman 1948: 63); (cursive) ρ (Kurbanov 2010: Fig. 93) *rho* <ρ>.

OM3 (SFG-95):
Rovash ancestor feature (grapheme):
TR Ӈ, Ч, *SHR* Н, *SR* Ӈ <r> (details: SFG-92).

OM+ (SFG-95):
Tamgas ancestor feature (glyph shapes or styles):
Tamgas (Bayte III) ⌑; (Sarmatia, 2nd half of 2nd c. – 1st half of 3rd c. AD) ⌑; (Sidak, 5th – early 8th c. AD) ▯; (Shaushukumtobe) ⌑ <tamga> (details: Table 8-34).

Evaluation (SFG-95):
Changed script: CBR & SR.
Region of relics: CBR: Carpathian Basin; SR: Inner Asia & Pontus Steppe.
Source script family:
OM1: Anatolian-Greek Alphabetic (glyph-variant forming [Table 4-2], line deletion [Table 4-3]).
OM2: Greek Alphabetic (simplification [Table 4-2], line deletion [Table 4-3]).
OM3: Rovash (internal development) (becoming similar, borrowing, closer shape forming or different visual identities [Table 4-2]; use of known glyph [Table 4-3]).
Period of change:
OM1: 9th–5th c. BC, the using period of the Ancient Greek script (Table 8-8).
OM2: AD 342–781, the using period of the Greco-Bactrian script (Table 8-13).
OM3: Up to the 8th c. AD, the limit is the age of the earliest CBR and SR script relics containing the descendant grapheme.
Region of change: OM1: Anatolia. OM2 & OM3: Inner Asia.
Glyph fit only with tamgas: OM1: 1. OM2: 1. OM3: 1.

Comments (SFG-95):
(i) In OM3, an analogue of the glyph transformation Ӈ > ◘ is the glyph distribution of TR <m>: ⋺, ⋺, ⋺, ◇, ◇ (SFG-67). Possibly, in both cases, tamgas affected the glyphs. Therefore, CBR ▯ <r>, SR □ <r1> could be formed from TR Ӈ, Ч, SHR Н, SR Ӈ <r> (SFG-21).
(ii) The Telugu-Kannada (ca. 7th–10th c. AD) ▯ <ra> (Salomon 1998: 40) is very similar to the descendant graphemes; however, the Telugu-Kannada script was used in southern India; therefore, this similarity is surely coincidence (homoplasy, Table 2-7).
(iii) The Northeastern Iberian <ŕ> a kind of liquid (Valério 2008: 130) or a simple trill (Ferrer i Jané & Moncunill 2019: 86), and the Northeastern Iberian <ř> is a multiple trill (Ferrer i Jané & Moncunill 2019: 86).
(iv) CBR and SR <r> represent a high degree of similarity between the Libyco-Berber, Northeastern Iberian and Celtiberian graphemes; however, it is problematic that the Libyco-Berber graphemes probably developed under a purely Phoenician influence, whereas Paleo-Hispanic Northeastern Iberian and Celtiberian scripts show a strong Ancient Greek influence (Table 8-10). Thus, it is conceivable that despite the phonological and shape similarities, all or part of the graphemes in SFG-95 are not directly related, but their similarity is only homoplasy (Table 2-7). However, their strikingly geometric shape is probably not accidental. The formation of both Libyco-Berber and Paleo-Hispanic scripts falls in the Geometric period (ca. 1100–800 BC), so the evolution in the direction of geometric shapes can easily be explained. The Geometric period is the period between the end of the Mycenaean civilization and the

emergence of Greek city-states- In that age, on ceramic, the earlier figural ornaments were replaced by simple symbols. The glyphs of CBR ▯ and SR ◘ <r> may also have evolved under such an effect.

SFG-96

Descendant feature (grapheme):

SHR (Székelydálya, around 1400) ⁄; (Wolfenbüttel, 1592–1666) /; (Rudimenta-Giessen, 1598) ⁄, |; (Bonyhai's Alphabet, 1627) |; (Szegedi, 1655) |; (Marsigli's Alphabet, 1690) ⁄ *r;* (Bél, 1718) ʃ *r* <r> /r/.

OM1 (SFG-96):

Middle Iranian ancestor feature (grapheme):

Middle Persian (Early Cursive Pahlavi) ɩ, (Book Pahlavi) ı (Skjærvø 1996: 518) *rēš* <r> /r/;

Middle Iranian witness feature (grapheme): *Middle Persian* (Psalter) (Bulayïq, 6th–7th c., a copy of an origin from the 4th c. AD) ɩ (Skjærvø 1996: 518) *rēš* <r> /r/.

OM2 (SFG-96):

Brahmic ancestor feature (grapheme):

Brāhmī ʕ, ɩ, ⌠, ɪ (Bühler 1898: Table after p. 123: Comparative Table of the oldest Semitic and the Brāhma alphabets); (Aśoka, around 250 BC) | (Cunningham 1877: Plate XXVII); (Socotra [Jemen], T 23-a, LTR inscription, end of 2nd c. AD – 4th c.) J (Strauch & Bukharin 2004: 128); (alphabet q [Turkestan Gupta]) ɉ, ɪ, ɪ, (alphabets r and s [Early Turkestan]) J, ɪ, I, (Standard North Turkestan (alphabet t [North Turkestan Type A]) ɪ, [alphabet u, Type B]) ɪ, (alphabet v [Khotanese]) ɪ (Sander 1968: Tafel 30); (Cursive Gupta of Central Asia) J, (Tocharian) ⅃ (Fischer 2001: 109) <ra>.

OM+ (SFG-96):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Tashkent Oasis) |; (Beskepe) /; (Basins of the Amu Darya and the Syr Darya, 1st c. BC –3rd c. AD) /; (Altay) |, /; (Mongolia) / <tamga> (details: Table 8-34).

Evaluation (SFG-96):

Changed script: SHR.

Region of relics: SHR: Carpathian Basin.

Source script family:

OM1: Middle Iranian.

OM2: Brahmic.

Period of change:

OM1: 3rd–7th c. AD, the using period of the Middle Persian script (Table 8-16).

OM2: 3rd c. BC – 9th c. AD, the using period of Brāhmī script (Table 8-15), the upper limit is the Hungarian conquest of the Carpathian Basin since after this any influence of the Brāhmī script was impossible.

Region of change: OM1 & OM2: Inner Asia.

Glyph fit only with tamgas: OM1: 0. OM2: 1.

Comments (SFG-96):

(i) It is unlikely that the glyphs of SHR ⁄, /, | <r> are simplified variants of the glyph of SHR Ƕ <r> (SFG-92) since in one of the earliest traditional SHR inscription, the Stick Calendar, only the one-line variant (⁄, /, | <r>) was used. Furthermore, the author of the first SHR textbook (Rudimenta, 1598), Telegdi makes a functional distinction between the ⁄ <r> and Ⲏ <r> by saying that the ⁄ <r> is used for the shake of brevity in the middle and at the end of the words (Sebestyén 1904c: 369–370).

(ii) The glyphs ᐟ, ⫽ of the Greco-Bactrian *rho* <ρ> (SFG-95) could be ancestor; however, these glyphs are only irregular forms of the usual loop Ᵽ-like shape; therefore, this is unlikely an ancestor of the descendant grapheme.

(iii) The glyphs of SHR ⁄, /, | <r> are not characteristic, its Glyph Complexity Parameter (GCP) is only 1 (Table 8-2). Therefore, it is difficult to determine which script SHR ⁄, /, | <r> can come from.

(iv) For possible layered origin of SHR, see Table 7-4 and Table 7-5: 7-2. §.

SFG-97

Descendant feature (grapheme):

TR (Y) ᛉ, ᛉ, (O) ᛉ (Kairžanov 2014: 18); (manuscript) ✱ (von Gabain 1941); (Küli Čur, 719–724; Kül Tegin, 732; Bilge Khagan, 735) 𐰽 (Róna-Tas 1987: 9), (T) ᛉ, ᛉ, (Y) ⊃⊣, (O) ᛉ, ʃ (Kairžanov 2014: 18) <s^1> /s/;

TR (Terh, 750–754; Tez, 750–753; Shine Usu, 760; Suǰi, 840) ¥, (Y) ¥; (Toñuquq, 726) 𐰽 (Róna-Tas 1987: 9), (O, T) ᛊ, ᛉ; (O, Y) ᛉ (Róna-Tas 1991: 111, Table I); (Y) ᛉ (Kyzlasov, I. L. 1994: 72); (Y) ᛋ, ᚠ; (Y) ᚠ (Büyük Larousse 9: 4679) <s^1, š>;

TR (Küli čur, 719–724; Kül Tegin, 732) ¥, (Bilge Khagan, 735) ¥ (Róna-Tas 1987: 9) <s^2, š>;

TR (T) ᛞ, ᚹ, (Y) ᛉ, (O) ᛉ (Kairžanov 2014: 18); (O) ¥; (manuscript) ✝ (von Gabain 1941); (Toñuquq, 726) ᛉ, (Kül Tegin, 732; Bilge Khagan, 735) ᛉ, (Toyok) ᛉ, (Khakassia, Tuva) ᛉ, ᛕ (Clauson 1970: 75); (O) ᛉ (Kairžanov 2014: 18); (Zhon-Aryk, Talas Valley, first half of 8th c.) ᛋ (Alimov & Tabaldiev 2005: 121–125); (Y) ᛉ (Kairžanov 2014: 18) <š> /š/;

SHR (Stick Calendar, ca. 15th c. surviving in a 17th c. copy) ᛉ /š, ž/; (Gyulafehérvár, 1655) ᛘ /š/; (Nikolsburg, 1490–1526) ᛉ *ſs, eſch* /ž/; (Szegedi, 1655) Ψ, ᛘ /ž/; (Gönczi, around 1680) ᛘ /ž/ <ž>;

SR (Khumara-6, 9th–10th c.) ᛉ; Khumara-8 [in copy], 9th–10th c.) ᛉ <s> /s/; (Mayatskoe-2, 9th c.) ᛚ; (Mayatskoe-10, 9th c.) ᛉ <s> /s/;

SR (Jitkov, first third of 8th c.) ᛉ; (Kermen Tolga, 8th–10th c.) ᛉ; (Novocherkassk, 8th–10th c.) ᛉ <š> /š/.

OM1 (SFG-97):

Aegean ancestor feature (grapheme):

Cypro-Greek (Paphian, 6th c. BC) ᛋ, Ψ, ᚹ (Valério 2016: 228); (common) ᚹ (Valério 2013: 15–17); (common) ᚹ, (Paphian) ᛋ; (Olivier 2007–2008: 617–618) (Paphian, late) ᛋ, ᛉ, ᛉ (Valério 2016: 229) <se> /se/ (Valério 2016: 206);

Aegean witness feature (grapheme): *Cypro-Greek* (common, Paphian, 6th c. BC, late) V (Davis 2010: 38–61); (common) V, (Paphian) Y (Olivier 2007–2008: 617–618); (Paphian, late) ᛉ, ᛇ (Valério 2016: 229) <sa> /sa/ (Valério 2016: 206).

OM2 (SFG-97):

Aramaic ancestor feature (grapheme):

Imperial Aramaic (monuments, Egypt, 4^{th}–3^{rd} c. BC) , (papyrus, Egypt, 2^{nd} c. BC) (Taylor 1883, vol. I: 250); (8^{th}–5^{th}/4^{th} c. BC) (Gibson 1975); (Elephantine Papyri, 6^{th} c. BC) (Glass 2000: 15); , ; (monumental) , (Assyrian and Egyptian papyri) , , (Babylonian Bowls) , (Faulmann 1880: 79); (Babylonian Bowl) (Layard 1853: 437); (Aśoka, around 250 BC) (Glass 2000: 15); (MacKenzie 1971: xi) *śin/šin* <š>;

Aramaic witness feature (grapheme): *Hebrew* (Qumran Manuscripts, 1^{st} c. BC) *śīn/šīn* <š, ś> /š, ś/; *Nabataean* , (Garbini 1979: Fig. 7); (late) (Macdonald 2008: 218) *šīn* <š> /š/; *Hatran* (H 79, soon before AD 240) (Beyer 1998: 10, 47–48); , , , , , (PROEL: Alfabeto Hatran, retrieved in 2016) <š>; *Palmyrene* , (Harmatta 2000: 181) *šīn* <š>; *Armazian* , (Cereteli 1948–1949 apud Róna-Tas 1987: 14) <š>; *Arabic* (early) , (modern) (Macdonald 2008: 218) *sīn* <s> /s/; *Arabic* (early) , (modern) (Macdonald 2008: 218) *šīn* <š, sh> /ʃ/.

OM3 (SFG-97):

Middle Iranian ancestor feature (grapheme):

Parthian (early) (Nisa, 1^{st} c. BC) (Rosenthal et al. 1986–2011: Table 3); (early) (Nisa, 1^{st} c. BC) (Skjærvø 1996: 518); (Avroman, 13/12 BC) (Minns 1915: 62); (inscriptional) (Rosenthal et al. 1986–2011: Table 3); (inscriptional) (Skjærvø 1996: 518); (coins of the Parthian kings, 1^{st}–2^{nd} c. AD) , , (Ḥājiābād, 3^{rd} c. AD) (Taylor 1883, vol. II: 236) *šīn* <š> /š, ž/ (Skjærvø 1996: 518);

Khwarazmian (coins) , , , , , (Toprak-kala) , (bowls) , , (Tok-kala, 7^{th}–8^{th} c. AD) (Vainberg 1977: Table VIII) <š>;

Sogdian (sutra) , (Skjærvø 1996: 519) *semkat* <s>;

Christian Sogdian , (Skjærvø 1996: 519) *šin* <š> /š/;

Middle Iranian witness feature (grapheme): *Sogdian* (Ancient Letters, early 4^{th} c. AD) *semkat* <s>; *Middle Persian* (Psalter) (Skjærvø 1996: 518) *semkat* <s>.

Evaluation (SFG-97):

Changed script: TR, SHR & SR.

Region of relics: TR: Inner Asia; SHR: Carpathian Basin; SR: Pontus Steppe.

Source script family:

OM1: Aegean.

OM2: Aramaic.

OM3: Middle Iranian.

Period of change:

OM1: 11^{th}–2^{nd} c. BC, the using period of the Cypro-Greek script (Table 8-3).

OM2: 7^{th}/6^{th}–1^{st} c. BC, the using period of the Imperial Aramaic script (Table 8-12).

OM3: 2^{nd} c. BC – 8^{th} c. AD, the union of the using periods of Parthian (Table 8-16), Khwarazmian, Sogdian and Christian Sogdian scripts; the upper limit is the age of the earliest TR, SHR or SR inscriptions (Table 8-19).

Region of change: OM1: Anatolia. OM2 & OM3: Inner Asia.

Glyph fit only with tamgas: OM1: 0. OM2: 0. OM3: 0.

Comments (SFG-97):

(i) Several researchers supposed the relationship of SHR <ž> and TR <ⁱčⁱ> (SFG-84) (Nagy 1895: 274; Sebestyén 1906: 273, 281), and the relation of SHR <ž> and TR , , ,

<š> (Sebestyén 1906: 281; Ligeti 1925: 51; Németh 1934: Appendix VII; Németh 1971: 38).

(ii) For the close relationship between the Old Turkic /s/ and /š/, see Table 7-9: 7-9. §.

(iii) According to Róna-Tas, TR <s^1, s^2, š> (SFG-97) could be derived from TR <l^2> (SFG-65) by adding a diacritic (Róna-Tas 1987: 7, 10). However, TR graphemes' shapes often reflect glyphs variations taken from other scripts, so it is unnecessary to derive the descendant TR graphemes studied from another TR glyph.

(iv) According to Clauson, TR <s^1> is not similar to either the Sogdian *semkat* <s> or the Middle Persian (Psalter) (Skjærvø 1996: 518) *semkat* <s>; but his opinion is that TR <s^1> is still close to these in that each consists of a combination of two curved lines (Clauson 1970: 70).

(v) According to Clauson, TR <š> originates from the *šin*, and he cites the example of early Sasanian glyphs, naming the Middle Persian (Psalter) <š>: (Clauson 1970: 70, 75) <š>. It should be noted that the glyph published by Skjærvø is somewhat different: (Skjærvø 1996: 518) <š>. It is unlikely that the—usually geometric—TR glyphs were created from these Middle Persian glyphs.

(vi) The Sogdian *semkat* <s> can be ancestor based on the sutra glyph.

(vii) The glyphs of the Imperial Aramaic <š> found in the inscriptions of the Babylonian Bowls are in Faulmann's publication (Faulmann 1880: 79). However, in other publications about the Babylonian Bowls' inscriptions (Layard 1853; Shaked et al. 2013), the variant of Imperial Aramaic <š> cannot be found. Only one stemless variant can be observed, e.g., (Layard 1853: 437).

(viii) In OM3, the Parthian and Khwarazmian glyphs are similar to the descendant Rovash glyphs.

(ix) Shapes of Hatran <š> and Armazian <š> are far from the descendant glyphs studied.

(x) Glass suggested the derivation of the Kharoṣṭhī (Aśoka, around 250 BC) (Glass 2000: 14) <ca> /c/ from the Aramaic *ṣāḏē* <ṣ> (SFG-82), and the lineage of the Kharoṣṭhī (Aśoka, around 250 BC) (Glass 2000: 63) <cha> /c^h/ from the Kharoṣṭhī <ca> (Glass 2000: 14, 16). The glyph of TR <s^1, s^2, š> is the same as the earliest (3rd c. BC) glyph of the Kharoṣṭhī <cha>, but due to the difference in their sound values, this lineage can be omitted. Moreover, the glyph distribution of TR demonstrates that the glyph variant TR could be derived by internal development.

SFG-98

Descendant feature (grapheme):

TR (Y) (Vasil'ev 1983 apud Harmatta 2004: 186), (Y: Begre, 8th–9th c.); (Y) (Kyzlasov, I. L. 1994: 70); (Y); (Kairžanov 2014: 18); (Kalbak-Tash I); (Y) (von Gabain 1941); (T) (Kairžanov 2014: 18) <š> /š/;

SHR (Erdőszentgyörgy, 13th–14th c.) /š/; (Székelydálya, around 1400) /ž/; (Nikolsburg, 1490–1526) /š/; (Wolfenbüttel, 1592–1666) /š/; (Rugonfalva, 16th–17th c.) /š/; (Gyulafehérvár, 1655) /ž/; (Kájoni's Ancient, 1673) *s* /š/ <š>;

SR (Mayatskoe-10, 9th c.) <š> /š/.

OM1 (SFG-98):

Kharoṣṭhī ancestor feature (grapheme):

Kharoṣṭhī (Aśoka, around 250 BC), (British Library) (Glass 2000: 14, 98) <śa> /ɕ/.

OM2 (SFG-98):
Brahmic ancestor feature (grapheme):

Brāhmī 𑀰, 𑀰, 𑀰 (Bühler 1898: Table after p. 123: Comparative Table of the oldest Semitic and the Brāhma alphabets); (Socotra [Jemen], T 32, LTR inscription, end of 2^{nd} c. AD – 4^{th} c.) 𑀰 (Strauch & Bukharin 2004: 133); (North Turkestan) 𑀰 (Róna-Tas 1991: 114, Table IV); (Standard North Turkestan) 𑀰 (Maue 2010: 9); (Tocharian) 𑀰 (Fischer 2001: 109) <śa>.

OM+ (SFG-98):
Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Achaemenid Iran) Λ; (Basins of the Amu Darya and the Syr Darya, 1^{st} c. BC –3^{rd} c. AD) Λ; (Sarmatia, 2^{nd} half of 1^{st} c. – 1^{st} half of 2^{nd} c. AD) Λ; (Kultobe, 1^{st}–3^{rd} c. AD) Λ; (Altay) Λ; (Mongolia) Λ; (Talas Valley) Λ <tamga> (details: Table 8-34).

Evaluation (SFG-98):
Changed script: TR, SHR & SR.
Region of relics: TR: Inner Asia; SHR: Carpathian Basin; SR: Pontus Steppe.
Source script family:
OM1: Kharoṣṭhī.
OM2: Brahmic.
Period of change:
OM1: 3^{rd} c. BC – 7^{th} c. AD, the using period of the Kharoṣṭhī script (Table 8-14).
OM2: 4^{th}–7^{th} c. AD, the using period of Brāhmī glyph variants presumed to be the ancestor (Table 8-15), the upper limit is the age of the earliest SHR or CBR inscriptions (Table 8-19).
Region of change: OM1 & OM2: Inner Asia.
Glyph fit only with tamgas: OM1: 1. OM2: 1.

Comments (SFG-98):

(i) Nagy supposed the relationship between SHR Λ <š> and TR ⅄ <č> (SFG-83) (Nagy 1895: 274).

(ii) Several researchers pointed to the agreement between SHR Λ <š> and TR Λ <š> (Sebestyén 1906: 273, 279; Ligeti 1925: 51; Németh 1934: Appendix VII; Németh 1971: 38; Püspöki Nagy 1977: 304). The grapheme presented by Sebestyén as the ancestor of Rovash Λ <š> is the Ancient Greek (8^{th}–5^{th} c. BC) 𐌑 (Powell 1991: 8) *san* <ᴍ> /s/ [s], for which he presumed the halving of the grapheme shape (Sebestyén 1906: 273, 279).

(iii) The basis of OM2 is Table 7-9: 7-10. §.

(iv) Interestingly, the descendant TR grapheme does not exist in the Orkhon variant of TR, only in the Yenisey and Talas variants.

(v) According to Róna-Tas, the TR grapheme with Λ glyph denoted [ʃ] near both velar and palatal vowels: <š> (Róna-Tas 1987: 9, 13).

(vi) According to Clauson, TR Λ <š> is presumably not borrowed, but it was own invention (Clauson 1970: 70).

(vii) The similarity of some South Semitic and Aegean graphemes can be observed (Hosszú 2017: 218), but no historical or cultural relationship is currently known to substantiate this, so these similarities are probably homoplasies (Table 2-7). An example of this is the South

Semitic <s^1>, some variants of which are similar to Rovash <š>: Safaitic (OCIANA-Safaitic 2017: xv); (O'Connor 1996: 99); , , , , , , , (Macdonald 2015: 31, 33, 37); , , , (Macdonald 2005: 82) <s^1> [ʃ] (Macdonald 2004: 496, 499).

SFG-99

Descendant feature (grapheme):

SHR (Nikolsburg, 1490–1526) *us* (Németh 1934) <š> /*š/;

CBR (Szarvas, first half of 8th c.) ; (Kiskundorozsma, end or last third of 8th c.) ; (Nagyszentmiklós, 8th–11th c.) , <š> /š/.

OM1 (SFG-99):

Anatolian-Greek Alphabetic ancestor feature (grapheme):

Carian (Memphis, Mylasa, Hyllarima, Sakkara, Sinuri, Stratonikeia) , (Kaunos, Memphis) , ; (Memphis, E.Me 37) (Masson 1978: 38; Adiego 2007a: 62–63), (Memphis, E.Me 14) (Masson 1978: 24; Adiego 2007a: 46), (Thessaloniki, pot fragment, first third of 5th c. BC) (Tzanavari & Christidis 1995: 13–17; Adiego 2007a: 164–165) <ś> /ç?/ (Adiego 2007a: 32, 215, 250; Adiego 2007e: 10);

Anatolian-Greek Alphabetic witness feature (grapheme): *Carian* (Memphis [Egypt]) , ; (Sais [Egyipt]) (Adiego 2007a: 32–33); (Hyllarima) , (Mylasa, Sinuri, Stratonikeia) , (Sinuri) , (Kaunos) ; (Kaunos, C.Ka 3) (Adiego 2007a: 152–153); (Kaunos, C.Ia 7) (Adiego 2007a: 149) <š> /š/ (Adiego 2007e: 250).

OM2 (SFG-99):

Kharoṣṭhī ancestor feature (grapheme):

Kharoṣṭhī (Aśoka, around 250 BC) , (Salomon 1998: 49); (British Library) , , ; (Khotan Dharmapada) ; (Niya) ; (Schøyen) , <ṣa> /ʂ/ (Glass 2000: 15).

OM3 (SFG-99):

Brahmic ancestor feature (grapheme):

Brāhmī (Archaic Tocharian) (Maue 2010: 10); (Standard Tocharian) (Maue 2010: 10); (North Turkestan) (Róna-Tas 1991: 73); (Tocharian) (Róna-Tas 1991: 114, Table IV); (Tocharian) (Sander 1968: Tafel 41) <ṣ̱a̱>;

Brāhmī (Tocharian) (Sander 1968: Tafel 41); (Tocharian) (Krause & Thomas 1960: 41); (North Turkestan) (Róna-Tas 1991: 73) <ṣ̱a̱>.

OM+ (SFG-99):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Achaimenid Iran) <tamga> (details: Table 8-34).

Evaluation (SFG-99):

Changed script: SHR & CBR.

Region of relics: SHR & CBR: Carpathian Basin.

Source script family:

OM1: Anatolian-Greek alphabetic.

OM2: Kharoṣṭhī.

OM3: Brahmic.

Period of change:

OM1: 7th–3rd c. BC, the using period of the Carian script (Table 8-8).

OM2: 3rd c. BC – 7th c. AD, the using period of the Kharoṣṭhī script (Table 8-14).
OM3: 4th–7th c. AD, the using period of Brāhmī glyph variants presumed to be the ancestor (Table 8-15), the upper limit is the age of the earliest SHR or CBR inscriptions (Table 8-19).

Region of change: OM1: Anatolia. OM2 & OM3: Inner Asia.
Glyph fit only with tamgas: OM1: 0. OM2: 1. OM3: 1.

Comments (SFG-99):

(i) The descendant graphemes of SFG-99 and SFG-100 may be relatives.

(ii) According to Adiego, the sound values of the Carian <ś> and Carian <š> could be very similar (OM1), in case of <ś> there are two possibilities: one is a palatal /ç/ similar to the Carian <š>, the other is an affricate differing from /tš/ (Adiego 2007a: 207, 250–251).

(iii) The basis of OM3 is Table 7-9: 7-10. §. Only the Tocharian variant of Brāhmī <ṣ̱a> is worth considering, not the other glyph variants.

(iv) According to Vékony, CBR <š> is inseparable from the Parthian *šīn* (Vékony 1987a: 53; Vékony 2004a: 155); however, the glyphs of the Parthian (1st–2nd c. AD) , *šīn* <š> /š, ž/ (Skjærvø 1996: 518) (SFG-97) alter from the glyphs of the descendant grapheme. The followings are also too different from the descendant grapheme: Hatran , , , , , , <š> (SFG-97); Manichean (Sogdian) (3rd c. AD or earlier) (Skjærvø 1996: 519) *šin* <š> /š/; Middle Persian (inscriptional) (Rosenthal et al. 1986–2011: Table 3); (Ḥājiābād, 3rd c. AD) , (coins, 4th–6th c. AD) (Taylor 1883, vol. II: 236) *šin* <š> /š/.

(v) Based on the glyphs, the Syriac (Estrangela) (ending), (Taylor 1883, vol. I: 288), (beginning, middle); (Nestorian) (ending), (beginning, middle) and Christian Sogdian (Skjærvø 1996: 519) *semkat* <s> /s/ could be ancestor; however, their /s/ sound value differs from the sound value of the descendant graphemes, which is consequently /š/. In the Turkic language, the /s/ > /š/ sound change was possible (Table 7-9: 7-9. §), but this would be an additional assumption; therefore, these graphemes are less likely ancestor (*lex parsimoniae,* Table 4-1).

(vi) For possible interactions between multiple descendant grapheme lineages, see Table 7-5: 7-1. §.

SFG-100

Descendant feature (grapheme):
TR (O, Y) (Kairžanov 2014: 18); (Y) , , ◇ (Kyzlasov, I. L. 1994: 94, 118); (Y) ◇, (Kairžanov 2014: 18) <š> /š/, /aš/, /ša/, /eš/, /še/ (Tuna 1960: 217) or /aš/ (Kyzlasov, I. L. 1994: 117, 131);
TR (Y) , (Büyük Larousse 9: 4679); (de Rachewiltz & Rybatzki 2010: Fig. 2) <š> (Büyük Larousse 9: 4679; de Rachewiltz & Rybatzki 2010: Fig. 2).

OM1 (SFG-100):
Brahmic ancestor feature (grapheme):
Brāhmī (alphabets r and s [Early Turkestan]) (Sander 1968: Tafel 30); (Cursive Gupta of Central Asia) , (Tocharian) (Fischer 2001: 109) <ṣa>.

OM+ (SFG-100):
Tamgas ancestor feature (glyph shapes or styles):
Tamgas (Bayte III) ◇, , ; (Basins of the Amu Darya and the Syr Darya, 6th–2nd c. BC)

ʘ, ◊; (Sarmatia, 2nd half of 2nd c. – 1st half of 3rd c. AD) ⌑; (coins with double-humped camel, 7th–8th c. AD) ✧ <tamga> (details: Table 8-34).

Evaluation (SFG-100):
Changed script: TR.
Region of relics: TR: Inner Asia.
Source script family:
OM1: Brahmic.
Period of change:
OM1: 4th–8th c. AD, the using period of Brāhmī glyph variants presumed to be the ancestor (Table 8-15), the upper limit is the age of the earliest TR inscriptions (Table 8-29).
Region of change: OM1: Inner Asia.
Glyph fit only with tamgas: OM1: 1.

Comments (SFG-100):

(i) All glyphs of descendant graphemes can be found among tamgas; therefore, it is very likely that descendant glyphs were borrowed from tamgas.

(ii) In the Old Turkic texts written with the Khotanese variant of Brāhmī script, the /š/ was represented by the Brāhmī <ś> (Róna-Tas 1991: 91, 114, Table IV), cf. Table 7-9: 7-10. §.

(iii) The basis of OM3 is Table 7-9: 7-10. §. Based on the topological difference, the Brāhmī ᔦ, ᔦ, ᔦ <śa> and ᔓ <s̱a̱> (SFG-99) were surely not ancestor in SFG-100.

(iv) In the Turkic language, the /s/ > /š/ sound change was possible (Table 7-9: 7-9. §). Despite of this, the following graphemes are not considered ancestor since their sound value is /s/ and not /š/: Imperial Aramaic (satrapies, 5th–4th c. BC) ⟋, ⟋, (monuments, Egypt, 4th–3rd c. BC) ᚴ, ᚴ, (papyrus, Egypt, 2nd c. BC) ᚺ (Taylor 1883, vol. I: 250); (7th c. BC) ᛏ, ᛁ, ᛁ, ᛏ, ᛁ, ᚦ, ᚦ, (6th c. BC) ᚦ, ᚦ (Gibson 1975); (Elephantine Papyri, 6th c. BC) ᚦ (Glass 2000: 14); ᚦ; (monumental) ᚦ, (Assyrian and Egyptian papyri) ᚦ, ᚺ, (Babylonian Bowls) ◿, ◻ (Faulmann 1880: 79); (Aśoka, around 250 BC) ᒣ (Glass 2000: 14); ᚦ (MacKenzie 1971: xi) *semkat* <s> /s/ [s]; Hebrew [Qumran Manuscripts, 1st c. BC] ס *sāmek* <s> /s/; Khwarazmian (coins) ᑐ, ᑐ (Vainberg 1977: Table VIII) <s>.

(v) Some glyphs of the Hatran ᐅ, ᑕ, ᐅ, ᒪ, ᑕ, ᑕ, ᛉ <š> (SFG-97) are somewhat similar to the studied TR ◊, ☐ glyphs; however, the Hatran script can be handled as a witness, only (Table 4-5: 4-10. §).

(vi) The glyph variants of the Greco-Bactrian (Surkh Kotal, SH 4M [Afganistan], after AD 162) Þ (Harmatta 1994a: 420–423); (Loulan, 4th c. AD) ᚦ (Ghirshman 1948: 63) <š> (Skjærvø 2006: 115) or <ṣ> (Harmatta 1994a: 413) /š/ differ from the descendant graphemes.

SFG-101

Descendant feature (grapheme):

TR (O, T, Y) | (Kyzlasov, I. L. 1994: 71); (Mendur-Sokkon IV) |, |, / <s^2> /s/ (Kyzlasov, I. L. 1994: 131); (O, Y) | <s^1, s^2, š^1, š^2> /s, š/ (Róna-Tas 1987: 9, 13); (O, T, Y) | (Kyzlasov, I. L. 1994: 71) <s^2> /s/ (Kyzlasov, I. L. 1994: 131); (O) | <s^2, š>, ↰ (von Gabain 1941) <s^1> /s/;

SHR (Homoródkarácsonyfalva Stone inscription, around 13th c.) |; (Erdőszentgyörgy, 13th–14th c.) \; (Nikolsburg, 1490–1526) | *s*; (Wolfenbüttel, 1592–1666) /; (Bél, 1718) ⌒ *ſz* <s> /s/;

CBR (Jánoshida, last third of 7th c.) ǀ; (Ozora-Tótipuszta, last third of 7th c.) ǀ; (Szarvas, first half of 8th c.) ǀ; (Nagyszentmiklós, 8th–11th c.) ǀ <s> /s/;
SR (Jitkov, first third of 8th c.) ǀ; (Mayatskoe-10, 9th c.) ǀ; (Homokmégy-Halom, 10th c.) ǀ <s> /s/.

OM1 (SFG-101):
Anatolian Hieroglyphic ancestor feature (grapheme):
Anatolian Hieroglyphic (KULULU 4) ǀ, ǀ (Payne, A. 2010a: 133) *380 <sa$_8$>.

OM2 (SFG-101):
Greek Alphabetic ancestor feature (grapheme):
Greco-Bactrian (Loulan, 4th c. AD) ϲ, ϲ, ϲ (Ghirshman 1948: 63) *sigma* <σ>;
Anatolian-Greek Alphabetic witness feature (grapheme): *Ancient Greek* (Naxos, 8th–7th c. BC) ≷, ≷ (Healey 1990a: 37) *sigma* <σ> /s/.

OM3 (SFG-101):
Kharoṣṭhī ancestor feature (grapheme):
Kharoṣṭhī (cursivized, the period of the post-Kaniṣka Kushan kings) 𐨯, (Senior 13r 3–47) 𐨯 (Glass 2000: 105–106) <sa>;
Kharoṣṭhī witness feature (grapheme): *Kharoṣṭhī* (Aśoka, around 250 BC) 𐨯 (Glass 2000: 14, 104); (British Library) 𐨯; (Niya) 𐨯; (Schøyen) 𐨯 (Glass 2000: 104) <sa>.

OM4 (SFG-101):
Rovash ancestor feature (grapheme):
TR ᛉ, ᛉ <s^1>, ᛉ, ᛉ <s^1, š>; *SR* ᛉ <s> (details: SFG-97).

OM+ (SFG-101):
Tamgas ancestor feature (glyph shapes or styles):
Tamgas (Tashkent Oasis) ǀ; (Altay) ǀ <tamga> (details: Table 8-34).

Evaluation (SFG-101):
Changed script: TR, SHR, CBR & SR.
Region of relics: TR: Inner Asia; SHR & CBR: Carpathian Basin; SR: Pontus Steppe & Carpathian Basin.
Source script family:
OM1: Anatolian Hieroglyphic.
OM2: Greek Alphabetic.
OM3: Kharoṣṭhī.
OM4: Rovash (internal development) (becoming similar, borrowing, glyph variant forming, separation or simplification [Table 4-2]; line deletion or use of known glyph [Table 4-3]).
Period of change:
OM1: around 7th c. BC, the end of Anatolian Hieroglyphic script (Table 8-5).
OM2: AD 342–781, the using period of the Greco-Bactrian script (Table 8-13).
OM3: 2nd–4th c. AD, the period of post-Kaniṣka Kushan kings, where the cursivized type of Kharoṣṭhī <sa> was used (cf. Glass 2000: 106, see Comments below).
OM4: Before 7th c. AD, the limit is the age of the earliest TR, SHR, CBR or SR inscriptions (Table 8-29).

Region of change: OM1: Anatolia. OM2, OM3 & OM4: Inner Asia.
Glyph fit only with tamgas: OM1: 0. OM2: 1. OM3: 1. OM4: 1.

Comments (SFG-101):

(i) Several pointed to the equality between SHR | <s> and TR | <s²> (Nagy 1895: 274; Sebestyén 1906: 273, 279; Mészáros 1915: 4; Németh 1934: Appendix VII; Németh 1971: 38; Püspöki Nagy 1977: 304).

(ii) For the close relationship of the Old Turkic /s/ and /š/, see Table 7-9: 7-9. §.

(iii) According to Sebestyén, the ancestor of Rovash | <s> is Ancient Greek *iota* (Sebestyén 1906: 273, 279), cf. Ancient Greek (Naxos, Boiotia, 8th–7th c. BC) | (Healey 1990a: 37) *iota* <ι>. This concept is unlikely.

(iv) The glyph variants TR ⤷ <s¹> and SHR ⤥ <s> are written with calligraphic style; therefore, from their curved shapes, it is not possible to conclude the provenance of the descendant graphemes.

(v) According to Clauson, TR | <s¹> originates from the Greek *sigma* <σ>. He cites the Hephthalite coins, on which the line of the <σ> is almost straight (Clauson 1970: 70), see OM2.

(vi) Concerning OM3, Kharoṣṭhī <sa> is taken as the most reliable test grapheme for dating Kharoṣṭhī inscriptions, since it has distinct types to different periods of Kharoṣṭhī script (Glass 2000: 104). The cursivized glyph type is characteristic of the period of the post-Kaniṣka Kushan kings (Glass 2000: 106); that is the period 2nd–4th c. AD.

(vii) In Old Turkic language there was a /z/ > /s/ devoicing (Table 7-9: 7-11. §). However, the descendant grapheme | <s> has never /z/ in any surviving inscription; therefore, it is difficult to support the | <s> represented ever /z/.

(viii) Surely the accented TR (Toyok) i (Clauson 1970: 75) <š²> /š/ belongs to SFG-101.

(ix) Strikingly, Sidetic (S2 Sidetic-Greek bilingual) | (Nikolaev 2017: 219) <ś> (Adiego 2007e: 14) or <z> (Nollé 2001: 629) /palatal sibilant/ (Nikolaev 2017: 219–226) resembles Rovash | <s> in shape and sound value.

SFG-102

Descendant feature (grapheme):

SHR (Nikolsburg, 1490–1526) ⊟ *eʒ* /z/; (Csíkszentmihály, 1501) ⊟ /z/; (Constantinople, 1515, LTR writing direction) ⊟, ⊟, ⊟ /z/; (Wolfenbüttel, 1592–1666) # /z/; (Rudimenta-Giessen, 1598) # /z/; (Farkaslaki, 1624) # /z/; (Bonyhai's Alphabet, 1627) # /z/; (Bonyhai's Example, ca. 1627) # /s, z?/; (Gyulafehérvár, 1655) B /z/; (Szegedi, 1655) ⊟ /z/; (Kájoni's Ancient, 1673) ⊟ *z* /z/; (Patakfalvi, 1776–1785) ⊟ /z/ <z>;

SHR (Farkaslaki, 1624) # /sá/ <za> (see Comments).

OM1 (SFG-102):

Brahmic ancestor feature (grapheme):

Brāhmī (Tocharian) ⟡ (Krause & Thomas 1960: 41); (Tocharian) ⟡ (Sander 1968: Tafel 41) <s̱a>.

OM+ (SFG-102):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Bayte III) ⊟; (Kanka) ⊟, ⊟ <tamga> (details: Table 8-34).

Evaluation (SFG-102):
Changed script: SHR.
Region of relics: SHR: Carpathian Basin.
Source script family:
OM1: Brahmic.
Period of change:
OM1: 4th–9th c. AD, the using period of Brāhmī glyph variants presumed to be the ancestor (Table 8-15), the upper limit is the Hungarian conquest of the Carpathian Basin since after this any influence of the Brāhmī script was impossible.
Region of change: OM1: Inner Asia.
Glyph fit only with tamgas: OM1: 10.

Comments (SFG-102):

(i) According to Sebestyén, SHR 𐳯 <z> is a relative of SHR 𐳆 <č> (SFG-82), he considers the former to be a variant of the latter created by adding a slant line (Sebestyén 1906: 273, 281). He noted that its glyph could be influenced by the glyph variant 𐌆 of the Ancient Greek *zeta* <ζ> (SFG-39).

(ii) According to Róna-Tas, in the Old Turkic texts written with Khotanese Brāhmī, the Old Turkic /z/ was denoted by the Brāhmī <s> or the digraph <ys> (Róna-Tas 1991: 91). However, in another page of his publication, Róna-Tas gives only the digraph <ys>, which denoted the Old Turkic /z/ in the Khotanese Brāhmī script (Róna-Tas 1991: 116, Table VI).

(iii) According to Maue, in Uigur, only /z/ is a member of the native phoneme system while /ʒ/ is marginal as a foreign phoneme in borrowed words. In Brāhmī script, /ʒ/ may be represented by <ź> or <ẓ>. In some Brāhmī manuscripts, <s> also stands for /z/. It is yet unclear whether it is a case of undifferentiated spelling or indication of linguistic development (Maue, Dieter: Personal communication by email, 9 December 2019).

(iv) Khotanese Brāhmī does not know <z>, but uses the digraph <ys> for [z] instead (cf. e.g., Emmerick 1989: 208).

(v) Parthian, Middle Persian and Manichean scripts used the *ṣāḏē* <č> (details: SFG-82 & SFG-83) to denote the Parthian *ž* and the Middle Persian *z* between vowels (Skjærvø 1996: 521). This Middle Iranian orthographic rule might be used for SHR 𐳆 /č/ <č>; SR 𐳆, 𐳆 /s/; 𐳆 /č/ <č> (SFG-82) to represent /z/; however, this assumption is improbable.

(vi) Neither TR 𐰕, 𐰖 <z> (SFG-40) nor CBR 𐳯 <z> (SFG-41) is likely ancestor of SFG-102.

(vii) In the ligature in Farkaslaki's inscription (𐳋𐳯𐳓𐳋𐳓𐳀𐳥𐳛 /felakas̲á̲k/ 'he will be hanged') and in Bonyhai's Example (𐳤𐳉𐳢𐳐𐳙𐳦 /serint/ 'according to') the sound value of SHR 𐳯 <z> is /s/ besides /z/. The reason for these cases is not clear. One possibility is that this notation is due to the Old Hungarian orthography of the Latin script (Table 8-18), but another possibility is that these are surviving examples of a more archaic sound value /s/.

(viii) The descendants of Old Canaanite (Serabit el-Khadem, ca. 18th c. BC) ═, ≠ (Albright 1948: 6–22); (Timna) ═ (Wimmer 2010: 7; Colless 2010: 78–84) <z/ḏ> are Phoenician 𐤆 <z> (SFG-39), South Semitic <z> (Hismaic I, ⊢⊣, Taymanitic ⊢⊣, Thamudic C I, ⊢⊣, Thamudic D ⊢⊣ [Macdonald 2004: 496], Geʿez abjad H <z> /z/), South Semitic <ḏ> (Ancient South Arabian [Minaic, Sabaic, Hasaitic] 𐩹, Dumaitic 8, Thamudic B ⫞⊦, ⧺, ╫ [Macdonald 2004: 496]; Dadanitic 𐪙, ⩔, ⩔, ⩔ [Macdonald 2010: 13–14] <ḏ> /ḏ/ [ð]); Etruscan

I, ↨ <z> /ts/ (Marchesini 2009: 125); Messapic (first half of 6th c. – end of 2nd c. BC) I <z> /z/. Among these descendants, there are graphemes with sound values /ts/ or /z/, and there are other graphemes with close shape. For the shape is the South Semitic H, 8 <ḏ>, and for sound value the Ancient Greek <z> /ds, sd/zd/dz/ and several Anatolian-Greek Alphabetic and Italic <z> /z/ graphemes are closer to SHR ⊟, N /z/ <z>. Overall, the descendants of the Old Canaanite H <z/ḏ> include graphemes very similar to the descendant graphemes in SFG-102, either in shape or sound value. Thus, there is evidence that the descendants of the Old Canaanite H <z/ḏ> underwent the formal and phonological development required for SHR <z> to form, but no grapheme is known among these descendants that are both formally and phonetically identical to SHR <z>. Based on all these arguments, this lineage cannot be expected.

SFG-103

Descendant feature (grapheme):

TR (Y) h (Vasil'ev 1983 apud Harmatta 1997b: 163); (Y) h, (O) h, (Y) h, (T) И (Kyzlasov, I. L. 1994: 71); (O) h; (T) И, (Y) ᒥ, ᒥ, h, h, h, (O) h, h, h (Kairžanov 2014: 18), (Y) h (von Gabain 1941), (Y) h, ᒋ (Büyük Larousse 9: 4679), (Toyok) ꞁ (Clauson 1970: 75); (Urkosh, 8th–9th c.) h (Tugusheva et al. 2014: 78, 81); (Kalbak-Tash V) h; (Bichiktu-Boom II/1) h <t^{2}> /t/.

OM1 (SFG-103):

Canaanite ancestor feature (grapheme):

Phoenician (ca. 700 BC) ꞁ, ꞁ, (end of 6th c. BC) ꞁ, (mid-5th c. BC) ꞁ, (mid-5th c. BC) ꞁ, (first half of 4th c. BC) ꞁ, (second half of 5th c. BC) ꞁ; (ca. 550 BC) ꞁ; (ca. 550 BC) ꞁ; (5th–4th c. BC) ꞁ, ꞁ, ꞁ, (386 BC) ꞁ, (ca. 305 BC) ꞁ, (96 BC) ꞁ *tāw* <t> /t/ (details: SFG-29).

OM2 (SFG-103):

Aramaic ancestor feature (grapheme):

Imperial Aramaic (satrapies, 5th–4th c. BC) ꞁ, ꞁ, (monuments, Egypt, 4th–3rd c. BC) ɦ, (papyrus, Egypt, 2nd c. BC) ꞁ (Taylor 1883, vol. I: 250); (7th–6th c. BC) ꞁ, ʌ, ꞁ, (6th c. BC) ꞁ (Gibson 1975); (Elephantine Papyri, 6th c. BC) ꞁ (Glass 2000: 14); (Daskyleion) ꞁ, (Kandahar) ꞁ (Rosenthal et al. 1986–2011: Table 3); (Aśoka, around 250 BC) ꞁ (Glass 2000: 14); ꞁ (MacKenzie 1971: xi); (monumental) ɦ, (Assyrian and Egyptian papyri) ɦ, (Babylonian Bowls) ɦ, ɲ (Faulmann 1880: 79) *tāw* <t> /t, θ/.

OM3 (SFG-103):

Middle Iranian ancestor feature (grapheme):

Parthian (early, Nisa, 1st c. BC) ꞁ (Rosenthal et al. 1986–2011: Table 3); ꞁ (Häberl 2006: 57); (Avroman, 13/12 BC) ꞁ, ꞁ (Ivantchik & Lurje 2013: 290); (inscriptional) ꞁ (Rosenthal et al. 1986–2011: Table 3); (inscriptions, 3rd c. AD) ꞁ (MacKenzie 1971: xi); ꞁ (Skjærvø 1996: 518); (coins of the Parthian kings, 1st–2nd c. AD) h, ꞁ, (Ḥājiābād, 3rd c. AD) ꞁ (Taylor 1883, vol. II: 236) *tāw* <t> /t, d/;

Khwarazmian (Chirik-Rabat [Kyzylorda Region, Kazakhstan], 4th–2nd c. BC) ꞁ (Ivantchik & Lurje 2013: 286–287); (coins) ꞁ, (Tok-kala, 7th–8th c. AD) ꞁ (Vainberg 1977: Table VIII) <t>;

Sogdian (early, Kultobe, before 4th c. AD) ꞁ (Sims-Williams & Grenet 2006: colour illustrations without page numbering); (Ancient Letters, early 4th c. AD) ꞁ, ꞁ

(Skjærvø 1996: 519); (Ancient Letters, beginning of 4th c. AD) ϧ (Harmatta 2004: 186); (sutra) ﻟ, (Skjærvø 1996: 519) *tāw* <t> /t, θ/;

Manichean (Sogdian) (3rd c. AD or earlier) (Skjærvø 1996: 519); (Durkin-Meisterernst 2005: Table 1) *tāw* <t> /t, θ/.

Evaluation (SFG-103):
Changed script: TR.
Region of relics: TR: Inner Asia.
Source script family:
OM1: Canaanite.
OM2: Aramaic.
OM3: Middle Iranian.
Period of change:
OM1: 11th c. BC – 2nd c. AD, the using period of the Phoenician script (Table 8-6).
OM2: 7th/6th–1st c. BC, the using period of the Imperial Aramaic script (Table 8-12).
OM3: 2nd c. BC – 8th c. AD, the union of the using periods of Parthian (Table 8-16), Khwarazmian, Sogdian and Manichean scripts; the upper limit is the age of the earliest TR inscriptions (Table 8-19).
Region of change: OM1: Anatolia. OM2 & OM3: Inner Asia.
Glyph fit only with tamgas: OM1: 0. OM2: 0. OM3: 0.

Comments (SFG-103):

(i) Presumably, SR (Homokmégy-Halom, 10th c.) ʎ <d/t> /d/ or /t/ (see Comments) is also part of SFG-103; however, due to the deciphering uncertaincy of the middle graph group of the Homokmégy-Halom inscription (ˈ˛ˈʎϑl) (Table 8-32) it is possible that the sound value of SR ʎ <d/t> is not /t/ but /d/ (Vékony 2004a: 58–59). This question is unresolved based on the available data.

(ii) According to Sebestyén, TR ʰ <t> originates from Aramaic <t> (Sebestyén 1906: 273, 280).

(iii) The characteristic types of the glyphs of TR <t2>: ɦ, ɓ and И. These glyphs can easily transform into each other, cf. TR N, ᴎ, ⲇ <AqA> (SFG-58).

(iv) According to Clauson, the TR ɦ <t2> may be similar to the Greco-Bactrian Loulan, 4th c. AD) (Ghirshman 1948: 63) *tau* <τ> (Clauson 1970: 70).

SFG-104

Descendant feature (grapheme):

SHR (Vargyas, 12th–13th c.) ˥ /d, t/; (Székelydálya, around 1400) ˥ /t/; (Nikolsburg, 1490–1526) ˥ *eth* /t/; (Constantinople, 1515, LTR writing direction) ˩ /d/; (Wolfenbüttel, 1592–1666) ɏ /t/; (Rugonfalva, 16th–17th c.) ˥ /t/; (Szegedi, 1655) ⅄ /t/; (Marsigli's Alphabet, 1690) ɏ *et* /t/; (Patakfalvi, 1776–1785) ˥ /t/ <t>.

OM1 (SFG-104):

Anatolian-Greek Alphabetic ancestor feature (grapheme):

Ancient Greek (Corinth, Potters' Quarter Ceramics, ca. 700 BC) ˥, Y, T, (Thera, Ankylion epitaph, early 7th c. BC) Ⴤ, Ꞁ (McCarter 1975) *tau* <τ> /t/;

Anatolian-Greek alphabetic witness feature (grapheme): *Ancient Greek* (Athens, 8th–7th c. BC) T, (Korkyra, 8th–7th c. BC) T (Healey 1990a: 37); Ꞁ (Jeffery 1961: 35–35); (Athens, Thera, Crete, Naxos, Korkyra, 8th–7th c. BC) Τ (Healey 1990a: 37); (Thera, 7th c. BC) Τ, Y (Haarmann 1990: 287) *tau* <τ> /t/;

Italic witness feature (grapheme): *Faliscan* (4th–1st c. BC) 𐌕, 𐌕 <t>; *Umbrian* (Etruscan, 4th c. – first half of 1st c. BC) 𐌕, 𐌕 <t> [d, t].

OM2 (SFG-104):
Middle Iranian ancestor feature (grapheme):
Parthian 𐭕, 𐭕, 𐭕 *tāw* <t> /t, d/ (details: SFG-103).

OM3 (SFG-104):
Rovash ancestor feature (grapheme):
TR 𐱅, 𐱅 <t^2> /t/ (details: SFG-103).

OM+ (SFG-104):
Tamgas ancestor feature (glyph shapes or styles):
Tamgas (Basins of the Amu Darya and the Syr Darya, 6th–2nd c. BC) ᛘ <tamga> (details: Table 8-34).

Evaluation (SFG-104):
Changed script: SHR.
Region of relics: SHR: Carpathian Basin.
Source script family:
OM1: Anatolian-Greek Alphabetic.
OM2: Middle Iranian.
OM3: Rovash (internal development) (becoming similar, borrowing or glyph-variant forming [Table 4-2]; straightening, mirroring or use of known glyph [Table 4-3]).
Period of change:
OM1: 9th–5th c. BC, the using period of the Ancient Greek script (Table 8-8).
OM2: 2nd c. BC – 3th c. AD, the using period of the Parthian script (Table 8-16).
OM3: 8th–9th c. AD, the upper limit is the Hungarian conquest of the Carpathian Basin since, after this, any influence of TR was very unlikely (Table 8-19).
Region of change: OM1: Anatolia. OM2 & OM3: Inner Asia.
Glyph fit only with tamgas: OM1: 0. OM2: 1. OM3: 1.

Comments (SFG-104):

(i) Nagy supposed the relationship of SHR 𐳦 <t> and TR 𐱅 <t^2> (SFG-103) (Nagy 1895: 274). According to Sebestyén, SHR 𐳦 <t> is ultimately derived from Phoenician 𐤕 *tāw* <t> (SFG-29), and also pointed out that Umbrian 𐌕 <t> is similar in shape to SHR 𐳦 <t> (Sebestyén 1906: 273, 279–280).

(ii) The /d/ sound value of SHR 𐳦 <t> could originate from the special properties of the Hungarian /language, where a /t/ > /d/ sound change happened in the Ancient Hungarian linguistic age (1st millennium BC – 9th c. AD). The fact that SHR 𐳧, 𐳧 <nt> (SFG-107) probably derived from SHR 𐳦 <t> survived only with voiceless sound makes it more likely that SHR 𐳦 <t> originally had only /t/ sound value and only because of the evolution of the Hungarian language also received /d/ sound value.

SFG-105

Descendant feature (grapheme):

TR (O, T, Y) 𐰞 (Thomsen 1893: 9; Kyzlasov, I. L. 1994: 70; Kairžanov 2014: 18) <ld>, <lt> /ld/, /lt/;

SR (Mayatskoe-10, 9th c.) 𐰞 <lt> /lt/.

OM1 (SFG-105):

Anatolian-Greek Alphabetic ancestor feature (grapheme):

Carian (Kaunos) H; (Kildara, Memphis, Sinuri, Stratonikeia) I; (Memphis, E.Me 37) I (Masson 1978: 38; Adiego 2007a: 62–63); (Hyllarima) Λ <λ> /λδ/? (Adiego 2007a: 249).

OM2 (SFG-105):

Middle Iranian ancestor feature (grapheme):

Parthian 𐭕, 𐭕 <t> (details: SFG-103);

Sogdian 𐼼, ħ <t> (details: SFG-103).

OM+ (SFG-105):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Basins of the Amu Darya and the Syr Darya, 1st c. BC –3rd c. AD) 𐰞; (Beskepe) 𐰞 <tamga> (details: Table 8-34).

Evaluation (SFG-105):

Changed script: TR & SR.

Region of relics: TR: Inner Asia; SR: Pontus Steppe.

Source script family:

OM1: Anatolian-Greek Alphabetic.

OM2: Middle Iranian.

Period of change:

OM1: 7th–3rd c. BC, the using period of the Carian script (Table 8-8).

OM2: 2nd c. BC – 8th c. AD, the union of the using periods of Parthian (Table 8-16) and Sogdian scripts, the upper limit is the age of the earliest TR or SR relics (Table 8-19).

Region of change: OM1: Anatolian-Greek Alphabetic. OM2: Inner Asia.

Glyph fit only with tamgas: OM1: 0. OM2: 1.

Comments (SFG-105):

(i) Concerning OM1, assuming a H > 𐰞 feature transformation, Carian <λ> might be the ancestor. Examples for similar feature transformations: TR 𐰛, 𐰜, 𐰝 <Ẅ> (SFG-35); Runic (Elder Fuþark) (Region of Denmark and the North Sea) ᚢ (Looijenga 1997: 73, 82), (Kylver Stone, ca. 5th c. AD) ᛖ, (Anglo-Frisian Fuþorc) ᛖ, (Elder Fuþark) ᛖ (Looijenga 2003: 6), (Bergakker, Engers) ᛖ (Looijenga 1997: 73, 82) <e>; Greco-Bactrian ϻ, ϻ, ϻ *mu* <μ> (SFG-69).

(ii) According to Róna-Tas, TR 𐰞 <ld> could be derived from Sogdian <l, δ> (Róna-Tas 1987: 10–12): (Ancient Letters, early 4th c. AD) ↘ (Skjærvø 1996: 519); (Ancient Letters, beginning of 4th c. AD) ↘ (Harmatta 2004: 186); (sutra) ↘, ↘ (Skjærvø 1996: 519) *lāmaḏ* <l, δ> /δ/ (Skjærvø 1996: 519). However, this does not seem likely, cf. Table 7-10: 7-16. §.

(iii) The background of OM2 is based on Table 7-10: 7-16. §, it is conceivable that a <t> was borrowed, and its glyph was replaced by a tamga listed in OM+.

SFG-106

Descendant feature (grapheme):

SHR (Nikolsburg, 1490–1526) Ẋ *athÿ;* (Bögöz, end of 15th – beginning of 16th c.) Ẋ; (Csíkszentmihály, 1501) Ẋ; (Farkaslaki, 1624) Ẋ; (Szegedi, 1655) ⋇, Ẋ; (Szentpéteri, 1699–1702) ✕ *ty* <t'> /t'/;

CBR (Ozora-Tótipuszta, last third of 7th c.) ᛉ; (Környe, end of 7th c.) ᚼ, ᚾ; (Kiskundorozsma, end or last third of 8th c.) ᛉ <t> /t/;

SR (Mayatskoe-2, 9th c.) Ẋ <t> /t/;

SR (Achik-Tash, 8th c.) ᛉ; (Khumara-6, 9th–10th c.) ᛏ; (Khumara-7, 9th–10th c.) ᛏ <t> /t/.

OM1 (SFG-106):

Canaanite ancestor feature (grapheme):

Phoenician (later) ᚠ, ᚮ (Fossey 1948); ᛠ (Faulmann 1880: 78) *tāw* <t> /t/;

Old Aramaic (Nineveh, 7th c. BC) ᚠ, ᚠ (Taylor 1883, vol. I: 250) *tāw* <t> /t/;

Canaanite witness feature (grapheme): *Phoenician* (ʿIzbet Ṣarṭah Ostracon, ca. 1100 BC) +, (arrowheads, mid-11th c. BC) ✕ (Rollston 2008a: 84); ✚ (Colless 2010: 96); (Byblos, 11th–10th c. BC) ✕; (Tell Faḫariyeh, 9th c. BC) X (Lipiński 1994: 27); (Kilamuwa Stele, Samal, ca. 825 BC) ⊁ (Valério 2008: 115); (Karatepe, ca. 700 BC) ⸸; (Ipsambul [Abu Simbel, Egypt] wall inscription, ca. 700 BC) ᚠ, ᚠ, (Sulcis inscription, Sardinia, end of 6th c. BC) ᚠ, (Yehaumilk inscription, Byblos, mid-5th c. BC) ᚠ, (Eshmunazor Sarcophagus, Sidon, mid-5th c. BC) ᚠ, (Batnoam Sarcophagus, Byblos, first half of 4th c. BC) ᚠ, (Bodashtart inscription, Sidon, second half of 5th c. BC) ᚠ (Röllig 1995: 206–207); (cursive, Kition Tariff A, ca. 550 BC) ᚠ (Healey 1974: 58); (influenced by cursive formal glyphs, Kition Tariff B, ca. 550 BC) ᚠ (Healey 1974: 58); (Saïda Ostraca, Sidon, 5th–4th c. BC) ᚣ, ᚣ, ᚣ, (Milkyaton inscription, Idalion, 386 BC) ᚠ, (Abdosir inscription, Lárnaka, ca. 305 BC) ᚠ, (Pirée inscription, Athens, 96 BC) ᚠ (Röllig 1995: 208–209); (Byblos, 5th–4th c. BC) ᚠ (Fossey 1948) *tāw* <t> /t/ [t] (Gutman & Avanzati 2013); *Punic* ᚠ, ᚠ (Amadasi Guzzo 2011: 131); (Carthage, 3rd c. BC) ᚠ; (cursive) ᚴ, ᚴ, T (Jensen 1969b: 282) *tāw* <t> /t/; *Old Aramaic* (Zinjîrlû [Zenjirli], late 9th–8th c. BC) ᚷ, ᚷ; (Deir ’Allā, around 800 BC) ᚠ (Glass 2000: 14); (ca. 900 – ca. 800/775 BC) (Rollston 2008a: 85) ᚠ; (10th–6th c. BC) ᚠ, ᚠ (Gibson 1975) *tāw* <t>;

South Semitic witness feature (grapheme): *Safaitic* ✕, ⊹, ⊹, ⊹, ⋊ (Macdonald 2015: 31, 37) <t> /t/;

Anatolian-Greek Alphabetic witness feature (grapheme): *Sidetic* (S2 Sidetic-Greek bilingual) ᛘ (Nikolaev 2017: 219), (inscriptions) Ⴎ, Ⴎ (Rizza 2005: 72), Ⴎ (Adiego 2007e: 14) <d>;

Paleo-Hispanic witness feature (grapheme): *Southeastern Iberian* (dual?) +, X (Faria 1992: 45) /ta?/, Ẋ /da?/ <da/ta> (Ferrer i Jané 2010: 80) or <ta> (Rodríguez Ramos 2002: 237); *Northeastern Iberian* X <ta> /da, ta/, (dual) /da/ (details: SFG-29); *Northeastern Iberian* (Gallia Narbonensis) Ẋ, X (Hesperia: Narbonensis, retrieved on 24 June 2016) <ta>; Ẋ, ⋇, ⋇ <da/ta> /da, ta/, (dual) ⋇, /ta/ (Ferrer i Jané 2005: 981; Ferrer i Jané 2014: 244–245).

OM2 (SFG-106):

Kharoṣṭhī ancestor feature (grapheme):

Kharoṣṭhī (Aśoka, around 250 BC) ⸸, (British Library) ⸸, ⸸, (Khotan Dharmapada) ⸸, (Niya) ⸸, (Schøyen) ⸸, ⸸ (Glass 2000: 77) <tha> /tʰ/;

Kharoṣṭhī witness feature (grapheme): *Kharoṣṭhī* (Aśoka [Kapur-di-giri], around 250 BC) (Taylor 1883, vol. II: 236); (British Library) , (Senior Collection) , (Niya) (Glass 2000: 69) <ṭa>; *Kharoṣṭhī* (Aśoka [Kapur-di-giri], around 250 BC) , (Bajaur inscription) (Glass 2000: 69) <ṭi>.

OM3 (SFG-106):
Brahmic ancestor feature (grapheme):
Brāhmī (alphabet q [Turkestan Gupta]) , , (alphabets r and s [Early Turkestan]) , , (alphabet t [North Turkestan Type A]) , (Standard North Turkestan [alphabet u, Type B]) , (alphabet v [Khotanese]) (Sander 1968: Tafel 37) <to>.

OM+ (SFG-106):
Tamgas ancestor feature (glyph shapes or styles):
Tamgas (Achaimenid Iran) , , , ; (Khumbuztepa, 6th–5th c. BC) ; (Basins of Amu Darya and Syr Darya, 1st c. BC –3rd c. AD) , ; (Sarmatia, 2nd half of 2nd c. – 1st half of 3rd c. AD) , , , ; (Kultobe) <tamga> (details: Table 8-34).

Evaluation (SFG-106):
Changed script: SHR, CBR & SR.
Region of relics: SHR: Carpathian Basin; CBR: Carpathian Basin; SR: Inner Asia & Pontus Steppe.
Source script family:
OM1: Canaanite.
OM2: Kharoṣṭhī.
OM3: Brahmic.
Period of change:
OM1: 11th c. BC – 2nd c. AD, the union of the using periods of the Phoenician (Table 8-6) and Old Aramaic scripts.
OM2: 3rd c. BC – 7th c. AD, the using period of the Kharoṣṭhī (Table 8-14) script.
OM3: 4th–7th c. AD, the using period of Brāhmī glyph variants presumed to be the ancestor (Table 8-15), the upper limit is the age of the earliest SHR, CBR or SR inscription containing the descendant grapheme (Kunágota, beginning of 7th c.).
Region of change: OM1: Anatolia. OM2 & OM3: Inner Asia.
Glyph fit only with tamgas: OM1: 0. OM2: 1. OM3: 1.

Comments (SFG-106):

(i) The (Kunágota, beginning of 7th c.) can be a tamga—identical to the (Sarmatia Sarmatia, regional signs, 2nd half of 2nd c. AD – 1st half of 3rd c.) <tamga> (Table 8-34)—or it is a grapheme that belongs to the CBR as <t>.

(ii) Nagy supposed the relationship of SHR , <t'> and TR <d²> (SFG-29) (Nagy 1895: 274).

(iii) According to Sebestyén, SHR <t'> originates from the duplication of SHR <t> (SFG-104) or from the ligature of SHR <t> and SHR <i> (SFG-53) (Sebestyén 1906: 273, 280). These ideas contain too many assumptions and are, therefore, unlikely.

(iv) The Phoenician , <t> and Old Aramaic <t> (OM1) prove that this glyph was generally used in the 7th c. BC. The Punic , , <t> and Sidetic , <d> represent similar glyph style; there was probably an interaction between the various scripts of Semitic origin, where glyph styles were borrowed (Table 2-9). After 7th c. BC, the glyph variants of the Imperial Aramaic <t> differ from the shape ℎ (SFG-103).

(v) Regarding the formation of the sound value of SHR <t'> /t'/, it is worth noting that there was no /t'/ sound in Hungarian in the 13th c. (E. Abaffy 2003b: 307). In the words (Stick Calendar) 𐳙𐳦⁄𐳥 /durᵘt'ᵗ'a/ 'Dorothea' and 𐳀𐳙𐳦𐳙𐳤 /máťáš/ 'Mathias' (Sándor 1991: 165; Hosszú 2013a: 220) the 𐳦 <t> (SFG-104) was used to represent /t'/. It probably retained an earlier state of the Hungarian language when these two words were pronounced with /t/. These two names in the Stick Calendar demonstrate how the notation of /t'/ could have been created: the grapheme used for /t/ was first applied to /t'/. Probably until the development of /t'/, in addition to the 𐳦 <t>, the X, X, X <t'> (SFG-106) was also used to denote /t/. After that, the sound value of 𐳦 <t> could still be only /t/, but the glyphs X, X and X were used to denote /t'/. Data on the use of X and X have only been available since the 16th c. AD.

(vi) Some SHR and Paleo-Hispanic glyph variants are similar. Since no data would support any relationship between them, these striking similarities suggest similar writing technologies (Table 4-2) or similar glyph styles. Glyph variants X, X, X, X, X, X of Rovash <t> contain auxiliary bars the use of which was similar in the first half of the 1st millennium BC in Paleo-Hispanic, Anatolian-Greek Alphabetic, Italic and South Semitic scripts, e.g., Paleo-Hispanic Ʊ, Ʊ <be> (SFG-14); Paleo-Hispanic X, X, X, X, ⁕ <bo> (SFG-15); Paleo-Hispanic Λ, Λ, Λ, Ⲁ, Ⲁ <ka/ga> (SFG-18); Anatolian-Greek Alphabetic O, ⊙, ⊖, ⊕, ⊗ <θ> (SFG-28, SFG-47); Italic O, ⊙, ⦶, ⊖, ⊖, ⊕ <θ> (SFG-47); Paleo-Hispanic ⦶, ⊘, ⊖, ⊗ <de/te> (SFG-28); Paleo-Hispanic √, √ <ki> (SFG-58); Paleo-Hispanic ⧖, ⧗ <ko/go> (SFG-88); Paleo-Hispanic X <ta> (SFG-29), X <da/ta> (SFG-106); Safaitic X, +, +, +, X <t> (SFG-106).

SFG-107

Descendant feature (grapheme):

SHR (Stick Calendar, ca. 15th c. surviving in a 17th c. copy, page 673 of Marsigli's Manuscript) ϒ; (Marsigli's Alphabet, 1690) ϒ *ent;* (Nikolsburg, 1490–1526) ϒ *enth,* (Rudimenta-Giessen, 1598) ϒ *ant,* (Bod's Rudimenta, 1739) ϒ *ant* <nt> /nt/.

OM1 (SFG-107):

Brahmic ancestor feature (grapheme):

Brāhmī (alphabet q [Turkestan Gupta]) ϒ, ϒ, (alphabets r and s [Early Turkestan]) ϒ, ϒ, (alphabet t [North Turkestan Type A]) ϒ, (Standard North Turkestan [alphabet u, Type B]) ϒ, (alphabet v [Khotanese]) ϒ <to> (details: SFG-106).

OM2 (SFG-107):

Rovash ancestor feature (grapheme):

TR ᚴ, ᚴ <t2> /t/ (details: SFG-103).

OM3 (SFG-107):

Rovash ancestor feature (grapheme):

SHR 𐳦 <t> (details: SFG-104).

OM+ (SFG-107):

Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Achaimenid Iran) ϒ, ϒ; (Bayte III) ϒ; (Basins of Amu Darya and Syr Darya, 6th–2nd c. BC) ϒ; (Kochkor Valley) ϒ <tamga> (details: Table 8-34).

Evaluation (SFG-107):
Changed script: SHR.
Region of relics: SHR: Carpathian Basin.
Source script family:
OM1: Brahmic.
OM2: Rovash (internal development) (separation [Table 4-2], duplication [Table 4-3, Table 7-8]).
OM3: Rovash (internal development) (separation [Table 4-2]; duplication, line insertion [Table 4-3, Table 7-8]).
Period of change:
OM1: 4th–9th c. AD, the using period of Brāhmī glyph variants presumed to be the ancestor (Table 8-15), the upper limit is the Hungarian conquest of the Carpathian Basin since after this any influence of the Brāhmī script was impossible.
OM2 & OM3: Before 15th c. AD, the limit is the age of the earliest SHR inscription containing the descendant grapheme.
Region of change:
OM1: Inner Asia.
OM2: Inner Asia, Pontus Steppe, Carpathian Basin.
OM3: Carpathian Basin.
Glyph fit only with tamgas: OM1: 1. OM2: 1. OM3: 1.

Comments (SFG-107):
(i) For the /n/ + C sound pairs, see Table 7-10.
(ii) The glyphs ᛏ, ᛏ of the descendant grapheme may be preserved the glyph of the ancestor of SHR 𐲦 <t>, cf. TR (Y) ᚴ, ᚽ <t²> (SFG-103). It is possible that at the very beginning of SHR, already in the Carpathian Basin, the glyphs of the ᚴ-like shapes were in use. Presumably, creation of SHR ᛏ, ᛏ <nt> was a result of the internal development; therefore, in SFG-107—opposite to SFG-104—the Parthian 𐭕 *tāw* <t> (SFG-103) is not considered a potential ancestor.

SFG-108
Descendant feature (grapheme):
CBR (Szarvas, first half of 8th c.) ◊; (Nagyszentmiklós, flat-shallow ladle No. 15 [inscription No. 8/1], 8th–11th c.) ◊, (Nagyszentmiklós, flat-shallow ladle No. 16 [inscription No. 8/2], 8th–11th c.) ◊ <t> /t/.

OM1 (SFG-108):
Anatolian Hieroglyphic ancestor feature (grapheme):
Anatolian Hieroglyphic (BABILON 1) (Payne, A. 2010a: 123); (Payne, A. 2010a: 14); (Payne, A. 2010a: 81); (Payne, A. 2010a: 6); , (Payne, A. 2010a: 79); (Hawkins 1986: 370–371); (Weeden 2014: 88); (MARAŞ 1) (Yakubovich 2015a: 12) *90 PES (leg) Hittite *tiya-* ‘step’ (Yakubovich 2008a: 25) <ti>.

OM2 (SFG-108):
Brahmic ancestor feature (grapheme):
Brāhmī (alphabet t [North Turkestan Type A]) , (Standard North Turkestan [alphabet u,

Type B]) (Sander 1968: Tafel 33); (Standard North Turkestan) (Maue & Sims-Williams 1991: 489 & Tafel I) <tu>;

Brahmic witness feature (grapheme): *Brāhmī* (alphabet q [Turkestan Gupta]) , , (alphabets r and s [Early Turkestan]) , , , (alphabet v [Khotanese]) (Sander 1968: Tafel 33) <tu>.

Evaluation (SFG-108):
Changed script: CBR.
Region of relics: CBR: Carpathian Basin.
Source script family:
OM1: Anatolian Hieroglyphic.
OM2: Brahmic.
Period of change:
OM1: Around 7th c. BC, the end of the using period of the Anatolian Hieroglyphic (Table 8-5) script.
OM2: 4th–7th c. AD, the using period of Brāhmī glyph variants presumed to be the ancestor (Table 8-15), the upper limit is the age of the earliest CBR inscriptions (Table 8-19).
Region of change: OM1: Anatolia. OM2: Inner Asia.
Glyph fit only with tamgas: OM1: 0. OM2: 0.

Comments (SFG-108):

(i) In OM1, a rotation by ca. 45° should be presumed (Hosszú 2017: 221). It is worth noting that there are several examples of rotating (Table 4-3) in script evolution, e.g., Anatolian Hieroglyphic , (Payne, A. 2010a: 14, 79) *412 <ru>; Carian I, H <λ> (SFG-105) and Carian Φ, Θ <ś> (SFG-99).

(ii) Only the North Turkestan glyph variants of the Brāhmī <tu> are suitable as ancestors, the earlier ones and the South Turkestan glyph variant are listed as witness glyphs.

(iii) The derivation of CBR <t> from Parthian , , *tāw* <t> (SFG-103) was proposed by Vékony in 1987 (Vékony 1987a: 90; Vékony 2004a: 155). However, the Parthian and its relative <t> graphemes have slightly different shapes. Similarly, the following graphemes are far from the descendant grapheme (despite of slight similarities): Imperial Aramaic (monuments, Egypt, 4th–3rd c. BC) (Taylor 1883, vol. I: 250); (monumental) , (Assyrian and Egyptian papyri) , (Babylonian Bowls) , (Faulmann 1880: 79) *tāw* <t> /t, θ/ (SFG-103); Middle Persian (inscriptions, 3rd c. AD) (MacKenzie 1971: xi); (inscriptional) (Rosenthal et al. 1986–2011: Table 3); (inscriptional) (Skjærvø 1996: 518); (Ḥājiābād, 3rd c. AD) , (coins, 4th–6th c. AD) (Taylor 1883, vol. II: 236); (Sasanian intaglio from an Avar cemetery, Szarvas [Békés County, Hungary], not later than 6th c. AD) (Harmatta 2003b: 306, 309) *tāw* <t> /t, d/; (Psalter) (Bulayïq, 6th–7th c., a copy of an origin from the 4th c. AD) (Rosenthal et al. 1986–2011: Table 3); (Psalter) (Skjærvø 1996: 518); (Early Cursive Pahlavi) (Skjærvø 1996: 518); (Book Pahlavi) (Rosenthal et al. 1986–2011: Table 3); (Book Pahlavi) (Skjærvø 1996: 518) *tāw* <t> /t, d/.

(iv) It may be that CBR , , <t> was formed as a connected variant of TR (Y) , (O) , <t^1> /t/ (SFG-48). This lineage would presume too many assumptions, so based on the cladistics' *lex parsimoniae* (Table 4-1), it is omitted.

SFG-109

Descendant feature (orthographic rule):

TR (Kül Tegin, 732) (Kara 1996: 538–539), (Küli čur, 719–724), (Eletmish Bilge Khagan [Moyn-Čor], 759); (Bichiktu-Boom III): in situ vertical columns; however, the glyphs are turned by 90°; therefore, it seems to be better seeing the text before the erection of the stela: bottom-up line order with RTL writing direction;

SHR (Patakfalvi, 1776–1785) bottom-up line order with RTL writing direction.

OM1 (SFG-109):

Indic ancestor feature (orthographic rule):

Brāhmī (Bugut inscription, shortly after 581 [Maue 2019: 109]) and (Khüis Tolgoi inscription, after 600 [Maue 2018: 291]): in situ vertical columns with RTL column order and top-down writing direction; however, the glyphs are turned by 90°; therefore, it seems to be better seeing the text before the erection of the stela: bottom-up line order with RTL writing direction.

Evaluation (SFG-108):

Changed script: TR, SHR.

Region of relics: TR: Inner Asia. SHR: Carpathian Basin.

Source script family:

OM1: Indic.

Period of change:

OM1: 6th–8th c. AD, the using period of the Brāhmī orthographic rule presumed to be ancestor; the upper limit is the age of the earliest TR inscriptions (Table 8-29).

Region of change: OM1: Inner Asia.

Glyph fit with tamgas: OM1: 0.

Comments (SFG-109):

(i) It is worth noting that there are several TR inscriptions with bottom-up line order. In contrast, almost all SHR inscriptions have top-down line order, except one, the two-page long text in the Patakfalvi-Bible.

(ii) Note that the Brāhmī line order is always top-down, except the Bugut and Khüis Tolgoi inscriptions.

(iii) Homoplasy (Table 2-7) is the similarity to the Southeastern Iberian (Table 8-10) La Bastida de les Alcusses Inscription (Mogente, Valencia Province, Spain), which has horizontal writing direction and its line order is also bottom-up.

SFG-110

Descendant feature (grapheme):

SHR ˌ <word separator>;

CBR (Szarvas, first half of 8th c.) ˈ; (Nagyszentmiklós, 8th–11th c.) ˈ <word separator>, <section separator>;

SR (Khumara-7, 9th–10th c.) ˌ <word separator>.

OM1 (SFG-110):
Canaanite ancestor feature (grapheme):
Phoenician (Shipitbaal inscription, Byblos, around 900 BC) ׀ <word separator> (Rollston 2010: 23);
Canaanite witness feature (grapheme): *Old Canaanite* (Qubur el-Walaydah Bowl) | (Rollston 2010: 16) <word separator>.

OM2 (SFG-110):
Aegean ancestor feature (grapheme):
Cypro-Greek ׀ <word separator> (Karnava 2014b: 406);
Aegean witness feature (grapheme): *Cretan Hieroglyphic* (stiktograms) | <separator> (Karnava 1999: 37); *Linear B* ׀ <word separator> (MNAMON); *Cypro-Minoan* | <separator> (Valério 2016: 157–158).

OM3 (SFG-110):
Anatolian-Greek Alphabetic ancestor feature (grapheme):
Carian (Memphis, E.Me 14) ((Masson 1978: 24; Adiego 2007a: 46) <word separator>;
Italic witness feature (grapheme): *Raetic* ׀ <word separator> (MNAMON).

OM4 (SFG-110):
Brahmic ancestor feature (grapheme):
Brāhmī (Steppe Brāhmī, Khüis Tolgoi inscription, after 600; in situ vertical columns with RTL column order and top-down writing direction) horizontal stroke <word divider> (Maue 2018: 291).

Evaluation (SFG-110):
Changed script: SHR, CBR & SR.
Region of relics: SHR & CBR: Carpathian Basin. SR: Pontus Steppe.
Source script family:
OM1: Canaanite.
OM2: Aegean.
OM3: Anatolian-Greek Alphabetic.
OM4: Brahmic.
Period of change:
OM1: 11th c. BC – 2nd c. AD, the using period of the Phoenician script (Table 8-6).
OM2: 11th–2nd c. BC, the using period of the Cypro-Greek script (Table 8-3).
OM3: 7th–3rd c. BC, the using period of the Carian script (Table 8-8).
OM4: 7th–8th c. AD, the using period of the Brāhmī orthographic rule presumed to be an ancestor, and the upper limit is the age of the earliest SHR, CBR or SR inscriptions (Table 8-19).
Region of change: OM1, OM2 & OM3: Anatolia. OM4: Inner Asia.
Glyph fit only with tamgas: OM1: 0. OM2: 0. OM3: 0. OM4: 0.

Comments (SFG-110):
(i) In the Brāhmī script, the *daṇḍa* is usual punctuation (Maue, Dieter: Personal communication by email, 8 February 2020). An example for the daṇḍa: Brāhmī (Standard North Turkestan) (Mz 639 Sanskrit-Sogdian Bilingual Manuscript [Mainz Collection]) ׀ (Maue

& Sims-Williams 1991: 489 & Tafel I) *daṇḍa* <section end mark>. There is a preference but by no means an obligation, to use daṇḍas and especially double daṇḍas (SFG-112) at the end of larger text units (Maggi, Mauro 2020: personal communication by email, 27 August 2020). The daṇḍa was never used as word divider; this function is unknown in any other variety of the Brāhmī (Maue, Dieter: Personal communication by email, 9 November 2020).

(ii) The regularly used <word divider> in the Khüis Tolgoi inscription is analogue to the daṇḍa as to the glyph since the daṇḍa forms a right angle with horizontal per line writing direction in other Brāhmī inscriptions. That is singular among the Brāhmī testimonies; surely a foreign feature (Maue, Dieter: Personal communication by email, 15 October 2020).

(iii) Note that the descendant feature is not characteristic, its Glyph Complexity Parameter (GCP) is only 1 (Table 8-2), which makes difficult to explore its lineage.

SFG-111

Descendant feature (grapheme):

TR ɺ, ɿ; ɪ (Amanjolov 2003) <word separator>;
TR (Bichiktu-Boom XVI/3) ʃ <section separator>.

OM1 (SFG-111):
Brahmic ancestor feature (grapheme):
Brāhmī (Standard North Turkestan) (Mz 639 Sanskrit-Sogdian Bilingual Manuscript [Mainz Collection]) ⸾, ⸾ (Maue & Sims-Williams 1991: 489 & Tafel I) <language separator>.

OM+ (SFG-111):
Tamgas ancestor feature (glyph shapes or styles):
Tamgas (Achaemenid Iran) ɿ, ɪ, ɪ; (Basins of the Amu Darya and the Syr Darya, 6th–2nd c. BC) ɺ; (Bayte III) ɺ; (Koy-Krylgan-kala) ɪ <tamga> (details: Table 8-34).

Evaluation (SFG-111):
Changed script: TR.
Region of relics: TR: Inner Asia.
Source script family:
OM1: Brahmic.
Period of change:
OM1: 4th–8th c. AD, the using period of Brāhmī glyph variants presumed to be the ancestor (Table 8-15), the upper limit is the age of the earliest SR inscriptions (Table 8-19).
Region of change: OM1: Inner Asia.
Glyph fit only with tamgas: OM1: 1.

Comments (SFG-111):

(i) Mz 639 uses three punctuation marks: *double daṇḍa* ǁ (SFG-112) at the end of a stanza; *daṇḍa* ˈ (SFG-110) between a Sanskrit word and its Sogdian translation; and ⸾ separates the two languages (Sanskrit and Sogdian) from each other (Maue, Dieter: Personal communication by email, 15 October 2020).

(ii) The glyphs ɿ, ɪ are maybe the result of borrowing shapes of tamgas. However, the glyph variant ɪ can be the result of a ɿ > ɪ development, which could be affected by the close relationship of the ɿ <A> and ɪ <A> graphemes.

(iii) Interestingly, both Anatolian Hieroglyphic *450 <a> (Payne, A. 2010a: 81) and TR <A> (SFG-4) were used as <word end mark>. Note, however, that according to A. Payne, a particular graphic practice affected the glyph of the *450 <a>, when it was in the word starting position. Notably, the Bronze Age Anatolian Hieroglyphic inscriptions and seals demonstrate that scribes often moved the glyph of the *450 <a> and wrote it at the end of the word rather than at the beginning. At present, this practice seems to have been widespread in the Iron Age, but later inscriptions have completely omitted this grapheme (Payne, A. 2010a: 16). Based on this, it seems that by the last stage of the Anatolian Hieroglyphic script, the tradition of using the *450 <a> as <word end mark> no longer existed, so it could not be passed on to other scripts. Thus the <word end mark> role of the Anatolian Hieroglyphic *450 <a> and TR <A> is certainly a coincidence (homoplasy, Table 2-7).

SFG-112

Descendant feature (grapheme):

SR (Achik-Tash, 8^{th} c.) ; (Kermen Tolga, 8^{th}–10^{th} c.) <end mark>;
SR (Mayatskoe-10, 9^{th} c.) , <word separator>.

OM1 (SFG-112):
Middle Iranian ancestor feature (grapheme):

Sogdian (BL Or. 8212/174) , (Ch/So 20182 v) , (P 18) (Pandey 2017: 65) <word separator>, <section end mark> & <text end mark> (Pandey 2017: 9–10);
Sogdian (So 10006 v) , , (P 3) , (P 22) (Pandey 2017: 66); (So 14800 r) (Pandey 2017: 69); (So 20195) (Pandey 2017: 77) <word separator>, <section end mark>, <text end mark> (Pandey 2017: 9–11).

OM2 (SFG-112):
Brahmic ancestor feature (grapheme):

Brāhmī (Tocharian) (THT 1020) (Maue 2010: 4–5); (Tocharian) (IOL Toch 81) (Maue 2008: 60–63); (Standard North Turkestan) (Mz 639 Sanskrit-Sogdian Bilingual Manuscript [Mainz Collection]) (Maue & Sims-Williams 1991: 489 & Tafel II) *double daṇḍa* <begin mark>, <end mark>; <stanza end mark> (Maue 2007: 228, 232, 233); <text end mark> (Maggi, Mauro 2020: personal communication by email, 27 August 2020).

OM+ (SFG-112):
Tamgas ancestor feature (glyph shapes or styles):

Tamgas (Bayte III) ; (Kanka) , <tamga> (details: Table 8-34).

Evaluation (SFG-112):
Changed script: SR.
Region of relics: SR: Inner Asia & Pontus Steppe.
Source script family:

OM1: Middle Iranian.
OM2: Brahmic.

Period of change:

OM1: 2^{nd}–8^{th} c. AD, the using period of the Sogdian script (Table 8-16), the upper limit is the age of the earliest SR inscriptions (Table 8-19).

OM2: 4^{th}–8^{th} c. AD, the using period of Brāhmī punctuation marks presumed to be the ancestor (Table 8-15), the upper limit is the age of the earliest SR relics (Table 8-19).
Region of change: OM1 & OM2: Inner Asia.
Glyph fit only with tamgas: OM1: 1. OM2: 1.

Comments (SFG-112):

(i) In the Brāhmī script, the double daṇḍa is usual punctuation (Maue, Dieter: Personal communication by email, 8 February 2020). There is a preference, but by no means an obligation, to use daṇḍas (SFG-110) and especially double daṇḍas at the end of larger text units (Maggi, Mauro 2020: personal communication by email, 27 August 2020).

(ii) It is not disclosed that the punctuation mark two vertical lines in the Sogdian script may originate from the double daṇḍa (Sims-Williams, Nicholas: Personal communication by email, 8 February 2020).

(iii) Surely, the similarity of the descendant graphemes to the following separator graphemes is homoplasy (Table 2-7): Anatolian Hieroglyphic (BABILON 1) 𔐀 <word end mark>, <-’>, 𔖱 <word end mark>, <·i> (Payne, A. 2010a: 17, 81, 122); Proto-Campanian (Oinochoe in Bucchero, Nuceria, the second half of 6^{th} c. BC; Little Cup in Bucchero, Sorrento, end of 6^{th} c. – the beginning of 5^{th} c. BC) ‖ (MNAMON: Oscan. http://mnamon.sns.it/index.php?page=Esempi&id=24&lang=en#203, retrieved on 11 March 2018) <word begin mark> and <word end mark>.

SFG-113

Descendant feature (grapheme):

TR (Küli Čur, 719–724) ⁖; (O, T, Y) ⁖; (Epitaph of Qarï Čor Tegin) ⁝ (Rybatzki & Wu 2014: 122–123) <word separator> (Kyzlasov, I. L. 1994: 71; Kara 1996: 537);
SR (Mayaki, 8^{th}–9^{th} c.) ⁖; (Kermen Tolga, 8^{th}–10^{th} c.) ⁚ <word separator>.

OM1 (SFG-113):
Canaanite ancestor feature (grapheme):
Old Aramaic ⁖, ⁝ (Bordreuil 2005: 21) <separator>;
Anatolian-Greek Alphabetic ancestor feature (grapheme):
Ancient Greek (Nestor’s Cup, Pithecussae, ca. 740–720 BC) : <separator> (Bordreuil 2005: 21);
Lydian (early, L24. Canoe-shaped Vase [Littmann 1916: 56–57]) : <word separator>;
Carian (Memphis, E.Me 30) ⁚ (Masson 1978: 34; Adiego 2007a: 58); (Bronze Lion, ca. 500 BC, E.xx 7, RTL writing direction) ⁖, ⁖ (Masson 1976: 82–83; Adiego 2007a: 128, 223) <word separator>;
Anatolian-Greek Alphabetic witness feature (grapheme): *Lycian* (Swiggers & Jenniges 1996: 282; Bordreuil 2005: 23); (TL 29) ⁚ (Kalinka 1901 *apud* Adiego 2015: 14) <separator>.
Paleo-Hispanic witness feature (grapheme): *Northeastern-Iberian* (Ullastret Lead Plaque, Mogente, Valencia, earliest inscriptions) ⁝, ⁖; (in usual inscriptions) :, · (Swiggers 1996a: 111–112); *Celtiberian* :, ⁝ <word separator> (Cólera 2007: 843–844; MNAMON: Celtic, Celtiberian. http://lila.sns.it/mnamon/index.php?page=Esempi&id=60&lang=en, retrieved on 21 June 2016);
Italic witness feature (grapheme): *Raetic* ⁝, ⁚ <word separator> (MNAMON); *Umbrian* (Iguvine Tablets, ca. 300–90 BC) ⁚ <word separator>.

OM2 (SFG-113):
Middle Iranian ancestor feature (grapheme):
Sogdian (Ch/So 14852a-f v) ∶ (Pandey 2017: 76) <word separator> (Pandey 2017: 10).

OM3 (SFG-113):
Brahmic ancestor feature (grapheme):
Brāhmī (Tocharian) ⁝ <pāda (foot as rhythmic unit, fourth part of a stanza) boundary mark> <sentence separator> (Maue 2007: 228, 232, 233).

Evaluation (SFG-113):
Changed script: TR & SR.
Region of relics: TR: Inner Asia. SR: Pontus Steppe.
Source script family:
OM1: Canaanite or Anatolian-Greek Alphabetic.
OM2: Middle Iranian.
OM3: Brahmic.
Period of change:
OM1: 9th–2nd c. BC, the union of the using periods of Old Aramaic (Table 8-6), Ancient Greek (Table 8-8), Lydian and Carian scripts.
OM2: 2nd–8th c. AD, the using period of the Sogdian script (Table 8-16), the upper limit is the age of the earliest TR or SR inscriptions (Table 8-19).
OM3: 4th–8th c. AD, the using period of the Tocharian Brāhmī script (Table 8-15), the upper limit is the age of the earliest TR or SR inscriptions (Table 8-19).
Region of change: OM1: Anatolia. OM2 & OM3: Inner Asia.
Glyph fit only with tamgas: OM1: 0. OM2: 0. OM3: 0.

Comments (SFG-113):

(i) The punctuation marks are not frequent in Khotanese Brāhmī; however, double dot and daṇḍa (SFG-110) are met with in later manuscripts (Maue, Dieter: Personal communication by email, 21 August 2020). According to Maggi, the colon marks a larger unit than the dot (SFG-118). In the manuscript of the Old Khotanese poem known as the Book of Zambasta, which is traditionally written one verse-line per manuscript line, dots may also be placed before the line's last syllable as mere fillers. In a Late Khotanese medical text (manuscripts P 2893 [Paris] + Ch. 00265 [London]) double colons in red separate the prescriptions, while dots in black mostly separate ingredients (Maggi, Mauro 2020: personal communication by email, 27 August 2020).

(ii) In the Tumshuqese manuscripts colon as pāda (foot, the fourth part of a stanza) separator is not found (Maue 2007: 230).

(iii) The ⁚ <separator> is very uncharacteristic; therefore, its origin cannot safely be determined.

SFG-114

Descendant feature (grapheme):
SHR (Stick Calendar, ca. 15th c. surviving in a 17th c. copy, page 681 of the Manuscript of Marsigli) ⁚; (Oertel's Album Entry, 1751) ⁚ <section of sentence delimiter>.

OM1 (SFG-114):
Rovash ancestor feature (grapheme):
TR, SR ⁚ <word separator> (details: SFG-113).

OM2 (SFG-114):
Slavic ancestor feature (grapheme):
Glagolitic (Münchener Abecedarium, last sheet of CML 14485, Bayerischen Staatbibliothek, München, second half of 11th–12th c.) ⁚ (Kempgen 2007) <separator>.

Evaluation (SFG-114):
Changed script: SHR.
Region of relics: SHR: Carpathian Basin.
Source script family:
OM1: Rovash (internal development) (borrowing [Table 4-2]).
OM2: Slavic.
Period of change:
OM1: Not later than 10th c. AD, the limit is the age of latest SR script relic (Homokmégy-Halom, Table 8-32) found in the Carpathian Basin, since after this any influences of TR or SR scripts were unlikely.
OM2: From 9th c. AD before 15th c., the using period of the Glagolitic (Table 8-21) script, the upper limit is the age of the earliest SHR relic containing the descendant grapheme.
Region of change:
OM1: Inner Asia, Pontus Steppe or Carpathian Basin.
OM2: Carpathian Basin.
Glyph fit only with tamgas: OM1: 0. OM2: 0.

Comments (SFG-114):
(i) In the case of OM1, SFG-113 and SFG-114 could be joined into a single SFG. Oppositely, in the case of OM2, the similarity of the descendant graphemes in SFG-113 and SFG-114 is homoplasy (Table 2-7).
(ii) The ⁚ <separator> is very uncharacteristic; therefore, its origin cannot safely be determined.

SFG-115

Descendant feature (grapheme):
SR (Mayatskoe-5, 9th c.) ◎ <end mark>.

OM1 (SFG-115):
Middle Iranian ancestor feature (grapheme):
Sogdian (P6, line 17) ⊙, (So 10100 (i) v, line 17) ⊙ (Pandey 2017: 69) <word separator>, <section end mark>, <text end mark> (Pandey 2017: 9, 67);
Manichean ⊙ <section end mark> (Durkin-Meisterernst 2005: Table 1).

OM+ (SFG-115):
Tamgas ancestor feature (glyph shapes or styles):
Tamgas (Basins of the Amu Darya and the Syr Darya, 1st c. BC –3rd c. AD) ⊙, ⦶, ⦵ <tamga> (details: Table 8-34).

Evaluation (SFG-115):
Changed script: SR.
Region of relics: SR: Pontus Steppe.
Source script family:
OM1: Middle Iranian.
Period of change:
OM1: 2nd–9th c. AD, the union of the using periods of Sogdian (Table 8-16) and Manichean scripts, the upper limit is the age of SR inscription containing the descendant grapheme (Table 8-19).
Region of change: OM1: Inner Asia.
Glyph fit only with tamgas: OM1: 1.

Comments (SFG-115):

(i) The descendant glyph ◎ is found at the end of an SR inscription ◎ ʖ) ◇Ү⸗ /onaq ^{ä}bi/ ‘Mansion of Onaq’ (Majackoje-5, 9th c. AD, Table 8-32). It is possible that the glyph ◎ is not an end mark, but a tamga.

SFG-116

Descendant feature (grapheme):
CBR (Nagyszentmiklós, Bowl No. 8, 8th c.) ✢ <word separator>.

OM1 (SFG-116):
Middle Iranian ancestor feature (grapheme):
Sogdian (P 12) ✣ (Pandey 2017: 75) <section end mark> (Pandey 2017: 10–11, 11, 75).

OM2 (SFG-116):
Middle Iranian ancestor feature (grapheme):
“Manichean” (Sasanian carved stone) **+** <Manichean cross symbol> (Kyzlasov, L. R. 2010: 353).

Evaluation (SFG-116):
Changed script: CBR.
Region of relics: CBR: Carpathian Basin.
Source script family:
OM1 & OM2: Middle Iranian.
Period of change:
OM1: 2nd–8th c. AD, the using period of the Sogdian script (Table 8-16), the upper limit is the age of CBR inscription containing the descendant grapheme.
OM2: before 6th c. AD – 8th c., for the lower limit, see Comments, the upper limit is the age of CBR inscription containing the descendant grapheme.
Region of change: OM1 & OM2: Inner Asia.
Glyph fit only with tamgas: OM1: 0. OM2: 0.

Comments (SFG-116):

(i) It is worth noting that the role of the descendant grapheme slightly differs from the role of the Sogdian grapheme.

(ii) In a strict sense, the equilateral Manichean cross (**+**) is not part of the Manichean script; however, it is strongly connected to the Manichean culture and religion. Therefore, in the numerical analysis based on the extended phenetic model, it is counted on the Manichean script. The Manichean crosses existed from before the 6th c. AD (Kyzlasov, L. R. 2010: 355).

(iii) The cross symbol could be a Christian cross; however, the meaning of the text where it survived is not religious, but an Ancient Hungarian felicitation phrase (Hosszú 2013a: 153).

SFG-117

Descendant feature (grapheme):

SHR (Homoródkarácsonyfalva Stone inscription, around 13th c.) ✛ <separator>.

OM1 (SFG-117)*:*

Latin Alphabetic ancestor feature (grapheme):

Latin <Christian cross symbol>.

Evaluation (SFG-117):
Changed script: SHR.
Region of relics: SHR: Carpathian Basin.
Source script family:
OM1: Latin Alphabetic.
Period of change:
OM1: 9th–13th c. AD, the lower limit is the estimated age of the Hungarians' appearance in the Carpathian Basin; the upper limit is the age of SHR inscription containing the descendant grapheme.
Region of change: OM1: Carpathian Basin.
Glyph fit only with tamgas: OM1: 0.

Comments (SFG-117):

(i) In the medieval Latin palaeography, the cross symbol was used in the texts.

(ii) SHR relic, where the descendant grapheme survived is a religious text (Homoródkarácsonyfalva Stone inscription); namely, a sentence cited from John's Gospel (Ioh 3:18). Moreover, it appears only once in the text, not regularly: ᒥΔ〉 ✛ ⋊ᛁ⊠ ᗺ〉 /n^{ä}m h^{i}<u>s^{ä}n</u> + n^{ä}ki/ 'He does not believe + Him' (Hosszú 2013a: 207–208). Consequently, its usage fits the Christian usage and is likely unrelated to the Sogdian ✣ <section end mark> (SFG-116).

SFG-118

Descendant feature (grapheme):

TR (Epitaph of Qarï Čor Tegin) · (Rybatzki & Wu 2014: 120–121) <word separator>, <section of sentence delimiter>;

SHR (Constantinople, 1515, LTR writing direction) · <word separator>; (Bél, 1718) · <section of sentence delimiter>; (Énlaka, 1668) · <sentence end mark>;

SR (Novocherkassk, 8th–10th c.) ·, (Khumara-6, 9th–10th c.) · <word separator>.

OM1 (SFG-118):

Middle Iranian ancestor feature (grapheme):

Sogdian (So 11500 r) · (Pandey 2017: 74) <word separator> (Pandey 2017: 10);

Sogdian (So 10026 r) • (Pandey 2017: 74) <section end mark> (Pandey 2017: 10, 75);

Manichean · <section end mark> (Durkin-Meisterernst 2005: Table 1).

OM2 (SFG-118):
Brahmic ancestor feature (grapheme):

Brāhmī (Tocharian) · <pāda (foot, fourth part of a stanza) boundary marker>, <separator> (Maue 2007: 228, 232, 233).

Evaluation (SFG-118):
Changed script: TR, SHR & SR.
Region of relics: TR: Inner Asia. SHR: Carpathian Basin. SR: Pontic Steppe
Source script family:

OM1: Middle Iranian.

OM2: Brahmic.

Period of change:

OM1: 2^{nd}–8^{th} c. AD, the union of the using periods of Sogdian (Table 8-16) and Manichean scripts, the upper limit is the age of the earliest TR, SHR or SR inscriptions (Table 8-19).

OM2: 4^{th}–8^{th} c. AD, the using period of the Tocharian Brāhmī script (Table 8-15), the upper limit is the age of the earliest TR, SHR or SR inscriptions (Table 8-19).

Region of change: OM1 & OM2: Inner Asia.
Glyph fit only with tamgas: OM1: 0. OM2: 0.

Comments (SFG-118):

(i) The similarity of the descendant graphemes to the followings is surely homoplasy (Table 2-7): Paleo-Hebrew (Mesha Stele, 9^{th} c. BC) . (Rollston 2010: 52, 54) <word separator>; Cypro-Minoan • <probably marks every tenth row> (Valério 2016: 157–158); Raetic • (MNAMON) <word separator>; Northeastern-Iberian (later inscriptions following a Roman pattern) · (MNAMON: Iberian, http://lila.sns.it/mnamon/index.php?page=Esempi&id=13&lang=en, retrieved in 2015); (in usual inscriptions) :, · (Swiggers 1996a: 111–112); Celtiberian · <word separator> (Cólera 2007: 843–844; MNAMON: Celtic, Celtiberian. http://lila.sns.it/mnamon/index.php?page=Esempi&id=60&lang=en, retrieved on 21 June 2016); Runic (Nydam II, Jutland, bronze sheath mount, ca. AD 250–320)· (Looijenga 1997: 157) <word separator>.

(ii) In the Khotanese Brāhmī, the dot above the line is used only calligraphically as line filler (Leumann 1934: 15 apud Maue, Dieter: Personal communication by email, 21 August 2020). According to Maggi, the dot is the most frequent Khotanese punctuation sign. In Late Khotanese poetry, dots may separate padas, while colons (SFG-113) may separate verses. However, only dots or only colons may also be used between padas and between verses (Maggi, Mauro 2020: personal communication by email, 27 August 2020).

(iii) The · <separator> is very uncharacteristic; therefore, its origin cannot safely be determined.

SFG-119

Descendant feature (grapheme):

SR ◌̇ <begin mark>, <end mark>, e.g., (Novocherkassk, 8^{th}–10^{th}. c.) <A> (SFG-8) with <begin mark>, <n^1> (SFG-71) with <end mark> (Turčaninov 1990: 214, Табл. XIII.1 рис. 1).

OM1 (SFG-119):
Brahmic ancestor feature (grapheme):

Brāhmī (Turkestan) ◌̇ <word end mark> (Róna-Tas 1991: 76; Maue, Dieter: Personal communication by email, 8 February 2020). Note that it is optionally used and only connected with the virāma stroke, see Comments (Maue, Dieter: Personal communication by email, 15 October 2020).

Evaluation (SFG-119):
Changed script: SR.
Region of relics: SR: Pontus Steppe.
Source script family:
OM1: Brahmic.
Period of change:
OM1: 4th–8th c. AD, the using period of Brāhmī glyph variants presumed to be the ancestor (Table 8-15), the upper limit is the age of the earliest SR inscriptions (Table 8-19).
Region of change: OM1: Inner Asia.
Glyph fit only with tamgas: OM1: 0.

Comments (SFG-119):

(i) It is worth noting that the literature is inconsistent in the case of the Novocherkassk inscription. The upper dot at the top of the word-beginning <A> is marked in some publications (Turčaninov 1964: 73, рис. 1; Turčaninov 1990: 214, Табл. XIII.1 рис. 1; Vékony 2004a: 243) and is missing in others. The upper dot at the top of the word-ending <n^1> only appears in one publication (Turčaninov 1990: 214, Табл. XIII.1 рис. 1), not in others.

(ii) In order to suppress the inherent vowel at the end of an akṣara, the Turkestan Brāhmī, and especially the Tocharian and Uyghur Brāhmī used the virāma grapheme, a line which connects the vowelless consonant (cluster) with the preceding akṣara. In some manuscripts, to the vowelless glyph was added a dot above. The final consonant (cluster) could coincide with the end of a word or phrase. In purely Indian texts, the virāma spelling usually only occurs at the end of a paragraph or verse. From this perspective, the virāma sign could be interpreted as punctuation (Maue, Dieter: Personal communication by email, 8 February 2020).

(iii) In the Manichean script, the omission of <’> in the ending *-ān* is marked by a superscript dot ◌̇ (Skjærvø 2006–2012). This grapheme is likely not an ancestor.

(iv) Interestingly, in Palmyran script the dot or stroke below the grapheme marked the word boundary (Harmatta 2000: 183–184).

6. Evaluation of the phenetic model

6.1. Phenogram based on the extended phenetic model

As it was stated earlier, the extended phenetic model of taxa P_E (Table 4-9: 4-15. §) is only comprehensive for the descendant taxa. A phenogram can be created for these descendant taxa. To perform a *hierarchical cluster analysis,* the submatrix $N_T^d \times N_F$ sized 2D binary taxon–feature data matrix of the $N_T \times N_F \times N_O$ sized data matrix X_E will be used, which is the basis of a simple phenetic model of descendant taxa (Table 4-9: 4-19. § and Figure 4-1). After this, a dissimilarity measure is computed for each taxa pair based on an appropriate metric. Cluster analysis is performed to classify the most similar taxa in the next step. An index of the average distance between each taxon could be calculated; these distances are fitted into a hierarchical clustering pattern.

Clustering (cluster analysis) is an unsupervised learning (exploratory data analysis) method, which needs very little *a priori* knowledge. It is a useful technique for classifying data points—in our case, taxa—that data points within a single group have similar characteristics, while data points in different groups are dissimilar. Clustering is the task of categorizing data points—taxa in our case—having several features into different groups (clusters) so that the data points belonging to the same cluster are similar, and those that are broken down into different clusters are not. In clustering, the problem is to group a given collection of unlabelled patterns into meaningful clusters. Labels are associated with clusters, but these category labels are data-driven; they are obtained solely from the data (Jain et al. 1999).

In clustering, the goal is to place data points into the same cluster when they are similar enough according to an appropriate metric. In scriptinformatics, the usual features have two states: presence or absence in a taxon. Therefore, these features are categorical data with binary values. The *Boolean* indicator variables are introduced for comparing categorical data. The formulae for the number of presence or absence feature states are written using the abbreviations in Table 6-1 (Podani 2000: 60).

Table 6-1: Parameters used in expressing the comparison of the features of taxa 1 and 2

	Features present in taxon 2	Features absent from taxon 2
Features present in taxon 1	a is the number of features present in both taxa 1 and 2	b is the number of features present in taxon 1 and absent from taxon 2
Features absent from taxon 1	c is the number of features absent from taxon 1 and present in taxon 2	d is the number of features absent from both taxa 1 and 2

The similarity of two data points can be expressed by a *dissimilarity function* that is a numerical measurement of how far apart data points are. There are several dissimilarity functions, and they are generally called various *dissimilarity indices,* among these are the *Simple Matching* (Sokal & Michener 1958), the *Jaccard* (Jaccard 1901), and the *Sørensen–Dice* (Dice 1945; Sørensen 1948) dissimilarity coefficients. The first one includes the impact of both co-occurrence (a) and double absence (d), as presented in (6-1).

$$\mathrm{d}_{\mathrm{SM}} = 1 - \frac{a+d}{a+b+c+d}, \tag{6-1}$$

Opposite to the Simple Matching dissimilarity coefficient, the Jaccard and Sørensen–Dice coefficients do not include the mutual absences when a feature is absent in both sets. The Jaccard index (6-2) is a statistic ordinarily applied to compare the similarity and diversity of the features of the examined taxa if the double absence (d) has no significance.

$$\mathrm{s}_{\mathrm{J}} = \frac{a}{a+b+c}, \quad i,j \in \{1, \dots, M\}, \tag{6-2}$$

The Jaccard distance (dissimilarity coefficient) is obtained from the Jaccard index, as shown in (6-3).

$$\mathrm{d}_{\mathrm{J}} = 1 - s_J = \frac{b+c}{a+b+c}, \tag{6-3}$$

The Sørensen–Dice dissimilarity coefficient enhance the impact of the co-occurrence (a), as presented in (6-4).

$$\mathrm{d}_{\mathrm{SD}} = 1 - \frac{2a}{2a+b+c}, \tag{6-4}$$

Among the dissimilarity coefficients, the Sørensen–Dice fits best with the examined dataset, since the clear majority of the features (Table 2-2) are symbols, and the absence of a symbol in a script (taxon) is not specific, since there are dozens of graphemes that are absent from a certain script which exists in other taxa under study. Considering the parameters in Table 6-1, in case of the historical scripts, the a is the most important, and the less important one is the d, since the whole set of features ever used in a certain script are usually unknown.

There are several clustering methods to calculate the distance between clusters during the hierarchical cluster analysis. Among these, the unweighted pair group method of agglomeration (UPGMA, Michener & Sokal 1957) and the weighted pair group method with arithmetic mean (WPGMA, Sokal & Michener 1958) are considered. Both UPGMA and WPGMA classify each taxon into a separate cluster and then gradually merge them, always merging the two nearest clusters. The difference is that for UPGMA, in deciding which pair of clusters to merge, a group (cluster) with a larger number of elements is considered with more impact during an intermediate step of the algorithm. In contrast, with WPGMA, clusters with a smaller number of elements are given more weight than the clusters with many elements. In this case, a cluster with a larger number of elements will not have a greater impact than a smaller one on deciding which clusters should be merged in the subsequent step. In scriptinformatics, WPGMA is preferable because it could be that fewer number of scripts evolved in one cluster of scripts, while in another there are more. However, when comparing different clusters of scripts based on their similarity, it is irrelevant to consider the number of scripts in the cluster.

The result of the WPGMA hierarchical cluster analysis, the obtained phenograms (dendrograms) are presented in Figure 6-1 for Simple Matching, in Figure 6-2 for Jaccard and in Figure 6-3 for Sørensen–Dice dissimilarity coefficients. These results are based on the presence or absence of the descendant features in the first part named "*Descendant feature*" of each SFG. The calculations were performed with the SYN-TAX 2000 mathematical framework (Podani 2001).

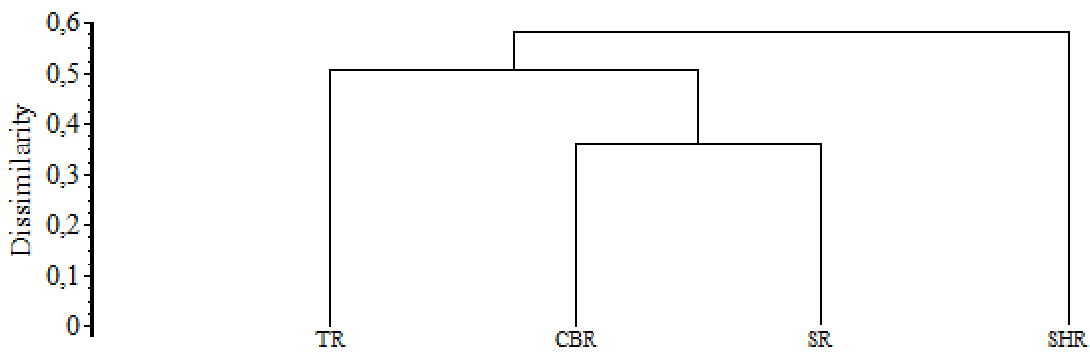


Figure 6-1: Phenogram of the simple phenetic model of descendant taxa using the Simple Matching dissimilarity coefficient

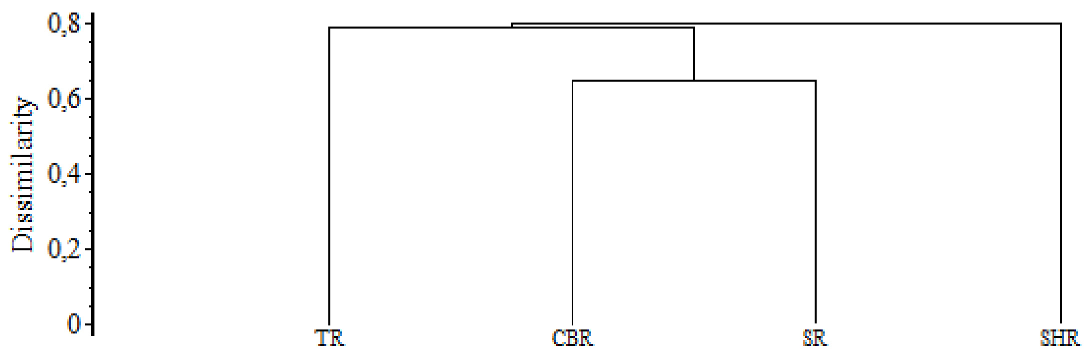


Figure 6-2: Phenogram of the simple phenetic model of descendant taxa using Jaccard distance

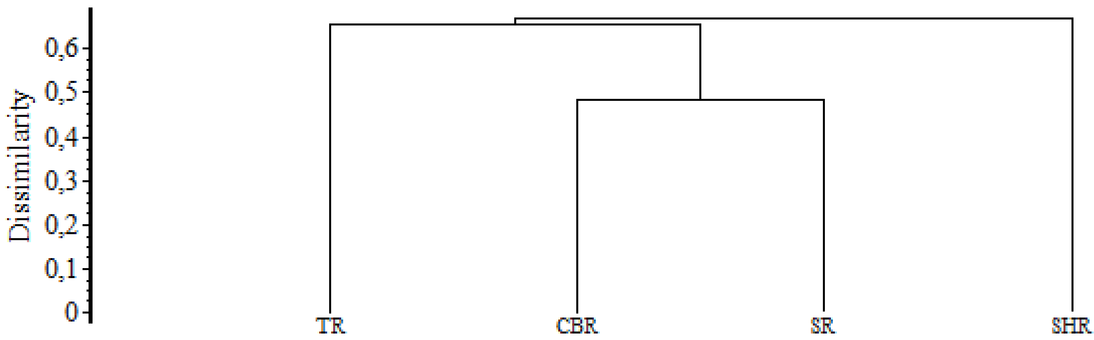


Figure 6-3: Phenogram of the simple phenetic model of descendant taxa using Sørensen–Dice dissimilarity coefficient

As it has been seen from the obtained dendrograms, the use of the three different dissimilarity coefficients led to essentially similar results; the more similar taxa are CBR and SR.

The 2D matrix of the simple phenetic model of descendant taxa based on the extended phenetic model of taxa P_E is directly not influenced by OMs, since OMs refer to the possible ancestor features. In other words, in an SFG, the presence of a feature in the descendant taxa is independent of OMs.

6.2. Script groups

While in the extended phenetic model P_E there are four descendant scripts (taxa), the number of potential ancestor scripts is 26. Many of them are related to each other, and their features in some cases are barely distinguishable. Therefore, it is advisable to treat them as script groups. Furthermore, scripts used at the same period, in the same region, but an evolutionary distance from one another, have been merged into a group for easier of use (Table 6-2).

Table 6-2: Groups of descendant and ancestor scripts and their impact areas

Script Group	Component Scripts	Impact Area
Aegean (Table 8-3), Canaanite (Table 8-6), Anatolian Hieroglyphic (Table 8-5) & Anatolian-Greek Alphabetic (Table 8-8)	Cypro-Greek; Phoenician, Old Aramaic; Anatolian Hieroglyphic; Old Phrygian, Ancient Greek, Lydian and Carian	Anatolia
Aramaic (Table 8-12)	Imperial Aramaic, Syriac and Armazian	Inner Asia
Greek Alphabetic (Table 8-13)	Greek and Greco-Bactrian	Inner Asia, Pontus Steppe or Carpathian Basin
Kharoṣṭhī [Table 8-14]	Kharoṣṭhī	Inner Asia

Script Group	Component Scripts	Impact Area
Brahmic [Table 8-15]	Brāhmī and Tibetan	Inner Asia
Middle Iranian (Table 8-16)	Parthian, Khwarazmian, Sogdian, Middle Persian, Manichean, Avestan and Christian Sogdian	Inner Asia
Slavic (Table 8-21)	Glagolitic and Early Cyrillic	Carpathian Basin
Latin Alphabetic (Table 8-18)	Latin	Carpathian Basin
Rovash (internal development, Table 8-19)	TR, SHR, CBR and SR	Inner Asia, Pontus Steppe or Carpathian Basin

6.3. *Processing operators*

It is not always possible to determine whether the existing features in two taxa (scripts) are related on an evolutionary basis or their similarity is a mere coincidence, even in the extended phenetic model of taxa P_e. However, while constructing a simple phenetic model of taxa, we had to make a probabilistic decision for each feature during the feature engineering phase, for building the extended phenetic model of taxa P_e, this decision about homoplasy is bypassed, and all reasonable options are incorporated into the alternative OMs in each SFG. Moreover, alternative ancestor taxa may be included within each OM in each SFG if necessary. An OM in an SFG generally refers to a group of ancestor taxa, and it is often not possible to decide, which one is the actual ancestor, so there may be several potential ancestor taxa in an OM of an SFG.

The consequence of the above is that most of SFGs in the extended phenetic model of taxa P_e are ambiguous in a sense that each of their descendant features has more than one ancestor feature in the same SFG. Thus, these SFGs should be excluded from further analysis during the evaluation of P_e. However, this would result in a significant loss of information (lower resolution). In the present state of the research, the extended phenetic model of taxa P_e contains $N_F = 119$ SFGs, out of which only 46 SFGs have an ancestor feature of a unique ancestor script (Table 6-4), and the other 73 SFGs have more potential ancestor features from multiple ancestor scripts.

To evaluate the extended phenetic model P_e, it is necessary to make P_e unambiguous even at the cost of reducing its accuracy in some way. The extended phenetic model P_e thus transformed into filtered phenetic models of taxa (Table 4-9: 4-16. §). This transformation step can be understood as a *processing operator.* A processing operator performs a transformation on the phenetic model as an argument and creates a more explicit, filtered phenetic model. In the following sections, some processing operators are introduced. The processing operators' series belongs to an algorithm called successive elimination presented in Figure 4-1.

6.4. Spectra of extended phenetic model

The successive elimination is presented on the example of Rovash scripts as descendant taxa. SFGs with multiple ancestor features are ambiguous concerning ancestor taxa. The simplest evaluation of the extended phenetic model to taxa P_e is only to consider those SFGs that contain a single ancestor taxon. Let $E_s(\quad)$ be a processing operator that generates a filtered phenetic model containing SFGs with a single ancestor taxon in each SFG. If the argument of the operator $E_s(\quad)$ is P_e, then the result is the filtered phenetic model P_{oneS}, see (6-5).

$$P_{oneS} = E_s(P_e) \tag{6-5}$$

The data matrix of the filtered phenetic model P_{oneS} presented in (6-6).

$$P_{oneS} = \begin{pmatrix} 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 3 \\ 2 & 2 & 1 & 1 \\ 10 & 4 & 1 & 5 \\ 0 & 3 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 4 & 0 & 0 \\ 2 & 10 & 2 & 3 \end{pmatrix}, \tag{6-6}$$

where the elements of the P_{oneS} are the numbers of those SFGs in which the ancestor features belong to only one ancestor script; the rows are the vectors of scripts (Imperial Aramaic, Middle Persian, Sogdian, Brāhmī, Glagolitic, Early Cyrillic, Latin and Rovash [internal development]) and the columns are the vectors of the descendant scripts (TR, SHR, CBR and SR). The script spectra of the descendant scripts (taxa) can be generated based on the number of SFGs in P_{oneS}, see Figure 6-4.

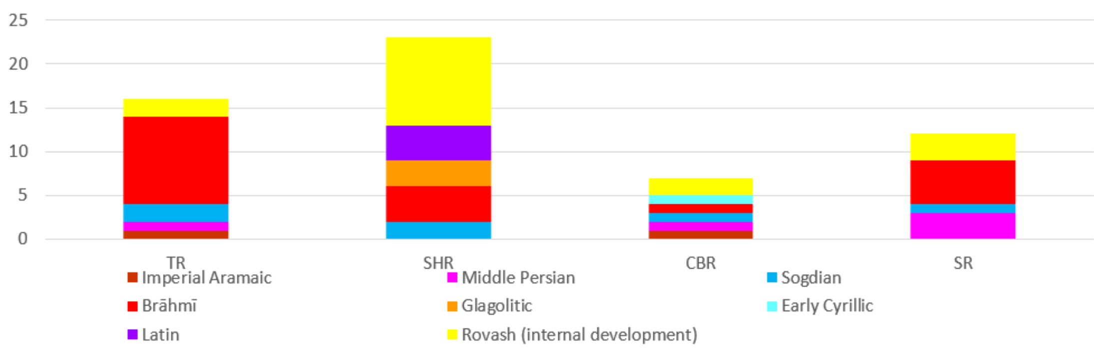


Figure 6-4: Script spectra of the descendant scripts based on the filtered phenetic model P_{oneS}

It is worth noting that these script spectra were generated based on only 45 SFGs of the total

$N_F = 119$ SFGs, since the operator $E_s(\ \ )$ skips SFGs with multiple ancestors when creating P_{oneS} (Table 6-4). However, suppose the ancestor scripts of an SFG belong to the same script group (Table 6-2). In that case, the uncertainty can be eliminated by specifying the ancestor script group instead of the ancestor scripts since these SFGs have only one ancestor script group; therefore, these SFGs become unambiguous. This increases the number of unequivocal SFGs in the filtered phenetic model and, thus, the evaluation's reliability.

Script-level unambiguous SFG means an SFG with a single ancestor script, *group-level unambiguous SFG* is an SFG with a single ancestor script group. By using the script groups, the extended phenetic model P_e can be evaluated by considering SFGs with a single ancestor script group rather than a single ancestor script applying the processing operator called $E_g(\ \ )$. The result of $E_g(\ \ )$ is the filtered phenetic model P_{oneG} according to (6-7).

$$P_{oneG} = E_g(P_e) \tag{6-7}$$

The data matrix of the filtered phenetic model P_{oneG} presented in (6-8). P_{oneG} is based on 52 SFGs with unique ancestor script groups (Table 6-4).

$$P_{oneG} = \begin{pmatrix} 1 & 0 & 1 & 0 \\ 3 & 3 & 5 & 7 \\ 10 & 4 & 2 & 5 \\ 0 & 3 & 1 & 0 \\ 0 & 4 & 0 & 0 \\ 2 & 10 & 2 & 3 \end{pmatrix}, \tag{6-8}$$

where the elements of the P_{oneG} are the number of those SFGs in which the ancestor features belong to only one ancestor script group, the rows are the vectors of script groups (Aramaic, Middle Iranian, Brahmic, Slavic, Latin Alphabetic and Rovash [internal development]), the columns as in (6-6). The group spectra of the descendant script groups can be created based on the number of SFGs in P_{oneG}, see Figure 6-5.

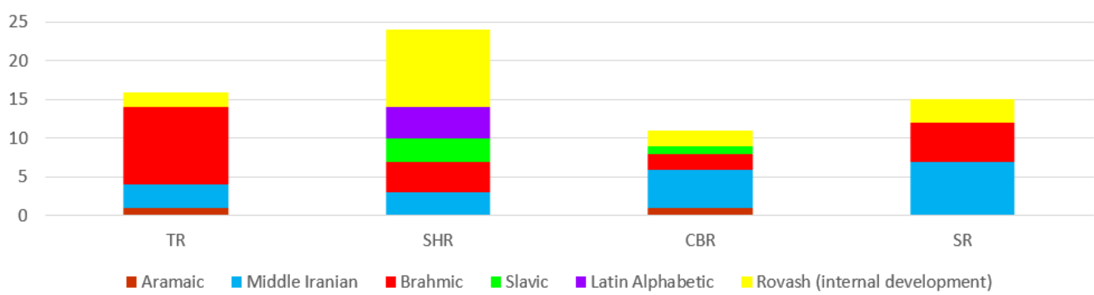


Figure 6-5: Group spectra of descendant script groups based on the filtered phenetic model P_{oneG}

6.5. Eliminating unlikely groups

The evaluation of the extended phenetic model of taxa P_e can be further improved by considering that many ancestor scripts are not single ancestors in any SFG. Moreover, the groups of some of these ancestor scripts are not single ancestor script groups in any SFG. From the literature on the evolution of scripts, it seems that the various historical scripts adopted graphemes from a relatively small number of other scripts. Therefore, it is probably a good evaluation strategy that if an ancestor script group in at least one SFG is not a single ancestor script group, then the scripts belonging to that script group are unlikely to be the ancestors of the descendant scripts under study.

If there are multiple ancestor script groups that are not single ancestors in SFGs, none of them may be single ancestor due to each other. Therefore, in the case of multiple ancestor script groups, it is worth omitting each ancestor script group one by one, and after each step, it is examined whether, with the elimination of one ancestor script group, the others have not become single ancestors in at least one SFG. It seems reasonable to start with the oldest or rarest ancestor script group. In SFG-1, there are two ancestor script families; namely, the Anatolian-Greek Alphabetic and the Greek Alphabetic, and none of them is a single ancestor script group in any SFG. In our case, after the elimination of the Canaanite, Anatolian Hieroglyphic & Anatolian-Greek Alphabetic ancestor script group (Table 6-2), the Greek Alphabetic ancestor script group became unique ancestor script group, and thus it is not left out of the further analysis.

This strategy is implemented by the $E_{ancG}(\quad)$ processing operator, which transforms the original P_e model to the filtered phenetic model P_{ancG} according to (6-9) by omitting those ancestor scripts from SFGs that are not members of a group that is a single ancestor group at least in one SFG.

$$P_{ancG} = E_{ancG} P_e \tag{6-9}$$

The number of SFGs in P_{ancG} equals to the number of SFGs in P_E, $N_F = 119$. Generally, the processing operator $E_{ancG}(\quad)$ does not create an unambiguous filtered phenetic model. However, a script spectrum or a group spectrum can only be generated from an unambiguous phenetic model, i.e., such model contains only script-level unambiguous SFGs or at least only group-level unambiguous SFGs. In the evaluation of the ambiguous filtered phenetic model P_{ancG}, the processing operators $E_s(\quad)$ and $E_g(\quad)$ that are already introduced should be applied to obtain an unambiguous model. By using $E_s(\quad)$, the script-level unambiguous SFGs of $P_{oneSAncG}$ are selected (6-10), and by applying $E_g(\quad)$, the group-level unambiguous SFGs of $P_{oneGAncG}$ are collected (6-11). The $P_{oneSAncG}$ and $P_{oneGAncG}$ are also filtered phenetic models.

$$P_{oneSAncG} = E_s(P_{ancG}) \tag{6-10}$$

$$P_{oneGAncG} = E_g(P_{ancG}) \tag{6-11}$$

The data matrix of the filtered phenetic model $P_{oneSAncG}$ presented in (6-12).

$$P_{oneSAncG} = \begin{pmatrix} 2 & 1 & 2 & 1 \\ 0 & 0 & 0 & 1 \\ 1 & 0 & 1 & 3 \\ 2 & 2 & 1 & 1 \\ 13 & 11 & 7 & 11 \\ 0 & 1 & 0 & 0 \\ 0 & 3 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 4 & 0 & 0 \\ 2 & 13 & 2 & 3 \end{pmatrix}, \tag{6-12}$$

where the elements of the $P_{oneSAncG}$ are the number of those SFGs in which the ancestor features belong to only one ancestor script, the rows are the vectors of scripts (Imperial Aramaic, Parthian, Middle Persian, Sogdian, Brāhmī, Greek, Glagolitic, Early Cyrillic, Latin and Rovash [internal development]), the columns as in (6-6). The script spectra of the descendant scripts (Figure 6-6) is generated based on the number of SFGs in $P_{oneSAncG}$, which is 61, a significant increase over the number of SFGs in P_{oneS}, see Table 6-4.

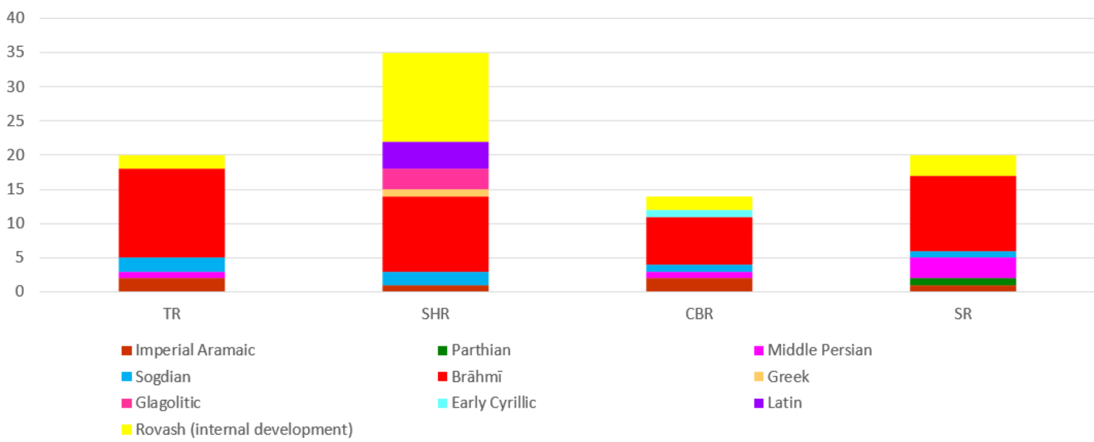


Figure 6-6: Script spectra of the descendant scripts based on the filtered phenetic model $P_{oneSAncG}$

The data matrix of the filtered phenetic model $P_{oneGAncG}$ presented in (6-13).

$$P_{oneGAncG} = \begin{pmatrix} 2 & 1 & 2 & 1 \\ 5 & 4 & 6 & 10 \\ 0 & 1 & 0 & 0 \\ 14 & 12 & 8 & 11 \\ 0 & 3 & 1 & 0 \\ 0 & 4 & 0 & 0 \\ 2 & 13 & 2 & 3 \end{pmatrix}, \tag{6-13}$$

where the elements of the $P_{oneGAncG}$ are the number of those SFGs in which the ancestor features belong to only one ancestor script group, the columns are the vectors of script groups (Aramaic, Middle Iranian, Greek Alphabetic, Brahmic, Slavic, Latin Alphabetic and Rovash [internal development]), the rows as in (6-6). The group spectrum of each descendant script group (Figure 6-7) is created based on the number of SFGs in $P_{oneGAncG}$, which is 72, a notable increase over the number of SFGs in P_{oneG}, see Table 6-4.

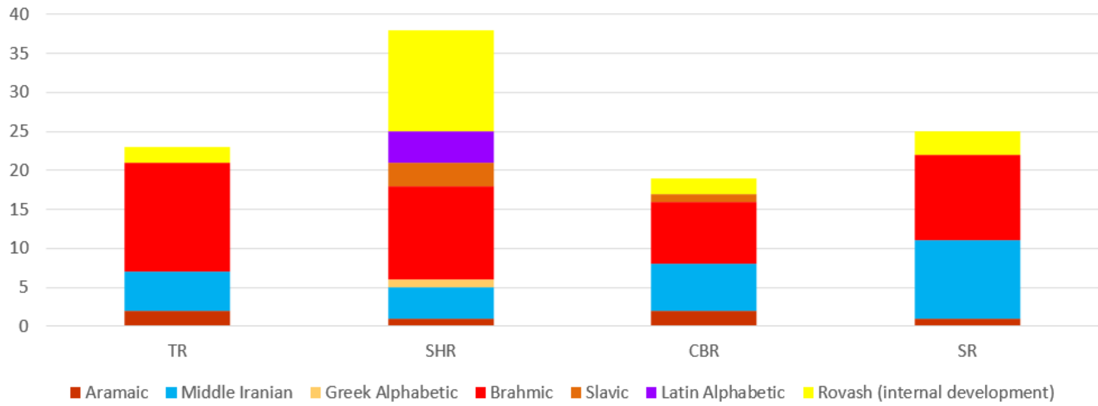


Figure 6-7: Group spectra of the descendant scripts based on the filtered phenetic model $P_{oneGAncG}$

Note that in performing the processing operator $E_{ancG}(\ \ )$ sorting order is needed to be set up when examining ancestor script groups. First, the earliest ancestor script group that is not single to any SFG should be examined. If this is omitted, some of the remaining ancestor script groups may become single in some SFGs. Then, of the remaining ancestor script groups that are not single to any SFG, the earliest one should be examined. This process takes place until there are no ancestor script groups that are not single to any of SFGs. E.g., the Greek Alphabetic ancestor script group was originally not single in any SFG (that is why it does not appear in Figure 6-5); however, by omitting the scripts of the Canaanite, Anatolian Hieroglyphic & Anatolian-Greek Alphabetic group (Table 6-2), the Greek Alphabetic group became single in some SFGs. That is why the Greek Alphabetic group presents in Figure 6-7. Without sorting, the Greek Alphabetic ancestor script group would have dropped out in the procedure $E_{ancG}(\ \ )$.

Based on Figure 6-6 and Figure 6-7, it is clear that the origin of the examined Rovash scripts is unrelated to the scripts from Anatolia. Therefore, the similarities of certain Rovash features to appropriate features of different Mediterranean scripts (Aegean, Canaanite, South Semitic, Anatolian Hieroglyphic, Anatolian-Greek Alphabetic, Berber, Paleo-Hispanic and Italic) are surely homoplasies (Table 2-7). Thus, the presumption of a relationship between the Cimmerians and Rovash scripts' evolution is superfluous.

6.6. *Eliminating unlikely scripts*

In the filtered phenetic model P_{ancG} (3), there are ancestor scripts that are not single ancestor scripts in any SFG, but their script groups appear as single ancestor script group in at least one SFG. Therefore, it can be presumed that those members of an ancestor script group that never appear as a single ancestor script in any SFG may not have influenced the descendant scripts, their presence in ancestor script groups is merely a result of their similarity to the true ancestor scripts. Based on this, the processing operator $E_{ancS}(\quad)$ introduced earlier creates the filtered phenetic model P_{ancS} (6-14) by omitting that ancestor features from SFGs of P_{ancG} for which the scripts belong to not single ancestors in any SFG.

$$P_{ancS} = E_{ancS}(P_{ancG}) \tag{6-14}$$

It should be noted that if there are multiple ancestor scripts that are not single ancestors in any of SFGs, none of them may be single ancestor due to each other. Therefore, in the case of multiple ancestor scripts that are not single ancestors in any SFG, it is worth omitting each ancestor script one by one, and after each step, it is examined whether, with the elimination of one ancestor script, the others have not become single ancestors in at least one SFG. It is worth starting with the oldest or rarest ancestor script.

The number of SFGs in P_{ancS} equals to the number of SFGs in P_{ancG} and in P_E, $N_F = 119$. In the evaluation of P_{ancS}, the processing operators $E_s(\quad)$ and $E_g(\quad)$ can be applied to it. By applying $E_s(\quad)$, the script-level unambiguous SFGs of $P_{oneSAncS}$ are gathered (6-15), and by applying $E_g(\quad)$, the group-level unambiguous SFGs of $P_{oneGAncS}$ are chosen (6-16). The $P_{oneSAncS}$ and $P_{oneGAncS}$ are filtered phenetic models.

$$P_{oneSAncS} = E_s(P_{ancS}) \tag{6-15}$$

$$P_{oneGAncS} = E_g(P_{ancS}) \tag{6-16}$$

The data matrix of the filtered phenetic model $P_{oneSAncS}$ presented in (6-17).

$$P_{oneSAncS} = \begin{pmatrix} 3 & 2 & 3 & 2 \\ 1 & 1 & 1 & 2 \\ 1 & 0 & 1 & 3 \\ 3 & 2 & 2 & 2 \\ 15 & 12 & 8 & 11 \\ 0 & 1 & 0 & 0 \\ 0 & 3 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 4 & 0 & 0 \\ 3 & 14 & 4 & 6 \end{pmatrix}, \qquad (6\text{-}17)$$

where the elements of the $P_{oneSAncS}$ are the number of those SFGs in which the ancestor features belong to only one ancestor script, the rows are the vectors of scripts (Imperial Aramaic, Parthian, Middle Persian, Sogdian, Brāhmī, Greek, Glagolitic, Early Cyrillic, Latin and Rovash [internal development]), the columns as in (6-6). The script spectrum of each descendant script (Figure 6-8) can be generated based on the number of SFGs in $P_{oneSAncS}$, which is 73, a significant increase over the number of SFGs in $P_{oneSAncG}$, see Table 6-4.

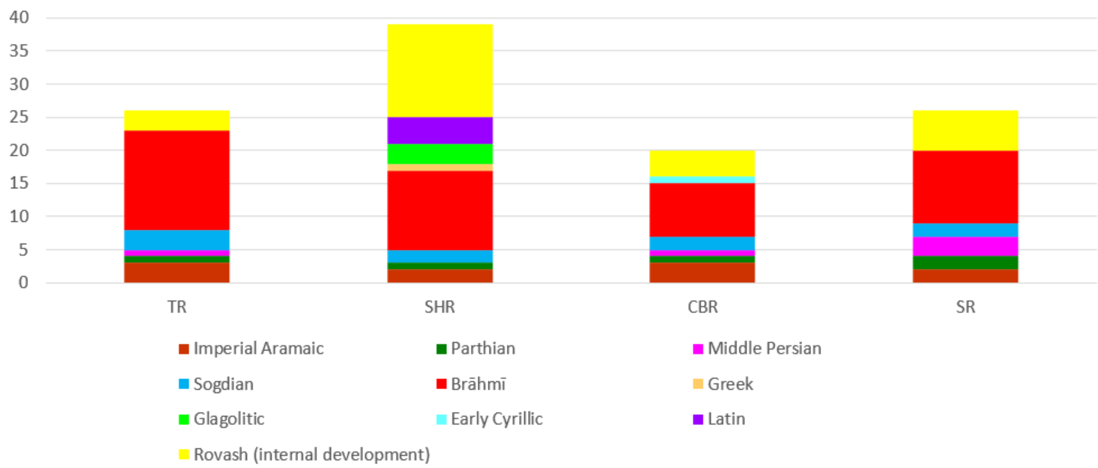


Figure 6-8: Script spectra of the descendant scripts based on the filtered phenetic model $P_{oneSAncS}$

The data matrix of the filtered phenetic model $P_{oneGAncS}$ presented in (6-18).

$$P_{oneGAncS} = \begin{pmatrix} 3 & 2 & 3 & 2 \\ 6 & 4 & 6 & 10 \\ 0 & 1 & 0 & 0 \\ 15 & 12 & 8 & 11 \\ 0 & 3 & 1 & 0 \\ 0 & 4 & 0 & 0 \\ 3 & 14 & 4 & 6 \end{pmatrix}, \qquad (6\text{-}18)$$

where the elements of the $P_{oneGAncS}$ are the number of those SFGs in which the ancestor features belong to only one ancestor script group, the rows are the vectors of script groups (Aramaic, Middle Iranian, Greek Alphabetic, Brahmic, Slavic, Latin Alphabetic and Rovash [internal development]), the columns as in (6-6). The group spectrum of each descendant script group (Figure 6-9) can be created based on the number of SFGs in $P_{oneGAncS}$, which is 78, a major increase over the number of SFGs in $P_{oneGAncG}$, see Table 6-4. In groups Aramaic, Greek alphabetic and Brahmic (Table 6-2) only one member remained in each group, the Imperial Aramaic, the Greek and the Brāhmī.

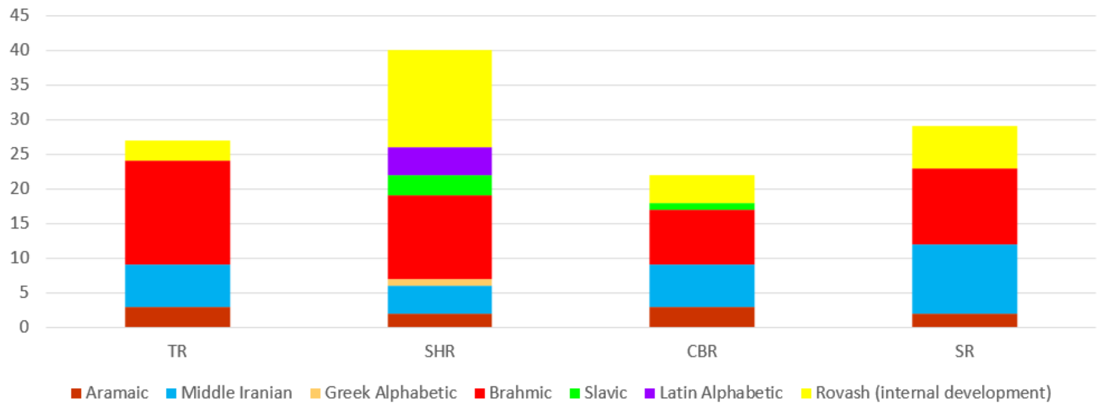


Figure 6-9: Group spectra of the descendant scripts based on the filtered phenetic model $P_{oneGAncS}$

The thus obtained spectra (e.g., Figure 6-8 and Figure 6-9) show some differences in ancestor scripts that affected each of the descendant scripts. It seems appropriate to conduct further investigations to clarify their origin.

6.7. Evaluation of reconfigured filtered phenetic models

The users of the studied Rovash scripts were nomadic, pastoral people. All fundamental economic processes in a pastoral society were performed within the households' framework. Therefore, specialised bureaucratic machinery was not needed to perform a managementredistributive activity. All social conflicts among the nomads were resolved by the traditional institutions of maintaining internal political stability. Naturally, foreign trade exchange was necessary, since the steppe states' stability depended on the ruler's ability to obtain hand-crafted goods from the settled areas (Kradin 2005: 151–152). The nomadic cultures were influenced by different scripts, which originated from the settled territories described in Table 6-3.

Table 6-3: Influences of foreign scripts in Inner Asian cultures

6-1 § *After the Achaemenid Empire:* In 330 BC, after the conquest of Alexander the Great and the fall of the Achaemenid Empire, the Greek became the official mediator of communication between the peoples, but the Imperial Aramaic remained widely used, although local variants developed in the 3rd c. BC (Goerwitz 1996: 489). Aramaic was retained by Alexander the Great and his successors even after the Achaemenid Empire's fall. The Greek only slowly took on a similar role in Hellenized countries (Harmatta 2003a: 82).
6-2. § *Sogdia:* It was a satrapy of Darius I (522–486 BC), so it already existed in this time (Golden 1992: 48). Consequently, the Sogdians directly obtained the Imperial Aramaic script in the Achaemenid Empire. As Golden pointed out, the Sogdians were in contact with China by the 3rd c. BC; therefore, their contact with Turkic-speaking people may be very old (Golden 1992: 122). The early Turks were influenced by their Iranian and Tokharian neighbours (Golden 1992: 122). The Sogdians' influence on the Turks was enormous; their contact probably dates back to the pre-imperial period (Golden 1992: 145). After the victory of the Turks over the Hephthalites near Nakhshab (Qarshi, Uzbekistan) in 560s, Sogdia was incorporated into the First Turkic Khaganate (Babayarov 2006: 71).
6-3 § *Yuezhi:* In the 3rd c. BC, the Yuezhi (cf. Table 3-2: 3-2 §) peaked power (Enoki et al. 1994: 171). The first records of the Yuezhi's existence in Inner Asia date from the 3rd c. BC. The Yuezhi adapted an advanced Aramaic-based writing system (Györffy & Harmatta 1997: 148; Harmatta 1997b: 173). In 203–177/176 BC or 175 BC (Jankowski 2013: 528), the Xiongnu defeated the Yuezhi tribes that migrated west to the rivers Ili, Chu and Narin. Earlier, the nomadic Yuezhi tribal confederation controlled the Altai Mountains area to the Yellow River (Harmatta 1994b: 479–480). The majority of the Yuezhi fled to the Tarim Basin's eastern part (Xinjiang, China) (Harmatta 1998: 130; Vásáry 2003: 38–42).
6-4. § *Greco-Bactrian Kingdom:* In ca. 250 BC, the Greco-Bactrian Kingdom was founded, in which the Kharoṣṭhī script was also used in addition to the Greek script (Harmatta 1994a: 433). The Greek script later developed into Greco-Bactrian script (Table 8-13).
6-5. § *Parthia:* In 247 BC, the Parthian (Arsacid) Empire was established, where the Middle Iranian languages (the Parthian and others) were used. Its first capital was Nisa in the area of Ashgabat (Turkmenistan).
6-6. § *Xiongnu:* In 209 BC, Maotun (Modu), son of Touman established the Xiongnu tribal alliance, and created an empire north to China. The name of Xiongnu ruler was shan-yü (chanyu). That was the Eurasian Steppe's first nomadic empire (Vásáry 2004: 10–13; Zimonyi 2007: 1). It existed in the period of 3rd c. BC–AD 155 (Jankowski 2013: 528). The Xiongnu Empire extended from Manchuria to the Kazakh Steppe (Zimonyi 2012: 200). There would be no evidence if the Xiongnu invented a script for their use. It is doubtful that the cultural and social-economic stage of Xiongnu had reached the level at which any kind of script would have been employed. However, there is evidence that the Xiongnu used ink; therefore, they

had some writing knowledge (Batsaikhan 2011: 128). Moreover, cf. the Xiongnu tamga  found in Noin Ula (Table 8-34); its possible influence is presented in SFG-44.

The Han [Sino] – Xiongnu war lasted from 133 BC to AD 89. In AD 87, a Xianbei army defeated the Xiongnu and killed the northern shan-yü. More than 200,000 Xiongnu tribesmen surrendered after this defeat, and a great Han victory in AD 89 completed the dismantlement of the Xiongnu confederation (Lewis 2007: 137–138).

An artefact with Sogdian inscription have been found in a Xiongnu settlement by the river Ivolga (near Ulan-Ude, in Buryatia, Russia) (Harmatta 1997b: 173). The Xiongnu had trade relations with the Chinese and Bactria (Honeychurch & Amartuvshin 2006: 265).

The Sogdian name of the Xiongnu was *hūn* (Maenchen-Helfen & Helfen 1973: xv), *xwn* (Payne, R. 2016: 7). The same name is in Middle Iranian language *hyōn/xyōn, xiyōn,* which corresponds to the Latin *Chionitae* (Golden 2013: 47). The Chionites and the Huns were the same (Kim 2013: 36).

In the middle of 1st c. AD, the Xiongnu groups started to migrate west from the territory of the Xiongnu Empire (Vásáry 2004: 10–13). According to R. Payne, the Xiongnu on the Mongolian frontier of China had gradually collapsed in 1st–2nd c. AD. However, some moved westwards and appeared in Indo-European languages as Huns (Payne, R. 2016: 7).

6-7. § *Tocharia* (Tocharistan): In 128 BC, the Yuezhi defeated Bactria, whose territory was then called Tocharia (Vásáry 2003: 50–51) or Tocharistan (Ilyasov 2019: 89). According to Sims-Williams, the Greek name of Yuezhi was *Tocharoi (Tokharoi).* Sims-Williams connects the Yuezhi with the *Asiani (Asii)* tribe, perhaps the Ossetians' ancestor (Sims-Williams 2002: 229–230, 236–240).

6-8. § *Kushan* (Kuṣāṇa): In AD 10, by unifying the Yuezhi principalities King Kujula Kaphises I, the founder of the Kushan dynasty created the Kushan Empire (Vásáry 2003: 51). The Kushans knew the dignity name *jabgu* (Puri 1994: 247). Later, this name was used by several Steppe people, the Turks, Khazars and Hungarians, among others.

6-9. § *States in the Tarim Basin:* The local rulers had embraced Buddhism in several Indo-Iranian states in the Tarim Basin. In the 7th c. AD, they had close relations with Turks. Many Sogdians lived in these states (de Rachewiltz & Rybatzki 2010: 13).

6-10. § *Silk Road:* From 2nd c. AD the use of Syriac language began on the Silk Road (Harmatta 2003a: 85). After 4th c. AD the most important languages of the Silk Road were Khwarazmian, Middle Persian (then New Persian) and Syriac (Harmatta 2003a: 85).

6-11. § *Rouran:* The first information about the Rouran was at the beginning of 4th c. AD (Kradin 2005: 153). In AD 402, the Rouran ruler, Shelun declared the imperial confederation establishment and took khagan's title (qaghan). He reorganised the military-administrative structure of the Rouran society, introducing a decimal system, dividing the population-army into hundreds and thousands and established stringent rules of behaviour in battle. The Rouran plundered its neighbours (China and Inner Asian states) to control trade routes. The Rouran extended to the Ili River and the Tarim Basin (Kradin 2005: 154–155).

At the end of the 5th c., the Rouran Khaganate government was simple. The Rouran had no scripts to write texts, but later, they learnt well to make records with the help of notches on wood (Kradin 2005: 156). Not later than at the turn of the 6th c., the Rouran adopted China's written language and used it in foreign relations and internal records. Early in the 6th c., the Rouran built their capital city (Mumocheng) encircled with two walls (Kradin 2005: 163). Kradin opened the question of whether the Rouran had their own script (Kradin 2005: 165). Buddhism was very important among the Rouran elite (de la Vaissière 2018: 315–316).

In 552, Bumin of the Turkic Ashina tribe defeated the Rouran Khaganate and declared himself Illig Khagan. Up to 555, the successors of Bumin completely crushed the Rouran. Avars were remnants of the Rourans or closely related to the Rouran state, and fled to Europe from the Turks

	(Golden 2013: 58–63). In 557, Avars appeared north of the Caucasus (Zimonyi 2007: 6). In 567, Avars occupied the Gepid Kingdom (eastern part of the Carpathian Basin) in alliance with the Langobards, and in 568, after the Alboin-led Langobards moved to Italy from the former Pannonia, the Avars dominated the entire Carpathian Basin (Vida 2007: 13; Zimonyi 2012: 205).
6-12.	§ *Kidarites:* By the AD 380s at the latest, these Hun groups (called Kidarites and Alkhan) started to conquer Iranian regions. The Kidarite Huns appeared in the middle of the 4th c. and were in firm possession of Bactria by AD 360 (Kim 2013: 36). They ruled Bactria and Sogdia in ca. 420–470 (Payne, R. 2016: 7–8).
6-13.	§ *Hephthalites:* A kind of Huns, who gradually supplanted the Kidarites in Bactria and Sogdia. They ruled Bactria from around 450, Sogdia from 509 to 560 and the Tarim Basin (Payne, R. 2016: 8). The Iranian East was under the rule of the Hun and, from the mid-6th c., Turkic rulers until the beginning of the Islamic conquests in the latter half of the 7th c. (Payne, R. 2016: 7–8). Around 557, the First Turkic Khaganate and the Sasanian Empire destroyed most of the Hepthalite Empire.
6-14.	§ *Huns in Europe:* In AD 370–375 the Huns (the late descendant of the Xiongnu groups moving west) defeated the Alans in the area northwest of the Caspian Sea and north of the Caucasus (Selmeczi 1992; Vásáry 2003: 51–53; Aibabin 2008: 2). The Huns adapted some Aramaic script (Györffy & Harmatta 1997: 148).
6-15.	§ *Turkic khaganates:* The First Turkic Khaganate existed in 552–659, the Second Turkic Khaganate was in 682–744. For the 7th c. AD, the number of Sogdians who lived in Turkic lands turned out to be very significant (Kyzlasov, L. R. 2004: 123–133). According to de la Vaissière, the Inner Asian peoples, especially the Sogdians and the Tokharian, played an important role in the Turkic khaganates' administration, economy, and social life. Tokharian Buddhism made inroads in the steppe under the Turks' protection (de la Vaissière 2012: 142–169). The first Buddhist temple is now known in Central Asia from the 7th–8th c. in the ruins of the city Suyaba on the left bank of the River Chu (Shu) Zhetysu [Semirechye, Kazakhstan and Kyrgyzstan]. The Sogdians used this Buddhist temple (Kyzlasov, L. R. 2004: 123–133). Nomadic elites from the Xiongnu onward frequently developed the institutions of urbanism, agriculture and literate administration (Payne, R. 2016: 11). The Iranian elite of Bactria and neighbouring areas came to exercise its authority on behalf of Hun and Turk rulers (Payne, R. 2016: 13). L. R. Kyzlasov pointed out the importance of Sogdian script in Turkic states; namely, the Sogdian script and language were the official written language in the First Turkic Khaganate (Kyzlasov, L. R. 2004: 123–133). However, Brāhmī script and Para-Mongolian as the imperial language (see Bugut and Khüis Tolgoi Brāhmī inscriptions) were also used in the eastern part of the First Turkic Khaganate (Maue, Dieter: Personal communication by email, 15 October 2020). The active Iranian-Turkic linguistic interaction was in the last quarter of the 6th c. AD. There are Turkic coins with the Sogdian script from the 7th–8th c. The Sogdian script is used mostly for the Old Turkic coins; however, there are legends in Middle Persian, Bactrian, Ancient Indian and TR scripts (Babayarov 2013: 330). In the western part of the First Turkic Khaganate possibly used Bactrian script and language (?) attested so far only by one fragmentary inscription from East Kazakhstan (Maue, Dieter: Personal communication by email, 15 October 2020). Sheguy Khagan's seal (Western Turkic Khaganate, reigned 611–618) exhibited Middle Persian and TR inscriptions (Payne, R. 2016: 17–18). The Second Turkic Khaganate used TR.

Based on Table 6-3, it is clear that if Rovash scripts had a common evolutionary period, it must have been in Inner Asia. Moreover, it is very likely the first period of Rovash scripts' development was influenced by Middle Iranian and Brāhmī writing cultures. The transition from the Aramaic to the Middle Iranian scripts was presumably continuous. Cf. the Imperial Aramaic script was largely unchanged in Iran in the early Parthian period (2nd–1st c. BC, Skjærvø 1996: 516–517). That is why in several SFGs the ancestor-candidate features could belong to all Imperial Aramaic and various Middle Iranian scripts, especially the earliest Parthian and the early variants of the Sogdian scripts. In some cases, the available Parthian glyphs are similar to Rovash glyphs (e.g., SFG-8, SFG-17, SFG-43, SFG-71, SFG-97 and SFG-103). Its reason could be that the available Parthian glyphs attest the early stages of Imperial Aramaic glyphs in Inner Asia. That is why merging the Imperial Aramaic, and the Middle Iranian scripts (Table 6-2) into one script group called Aramaic & Middle Iranian is well-founded.

The Greek, Latin and Slavic scripts were used outside of Inner Asia; therefore, they did not influence the earliest period of the descendant scripts under study. Note that the Greek Alphabetic script group could also include the Greco-Bactrian script used in Inner Asia (Table 6-2). However, the Greco-Bactrian script was eliminated by the processing operator $E_{ancS}(\quad)$ (6-14). Without the Greco-Bactrian script, the Greek Alphabetic script group contains only the Greek script, which could affect Rovash scripts in Europe but not in Inner Asia. The data matrix of the reconfigured filtered phenetic model with the merged Aramaic & Middle Iranian script group is defined by the $P^0_{oneGAncS}$ presented in (6-19).

$$P^0_{oneGAncS} = \begin{pmatrix} 19 & 12 & 16 & 22 \\ 0 & 1 & 0 & 0 \\ 15 & 12 & 8 & 11 \\ 0 & 3 & 1 & 0 \\ 0 & 4 & 0 & 0 \\ 3 & 14 & 4 & 6 \end{pmatrix}, \tag{6-19}$$

where the elements of the $P^0_{oneGAncS}$ are the numbers of those SFGs in which the ancestor features only belong to one ancestor script group, the rows are the vectors of script groups (Aramaic & Middle Iranian, Greek Alphabetic, Brahmic, Slavic, Latin Alphabetic, Rovash [internal development]), the columns as in (6-6). The number of SFGs is 92, a great increase over the number of SFGs in $P_{oneGAncS}$, see Table 6-4. The group spectrum of each descendant script (Figure 6-10) can be created based on the number of SFGs related to each ancestor script group in $P^0_{oneGAncS}$.

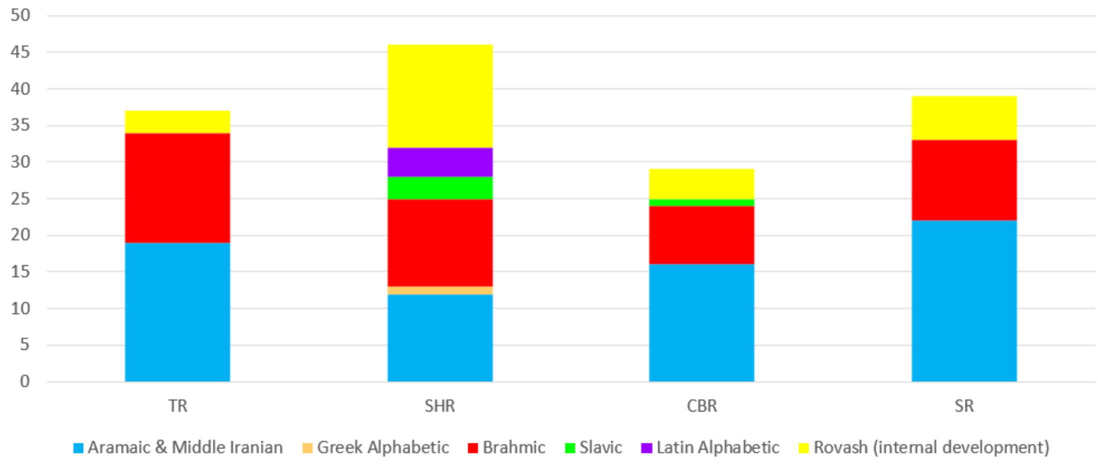


Figure 6-10: Group spectra based on $P^0_{oneGAncS}$

Since the resolution of the $P^0_{oneGAncS}$ is the highest among the various filtered phenetic models (Table 6-4); therefore, the $P^0_{oneGAncS}$ is used for evaluating the possible influence of tamgas. In order to measure the possible effects of tamgas on descendant scripts, it is necessary to determine the number of SFGs in the $P^0_{oneGAncS}$. For this, the values of the model parameter "Glyph fit only with tamgas" in each SFG has to be used. Suppose the value of this model parameter for a certain OM is 1 in a certain SFG. In that case, the ancestor features that belong to this OM could be hybridized by the glyph shapes or glyph styles of the tamgas listed in the "Tamgas ancestor feature (glyph shapes or styles)" field of that SFG. This tamga feature (glyph shape or style) could affect an ancestor script, and this ancestor script belongs to a script group listed in an OM in the given SFG. Therefore, the group spectra for describing the possible effects of tamgas will be composed of the number of SFGs in which the model parameter "Glyph fit only with tamgas" is 1, and this can be associated with a certain script group as described in the previous lines. The matrix of the group spectra of the possible effect of tamgas $T\left(P^0_{oneGAncS}\right)$ is presented by (6-20), which is based on the reconfigured filtered phenetic model $P^0_{oneGAncS}$ given in (6-19).

$$T\left(P^0_{oneGAncS}\right) = \begin{pmatrix} 6 & 5 & 6 & 8 \\ 0 & 0 & 0 & 0 \\ 10 & 8 & 4 & 5 \\ 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 \\ 3 & 8 & 3 & 3 \end{pmatrix}, \qquad (6\text{-}20)$$

where the operator $T(\quad)$ expresses the effect of tamgas, the elements of the $T\left(P^0_{oneGAncS}\right)$ are the number of those SFGs in which the ancestor features belong to only one ancestor script group and the model parameter "Glyph fit only with tamgas" related to that script group is 1; the rows and columns as in (6-19). The number of SFGs belonging to $P^0_{oneGAncS}$ where there is the theoretical possibility of the effect of tamga is 44. Since the number of SFGs in $P^0_{oneGAncS}$

is 92 (Table 6-4), so the 48% of SFGs in $P^0_{oneGAncS}$ might be associated with tamgas. It is worth noting that it does not mean certain relationship, only the possibility of symbol-level hybridization (Table 2-10: 2-6. §) with tamgas.

The $T\left(P^0_{oneGAncS}\right)$ (6-20) demonstrates that the script groups influencing in the Carpathian Basin (Greek Alphabetic [Greek], Slavic [Glagolitic and Early Cyrillic] and Latin Alphabetic [Latin]) do not indicate the impact of the tamgas, except in two cases (SFG-46 and SFG-77). The internal development of the descendant scripts is difficult to evaluate because it is not usually known exactly when and where each step of internal development occurred, nor is it known how long the glyph of each tamga was known to users of a given script. Therefore, only the cases of the Aramaic & Middle Iranian and the Brahmic script groups are compared to each descendant script. Figure 6-11 presents the comparison of the total number of Aramaic & Middle Iranian derived SFGs, and the number of those Aramaic & Middle Iranian derived SFGs in which the features were possibly influenced by tamgas.

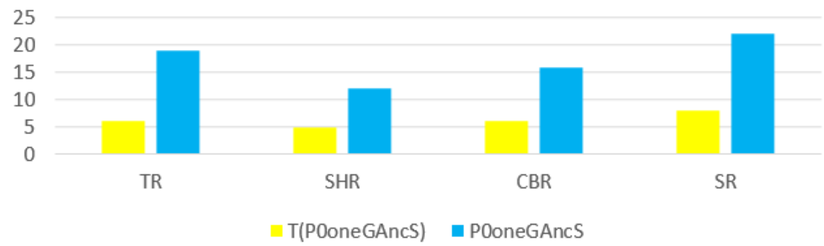


Figure 6-11: Possible influence of tamgas on the Aramaic and Middle Iranian origin parts of the descendant scripts based on $P^0_{oneGAncS}$

Figure 6-12 presents the comparison of the number of SFGs that are influenced by the Brāhmī script and the number of SFGs that are influenced by the Brāhmī script and possibly by one or more Eurasian tamgas (Table 8-34).

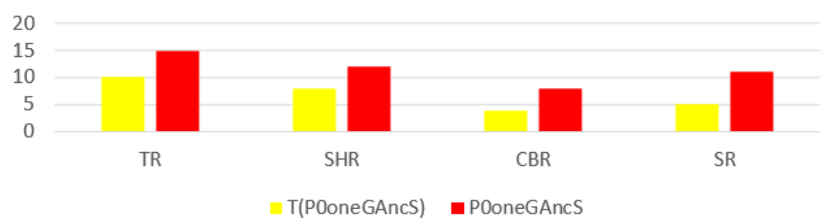


Figure 6-12: Possible influence of tamgas on the Brāhmī origin parts of the descendant scripts based on $P^0_{oneGAncS}$

It can be seen from Figure 6-11 and Figure 6-12 that some of the features of both Aramaic & Middle Iranian and Brāhmī origin may have been influenced by Eurasian tamgas (Table 8-34). Most Brāhmī-derived features have a higher rate of possible symbol-level hybridization with tamgas. Perhaps the reason for this was that, in adopting the generally calligraphic Brāhmī glyphs, the more familiar tamga shapes or their glyph styles were preferred.

Comparing the numbers of SFGs in the unambiguous filtered phenetic models used for creating script and group spectra are presented in Table 6-4. It is clear that the reconfigured filtered phenetic model $P^0_{oneGAncS}$ (Table 4-9: 4-17. §) utilizes by far the most of the features of the original extended phenetic model P_E; which can be expressed that they have the highest resolutions (Table 4-9: 4-16. §). Therefore, these group spectra based on the reconfigured filtered phenetic model is presumably the most reliable.

Table 6-4: Comparing the resolution of filtered phenetic models of taxa

Filtered or reconfigured filtered phenetic models of taxa	Number of SFGs (resolution) as the percentage of the original P_E
P_{oneS}, a filtered phenetic model containing SFGs with single ancestor script (6-6)	45 (38%)
P_{oneG}, a filtered phenetic model containing SFGs with single ancestor script group (6-8)	52 (44%)
$P_{oneSAncG}$, a filtered phenetic model without unlikely script groups containing SFGs with single ancestor script (6-12)	61 (51%)
$P_{oneGAncG}$, a filtered phenetic model without unlikely script groups containing SFGs with single ancestor script group (6-13)	72 (61%)
$P_{oneSAncS}$, a filtered phenetic model without unlikely scripts containing SFGs with single ancestor script group (6-17)	73 (61%)
$P_{oneGAncS}$, a filtered phenetic model without unlikely scripts containing SFGs with single ancestor script group (6-18)	78 (66%)
$P^0_{oneGAncS}$, a reconfigured filtered phenetic model using merged group-structure without unlikely scripts containing SFGs with single ancestor script group (6-19)	92 (77%)

Using the script groups of the reconfigured filtered phenetic model $P^0_{oneGAncS}$ (6-19), a simple phenetic model of descendant taxa can be generated by considering the four descendant scripts, only (Table 4-9: 4-19. §). For the phenogram (dendrogram), the Sørensen–Dice dissimilarity coefficient (6-4) and the WPGMA clustering method was applied to calculate the distance between clusters (see details at Figure 6-3). The phenogram of the simple phenetic model based on the reconfigured filtered phenetic model $P^0_{oneGAncS}$ (6-19) is seen in Figure 6-13. The calculations were performed with the SYN-TAX 2000 (Podani 2001).

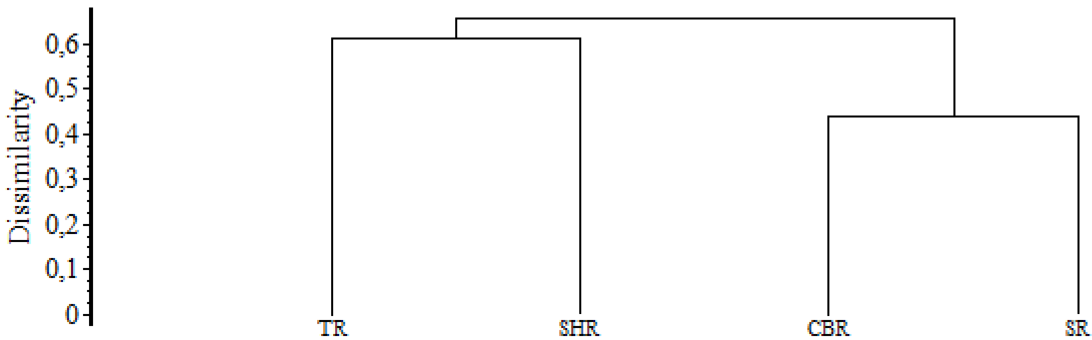


Figure 6-13: Phenogram of the descendant taxa based on the reconfigured filtered phenetic model of taxa $P^{0}_{oneGAncS}$

6.8. *Evaluation of reduced filtered phenetic models*

Considering the likely history of the studied descendant taxa (Rovash scripts), it is clear, that there are two stages of development: (i) in Inner Asia, they were influenced by the Middle Iranian and Brāhmī scripts; (ii) in the Carpathian Basin, SHR and CBR could be affected by the Early Cyrillic, Glagolitic, Greek and Latin scripts. TR could also have developed further, since it was surely affected by the Sogdian and the Brāhmī scripts in that period, when the other three examined Rovash scripts have already been used far from the Turkic khaganates, in Europe. Presumably, most of the descendant taxa's internal development also occurred during this second phase. Based on this, a reduced filtered phenetic model of taxa (Table 4-9: 4-18. § and Figure 4-1) can be generated from the extended phenetic model of taxa by removing those SFGs that have ancestor features from the Greek, Latin, Early Cyrillic and Glagolitic scripts, moreover—for the simplicity—all of the internal developments of Rovash scripts in case of the $P^{0}_{oneGAncS}$, see (6-19). Therefore, it can be useful to compare the numbers of those SFGs of $P^{0}_{oneGAncS}$ in which there are single ancestor scripts and they were probably used in Inner Asia. The same way, a sub-spectrum can be created for each descendant taxon. Figure 6-14 presents the normalized form of the group spectra (sub-spectra) of the descendant taxa to eliminate the effect of the altering number of their features using the reconfigured groups.

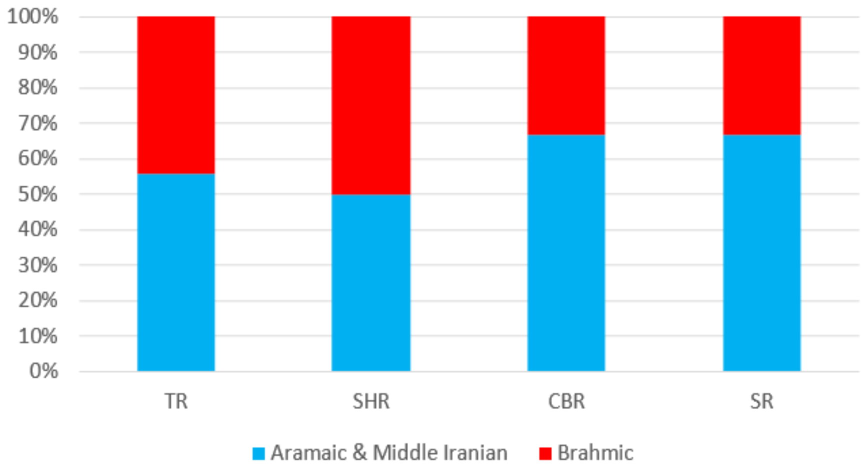


Figure 6-14: Normalized group spectra based on $P^0_{oneGAncS}$ using only Inner Asian ancestors (sub-spectra)

In Figure 6-14, the TR and SHR have similar group spectra, and the group spectra of CBR and SR equal, but the two pairs (TR & SHR vs CBR & SR) differ from each other.

Using the script groups of the reduced reconfigured filtered phenetic model based on $P^0_{oneGAncS}$ (6-19) a simple phenetic model of descendant taxa can be generated by considering the four descendant scripts only (Table 4-9: 4-19. §). For the phenogram (dendrogram), the Sørensen–Dice dissimilarity coefficient (6-4) and the WPGMA clustering method was applied to calculate the distance between clusters (see details at Figure 6-3). The phenogram of the simple phenetic model created from the reduced reconfigured filtered phenetic model based on $P^0_{oneGAncS}$ (6-19) is seen in Figure 6-15. The calculations were performed with the SYN-TAX 2000 (Podani 2001).

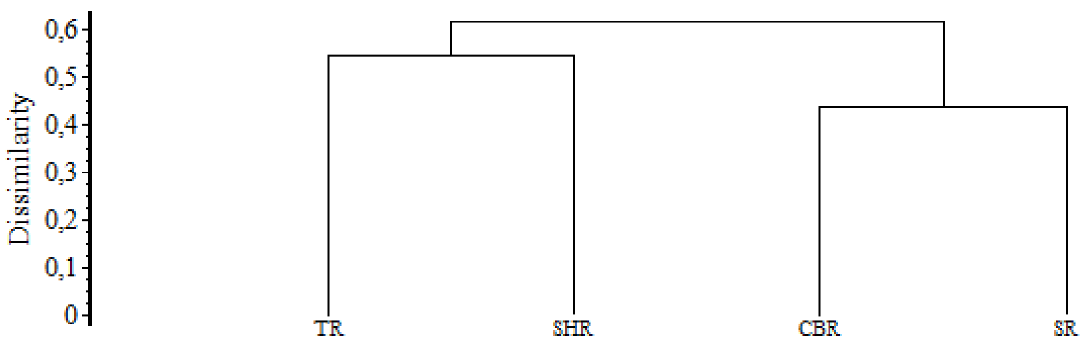


Figure 6-15: Phenogram of the descendant taxa based on the reduced reconfigured filtered phenetic model of taxa $P^0_{oneGAncS}$

Based on phenograms obtained from the original (Figure 6-13) and the reduced (Figure 6-15) reconfigured filtered phenetic models, it is clear that CBR and SR are undoubtedly close to each other. A comparison of Figure 6-13 vs Figure 6-15 demonstrates that similarity inside the cluster of TR and SHR and in the cluster of CBR and SR was larger before leaving Inner Asia than in their fully developed state; which corresponds to the results obtained from the sub-spectra based on $P^{0}_{oneGAncS}$ (Figure 6-14).

6.9. Consequences of the analyses

The following consequences can be derived based on the results described above, see Table 6-5.

Table 6-5: Basic consequences of the phenetic and evolutionary analyses

6-16. § The structure of the normalized group spectrum of each descendant script under study are similar to each other in some degree (Figure 6-14), which demonstrates that the earlier presumption of a common ancestor script called *Proto-Rovash (Hosszú 2019: 390–392) is confirmed. There are unambiguous SFGs with Aramaic, Middle Iranian or Brāhmī origin that their features are attested in SHR, CBR or SR, but not in TR (e.g., SFG-8, SFG-25, SFG-42, SFG-43 and SFG-71 for Aramaic or Middle Iranian origin, and SFG-16, SFG-82, SFG-88, SFG-99, SFG-102 and SFG-108 for Brāhmī origin). This support that SHR, CBR and SR not simply seceded from the TR; but there was a common ancestor (*Proto-Rovash), and each of TR, SHR, CBR and SR inherited some of its features.
6-17. § There are Rovash inscriptions in the Carpathian Basin from the beginning of 7th c. AD (Vékony 2004a: 197; Table 8-31). Thus, the individual Rovash scripts had to come into existence by the 6th c. AD at the latest.
6-18. § The basic orthographic properties of Rovash scripts are the RTL writing direction and only partly written vowels; these properties are similar to the Aramaic (Table 8-12) and the Middle Iranian (Table 8-16) scripts. It suggests that Rovash scripts' evolution started from an Aramaic derivative script (cf. Table 6-3: 6-2. §). It is worth noting that according to Vásáry, the TR is based on a local variant of the Sogdian script (Vásáry 2003: 80–81).
6-19. § Besides later Middle Iranian graphemes (e.g., SFG-52), several Rovash graphemes are most similar to the Imperial Aramaic or earlier Middle Iranian glyph variants, e.g., SFG-3, SFG-17, SFG-21, SFG-42, SFG-43, SFG-44, SFG-50, SFG-71, SFG-78, SFG-92 and SFG-103. These Imperial Aramaic or earlier Middle Iranian glyphs were typically used not later than the 5th c. AD (cf. Table 2-9: 2-4. §). Then, the Middle Iranian glyph style changed to cursive, far from the corresponding Rovash glyphs. Moreover, since the First Turkic Khaganate started in mid-6th c. AD (Table 6-3: 6-15. §) and the hypothetical *Proto-Rovash script had to be created using Aramaic or Middle Iranian glyphs earlier than the First Turkic Khaganate; presumably in the period of the Rouran Khaganate or even earlier. The identity of the first users of the hypothetical *Proto-Rovash script (cf. Table 6-3: 6-2. §) is still unclear. Note that Klyashtorny suggested that Sogdian script was adapted to the Turkic language in the 5th c. AD (Golden 1992: 151).
6-20. § According to Tryjarski, no Turkilogists could explain the existence of double graphemes that were used to represent the same phonemes (Tryjarski 1997: 366). TR script can be a direct

consequence of the syllabic Brāhmī script's influence. Since in each Rovash script, a significant Brāhmī influence is detected (Figure 6-14), it is clear that the separation of these scripts happened after the Brāhmī script begun to affect them. This is supported by the fact that all inscriptions of each Rovash script contain either Aramaic or Middle Iranian and Brāhmī features, respectively (not taking into account the extremely short inscriptions). Considering 6-17. §, the adaptation of the Brāhmī graphemes in Inner Asia had to happen or at least to begin not later than the 6th c. AD. It is following the fact that the first adaptation of the Brāhmī script to the official language of the First Turkic Khaganate, which was probably a Mongolic language, happened not later than the 6th or early 7th c. (Table 8-15).

6-21. § The normalized group spectra (Figure 6-14) demonstrate that CBR and SR were slightly less influenced by Brāhmī script than TR and SHR. SHR, CBR and SR differ from TR in that they do not contain all graphemes for the full vowel harmony. However, SHR, CBR and mostly SR show traces of vowel harmony. Presumably, SHR, CBR and SR lost some graphemes—especially graphemes being necessary for the vowel harmony—during their evolution.

6-22. § Considering Figure 6-14 and Figure 6-15, a possible consequence of these is that users of the CBR and SR left the presumed common origin niche (surely Inner Asia) earlier than users of SHR and TR. Users of SHR had to leave the niche when both Brahmic and Aramaic & Middle Iranian impacts were more or less completed. The distance between SHR and TR may originate from the facts that (i) the language of the users of SHR changed from Turkic to Hungarian (this could have led to a loss of vowel harmony of graphemes denoting consonants, Table 7-1) and (ii) SHR was affected by some cultural influences in the Carpathian Basin; namely, as a consequence of Christian conversion, the influence of Greek, Slavic and Latin scripts may have arisen.

6-23. § It is worth noting that these results could be significantly influenced by modelling disturbances listed in Table 4-10.

The most important ancestor scripts are the Aramaic, Middle Iranian (Parthian, Sogdian and Middle Persian) and Brāhmī scripts. Greek, Glagolitic, Early Cyrillic and Latin scripts only affected Rovash scripts in the Carpathian Basin, so their effects could not prevail after the split of Rovash scripts. The putative geographical transmissions of Rovash features are presented in Figure 6-16 following the group spectra of the descendant scripts based on the filtered phenetic model $P_{oneGAncS}$ (Figure 6-9).

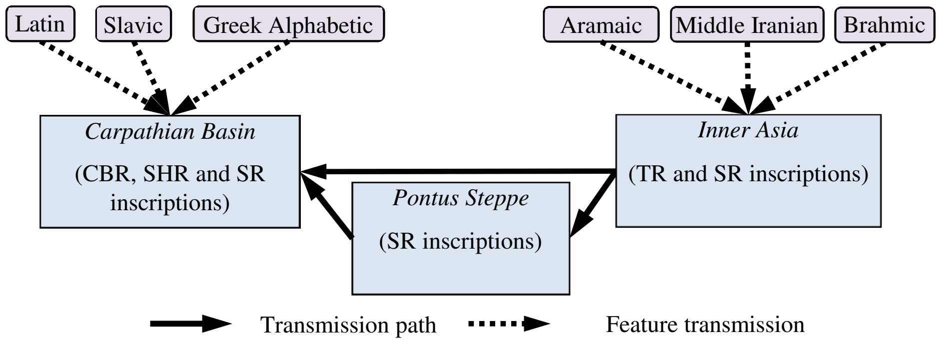


Figure 6-16: The geographical influences of the ancestor script groups on Rovash scripts based on group spectra (Figure 6-9)

7. Peculiarities on the scripts studied

7.1. Vowel harmony in Rovash scripts

As Erdal pointed out, *vowel harmony* (synharmonism) and the presence of the front rounded vowels *ö* and *ü*, both are equally untypical of Semitic, Caucasian, East Asian and Early Indo-European (Erdal 2004: 39). Semitic scripts distinguish only velar and uvular /k/ (*'k'* and *'q'*) and /g/ (often noted *g* and *γ* respectively), a distinction used for expressing front vs back in Turkic languages.

The following are known vowel harmonies of consonants in TR: /b/, /d/, /t/, /g, γ/, /k, q/, /l/, /n/ /r/, /s/ and /j/. In case of the *k* and *q* different graphemes were used even for the following syllables: /ïq/, /Wq/ and /Ẅk/. Moreover, I. L. Kyzlasov claimed that certain graphemes could have been used for syllables /ït/, /ïš/, /ïs/, /id/ed/, /ič/eč/ and /im/em/ (Kyzlasov, I. L. 1994: 131).

The vowel harmony traces in the different Rovash scripts are presented in Table 7-1. Several different graphemes denoting the same consonant in one script may result from vowel harmony. However, it may also result from an earlier script-level hybridization (Table 2-10: 2-5. §), if a script was composed of different scripts or script variants, cf. the earlier introduced layered script evolution model and Table 7-4.

Table 7-1: Vowel harmony in each Rovash script

Script	Vowel harmony in each script
TR	The vowel harmony as an orthographic rule was generally applied in TR (e.g., Table 7-2); however, there were examples for its inconsequent uses (Table 7-3).
SHR	The vowel harmony does not exist in SHR; however, some SHR consonants are denoted with multiple graphemes (Table 7-4). The letter names in the earliest surviving SHR abecedary (*ac* [SFG-58], *ek* [SFG-91] in the Nikolsburg Alphabet) refer to vowel harmony, and traces of the distinction between the two <k> graphemes can be discovered in a very few SHR script relics (Table 8-30).
CBR	The vowel harmony does not exist in CBR; however, some CBR consonants are denoted with multiple graphemes: CBR ᛅ (SFG-58), ꞵ (SFG-89) <k>; CBR ϒ (SFG-106), ◊ (SFG-108) <t>; and CBR ᑐ (SFG-71),) (SFG-72) <n>.
SR	Sporadically and not consequently, SR applied synharmonism in the case of some consonants (Vékony 2004a: 193). E.g., ϛ <n¹, n²> vs ϟ <n¹> (SFG-71).

In Rovash scripts, a particularly wide variety of graphemes denoted *k*, *q* and *χ* sounds, so their possible relations are reviewed in Table 7-2.

Table 7-2: Rovash graphemes denoting voiceless velar or uvular plosives or fricatives

TR	SHR	CBR	SR
-	-	ᛏ, ᛏ <χ> (SFG-44, SFG-45)	⅄, ⅄ <h> (SFG-44); ᘏ, ϡ <χ> (SFG-42)
⅋, ϶ <^{I}k^{I}> (SFG-57)	-	-	⋺, ϶ <k> (SFG-57)
N, ꟽ <^{A}q^{A}> (SFG-58)	ᛂ, ʅ, N <k> (SFG-58)	ᛂ <k> (SFG-58)	ʗ, ʗ <^{A}q^{A}> (SFG-59)
◁, ᐅ <^{i}q^{i}> (SFG-61)	∆, ∆ <k> (SFG-61)	-	-
-	◊ <k> (SFG-91)	-	◊, ◊ <q> (SFG-91)
↓, ↑ <^{W}q^{W}> (SFG-62)	-	-	-
ß <$^{\ddot{W}}$k$^{\ddot{W}}$> (SFG-89)	Ӿ <χ> /χ/ (SFG-90)	8 <q> (SFG-88), ß <k> (SFG-89)	8 <q>; ⧖ <^{W}q^{W}> (SFG-88)

In TR, it frequently happened that the same grapheme was once used in palatal, other times in a velar syllable (e.g., Konkobaev et al. 2015: 344). Table 7-3 presents some examples of such uncertainties.

Table 7-3: Examples for wobbliness in the application of the vowel harmony in TR

TR ꝺ <b^{1}> ↔ Ꝺ <b^{2}> (SFG-17); ᛟ <b^{1}> ↔ ᛟ <b^{2}> (SFG-14)
TR ꟼ <y^{1}> ↔ ꟼ <y^{2}> (SFG-56); D <y^{1}> ↔ D <y^{2}> (SFG-55)
TR Y <l^{1}> ↔ Y <l^{2}> (SFG-65)
TR ϒ <r^{1}> ↔ ϒ <r^{2}> (SFG-93)
TR ¥ <s^{1}> ↔ ¥ <s^{2}> (SFG-97), I <s^{1}> ↔ I <s^{2}> (SFG-101)

7.2. Traces of reticulate evolution in Rovash scripts

In each of the examined descendent scripts, the graphemes' redundancy can be observed; namely, there are multiple graphemes in the same script for the same sound. The reason for this cannot be exclusively vowel harmony (Table 7-1), as it is found only in TR and appears inconsistently even in SR. Another reason for the redundancy of different graphemes with the same sound value may be that a script was perhaps made up of multiple scripts that existed separately during its development, which phenomenon can be characterized by a layered script evolution model. This phenomenon is examined as follows, in the case of SHR. Table 7-4 presents those SHR graphemes that denote the same sound at the same or different times in each group of rows separated by solid lines. Of these, the multiplicity of consonant graphemes <k>, <š> and <ž> as well as <d>, <nd>, <t> and <ť> could be explained by the hypothesis that they had remained in SHR from a time when vowel harmony (Table 7-1) was expressed through different graphemes. However, vowel harmony cannot explain the multiplicity of SHR graphemes <e> and <e>, <Ẅ> and <v>; furthermore, <c> and <č>. Their existence suggests that multiple scripts or script variants merged at the time of SHR formation, in such a way, a symbol-level hybridization (Table 2-10: 2-6. §) could occur. Vékony proposed that SHR was derived from the compound of CBR and SR (Vékony 2004a: 111). However, it cannot be disclosed that the formation components of SHR may have included script variants or individual scripts that have not yet been identified due to the lack of readable script relics.

Table 7-4: SHR graphemes with the same sound value and their parallels found in other Rovash scripts

SHR graphemes with the same sound value	Possible TR, CBR and SR parallels
Ꭓ <e> /ä, e, ē/ (SFG-3); Ꭓ, ƻ <e> /ä, ē/ (SFG-11); Ꞁ <e> /ä, e/ (SFG-13); Ꭓ, ᛝ <e> /e, ē/ (SFG-6)	TR Ӿ <A> /e/; (maybe TR ᛝ <e> [SFG-6] or SR ȝ <e> [SFG-10]); TR ᛝ, Ɛ, ᚷ <e> /e/; SR Ꭓ <e> /e/
Ӽ <ö> /ö, ő/ (SFG-5); Ӿ, Ꭓ <Ẅ> (SFG-7); ᛋ, ≳ <Ẅ> (SFG-35); ᛖ <v> /u, ü, v/ (SFG-37)	- - TR ᚴ, ᚹ <Ẅ>; SR ᛖ <Ẅ>
↑ <c> /c, č/ (SFG-85); ᚺ <č> /č/ (SFG-82)	TR ⅄ <^{i}č^{i}, ^{i}ğ> (SFG-84); SR ᚺ /s/, ᚺ /č/ <č>
ᛇ <k> (SFG-58); Ⲇ, Δ <k> (SFG-61); ◊ <k> (SFG-91)	CBR ᛇ <k>; TR ᚺ <^{A}q^{A}>; TR ⊲ <^{ï}q^{ï}>; SR ◊ <q> (SFG-91); (maybe TR ◊, O <ṅ> /ŋ/ [SFG-23])
H <r> (SFG-92); ⁄ <r> (SFG-96)	TR ᛋ <r^{1}>; SR H, h <r> -
Y <ž> /š, ž/ (SFG-97); Λ <š> /š, ž/ (SFG-98); 0 <š> (SFG-99)	TR ᛉ <s^{1}>, ᛉ <š^{2}>, ᛉ <^{i}č^{i}, ^{i}ğ>; SR Y <š>; TR ∧ <š>; SR ᚦ <š^{2}>; CBR Φ <š>
ᛁ <t> /t, d/ (SFG-104); Ӿ, Ӿ, Ӿ, Ӿ <ť> /ť/ (SFG-106)	TR ᚴ <t^{2}> /t/ (SFG-103); CBR ᛯ, ᛯ <t>; SR ᚫ <t>

According to the second group of rows in Table 7-4, it is worth noting that the appearances of SHR Ӽ <ö> /ö, ő/ (SFG-5) and SHR Ӿ, Ꭓ <Ẅ> (SFG-7) are probably due to the labialization of the Hungarian language, and independent from the existence of other graphemes for /ö, ő/ or /ü, ű/. Regarding the last row of Table 7-4, note that SHR graphemes denoting /ť/ earlier could denote /t/ since in the Hungarian language there was not /ť/ even in the 13th c. AD (E. Abaffy 2003b: 307). Table 7-5 presents some decisions based on the combined consideration of various descendants graphemes.

Table 7-5: Combined decisions on descendant graphemes

7-1. § SHR 0, ⊘, 0 <Í> (SFG-55) and SHR 0 <š> (SFG-99) were probably not used in the same script variant of SHR, since their visual identities (Table 2-6) are very similar, cf. feature evolution principle referred as "different visual identities" (Table 4-2). It is worth noting that SHR 0 <š> (SFG-99) survived in only one abecedary (Nikolsburg). Cited: SFG-55, SFG-99.
7-2. § It is striking that SHR ⁄, /, ǀ <r> (SFG-96) and SHR ǀ <s> (SFG-101) coexisted in SHR, as the two glyphs can easily be confused. This may lead to the assumption that SHR was composed of several layers (layered script evolution model, script-level hybridization [Table 2-10: 2-5. §]). SHR ⁄, /, ǀ <r> is perhaps from an ancestor script in which not the single-line ǀ <s> (SFG-101) denoted /s/, cf. TR ɏ, ꟻ, ꟼ, ϒ, ϒ <s^1, s^2, š> (SFG-97). It is worth noting that in SHR, /s/ is denoted exclusively by ǀ <s>. Cited: SFG-96.

Some possible examples of the horizontal transference are listed in Table 7-6.

Table 7-6: Possible examples for horizontal transferences

7-3. § The development of SR ꟻ <I> (SFG-52) can be the result of a glyph style transfer (Table 2-9: 2-4. §). However, this development can also be interpreted as a glyph shape transfer (Table 2-9: 2-2. §) from the Middle Persian (Book Pahlavi) ؋ (Skjærvø 1996: 518) <y> /y, ĕ̆, ĭ, ǰ/ (SFG-51) to the SR Ր, Ꞁ <I> (SFG-50).
7-4. § The problem is the origin of TR ʢ <g^2> (SFG-18) and TR ᚴ <^{I}k^{I}> (SFG-57): Looking at the glyph variants of TR ʢ <g^2> and TR ᚴ <^{I}k^{I}>, it can be seen that there is an overlap in their glyph distribution, e.g., TR ℈, ⋲ <g^2> and TR ℈, ⅄ <^{I}k^{I}>. If the origins of TR ʢ <g^2> (SFG-18) and TR ᚴ <^{I}k^{I}> (SFG-57) are different, they possibly interacted within TR script. In this case, a glyph shape transfer (Table 2-9: 2-2. §) could have occurred, cf. that in the Old Turkic language the /k/ and /g/ were not distinguished if they used near front vowels (Table 7-9: 7-6. §).

7.3. Regularity and symmetry in the evolution

The strive for regularity can be observed in each Rovash script (regularity, Table 4-2), see some example in Table 7-7. In the case of SHR, earlier scholars already pointed out regularity in the glyphs (Vásáry 1974: 168–169, Sándor 1996). According to Püspöki Nagy, several SHR glyphs were created by conscious differentiation (Püspöki Nagy 1977: 305). This is in line with the feature evolution principle referred to as "different visual identities" (Table 4-2). This may explain why SHR ꟼ <p> (SFG-80) has three arms since it differs from Rovash Ր, Ꞁ <I> (SFG-50) and ꟻ <β> (SFG-16) this way. Note that there is no three-arm variant of the <p> in CBR, which may be related to the existence of the often-used three-arm CBR ꟼ, ꟼ, ꟼ <z> (SFG-41). Its reason could be the feature evolution principle referred to as "different visual identities" (Table 4-2). It is worth noting that there are several irregularities in the graphemes' glyphs, and the virtual regularity is usually not evolutionary but accidental instead.

Table 7-7: Examples for virtual regularity in different scripts

Script	Quasi-regular, but usually unrelated series of glyphs
CBR	ǀ <s> (SFG-101), ˥ <i> (SFG-50), ⊣ <β> (SFG-16), ⅃ <f> (SFG-80), ⊣, ⫤, ⫥ <z> (SFG-41)
SHR	ǀ <s> (SFG-101), ˥ <i, j> (SFG-50), (reconstructed from a ligature) *⊣ <β> (SFG-16), ⫤, ˥ <p> (SFG-80)
Etruscan	1 <p>; ⊣ <v>; ⫤, ⫥ <e> (MNAMON)
Early Latin	ǀ <i>, ᛚ <l>, ᚨ <f>, ᛈ <e> (MNAMON)
Runic	⅄ (Looijenga 2003: 6) <g>; ↑ <t>; ᛉ, ᛯ (Mees 2000: 50) <z>; ↓ <k> (SFG-62)
SHR	ǀ <s> (SFG-101), ⺊ <d> (SFG-29), †, ‡, † <i>; ⧧ <ď> (SFG-39), ⧧ <p> (SFG-81)
TR	> <W> (SFG-31); ≫, ≪ <d1> (SFG-27); ≫, ≷ <nč> (SFG-87); ⩓ <t1> (SFG-48); ∧ <š> (SFG-98)
SHR	∧ <š> (SFG-98), Λ, Λ, Λ <g> (SFG-18), Λ, A, A <l> (SFG-64)
SR	) <n1> (SFG-72), ℶ, ℶ, ℶ, ℶ <I> (SFG-51), ℨ, ℨ, ℨ <e> (SFG-11)
SHR	) <n> (SFG-72), ℨ, ℶ, Þ <e> (SFG-11), ʖ, ʖ, – <é> (SFG-12)
Runic	ᚢ <u>; ⊓, ᛖ <e> (SFG-105); ⊔, ⊔ <p> (SFG-38)
SHR	ᚺ <r> (SFG-92), ᚺ, ᚹ, □ <č> (SFG-82), ᚺ, ⋕ <z> (SFG-102)
Early Latin	Ϙ <q>, P <p>, P <r>, B <b> (MNAMON)
Northeastern Iberian	⊟, ▯, ⊟ <bu>; H, H, H, θ <o>; ◻, ◇, ◇ <gu/ku> (Hesperia)
SHR	0, ʘ, Ø, 0, 0, ⊖ <Í> (SFG-55), Ø <š> (SFG-99), Ø, ⊘ <f> (SFG-47), ⌧, ∝ <Ẅ> (SFG-7)

In the development of Rovash graphemes, it is remarkably common to create new graphemes by various feature transformations (Table 4-3) so that the resulting glyph becomes axially or centrally symmetrical (feature evolution principles, Table 4-2). Examples of this are presented in Table 7-8. It is worth noting that the initial grapheme was also symmetrical in some cases, and the descendant grapheme did not become more symmetrical. Furthermore, it is by no means certain that the purpose of modifying the glyph was to make it symmetrical.

Table 7-8: Presumed creation of symmetrically shaped Rovash graphemes with different feature transformations

Presumed ancestor grapheme	Rovash descendant grapheme
SHR ⊲ <a> (SFG-1)	SHR ⋘ <á> (SFG-2, duplication)
Kharoṣṭhī ʒ <dha>, Armazian ≷ <d>, Brāhmī ⋞ <da>, Middle Persian ʒ <d> (SFG-27)	TR ≫, §, ⋙ <d1> (SFG-27, duplication)
SHR ᛖ <u> (SFG-37)	SHR ⋈, ⧗, ⋈ <u> (SFG-38, line insertion)
SHR ↑ <c> (SFG-85)	SHR ↕ *encz* <nc> (SFG-86, duplication)
CBR ⩚ <χ> (SFG-44)	CBR ⩓ <χ> (SFG-45, use of known glyph)
SHR ⟟, ⟟, ⵤ <k>, TR И, N <AqA>, CBR ⟟ <k> (SFG-58)	SHR ⋊ *vnc* <nk> (SFG-60, duplication or use of known glyph)

Presumed ancestor grapheme	Rovash descendant grapheme
SHR X, **X** <b>, CBR X <b>, SR X <b> (SFG-15)	SHR ꭗ *amb* <mp> (SFG-70: duplication, ornamenting or use of known glyph)
SHR ꟻ, ꟻ <p> (SFG-80)	SHR ≠, ǂ, ≠ <p> (SFG-81, line shifting or use of known glyph)
TR Ч, И <r^1> (SFG-92)	SHR H, H, N <r> (SFG-92: line shifting)
Brāhmī 𑀚 <ja> (SFG-87)	TR ʒ, ⌇, ʔ, ⌇, {, ɜ, ≹ <nč> (SFG-87, mirroring and straightening)
SHR ƚ <d> (SFG-29)	SHR + <d> (SFG-29, rotating)
SHR ƚ <d> (SFG-29)	SHR Ӿ *and* <nd> (SFG-30, duplication)
SHR Ẋ, Ẋ <ť> (SFG-106)	SHR Ẍ *athÿ,* Ẍ <ť> (SFG-106, line shifting)

7.4. *Biosemiotic analogy*

Based on studies to date, it is certain that Rovash scripts have borrowed features (Table 2-2) from multiple scripts during their development. This process can be related to the biosemiotics principle that the interpretation and use of signs between species help the biological development of a species. As a result of this, a species is more evolving, the more it can interpret and use signs between species. Biological species that can use the sign sets of several species can develop, leading to a new quality (Szívós 2016: 194). Applying this to scriptinformatics means that if the script users can learn and borrow features (Table 2-2) from other scripts as needed (cf. Table 2-9), it helps evolve their script.

This phenomenon can be seen in the case of TR, where vowel harmony (Table 7-1) developed, which uses different graphemes near the velar and palatal vowels, so vowel harmony requires additional graphemes, which TR has borrowed from other scripts. CBR also has been able to write down Slavic texts by borrowing the Early Cyrillic Ѫ *onsъ* <ǫ> (SFG-77) (Hosszú & Zelliger 2014a: 187). Another example is that the Latin script that had become suitable for the notation of some Germanic languages (Icelandic, Old English, Old Norse and Old Swedish) by borrowing two graphemes from the Runic script: Latin (Old English) þ *thorn* <þ> [θ], [ð] from Runic ᚦ *thorn/thurs* <þ> /θ/ (Looijenga 2003: 6) and Latin (Old English) ƿ *wynn* <ƿ> [w] from Runic ᚹ **wunjō* <w> (Looijenga 2003: 6), cf. symbol transfer (Table 2-9: 2-1. §).

It is worth noting that adapting a script to its semiotic niche (cultural and social environment) does not mean unconditional survival. An example of this is the 'Phags-pa script (Table 8-15), one of the most elaborate scripts—and did not survive. Consequently, a script's evolutionary ability can be improved by learning about the sign sets of other species, but this does not ensure the survival of the script.

7.5. *Effect of language phenomena*

In examining Rovash scripts' evolution, we have to mention the phenomena specific to different languages, summarized in Table 7-9.

Table 7-9: Language phenomena and their impact on Rovash scripts' evolution

7-5. § There was no /t/ > /d/ or /d/ > /t/ sound change in Old Turkic language (Danka, Balázs: Personal communication by email, 5 February 2014). Cited: SFG-29.
7-6. § In Hungarian and Turkic languages the /g, γ/ >/k/, devoicing is unlikely (/γ/ is an allophone of /g/ in Turkic). Oppositely, there are examples for the /k/ > /g, γ/ voicing (sonorization) in Turkic and its relative languages. E.g., in R-Turkic Ogur there was an onset [k-] > [g-] sonorization, while Common Turkic Cuman retained /k-/ (Agyagási 2013: 164–165, 171). Cited: SFG-18, SFG-20, SFG-21 and SFG-22.
7-7. § Certain sounds of the R-Turkic Ogur languages consequently differ from the Common Turkic: Common Turkic /š/ ~ Ogur /l/ (*lambdacism*, change of a sound to /l/) and Common Turkic /z/ ~ Ogur /r/ (*rhotacism*, change of a sound to /r/) (Róna-Tas 1991: 28). Cited: SFG-65, SFG-93.
7-8. § There was an Old Turkic /š/ ~ /č/ alternation (Erdal 2004: 103). Cited: SFG-83 and SFG-84.
7-9. § Erdal discussed the close relationship of the Old Turkic /s/ and /š/ (Erdal 2004: 102). The /s/ > /š/ sound change is possible in Turkic languages (Vásáry, István: Personal communication, 2010–2011). Cited: SFG-101, SFG-97, SFG-99 and SFG-100.
7-10. § In Turkic, there is only one /š/ phoneme; therefore, both <ṣa> and <śa> could have been borrowed to a script used for the Old Turkic language. Furthermore, when the Uighurs adopted the Brāhmī script they used both Brāhmī graphemes <ṣa> and <śa> *promiscue* to express their postalveolar sibilant (Maue, Dieter: Personal communication by email, 24–25 January 2020). Cited: SFG-98, SFG-99 and SFG-100.
7-11. § In the Turkic languages there was a /z/ > /s/ sound change called *onset devoicing;* furthermore, the initial /z/ of suffixes or syllable is generally not stable (Erdal 2004: 121–122). There was a devoicing in the Kipchak languages: /d/ > /t/ and /z/ > /s/ (Vásáry, István: Personal communication, 2010–2011). Cited: SFG-101.

7.6. *Signs of combinatorial variants of nasals*

During the evolution of scripts, in addition to the marking of individual sounds, there are examples for representing the consonant cluster C_{nasal} + C_{stop} with a single grapheme (Table 7-10); its fundamental reason could be that nasals change their place of articulation due to the consonant that follows them (Olaszy 2006: 31–32). Of nasals, /n/ has allophones in most places of articulation (Vago 1980: 33, 36). Consequently, the co-articulation of the /n/ + C_{stop} sound pairs causes a particularly significant modification in pronunciation (Gósy 2004: 149–150). This explains why /n/ + C_{stop} sound pairs play a significant role in various scripts.

Table 7-10: Appearance of the effect of C_{nasal} + C_{stop} sound pairs in different scripts

7-12. § In Anatolian Hieroglyphic (Table 8-5) script, /n/ before a consonant was seldom written out (Payne, A. 2010a: 15), similar to Aegean syllabic scripts (Fischer 2001: 75).
7-13. § The sound value of Ancient Greek (Table 8-8) *gamma* <γ> (SFG-18) before *gamma* <γ>, *kappa* <κ> (SFG-62), *chi* <kh> (SFG-44, SFG-58) and *xi* <ξ> (SFG-41) was [ŋ], otherwise [g]. Cited: SFG-24.
7-14. § In Greco-Bactrian script (Table 8-8), the Greek custom of representing *ng* [n͡gg] with double *gamma* <γ> (<γγ>) was retained (Skjærvø 2006–2012). This is supported by the Bactrian inscription on the seal of Khingila (first half of 5th c. AD) (Kurbanov 2010: 69 and Fig. 54). Cited: SFG-60.
7-15. § In Old Persian orthographies (Table 8-16), nasals (/m, n/) are marked before a consonant only in exceptional cases (Schmitt 1993: 456–462).
7-16. § In Sogdian language, the voiced dental plosive was pronounced as a fricative, except after /n/, here it remains plosive and is written through a different grapheme. According to some scholars, the situation in Old Turkic is similar, phonetically and graphematically: /d/ has two allophones, *ð* (represented through <d> and *d,* the latter after *n* (as in Sogdian) and *l,* which is written <t> or together with *n* through digraph <nD> (Maue, Dieter: Personal communication by email, 15 October 2020). Cited: SFG-105.
Examples for graphemes representing /n/ + C or /l/ + C sound pairs: <ṅ> (SFG-23), <ṅ> (SFG-24), <nd, nt> (SFG-28), <nd> (SFG-30), <nk> (SFG-60), <mb, mp> (SFG-70), <nc> (SFG-86), <lt> (SFG-105) and <nt> (SFG-107).

7.7. *The /m/ ~ /b/ transformation*

The change of sounds /m/ and /b/ into each other can be observed in some languages, affecting writing, see Table 7-11.

Table 7-11: Data related to the /m/ ~ /b/ transformation

The interchange /m/ ~ /b/ can be observed in some languages, e.g., the Proto-Celtic /mr, ml/ > P-Celtic /br, bl/.
In the Old Turkic, if onset [b] (after a vowel) is followed by a nasal, [b] was replaced by /m/ (Erdal 2004: 62, 74).
The influence of the interchange /m/ ~ /b/ arose in the following SFGs: <b^2> (SFG-14), <b> (SFG-15), <m> (SFG-67) and <m> (SFG-68).

8. Palaeographic data

8.1. Notation and abbreviations

An important attribute of a grapheme is the *transliteration value* (Table 2-3), replacing graphemes in one script with graphemes in another script. The notation of transliteration is marked in < >, the phonemic transcription of the phonemes are denoted in / / and the phonetic transcription of the sound values (phonemes and allophones separately) are denoted by IPA notation in [ ]. In transliteration, the indication that a consonant is used in conjunction with (a) specific vowel(s) or consonant before or after it is done by placing the transcription value of the vowel(s) or consonant before or after the consonant transcription value in the superscript, e.g., <$^{\ddot{W}}$k$^{\ddot{W}}$>. If the transcription of a grapheme's sound value does not differ from the transliteration value (e.g., /b/ and <b>), only the latter is marked in many cases.

Anatolian Hieroglyphic (Table 8-5) symbols are numbered according to Laroche's catalogue (Laroche 1960), denoted by * in front of the symbol identification number. In the case of the transliteration of Turkic Rovash, the usual notation is applied in this book. In Steppe Rovash, for which grapheme the vowel harmony can be detected, there the difference is marked (velar: ^{1}, palatal: ^{2}). In Turkic Rovash there is a system of five different graphemes for representing the sounds /k/ and /q/ depending on the conjuncted vowels: <^{A}q^{A}> (SFG-58), <^{I}k^{I}> (SFG-57), <$^{\ddot{I}}$q$^{\ddot{I}}$> (SFG-61), <^{W}q^{W}> (SFG-88) and <$^{\ddot{W}}$k$^{\ddot{W}}$> (SFG-89); for alternative notation see Table 8-1. In Steppe Rovash, there are only traces of a similar system. Therefore, in the Steppe Rovash script, the difference between the different sounds *k* and *q* is not made by an index but is denoted by the transliteration with <k> and <q>. An exception to this is that, based on the surviving and readable few Steppe Rovash relics, it appears that a certain (⧖) Steppe Rovash grapheme with /q/ sound value was used only near /o/ or /u/ (Table 8-27). In this case, the transliteration follows the Turkic Rovash: SR ⧖ <^{W}q^{W}> (SFG-88).

The transliteration of some specific sounds and another kind of notations is in Table 8-1. Throughout the book, the traditional names of the graphemes (Semitic or Greek letters) or the letter names from the script relics (e.g., Nikolsburg Alphabet, Table 8-30) are typed in italics.

Table 8-1: Some specific transliteration and transcription symbols with further notations

Notation	Description
*	A reconstructed script, glyph or grapheme.
/	The alternative hypotheses are separated by a slash.
/ /	Double slashes denote phonemic transcription (denoting phonemes), phonemic representation of grapheme.
/i̯/	Close (high) back unrounded vowel (velar *i*), used in the Hungarian phonology (SFG-89).
/m̥/	Voiceless bilabial nasal, used in Lycian (Table 8-8, SFG-15).

Notation	Description
/Ø/	Sound value of a grapheme without pronunciation but with a grammatical role, used in the Middle Iranian phonology (Table 8-16, SFG-42, SFG-44)
?	non-consensual transcription or phonetic value
[ ]	Square brackets denote phonetic transcription (denoting allophones) using IPA symbols. The square bracket denotes the optional texts, too.
[c]	Unaspirated voiceless palatal plosive, transcription: /c/, /ť/ or /k̂/.
[ç]	Voiceless palatal fricative, transcription: Carian /ç/, /χ́/ or Ancient North Arabian /y/.
[c^{h}]	Aspirated voiceless palatal plosive, transcription: /c^{h}/ or /ch/.
[ð]	Voiced dental fricative, transcription: /ð/ or /δ/
[d͡z]	Voiced alveolar affricate, transcription: /dz/, /ź/ or /ʒ/.
[d͡ʒ]	Voiced alveopalatal affricate, transcription: /ǰ/, /ğ/, /ǯ/ or /dž/.
[j]	Voiced palatal approximant, transcription: /j/ or /y/.
[ɟ]	Unaspirated voiced palatal plosive, transcription: /ď/ or /ĝ/.
[k^{h}]	Aspirated voiceless velar occlusive (aspirated *k*), transcription: /k^{h}/.
[ɲ]	Voiced palatal nasal, transcription: /ñ/ or /ń/.
[ŋ]	Voiced velar nasal, transcription: /ṅ/ or /ŋ/.
[ø]	Short lower mid [close-mid] front rounded vowel, transcription: /ö/.
[øː]	Long lower mid [close-mid] front rounded vowel, transcription: /ő/.
[s]	Voiceless alveolar fricative, transcription: /s/.
[ʃ]	Voiceless palato-alveolar fricative, transcription: /š/, /ś/ or /ʃ/.
[t͡s]	Voiceless alveolar affricate, transcription: /ts/.
[t͡ʃ]	Voiceless postalveolar affricate, transcription: /tʃ/ or /tš/.
[t͡s^{ʕ}]	Pharyngalized voiceless alveolar affricate, transcription: /ṣ/ or /ts^{ʕ}/; used in Phoenician and Paleo-Hebrew.
[w]	Voiced labio-velar approximant, bilabial flap (Erdal 2004: 63). Its transcription in the Hungarian phonology is /u̯/, in case of the Runic script is /w/ (Looijenga 1997: 82).
[x]	Voiceless velar fricative, transcription: /k̲/, /kh/, /x/ or /χ/.
[y]	Short high [close] front rounded vowel, transcription: /ü/.
[ʎ]	Voiced palatal lateral approximant, transcription: /ʎ/.
[yː]	Long high [close] front rounded vowel, transcription: /ű/.
[z]	Voiced dental sibilant fricative, transcription: /z/.
[ʒ]	Voiced palato-alveolar fricative, its transcription: /ž/.
[θ]	Voiceless dental non-sibilant fricative
< >	Angled brackets are used for denoting transliteration value. In transliteration, the case that a consonant used before or after a sound is denoted by writing the transliteration value of that sound in superscript, e.g., <$^{\ddot{W}}$k$^{\ddot{W}}$>.

Notation	Description
<A>	Alternatively <e/a> (Konkobaev et al. 2015: passim.). Transcription: /a, ä/, alternatively /a, e/ or /a, æ/ [a, æ]. Transliteration value of Rovash graphemes with /a, ä/ phonemes. Used in Rovash scripts.
<á>	Transcription in Hungarian texts: /ā/ [aː] (SFG-2); used in SHR.
<$^{A}q^{A}$>	TR grapheme for representing /q/ near /a/ or /ä/. Alternative transliteration: <$^{a}k^{a}$>, <k^{1}> or <^{1}q>. Used in SFG-58 among others.
<c>	Transcription in Hungarian texts: /ts/ [t͡s]; used in SHR.
<č>	Transcription in Hungarian texts: /tʃ/ [t͡ʃ]; used in SHR.
<ca>	Transcription: /c/; used in IAST.
<cha>	Transcription: /c^{h}/; used in IAST (SFG-97).
<ď>	Transcription in Hungarian texts: /ď/ [ɟ]; used in SHR.
<e>	Alternative transliteration: <ë>, <ė> (Németh 1971: 38) or /ẹ/ (Kyzlasov, I. L. 2015: 199; Vékony 2004a: 290). Transcription in Hungarian texts: /e/ /ä, e/ [ɛ, e], historically also /ē/ [eː] (SFG-11). Transcription in Turkic texts: /e/ (Kara 1996: 537), alternatively /ë/, /ė/ [e] (Kara 1996: 537). Used in Rovash scripts.
<é>	Transcription in Hungarian texts from 17th c. AD: /ē/ [eː] (SFG-12); used in SHR.
<g^{1}>	If there is vowel harmony in a Rovash script (Table 7-1), then a type of Rovash <g> being in a syllable with a velar vowel. In this case, its sound value is /γ/. Further notations: <$^{1}\gamma$>, <γ^{1}>.
<g^{2}>	If there is vowel harmony in a Rovash script (Table 7-1), then a type of Rovash <g> being in a syllable with a palatal vowel. In this case, its sound value is /g/. Further notation: <^{2}g>.
<ẖ>	Transcription: /ḵ/, /kh/, /x/ or /χ/ [x]. Further notations: <χ> or <ḵ>.
<i>	Transcription in Hungarian texts: /i/ [i] (close front unrounded vowel) and /í/ [iː] (long [i]) (SFG-54); used in SHR.
<I>	Alternatively <i/ı> (Konkobaev et al. 2015: passim.). Transliteration value of Rovash graphemes with /i, ï/ phonemes; in case of the Orkhon inscriptions, also /e/ (with alternative notation: /ë/ [Kara 1996: 537]). Used in Rovash scripts.
<$^{I}k^{I}$>	TR grapheme for representing /k/ near /i/ or /e/. Alternative transliteration: <$^{e,i}k^{e,i}$> or <k^{2}>. Used in SFG-57 among others.
<$^{ï}q^{ï}$>	TR grapheme for representing /q/ near /ï/. Alternative transliteration: <k^{3}> (Róna-Tas 1991: 111, Table I) or <$q^{ï}$> (Kara 1996: 537). Used in SFG-61 among others.
<j>	Transcription in Hungarian texts: /y/ [j]; used in SHR and CBR.
<kha>	Transcription: /k^{h}/ [k^{h}]; used in IAST.
<kṣa>	Transcription: /ṭṣ/ for Kharoṣṭhī and in Gandhari and Sakan version of Brāhmī, cerebral (retroflex, cacuminal) affricate (Hitch 1984: 199); used in IAST (Kharoṣṭhī script, SFG-83).
<ĺ>	Its sound value was /ʎ/ in early Hungarian texts. Its transcription in present-day Hungarian texts is /j/. Used in SHR.
<ń>	Transcription: /ñ/ or /ń/ [ɲ]; used in Rovash scripts, IAST, etc.

Notation	Description
<ṅ>	Alternatively <ŋ> (Konkobaev et al. 2015: 79). Transcription: /ṅ/ or /ŋ/ [ŋ]; used in Rovash scripts, IAST, etc.
<ö>	Transcription in Hungarian texts: /ö/ [ø], /ő/ [øː] (SFG-5); used in SHR.
<s>	Transcription: /s/ [s].
<ś>	Transcription in Carian script: /ç/ (Adiego 2007a: 250–251)
<š>	Alternative transliteration: <ş> (Konkobaev et al. 2015: 79). Transcription: /š/, /ś/ or /ʃ/ [ʃ]; used in Rovash (e.g., SFG-98) etc.
<śa>	Transcription: /ɕ/, voiceless alveolo-palatal (palatal sibilant) fricative; used in IAST.
<ṣa>	Transcription: /ʂ/, voiceless retroflex (cerebral sibilant) fricative; used in IAST.
<ť>	Transcription in Hungarian texts: /ť/ [c]; used in SHR.
<ü>	Transcription in Hungarian texts: /ü/ [y], /ű/ [yː] used in <Ẅ> (SFG-35).
<W>	Alternatively <o/u> (Konkobaev et al. 2015: 233) or <U> (Nevskaya 2012: 44). Transliteration value of Rovash graphemes with /o, u/ phonemes (Erdal 1991: 15). Used in TR, CBR and SR.
<Ẅ>	Alternatively <ö/ü> (SFG-35) (Konkobaev et al. 2015: passim.) or <Ü> (Nevskaya 2012: 44). Transliteration value of Rovash graphemes with /ö, ü/ phonemes (Erdal 1991: 15). Used in Rovash scripts.
<$^{\ddot{W}}k^{\ddot{W}}$>	TR grapheme for representing /k/ near /ö/ or /ü/. Alternative transliteration: <k^4> (Róna-Tas 1991: 111, Table I) or <$k^{\ddot{o}}$> (Kara 1996: 537). Used in SFG-89 among others.
<$^{W}q^{W}$>	TR grapheme for representing /q/ near /o/ or /u/. Alternative transliteration: <k^5> (Róna-Tas 1991: 111, Table I), <q^{o}> (Kara 1996: 537), <$q^{o,\,u}$> or <ko, ku/ok, uk> (Konkobaev et al. 2015: 90). Used in SFG-88 among others.
<y>	Transcription in Ancient North Arabian (Table 8-7) script family: /y/ (Macdonald 2004: 497)
<y>	Transcription in Turkic texts: /y/ [j]. Used in TR and SR.
<ž>	Transcription: /ž/ [ʒ].
<γ>	If there is no vowel harmony in a script (Table 7-1) or it is not explicitly represented, this is the transliteration value of the grapheme denoting /γ/ sound value. Further notations: <ğ> (Clauson 1970: 53) or <ǧ> (Golden 1992: 17).

The Old Turkic language had nine short vowels (*a ä, e, i, ï, o, ö, u, ü*), and their long pairs. The vowel *ä* is called “open e,” the vowel *e* (alternative notation: *ë* or *ė*) is the “closed e.” The closed e occurred only in Old Turkic in a few stems and alternated with *i;* sometimes, it was completely omitted in writing (de Rachewiltz & Rybatzki 2010: 21). The abbreviations used in the book are listed in Table 8-2.

Table 8-2: Abbreviations

Abbreviation	Description
2D	two-dimensional
3D	three-dimensional
C	consonant
GCP	Glyph Complexity Parameter (Hosszú 2014a: 66–67; Hosszú 2015: 2022)
CBR	Carpathian Basin Rovash (Table 8-19)
C_{nasal}	nasal consonant
C_{stop}	stop (plosive) consonant
IAST	International Alphabet of Sanskrit Transliteration
IPA	International Phonetics Association
LTR	left-to-right writing direction (dextrograde, dextroverse, sinistrodextral)
O	Orkhon (Orhon) variant of TR (Table 8-19)
OM	Origin Model of an SFG in the phenetic analysis
RTL	right-to-left writing direction (sinistrograde, sinistroverse, dextrosinistral)
SFG	Similarity Feature Group in the phenetic analysis
SHR	Székely-Hungarian Rovash (Table 8-19)
SR	Steppe Rovash (Table 8-19)
T	Talas variant of TR (Table 8-19)
TR	Turkic Rovash (Table 8-19)
V	vowel
Y	Yenisey (Enisei, Jenisej, Yenisei) variant of TR (Table 8-19)

8.2. Script families

For a systematic description, scripts are categorized as taxa. The definition of species is not always clear in biology, nor is it in scriptinformatics: it is not always clear what is considered a separate script and a script variant of another script. E.g., some Middle Persian script variants are often treated as separate scripts (such as inscriptional and Psalter; see Table 8-16). Another problem is that many of scripts that can be considered separate scripts are strikingly similar. This issue is expressed by categorising scripts into so-called script families. Scripts with similar origins and usage characteristics are placed in the same script family. The scripts belonging to each script family are presented in the following tables, which contain the approximate usage time of scripts and related data. These tables mainly list the scripts that play a role in the present analysis.

During the categorization of scripts, based on the significant relationship between the Ancient Greek and various Anatolian alphabetic scripts, the new taxonomic term *Anatolian-Greek Alphabetic* (Table 8-8) was introduced for that script family (Hosszú 2017: 195, 198). Young called these scripts Asianic alphabets (Young 1969: 255). In case of Runic script, the name of the script family is also *Runic* (Table 8-17), to which perhaps even the Ogham script belongs. The Anatolian Hieroglyphic script has no relatives; however, for the systematisation's uniformity, the term *Anatolian Hieroglyphic* script family (Table 8-5) was used. Anatolian Hieroglyphic script family is in strong contrast with the name of the Anatolian-Greek Alphabetic, which represents the same taxonomic level, and both script families were developed in similar geographical areas. The Greek script and its descendants are collectively called *Greek Alphabetic* script family (Table 8-13). The Latin script is classified as *Latin Alphabetic* script family (Table 8-18), as the Latin script and its variants are no longer related directly to the *Italic* scripts (Table 8-11). The Latin script's national variants are usually not treated as separate scripts due to their close interaction. However, the Latin Alphabetic script family does not consists of one member only, since there are artificial scripts derived from the Latin script; for example the Fraser script. The Uyghur script and its descendants have numerous common properties; therefore, these scripts are collectively called *Uyghur* script family (Table 8-20).

The term *Aegean* script family (Table 8-3) is used for the Cretan Hieroglyphic and its descendant scripts. Of this, Linear B and Cypro-Greek are almost completely interpreted, while Cretan Hieroglyphic, Linear A and Cypro-Minoan are only partially deciphered, although recently significant progress has been made in these areas (e.g., Valério 2016). Examples of the relationship between Aegean scripts, justifying their classification into a common script family: Cretan Hieroglyphic , , *092 <ru> (Younger 1998: 396); Linear A (Valério 2016: 266); (Valério 2013: 15–17) AB 26 <ru?>; Linear B AB 26 <ru> /lu, ru/ (cf. SFG-93: Comments); Cypro-Minoan ; (Valério 2016: 266); CM 010; CM 28 <lu?> (Valério 2016: 431, 442); Cypro-Greek (Valério 2016: 266); (common) (Davis 2010: 38–61); , (Paphian, late) (Olivier 2007–2008: 617–618); (Paphian, late) (Valério 2016: 229) <lu>.

Table 8-3: The Aegean script family

Cretan Hieroglyphic: 2000/1900–1700/1650 BC (Karnava 2014a: 398). It is syllabic, its writing direction is RTL or LTR. Sometimes every second line was written in the opposite direction, and there is an example of the spiral writing direction (Table 2-4) (Fischer 2001: 76). Cf. Table 4-5: 4-1. §.

Linear A: 19th–15th c. BC. Its inscriptions were found in Creta (Greece) and some Aegean islands, the period of its use is from ca. 1900/1800 to ca. 1500–1450 BC. It is only partially deciphered (Steele 2017b: 2–3). Syllabic, its writing direction is LTR, originates from the Cretan Hieroglyphic script. Cf. Table 4-5: 4-1. §.

Cypro-Minoan: 16th–11th c. BC, it has not been completely deciphered. Its script relics are from the 16th/15th–11th c. BC (Valério 2016: 27). Syllabic, its writing direction is usually LTR per line; however, there is an inscription with boustrophedon. Occasionally the rows were separated by parallel lines (text-separation, Table 2-3). It originates from the Linear A script (Davis 2011: 42). Cf. Table 4-5: 4-1. §.

Linear B: 15th–13th c. BC (Steele 2017b: 3–4; Ferrara 2010: 13; Petrolito et al. 2015: 95; Davies & Olivier 2012: 108). Syllabic, its writing direction is LTR horizontal per line. It came from Linear

A, adapted to the Mycenaean Greek language. It is characterized by dividing lines between rows (text-separation, Table 2-3) (Healey 1990a: 40). Cf. Table 4-5: 4-1. §.

Cypro-Greek ([Classical] Cypriot Syllabary, Cypriot syllabic, Cypro-Syllabic, Linear C)*:* 11th–2nd c. BC; it was used on Cyprus and some surrounding places (Steele 2014: 142; Valério 2016: 237). Egetmeyer introduced the term *syllabaire chypro-grec* (Egetmeyer 2010: 1; Valério 2014b: 264–267; Steele 2014: 142). It is syllabic, its variants: common and Paphian. The Opheltau (Opheltas) inscription is the earliest Greek text after the Linear B inscriptions, and its age is 1050–950 BC (Perna 2010: 148, 154; Steele 2016: 11; Valério 2016: 236).

Table 8-4: The Semitic script family

Old Canaanite (Proto-Canaanite, Proto-Sinaitic, Early Alphabetic, Protoalphabet, Proto-consonantary): 19th/17th–12th c. BC; however, the definition of this script and its accurate dating is highly debated (Haring 2020: 56–58). It is consonantal; its writing direction is LTR or RTL horizontal or vertical per line (Healey 1990b: 212–213, 218). Cross sets the age of the Old Canaanite script relics to 17th–12th c. BC and its evolution to the 18th c. BC (Cross 1989: 80). According to Goldwasser, the Sinai Peninsula inscriptions were made around 1840 BC, in the age of the Dynasty XII (Goldwasser 2006: 130–156; Goldwasser 2012: 9). In the late Bronze Age, its development split in two, one part to the Canaanite script family (Table 8-6) and the other part to the South Semitic script family (Table 8-7); the two script families developed in parallel (Macdonald 2010: 5).

Northwest Semitic (North-West Semitic) script family: Its members form the Canaanite script family (Table 8-6) and the later Aramaic script family (Table 8-12).

South Semitic script family: Details are in Table 8-7.

Table 8-5: Anatolian Hieroglyphic script family

Anatolian Hieroglyphic (Luwian / Luvian / Anatolian Hieroglyphic / hyeroglyphs / syllabary / syllabic): 1400–700 BC (Yakubovich 2010: 203). The Anatolian Hieroglyphic script began in the 18th–17th c. BC, but then it was probably just pictograms (Ferrara 2017: 18). The end of use is ca. 700 BC, when most New Hittite states had lost their independence (Klock-Fontanille 2008: 3–6). The columns of the graphemes are arranged in rows, separating lines between rows. The vertical groups of graphemes are always written sequentially with boustrophedon. Its writing direction is top-down per line, every second line is in reverse, without word separators (Fischer 2001: 74). Its boustrophedon writing direction could be RTL or LTR horizontal or top-down vertical. In the latter case, the columns' order was RTL or LTR. The graphemes were vertically mirrored according to the writing direction. It had logographic, semi-logographic and phonetic attributes (Weeden 2014: 81; Yakubovich 2011: 542–543). Luwian and Lycian languages did not know the /o/ phoneme. Luwian /u/ was usually transcribed by Greeks with the Ancient Greek <ω> /ŏ, ō/ (Simon 2006: 166). Anatolian Hieroglyphic script was open, and the scribe could create new glyphs (graphemes) as needed. The new phonetic usage depended on the scribe's imagination, regional characteristics, and the writing material's consequences (Klock-Fontanille 2008: 3). Because of this, many graphemes can denote the same sound value, called homophone graphemes. In the literature, homophone graphemes are distinguished by an index. The more common the grapheme-like graph, the lower is its index (Payne, A. 2012: 6–7, 10, 13). Cf. Table 4-5: 4-2. §, ill. Table 7-10: 7-12. §.

Table 8-6: The Canaanite script family

Phoenician: From 11th c. BC (Cross 1989: 80) to 2nd c. AD (MNAMON: Phoenician, retrieved in 2014). It derived from the Old Canaanite script (Table 8-4). It is consonantal; its writing direction is RTL horizontal per line, occasionally parallel lines separated the rows (text-separation, Table 2-3) (Fischer 2001: 86, Fig. 53), e.g., the inscription on the Stele of Kilamuwa and king of Samal (Zincirli, Turkey) (Rollston 2008b: 80). Word separators are not used; Phoenician inscriptions are written in *scriptio continua* (Table 2-3) (Waal 2020: 111). For some Phoenician letters, the newer interpretation is used instead of the traditional one, *zai* <z>: /dz/ instead of /z/ (SFG-39), *semka* <s>: /ts/ instead of /s/ (SFG-41: Comments), *ṣāḏē* <ṣ>: /t͡sˤ/ instead of /sˤ/ (SFG-83), *śin/šin* <š>: /s/ instead of /ʃ/ (SFG-87) (Hackett 2008: 86). In the Anatolian Cilicia (2nd millennium BC Kizzuwatna, in late Bronze Age Ḫiyawa, in Iron Age Hiyawa, in Neo-Assyrian sources Qawa, Que [Simon 2012: 20, 25]) Phoenician script was used for recording the Luwian names. In the Luwian language, there were only three vowels (/a/, /i/ and /u/); these were represented using Phoenician *matres lectionis* letters. This system was borrowed by the Greeks, too (Ancient Greek, Table 8-8); but they extended it (Valério 2008: 116).

Paleo-Hebrew (Old Hebrew, Palaeo-Hebrew, Proto-Hebrew): From the 9th c. BC (Rollston 2016) to the first quarter of the 6th c. BC. It is consonantal; it derived from the Phoenician script. According to Rollston, the inscription of Mesha Stele (Moabite Stone, erected by Mesha, Moabite king in 9th c. BC) in Moabite language was written with Paleo-Hebrew script (Rollston 2010: 53–54). Cf. Table 4-5: 4-3 §.

Old Aramaic (Ancient/Early Aramaic, *Altaramäish*): 9th–7th/6th c. BC. It originated from the Phoenician script and evolved into the Imperial Aramaic script (Table 8-12). According to Gzella, the Old Aramaic script appeared in the 9th c. BC (Gzella 2014: 78). According to Cross, the beginning of the Old Aramaic script cannot be later than the 11th c. BC (Cross 1989: 86). Fitzmyer makes the boundary between the Old Aramaic and the Imperial Aramaic (Table 8-12) scripts around 700 BC, with 612 BC as an acceptable boundary (Fitzmyer 2004: 30). Others call Late Old Aramaic the period of 7th–6th c. BC, when the local variants of the Old Aramaic script were developed (Gzella 2014: 104–105). Based on these, the beginning of the Imperial Aramaic script can be dated to the 7th–6th c. BC with great uncertainty. It should be noted that for each Old Aramaic letter, the distinction from the appropriate Phoenician letter occurred at different times. In around the mid-8th c. BC, the Neo-Assyrian Empire started to use the Aramaic language and besides the Neo-Assyrian cuneiform the Old Aramaic script (Hitch 2010: 3). Sargon II Assyrian king (ruled 722/721–705 BC) consciously sought to unify his empire linguistically, which meant accepting the Aramaic (Schniedewind 2006: 138–139). In 9th–10th c. BC, in the Old Aramaic, the <-w> denoted only /-ū/, the <-y> represented /-ī/ and /-ē/, the <-h> meant /-ā/ and /-ē/, and the <-’> denoted mainly /-ā/, rarely /-ē/- (Segert 1978: 113).

Punic: 6th–2nd c. BC, (Neo-Punic, Neopunic [Amadasi Guzzo 2011: 119]): 2nd c. BC – 4th c. AD. A variant of the Phoenician script used by the Carthaginians. From this evolved the *Neo-Punic* script variant with Latin influence. A variant of Neo-Punic script is the Libyo-Phoenician script used in the southern territory of Spain.

Table 8-7: The South Semitic script family

Ancient South Arabian (Early South Arabian, ASA): 10th c. BC – 6th c. AD, in the southwestern part of the Arabian Peninsula. Its earliest script relics are from the 10th c. BC, in the Arabian Peninsula

(Stein 2013: 194). Its writing direction is primarily RTL, but it was occasionally written in LTR. Variants of the Ancient South Arabian script according to the glyph styles are inscriptional and cursive; while according to the languages used are Sabaic (Sabaean, Ancient/Old Yemeni), Minaic (Maḏābic/Madhabic, earlier Minaean [Macdonald 2000: 30, 64]), Qatabanic, Hadramitic, Hasaitic and Himyaritic. The Ancient South Arabian script in the Arabian Peninsula became extinct by the end of 6th c. AD, but from this descends the East African Geʿez abjad (Macdonald 2010: 5).

Taymanitic (earlier Thamudic A or Taymanite), *Dadanitic, Dumaitic* (earlier Jawfian [Macdonald 2000: 29], *Dispersed Oasis North Arabian, Safaitic, Hismaic* (earlier Thamudic E, Tabuki Thamudic, South Safaitic), *Thamudic B, Thamudic C, Thamudic D* (Ancient North Arabian script family): 8th c. BC – 4th c. AD, in the central and northern part of the Arabian Peninsula and the south of Syria. The Dumaitic, Taymanitic, Dadanitic and Dispersed North Arabian scripts form the Oasis North Arabian script family. The number of known script relics is well over forty thousand (Macdonald 2004: 488–533). The writing direction of the Dumaitic, Taymanitic and Dadanitic scripts used in large oases is almost always LTR. In the Taymanitic the writing direction is boustrophedon or per line. The texts are usually written in s*criptio continua* (Table 2-3). However, word separator is regularly used in the Dadanitic monumental and the Hasaitic texts; moreover, usually but not consequently in the Dadanitic wall inscriptions, and the Taymanitic and Dumaitic texts. In the Hasaitic script, the writing direction can be per line and boustrophedon. The Thamudic B, Hismaic and Safaitic scripts used primarily by the nomads have no defined writing direction (LTR, RTL, top-down or bottom-up, horizontal and vertical per line, circle or spiral, see Table 2-4), and they do not use word separator. The Thamudic C and Thamudic D scripts used probably by the nomads do not use word separators; however, their writing direction was a primarily vertical per line (Macdonald 2004: 495).

Geʿez abjad (Ethiopic Consonantal)*:* 800 BC – 4th c. AD. Its users are from South Arabia; it is a descendant of the Ancient South Arabian script (Kitchen et al. 2009: 2709; Healey 1990b: 220).

Geʿez abugida (Classical Ethiopic, Fidäl): From the 4th c. AD. It is a syllabic script developed under the influence of Christian literacy. Variants of originally consonant-marking graphemes from Geʿez abjad supplemented by diacritics are used to denote syllables. It has some variants, e.g., Amharic, Tigrinya, Tigre and Bilen alphabets.

Separated from the Anatolian-Greek Alphabetic script family (Table 8-8), the Greek Alphabetic script family (Table 8-13) contains the classical Greek script and its derivatives, e.g., Gothic and Neo-Phrygian.

Table 8-8: The Anatolian-Greek Alphabetic script family

Old Phrygian (Paleo-Phrygian): 9th c. BC (Yakubovich 2015b: 49) – 4th c. BC. According to A. Payne, the earliest Phrygian inscriptions are from before 800 BC (9th c. BC), because of new archaeological (C-14) dating of the destruction level of Gordion. It now antedates the earliest Greek inscriptions, which is significant for the question where, how and through whom the alphabetic script reached Anatolia (Payne, Annick: Personal communication by email, 24 October 2017). The Old Phrygian script is similar to the red variant of Ancient Greek script (Swiggers & Jenniges 1996: 282). Young pointed out that while the writing direction of the Ancient Greek script was initially RTL, the clear majority of the Old Phrygian inscriptions from the 8th c. BC are LTR (Young 1969: 266). The Old Phrygian script originates directly from Cilicia and the Levant coast.

While Old Phrygian script differs from Ancient Greek script in several details, they are similar in the use of five vowels *(ʼālep̄, hē, yōḏ, ʿayin, wāw-upsilon)*. In such a way, the source of these two scripts is identical, and later these two scripts diverged (Young 1969: 255–256). For the transliteration of Old Phrygian graphemes, see Brixhe & Lejeune 1984.

Ancient Greek (Archaic Greek, Early Greek): 9th c. BC (Cross 1989: 8; McCarter 1998) – 5th c. BC. It is of Northwest Semitic (Table 8-4) origin; however, its accurate lineage is highly debated. The date of its origin is also uncertain; there might be a presently unattested alphabetic script with vowels that could be the direct ancestor of the Ancient Greek script (Waal 2020: 118–124). Before c. 500 BC, the writing direction could be LTR or RTL per line or boustrophedon (vertical or horizontal) (Waal 2020: 111; Steele 2020: 145–147). In the Greek letter names, the suffix *-a* is not a Phoenician, but an Aramaic characteristic. This may suggest that before Phoenician handover, some Canaanite script variant may have come into contact with the Greeks from Northeast Syria through Asia Minor, and this may have been the earlier source of the Ancient Greek script (Healey 1990a: 38). According to Cross, the Ancient Greek script could not have been adopted later than the period of the transformation of the Old Canaanite script [Table 8-4] into Phoenician script [Table 8-6], that is, the 11th c. BC (Cross 1989: 86). The sound value of some Ancient Greek graphemes varied according to the geographical location of Greek cities. These variants are marked in different colours following Kirchhoff. According to Woodard, in addition to the Phoenician script, Mycenaean Greek Linear B (Table 8-3) and Cypro-Greek scripts played a role in the evolution of Ancient Greek script (Woodard 1997). The mediators between the Semitic and the Greek world were the Arameans according to Segert and Knauf; North Syrians according to Helck; and Anatolian non-Semitic groups (Phrygia, Cilicia) according to Jeffery, Brixhe and Lemaire (Segert 1963 apud Swiggers 1996b: 266; Knauf 1987; Helck 1979; Jeffery 1982; Brixhe 1991; Lemaire 1991). According to Swiggers, the Greek letter names *iōta* and *rhō* refer to a Phoenician source, even if there was Asia Minor connection, too. Swiggers's opinion is that Cilicians may have taken over Phoenician script earlier, but it was only used to make Phoenician inscriptions (Swiggers 1996b: 266–267). It is worth noting that according to Yakubovich, the Greek colonialization of Asia Minor already started even in the Bronze Age, and after the collapse of the Mycenaean states around 1200 BC, this process accelerated. The Greeks established their first colonies in the area of Miletus but gradually extended them along the Mediterranean coast east to Pamphilia and Cilicia (Yakubovich 2008b: 200). In the early Ancient Greek inscriptions, multiple dots and short vertical strokes (Waal 2020: 111) and—in Crete—long dividers (Steele 2020: 145) were used as word separators.

Lydian: late 8th/early 7th–3rd/2nd c. BC (Gérard 2005: 20, Tableau 1; Melchert 2008b: 56). It was used off the west coast of Asia Minor (Melchert 2004: 602–603). The writing direction of the early Lydian inscriptions are LTR and RTL; the later ones are in RTL; the line order is top-down (Swiggers & Jenniges 1996: 284; Adiego 2007d: 771). The writing direction of the Lydian inscription LW30 is boustrophedon (Payne, Annick: Personal communication by email, 24 October 2017). The inscription of the L24 Canoe-shaped Vase is also boustrophedon; it has Lydian glyphs, considered as the earliest in 1916 (Littmann 1916: 56–57).

Carian: 7th–3rd c. BC. Its writing direction is LTR and RTL (Adiego 2007a: 130, 206). Its earliest inscriptions are from the 7th c. BC (Steele & Torsten 2017: 105). 7th–5th c. BC is the period of creation of epitaphs and graffiti from Carian mercenaries found in Egypt (Melchert 2008c: 64). The age of the Carian inscriptions found in Caria is ca. 4th–3rd c. BC (Melchert 2008c: 64).

Pamphylian: 6th c. BC – 200 BC (Durnford 2013: 56). It was in use in the southern coast of Anatolia; it is close to the blue variant of Ancient Greek script (Swiggers & Jenniges 1996: 281–282). It has no role in the present analysis.

Lemnian: 6th c. BC. It originates from the red (western) variant of Ancient Greek script. Like Etruscan, Lemnian language did not have voiced plosive /b, d, g/, and did not distinguish between /o/ and /u/. Usually, its writing direction is RTL per line; but occasionally LTR boustrophedon (MNAMON: Lemnian, retrieved in 2015).

Lycian: 5th–4th c. BC. It is close to the red variant of Ancient Greek script (Bryce 1986: 45; Swiggers & Jenniges 1996: 282; Adiego 2007c: 763–767). According to A. Payne, the period of the datable Lycian inscriptions is late 5th c. – late 4th c. BC (Payne, A. 2006: 121). According to Young, there is no reason to date any Lycian inscription earlier than the 6th c. BC (Young 1969: 255). Its writing direction is almost always LTR; the line order is top-down (Swiggers & Jenniges 1996: 282, 284). In 5th–4th c. BC Lycia was a connection to the Hittite world, while Greek influence grew (Payne, A. 2008: 471–472).

Sidetic: 5th–2nd c. BC. Its earliest relic is from the end of 5th c. BC (Adiego 2007e: 14). Its relics are from the ancient city of Side, Pamphylia, on the southern coast of Asia Minor. The writing direction of the Sidetic–Greek bilingual inscription S2 is RTL (Nikolaev 2017: 219).

Greco-Iberian (Graeco-Iberian, Greek-Iberian): 4th c. BC (Darasse 2020: 199). The Iberian variant of Ancient Greek script, applied for Iberian language (de Hoz 1991: 669; Valério 2014a: 440).

Pisidian: ca. 200 BC. Its inscriptions were found north of Lycia (Swiggers & Jenniges 1996: 281; Durnford 2013: 56). It has no role in the present analysis.

Table 8-9: The Berber script family

Libyco-Berber (Ancient Berber, Libyc [Yahia 2014: 1812], Libyc-Canarian, Numidian): 9th/7th c. BC – 7th c. AD. It is a consonantal script. It was used to record the native languages of Northwest Africa. Its variants have been used from present-day Libya to the Canary Islands. Its glyphs are geometric as they consist mainly of straight lines and circles. It was used as an official script in the Kingdom of Numidia in parallel with Punic script. According to Farrujia de la Rosa et al., the Libyco-Berber script evolved from Phoenician in ca. 8th–7th c. BC, and its earliest inscriptions survived in the High Atlas (Farrujia de la Rosa et al. 2009: 90; Farrujia de la Rosa et al. 2010: 22–25). According to Ulbrich, the most likely is Pichler's view that its using period is perhaps from 9th c. BC to 4th c. AD (Pichler 2007: 115–116; Ulbrich, Hans-Joachim: Personal communication by email, 2 November 2017).

Tifinagh (Traditional Tifinagh, Shifinagh [in Niger]): The surviving variant of Libyco-Berber script among Tuaregs, it is consonantal. It has no role in the present analysis.

Paleo-Hispanic scripts (Table 8-10) are probably of Phoenician origin; however, they have a mixed structure of alphabet and syllabary, their majority are semi-syllabic (Darasse 2020: 197, 206). The development of Paleo-Hispanic scripts from the consonantal Phoenician script to a semi-syllabic script could raise the possibility of the influence of Cypro-Greek syllabic script (Table 8-3). It is known that Cypriot sailors played a crucial role in the first period of Phoenician appearance in Iberia. However, the syllabic type may have evolved from a consonantal script in other ways, e.g., the syllabic Geʿez abugida script evolved from the consonantal Geʿez abjad (Table 8-7).

In each Paleo-Hispanic script the original glyphs denoted voiced plosives, and then the unvoiced plosives were marked with glyphs formed by adding a stroke. Particularly, in Northeastern Iberian script, graphemes denoting voiceless plosives were often created by adding a dot or a stroke to the graphemes denoting voiceless plosives (Rodríguez Ramos 2001: 35). The grapheme set formed in such way is called *dual grapheme set* or *dual system.* Paleo-Hispanic graphemes belonging to the dual system are hereinafter referred to as “dual”.

Table 8-10: Paleo-Hispanic (Paleohispanic) script family

Espanca (Tartessian): A script relic called Espanca Tablet was found in Castro Verde (Portugal) in 1987, showing a double-described signary (Correa Rodríguez 1990: 132–143; de Hoz 1991: 673). The age of the inscription is unknown (Valério 2008: 111; Vidal 2014: 1). Its graphs are similar to the Southwestern graphemes, but it contains much more graphemes. The first 13 graphs of the inscription originate from the Phoenician script, and even their order is the same as that of Phoenician grapheme set (de Hoz 1991: 674). It may be the ancestor of the other Paleo-Hispanic scripts (de Hoz 1991: 677–678).

Southwestern (SW, Southwest, Tartessian, South Lusitanian, Bastulo-Tartessian, Southern Portugal): 8^{th}–4^{th} c. BC (Valério 2016: 179–180), it may have been created earlier (Koch 2014: 335). The language recorded with it is called Southwestern. It is not completely deciphered (Darasse 2020: 199). The Southwestern script is probably from the Phoenician script. Its writing direction is often LTR or RTL boustrophedon; the text was in many cases written between parallel lines (text-separation, Table 2-3). No word separators were used. It is a semi-syllabic script; its system is not dual. It differs from other semi-syllables in that in the case of vowel-dependent graphemes the vowels were also written separately. This is called the *redundancy principle.* Interesting parallelism is striking concerning the redundancy principle. Namely, in the Assyrian cuneiform and the Anatolian Hieroglyphic scripts, the long consonants at the end of the word are denoted by the letter combination CV+V, e.g., the letter pair <ki>+<i> denoted /kī/ (Segert 1978: 111–112). The creation of the Southwestern script may be related to the appearance of Phoenician merchants and settlers in the Iberian Peninsula in the 9^{th} c. BC or shortly after that (Untermann 1997a: 49–66). Phoenician (namely Tyrean) merchants and settlers arrived in the Iberian Peninsula in the 9^{th} c. BC or shortly after that, where Syriac and Palestinian typology pottery appeared in the 8^{th} or 7^{th} c. BC. The small number of Aegean pottery dates from the 8^{th} c. BC. The impact of significant Greek (Ionic) coastal colonization has been evident since the 6^{th} c. BC in the emergence of the Greco-Iberian script (Table 8-8) based on the Ionic variant of Ancient Greek script (Valério 2008: 109, 111, 117–118, 133–134). About 100 script relics of the Southwestern script are known, some of which date from the 7^{th} c. BC, probably as far back as the 8^{th} c. and possibly earlier (Koch 2014: 335). Ruiz-Gálvez Priego places the beginning of the age of the Southwestern inscriptions to the 9^{th}–10^{th} c. BC. According to him, Southwestern script has more archaic properties than the Phoenician, both in its specific glyphs and in its RTL, LTR and boustrophedon writing direction, which contrasts with the consistent Phoenician RTL writing direction. He believes that the source of the Southwestern script is Old Canaanite (Table 8-4) script from the late 2^{nd} millennium or the 10^{th} c. BC, instead of Phoenician (Table 8-6) (Ruiz-Gálvez Priego 2013: 307–308 apud Koch 2014).

Southeastern Iberian (SE-Iberian, Meridional Iberian): 4^{th}–1^{st} c. BC (de Hoz 1991: 670; Valério 2008: 108; Valério 2014a: 444). It is only partially deciphered (de Hoz 1991: 670; Valério 2008: 108; Valério 2014a: 444; Darasse 2020: 199). Its writing direction is RTL horizontal per line, and the line order is bottom-up (Ferrer i Jané 2010: 77–78). It is semi-syllabic. The La Bastida de les Alcusses inscription (area of Mogente, Spain) was written on a lead board between straight lines.

Northeastern Iberian (NE-Iberian, Levantine [Iberian]): 5^{th}–1^{st} c. BC (Valério 2008: 108; Valério 2014a: 440). It is a semi-syllabic script. The dual system is typical of letters for plosives; the dual system can be observed in the 5^{th}–3^{rd} c. BC inscriptions, not in the later ones. Its writing direction is LTR, rarely RTL per line, but the Penya del Moro inscription has boustrophedon writing direction. There is a script relic whose rows were written between parallel lines (text-separation, Table 2-3) (Swiggers 1996a: 111–112). Inscriptions have also been produced in a former Roman province, Gallia Narbonensis (Southern France).

Celtiberian: End of 3^{rd} c. BC – beginning of 1^{st} c. AD (MNAMON: Celtic, Celtiberian, retrieved in 2015) used for writing the Celtiberian language. It is semi-syllabic; its writing direction is LTR per line. There are inscriptions where horizontal dividing lines were used between the rows (Cólera 2007: 843–844). The western variant of the Celtiberian script used a dual system (Simkin 2012: 95).

The ancestor of the Italic script family (Table 8-11) is, according to Thompson, the Chalcidian variant of Ancient Greek script (Table 8-8), which is also named the Pelasgian alphabet (Thompson 1912: 5). According to Buck, Early Latin and the primitive Etruscan originate from the Chalcis variant of Ancient Greek script, and their descendants are Campanian variant of Etruscan script, Oscan script, Etrurian variant of Etruscan script, and Umbrian script (Buck 1904: 25).

Table 8-11: The Italic (Ancient/Old Italic) script family

Camunic (Sondrio, Gruppe Valcamonica): It is a Northern Italic script used around Sondrio. Its writing direction can be LTR or RTL (Morandi 2004: 670–671, 692–694). The inscriptions were often framed (Tibiletti Bruno 1989: 80–81). Every letter of the Ancient Greek script has a counterpart in the Camunic script, suggesting that the Camunic script, might come directly from the Ancient Greek, without Etruscan mediation. Moreover, it could not even come from the red variant of the Ancient Greek script (Table 8-8). Its glyphs are also very unusual (TIR: Script, retrieved on 20 February 2018). It is practically undeciphered.

Early Latin: The earliest Latin inscriptions are from 7^{th}–6^{th} c. BC and the archaic variant of the Latin script were used up to the 2^{nd} c. BC (MNAMON: Latin, retrieved in 2015). Its writing direction was RTL per line or boustrophedon (Healey 1990a: 40). On the Duenos inscription, the writing direction is spiral. Cf. Latin script (Table 8-18).

Elymian: 5^{th} c. BC. It was used in Northwestern Sicily, written in Elymian. It has script relics with LTR writing direction. No word separators were used (Marchesini 2012).

Etruscan: 8^{th}–1^{st} c. BC, it has RTL writing direction. In the Tabula Capuana script relic, sections of the text were separated by horizontal lines (Bonfante 1996: 297–311; MNAMON: Etruscan, retrieved in 2015). The Etruscans could borrow the Greek script from the settlers, who originated from Chalcis (Euboea, Greece) around 8^{th} c. BC (Healey 1990a: 39). In the Etruscan language there was not voiced plosive (/b, d, g/), and there was not individual phoneme for the /o/ and /u/ (cf. Lemnian script, Table 8-8). In the Etruscan script the /f/ was represented by <hv> or <vh> digraphs even in the late 6^{th} c. BC (MNAMON: Faliscan, retrieved in 2015). The number of surviving inscriptions is ca. 11000 from 7th–1st c. BC. One of them, found in Magliano is an inscription on a lead disk from 5th–4th c. BC; its writing direction is spiral; the rows are separated by lines.

Faliscan (faliscus [Györffy & Harmatta 1997: 153]): 7th–2nd c. BC, similar to the Latin script. Its writing direction is usually RTL, but the vasa inscriptions are often written with LTR. It differs from the Etruscan script in those separate letters were used for certain voiced plosives (/d, g/). In the Faliscan script, <q> was used before /o, u/, like Etruscan (MNAMON: Faliscan, retrieved in 2015).

Gallo-Etruscan (Lugano): 4th–2nd c. BC. It was used to write the Gaulish language in the Etruscan script around Lugano's city (Northern Italy). It is not the same as the Lepontic script. It does not make a distinction between the voiced and voiceless plosives. Its writing direction is LTR or RTL (MNAMON: Celtic, Gaulish, retrieved in 2015).

Gallo-Greek: 3rd c. BC – 1st c. AD. It was used to record the Gaulish language in Greek script (Table 8-13) around Marseille and in what is now East-Central France. It is characterized by the /ts/ sound value of the Gallo-Greek (3rd c. BC – 1st c. AD) (engraving) Ө, ⊖, (pottery) θ, ϑ <θ> (MNAMON: Celtic, Gaulish, retrieved in 2015) although this letter originates from the Ancient Greek *theta.*

Lepontic (Cisalpine Gaulish, Lugano, Leponzi): Its oldest variant was used in the 6th–5th c. BC and the later variant applied for the Gaulish language was used in the 3rd–1st c. BC (Eska 2008: 165). The Lepontic script was very similar to Etruscan script in its earliest using period. Its script relics were unearthed from the Lugano area, from Northern Italic and Southern Switzerland. The voiced and voiceless plosives were denoted with the same letter, the length of the vowels was not marked, and three vertically spaced points were used as word separators. Its writing direction is mainly RTL, sometimes LTR per line or boustrophedon. It was often written between parallel lines (text-separation, Table 2-3) (MNAMON: Celtic, Lepontic, retrieved in 2015).

Messapic (messapus [Györffy & Harmatta 1997: 153]): 6th–2nd c. BC. It was used in Southeastern Italy; the region of the former Apulia and Calabria, now Puglia. Its writing direction is usually LTR per line; however, it is boustrophedon in some archaic relics. There are no separators between the words (*scriptio continua,* Table 2-3) (MNAMON: Messapic, retrieved in 2015).

Oscan (oscus [Györffy & Harmatta 1997: 153]): first half of 4th c. –first half of 1st c. BC. This script was used for an intermediary language developed from central-southern Italy languages. There are three altering variants with three different origins, Etruscan, Greek, and Latin. Etruscan origin was used from the first half of 4th c. BC to the first half of 1st c. BC; its writing direction is RTL. The variant from Greek origin was used from the first half of 4th c. BC to the first half of 1st c. BC; its writing direction is LTR. The variant from Latin origin was in use from the mid-2nd c. BC to the first half of 1st c. BC; its writing direction is LTR (MNAMON: Oscan, retrieved in 2015).

Paleo-Umbrian (Archaic Umbrian, Sabellic): It is the ancestor of the Umbrian script. One of its relics, the Tolfa inscription (ca. 530–525 BC) has LTR serpentine writing direction (Table 2-4) without line breaking (Bakkum 2009: 380).

Proto-Campanian (Protocampano, Nucerino, Paleoitalico): The ancestor of the Oscan script, its script relics date from the second half of 6th c. BC – beginning of 5th c. BC. Its writing direction is RTL horizontal per line (MNAMON: Oscan, retrieved in 2015). It is characterized rotation of some glyphs by 90°.

Raetic: 5th–1st c. BC. It was used in *scriptio continua,* usually without spaces, although punctuation marks existed. Its writing direction is usually RTL; in some cases, the rows are separated by lines, e.g., Steinberg am Rofan (Tyrol State, Austria) inscription (Mansell 2011: 644).

South Picene: 6th–3rd c. BC. Its script relics are from the central part of the eastern side of Italy (formerly Picenum, present-day Teramo). Its writing direction is LTR or RTL horizontal boustrophedon (Salmon 1996: 697; MNAMON: South Picene, retrieved in 2015).

Umbrian: 4th c. – first half of 1st c. BC. It was used for languages in Central Italy. Its writing direction is RTL. Its most important relic is the bronze Iguvine tablets made with two (Etruscan and Latin) varieties of the Umbrian script (MNAMON: Umbrian, retrieved in 2015).

Venetic: 6th–1st c. BC. It is characterized by *scriptio continua,* its writing direction was RTL and LTR per line, spiral or boustrophedon. There are examples of inscriptions being written in parallel lines (text-separation, Table 2-3) (MNAMON: Venetic, retrieved in 2015).

Volscian (Volscan, Volsci): One of its relics is a miniature of lead ax found in Satricum in a 5th c. BC tomb (Cornell 1995: 458; Urbanová 2003: 34).

Table 8-12: The Aramaic script family

Imperial Aramaic (Official/Standard/Achaemenid Aramaic quadrat, *Reichsaramäisch*): 7th/6th–1st c. BC. It originates from the Old Aramaic (Table 8-6) script, a Canaanite script family member. The border between the Old Aramaic and the Imperial Aramaic scripts is uncertain; moreover, the transition date depends on the actual letters and geographical areas. The Imperial Aramaic became uniform during its regular and official usage. At the end of the 6th c. BC, the Achaemenid Empire (549–330 BC) adopted the Aramaic language and script as the official mediating language and script in the royal chancelleries in the western half of the empire. This developed to the Imperial Aramaic language and script as it was used in written communication between different parts of the empire from southern Egypt to the Indus River and the Pamir Mountains (Györffy & Harmatta 1997: 147; Merlo 2014: 111). The great king of Persia and his officials dictated their decrees in Old Persian, translated them into Aramaic by the scribes, and sent them to the chancellors of the provinces (O'Connor 1996: 96; Harmatta 2003a: 82). The Imperial Aramaic script appeared in Inner Asia in the 5th c. BC and the Middle Iranian scripts (Table 8-16) from it began to evolve from the 2nd c. BC (Harmatta 1997: 161–162). According to Skjærvø, the Imperial Aramaic script remained largely unchanged in Iran in the Achaemenid (549–330 BC), in the Seleucid (330– ca. 210 BC) and in the early period of the Parthian (210 BC–AD 224) age (Skjærvø 1996: 516–517). The Imperial Aramaic script was used by Parthia, the local Persian dynasty in Pārs, Khwarazm and Sogdia (Skjærvø 2006–2012). Its writing direction is RTL.

Hebrew (quadratic [Aramaic], Jewish, *scriptio quadrata*): 3rd c. BC – present. It evolved from the Imperial Aramaic; its writing direction is RTL. Traditionally it is consonantal; later a set of vowel points to indicate vowels was developed. One of its relics is the Nash Papyrus (150–100 BC) (MNAMON: Hebrew, retrieved in 2015).

Nabataean: Middle Aramaic script, its descendant is the Arabic script. Nabataean language and script as a locally developed variant of Aramaic—as evidenced by data—were present in Syria and Arabia from the 2nd c. BC. The 4th c. AD is the end of the Nabataean script (MNAMON: Aramaic, retrieved in 2014). The Nabataean language gradually shifted to Arabic.

Hatran (Ashurian Aramaic): 1st c. BC – 3rd c. AD. Middle Aramaic script, which was used in the city of Hatra (today Al-Hadr, Iraq) (Beyer 1998: 10, 47–48; Shahbazi 2002). Hatra was independent of both Romans and Parthians (Chrisomalis 2010: 81).

Palmyrene: 1st c. BC – 3rd c. AD. Middle Aramaic script, its writing direction is RTL (MNAMON: Aramaic, retrieved in 2014).

Syriac: 1st c. AD – present. Late Aramaic script, its earliest relic from ca. AD 6 was found in Edessa (today Urfa, Şanlıurfa Province, Turkey) (Drijvers & Healey 1999). The Syriac script became independent of the cursive Aramaic script used by the Syriac Christians. The earliest variant of Syriac script is the *Estrangela* (Estrangelo, ʾEsṭrangēlā), which was almost exclusively used up to ca. AD 500. In the 5th c. AD, the Syriac Christian Church was split in two (the Nestorians seceded), and the script variant used by the western branch is called *Western* (Serṭā, Serṭo, Pšīṭā), while the script variant used by the eastern branch is called *Nestorian* (East Syriac, Maḏnḥāyā, Swāḏāyā, Āṯūrāyā, Kaldāyā); the latter was used in Inner Asia and Siberia (Daniels 1996b: 499–500; Aydin 1997). In the 5th–6th c. AD, Nestorianism (Church of the East) reached Sogdiana (de la Vaissière 2012: 142–169).

Armazian (Armazi, Armazuli, Armazian Aramaic, Armazic): 1st–2nd c. AD. Late Aramaic script; used in eastern Georgia, the dialect recorded in its surviving inscriptions is Armazian language for the ancient Georgian capital, Armazi. Its writing direction is RTL (Rapp, Jr. 2005: 196). Armazian script derived from the northern Mesopotamian variant of Aramaic script. Its development began in the 1st c. BC, possibly earlier, and was completed by the 1st c. AD (Tsereteli 1998 [2013 edition]: 160).

Mandaic: Late Aramaic script; it appeared between the second half of 1st c. AD and the end of 2nd c. AD. Its writing direction is RTL; it originated from the Parthian (Table 8-16) script (Häberl 2006: 57, 61). The largest body of physical evidence for the Mandaic script consists of a corpus of incantation bowls that have been discovered in various locations in Mesopotamia (Häberl 2006: 54). The Mandaic script is unique because even its earliest inscriptions have a fully developed system of vowel letters (Häberl 2006: 54).

Elymaic (Elymaean): 2nd–3rd c. AD. Late Aramaic script, its relics survived on coins and rock inscriptions (Healey 1990a: 46). It dated from the second half of the Parthian era and was used in the semi-independent province of the Parthian Empire called Elymais. After Ardaxšir (Ardašēr), satrap of Persia defeated the last local ruler of Elymais in AD 221 and seized Elymais, and the Elymaic script disappeared from history (Häberl 2006: 55). Location of its script relics: Tang-e Sarvak (Iran) and Simbar (ancient Elyamis, Iran) (Häberl 2006: 55, 61).

Characenean: Late Aramaic script; it is a product of the latter half of the Parthian period (Häberl 2006: 55, 61); it was used in the southern part of present-day Iraq called Characene (Mesene, Maysān). The end of the Characene Kingdom was in AD 222 when Ardaxšir subdued it.

Arabic: ca. 5th/6th c. AD – present, it is an abjad. It likely evolved gradually from the Nabatean script. The Aramaic language contains fewer consonants than Arabic. Therefore, to avoid ambiguity, new Arabic letters were created during the 7th century by adding points from existing letters (Daniels 2000: 81–82). It is partially consonantal; it contains graphemes and diacritics for some vowels. Its writing direction is RTL horizontal per line. Arabic script is applied to several languages, and Arabic script has been supplemented with additional letters to denote their extra phonemes.

Table 8-13: The Greek Alphabetic script family

Greek: 4th c. BC –present. The boundary line between Ancient Greek and Greek scripts is the 4th c. BC, the century after the official acceptance of the dark blue variant of Ancient Greek script by Athens

(403–402 BC). Henceforth, the Ancient Greek script can be called the classical alphabet of Greek script, in which, e.g., its writing direction is already fixed, LTR (Healey 1990a: 39). The uncial variant of Greek script known from the 1st c. BC (Thompson 1912: 116–120) influenced the Latin and Slavic scripts.

Greco-Bactrian (Bactrian, Greco-Bactrian, Heftalite, Kushan, Kushano-Bactrian, earlier: Indo-Scythic Greek [Cunningham 1893]): AD 342–781 (Sims-Williams 2002: 226). The inscriptions from the Tochi Valley could have been created even later (Maue, Dieter: Personal communication by email, 15 October 2020). After the death of Alexander the Great (323 BC), in the middle of the 3th c. BC, the Greco-Bactrian Kingdom was established (Table 6-3: 6-12. §). The Greco-Bactrian script evolved from the Greek script adapted to Bactrian language. Some Greco-Bactrian fragments (stored in the Berlin-Brandenburg Academy of Sciences and Humanities, from the collection of A. von Le Coq) were found in the ruins of a monastery in the Turfan oasis (Xinjiang, China), which is northeast of the Tarim Basin, far from Bactria (Kurbanov 2010: 224).

Neo-Phrygian: 1st–3rd c. AD, it is practically identical to the classical Greek script. It has no role in the present analysis. Cf. The Old Phrygian script in Table 8-8.

Gothic: Ulfilas (Ulphilas, Wulfila) bishop, Christian missionary, creator of the Gothic script (ca. 311–383). The Gothic script is based on the Greek script, although it also contains letters of Latin and Runic origin (Marchand 1973: 19, 21). Ulfilas translated the Bible into Gothic using the Gothic script. Thus, the Gothic script replaced the Runic script (Table 8-17) at the Goths.

Coptic: From ca. 4th c. AD. It evolved from the Greek script but also borrowed eight Demotic letters. It has no role in the present analysis.

According to Maue, a common feature of Kharoṣṭhī (Table 8-14) and Brāhmī scripts (Table 8-15) is the akṣara principle (including initial consonant clusters and vowel diacritics) and the anusvāra; but their glyphs are different in a way that Kharoṣṭhī and Brāhmī cannot be descendants of a common ancestor although presently it is unknown, whom they owe for the common features (Maue, Dieter: Personal communication by email, 15 October 2020). Therefore, the Brahmic scripts and the Kharoṣṭhī script are classified into two separate script family.

Table 8-14: Kharoṣṭhī script

Kharoṣṭhī (Kharosthi, Kharoshthi): Not later than the 3th c. BC – 7th c. AD. It was known in 3rd c. BC in the area of Šahbāzgaṛhī and Mānsehrā (modern-day Northern Pakistan). Its origin is highly debated (cf. Salomon 1995: 271; Salomon 1996: 373; Salomon 1998: 42–46; Strauch 2012: 131, among others). The Kharoṣṭhī glyphs originated from the Aramaic glyphs (Bühler 1896: 21 ff.; Bühler 1898: 100). In its homeland, the use of Kharoṣṭhī script ceased in the 3rd c. AD (Salomon 1998: 46–47); however, from the 1st c. AD the Kharoṣṭhī script started to be used in the Tarim-basin, and the 3rd c. AD became the most important script of the administration of the Shanshan Kingdom, including Niya (Felföldi 2013: 64). It was also applied in official documents, literary productions and epigraphs in Khotan and Loulan (Xinjiang, China) in the 3rd and 4th c. AD, and appears to have survived in the cities of the Northern silk route as late as the 7th c. (Harmatta 1994a: 428; Glass 2000: 2–3). It was known in the northern part of the Tarim-basin: Kizil, Kucha, Shorchuk; and in the southern part of the Tarim-basin: Khotan, Niya, Endere, Loulan (Glass 2000:

1–10), in Bactria (Ma & Wang 1994: 237) and the northern part of the Kushan Empire (Harmatta 1994a: 433). It is syllabic, its writing direction is mainly RTL, but in some cases, LTR per line.

Table 8-15: Brahmic script family (example list)

Brāhmī (Brahmi): Not later than the 3rd c. BC – after AD 1368, if testimonies in the Turkic variety of the Brāhmī script are included here (Róna-Tas 1991: 69). The last manuscripts whose date can be identified are from 1277/78, but it was also used in manuscripts of the Yuan and post-Yuan periods. Its origin is highly debated (cf. Bühler 1896: 11 ff.; Salomon 1995: 271; Salomon 1998: 7–42; Strauch 2012: 131, among others).

It is syllabic, its writing direction is variable, but in the earlier inscriptions are LTR, usually horizontal per line with top-down line order.

Buddhism was presumably established in southern Inner Asia since the 1st c. BC. Brāhmī reached Inner Asia through the missionary activities of Buddhist monks and reached Turkestan oases (Róna-Tas 1991: 63) at about the end of 2nd c. AD or beginning of 3rd c.

After the Gupta dynasty (AD 320–535), the Brāhmī started to be adapted to local languages (Róna-Tas 1991: 63). Its first stage was *Northwestern Gupta [Brāhmī]* script from the ca. 4th–6th c. AD (Sander 2005: 135), later it evolved into *Turkestan Gupta [Brāhmī]* script (ca. 4th–5th c. AD), which is identical with Sander's alphabet q. Its writing direction is LTR.

Sander's alphabets r and s are called *Early Turkestan Brāhmī* (Sander 2005: 135). Early Turkestan Brāhmī is the precursor of the Khotanese [Brāhmī] (South Turkestan Brāhmī) and North Turkestan Brāhmī script variants; namely, Tocharian [Brāhmī], Tumshuqese [Brāhmī], Steppe Brāhmī, Uyghur Brāhmī and Sogdian Brāhmī (Maue 2010: 2–4; Maue 2016b: 155).

Khotanese [Brāhmī] script was used in the region of Khotan (present-day Hotan [Xinjiang, China]) by Buddhist monks in 5th–10th c. AD (Maue 2010: 4). The Khotanese had the concept to use <a> as alif, so that initial vowels other than *a* could be expressed by <a>+<diacritics> while initial *i, e, u,* etc. in other variants of Brāhmī were represented by the graphemes of their own. The same principle is met within Tibetan script, most probably borrowed from Khotanese (Maue, Dieter 2020: personal communication by email, 21 January 2020). According to Maggi, the Khotanese punctuation signs are used rather freely and interchangeably. They may, but must not, separate clauses or sentences in prose, and padas or verses in poetry (4 padas usually forming a verse[-line]) (Maggi, Mauro 2020: personal communication by email, 27 August 2020).

North Turkestan Brāhmī script variants were first used by the Tocharians and the Tumshuq Sakas. Sander dealt with two variants of North Turkestan Brāhmī: alphabet t *(North Turkestan Brāhmī Type A)* and alphabet u *(North Turkestan Brāhmī Type B)* (Sander 1968: *passim.*). The differences between the alphabet t and u are limited to some graphemes. The alphabet t seems to predate alphabet u; the alphabet u is called *standard North Turkestan Brāhmī.* The standard North Turkestan Brāhmī was known from about AD 600 till 14th c. (Maue 2016b: 141; Maue, Dieter: Personal communication by email, 3 December 2019).

Tocharian [Brāhmī] script started at the end of 3rd or the beginning of 4th c. AD. *Standard Tocharian Brāhmī* script was fully developed in 7th c. AD; it was known until the end of 13th c. AD (Maue 2010: 2). The basis of the standard Tocharian Brāhmī was the standard North Turkestan Brāhmī (Sanders' alphabet u) (Maue 2016b: 141; Maue, Dieter: Personal communication by email, 3 December 2019). The Tocharian Brāhmī was used, e.g., in the area of Kučā and Shorchuk (Xinjiang, China) (Maue 1997: 1).

The preserved manuscripts were written with *Tumshuqese [Brāhmī]* script are from the end of 7th and the middle of 8th c. AD; they are generally found near Tumshuq (Tumšuk, present-day Tumxuk [Xinjiang, China]) (Maue 2010: 2). It is worth noting that the Karmavācanā manuscript seems to predate the other testimonies; it was written in a less elaborated variant of Tumshuqese script (Maue, Dieter: Personal communication by email, 15 October 2020).

We are still unsure about the exact period when Turkic-speaking peoples first embraced Buddhism (Wilkens 2016: 193). In the epigraphic relics of the Second Turkic Khaganate, there is not any trace of Buddhism (Wilkens 2016: 194). However, it is possible that in the Western part of the Tarim Basin Turks were already involved in Buddhism many years before the distributions of Buddhism among the Uyghurs in the 9th or 10th centuries (Wilkens 2016: 194). We are also unsure about when the Uyghurs first made contacts with Buddhism (Wilkens 2016: 195).

Steppe Brāhmī script was evolved in the late 6th c. and it was used in the First Turkic Khaganate (Bugut and Khüis Tolgoi inscriptions); it is one of the direct ancestors of Uyghur Brāhmī (Maue, Dieter: Personal communication by email, 25 October 2019; Maue 2016b: 154–155; Maue 2019). On the Mongolian steppe, the use of Brāhmī script is attested only for the First Turkic Khaganate; namely, the Bugut stele in memory of Tadpar Khagan († 581) (Ölmez & Maue 2019: 79) from shortly after his death (Maue 2018: 291). The Bugut stele also contains Sogdian inscription on the backside and its both falks (Hayashi 2015: 49). Somewhat later is the Khüis Tolgoi inscription (de la Vaissière et al. 2018; Ölmez 2018a; Maue 2018; Vovin 2018; de la Vaissière 2018), since a protagonist referred to in the text is Niri Khagan of the Western Turkic Khaganate who died in ca. 604 (Maue 2018: 291). Both the Bugut and the Khüis Tolgoi inscriptions are written vertically (Maue 2019: 109). The Bugut inscription consists of 24 columns, and the Khüis Tolgoi contains 11 columns. In both cases, the column order is RTL, and its writing direction is top-down (Maue 2018: 291).

Besides the Sogdian-origin Uyghur script (Table 8-20), *Uyghur Brāhmī* script was also in use from after AD 840 till shortly after 1200 in the Uyghur Kingdom Xočo (Khocho) in the Turfan (Tulufan, present-day Turpan [Xinjiang, China]) (Maue 2010: 2).

Ten or eleven fragments with *Sogdian Brāhmī* script have survived in Turfan area (Maue 2010: 3). The probable interrelations of the variants of the North and South Turkestan Brāhmī are described by Maue (Maue 2016b: 143–144, 155). Kharoṣṭhī script possibly influenced both North and South Turkestan Brāhmī (Hitch 1984: 187).

In Brāhmī script, a consonant cluster itself must be understood with following *a;* other vowels and diphthongs are marked through diacritics. Similar to many scripts in the Brahmic script family, Brāhmī also used a diacritic called *anusvāra.* Its glyph is a dot above akṣara. The anusvāra in Brahmic script family often means either nasalization or a nasal pronounced in a homorganic manned with a subsequent consonant. In Tocharian, Sogdian and Uyghur Brāhmī, the anusvāra is representing the phoneme /n/ (Maue 2008: 64). Note that the anusvāra is written in the preceding akṣara (Maue, Dieter: Personal communication by email, 15 October 2020).

Siddhamātṛkā (Siddhaṃ): around late 6th c. AD – 10th c. It evolved from the Gupta Brāhmī. Its principal attribute is a strongly angular aspect with a sharp angle at the lower right corner of each grapheme (Salomon 1998: 39–40). It has no role in the present analysis.

Telugu-Kannada: It was used in the upper part of southern India (Salomon 1998: 40). It has no role in the present analysis except for comment in SFG-95.

Tibetan: From the period of AD 630–648 (Laufer 1918: 36), from the 630s or 640s (van Schaik 2011: 76). Its writing direction is LTR, and its origin is Siddhamātṛkā script (Salomon 1998: 41). The Tibetans had contact with the Turks from the 7th c. AD (Róna-Tas 1991: 92). Politically, Tibet was active in East Turkestan since the 7th c., and it had special cultural contacts with Khotan. Presumably, it borrowed the way of representing initial vowels other than *a* from Khotanese Brāhmī script (Maue, Dieter: Personal communication by email, 21 January 2020).

Devanāgarī (Devanāgarī): It was evolved in 10th–13th c. AD from the Siddhamātṛkā script. It has no role in the present analysis.

'Phags-pa: It was developed based on the Tibetan script by the Tibetan monk Drogön Chögyal Phagpa in 1269. The period of its use is 13th–14th c. AD. Its writing direction is top-down. It has no role in the present analysis.

Table 8-16: The Middle Iranian scripts

Parthian (Arsacid Pahlavi, Pahlawānīg, Chaldaeo-Pahlavi): 2nd c. BC – 3rd c. AD. The surviving inscriptions from the early Parthian period (2nd–1st c. BC) are found in Nisa (Parthaunisa, Mithradatkirt, in the area of Ashgabat [Turkmenistan]) (Skjærvø 1996: 516–517). The glyphs of the Imperial Aramaic and the early Parthian (Nisa, 1st c. BC) scripts are often indistinguishable (Rosenthal et al. 1986–2011: Table 3). One of the parchments found near Avroman (Auroman, Shahr-i Avroman, Uraman Takht [Kurdistan Province, Iran]) village has a Parthian inscription dating from 13/12 BC (Edmonds 1952: 478). The final form of the official Parthian script developed in the 2nd c. AD (Skjærvø 1996: 517), also known as the Sasanian Parthian (Skjærvø 1997: 100). The last Parthian inscription is from AD 292, and this is the Paikuli inscription (Iraq) (Skjærvø 1996: 516–517). The Parthian chancery script heavily influenced new scripts for formerly unwritten Aramaic languages such as Elymaic, Characenean and Mandaic (Table 8-12); their adoption followed the Arsacids' gradual abandonment of Hellenism from AD 53 onward (Häberl 2006: 53, 61). The Parthian state was of nomadic origin (from the Dahae Confederation of Central Asian), and it never ceased to establish close ties with the nomadic world and to exercise significant influence over the nomadic world. The Parthian Empire had a serious impact from the Caspian Sea to the Amu Darya Basin (Olbrycht 2015: 333, 335; Gregoratti 2018). The second half of 1st c. AD Parthian political relationship with Central Asia declined due to the rise of the Kushan Empire in Bactria; however, their cultural relations continued to flourish after 1st c. AD (Olbrycht 2015: 377; Gregoratti 2018).

Khwarazmian (Khwarezmian, Choresmian, [Old] Chorasmian, *Хорезм*): 1st/2nd c. AD – late 7th /8th c. The age of the earliest inscriptions is uncertain, maybe the 1st c. AD (Frumkin 1970: 97) or the end of 2nd c. AD (MacKenzie 1991–2011). The last inscriptions are from the 8th c. AD (Frumkin 1970: 100) or the late 7th c. AD (MacKenzie 1991–2011). It evolved from the Aramaic script and was used to record the Khwarazmian language before the Islamic conquest; its writing direction is RTL. Its script relics are, e.g., inscriptions on coins and bowls, Toprak-kala (Karakalpakstan, Uzbekistan) inscriptions and Tok-kala (ancient Darsan in Karakalpakstan, Uzbekistan) inscriptions of ossuaries (7th–8th c. AD [Frumkin 1970: 100]) (Vainberg 1977).

Sogdian: 2nd–13th c. AD. According to Hitch, the Sogdian scripts' earliest reliable relics are from before the 4th c. AD (Hitch 2010: 11), but according to Sims-Williams, the earliest Sogdian inscriptions can be found on the coins from the 2nd c. AD (Sims-Williams 1989: 174). The Sogdian Ancient Letters were probably written in AD 313–314 (Sims-Williams & Grenet 2006: 95), which are Sogdian texts found by Sir Marc Aurel Stein in 1907 near Dunhuang (present-day Dunhuang in Gansu, China). It is worth noting that according to Harmatta, the Ancient Letters were made in AD 196 (Harmatta 1997b: 160; Harmatta 2003a: 84). There were several variants of the Sogdian script, such as the glyphs of the Kultobe inscriptions (in the present-day city of Turkistan [Turkistan Region, Kazakhstan]) before the 4th c. AD, the Ancient Letters with unconnected glyphs, a characteristic cursive variant of Sogdian script, the variant of which is called formal (sutra) and finally the Uyghur variant (Skjærvø 1996: 517, 519, 529–530). In the 10th c. AD, the usage of the

Sogdian script generally ceased, but in certain areas, it remained in use to the 13th c. Its writing direction is RTL. The Sogdians were Iranian and played an important role in the travelling trade, and their language was in early times the most important language of the Silk Road in addition to the Prakrit of Indian origin. The most important city of the Sogdians was Marakanda (today Samarkand, Uzbekistan). Sogdiana was occupied by the steppe tribes in the 3rd c. BC (Olbrycht 2015: 334). In the 350s AD, the Huns from the Altai suddenly moved south and conquered Transoxiana in the mid-4th c. AD (Kim 2013: 36). A Hun group, the Hephthalites gradually displaced the other Hun group, the Kidarites in Bactria and Sogdia, and ruled these territories up to the rise of the First Turkic Khaganate in 560 (Payne, R. 2016: 8). The Sogdians transported silk and other goods from China to Khwarazm (Xvārizm, present-day Khiva [Xorazm Region, Uzbekistan]), Parthia, the Sasanian Iran and Gandhara (its area is mainly in Pakistan, to a lesser extent in Afghanistan). In Khwarazm, local merchants took over these goods and carried them to Eastern Europe, while in Iran Parthians, later Persians, in Gandhara Indian, and finally to the Roman Empire Palmyrene and Syriac merchants were involved in the transport (Harmatta 2003a: 85). The Sogdian punctuation strongly varies; one might almost say that each scribe uses his own system (Sims-Williams, Nicholas: Personal communication by email, 8 February 2020). The Bugut inscription (in Mongolia) from shortly after 581 (Maue 2019: 109) demonstrates that the Turks used the cursive variant of the Sogdian script (Kara 1996: 536). Turks closely allied with the Sogdian merchants throughout their history; the Sogdian cities grew significantly during the 5th–6th c. AD. Before AD 558, Turks defeated Hephthalites and conquered Sogdia, and likely in the final decade of the 6th c. Turks subjugated Eastern Bactria (Payne, R. 2016: 9, 16).

Middle Persian (Sasanian Pahlavi): 3rd–7th c. AD. There are Pre-Sasanian Middle Persian script relics from the 2nd–1st c. BC (Skjærvø 1997). The Middle Persian was the official language of the local Persian kings between ca. 200 BC and AD 224, and in the time of their descendants, the Sasanians (AD 224–651). After the Sasanians' fall, the Zoroastrians used the Middle Persian language. The script for the Middle Persian language was developed in Pārs, southwestern Iran, during the late Parthian period (Skjærvø 2009: 196–278). From AD 224, the formation of the Sasanian Empire, the Parthian script was gradually replaced by the Middle Persian as an official script, which remained unchanged to the 5th c. The main variants of the Middle Persian script that can also be considered as individual scripts are Inscriptional Pahlavi, Psalter [Pahlavi], Early Cursive Pahlavi and Book Pahlavi (Skjærvø 1996: 516–517). The first found script relic of the Psalter variant of Middle Persian script was found in Bulayïq (Bīlayuq, near Turfan in eastern Turkistan [Xinjiang, China]), it was made in the 6th or 7th c. AD; however, its original manuscript was written in the 4th c. AD (Gignoux 2002).

Manichean: In 3rd c. AD, but probably even earlier, Manichean missionaries used a Semitic script in Iran and Inner Asia to write various languages; from this, the Manichean script evolved. According to Durkin-Meisterernst, the ancestor of the Manichean script was closely related to Palmyrene and Estrangelo variant of Syriac script. It seems likely that Mani or his disciples applied a script already available to them, and they modified it to represent non-Semitic languages. The orthographies of the Manichean inscriptions that survived in Inner Asia are similar to the Hatran (Table 8-12) script (Durkin-Meisterernst 2005). The Manichean script was used for recording the following languages: Parthian, Middle Persian, Sogdian, Tokharian, Bactrian and Uyghur (Kara 1996: 542–545; Durkin-Meisterernst 2005; Skjærvø 2006: 530–533; Skjærvø 2006–2012). The variants of the Manichean scripts are named after the language used to write it down, such as Manichean Parthian and Manichean Sogdian (Skjærvø 2006: 530–533). In the 6th c. there was an exodus of Iranian Manichaeans from Iran to the east and northeast. By the 7th century, the official language of the eastern Manichaean church was Sogdian (Kyzlasov, L. R. 2004: 123–133). Manicheism spread to China from the second half of 6th c. AD (de la Vaissière 2012: 142–169).

Avestan: Its beginning could be around 5th c. AD (Daniels 2000: 81). Although the earliest survived Avestan manuscript is from AD 1288, the Avestan script was formed in the Sasanian era (AD 224–651) (Hoffmann 1987–2011). It may have evolved from a mixture of the Psalter and the Book Pahlavi variants of the Middle Persian script (Skjærvø 2006–2012; Skjærvø 1996: 517). Its writing direction is RTL. It is an alphabetic script since it included individual letters for each required vowel. A variant of Avestan script is the Pazend (Pazand) script.
Christian Sogdian: After the 5th c. AD (the secession of the Nestorians from the Church of Syriac) Christians missionaries used the so-called Nestorian variant of Syriac script (Table 8-12), from which Christian Sogdian script emerged (Skjærvø 2006: 533–534; Skjærvø 2006–2012).

Table 8-17: Runic script family

Runic: 2nd–15th c. AD (Looijenga 1997: 14; Looijenga 2003: 5; Barnes 2012: 5; Jansson 1997). The earliest Runic relic is the Vimose Comb from AD 160 (Vimose is a bog on the island of Funen [Denmark]). According to Sebestyén, one of Tacitus' descriptions of the wooden sticks used by the Germans to prophesy may suggest the existence of Runic script in the 1st c. AD (Sebestyén 1904a: 244). Its oldest variants are *Elder Fuþark:* ca. 150–650 (Looijenga 1997: 14), *Anglo-Frisian Fuþorc:* ca. AD 450–1000 (Barnes 2012: 5) and *Younger Fuþark:* 7th c. (Looijenga 2003: 5) –11th c. AD. The writing direction of the Runic script is LTR, RTL, top-down or bottom-up per line or boustrophedon (Looijenga 1997: 111). The writing direction of the early relics of the Runic script is RTL or LTR, even mixed (Looijenga 1997: 73, 85). The rows on the Rök runestone (9th c. AD, Rök, Östergötland County, Sweden) are separated by parallel lines (text-separation, Table 2-3). The Runic script is derived from the Northern Italic scripts (Györffy & Harmatta 1997: 153; Mees 2000), but in part, it is perhaps a descendant of the Punic (Table 8-6) script (Vennemann 2015: 295–330). According to Barnes, Ancient Greek script from around 400 BC has been identified as a likely source of the Runic script (Barnes 2012: 13).
Ogham: 4th–9th c. AD. Probably it belongs to Runic script family; however, according to Barnes, it was derived from the Latin script. It was used for recording the Irish language. The letters have their letter names (Barnes 2012: 13). It has no role in the present analysis. Its traditional writing direction is up-right-down (Table 2-4).

Table 8-18: The Latin Alphabetic (Roman Alphabetic) script family

Latin: A variant of the Early Latin script after the 2nd c. AD that is still used today. Its writing direction is LTR per line. Many variations of the Latin script have been developed that are often referred *orthographies* or *alphabets,* e.g., Old English alphabet (9th–12th c. AD), English alphabet, Old Hungarian orthography (9th c. AD – 1526), Middle Hungarian orthography (1526–1832) and Hungarian orthography (Hungarian alphabet, from 1832 to the present day) (Kniezsa 1952: 5–60; Kniezsa 1959: 4–5). In these Latin script variants, many new graphemes were created by ligature formation or glyph modification (e.g., using an accent).
Fraser (Old Lisu): Artificial script invented in 1907 in order to write Lisu language (Morse & Tehan 2000). It has no role in the present analysis.

Table 8-19: Rovash scripts

Turkic Rovash (TR, Turkish runes, Turkic runic, Turkic runiform, East Turkic Runic, Orkhon-Yenisey [Tryjarski 1997: 365], Orkhon-Yenisey Türk runic [Harmatta 1994a: 408], Old Turkic Runic [Tryjarski 1995: 192], steppe Runic, Old-Turkic runiform [Kempf 2004], *древнетюркская руническая* [Rogozhinskii & Kyzlasov 2004: 41], *Eski Türk runic* [Tekin: 2003: 20]): The age of TR relics with reliable readings is 8th–10th c. AD. The earliest TR inscriptions are from Mongolia, and none predate the AD 720s (Róna-Tas 1991: 56). TR inscriptions are presumably from 7th–10th c. AD (Erdal 2004: 6). Some TR inscriptions are listed in Table 8-29, and the TR signary is presented in Table 8-22. The official script of the First Turkic Khaganate (552–659) was the Sogdian (Table 8-16); TR became official script only in the Second Turkic Khaganate (682–744). The Second Turkic Khaganate centre was in the middle of present-day Mongolia, in the Orkhon River valley. The inscriptions discovered in Khakassia and Tuva are later and much more irregular and misshapen than those of the great monuments in Mongolia (Clauson 1970: 53). The Orkhon script relics belonging to the Second Turkic Khaganate's official inscriptions are the earliest readable, interpretable, and dated texts written with TR.

Von Gabain views TR as an adaptation of the cursive Aramaic script that had been in use in the Parthian chancellery, and it was developed by the Western Turks due to their contact with Iran in the late 6th c. AD (Golden 1992: 152). Golden suggested that TR evolved from the Aramaic script with modifications due to the technology of carving into stone, even the Chinese artisans carving the Orkhon inscriptions could have aesthetic contributions to the evolution of TR (Golden 1992: 152). According to Róna-Tas, TR's introduction was related to establishing the Second Turkic Khaganate (Róna-Tas 1996c: 13, 16). In the period 735–840, TR was used in the Uyghur Khaganate (Róna-Tas 1996c: 13). The last known TR inscription is from 840 (Róna-Tas 1996c: 13). According to Vékony, TR's roots with the other Rovash scripts originate from the Rourans (330–552) (Vékony 2004a: 59). One idea is that TR was created for administrative purposes of the First Turkic Khaganate at the direction of Istemi Khagan, the ruler of the western part (Clauson 1970: 55; Györffy et al. 1996: 23). It is unlikely that TR was applied in the cultural centres of Eastern Turkestan after the 10th–11th c. (Klyashtorny 2008: 63–64).

8-1. § According to Klyashtorny, in Eastern Turkestan, the glyph style of TR inscriptions is closer to the Yenisey type than to the Orkhon variety and is different from TR glyphs used in the manuscripts. All of the short inscriptions belong to the Buddhist milieu. Turkic Buddhism emerged in Eastern Turkestan and Mongolia not later than the second half of the 6th c. Still, earlier Buddhism had developed in the late Hun states of Eastern Turkestan in the 4th–5th c. (Klyashtorny 2008: 56). The first steps for the official introduction of Buddhism into the Turks' religious practice were taken by Mukhan Khagan (553/554–572). Then, the Buddhist community's continuous existence is undoubted (Klyashtorny 2008: 57).

The Sogdian script affected TR (Kara 1996: 536; Róna-Tas 1996c: 12; Erdal 2004: 4). TR's writing direction is predominantly RTL; however, in a few Yenisey inscriptions, the writing direction is LTR; in this case, the graphemes are engraved reversely (Tekin 2003: 20). The Tanbaly-Tash inscription (Table 8-29) is an example for LTR writing direction. The TR inscriptions' writing direction is usually per line, but can also be boustrophedon. The line order (order of rows) can be bottom-up advanced as well (e.g., Kül Tegin inscription, AD 732) (Kara 1996: 538–539); however, the lines are vertical. TR marks consonants in two or more different ways depending on the vowel next to them because the notation of vowels is incomplete (Kara 1996: 537).

Occasionally, the rows of the inscriptions were separated by parallel lines (text-separation, Table 2-3), and tamgas are used on epitaphs (Kyzlasov, I. L. 1994: 226). Berta analysed TR inscriptions in details (Berta 2004). TR was the official script of the Second Turkic Khaganate (681–745), its reliably dated relics are not older than ca. 8th c. AD.

Székely-Hungarian Rovash (SHR, Székely, Sekler, [Old] Hungarian): From around AD 900 based on the known script relics (Vékony 2004a). It remained in use until today (Hosszú 2013a: 203–272). Table 8-30 introduces several SHR inscriptions shortly, and its signary is given in Table 8-23. The writing direction of SHR is usually RTL per line; however, in case of some inscriptions, LTR, where the graphemes are generally written in a reversed form. The line order is generally top-down advanced; however, there is one example for the bottom-up: the Patakfalvi-Bible. It is a characteristic of SHR that ligatures were used relatively often (Table 8-24).
Carpathian Basin Rovash (CBR, Nagyszentmiklós, Tisza): 7th–11th c. AD based on the surviving deciphered inscriptions (Vékony 2004a: 126–207). Table 8-31 introduces the most important CBR inscriptions shortly, and its signary is presented in Table 8-25. All deciphered inscriptions' writing direction is RTL per line; the line order is top-down advanced. Ligatures were sporadically used in CBR (Table 8-26).
Steppe Rovash (SR, Steppean Rovash, Khazarian Rovash, Khazar, Don-Kuban-South-Yenisey-Ačïqtaš-Isfar): 8th–10th c. AD based on the known script relics (Vékony 2004a: 49–125, 214–319). Table 8-32 introduces the most important SR inscriptions shortly; its signary is presented in Table 8-27. All deciphered inscriptions' writing direction is RTL per line; the line order is top-down advanced. There are many script relics that may belong to SR script (e.g., Kyzlasov, I. L. 1994: *passim.*; Koloda 2014: 183–189), but the graphs of these uncertain, undeciphered inscriptions are not used in the present analysis. Ligatures were used relatively frequently in SR inscriptions (Table 8-28).

Table 8-20: The Uyghur script family

Uyghur (Uighur, Uigur, Uyghur Turkish, Old Uyghur): It was in use in the Turkic-speaking Uyghur Khaganate in the 8th–9th c. and the Uyghur groups in Gansu (China) continued its use until the 17th c. (Kara 1996: 539). It comes directly from the Sogdian cursive script (Sims-Williams 1981b: 347–348). Its writing direction is vertical per line; the columns follow each other in LTR order; in each column, the writing direction is top-down.
Classic Mongolian (Kara 1996: 545–547), *Oirat Clear* (tod bičig, clear script) (Kara 1996: 548; Kempf 2004: 41), *Manchu* (Kara 1996: 551–553), *Buryat* (Kara 1996: 555): These scripts have no role in the present analysis.

Table 8-21: The Slavic script family

Glagolitic: 9th–present. AD; St. Methodius and Cyril (Constantine) used the Glagolitic script in Moravia from the fall of 863 to 885 to write down the Slavic translation of the Bible. According to Mathiesen, the Glagolitic script was created by St. Constantine in 863, which was later amended several times (Mathiesen 2014: 187). It originally contained 36 graphemes (Diem et al. 2010: 296). It was developed from the minuscule variant of Greek script (Györffy & Harmatta 1997: 153). In 886, Wiching, the Bishop of Nitra (Slovakia) banned the Glagolitic script. After 886, some disciples of St. Cyril and Methodius went to Croatia, where they continued to use the Glagolitic script and developed a square variant of it. Its writing direction is LTR. After the Glagolitic formation, the glyphs gradually changed into two main variants, the more original *Old Church Slavonic* (rounded, Bulgarian) (Cubberley 1996: 350) and the 13th c. *Croatian* (angled, square)

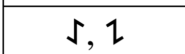
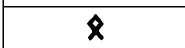
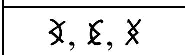
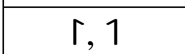
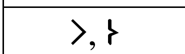
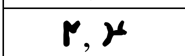
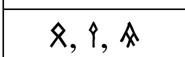
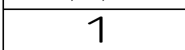
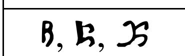
(Cubberley 2002: 32). The 10th–11th c. Haskovo amulet in mixed form, written with Glagolitic and Early Cyrillic graphemes. The use of Glagolitic script was gradually suppressed from the 16th c.

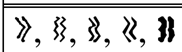
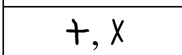
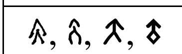
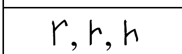
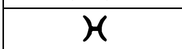
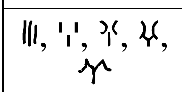
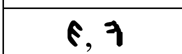
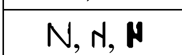
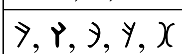
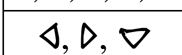
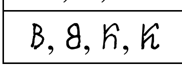
Early Cyrillic, Cyrillic: Early Cyrillic was developed between 893 and 927 in the court of the Bulgarian Tsar Simeon I in Preslav (Róna-Tas 1996a: 338). The style of the Early Cyrillic script is called *ustav* (in Old Church Slavonic оуставъ), which evolved primarily from the Byzantine uncial variant of Greek script (only uppercase, unconnected, round glyphs) (Györffy & Harmatta 1997: 153), but also used Glagolitic graphemes. The Cyrillic script is a post-medieval variant of Early Cyrillic script. Originally, the Glagolitic script was used in both Ohrid and Pliska literary schools, but later, the Cyrillic script was developed in Preslav (Curta 2006: 221). Some Cyrillic manuscripts also contain Glagolitic graphemes, words and sentences (Curta 2006: 215). After the Middle Ages, the Early Cyrillic gradually evolved to the modern Cyrillic.

8.3. *Sign tables of Rovash scripts*

The typical glyphs of Rovash scripts are also presented: Table 8-22 for TR, Table 8-23 for SHR, Table 8-25 for CBR and Table 8-27 for SR. In the signaries, the following groups of graphemes are separated by a double line border: vowels; plosives; nasals; fricatives; affricates; approximants & liquids; consonant clusters and punctuation marks. The specification of the punctuation marks are simplified, more detailed information can be found in each SFG. Furthermore, some examples of ligatures in SHR (Table 8-24), CBR (Table 8-26) and SR (Table 8-28) are also given.

Table 8-22: Typical glyphs of the Turkic Rovash (TR) signary

Glyph	Transliteration	SFG
	<A>	SFG-3
	<A>	SFG-4
	<A>	SFG-6
	<e>	SFG-6
	<I>	SFG-50
	<I>	SFG-53
	<W>	SFG-31
	<Ẅ>	SFG-35
	<b^{1}>	SFG-17
	<b^{2}>	SFG-14
	<p>	SFG-78
	<$^{W/\ddot{W}}$p>	SFG-79

Glyph	Transliteration	SFG
	<d^{1}>	SFG-27
	<d^{2}>	SFG-29
	<t^{1}>	SFG-48
	<t^{2}>	SFG-103
	<g^{1}>	SFG-21
	<g^{1}>	SFG-22
	<g^{2}>	SFG-18
	<^{A}q^{A}>	SFG-58
	<^{I}k^{I}>	SFG-57
	<^{ï}q^{ï}>	SFG-61
	<$^{\ddot{W}}$k$^{\ddot{W}}$>	SFG-89

Glyph	Transliteration	SFG
	<$^{W}q^{W}$>	SFG-62
	<m>	SFG-67
	<n^1>	SFG-72
	<n^2>	SFG-75
	<ń>	SFG-74
	<ṅ>	SFG-24
	<ṅ>	SFG-23
	<z>	SFG-40
|	<s^1, s^2, š>	SFG-101
	<s^1, s^2, š>	SFG-97
	<š>	SFG-98
	<š>	SFG-100
	<č, ğ>	SFG-83

Glyph	Transliteration	SFG
	<^{i}č^{i}, ^{i}ğ>	SFG-84
	<l^1>	SFG-63
	<l^2>	SFG-65
	<y^1>	SFG-55
	<y^2>	SFG-56
	<r^1>	SFG-92
	<r^2>	SFG-93
	<nd, nt>	SFG-28
	<nč>	SFG-87
	<ld, lt>	SFG-105
	<separator>	SFG-111
:	<separator>	SFG-113
	<separator>	SFG-118

Table 8-23: Typical glyphs of the Székely-Hungarian Rovash (SHR) signary

Glyph	Transliteration	SFG
	<a>	SFG-1
	<á>	SFG-2
	<e>	SFG-11
	<e>	SFG-13
	<e>	SFG-3
	<e>	SFG-6
	<é>	SFG-12
	<i>	SFG-54
	<i, j>	SFG-50
	<o>	SFG-32
	<o>	SFG-76

Glyph	Transliteration	SFG
	<ö>	SFG-5
	<u>	SFG-38
	<Ẅ>	SFG-7
	<Ẅ>	SFG-35
	<b>	SFG-15
	<p>	SFG-80
	<p>	SFG-81
	<p>	SFG-78
	<d>	SFG-29
	<d’>	SFG-39

Glyph	Transliteration	SFG
	<t>	SFG-104
	<ť>	SFG-106
	<g>	SFG-18
	<k>	SFG-58
	<k>	SFG-91
	<k>	SFG-61
	<m>	SFG-68
	<n>	SFG-72
	<ń>	SFG-73
(reconstructed from the ligature <βna>) *	<β>	SFG-16
	<v>	SFG-37
	<f>	SFG-47
	<z>	SFG-102
	<s>	SFG-101
	<ž>	SFG-97
	<š>	SFG-98
	<š>	SFG-99
	<γ>	SFG-21

Glyph	Transliteration	SFG
	<χ>	SFG-90
	<h>	SFG-46
	<c>	SFG-85
	<č>	SFG-82
	<l>	SFG-64
	<í>	SFG-55
	<r>	SFG-92
	<r>	SFG-96
	<mb, mp>	SFG-70
	<nd>	SFG-30
	<nt>	SFG-107
	<nk>	SFG-60
	<nc>	SFG-86
	<separator>	SFG-110
	<delimiter>	SFG-114
	<separator>	SFG-117
	<end mark, delimiter, separator>	SFG-118

Table 8-24: Examples for Székely-Hungarian Rovash ligatures (literature in Table 8-30)

Székely-Hungarian Rovash ligature	Székely-Hungarian Rovash components
(Bodrog-Alsóbű, around 900 or first half of 10th c.) <βna> /βnå/	* <β> (SFG-16), <n> (SFG-72) and <a> (SFG-1)
(Constantinople, 1515, LTR writing direction) <ab> /ab/	<a> (SFG-1) and <b> (SFG-15)
(Constantinople, 1515, LTR writing direction) <al> /al/	<a> (SFG-1) and <l> (SFG-64)

Székely-Hungarian Rovash ligature	Székely-Hungarian Rovash components
(Constantinople, 1515, LTR writing direction) <irt> /írt/	<i> (SFG-54), <r> (SFG-92) and <t> (SFG-104)
(Csíkszentmihály, 1501) <lt> /lt/	<l> (SFG-64) and <t> (SFG-104)
(Csíkszentmihály, 1501) <nd> /nd/	<n> (SFG-72) and <d> (SFG-29)
(Csíkszentmihály, 1501) <t̮a> /t̮á/	<t̮> (SFG-10) and <a> (SFG-1)
(Homoródkarácsonyfalva Stone inscription, around 13th c.) <sn> /sän/ (SFG-117)	<s> (SFG-101) and <n> (SFG-72)
(Kájoni's Rudimenta-like, 1673) <ge> /ge/	<g> (SFG-18) and <e> (SFG-11)
(Nikolsburg, 1490–1526) *eczk* <ck> /ck/	<c> (SFG-85) and <k> (SFG-58)
(Nikolsburg, 1490–1526) *encź, ench* <nč> /ncs/	<n> (SFG-72) and <č> (SFG-82)
(Nikolsburg, 1490–1526) *ezt* <zt> /zt/	<z> (SFG-102) and <t> (SFG-104)
(Rudimenta-Giessen, 1598) <nk> /nk/	<n> (SFG-72) and <k> (SFG-91)
(Rudimenta-Giessen, 1598) *nt* <nt> /nt/	<n> (SFG-72) and <t> (SFG-104)
(Stick Calendar, ca. 15th c. surviving in a 17th c. copy) <albrt> /albärt/	<a> (SFG-1), <l> (SFG-64), <b> (SFG-15), <r> (SFG-96) and <t> (SFG-104)
(Stick Calendar, ca. 15th c. surviving in a 17th c. copy) <ntl> /antal/	<nt> (SFG-107) and <l> (SFG-64)
(Stick Calendar, ca. 15th c. surviving in a 17th c. copy) <ar> /ár/	<a> (SFG-1) and <r> (SFG-96)
(Stick Calendar, ca. 15th c. surviving in a 17th c. copy) <na> /ná/	<n> (SFG-72) and <a> (SFG-1)
(Stick Calendar, ca. 15th c. surviving in a 17th c. copy) <nc> /nc/	<n> (SFG-72) and <c> (SFG-85)
(Szamosközy's Note, before 1593) <art> /art/	<a> (SFG-1), <r> (SFG-92) and <t> (SFG-104)
(Székelyderzs, 1490s) <oš> /óš/	<o> (SFG-32) and <š> (SFG-98)

Table 8-25: Typical glyphs of the Carpathian Basin Rovash (CBR) signary

Glyph	Transliteration	SFG
	<A>	SFG-8
	<I>	SFG-50
	<I>	SFG-51
	<W>	SFG-31
	<ǫ>	SFG-77
	<Ẅ>	SFG-36
	<b>	SFG-14
	<b>	SFG-15

Glyph	Transliteration	SFG
	<p>	SFG-78
	<d>	SFG-25
	<t>	SFG-106
,	<t>	SFG-108
	<g>	SFG-19
	<k>	SFG-58
	<k>	SFG-89
	<q>	SFG-88
	<m>	SFG-69
	<n>	SFG-71
,	<n, ń>	SFG-72
	<β>	SFG-16
	<f>	SFG-80

Glyph	Transliteration	SFG
, ,	<z>	SFG-41
	<s>	SFG-101
,	<š>	SFG-99
, ,	<γ>	SFG-21
	<χ>	SFG-44
	<χ>	SFG-45
	<l>	SFG-63
,	<l>	SFG-66
	<j> or <y>	SFG-55
	<r>	SFG-95
	<separator>	SFG-110
	<separator>	SFG-116

Table 8-26: Examples for Carpathian Basin Rovash ligatures (literature in Table 8-31)

Carpathian Basin Rovash ligature	Carpathian Basin Rovash components
(Jánoshida, last third of 7th c.) <rg> /rg/	<r> (SFG-95) and <g> (SFG-19)
(Ozora-Tótipuszta, last third of 7th c.) <Iγ> /ïγ/	<I> (SFG-50) and <γ> (SFG-21)
(Szarvas, first half of 8th c.) <βγr> /β^{a}rγ/	<β> (SFG-16), <γ> (SFG-21) and <r> (SFG-95)

Table 8-27: Typical glyphs of the Steppe Rovash (SR) signary

Glyph	Transliteration	SFG
, , ,	<A>	SFG-8
	<A>	SFG-9
	<e>	SFG-6
, ,	<e>	SFG-10
,	<I>	SFG-50
, , ,	<I>	SFG-51

Glyph	Transliteration	SFG
,	<I>	SFG-52
	<W>	SFG-33
	<W>	SFG-34
	<Ẅ>	SFG-36
	<Ẅ>	SFG-37
,	<b^{1}>	SFG-17
	<b^{2}>	SFG-14

Glyph	Transliteration	SFG
X	<b>	SFG-15
[illegible]	<p>	SFG-80
1	<p>	SFG-78
>, [illegible]	<d>	SFG-25
[illegible]	<d>	SFG-26
[illegible]	<t^2>	SFG-49
[illegible], [illegible]	<t>	SFG-106
[illegible]	<g^1>	SFG-22
[illegible], [illegible], [illegible]	<g^1, g^2>	SFG-20
[illegible], H, И, [illegible]	<g^1, g^2>	SFG-21
[illegible]	<q>	SFG-59
[illegible]	<k>	SFG-57
8	<k>	SFG-88
[illegible]	<$^wq^w$>	SFG-88
◊	<q>	SFG-91
O	<m>	SFG-67
[illegible], [illegible], [illegible]	<m>	SFG-69
[illegible], [illegible]	<n^1>	SFG-71
[illegible],)	<n^1>	SFG-72
[illegible]	<n^2>	SFG-75
[illegible]	<ṅ>	SFG-24
[illegible]	<β>	SFG-16
[illegible]	<z>	SFG-40

Glyph	Transliteration	SFG
I	<s>	SFG-101
[illegible], Y	<s>	SFG-97
[illegible]	<š>	SFG-97
[illegible]	<$š^2$>	SFG-98
[illegible], [illegible]	<χ>	SFG-42
[illegible]	<χ>	SFG-43
[illegible], [illegible]	<h>	SFG-44
[illegible], [illegible], [illegible]	<č>	SFG-82
), [illegible]	<l>	SFG-63
[illegible]	<l>	SFG-64
D, O	<y^1>	SFG-55
h, H	<r>	SFG-92
[illegible]	<r^1>	SFG-95
∩	<r^2>	SFG-94
M	<lt>	SFG-105
ı	<separator>	SFG-110
[illegible], [illegible], [illegible]	<end mark, separator>	SFG-112
:	<separator>	SFG-113
[illegible]	<end mark>	SFG-115
·	<separator>	SFG-118
[illegible]	<begin mark, end mark>	SFG-119

Table 8-28: Examples for Steppe Rovash ligatures (literature in Table 8-32)

Steppe Rovash ligature	Steppe Rovash components
(Achik-Tash, 8th c.) [illegible] <<u>šId</u>> /šiδ/	[illegible] <š> (SFG-97), 1 <I> (SFG-50) and > <d> (SFG-25)
(Devitsa, 754 – ca. 820/821) [illegible], [illegible] <<u>šd</u>> /ʲšᵃδ/	[illegible]<š> (SFG-97) and > <d> (SFG-25)
(Jitkov, first third of 8th c.) [illegible] <<u>dkA</u>> /δkä/	> <d> (SFG-25), [illegible] <k> (SFG-57) and [illegible] <A> (SFG-8)

Steppe Rovash ligature	Steppe Rovash components
(Kermen Tolga, 8^{th}–10^{th} c.); (Mayatskoe-10, 9^{th} c.) <dI> /de/	<d> (SFG-26) and <I> (SFG-50)
(Khumara-6, 9^{th}–10^{th} c.) <r^1At> /rat/	<r^1> (SFG-95), <A> (SFG-8) and <t> (SFG-106)
(Khumara-6, 9^{th}–10^{th} c.) <tg^2> /t^eg/	<t> (SFG-106) and <g^2> (SFG-21)
(Khumara-8 [in copy], 9^{th}–10^{th} c.) <An^1> /an/	<A> (SFG-8) and <n^1> (SFG-72)
(Khumara-8 [in copy], 9^{th}–10^{th} c.) <In^1> /ïn/	<I> (SFG-50) and <n^1> (SFG-72)
(Kievan Letter, 955–961) <Il> /il/	<I> (SFG-50) and <l> (SFG-63)
(Kievan Letter, 955–961) <Iq> /ïq/	<I> (SFG-50) and <q> (SFG-91)
(Mayatskoe-1, 9^{th} c.); (Mayatskoe-10, 9^{th} c.) <dA> /da/	<d> (SFG-26) and <A> (SFG-8)
(Novocherkassk, 8^{th}–10^{th} c.) , <Ar> /är/	<A> (SFG-8) and <r> (SFG-92)

8.4. Inscriptions of Rovash scripts

Only glyphs from deciphered, readable inscriptions on archaeologically and palaeographically reliable script relics are considered in the present analysis. Moreover, glyphs created from the graphs of the inscriptions on these relics are typically used. However, in some cases, glyphs are so clear and commonly used in the literature that it makes no sense to relate to a single script relic or a certain literature source; in this case, the source's reference is omitted. The palaeographic literature of various scripts differs in that they use typized glyphs or individual drawn glyphs based on the graphs of certain inscriptions. This difference is also reflected in the database of the Similarity Feature Groups (SFGs), although unique glyphs being specific to each script relic are preferred.

It is worth noting that many Rovash inscriptions have not read, and for a significant part of them it is not even possible to decide which script they belong to. Several Rovash inscriptions in Inner Asia might belong to TR; however, they have not reliable reading (e.g., Saurykov 2014: 170–171). In Europe, also there are uncertain inscriptions. E.g., Alsószentmihályfalva inscription (Benkő, E. 1972a; Benkő, E. 1972b: 453 and Appendix; Vásáry 1974: 165; Ferenczi, G. & Ferenczi, I. 1979: 29; Vékony 1987a: 19, 108–117; Vékony 1987c: 378–384; Benkő, E. 1994a: 158–160; Ráduly 1995b: 17–18; Vékony 2002: 185; Vékony 2004a: 217–230; Hosszú 2013a: 122–125); and the Mikulčice bone-plate, probably with CBR inscription (Klanica 1995: 43–71; Vékony 2004b; Csiky, Gergely: Personal communication, 2013 apud Hosszú 2013b: 32). Several SR script relics do not have reliable reading, one of them was found in Qaratöbe (Karatöbe, Қаратөбе in Turkistan Region, Kazakhstan), which have very similar graphs found in the Achik-Tash inscription (Bazılhan 2014: 10); however, it has been undeciphered. According to I. L. Kyzlasov, the Karban inscription (A-50, Chemalsky District, Altai Republic, Russia) belongs to the South-Yenisey subgroup of the Euroasiatic group of runic scripts (Kyzlasov, I. L. 1994: 315–317), which means that the Karban inscription should belong to the Steppe Rovash (SR).

Literature sources of the description and deciphering of these script relics are listed in the following tables: Table 8-29 for Turkic Rovash (TR), Table 8-30 for Székely-Hungarian Rovash (SHR), Table 8-31 for Carpathian Basin Rovash (CBR) and Table 8-32 for Steppe Rovash (SR).

Table 8-29: Examples of Turkic Rovash (TR) inscriptions

There are several Turkic Rovash (Table 8-19) inscriptions, a few of them are listed below. Listing the related very large literature is out of this book's scope, only a fragment of the literature is cited below.

Abakan (E-48, Abakan [Khakassia, Russia]), 8th–9th c. AD: Vasil'ev 1976: 71–81; Tekin 2003: 234–235; Kormushin 2008: 138–139.

Achury (E-26, Ochury, Açurae [Khakassia, Russia]): Malov 1952: 47–50; Vasil'ev 1976: 71–81; Tekin 2003: 232–233; Kormushin 2008: 115.

Akterek ([Akterek village, Jambyl Region, Kazakhstan]): Kyzlasov 2010: 345–346; Rogozhinskii 2010: 333 and Рис. 3; Bazılhan 2014: 4–5. Rock inscription.

Almaly I (Almaly Valley [Chu-Ili Mountains, Semirechye, Kazakhstan]): Rogozhinskiy & Tishin 2018b: 83–85; Tishin & Rogozhinskiy 2018: 77–78.

Almaly II (Almaly Valley [Chu-Ili Mountains, Semirechye, Kazakhstan]): Rogozhinskiy & Tishin 2018b: 85–89; Tishin & Rogozhinskiy 2018: 78–85.

Almaly III (Almaly Valley [Chu-Ili Mountains, Semirechye, Kazakhstan]): Rogozhinskiy & Tishin 2018b: 89; Tishin & Rogozhinskiy 2018: 85–88.

Altyn-kol I (E-28, Altınköl I [Khakassia, Russia]), 8th–9th c. AD: Malov 1952: 52–54; Vasil'ev 1976: 71–81; Tekin 2003: 233; Kormushin 2008: 117–119.

Altyn-kol II (E-29, Altınköl II [Khakassia, Russia]): Malov 1952: 55–57; Vasil'ev 1976: 71–81; Tekin 2003: 233–234; Kormushin 2008: 120–121.

Barlyk I (E-5, Барык I [Tuva, Russia]), 8th–9th c. AD: Malov 1952: 20; Kormushin 2008: 95.

Barlyk II (E-6, Барык II [Tuva, Russia]), 8th–9th c. AD: Malov 1952: 21; Kormushin 2008: 96–97.

Barlyk III (E-7, Барык III [Tuva, Russia]), 8th–9th c. AD: Malov 1952: 22; Vasil'ev 1976: 71–81; Tekin 2003: 230; Kormushin 2008: 98.

Begre (E-11, Tuva, Russia), 8th–9th c. AD: Malov 1952: 29–33; Vasil'ev 1976: 71–81; Tekin 2003: 321; Kormushin 2008: 102–104; Türik Bitig, http://bitig.org/show_big.php?fn=copies/535.gif, retrieved on 20 March 2015.

Bichiktu-Boom II/1 (A-14, Ongudaysky District, Altai Republic, Russia): Tybykova et al. 2012: 55–56; Konkobaev et al. 2015: 45–48.

Bichiktu-Boom II/2 (A-15, Ongudaysky District, Altai Republic, Russia): Konkobaev et al. 2015: 49–51.

Bichiktu-Boom III (A-16, Ongudaysky District, Altai Republic, Russia): Tybykova et al. 2012; Konkobaev et al. 2015: 52–56; Vavulin 2017: 259–260; Nevskaya & Tybykova 2018: 11–23; Nevskaya et al. 2018: 205–213. The two lines of the inscription are in a vertical position. However, considering the glyphs' stance, its writing direction is RTL bottom-up.

Bichiktu-Boom IV (A-54, Ongudaysky District, Altai Republic, Russia): Matočkin 2015: 88; Konkobaev et al. 2015: 189.

Bichiktu-Boom XVI/3 (A-98, Ongudaysky District, Altai Republic, Russia): Konkobaev et al. 2015: 330–333.

Bilge Khagan (Bilgä Qaghan/Qağan/Qaγan, Bilge Xağan/Kagan, Mogilyan, Hosho Tsaidam; found in Valley of the Orkhon River [Arkhangai Province, Mongolia]), AD 735: Thomsen 1893; Malov 1959: 11–25; Róna-Tas 1987: 9; Tekin 2003: 221, 267; Kempf 2004: 44.

Buy-bulun II (E-49, Bay-Bulin II, Tuva I [Tuva, Russia]), 8th–9th c. AD: Tekin 2003: 235; Kormushin 2008: 140.

Chaa-khol I (E-13, Çaa-Höl I [Tuva, Russia]), 8th–9th c. AD: Malov 1952: 35–36; Vasil'ev 1976: 71–81; Tekin 2003: 231–232; Kormushin 2008: 105.

Chaa-khol II (E-14, [Tuva, Russia]), 9th–10th c. AD: Malov 1952: 37; Vasil'ev 1976: 71–81; Kormushin 2008: 106.

Chaa-khol III (E-15, [Tuva, Russia]), 9th–10th c. AD: Malov 1952: 37; Vasil'ev 1976: 71–81. Its location is presently unknown.

Chaa-khol IV (E-16, Çaa-Höl IV [Tuva, Russia]): Malov 1952: 38; Vasil'ev 1976: 71–81; Tekin 2003: 232; Kormushin 2008: 108.

Chaa-khol V (E-17, Çaa-Höl V [Tuva, Russia]): Malov 1952: 39; Vasil'ev 1976: 71–81; Tekin 2003: 232; Kormushin 2008: 108.

Chaa-khol VI (E-18, Çaa-Höl VI [Tuva, Russia]): Malov 1952: 40; Kormushin 2008: 110.

Chaa-khol VII (E-19, Çaa-Höl VII [Tuva, Russia]), 9th–10th c. AD: Malov 1952: 41; Vasil'ev 1976: 71–81; Kormushin 2008: 110. Its writing direction is LTR; the glyphs of the graphemes are mirrored.

Chaa-khol VIII (E-20, Çaa-Höl VIII [Tuva, Russia]), 9th–10th c. AD: Malov 1952: 41; Kormushin 2008: 111.

Chaa-khol IX (E-21, Çaa-Höl IX [Tuva, Russia]): Malov 1952: 42; Kormushin 2008: 112.

Chaa-khol X (E-22, Çaa-Höl X [Tuva, Russia]): Malov 1952: 42; Kormushin 2008: 112.

Chaa-khol XI (E-23, Çaa-Höl XI [Tuva, Russia]): Malov 1952: 43; Kormushin 2008: 113.

Darkhan Moomingyan (Darhan Maoming'an [Inner Mongolia, China]): Ölmez 2016: 4, 8.

Dunhuang Letter (Dunhuang, Tun-huang): Clauson 1970: 74.

Dzürijn ovoo (Dzüriin ovoo, Tes II, Tez II, found in Zavkhan Province [Mongolia]), 8th–9th c. AD: Klyashtorny 1978: 151–158; Kampf 2004: 44.

Elegest (E-10, Tuva, Russia): Vasil'ev 1976: 71–81; Tekin 2003: 230–231; Kormushin 2008: 100–101.

Hirgisiyn Ovoo (Bayankhongor Province, Mongolia): Ölmez 2018b: 24–30.

Inegen II (A-86, Ongudaysky District, Altai Republic, Russia): Konkobaev et al. 2015: 280–282.

Ïrq Bitig Manuscript (Irk Bitig, Book of Omens, Гадательная книжка) manuscript, late 9th c. AD (Tekin 1993: 1–2, 236, 272), but according to Klyashtorny, it was completed on 17 March 930 (Klyashtorny 2002: 42): von Gabain 1941; Malov 1951: 80–92; Erdal 1997.

Kalbak-Tash I (A-23, Ongudaysky District, Altai Republic, Russia): Konkobaev et al. 2015: 78–81.

Kalbak-Tash II/XV (A-33, Ongudaysky District, Altai Republic, Russia), 8th c. AD: Konkobaev et al. 2015: 119–123; Kubarev 2016: 92–101.

Kalbak-Tash III (A-24, Ongudaysky District, Altai Republic, Russia): Konkobaev et al. 2015: 86–88.

Kalbak-Tash IV/VI (A-25, Ongudaysky District, Altai Republic, Russia): Konkobaev et al. 2015: 89–91.

Kalbak-Tash V (A-26, Ongudaysky District, Altai Republic, Russia): Konkobaev et al. 2015: 92–96.

Kalbak-Tash XX (A-43, Ongudaysky District, Altai Republic, Russia): Matočkin 2015: 87–88; Konkobaev et al. 2015: 149–153.

Kalbak-Tash XXX (A-58, Ongudaysky District, Altai Republic, Russia): Konkobaev et al. 2015: 201–204.

Kemer (Кемер [Talas District, Jambyl Region, Kazakhstan]): Rogozhinskii 2010: 332–333 and Рис. 2; Bazılhan 2014: 7.

Kezheelig-Khovu (E-45, Kejeelig-Hovu, Кӧжээлиг-Хову [Tuva, Russia]), 8th–9th c. AD: Vasil'ev 1976: 71–81; Tekin 2003: 234; Kormushin 2008: 134–135; Kyzlasov, I. L. 2017: 71.

Khangyt-khat (Хангыт-хат cliff [Bulgan Province, Mongolia]), end of 7th – the beginning of 8th c. AD: Klyashtorny 1978: 156.

Khentii (Hentij, Хэнтэйская [надпись], found in Khentii Mountains [Mongolia]), the second half of 8th – beginning of 9th c. AD: Klyashtorny 1978: 156–158.

Kochkor (eight inscriptions in Kochkor Valley [in Central Tien Shan, Naryn Region, Kyrgyzstan], the first half of 8th c. AD): Klyashtorny 2001: 203–206.

Koytübek (Койтубек [Kurshim District, East Kazakhstan Region, Kazakhstan]): Amanjolov 2003: 203–204; Rogozhinskii 2010: 330–331 and Рис. 1; Bazılhan 2014: 3–4.

Kuljabasy I ([Semirechye, Kazakhstan], the second half of 8th c. or 9th–10th c. AD): Rogozhinskiy & Tishin 2018a: 143–150; Tishin & Rogozhinskiy 2018: 66–73.

Kuljabasy II (Semirechye, Kazakhstan): Rogozhinskiy & Tishin 2018a: 150–157; Tishin & Rogozhinskiy 2018: 73–76.

Kupchegen (A-49, Kypchegen [Altai Republic, Russia]): Konkobaev et al. 2015: 176–178.

Kül Tegin (Köl tegin, Kül Tégin, Kul Tigin, Kül Tigin, Valley of the Orkhon River, [Arkhangai Province, Mongolia]), AD 732: Malov 1951: 19–55; Malov 1959: 25–30; Novgorodova 1981: 203–218; Róna-Tas 1987: 9; Kara 1996: 538–539; Tekin 2003: 219–220, 265–266; Kempf 2004: 45; Kyzlasov, I. L. 2017: 29.

Küli Čur (Kul-Chur, Küli Čor, İhe-Hüşötü, Köli čor, Ihe Höshütü [Tuv Province, Mongolia]), AD 719–724: Róna-Tas 1987: 9; Tekin 2003: 15, 227–229; Kempf 2004: 45; Türik Bitig, http://bitig.org/show_big.php?fn=copies/316.gif, retrieved on 21 April 2018.

Kyzyl-Chiraa I (E-43, Kızıl-Çıra I [Tuva, Rusia]), 8th–9th c. AD: Malov 1952: 78; Kormushin 2008: 132.

Kyzyl-Chiraa II (E-44, Kızıl-Çıra II [Tuva, Russia]), 8th–9th c. AD: Malov 1952: 79–80; Vasil'ev 1976: 71–81; Tekin 2003: 234; Kormushin 2008: 133.

Manichean texts: Clauson 1970: 75.

Manyrlu-Koby I (A-64, Ongudaysky District, Altai Republic, Russia): Konkobaev et al. 2015: 218–219.

Manyrlu-Koby II (A-65, Ongudaysky District, Altai Republic, Russia): Konkobaev et al. 2015: 220–221.

Mendur-Sokkon I/1 (A-6, Čaryš [Ust-Kansky District, Altai Republic, Russia]): Tybykova et al. 2012: 129–130; Konkobaev et al. 2015: 294–301.

Mendur-Sokkon IV (A-12, Ust-Kansky District, Altai Republic, Russia): Tybykova et al. 2012: 134–135; Konkobaev et al. 2015: 40–41; Kyzlasov, I. L. 2017: 105.

Ongi (Ong, Ongin, Ongiin [Uvurkhangai Province, Mongolia]), 740 (Dobrovits 2004: 35): Malov 1959: 7–11; Róna-Tas 1987: 9; Tekin 2003: 224–225; Dobrovits 2004: 29–35.

Oznaçennoye I (E-25, Khakassia, Russia): Tekin 2003: 232; Kormushin 2008: 114.

Qara Balgasun II (fragments of the granite stele, Qara-balgasun, Qarabalgasun, Kara Balgasun, Kara Balgassun, Kara-Barugasun, Karabalgasun, Karabarugasun, Ordu-Baliq [Arkhangai Province, Mongolia]), trilingual inscription in Turkic Rovash, Sogdian and Chinese of the eighth Uyghur khagan, ruled 808–821 (Yoshida 2010–2012): Alimov 2015b: 27–38.

Qarï Čor Tegin (epitaph, Xi'an, China): Rybatzki & Wu 2014.

Qulan-Saj (Terek-Saj, Talas VI/1 and Talas VI/2), 8th–10th c. AD: Malov 1936: 27–28.

Sary-Koby (A-72, Ustügï Sarï-Kobï [Ongudaysky District, Altai Republic, Russia]): Konkobaev et al. 2015: 232–234.

Shine Usu (Bayan chor, Eletmish Bilge Qaghan, Moyn-Čor, Moyin chor, Moyun Čor, Selenginskij kamen', Šine us, Šine usu, Yaklagar [Bulgan Province, Mongolia]), AD 759–760: Malov 1959: 30–44; Róna-Tas 1987: 9; Kempf 2004: 46; Türik Bitig, http://bitig.org/show_big.php?fn=copies/10.gif, retrieved on 6 February 2020.

Sudzi (Suǰi, Suci [Mongolia]), AD 840–862: Malov 1951: 76–77; Róna-Tas 1987: 9; Tekin 2003: 229.

Talas I, 8th–10th c. AD: Malov 1951: 74–75.

Talas II, 8th–10th c. AD: Malov 1936: 16–22.

Talas III, 8th–10th c. AD: Malov 1936: 23–24.

Talas V, 8th–10th c. AD: Malov 1936: 25–26.

Tanbaly-Tash (Tañbalı Taş, Тамгалы in Zhetysu [Semirechye, Almaty Region, Kazakhstan]), 9th–10th c. AD: Rogozhinskii & Kyzlasov 2004: 41–46; Bazılhan 2014: 2–3. Its writing direction is LTR.

Terh (Cagan-nuur, Taryat, Terek, Terhijn gol, Terhin, Terhyin, Terkhin [Arkhangai Province, Mongolia]), mid-8th c. AD: Róna-Tas 1987: 9; Tekin 2003: 226–227, 270; Kempf 2004: 46.

Tez (Tes, [Khuvsgul Province, Mongolia]), AD 750–753: Róna-Tas 1987: 9; Kempf 2004: 43, 46.

Toñuquq (Baïn Tsokto, Bayan Cokto, Toñukuk, Tunyukuk, found in Tuv Province [Mongolia]), AD 720–726: Malov 1951: 56–73; Róna-Tas 1987: 9; Tekin 2003: 15, 222–223, 268–269; Kempf 2004: 47.

Toyok: Klyashtorny 2002: 42.

Tsetsüüh (inscription on a roof tile, the site is in the valley of the river Deed Tsetsüüh, near river Ider [Mongolia]): Hayashi 2015: 46–54.

Tuba I (E-35), 8th–9th c. AD: Malov 1952: 65.

Tuba II (E-36), 8th–9th c. AD: Malov 1952: 66.

Tuba III (E-37, River Tes [Khakassia, Russia]): von Stahlenberg 1730: Tab XII; Kormushin 2008: 127.

Tuekta I (A-3, Ongudaysky District, Altai Republic, Russia): Tybykova et al. 2012: 117–118; Konkobaev et al. 2015: 22–24.

Tuekta V (A-90, Ongudaysky District, Altai Republic, Russia): Konkobaev et al. 2015: 290–293; Nevskaya et al. 2018: 198–203.

Tumshuk-Koby (A-91, Ust-Kansky District, Altai Republic, Russia): Konkobaev et al. 2015: 302–304.

Urkosh (Central Altai [Altai Republic, Russia]), 8th–9th c. AD: Tugusheva et al. 2014: 77–92.

Uyk-Tarlaq (E-1, Uyuk-Tarlak [Tuva, Russia]), 8th–9th c. AD: Malov 1951: 78–79; Malov 1952: 11–12; Vasil'ev 1976: 71–81; Tekin 2003: 230; Tekin 2006: 201–211; Kormushin 2008: 90.

Uyuk-Turan (E-3, [Tuva, Russia]), 8th–9th c. AD: Malov 1952: 16–19; Vasil'ev 1976: 71–81; Vasil'ev 1983: 84; Tekin 2003: 230, 271; Kormushin 2008: 92–93.

Yabogan (A-84, Jabogan [Ust-Kansky District, Altai Republic, Russia]): Nevskaya 2012: 39–57; Konkobaev et al. 2015: 268–276.

Yar Khoto 21 (wall inscription, Yar-Khoto, Jiaohe [Yarnaz Valley, 10 km west of Turpan in Xinjiang, China]): Erdal 1993: 91, 104–105.

Zhalgyz-Tobe I (A-34, Zhalgyz-Tjobe [Kosh-Agachsky District, Altai Republic, Russia]): Konkobaev et al. 2015: 124–130.

Zhon-Aryk (T-14, Talas), first half of 8th c. AD: Alimov & Tabaldiev 2005: 121–125; Alimov 2015a: 39–40.

Table 8-30: Examples of Székely-Hungarian Rovash (SHR) inscriptions

Bágy (Stone inscription in the Calvinistic church of Bágy [Romanian: Bădeni in Harghita County, Romania]), 15th c. AD: Szász 2013: 7; Ráduly 2013a; Sándor 2014a: 184–189; Fehér 2020b: 259–260. The church of Bágy could be built in the turn of the 15th–16th c. (Ferenczi, G. 2002).

Bél, AD 1718 (Alphabet and Lord's Prayer published by Mátyás Bél in his book): Bél 1718 apud Sebestyén 1904c: 403–408; Hosszú 2013a: 246; Hosszú 2013b: 85; Zsupos 2019b: 66.

Bod's Rudimenta, AD 1739 (Modified copy of the Rudimenta made by Péter Bod): Musnai 1936: 229–233; Ferenczi, G. 1997: 56–57; Hosszú 2013a: 248.

Bodrog-Alsóbű (Bodrog-Alsóbű clay twyer fragment, Alsóbű is a Farmstead, which is part of Bodrog Village [Somogy County, Hungary]), around AD 900 (Vékony 2004a: 38) or first half of 10th c. AD (Gömöri, J. 2000b: 171): Magyar 1999; Gömöri, J. 1999; Gömöri, J. & Magyar 1999: 299; Vékony 1999a: 226–229; Vékony 1999b: 30–31; Vékony 1999c: 36–47; Fodor 1999a: 32; Vékony 1999b; Magyar 2000: 115–161; Erdélyi 2000: 93; Gömöri, J. 2000b: 165, 167–171, 189; Vékony 2000: 219–225; Márton 2000: 227–228; Magyar 2001; Vékony 2004a: 25–45; Ráduly 2008a: 5–7; Hosszú 2012a: 188; Hosszú 2013a: 203–204; Ráduly 2013c: Part 1; Hosszú 2013b: 57–58; Hosszú & Zelliger 2014b: 417–431; Sándor 2017: 191–193; Fehér 2019a: 20, Footnote 10; Szentgyörgyi 2019: 38–40; Zelliger 2019b: 13–14; Fehér 2020b: 168–170; Hosszú & Zelliger 2020: 61–63; Szentgyörgyi 2020: 267–269; Zelliger 2020: 316–317. In connection with this script relic, it should be noted that according to J. Gömöri, in Pannonia, the first iron smelting plants appeared in the second half of 7th c. AD (Gömöri, J. 2000a: 350).

Bonyhai's Alphabet (Alphabet written by Mihály Bonyhai Moga), AD 1627: Benkő, E. 1996a: 52–64; Benkő, E. 1996b: 33; Hosszú 2013a: 238–240; Hosszú 2013b: 79–80; Sándor 2014a: 250, 255–256.

Bonyhai's Example (Example sentence maybe written by Mihály Bonyhai Moga), ca. AD 1627: Benkő, E. 1996a: 52–64; Benkő, E. 1996b: 33; Hosszú 2013a: 238–240; Hosszú 2013b: 79–80; Sándor 2014a: 250, 255–256.

Bonyhai's Christmas inscription (Inscription of Mihály Bonyhai Moga before Christmas), AD 1629: Benkő, E. 1996a: 52–64; Benkő, E. 1996b: 33; Hosszú 2013a: 238; Hosszú 2013b: 79–80; Sándor 2014a: 252.

Bögöz (Fresco inscription of Bögöz [Romanian: Mugeni in Harghita County, Romania]), end of 15th – beginning of 16th c. AD: Szigethy 1930: 368–369; Jakubovich 1931: 81–84; Németh 1934: 8–11; Pálffi 1934: 222; Csallány 1960: 70; Püspöki Nagy 1972–1974: 43; Kósa 1983: 85, 88; Vékony 1985a: 80; Benkő, E. 1994a: 162, 165; Erdélyi & Ráduly 2010: 102; Hosszú 2013a: 233; Hosszú 2013b: 70–71; Fehér 2020b: 244–247.

Constantinople (Constantinople inscription, Istanbul inscription), AD 1515: Babinger 1913: 129–139; Sebestyén 1913: 139–146; Babinger 1914: 41–52; Sebestyén 1915: 69–81; Sebestyén 1915: 69–81; Németh 1934: 9–10, Appendix II; Pálffi 1934: 222; Pais 1935; Csallány 1972: 141; Vékony 1985a: 80; Róna-Tas 1985–1986: 178–179; Vékony 2004a: 22; Ráduly 2007a; Horváth 2007; Erdélyi & Ráduly 2010: 106–107; Hosszú 2013a: 230–232; Hosszú 2013b: 72–74; Zelliger & Hosszú 2014: 89–124; Hosszú 2017: 239–240; Fehér 2020b: 320–326. In 1515 in Constantinople (Turkish: Istanbul [Turkey]), Tamás Kidei Székely, member of the Hungarian delegation wrote an SHR inscription on the wall of the Ambassadors' House. Between 1553 and 1555, the numismatist and epigraphist Hans Dernschwam discovered and copied it; later the building was destroyed in an accidental fire. The writing direction of the inscription is LTR.

Csíkszentmihály (Inscription in the oratory of the earlier Christian church of Csíkszentmihály [Romanian: Mihăileni in Harghita County, Romania]. It was discovered and copied in the 18th c.; however, the original inscription was destroyed due to rebuilding. Incorrect names of the relic: Csíkszentmárton inscription, Csíkszentmiklós inscription), AD 1501: Kunits 1731; Dezsericzky 1753: 154–155; Szabó, K. 1866a: 134–139; Szabó, K. 1866b: 107–115 and Appendix; Réthy 1888: 57; Sebestyén 1904c: 343–354; Sebestyén 1915: 57–68; Németh 1932d: 434–436; Németh 1934; Csallány 1960: 71–76; Püspöki Nagy 1972–1974: 38–43; Ferenczi, G. & Ferenczi, I. 1979: 24–25; Vékony 1985a: 80; Ráduly 1997a: 4; Ráduly 1997b: d; Ráduly 1998a: 7–9.; Libisch 2004; Ráduly 2004: 45–48; Erdélyi & Ráduly 2010: 80–81; Hosszú 2013a: 229–230; Ráduly 2013c: Part 2; Ráduly 2015b: 32–33; Hosszú 2013b: 71–72; Fehér 2020b: 291–295.

Csulai (Entry of György Csulai into the peregrination album [dating book] of István Miskolczi Csulyak), AD 1644: Jakó 1972; Benkő, E. 1994c; Zsupos 2019b: 56.

Dálnok (Wall inscription of the Calvinist church of Dálnok [Romanian: Dalnic in Covasna County, Romania]), AD 1526: Ferenczi, G. & Ferenczi, I. 1978; Kónya 1978; Ferenczi, G. 1992: 56; Benkő, E. 1981: 138–145; Mike & Kósa 1981: 214–218; Benkő, E. 1994a: 162–166; Vékony 1987a: 19; Erdélyi & Ráduly 2010: 82–83; Hosszú 2013a: 232–233; Hosszú 2013b: 74–75; Fehér 2020b: 300–303.

Dési (Alphabets and ligatures of Dési), AD 1753: Sebestyén 1904c: 414–417; Sebestyén 1915: 117; Hosszú 2013a: 248–249.

Dobai (Alphabet of István Dobai), AD 1753: Sebestyén 1904c: 415–417; Sebestyén 1915: 117; Hosszú 2013a: 248–249; Zsupos 2019b: 67.

Énlaka (Énlaka inscription [Romanian: Inlăceni in Harghita County, Romania]), AD 1668: Orbán 1864; Szabó, K. 1864; Szabó, K. 1866b: 115–117 and Appendix; Réthy 1888: 57; Sebestyén 1904c: 390–396; Sebestyén 1915: 118–119; Németh 1934; Pálffi 1934: 217–221; Ferenczi 1935: 5; Ferenczi 1936: 5–6, 25–26, 28, 62, 77; Ferenczi, G. 1971; Ferenczi, G. 1971–1972; Püspöki Nagy 1972–1974: 43–44; Ferenczi, G. & Ferenczi, I. 1979: 28; Vékony 1985a: 80; Ferenczi, G. 1994b: 73; Ráduly 2008c: 14–15; Erdélyi & Ráduly 2010: 95; Ráduly 2011: 41–45; Hosszú 2013a: 242–243; Hosszú 2013b: 81–82; Fehér 2020b: 344–350.

Erdőszentgyörgy (Stone inscription in the Calvinistic church of Erdőszentgyörgy [Romanian: Sângeorgiu de Pădure in Mureș County, Romania]), 13th–14th c. AD: Bözödi 1935; Ferenczi, G. & Ferenczi, I. 1979: 29–30; Ráduly 1998a: 54–55 and 90; Ráduly 2004: 98–99; Ráduly 2007b: 3; Ráduly 2007c: 9; Erdélyi & Ráduly 2010: 84; Ráduly 2011: 15–23; Ráduly 2013b; Hosszú 2013b: 62–63; Szentgyörgyi 2019: 40–41; Fehér 2020b: 229–231; Zelliger 2020: 319–320.

Farkaslaki (Note of Mátyás Farkaslaki in the book Jacobus Gretser *Institutionum…*), AD 1624: Dankanits 1970: 378–379; Vásáry 1974: 166; Tubay 2015b: 201–202.

Gelence (Fresco inscription of Gelence [Romanian: Ghelinţa in Covasna County, Romania]), AD 1497: Kónya 1994: 4; Sándor 1996: 80–82; Horváth et al. 2011: 77; Hosszú 2013a: 215; Tubay 2018: 126; Fehér 2020b: 288–289.

Gönczi (Note in the book György Gönczi *De disciplina ecclesiastica,* Debrecen [Hungary], 1613), around AD 1680: Sebestyén 1904c: 400–401; Sebestyén 1915: 112.

Gyulafehérvár (SHR inscriptions written by the steward of the college of the Transylvanian princes Gábor Bethlen and György Rákóczi II in Gyulafehérvár [Romanian: Alba Iulia in Alba County, Romania]), AD 1655: Csallány 1960: 99–100; Hosszú 2013a: 241–242; Hosszú 2013b: 82–83.

Hickes (*Antiqua Hunnorum Elementa,* Alphabet published by George Hickes): Hickes 1705: Præf. pag. VIII, Fig. VII; Fischer 1889: 19; Sebestyén 1904c: 399–400; Sebestyén 1915: 112; Gömöri, G. 2004: 344–345; Libisch 2004; Hosszú 2013a: 245. This alphabet presumably comes from János Harsányi. Further publications are presumably related to Hickes or Harsányi: Hensel 1741: colour map *"Europa Polyglotta, Linguarum Genealogiam exhibens, una cum Literis, scribendique modis, omnium gentium"* (*Hunnorum Elementa,* Alphabet published by Gottfried Hensel); Fournier 1766: 209 (*Alphabete des Huns,* Alphabet published by Pierre-Simon Fournier) and Fry 1799: 152 (*Huns,* Alphabet published by Edmund Fry).

Homoródkarácsonyfalva stone inscription (Stone inscription of the Unitarian Church of Homoródkarácsonyfalva [Romanian: Crăciune in Harghita County, Romania]), around 13th c. AD:

Németh 1945; Püspöki Nagy 1972–1974: 47–48; Ferenczi, G. 1979: 273–281; Ferenczi, G. & Ferenczi, I. 1979: 19; Vékony 1985a: 79; Benkő, E. 1996b: 31–33; Györffy & Harmatta 1997: 152; Ráduly 1998a: 62, 94–95; Ráduly 1998b: 8; Ráduly 2003b: B, D; Vékony 2004a: 9–16, 111–114; Ráduly 2007d: 30; Ráduly 2008a: 20–23; Erdélyi & Ráduly 2010: 88–89; Ráduly 2011: 11; Hosszú 2013a: 206–208; Ráduly 2013c: Part 1; Hosszú 2013b: 61–62; Sándor 2013; Sándor 2014a: 177–179; Ráduly 2015a; Ráduly 2015d: 6–31; Róna-Tas 2017: 12; Fehér 2020b: 224–226; Zelliger 2020: 320.

Homoródkarácsonyfalva wall inscription (Wall inscription of the Unitarian Church of Homoródkarácsonyfalva [Romanian: Crăciune in Harghita County, Romania]), 1625: Ráduly 2006: 16; Mihály 2007: 4–5; Ráduly 2008a: 27–31; Hosszú 2013a: 206–208; Fehér 2020b: 343–344.

Huszti (Entry of Zsigmond Huszti N. into the peregrination album [dating book] of István Miskolci Csulyak), AD 1715: Jakó 1971: 65; Benkő, E. 1994c: 81–82 and image without page numbering.

Kájoni's Ancient (Ancient Alphabet of János Kájoni and two sentences with SHR written by Kájoni), AD 1673: Sebestyén 1904c: 396–399; Sebestyén 1915: 124–126; Vékony 1992b: 289; Vékony 2004a: 103–115; Hosszú 2013a: 243–244; Hosszú 2013b: 83–84. According to Vékony, the Kájoni's Ancient could be a copy of an alphabet dates back to 13th c. AD (Vékony 2004a: 106).

Kájoni's Rudimenta-like (Alphabet of János Kájoni based on Thelegdi's Rudimenta and example texts with SHR written by Kájoni), AD 1673: Sebestyén 1915: 124–126; Hosszú 2013a: 244–245.

Marsigli's Alphabet (SHR alphabet found in the manuscript of Luigi Ferdinando Marsigli near the copy of the Stick Calendar, Alphabet of Bologna), AD 1690: Beliczay 1881; Veress 1906 apud Sebestyén 1915: 35–56; Németh 1934: Appendix II; Sándor 1991; Hosszú 2013a: 215–219; Hosszú 2013b: 67–68; Sándor 2014a: 219; Szentgyörgyi 2019: 42; Fehér 2020b: 263–281.

Miskolci Csulyak, Gáspár (Gáspár Miskolci Csulyak's memory script), AD 1654: Sebestyén 1904c: 389–390; Jakubovich 1935; Hosszú 2013a: 240–241; Hosszú 2013b: 81; Zsupos 2019b: 53.

Miskolci Csulyak, István (Two alphabets of István Miskolci Csulyak), AD 1610–1645: Jakubovich 1935; Horváth et al. 2011: 78–80; Hosszú 2013a: 240–241; Hosszú 2013b: 81; Tubay 2015b: 201; Zsupos 2019b: 53, 56.

Nikolsburg (Nikolsburg Alphabet), AD 1490–1526: Németh 1934; Jakubovich 1935: 1–17; Dán 1964; Csallány 1972: 138–141; Vékony 1985a: 79; Róna-Tas 1985–1986: 174–178; Vékony 1987a: 20; Vékony 1993: 783–796; Róna-Tas 1995; Máté 2001: 186–192; Vékony 2004a: 95–96; Horváth et al. 2011; Szelp 2011: 407–428; Hosszú 2013a: 210–214; Hosszú 2013b: 65–66; Sándor 2014b: 330–332; Tubay 2015b: 140–141; Hosszú 2017: 239–240; Szentgyörgyi 2019: 42; Fehér 2020b: 281–285; Zelliger 2020: 319. The alphabet and example text was written by Philipus de Penczicz; the inscription survived in a book in Nikolsburg [Czech: Mikulov in South Moravian Region, Czechia].

Oertel's Alphabet, AD 1719: Sebestyén 1904c: 408–410.

Oertel's Album Entry, AD 1751: Sebestyén 1904c: 409–411.

Patakfalvi (Patakfalvi-Bible), AD 1776–1785: Tisza et al. 2009; Unitarian knowledge base: Sámuel Patakfalvi. http://unitarius.eu/Patakfalvi-Biblia/index.htm, retrieved in 2014; Hosszú 2010b; Hosszú 2013a: 250–251; Hosszú 2013b: 85–87. Handwritten two-page long SHR inscription of the Bible has been owned by the Patakfalvi family for centuries. Some interesting features of this SHR inscription: (i) The style of the glyphs is identical to the style of the Nikolsburg Alphabet (see above). (ii) There are special glyph variants of the usual SHR 𐳀 <a> (SFG-1), Ꭴ, Ӿ <Ẅ> (SFG-7), ϟ, ≳ <Ẅ> (SFG-35) and ˥ <t> (SFG-104) in this relic: 𐲀 <a>, ∝ <Ẅ> /ü/, ⋝ <Ẅ> /ö/ and \| <t>, respectively. (iii) The sound value of the 𐲀 <a> only (short) /ɔ/, and its duplication represents the (long) /ā/, cf. Table 7-8. (iv) This script relic is generally independent of the Rudimenta tradition. (v) It distinguishes between the Hungarian sounds /ä/ and /ē/: 𐲉 <e> /ä/ (SFG-11) and ‐ <é> /ē/ (SFG-12), similarly to the orthographies of other SHR relics in the 18th c. AD. (vi) The line order of this inscription is bottom-up advanced.

Rettegi (Alphabet of István Rettegi), AD 1710: Sebestyén 1904c: 411–414; Sebestyén 1915: 84–85.

Rudimenta-Giessen (The earliest copy of the Rudimenta found in Giessen), AD 1598: Thelegdi /1598; Réthy 1888: 57; Sebestyén 1904c: 354–387; Sebestyén 1915: 91–106, Appendix XVII; Németh 1934; Kósa 1983: 89; Vékony 1985a: 77; Róna-Tas 1985–1986: 173–174; Sándor 1991; Horváth 2007; Hosszú 2013a: 233–236; Hosszú 2013b: 75–76; Hosszú 2013c: 98–99; Zsupos 2019b: 67. The complete name of the short monograph is *Rudimenta Priscae Hunnorum linguae* 'Elements of the old language of the Huns'. The monograph greatly influenced pen-written SHR writing. Its author, Ioannis Thelegdi discussed the orthographic rules of SHR. The book was distributed as a manuscript, of which several copies survived.

Rugonfalva (Rugonfalva inscription [Romanian: Rugănești in Harghita County, Romania]), 16th–17th c. AD: Benkő, E. 1991: 20; Ferenczi, G. 1992: 57–58; Ferenczi, G. 1994b: 78; Benkő, E. 1994a: 165; Ferenczi, G. 1997: 21–22; Benkő, E. 1997: 181–182; Ráduly 1998a: 98; Ráduly 2003a: 4; Ráduly 2008a: 64–66; Hosszú 2013b: 77–78; Hosszú & Zelliger 2013; Fehér 2020b: 313–315.

Stick Calendar (Copy of an SHR calendar found in the manuscript of Luigi Ferdinando Marsigli, Bologna Rovash relic), ca. 15th c. AD surviving in a 17th c. copy: Beliczay 1881; Veress 1906 apud Sebestyén 1915: 35–56; Ligeti 1925: 50, 52; Németh 1934: 17; Ferenczi, G. & Ferenczi, I. 1979: 15; Kósa 1983: 84–98; Vékony 1985a: 80; Vékony 1987a: 289; Sándor 1989–1990: 70; Sándor 1991; Vékony 1992b: 289; Forrai 1994: 137–248; Vékony 1997b: 1334; Vékony 2002: 196; Vékony 2004a: 96, 104–108; Hosszú 2013a: 215–229; Hosszú 2013b: 67–69; Sándor 2014a: 219; Sándor 2014b: 332–333; Fehér 2020b: 262–281; Zelliger 2020: 321.

Szamosközy's Note (Note of István Szamosközy regarding to the year 1587), before AD 1593: Szilágyi 1880: 18 apud Sebestyén 1915: 82–83, 88–89; Vékony 1985a: 80; Horváth et al. 2011: 78–84; Fehér 2020b: 308–309.

Szamosközy's Poem (Pasquinade of István Szamosközy against Emperor Rudolf II), AD 1604: Szilágyi 1880: 216 apud Sebestyén 1915: 82–83, 87–90, Appendix XII; Horváth et al. 2011: 78–83; Hosszú 2013a: 237; Fehér 2019b: 124–127; Fehér 2020b: 315–318.

Szegedi (Alphabet of Zsigmond Szegedi), AD 1655: Zsupos 2015: 29–44; Zsupos 2019b: 53, 56, 66.

Székelydálya (It is only partly deciphered; in the analysis, the glyphs of only those parts of the inscription are used, which are reliably deciphered; Székelydálya in Romanian: Daia [Harghita County, Romania]), around AD 1400: Ferenczi, G. 1994b; Benkő, E. 1996b: 31–33; Benkő, E. 1996c: 75–80; Györffy & Harmatta 1997: 152; Ráduly 2000a: 5; Ráduly 2000b: 4; Erdélyi & Ráduly 2010: 94; Hosszú 2013a: 192, 208–209; Hosszú 2013b: 63–64; Sándor 2013; Sándor 2014a: 181–183; Fehér 2020b: 252–259; Szentgyörgyi 2020: 266–267; Zelliger 2020: 316–317.

Székelyderzs (Brick inscription of Székelyderzs [Romanian: Dârjiu in Harghita County, Romania]), AD 1490s: Jakubovich 1932: 264–274; Pais 1932; Németh 1934: 4–6, Appendix V; Csallány 1960: 39; Püspöki Nagy 1972–1974: 37–38; Ferenczi, G. & Ferenczi, I. 1979: 15–18, Image 18; Kósa 1983: 85, 95; Vékony 1985a: 79; Benkő, E. 1994a: 157–168; Benkő, E. 1997: 180; Ráduly 2004: 36–39; Erdélyi & Ráduly 2010: 98–99; Ráduly 2013c: Part 1; Hosszú 2013a: 209–210; Hosszú 2013b: 69–70; Szentgyörgyi 2019: 42; Fehér 2020b: 285–287.

Szentpéteri (Alphabet of János Szentpéteri B. [Hodor]), AD 1699–1702: Zsupos 2019a: 2–28, 43, Image 15.

Vargyas (Baptismal font of Vargyas [Romanian: Vârghiș in Covasna County, Romania]), 12th–13th c. AD: Benkő, E. 1994b: 487–489; Ferenczi, G. 1994a: C; Ferenczi, G. 1994c: 148; B. Kovács 1994: 1; Kósa 1994: 153–155; Ráduly 1994: C; Bartók 1995: 145; Ráduly 1995a: 79–95; Benkő, E. 1996b: 31–33; Benkő, E. 1996c: 79; Vékony 2004a: 13–24; Kósa 2008: 73–80; Erdélyi & Ráduly 2010: 64; Ráduly 2011: 29; Hosszú 2013a: 204–206; Hosszú 2013b: 58–61; Hosszú 2013c: 97–98; Ráduly 2013c: Part 1; Sándor 2013; Sándor 2014a: 179–181; Ráduly 2015c; Zelliger 2016: 92–98; Hosszú 2017: 238–239; Szentgyörgyi 2019: 43–47; Fehér 2020b: 226–229; Zelliger 2020: 318.

Wolfenbüttel (Surviving inscriptions in the handwritten florilegium of August the Younger, Duke of Brunswick-Lüneburg, Prince of Braunschweig-Wolfenbüttel, the library he founded was in Wolfenbüttel [Lower Saxony State, Germany]), AD 1592–1666: Förköli & Tubay 2015: 443–453; Förköli & Tubay 2017: 89–98.

Table 8-31: Examples of Carpathian Basin Rovash (CBR) inscriptions

Békés-Povádzug (Bone covers of a bow from Békés-Povádzug [Békés County, Hungary]), the second half of 11th – the beginning of 12th c. AD: Archaeological description: Trogmayer 1962: 9–38; Dienes 1962: 95–109, Figure 36. Age determination: Szenthe, Gergely: Personal communication, 2012 apud Hosszú 2013a: 163. There are two inscriptions; each of them contains only one graph: ᛦ and ᛦ. Deciphering: Csallány 1972: 136–137; Vékony 1987a: 106–107; Vékony 2004a: 110–111, 214–216; Erdélyi & Ráduly 2010: 48; Vásáry, István: Personal communication, 2010–2011 apud Hosszú 2013a: 163–164; Danka, Balázs: Personal communication, 2013 apud Hosszú 2013a: 163; Hosszú 2013b: 41; Fehér 2020b: 171–173. The graphs survived on bone covers, and Vékony's reading is $/^{o/u}\chi/$ 'shoot!'. This is following the fact that each graph is on a bone plate since they can be seen as a magical wish to ensure the smooth use of the bow. Based on this, the graphs presumably mean a grapheme and not tamga. Maybe they belong to CBR (Vékony 2004a: 110–111); but Vékony did not rule out that they belonged to SR (Vékony 2004a: 214).

Jánoshida (Needle case of Jánoshida, found in Jánoshida-Tótkéripuszta [Jász-Nagykun-Szolnok County, Hungary], grave 228), last third of 7th c. AD: László 1941: 186; Erdélyi 1958a: 39, Table XLIV/2; Erdélyi 1958b: 59–61; Erdélyi 1961: 279–280; Csallány 1968: 302–303; Vásáry 1972: 337–338; Harmatta 1983: 71–84; Vékony 1985a: 166–168; Vékony 1987a: 74–76; Vékony 1987b: 249–251; Vékony 2004a: 182–191; Erdélyi & Ráduly 2010: 20–21; Hosszú 2013a: 141–142; Hosszú 2013b: 30; Ünal 2013: 173–182; Fehér 2020a: 112, 117–120, 123–136, 577–578, 626–627; Fehér 2020b: 104–106.

Kiskőrös-Vágóhíd (Silver chalice of Kiskőrös-Vágóhíd [Vágóhíd-dűlő, part of Kiskőrös in Bács-Kiskun County, Hungary]), last third of 7th c. AD: László 1955: 160–161; Vásáry 1972: 344, 347; Garam 1976: 143–144; Harmatta 1984b: 278–280; Vékony 1987a: 87; Vékony 2004a: 203; Erdélyi & Ráduly 2010: 32; Hosszú 2013a: 142–143; Fehér 2020b: 92–94.

Kiskundorozsma (Bone plates for the grip of a bow of Kiskundorozsma [today part of Szeged city in Csongrád County, Hungary]), end or the last third of 8th c. AD: Szalontai & Károly 2019; Szalontai et al. 2014; Sándor 2017: 188–189; Hosszú & Zelliger 2019; Fehér 2020b: 111–112.

Környe (Bone plates for the grip of a bow of Környe [Komárom-Esztergon County, Hungary]), end of 7th c. AD: Erdélyi 1969: 209–210; Salamon & Erdélyi 1971: 51–52, 145, Tafel XXVIII; Csallány 1972: 152–153, Table XIX; Vásáry 1972: 139; Erdélyi 1982: 183, 209; Harmatta 1984a: 100–113; Vékony 1985b: 1141; Vékony 1987a: 89–92; Vékony 2004a: 203–207; Hosszú 2013a: 139–140; Hosszú 2013b: 28–29; Fehér 2020b: 81–83. The inscription is [illegible], Vékony's transliteration is <tγ γt lβld ńll ln>; his transcription is /t^{i}γ ^{i}γ^{å}t l^{e}β^{e}ld ń^{i}l^{å}l ^{ä}l^{ä}n/, its meaning: 'Shoot [the] arrow with [the] bow against [him]!'. The text is an early Hungarian magical text for ensuring the successful operation of the bow. Vékony's transcription was improved by Zelliger (Zelliger, Erzsébet: Personal communication, 2011–2011). The graphs of the inscription are significantly distorted.

Kunágota (Silver jug of Kunágota [Békés County, Hungary]), beginning of 7th c. AD: Garam 1976; Bóna 1984b: 140; Harmatta 1984b: 273–277; Vékony 1985b: 1141; Vékony 1987a: 85; Vékony 1987b: 253–254; Vékony 2004a: 197; Hosszú 2013a: 143–144; Fehér 2020b: 81.

Nagyszentmiklós (Golden treasure of Nagyszentmiklós [Romanian: Sânnicolau Mare in Timiş County, Romania]), 8th–11th c. AD: Hampel 1884; Hampel 1905; Mészáros 1915; Németh 1932a; Németh 1932b; Németh 1932c; Csallány 1967; Erdélyi & Pataky 1968; Németh 1971: 1–37; László & Rácz 1977; Bóna 1984a; Bóna 1984b; Róna-Tas 1985a: 96–97; Róna-Tas 1985b: 238–245; Vékony 1985a: 147–153; Erdélyi 1986; Vékony 1987a: 31–55, 118–123; Vékony 1987b: 211–233; Trugly 1991; Göbl & Róna-Tas 1995; Róna-Tas 1996a; Bálint 2002: 3–7; Garam 2002a; Kovács 2002; Bálint 2004; Erdélyi 2004b: 165; Vékony 2004a: 126–157; Vékony 2004c: 140; Erdélyi 2005; Trugly 2008; Bálint 2010; Erdélyi & Ráduly 2010: 35–44; Hosszú 2013a: 151–162; Hosszú 2013b: 34–39; Hosszú & Zelliger 2014a; Hosszú 2017: 237–238; Sándor 2017: 188; Zelliger 2019b: 10–25; Fehér 2020b: 125–153. It is worth noting that each pieces of the collection was made in different ages in the period of 8th–11th c. However, the inscription on the Bowl No. 8 was surely made during its manufacturing, and its style is clearly from the 8th c. AD; therefore, its inscription can be dated to that age.

Ozora-Tótipuszta (Silver vessel of Ozora-Tótipuszta [Tolna County, Hungary]), last third of 7th c. AD: Vásáry 1972: 343–344; Harmatta 1984b: 280–283; Vékony 1985b: 1141; Vékony 1987a: 81–84; Vékony 1987b: 252–254; Szádeczky-Kardoss 1990: 206–228, 452–457; Garam & Kiss 1992: 18; Róna-Tas 1996a: 108; Szádeczky-Kardoss 1998; Vékony 2004a: 192–196; Erdélyi & Ráduly 2010: 22; Hosszú 2013a: 140–141; Hosszú 2013b: 30; Fehér 2020b: 98–99.

Szarvas (Needle Case of Szarvas [Békés County, Hungary]), first half of 8th c. AD: Juhász 1983: 373–377; Juhász 1985: 92–95; Róna-Tas 1985a: 95–98; Róna-Tas 1985b: 225–248; Vékony 1985a: 153–166; Vékony 1985b: 1133–1140; Róna-Tas 1986a: 35–37; Róna-Tas 1986b: 70–71; Vékony 1987a: 56–73; Vékony 1987b: 234–248, 254–255; Harmatta 1990: 256–259; Róna-Tas 1990: 1–30; Róna-Tas 1996a: 110; Györffy & Harmatta 1997: 154; Vékony 1997b: 1328–1329; Róna-Tas 1999a: 132; Garam 2002b: 109; Vásáry 2003: 137; Vékony 2004a: 158–181; Erdélyi & Ráduly 2010: 27–29; Hosszú 2013a: 147–150; Hosszú 2013b: 32–34; Hosszú 2013c: 94–97; Sándor 2017: 188; Fehér 2020a: 111–117, 130–135; Fehér 2020b: 112–115.

Table 8-32: Examples of Steppe Rovash (SR) inscriptions

Achik-Tash (деревянная палочка с рунами [Malov 1936: 28], Talas VII, Achiktash, Ačïqtaš, wooden stick ["Pecheneg ladder"] from Ačyq-Taš [Tryjarski 1997: 366], wooden stick from the Talas

Valley, ачикташская [таласская] палочка [Kyzlasov, I. L. 1994: 279]; Achik-Tash is in Talas Valley [Kyrgyzstan]), 8th c. AD: Malov 1936: 28–38; Turčaninov 1971: 89–96, XXVII–XXVIII, Табл. XXXIX; Németh 1971: 41–42, 51; Harmatta 1984b: 276; Vékony 1987a: 28–29; Tryjarski 1997: 366; Vékony 2004a: 285–297, 314–315, column 9; Vékony 2004b apud Hosszú 2013a: 174–175.

Devitsa (Devitsa [Девица in Voronezh Oblast, Russia] Coins, Devitsa Hoard), AD 754 – ca. 820/821 (Bykov 1971: 27, 33): Bykov 1971: 26–35; Bálint 1980: 384; Bálint 1981: 410; Ludwig 1982: 274; Vékony 1987a: 28; Shake 2000: 35–36; Kovalev 2004: 113; Hosszú 2013a: 173–174. There is a graph on the Type VIII of the Devitsa dirham coins. It was supposed a tamga; however, according to Vékony, it is a ligature, and its meaning is *Ishad* /išaδ/, the alternate name of the vice-khagan *Ilik* of the Khazar Khaganate (Vékony 1987a: 28). According to him, this ensured the officiality of the coins. According to Golden, *Ishad* is a version of an Iranian dignitary name (Golden 1980: 206–208). Cf. Table 8-28.

Homokmégy-Halom (Quiver inscription of Homokmégy-Halom, Inscription on a bone-plate covering a quiver from the grave No. 6 of a cemetery dating to the period of the Settlement of the Magyars in Hungary in Homokmégy-Halom [Bács-Kiskun County, Hungary]), 10th c. AD: Dienes 1972: 67; Vasil'ev 1983; Dienes 1992a: 537–541; Dienes 1992b: 31–40, 39; Vasziljev 1992: 547–548; Vékony 1992a: 542–545; Vékony 1992d: 42; Vasil'ev 1994: 190 apud Sándor 2017: 190–191; Györffy & Harmatta 1997: 153–155; Vékony 2004a: 50, 56–59, 108–109, 116–117, 121–123; Erdélyi & Ráduly 2010: 49; Hosszú 2013a: 131–132; Hosszú 2013b: 25; Sándor 2017: 189–191; Fehér 2020b: 174–176. Vasil'ev deciphered the middle part of the Homokmégy-Halom inscription with the Yenisey variant of TR (Vasil'ev 1983; Vasziljev 1992: 547–548; Vasil'ev 1994: 190 apud Sándor 2017: 190–191). However, the reading of Vasil'ev limited to only 5 of the 11 graphs of the inscription. Oppositely, the reading of Vékony covers the whole inscription: ǀX ⟩'¦'⅄ϑǀ '¦'ΛⵝᐳǀX /^{o}noql^{ï}ġ s^{a}γd^{a}ġ^{ï}n b^{a}s/ or /^{o}noql^{ï}ġ s^{a}γt^{a}ġ^{ï}n b^{a}s/ 'Triumph with [a] quiver of ten arrows.' (Vékony 1992a: 542–545; Vékony 1992d: 42; Vékony 2004a: 50–59). Vékony's reading was improved by Vásáry (Vásáry, István: Personal communication, 2010–2011) and Danka (Danka, Balázs: Personal communication, 2013). Therefore, the latter is used in the phenetic analysis. Vékony supposes a Turkic word *saγdaġ* or *saγtaġ* with the meaning 'quiver' as the reading of the middle part of the inscription '¦'⅄ϑǀ. Vékony's examples: Chagatai *saγdaq,* Mongolian *saγadaγ* (Vékony 2004a: 53–54). According to this word, Kincses Nagy's examples: Mongolian *saġadaġ,* Chagatai *saġadaġ, saġdaġ, sadaġ,* Karaim, Turki, Turkmen, Uyghur *saġdaq,* Taranchi *sāġidaq,* Yellow Uyghur *saġadaq, saġataq, saġïdaq, saγadaq, saγataq, saγïdaq* (Kincses Nagy 2009: 168–169). Vékony thinks that it is possible to read *saγtaġ* instead of *saγdaġ* so that graph ⅄ would match TR ɦ <t^{2}> (SFG-103) (Vékony 2004a: 59). Thus, based on the readings /saγtaġïn/ or /saγdaġïn/, the sound value of SR ⅄ <d/t> (SFG-103) cannot be determined to be /d/ or /t/. According to Vásáry, the language of the inscription could be either Common Turkic or Ogur (Vásáry, István: Personal communication, 2010–2011).

Jitkov (Bow Cover of Jitkov [Rostov Oblast, Russia]), 8th c. AD: Semenov 1988: 108–109; Kyzlasov, I. L. 1994: 275–276; Vékony 2004a: 122; Vékony 2004b apud Hosszú 2013a: 173. In 1986, Y. I. Bespalyi found a horn cover for a bow with a Rovash inscription in burial No. 1 of kurgan No. 4 on the field Jitkov II in the Rostov region (Rostovskaya oblast) (Semenov 1988: 109).

Kermen Tolga (Cuttle skull of Kermen Tolga, Bull skull of Elista [Kalmykia, Russia]), 8th–10th c. AD: Vásáry 1974: 170; Klyashtorny & Vásáry 1987: 171–179; Vékony 1987c: 379; Kyzlasov, I. L. 1990: рис. 13, 14, 42–47; Erdélyi 1991: 150–153; Kyzlasov, I. L. 1994: 251–252; Vékony 1997a: inside the cover; Vékony 2004a: 314–315, column 8; Vékony 2004b apud Hosszú 2013a: 185–187; Danka, Balázs: Personal communication, 2013.

Khumara-1 (No. 1 inscription of Khumara [Kyzlasov, I. L. 1994: 19, 269], a fragmentary inscription from Khumara Fortress, One-row Ogur inscription of Khumara [Hosszú 2013a: 175]; Khumara is in Karachay-Cherkessia [Russia]), the second half of 9th – beginning of 10th c. AD: Ščerbak 1962: 283, Fig. 1; Kuznecov 1963: 300, рис. 1; Németh 1971: 44–47; Vékony 2004a: 314–315, column 5; Vékony 2004b apud Hosszú 2013a: 175–176. Khumara is a former Khazar castle on the right bank of the Kuban River. It has no reliable reading; therefore, it is not included in the present analysis.

Khumara-6 (No. 6 inscription of Khumara [Kyzlasov, I. L. 1994: 19, 270], Three-row inscription of Khumara [Hosszú 2013b: 43–44]; Khumara is in Karachay-Cherkessia [Russia]), mid-9th – beginning of 10th c. AD: Kuznecov 1963: 301, рис. 2; Gadlo 1979: 152–153; Erdélyi 1983: 264; Vékony 1987a: 27; Bajčorov 1989: табл.145-2; Vékony 2004a: 314–315, column 5; Vékony 2004b apud Hosszú 2013a: 177–178.

Khumara-7 (No. 7 inscription of Khumara [Kyzlasov, I. L. 1994: 19, 270], One-row inscription of Khumara [Hosszú 2013b: 43]; Khumara is in Karachay-Cherkessia [Russia]), middle of 9th – beginning of 10th c. AD: Bajčorov 1989: 67, 170–173, табл.142; Kuznecov 1963: 301, рис. 2; Vékony 1987a: 27; Vékony 2004a: 314–315, column 5; Vékony 2004b apud Hosszú 2013a: 176–177.

Khumara-8 (No. 8 inscription of Khumara [Kyzlasov, I. L. 1994: 19, 271], Two-row inscription of Khumara [Hosszú 2013a: 179]; Khumara is in Karachay-Cherkessia [Russia]), middle of 9th – beginning of 10th c. AD: Kuznecov 1963: 302, рис. 3; Bajčorov 1989: табл. 143; Vékony 2004b apud Hosszú 2013a: 178–179. The original relic was destroyed before the arrival of the archaeologists; only its copy made by the student A. D. Besleneev survived.

Kievan Letter, AD 955–961: It is disputed whether the letter was made in Kiev or addressed to Kiev (Zuckerman 2011). Vékony's opinion is that it was made in the Khazar capital, <k'rmn> *Kermen* according to Hebrew text of the Kievan Letter, and it was addressed to Kiev (Schwarzfuchs 1984: 432–434; Harmatta 1997a: 119–140). The letter, written in Hebrew, is reconfirmed by the *ilik,* the Khazar vice-king with a TR inscription (Vékony 1987a: 28). Generally, the variant *yilik* is known for the vice-king (Golden 1980: 162, 184–185), but Gombocz proved that the Arabic form *yilik* 'vice-king' can also be transcribed as *ilik* (Gombocz 1908: 22; Gombocz 1912; Gombocz 1915: 48). According to Róna-Tas, the Kievan Letter is from 955 to 961 for historical reasons (Róna-Tas 2001: 181). Pritsak and Ligeti tried to read supposing that Rovash inscription is written in TR (Golb & Pritsak 1982; Ligeti 1984: 10–17). Pritsak's reading was disputed by Erdal (Erdal 1999: 97). Pritsak's transcription of the inscription ⟩ᔑ ᑭ⟩ᓄ⟩ᕕ was /<u>ho</u>kurüm/, while Ligeti read *oqurïm* (Ligeti 1984: 13–14 apud Vékony 2004a: 276). However, the last (leftmost) graph of the inscription is far from being a normal TR 𐰢, 𐰢, 𐰢 <m> /m/ (SFG-67) letter (Erdal 1999: 97). Furthermore, the first (rightmost) graph of the inscription is only hypothetically taken to be the ligature of a Hebrew ה *hē* <h> (SFG-44) with TR ⟩ <W> /o, u/ (SFG-31) letter (Erdal 1999: 97). These difficulties make decipherings of Pritsak and Ligeti problematic. By contrast, Vékony's reading (/oγïδ<u>ïq</u> <u>il</u>ik/ 'We have read. Ilik') is based on the assumption that Rovash inscription was written with SR and not TR (Vékony 1985b: 1145; Vékony 1987a: 28; Vékony 1992e: 934–938; Vékony 2004a: 276–284; Hosszú 2013a: 187–189; Hosszú 2013b: 44). It should be noted that there is currently no full agreement on reading Rovash inscription on the Kievan Letter. It is worth noting that the word *illik* appears in a TR inscription in Tsetsüüh (Hayashi 2015: 46–54), see Table 8-29.

Mayaki (Mayaki Amphora; Mayaki is in Donetsk Oblast [Ukraina]), 8th–9th c. AD: Klyashtorny 1979: 270–275; Klyashtorny & Vásáry 1987: 172; Kyzlasov, I. L. 1994: 273, Photo K9 between the pages 288 and 289; Vékony 1987a: 27–28, 83; Vékony 2004a: 267–275, 314–315, column 3; Hosszú 2013a: 118–119; Hosszú 2013b: 21.

Mayatskoe-1 (Mayatskoe Gorodishche inscription No. 1 [Kyzlasov, I. L. 1994: 241–248]; Mayatskoe Gorodishche is in Voronezh Oblast [Russia]), 9^{th} c. AD: Makarenko 1911: 23, рис. 23; Turčaninov 1964: 78, рис. 9; Németh 1971: 43–46; Vásáry 1974: 170; Turčaninov 1990: 215, Табл. XIII.2 рис. 10; Erdélyi 1991: 150–153; Kyzlasov, I. L. 1994: 241–242, рис. Д1; Erdélyi 2004a: 76; Vékony 2004a: 297, 314–315, column 6; Vékony 2004b apud Hosszú 2013a: 182. Mayatskoe Gorodishche was a Khazar-age stone castle [Türk 2011: 59].

Mayatskoe-2 (Mayatskoe Gorodishche inscription No. 2 [Kyzlasov, I. L. 1994: 242]; Mayatskoe Gorodishche is in Voronezh Oblast [Russia]), 9^{th} c. AD: Makarenko 1911: 22, рис. 19, рис. 20; Turčaninov 1964: 75, рис. 4, 79, рис. 10; Turčaninov 1990: 214–215, Табл. XIII.1 рис. 3, Табл. XIII.2 рис. 12; Kyzlasov, I. L. 1994: 242; Vékony 2004a: 314–315, column 6; Vékony 2004b apud Hosszú 2013a: 122.

Mayatskoe-5 (Mayatskoe Gorodishche inscription No. 5 [Kyzlasov, I. L. 1994: 241–248]; Mayatskoe Gorodishche is in Voronezh Oblast [Russia]), 9^{th} c. AD: Makarenko 1911: 27, рис. 27; Turčaninov 1964: 75–76, рис. 7; Németh 1971: 43–46; Bajčorov 1989: табл. 120; Turčaninov 1990: 214, Табл. XIII.1 рис. 8; Erdélyi 1991: 150–153; Kyzlasov, I. L. 1994: 244; Erdélyi 2004a: 76; Vékony 2004a: 314–315, column 6; Vékony 2004b apud Hosszú 2013a: 184.

Mayatskoe-9 (Mayatskoe Gorodishche inscription No. 9 [Kyzlasov, I. L. 1994: 241–248]; Mayatskoe Gorodishche is in Voronezh Oblast [Russia]), 9^{th} c. AD: Turčaninov 1990: 215, Табл. XIII.2 рис. 10; Erdélyi 1991: 150–153; Kyzlasov, I. L. 1990: 18, рис. 5; Kyzlasov, I. L. 1994: 255–256; Erdélyi 2004a: 76; Vékony 2004a: 314–315, column 7; Vékony 2004b apud Hosszú 2013a: 179–181. Graphs of the short inscription are only partially visible and therefore omitted from the present analysis.

Mayatskoe-10 (Mayatskoe Gorodishche inscription No. 10 [Kyzlasov, I. L. 1994: 241–248]; Mayatskoe Gorodishche is in Voronezh Oblast [Russia]), 9^{th} c. AD: Turčaninov 1990: 215, Табл. XIII.2 рис. 10; Erdélyi 1991: 150–153; Kyzlasov, I. L. 1990: 18, 22, рис. 6; Kyzlasov, I. L. 1994: 256; Erdélyi 2004a: 76; Vékony 2004a: 314–315, column 7; Vékony 2004b apud Hosszú 2013a: 179–181.

Novocherkassk (inscription on a clay flask, Németh named Novocherkassk I flask; Novocherkassk is in Rostov Oblast [Russia]), 8^{th}–10^{th} c. AD: Artamonov 1954: 263–268; Turčaninov 1964: 73, рис. 1; Vásáry 1974: 170; Vékony 1985b: 1145; Vékony 1987a: 27; Bajčorov 1989: табл. 113; Németh 1971: 43–45, 51; Turčaninov 1990: 214, Табл. XIII.1 рис. 1; Kyzlasov, I. L. 1994: 248; Vékony 2004a: 243–252, 314–315, column 1; Vékony 2004c: 140; Hosszú 2013a: 120; Hosszú 2013b: 22. Vékony read the Novocherkassk inscription in Common Turkic, his reading: ʒՈYʕꟻ•>OЖY•>⋗•>OЖY•Y /a ^{i}šärm^{i}δ b^{i}δ ^{i}šärm^{i}δ voš$^{a/u}$d^{ï}n/ ‘Oh. Let us drink. We drink from [this] vosha.’ (Vékony 1987a: 27; Vékony 2004a: 250). However, in case of the Novocherkassk inscription, Vékony supposed that the drink name Yʕꟻ /voš$^{a/u}$/ was a Bulgar-Turkic loanword (Vékony 2004a: 250); therefore, he assumed the word-initial /v/. It is worth noting that /b/ was denoted by ⋗ <b^{2}> (SFG-14) in the Novocherkassk inscription.

Stanitsa Krivyanskoe (inscription on a clay flask, Németh named Novocherkassk II flask), 8^{th}–10^{th} c. AD: (Artamonov 1954: 263–268; Turčaninov 1964: 73, рис. 2; Turčaninov 1971: XVIII; Németh 1971: 43–46, 52; Bajčorov 1989: табл. 116; Turčaninov 1990: 214; Kyzlasov, I. L. 1994: 248–249; Vékony 2004a: 253–266; Vékony 2004c: 140). It has no reliable reading; therefore, it is not included into the present analysis.

8.5. Debated Rovash graphs

There are presumably Rovash graphemes whose sound values are not identified in the palaeographic literature. There were left out of the phenetic analysis. Some of them are listed in Table 8-33.

Table 8-33: Debated Rovash graphemes omitted from the present analysis

TR (T, Y) 𐰢, (T) 𐰭 (Kyzlasov, I. L. 1994: 71, 94, 118), 𐰶, (Kochkor, the first half of 8th c.) 𐱁 (Klyashtorny 2001: 203–206) <g^1> /γ/ (Kyzlasov, I. L. 2015: 199) or /ga/ (Kyzlasov, I. L. 1994: 117, 131) vs (Zhon-Aryk, Talas Valley, first half of 8th c.) 𐰭 (Alimov & Tabaldiev 2005: 121–125) <nč> /nč/ (Alimov 2015a: 38–40). The sound value of 𐰢, 𐰭, 𐰶, 𐱁, 𐰭 is still debated.
TR (Y) ⊗ (Kyzlasov, I. L. 1994: 118, 131): Clauson debated its existence (Clauson 1970: 72). Other opinions: /nt/ (Malov 1951: 17); *däm* (Tekin 2003: 23, but critics: Erdal 2004: 38); <d^2> (Erdal 2004: 38; de Rachewiltz & Rybatzki 2010: Fig. 2); <d^ä> or <^{e}d> (Kyzlasov, I. L. 1998: 80; Kyzlasov, I. L. 2015: 199); Erdal considers it as a variant of TR ✕ <d^2> (Erdal 2004: 38).
TR (Y) ⋈ (Vasil'ev 1983 *apud* Harmatta 2004: 186): Clauson debated its existence, the basis for the mistake, according to him, was to read two consecutive letters (Clauson 1970: 71–72). Other opinions: *baš* (Tekin 2003: 23, but critics: Erdal 2004: 38); <d^2> (Erdal 2004: 38); <^{ï}s> (Kyzlasov, I. L. 1994: 94, 118, 131); /ïs/ (Kyzlasov, I. L. 2015: 199); <rt> (Amanjolov 2003; Kairžanov 2014: 18).
TR (Y) 𐰚 (Kyzlasov, I. L. 1994: 94, 131–132); (Y) ꓘ (Tekin 2003: 23); (Y) ꓘ (Kairžanov 2014: 18): According to Clauson, it does not exist (Clauson 1970: 72). Other opinions: *kiš* (Tekin 2003: 23, but critics: Erdal 2004: 38); <š^2> (Kairžanov 2014: 18); /tï/ (Kyzlasov, I. L. 2015: 199); <t^ï> (Kyzlasov, I. L. 1994: 94, 131–132)
SHR (Nikolsburg, 1490–1526) 𐳬 *tprz̧:* Its sound value is debated (Németh, Gy. 1934; Vékony 1987a: 21; Vékony 2004a: 95–96; Máté 2001: 186–192).
SR (Mayatskoe-9, 9th c.) ϒ: /t/ (Vékony 2004a: 314–315, column 7). The Mayatskoe-9 inscription is only partially visible (Table 8-32).
SR (Stanitsa Krivyanskoe, 8th–10th c. AD) ɸ: /f/; ᑎ: /χ/; Ω: /r/; ⊣: /š/; ᕁ: /z/ (Vékony 2004a: 253–266), Vékony's deciphering has not been certified by linguists (Table 8-32).

8.6. Tamgas, nishāns, gakks

The tamga (one kind of semiotic symbols, Table 2-1) were important in Eurasia; similar tamgas were found on rock art and small finds in Mongolia or Transbaikalia and the Black Sea (Brosseder 2015: 233). The use of tamgas may have been inherited among the steppe cultures. The tamgas evolved from the animal brands as property signs into dynastic signs and emblems of states (Ilyasov 2010: 214). The Iranian-speaking peoples also extensively used tamga-like symbols called *nishān* (Persian) or *gakk* (Ossetian) throughout the Eurasian Steppe (Ilyasov

2010: 213; Yatsenko 2010a; Yatsenko 2010b; Yatsenko 2013). According to Ilyasov, in Inner Asia, there were two large groups of tamgas in the late centuries BC and early centuries AD, namely, tamgas in Kangju and Yuezhi-Kushan tamgas in Bactria (Ilyasov 2019: 96). Each nomadic and semi-nomadic state had its dynastic tamgas (Babayarov 2010: 393).

Together with Rovash inscriptions, the usage of tamgas is very common (László 1955; Erdélyi 1982: 184; Rogozhinskii & Yatsenko 2015: 109–125). There are surviving Iranian, Hiungnu or Turkic-related relics with tamgas (e.g., Obrusánszky 2011: 4–9; Stark 2015: 483–487), see a selection of them in Table 8-34. The concept that some Turkic Rovash graphemes are derived from Turkic tamgas has not been proved (Ölmez 2016: 2). The tamgas did generally not become graphemes used in scripts; however, they could influence the glyphs used in the scripts. In this case, the influence of the tamgas can be considered a symbol-level hybridization (Table 2-10: 2-6. §). The term of tamga is used in the broadest possible sense in Table 8-34.

Table 8-34: Selection of tamgas of the Eurasian steppe

(Achaimenid Iran)), ∩, ∧, ⇃, ʃ, ⌒, +, Y, Ψ, T, ↑, ᛯ, ᛯ, ᛋ, ≈, ᚴ, ᛸ, ᚨ, ᛞ, H, ᛝ, ᛝ, ᛝ, ⇕, ᚤ, O, Δ, ♀, ᛟ, ᛟ, ᛟ, ᛟ, ᛯ, ᛃ, ᛜ, ᛜ, Ф (Yatsenko 2001: 182, Рис. 32) <tamga>.

(Alans, medieval) ᛯ (Yatsenko 2001: 186, Рис. 36) <tamga>.

(Almaly [Almaly Valley, Chu-Ili Mountains, Semirechye, Kazakhstan]) ᛯ, ᛯ, ᛯ (Rogozhinskiy & Tishin 2018b: 79–80) <tamga>.

(Altay) I, /, ∧, N, ᛯ, III, ᚴ, +, X, ǂ, ᛯ, 8, ᛘ (Yatsenko 2001: 185, Рис. 35) <tamga>.

(Ancient Turkic tribal tamgas) ᛯ, ᛯ, ᛯ, ᛯ, X, ᛯ, ᛯ, ᛯ, ᛯ, ᛯ, ᛯ, ᛯ, IYI, ᛯ, ᛯ, ᛯ, ᛯ, ᛯ, ᛯ, ᛯ, ⊢, ᛯ, ᛯ (Vámbéry 1885: 45) <tamga>.

(Bactrian sign, northern Afghanistan, Bronze Age) ᛯ, ᛯ, ↑, X, Θ, ᛯ (Ilyasov 2019: 99) <tamga>.

(Bactrian sign, Sapalli Culture, Bronze Age) ᛯ, ᛯ (Ilyasov 2019: 99) <tamga>.

(Basins of Amu Darya and Syr Darya, 1st c. BC –3rd c. AD) /, ᛯ, ∩, ∧, ᛯ, ᛯ, ᛯ, ᛯ, ᛯ, H, H, T, X, +, ᛯ, ᛯ, ᛯ, ᛯ, ᛯ, ᛯ, ᛯ, ᛯ, D, ⊙, Ф, ᛯ, ᛯ, ♀, B, 8, 8, X (Yatsenko 2001: 178, Рис. 28) <tamga>.

(Basins of Amu Darya and Syr Darya, 4th–8th c. AD) X, ᛯ, ᛯ, ᛯ, ᛯ, ᛯ, ᛯ, ᛯ, ᛯ, ᛯ, O, H, ᛯ, X (Yatsenko 2001: 179, Рис. 29) <tamga>.

(Basins of Amu Darya and Syr Darya, 6th–2nd c. BC) III, ᛯ, ᛯ, ᛯ, T, ↑, ᛯ, ᛯ, ᛯ, ǂ, H, ᛯ, ᛯ, ⊙, ⊙, ᛯ, ♀, Δ, D, ⊗ (Yatsenko 2001: 177, Рис. 27) <tamga>.

(Bayte [Mangystau Region, Kazakhstan], 3rd c. BC –2nd AD) ᛯ (Yatsenko 2010b: 140) Sarmatian/Massagetian sign.

(Bayte III [Ustyurt Plateau, Kazakhstan]) ∩, ᛯ, III, ᛯ, ᛯ, ᛯ, ᛯ, X, Y, ᛯ, Δ, ᛯ, ☐, ◇, ᛯ, ᛯ, ᛯ (Yatsenko 2019: 82) <tamga>.

(Beskepe [near Kyzylaut Village, Jambyl Region, Kazakhstan], sanctuary) /, ∩, M, O, ᛯ, ᛯ, ᛯ, ᛯ, ᛯ, ᛯ (Smagulov & Yatsenko 2019: 193) <tamga>.

(Budapest District 14—Tihany Square, silver chalice [Budapest, Hungary], the turn of the 7th and 8th centuries) ᛯ (László 1942, Fig. 1; László 1955: 45, Image 1; Vásáry 1972: 343–344; Harmatta 1984b: 277–278; Vékony 2004a: 202; Erdélyi & Ráduly 2010: 31). Interestingly, the shape of the graph ⫲ is identical to the Sogdian (So 20195) 𐼼 (Pandey 2017: 77) <separator>. However, alternatively, the graph could be interpreted as /γ/, cf. TR ⫴, ⟅ <g[1]> (SFG-22).

(Chu-Ili interfluve and Issyk-Kul Lake Area) ⮌ (Yatsenko & Rogozhinskii 2019: 41) <tamga>.

(Chu-Ili interfluve) >, Y, O (Yatsenko & Rogozhinskii 2019: 41) <tamga>.

(Chu-Ili interfluve, Central and East Kazakhstan) ⴴ (Yatsenko & Rogozhinskii 2019: 41) <tamga>.

(Coins with double-humped camel, 7th–8th c. AD) ✧ (Babayarov 2007: 20–21; Babayarov 2013: 336–337) <tamga>.

(Gol Mod-2 [Arkhangai Province, Mongolia], grave No. 3, BC 1st c. – 1st c. AD) +, + (Turbat et al. 2012: 157) <tamga>.

(Issyk-Kul Lake area [Kyrgyzstan]) ⴽ, ⵟ, ϟ (Tabaldyev 2019: 373) <tamga>.

(Kampyrtepa [Muzrabot District, Surxondaryo Region, Uzbekistan]) ⩓, ⍋ (Ilyasov 2019: 125) <tamga>.

(Kampyrtepa [Muzrabot District, Surxondaryo Region, Uzbekistan], ca. AD 127–133 [Kanishka I period]) ⩗ (Ilyasov 2010: 214) <tamga>.

(Kanka [Chach, Uzbekistan]) ∃, Δ, ⧗ (Yatsenko & Smagulov 2019: 204) <tamga>.

(Kanka [Chach, Uzbekistan]) ⸗, ⟆, O, Δ, ⧖, Ø, ⊖, ⍓, ⊟ (Yatsenko & Smagulov 2019: 216) <tamga>.

(Kaunchitobe [Chach, Uzbekistan]) ⵣ (Yatsenko & Smagulov 2019: 204) <tamga>.

(Kazakhstan and Issyk-Kul Lake Area) ⩡, + (Yatsenko & Rogozhinskii 2019: 41) <tamga>.

(Kharguaytin belchir [Харгайтын бэлчир in Khovd Province, Mongolia]) ⸪ (Turbat et al. 2012: 159) <tamga>.

(Khumbuztepa [Xorazm Region, Uzbekistan], graphs on ceramic items, 6th–5th c. BC) ⋈ (Baratov 2019: 45) <tamga?>.

(Khumbuztepa [Xorazm Region, Uzbekistan], graphs on ceramic items, 4th c. BC) ↓ (Baratov 2019: 47) <tamga?>.

(Khumbuztepa [Xorazm Region, Uzbekistan], graphs on ceramic items, 3rd–1st c. BC) ∓ (Baratov 2019: 47) <tamga?>.

(Kochkor Valley [Kyrgyzstan]) ♈, ⩞, ⩓ (Tabaldyev 2019: 367) <tamga>.

(Kok-Mardan [Otrar Oasis, Turkistan Region, Kazakhstan] site and necropolis) ⅄, ∃ (Smagulov & Yatsenko 2019: 164) <tamga>.

(Kopeny [Копёны in Khakassia, Russia]) ⍋ (Stančev & Ivanov 1958: 91–92, Image 26 apud Dienes 1962: 103–104) silver vessel <bottom stamp>.

(Koy-Krylgan-kala [Khwarezm], pottery) ⵅ (Yatsenko 2001: 180, Рис. 30) <tamga>.

(Környe, end of 7th c. AD) ⫽ (literature in Table 8-31) <tamga>. It may be a drawing of a bird. Cf. SFG-44. Among others, Erdélyi suggested that the graph ⫽ is a tamga (Erdélyi 1969: 210). According to Harmatta, the parallels of the graph ⫽ can be found on the inscriptions at the Yenisey River (Harmatta 1984a: 110).

(Kultobe [Turkistan Region, Kazakhstan]) ⋊ (Smagulov & Yatsenko 2019: 164) <tamga>.

(Kultobe [Turkistan Region, Kazakhstan], 1st–3rd c. AD) (Smagulov & Yatsenko 2019: 164) <tamga>.

(Kül Tegin, AD 732) (Babayarov 2010: 395; Babayarov & Kubatin 2013: 49) <tamga>; mountain goat, tamga of the Ashina clan. This tamga is seen on the Hirgisiyn Ovoo inscription (Ölmez 2018b: Figure 2), too.

(Kunágota [Békés County, Hungary], beg of 7th c. AD) (literature in Table 8-31) <tamga>. Cf. (Basins of Amu Darya and Syr Darya, 6th–2nd c. BC) <tamga>; (Kok-Mardan site and necropolis) <tamga>.

(Kuray [Курай in Altai Republic, Russia]) (Stančev & Ivanov 1958: 91–92, Image 26 apud Dienes 1962: 103–104) silver vessel <bottom stamp>.

(Minguriuk hillfort [Chach, today Tashkent, Uzbekistan], stone plate, Kangju period, 1st c. BC – 3rd c. AD) (Yatsenko & Smagulov 2019: 201) <tamga>.

(Mongolia) (Yatsenko 2001: 185, Рис. 35) <tamga>.

(Muruisky Island on the Angara River [Russia]) (Rogozhinsky & Cheremisin 2019: 50–51; Tishin et al. 2020: Table 2, Table 3) <tamga>.

(Nagyszentmiklós, inscription No. 14 [Romanian: Sânnicolau Mare in Timiș County, Romania], 8th–11th c. AD) (Erdélyi 1986: 31; Göbl & Róna-Tas 1995) <tamga>.

(Nagyszentmiklós, inscription No. 15 [Romanian: Sânnicolau Mare in Timiș County, Romania], 8th–11th c. AD) (literature in Table 8-31) <tamga>.

(Nagyszentmiklós, inscription No. 17 [Romanian: Sânnicolau Mare in Timiș County, Romania], 8th–11th c. AD) (Erdélyi 1986: 35; Róna-Tas 1996a: 114) <tamga>.

(Noin Ula [Noin-Ula, Noyon Uul in Tov Province, Mongolia]) (Turbat et al. 2012: 157), 2 BC (Louis 2006–2007: 50). Tamgas of the ruling tribe Luandi (Xulianti) of the Xiongnu.

(Novi Pazar [Нови пазар in Shumen Province, Bulgaria]) (Stančev & Ivanov 1958: 91–94, Table XXI apud Dienes 1962: 103–104) <stamp>, stamps of vessels.

(Old Turkic coins of Tokharistan, 7th–8th c. AD) (Babayarov 2013: 344) <tamga>.

(Sarmatia, regional signs, 2nd half of 1st c. AD – 1st half of 2nd c.) (Yatsenko 2001: 155, Рис. 5) <tamga>.

(Sarmatia, regional signs, 2nd half of 2nd c. AD – 1st half of 3rd c.) (Yatsenko 2001: 155, Рис. 6) <tamga>.

(Sharkel [Sharkil, Sarkel, Šarkel in Rostov Oblast, Russia]) (Stančev & Ivanov 1958: 91–92, Image 26 apud Dienes 1962: 103–104) <shoulder stamp of a pot>.

(Shaushukumtobe [Chach, Uzbekistan]) (Yatsenko & Smagulov 2019: 204) <tamga>.

(Shiveet Ulaan [Шивэт улан in Mongolia]) (Rogozhinsky & Cheremisin 2019: 50–51; Tishin et al. 2020: 197–198, Table 3). It is worth noting that this tamga is similar to tamgas ( ) in the Nagyszentmiklós inscriptions No. 14 and No. 15, see above.

(Sidak [Turkistan Region, Kazakhstan] sanctuary, 5th – early 8th c. AD) (Smagulov & Yatsenko 2019: 166) <tamga>.

(South and East Kazakhstan, Chu-Ili interfluve, Dzungarian Altai and Issyk-Kul Lake Area) ⋈ (Yatsenko & Rogozhinskii 2019: 41) <tamga>.

(South Kazakhstan and Chu-Ili interfluve) ⫼ (Yatsenko & Rogozhinskii 2019: 41) <tamga>.

(South Kazakhstan and Dzungarian Altai) ȣ (Yatsenko & Rogozhinskii 2019: 41) <tamga>.

(South Kazakhstan) ᛘ, Y, ᛗ (Yatsenko & Rogozhinskii 2019: 41) <tamga>.

(Talas Valley [Kyrgyzstan]) ⋀, ᛅ, ⊙ (Tabaldyev 2019: 373) <tamga>.

(Tardu Khagan's coin, last quarter of the 6th c. – beginning of 7th c. AD) ⊦З (Babayarov 2007: 9; Babayarov 2013: 335) <tamga>.

(Tashkent Oasis [Uzbekistan]) |, ¤ (Yatsenko & Smagulov 2019: 222) <tamga>.

(Western Turkestan) ⅄ (Yatsenko 2001: 184, Рис. 34) <tamga>.

(Zalavár-Vársziget [Zala County, Hungary]) \Y| (Szőke 2014b: 110) <tamga>. According to Szőke, the graph represents the Old Bulgar chief god *Tangra* or *Tengri*. The script relic was found in Mosaburg (present-day Zalavár, Hungary) on a clay pot fragment (Szőke 2014a: 35; Szőke 2014b: 110). Cf. Ancient Turkic tribal tamga |Y| above.

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10. Alphabetical index

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Scripts (writing systems) usually belong to specific languages and have temporal, spatial and cultural characteristics. The evolution of scripts has been the subject of research for a long time. This is probably because the long-term development of human thinking is reflected in the surviving script relics, many of which are still undeciphered today. The book presents the study of the script evolution with the mathematical tools of systematics, phylogenetics and bioinformatics. In the research described, the script is the evolutionary taxonomic unit (taxon), which is analogous to the concept of biological species. Among the methods of phylogenetics, phenetics classifies the investigated taxa on the basis of their morphological similarity and does not primarily examine genealogical relationships. Due to the scarcity of morphological diversity of scripts' features, random coincidences of evolution-independent features are much more common in scripts than in biological species, thus phenetic modelling based solely on morphological features can lead to erroneous results. For this reason, phenetic modeling has been extended with evolutionary considerations, thereby allowing the modelling uncertainties observed in the script evolution to be addressed due to the large number of random coincidences (homoplasies) characterizing each script. The book describes an extended phenetic method developed to investigate the script evolution. This data-driven approach helps to reduce the impact of the uncertainties inherent in the phenetic model due to the large number of homoplasies that occur during the evolution of scripts. The elaborated phenetic and evolutionary analyses were applied to the Rovash scripts used on the Eurasian Steppe (Grassland), including the Turkic Rovash (Turkic Runic/runiform) and the Székely-Hungarian Rovash. The evaluation of the extended phenetic model of the scripts, the various phenograms, the script spectra and the group spectra helped to reconstruct the main ancestors and evolutionary stages of the investigated scripts.

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